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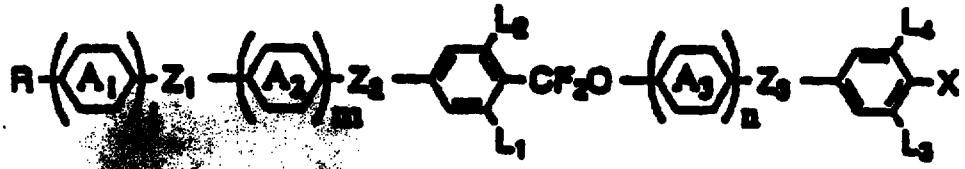
(71) 出願人（米国を除くすべての指定国について）
チッソ株式会社(CHISSO CORPORATION)[JP/JP]
〒530 大阪府大阪市北区中之島三丁目6番32号 Osaka, (JP)
(72) 発明者；および
(75) 発明者／出願人（米国についてのみ）
松井秋一(MATSUI, Shuichi)[JP/JP]
〒290 千葉県市原市辰巳台東2丁目17番地 Chiba, (JP)
宮沢和利(MIYAZAWA, Kazutoshi)[JP/JP]
〒290-01 千葉県市原市ちはら台3-27-7 Chiba, (JP)
大西徳幸(OHNISHI, Noriyuki)[JP/JP]
〒867 熊本県水俣市築地8丁目214番地 Kumamoto, (JP)
長谷場康宏(HASEBA, Yasuhiro)[JP/JP]
〒290 千葉県市原市辰巳台東3丁目27番地 Chiba, (JP)
後藤泰行(GOTO, Yasuyuki)[JP/JP]
〒290 千葉県市原市西広462番2号 Chiba, (JP)
中川悦男(NAKAGAWA, Etsuo)[JP/JP]
〒290 千葉県市原市五井8890番地 Chiba, (JP)
澤田信一(SAWADA, Shinichi)[JP/JP]
〒290 千葉県市原市西広316-1 168街区11 Chiba, (JP)
(74) 代理人
弁理士 川北武長(KAWAKITA, Takenaga)
〒103 東京都中央区日本橋茅場町二丁目3番6号 Tokyo, (JP)

(81) 指定国
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(54) Title : DIFLUOROXYMETHANE DERIVATIVE AND LIQUID CRYSTAL COMPOSITION

(54) 発明の名称 ジフルオロオキシメタン誘導体および液晶組成物



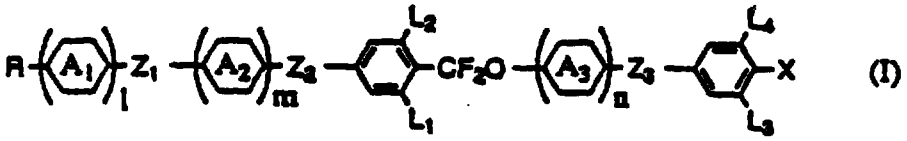
(I)

(57) Abstract

A difluoroxymethane derivative represented by general formula (I), which is lowly viscous, has a high permittivity anisotropy and is useful as a low-voltage liquid crystal material for various liquid crystal displays (wherein l, m and n represent each 0 or 1; rings A_1 to A_3 represent each independently a 6-membered ring such as trans-1,4-cyclohexylene or 1,4-phenylene; Z_1 to Z_3 represent each independently a covalent bond or a bonding group such as $-CH_2CH_2-$; L_1 to L_4 represent each hydrogen or halogeno; and X represents halogeno, OCF_3, etc.). The compound is useful as a low-voltage liquid crystal material of various modes including active matrix and STN systems.

（５７）要約

種々の液晶ディスプレーにおける低電圧用液晶性材料として有用な、大きな誘電率異方性を持ち、かつ低粘性である新規な化合物を提供し、液晶組成物の特性を改良するために、一般式（Ｉ）



（Ｉ）

（式中１、ｍ、ｎは各々０または１、環Ａ$_1$～Ａ$_3$はそれぞれ独立してトランス－１，４－シクロヘキシレン、１，４－フェニレン等の６員環、Ｚ$_1$～Ｚ$_3$はそれぞれ独立して共有結合または－ＣＨ$_2$ＣＨ$_2$－等の結合基、Ｌ$_1$～Ｌ$_4$は水素またはハロゲン、Ｘはハロゲン、ＯＣＦ$_3$等の基を表す）で表されるジフルオロオキシメタン誘導体およびこれを含む液晶組成物が提供される。

アクティブマトリックス方式、ＳＴＮ方式等の種々のモードにおける低電圧用液晶材料として有用である。

情報としその用途のみ

ＰＣＴに基づいて公開される国際出願をパンフレット第一頁にＰＣＴ加盟国を同定するために使用されるコード

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明　細　書

ジフルオロオキシメタン誘導体および液晶組成物

技術分野

本発明は、種々の液晶ディスプレーにおける液晶材料として好適な液晶性化合物としてのジフルオロメタン誘導体およびこれを含む液晶組成物に関する。

背景技術

液晶表示素子は液晶物質が有する光学異方性および誘電率異方性を利用するものであるが、その表示タイプとしては、ねじれネマチック型（ＴＮ型）、スーパーツイストネマチック型（ＳＴＮ型）、動的散乱型（ＤＳ型）、ゲスト・ホスト型（Ｇ－Ｈ型）、ＤＡＰ型等が知られている。また、これらの駆動方式として、スタティック駆動方式、時分割駆動方式、アクティブマトリックス駆動方式、２周波駆動方式等が知られている。このような液晶表示素子に用いられる液晶物質の性質はその用途に応じて種々異なるが、いずれの液晶物質も水分、空気、熱、光等外的環境因子に対して安定であること、また、室温を中心としてできるだけ広い温度範囲で液晶相を示し、低粘性であり、かつ駆動電圧が低いことが要求される。さらに通常、液晶表示素子に用いられる液晶物質は、個々の表示素子に要求される最適な誘電率異方性（$\Delta\varepsilon$）または屈折率異方性（Δn）を得るために、数種ないし十数種の液晶性化合物から構成されている。このため、他の液晶性化合物との相溶性、特に最近では種々の環境下での使用要求から低温相溶性に関しても良好であることが望まれている。

ところで近年、コントラスト、表示容量、応答時間等の表示性能の面から、アクティブマトリックス方式、特にＴＦＴ（薄膜トランジスタ）方式がテレビジョンやビューファインダー等の表示モードとして盛んに採用されている。また、大きい表示容量を持ちながら製造工程が簡単でコストが安いＳＴＮ方式も、パーソナルコンピューター等のディスプレーとして、多く採用されている。

これらの分野の近年における開発傾向は、小型軽量で、携帯できることを特長としたテレビや、ノート型パーソナルコンピューターに代表されるように、液晶表示素子の小型化、携帯化が中心となって進められており、材料の面からはＩＣの耐電圧から駆動電圧の低い、すなわちしきい値電圧の低い液晶性化合物ならび

に液晶組成物の開発が中心に行われている。

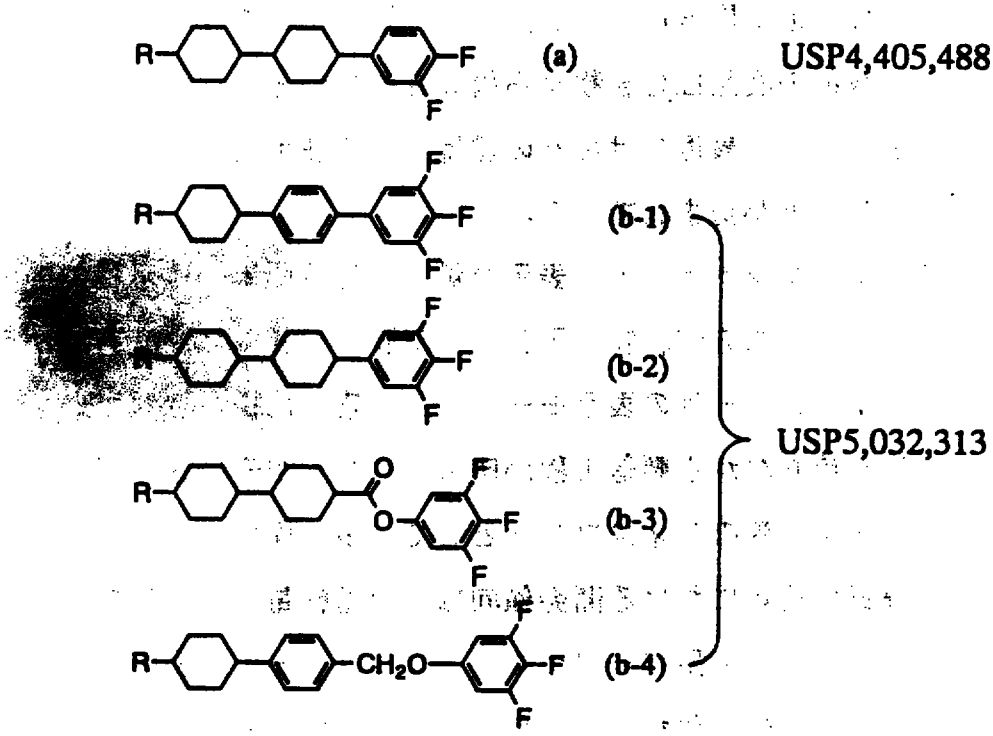
しきい値電圧（V_{th}）は、以下の式（H.J.Deuling, et al.,Mol.Cryst.Liq.Cryst.,27 (1975)81）によって表されることが知られている。

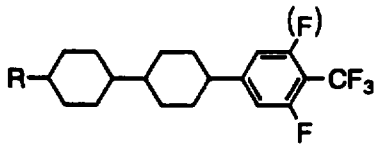
$$V_{th}=\pi(K/\varepsilon_0\Delta\varepsilon)^{1/2}$$

上式においてKは弾性定数、ε_0は真空の誘電率である。上式からしきい値電圧を低下させるには誘電率異方性（$\Delta\varepsilon$）の大きな材料を使用するのが常法であり、このため大きな誘電率異方性値を有する化合物の開発が盛んに行われている。

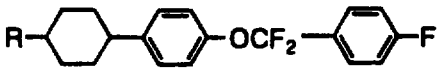
一方、フッ素原子を置換基として有する液晶性化合物において、その誘電率異方性を増大させるには、分子上のフッ素原子の置換数を増加させることが効果的であることが知られている。しかし化合物分子上のフッ素原子の置換数と粘性とは比例的な関係があり、さらにフッ素原子の置換数が増えれば液晶相温度範囲が低下することも当業者の間で経験的に知られている。従って粘性の上昇を抑制し、かつ液晶相温度範囲の低下を抑制して誘電率異方性のみを向上させることは困難と考えられている。

従来のフッ素原子多置換の液晶性化合物の一例として、下記のものが開示されている。

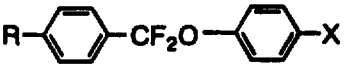




(c) DE4027840A1



(d) 特開平2-289529号



X=F,CF_3,OCF_3

(e) 特開平5-112778号

化合物（ａ）および（ｂ－１）～（ｂ－４）はいずれも化合物分子末端に数個のフッ素原子を有する化合物である。その誘電率異方性の大きさを比較すると以下の順番となる。

（ｂ－３）＞＞（ｂ-１）、（ｂ－２）、（ｂ－４）＞（ａ）

化合物（ｂ－３）は分子骨格間の結合基としてエステル結合基を有しており、エステルカルボニル基の大きな分極が化合物分子長軸の誘電率に有効に寄与し、非常に大きな誘電率異方性を示すと考えられている。しかし反面、（ｂ－３）は（ａ）や（ｂ－１）、（ｂ－２）、（ｂ－４）よりも著しく大きな粘性を有することから応答速度の面で好ましい化合物とは言えない。また、化合物（ｃ）に関しても比較的大きな誘電率異方性を有するが、（ｂ－３）と同様に粘性も大きく、従って要求を満たす化合物とは言えない。

ところで、液晶性化合物においてその分子中に－ＣＦ$_2$Ｏ－の部分構造を有するものとして、分子末端基にこれを有するものは公開特許公報等において既に報告されているが、化合物構造中の結合基として２つのベンゼン環を架橋した部分構造を有するものとしては、特開平２－２８９５２９号および特開平５－１１２７７８号にそれぞれ記載の化合物（ｄ）および（ｅ）が開示されているにすぎない。さらに、上記公報中には構造式の記載はあるものの化合物の物理データならびに液晶性化合物としての有用性を評価する具体的な物性値等は全く開示されておらず、２つのベンゼン環を－ＣＦ$_2$Ｏ－基で結合した部分構造を有する液晶性化合物の性質は全く知られていない。ところで本発明者等は、化合物（ｄ）は、分子末端のフッ素原子の分極に対して分子中の結合基である－ＯＣＦ$_2$－基の分極が逆の向きであるため、分子長軸方向の誘電率が相殺され、大きな誘電率異方

性を期待することはできないと予想した。また、化合物（ｅ）についても－ＣＦ$_2$Ｏ－基の分極の寄与から比較的大きな誘電率異方性は期待できるものの、骨格構造が２環系の化合物であるため、高い透明点は期待できないと思われた。このように、化合物（ｄ）、（ｅ）をはじめとする－ＣＦ$_2$Ｏ－結合基の効果、特にその誘電率異方性と粘性との関係に関する知見は、全く知られていないのが現状であった。

発明の開示

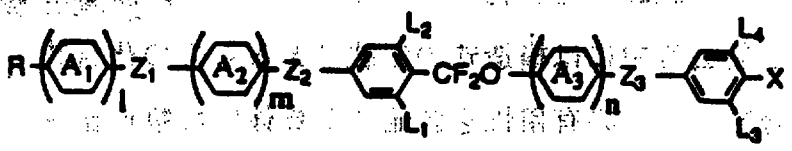
本発明の目的は、アクティブマトリックス方式およびＳＴＮ方式をはじめ種々のモードにおける低電圧用液晶性化合物として、大きな誘電率異方性を有すると共に著しく低粘性である新規な液晶性化合物およびこれを含有する液晶組成物を提供することにある。

本発明者らは、フェニルベンゾアート誘導体から誘導できる新規なジフルオロオキシメタン誘導体の物性を検討したところ、結合基であるジフルオロメトキシ基の２つのフッ素原子の分極による双極子モーメントの方向が化合物分子長軸方向の誘電率の増加に有効に寄与し、大きな誘電率異方性を有すること、また、フッ素原子を分子内に持つにもかかわらず粘度は著しく小さいことを見い出した。

さらに、これらの化合物の末端の置換基としてフッ素系置換基を選択したものはアクティブマトリックス方式において、またシアノ基を代表とするその他の置換基を選択したものはＳＴＮをはじめとする種々のモードにおいて有用な低電圧用新規液晶性化合物であることを見い出し、本発明を完成するに至った。

本[redacted]を受けようとする発明は以下のとおりである。

（１[redacted]



(I)

（式中１、ｍ、ｎは各々０または１であり、環Ａ$_1$、Ａ$_2$はそれぞれ独立してトランス－１，４－シクロヘキシレン基、６員環の１個以上の水素原子がハロゲン原子により置換されていてもよい１，４－フェニレン基、トランス－１，３－ジオ

キサン－２，５－ジイルまたはピリミジン２，５－ジイルを表し、環A_3は６員環の１個以上の水素原子がハロゲン原子により置換されていてもよい１，４－フェニレン基、トランス－１，３－ジオキサン－２，５－ジイルまたはピリミジン－２，５－ジイルを表し、Z_1、Z_2、Z_3はそれぞれ独立して共有結合、－CH_2－、－COO－、－CF_2O－、－OCF_2－、－CH_2O－、－OCH、－CH＝CH－または－C≡C－であり、L_1、L_2、L_3、L_4はそれぞれして水素原子またはハロゲン原子であり、Xはハロゲン原子、CN、CF_3、OCF_3、$OCHF_2$、OCH_2F、炭素数１～１０の直鎖もしくは分岐のアルキ基、アルケニル基またはアルコキシ基であり、Rは炭素数１～１０の直鎖もしくは分岐のアルキル基またはアルケニル基であり、該R中の１つもしくは隣接しない２つ以上のCH_2基は酸素原子により置換されていてもよい。ただしZ_2が－F_2O－または－OCF_2－である場合以外は、Xがアルキル基、アルケニル基またはアルコキシ基であることはない。）で表されるジフルオロオキシメタン誘導体。

（２）一般式（Ｉ）において$l=1$、$m=0$、nは０または１であり、Z_1は共有結合または－CH_2CH_2－、Z_2およびZ_3はともに共有結合、A_1はトラ－１，４－シクロヘキシレン基、A_3は１，４－フェニレン基、Rは炭素数１～１０の直鎖のアルキル基またはアルケニル基である（１）に記載のジフルオロオキシメタン誘導体。

（３）L_3 およびL_4 の少なくとも一方がハロゲン原子である（１）または（２）に記載のジフルオロオキシメタン誘導体。

（４）一般式（Ｉ）において$l=m=n=0$であり、Z_1、Z_2およびZ_3がともに共有結合である（１）に記載のジフルオロオキシメタン誘導体。

（５）一般式（Ｉ）において$l=1$、$m=n=0$であり、Z_2、Z_3がともに共有結合である（１）に記載のジフルオロオキシメタン誘導体。

（６）一般式（Ｉ）においてL_3、L_4、Xがともにフッ素原子である（１）なし（５）のいずれかに記載のジフルオロオキシメタン誘導体。

（７）一般式（Ｉ）においてXがOCF_3である（５）に記載のジフルオロオキシメタン誘導体。

（８）一般式（Ｉ）においてXがCNである（５）に記載のジフルオロオキシメ

タン誘導体。

（９）一般式（Ｉ）において１＝１であり、環Ａ$_1$が６員環の１個以上の水素原子がハロゲン原子により置換されていてもよい１，４－フェニレン基、Ｚ$_1$が－ＯＣＦ$_2$－、Ｚ$_2$、Ｚ$_3$がともに共有結合、Ｘが炭素数１～１０の直鎖もしくは岐のアルキル基、アルケニル基またはアルコキシ基で表される（１）に記載のジフルオロオキシメタン誘導体。

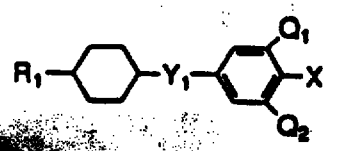
（１０）一般式（Ｉ）において１＝ｍ＝０、ｎ＝１であり、Ｚ$_1$、Ｚ$_2$がともに有結合であり、環Ａ$_3$が１，４－フェニレン基である（１）に記載のジフルオロオキシメタン誘導体。

（１１）一般式（Ｉ）においてＺ$_3$が共有結合である（１０）に記載のジフルオロオキシメタン誘導体。

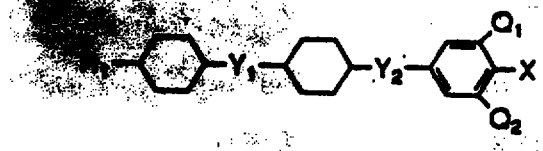
（１２）一般式（Ｉ）においてＺ$_3$が－ＣＨ$_2$ＣＨ$_2$－である（１０）に記載のフルオロオキシメタン誘導体。

（１３）（１）～（１２）のいずれかに記載のジフルオロオキシメタン誘導体を少なくとも１種含有することを特徴とする液晶組成物。

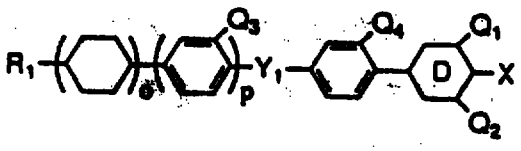
（１４）第１成分として（１）～（１２）いずれかに記載のジフルオロオキシメタン誘導体を少なくとも１種含有し、第２成分として一般式（II）、（III）および（IV）



(II)



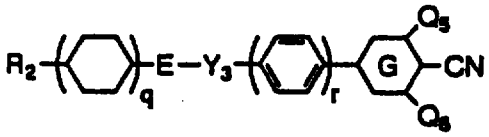
(III)



(IV)

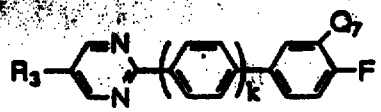
（式中R_1は炭素数１～１０のアルキル基を示し、XはF、Cl、CF_3、OCF_3、OCF_2Hまたは炭素数１～１０のアルキル基を示し、Q_1、Q_2、Q_3、それぞれ独立してHまたはFを示し、oは１または２を示し、pは０または１を示す。Y_1およびY_2はそれぞれ独立して$-CH_2CH_2-$、$-CH=CH-$または共有結合を示す。環Dはトランス－１，４－シクロヘキシレン基または１，４－フェニレン基を示す。）で表される化合物群から選択される化合物を少なくとも１種含有することを特徴とする液晶組成物。

（１５）第１成分として（１）～（１２）のいずれかに記載のジフルオロオキシメタン誘導体を少なくとも１種含有し、第２成分として一般式（V）、（VI）、（VII）、（VIII）および（IX）



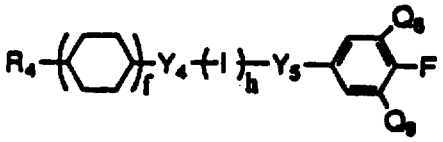
(V)

（式中R_2はフッ素原子、炭素数１～１０のアルキル基または炭素数２～１０のアルケニル基を示す。いずれにおいてもそのうちの１つもしくは隣接しない２以上のCH_2基は酸素原子によって置換されていてもよい。Y_3は$-CH_2CH_2-$、$-COO-$または共有結合を示し、Q_5およびQ_6はそれぞれ独立して水素またはフッ素原子を示し、Eはトランス－１，４－シクロヘキシレン、１，４－フェニレン、トランス－１，３－ジオキサン－２，５－ジイルを示し、環Gはトランス－１，４－シクロヘキシレン、１，４－フェニレンを示し、q、rはそれぞれ独立して０または１を示す。）



(VI)

（式中R_3は炭素数１～１０のアルキル基を示し、Q_7は水素またはフッ素原子を示し、kは０または１を示す。）

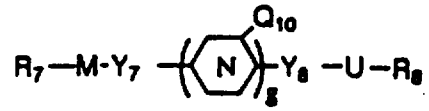


(VII)

（式中R_4は炭素数１～１０のアルキル基を示し、Ｉはトランス－１，４－シクロヘキシレンまたは１，４－フェニレンを示し、Q_8およびQ_9は水素またはフ素原子を示し、Y_4は－ＣＯＯ－または－Ｃ≡Ｃ－を示し、ｆ、ｈはそれぞれ独立して０または１を示す。）

$$R_5-J-Y_6-K-R_6 \qquad (\text{VI})$$

（式中R_5およびR_6はそれぞれ独立して炭素数１～１０のアルキル基、アルコシ基またはアルコキシメチル基を示し、Ｊはトランス－１，４－シクロヘキシレン、１，３－ピリミジン－２，５－ジイルまたは１，４－フェニレンを示し、Ｋはトランス－１，４－シクロヘキシレンまたは１，４－フェニレンを示し、Y_6は－Ｃ≡Ｃ－、－ＣＯＯ－、－CH_2CH_2－または共有結合を示す。）



（式中R_7は炭素数１～１０のアルキル基またはアルコキシ基を示す。R_8は炭数１～１０のアルキル基を示し、そのうちの１つまたは２つ以上の隣接しないCH_2基は酸素原子により置換されてもいてよい。Ｍはトランス－１，４－シクロヘキシレンまたは１，３－ピリミジン－２，５－ジイルを示し、環ＮおよびＵはそれぞれ独立してトランス－１，４－シクロヘキシレンまたは１，４－フェニレンを示し、Y_7は－CH_2CH_2－、－ＣＯＯ－または共有結合を示し、Y_8は≡Ｃ－、－ＣＯＯ－または共有結合を示し、ｇは０または１を示し、Q_{10}は水素または[illegible]原子を示す。）で表される化合物群から選択される１種以上の化合物を[illegible]ことを特徴とする液晶組成物。

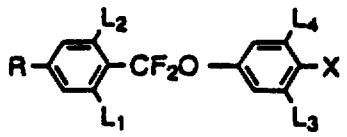
（１６）第１成分として（１）～（１２）のいずれかに記載のジフルオロオキシメタン誘導体液晶を少なくとも１種含有し、第２成分の一部分として一般式（III）、（III）および（IV）で表される化合物群から選択される１種以上の化合物を含有し、第２成分の他の部分として一般式（Ｖ）、（VI）、（VII）、（VIII）および（IX）で表される化合物群から選択される１種以上の化合物を含有することを特徴とする液晶組成物。

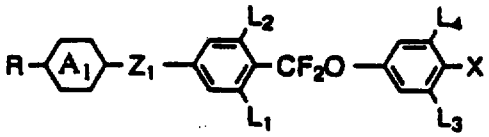
（１７）（１３）～（１６）のいずれかに記載の液晶組成物を用いて構成された

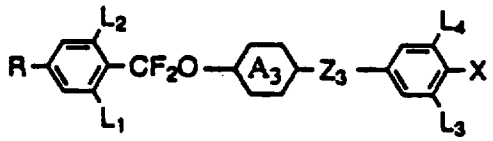
液晶表示素子。

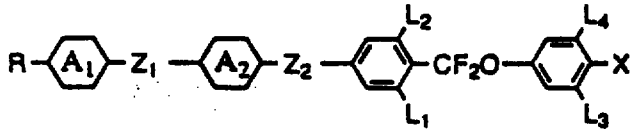
発明を実施するための最良の形態

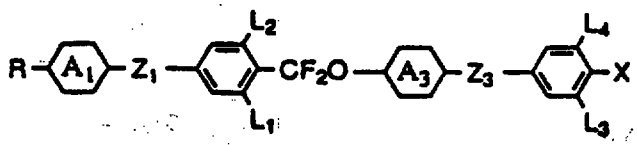
本発明において、一般式（Ｉ）で表されるジフルオロオキシメタン誘導体の好ましい態様は、次の（Ｉａ）～（Ｉｅ）の一般式群により表される化合物である。


(Ia)

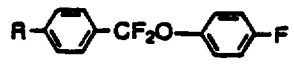

(Ib)

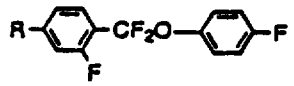

(Ic)

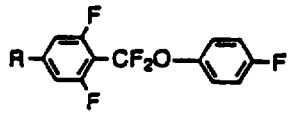

(Id)

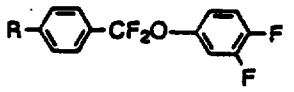

(Ie)

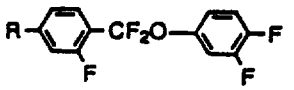
一般式群（Ｉａ）～（Ｉｅ）で表されるジフルオロオキシメタン誘導体の具体例として、さらに以下の（１）～（６６１）に示す化合物を挙げることができる。

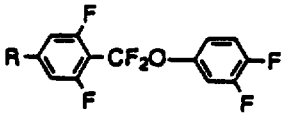

(1)

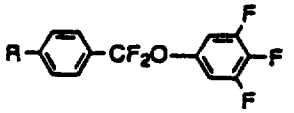

(2)

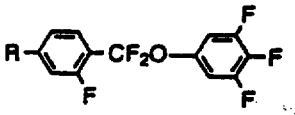

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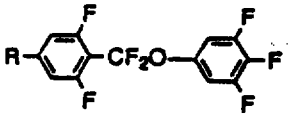

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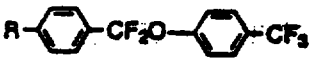

(5)


(6)

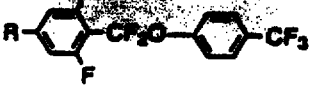

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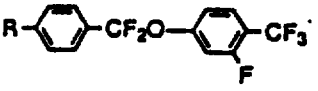

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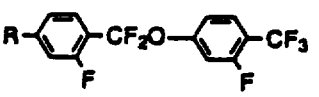

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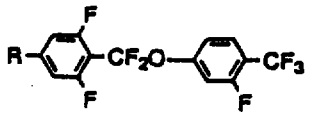

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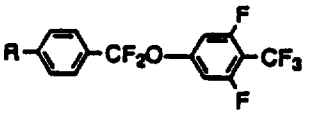

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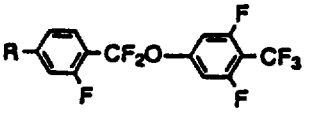

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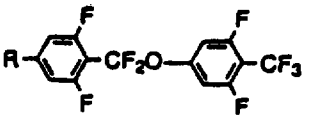

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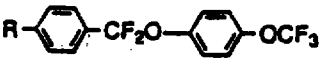

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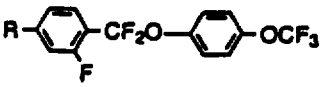

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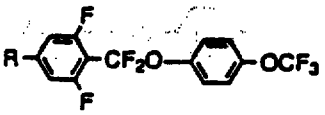

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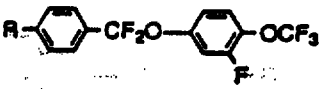

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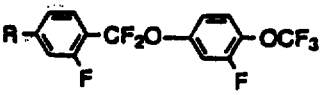

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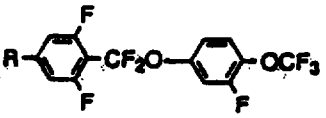

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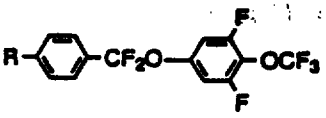

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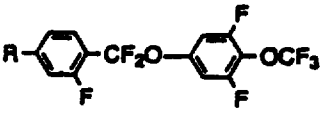

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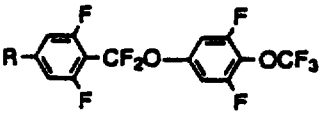

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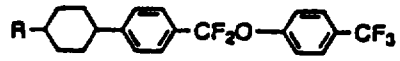

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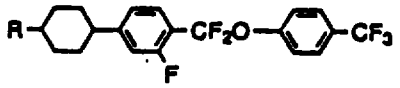

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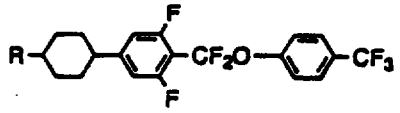

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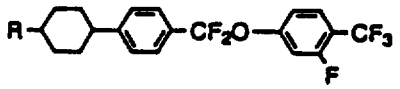

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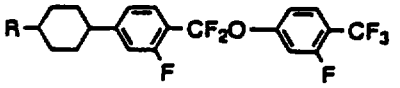

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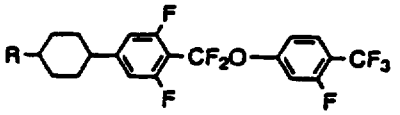

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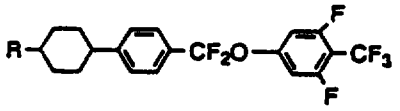

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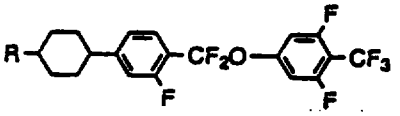

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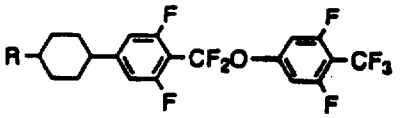

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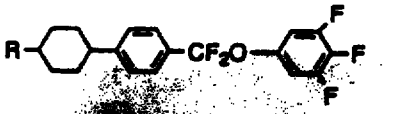

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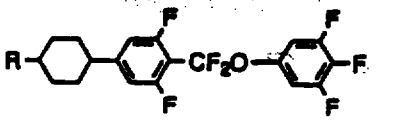

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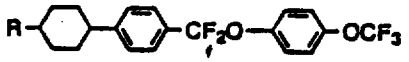

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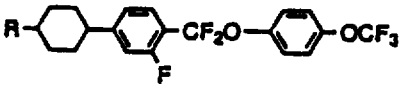

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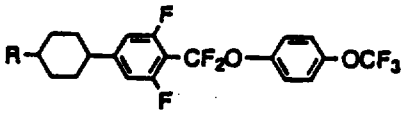

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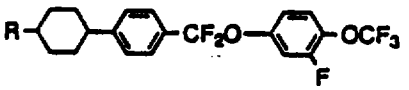

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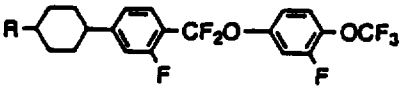

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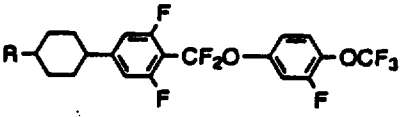

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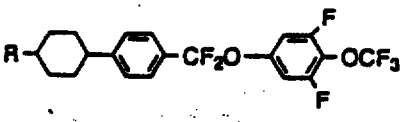

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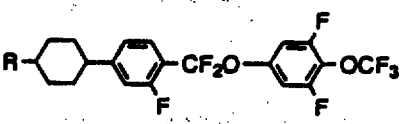

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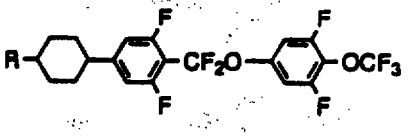

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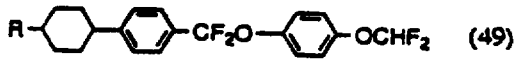

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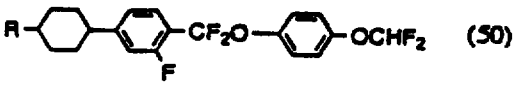

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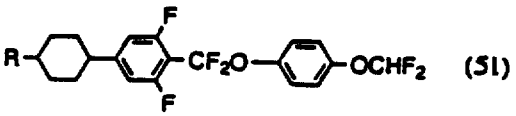

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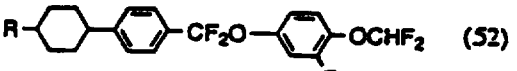

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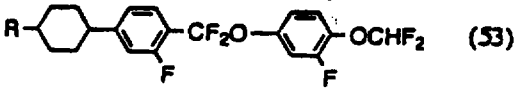

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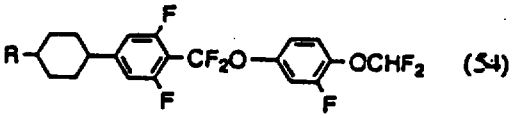

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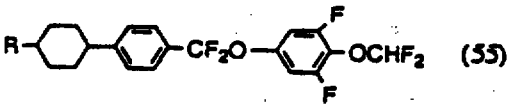

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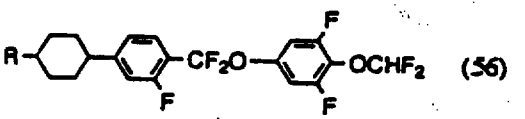

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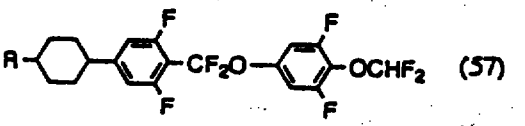

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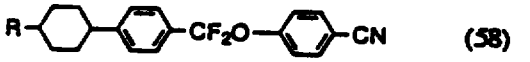

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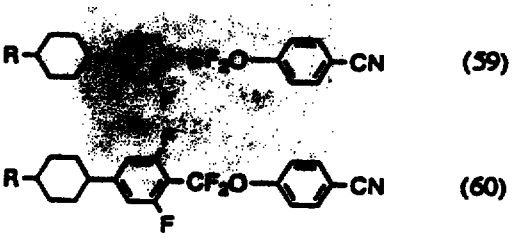

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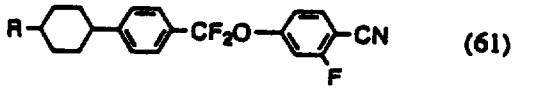

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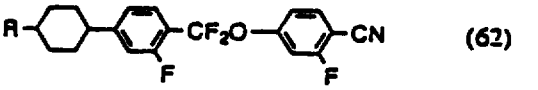

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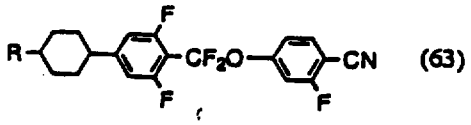

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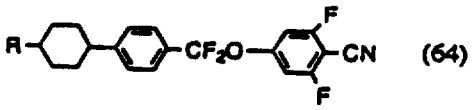

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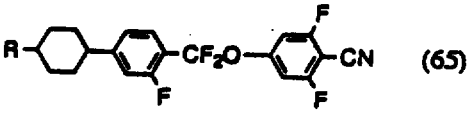
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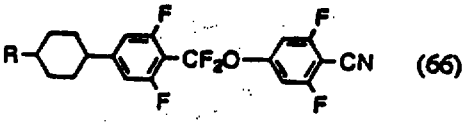

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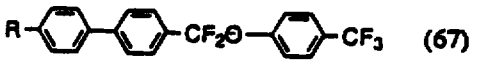

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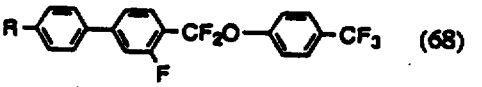

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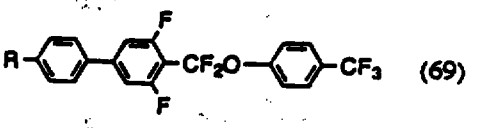

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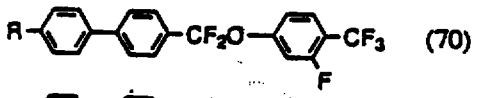

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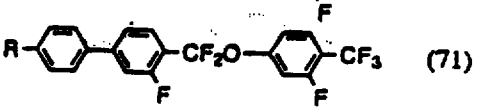

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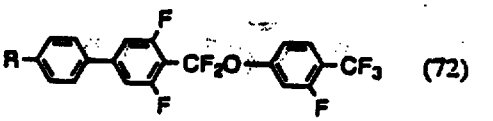

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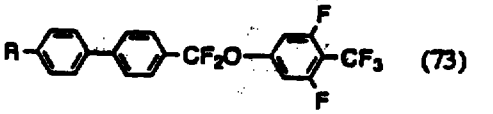

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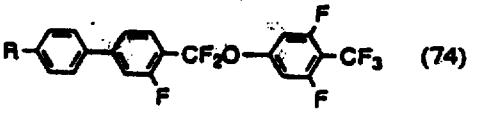

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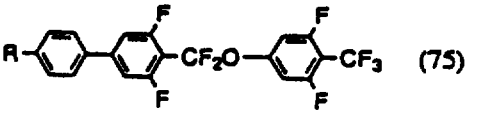

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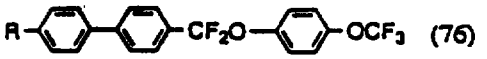

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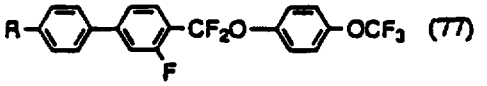

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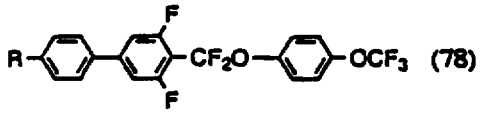

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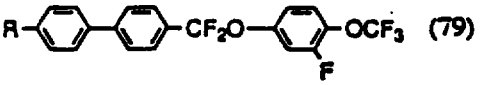

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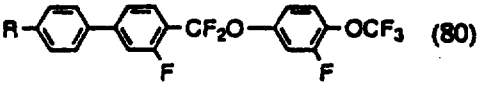

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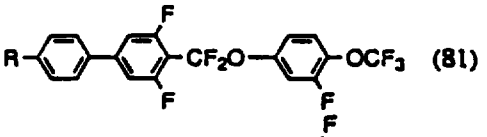

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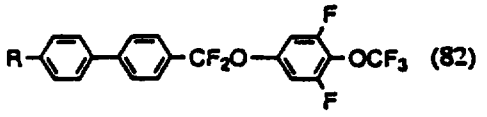

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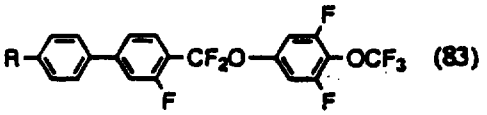

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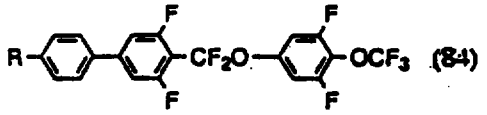

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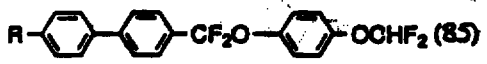

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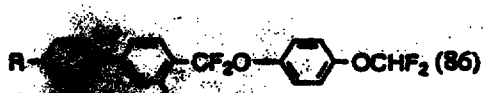

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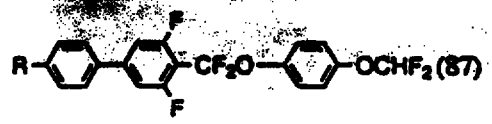

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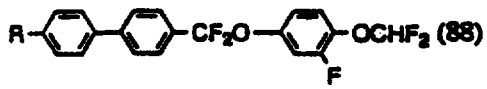

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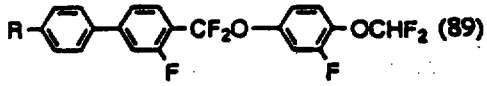

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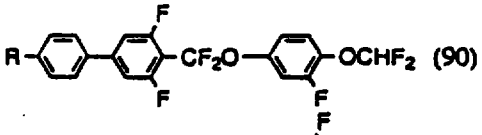

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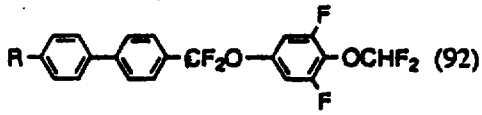

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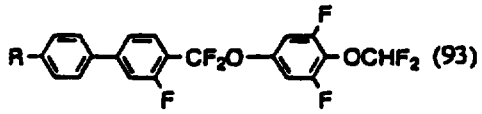

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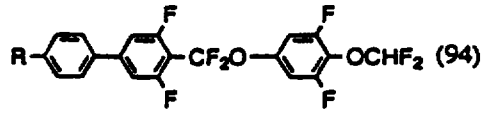

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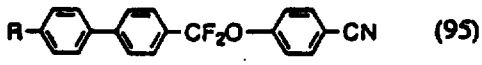

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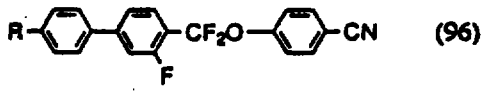

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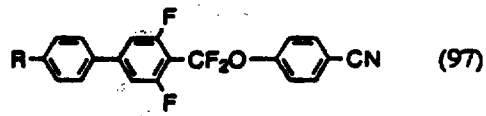

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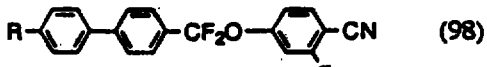

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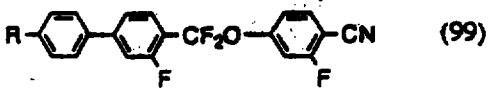

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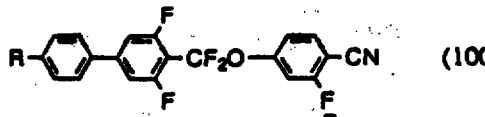

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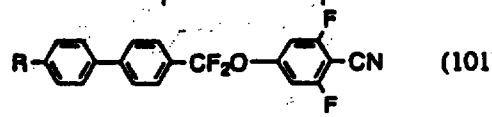

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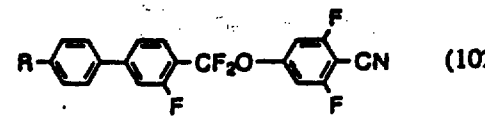

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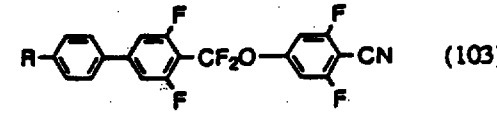

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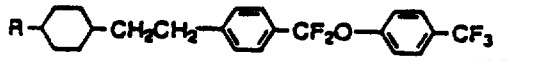

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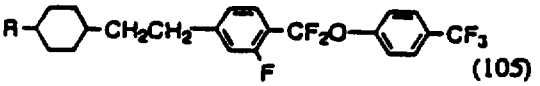

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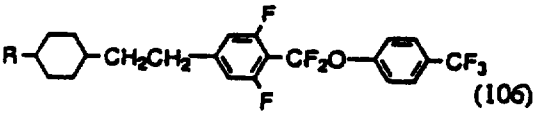

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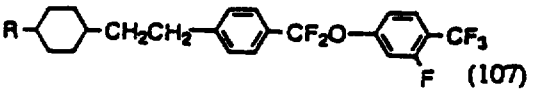

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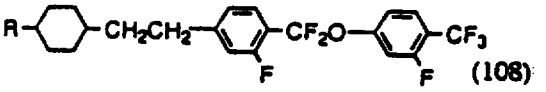

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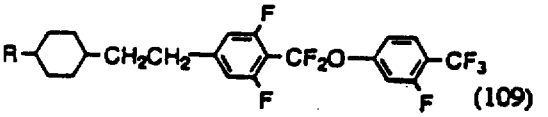

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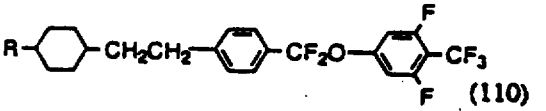

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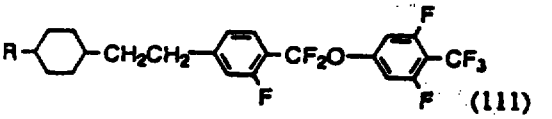

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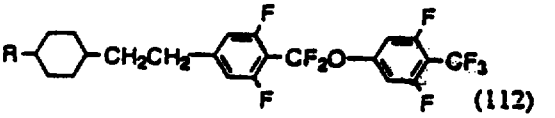

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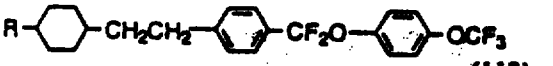

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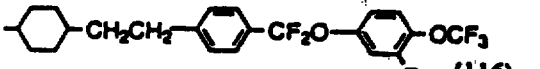

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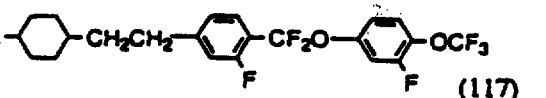

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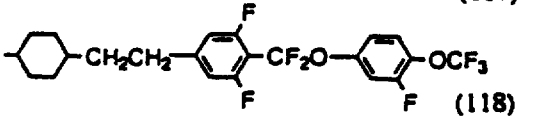

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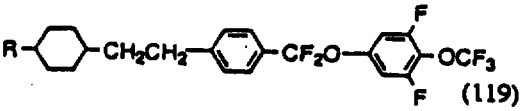

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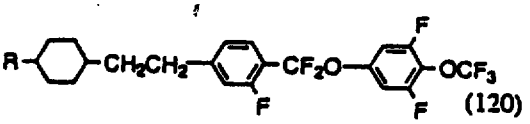

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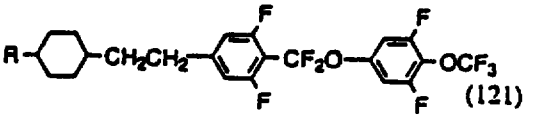

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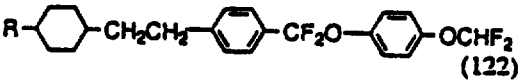

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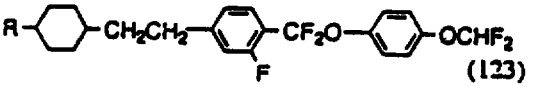

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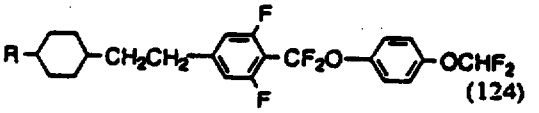

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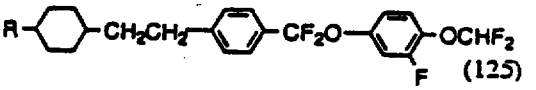

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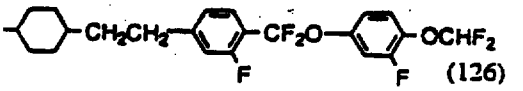

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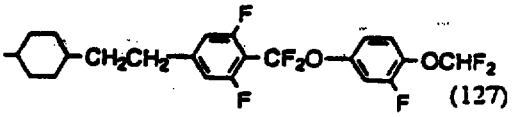

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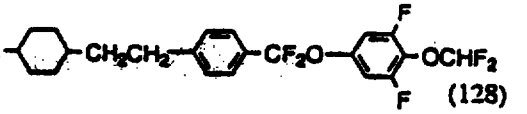

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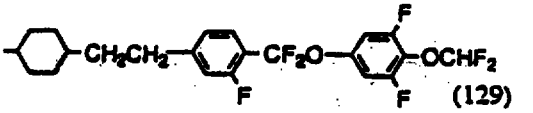

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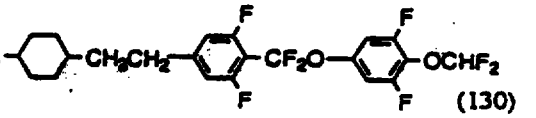

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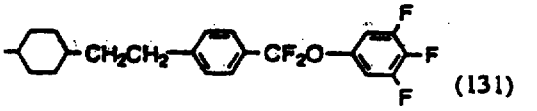

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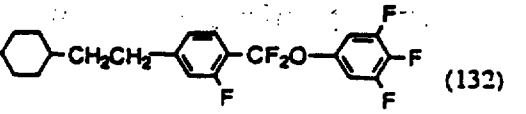

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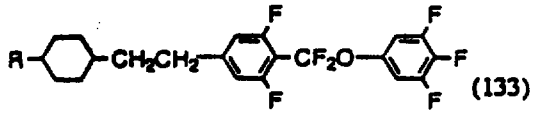

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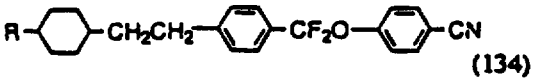

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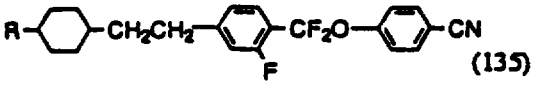

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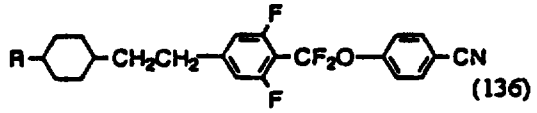

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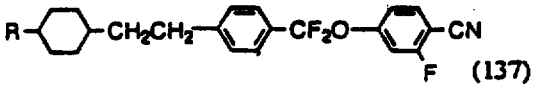

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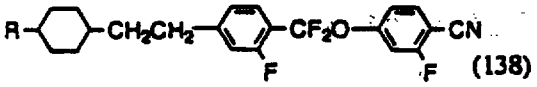

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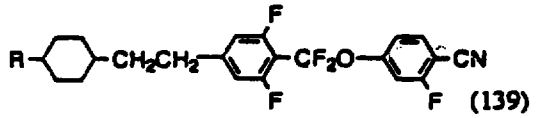

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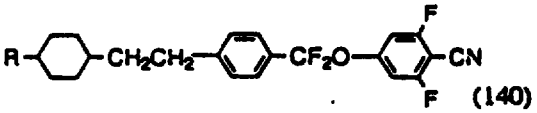

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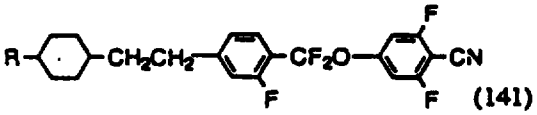

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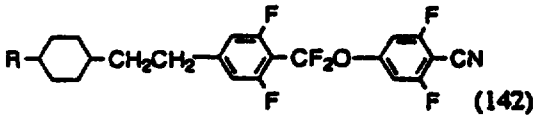

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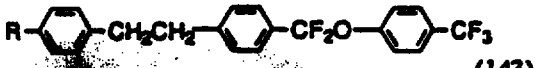

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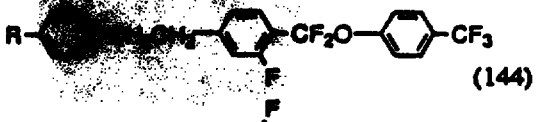

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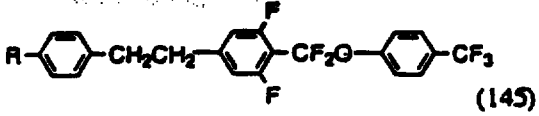

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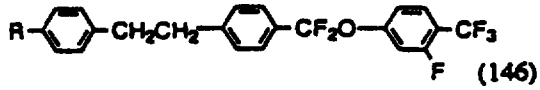

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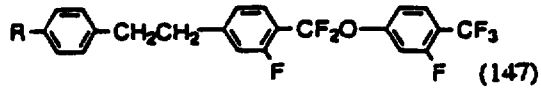

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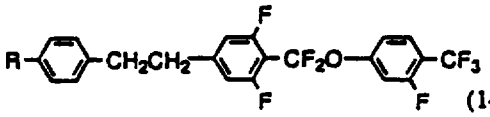

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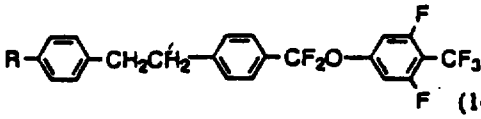

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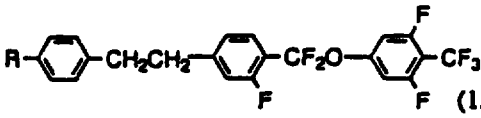

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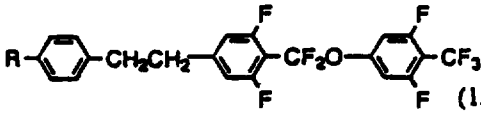

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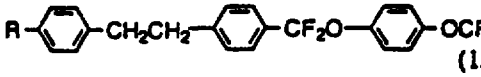

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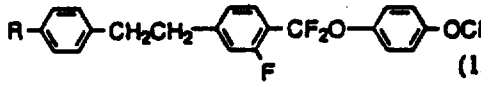

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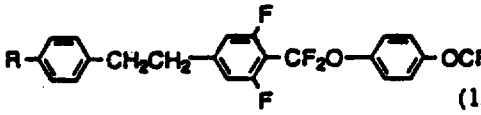

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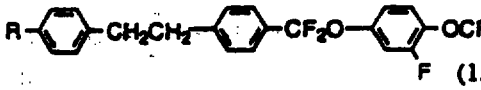

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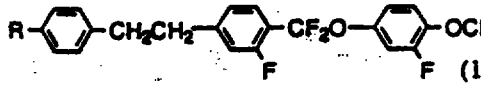

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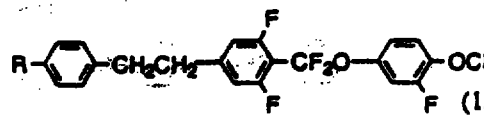

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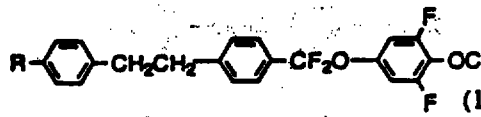

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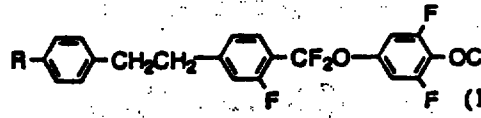

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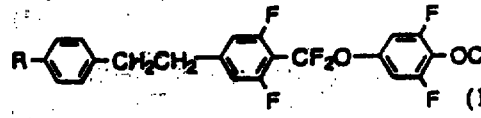

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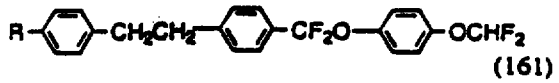

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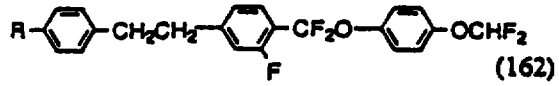

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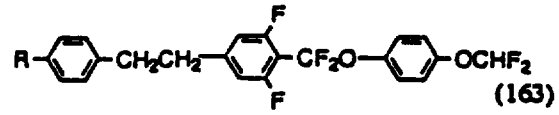

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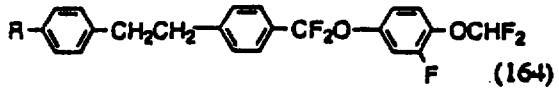

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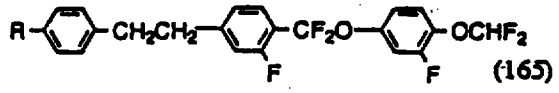

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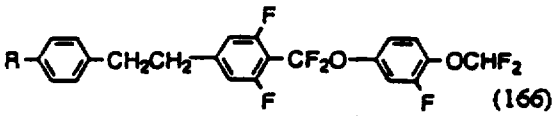

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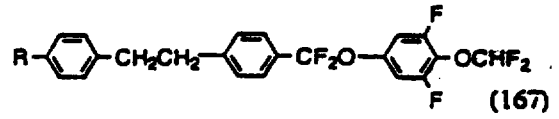

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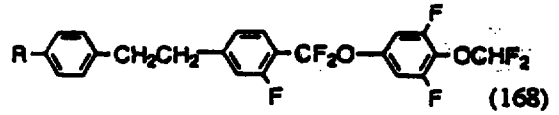

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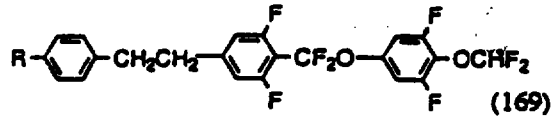

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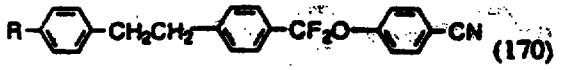

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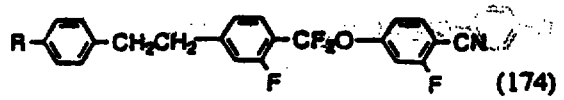

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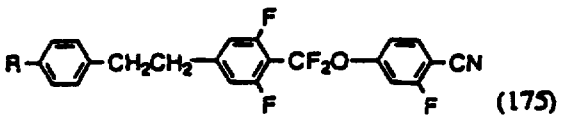

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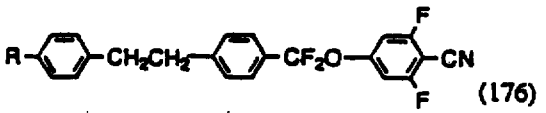

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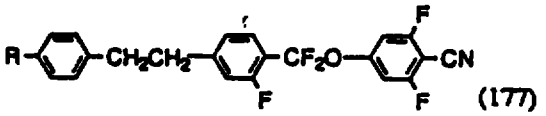

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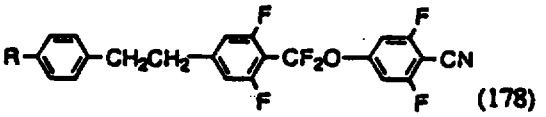

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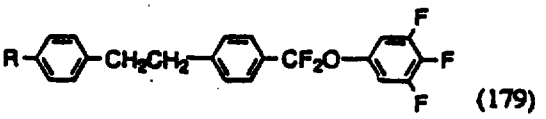

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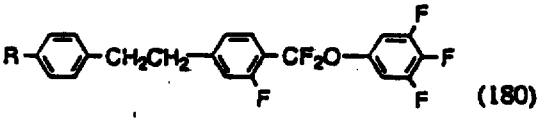

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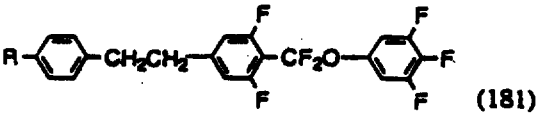

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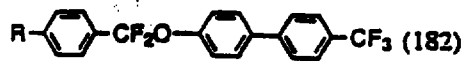

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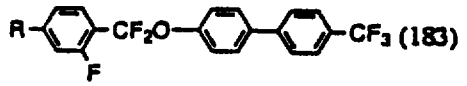

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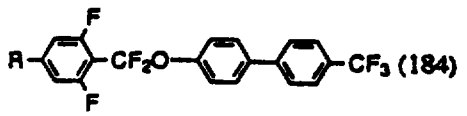

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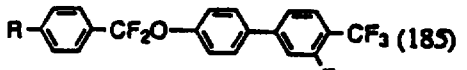

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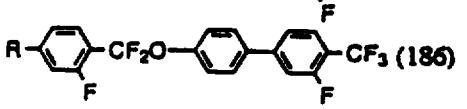

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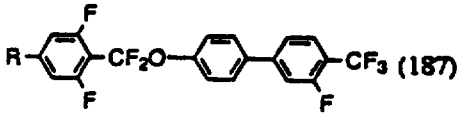

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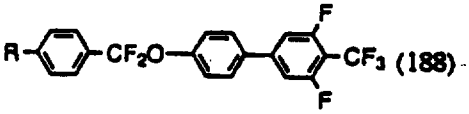

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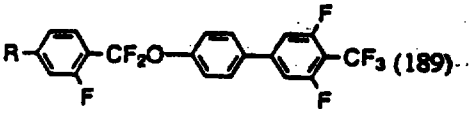

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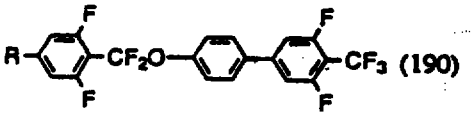

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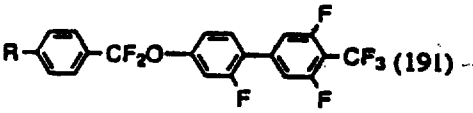

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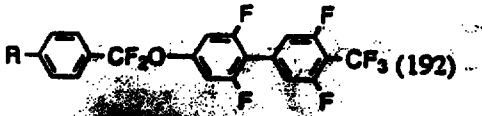

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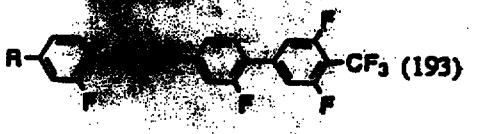

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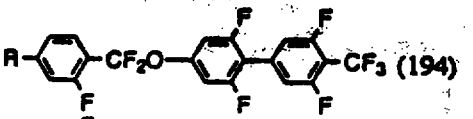

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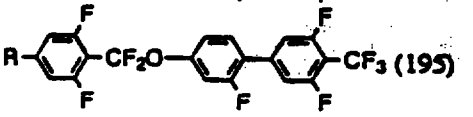

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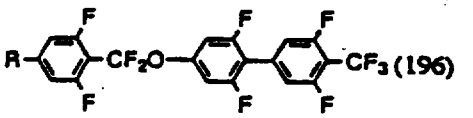

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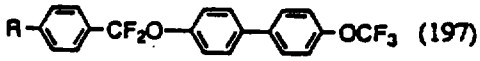

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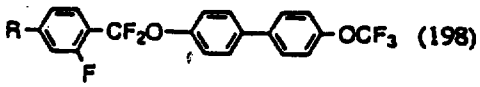

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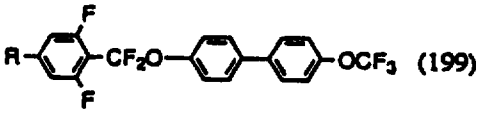

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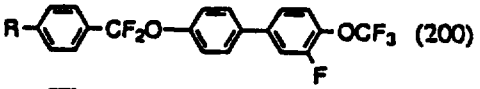

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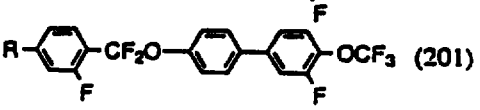

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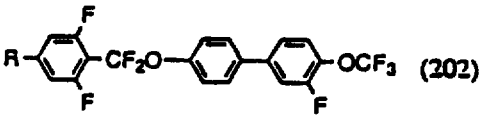

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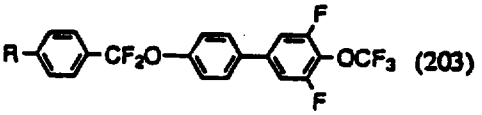

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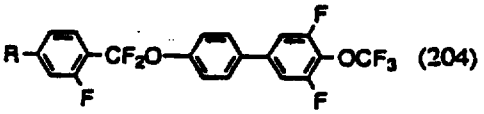

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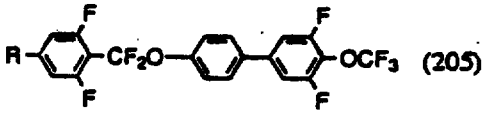

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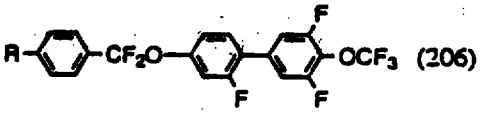

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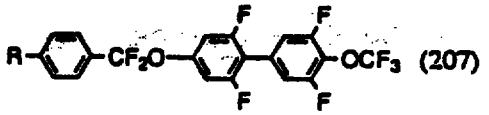

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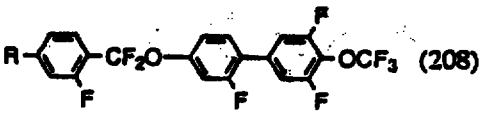

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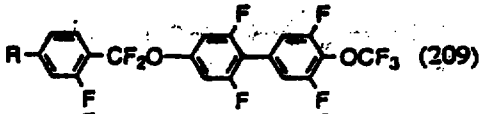

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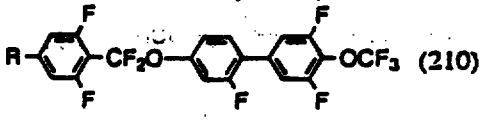

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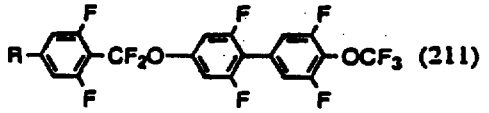

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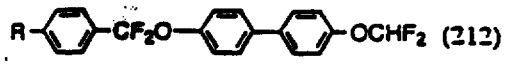

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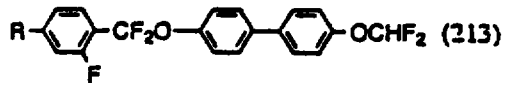

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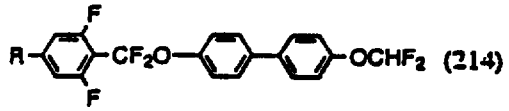

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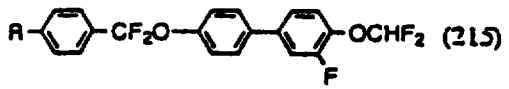

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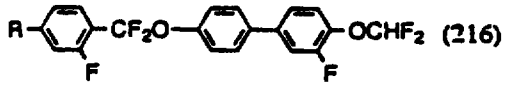

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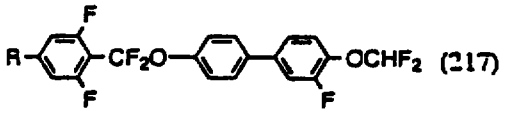

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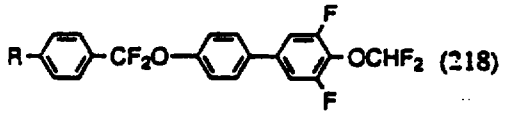

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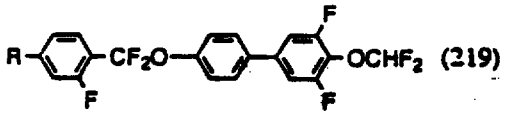

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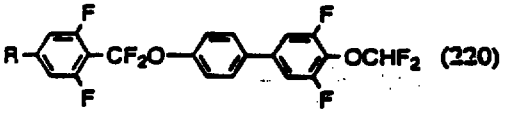

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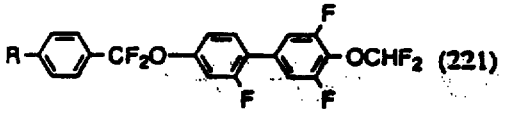

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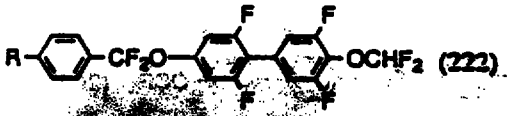

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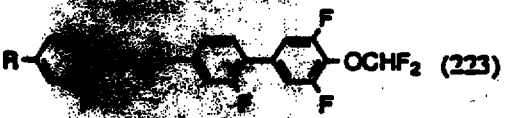

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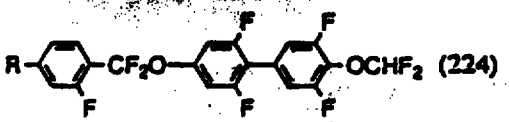

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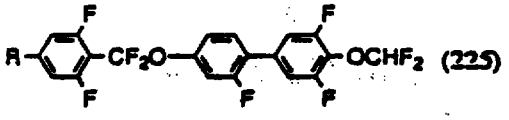

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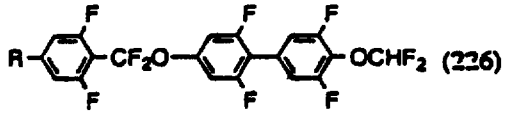

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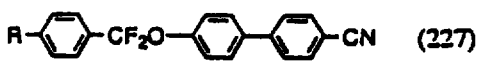

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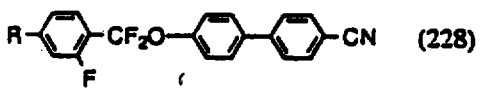

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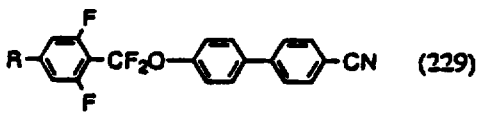

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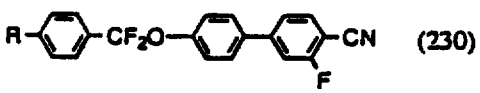

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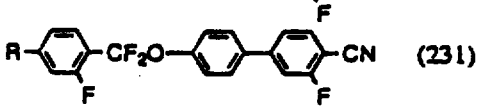

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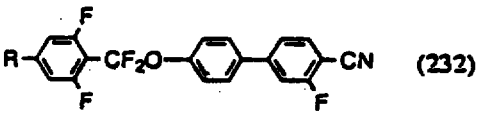

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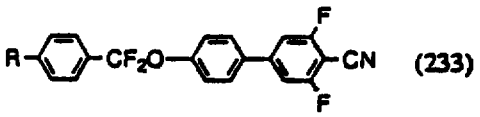

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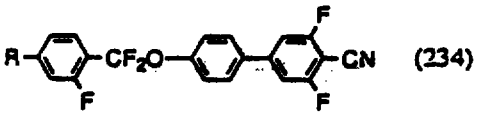

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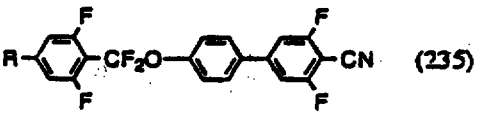

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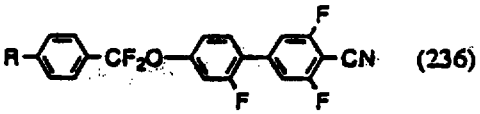

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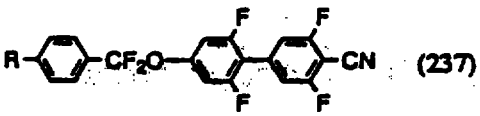

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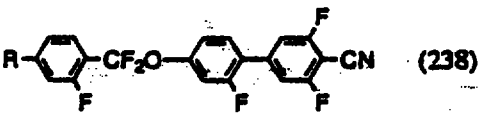

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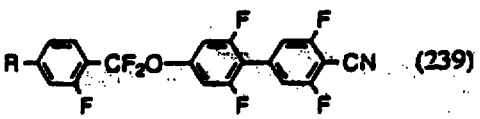

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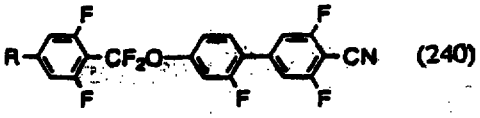

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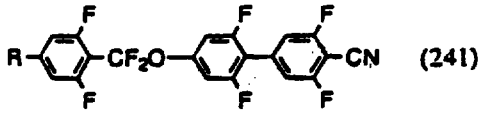

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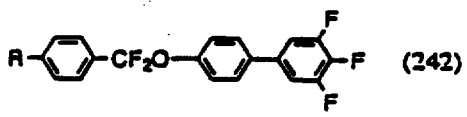

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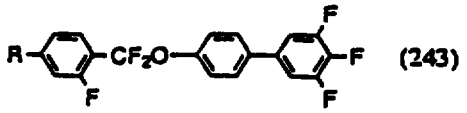

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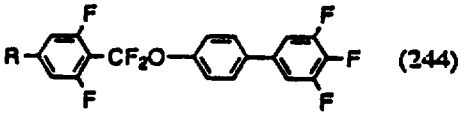

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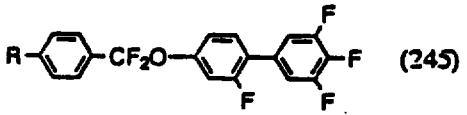

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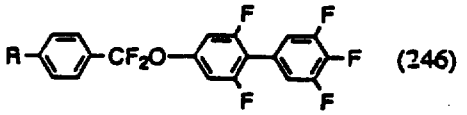

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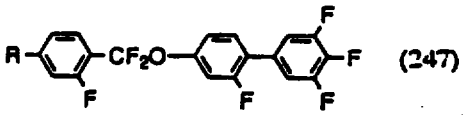

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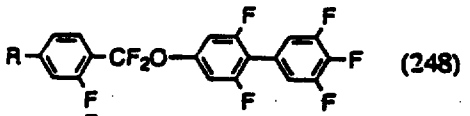

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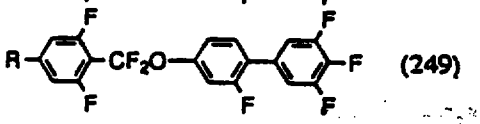

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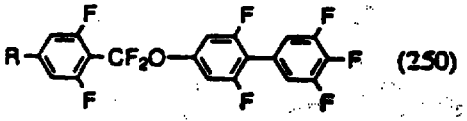

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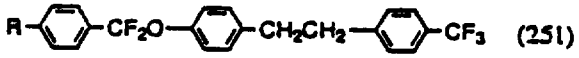

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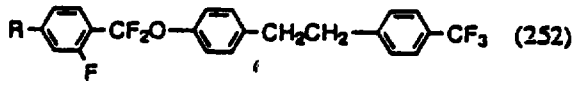

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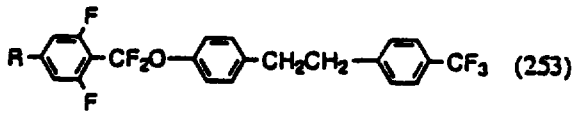

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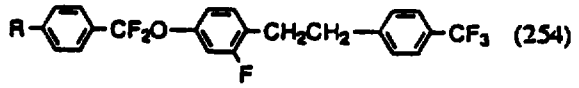

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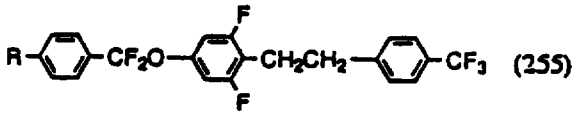

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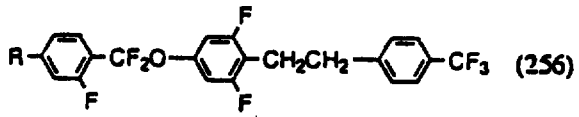

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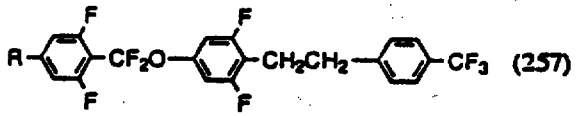

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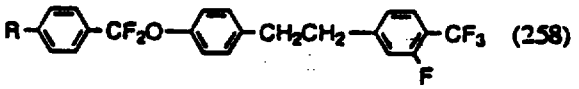

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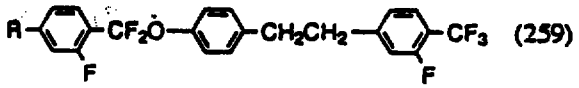

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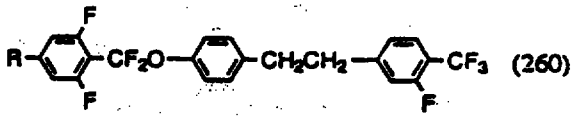

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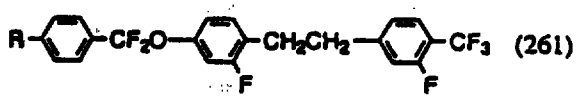

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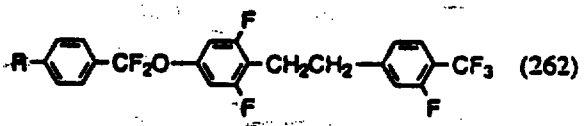

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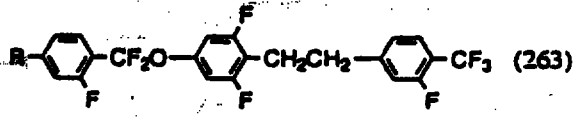

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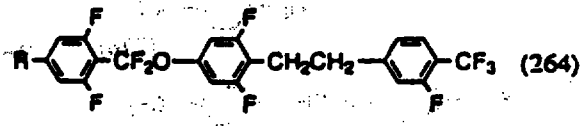

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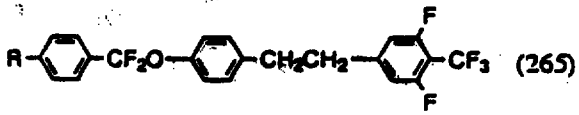

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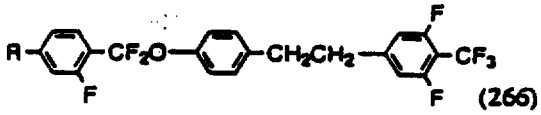

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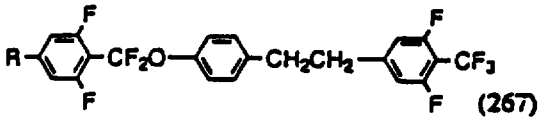

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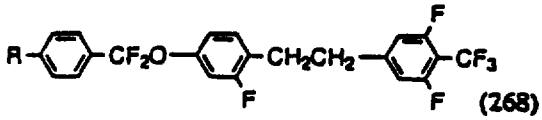

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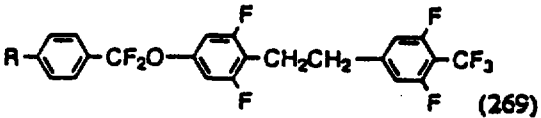

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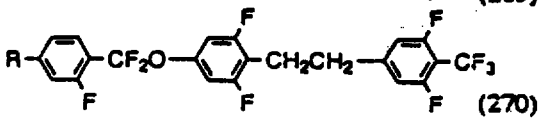

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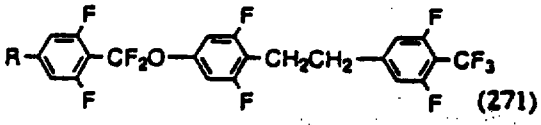

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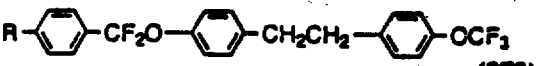

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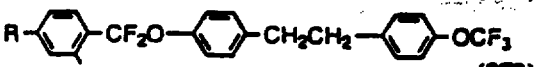

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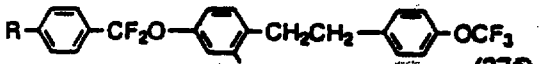

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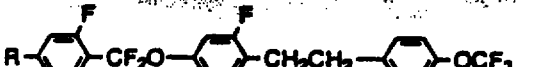

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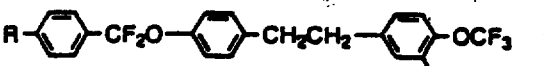

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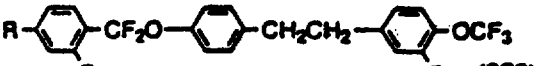

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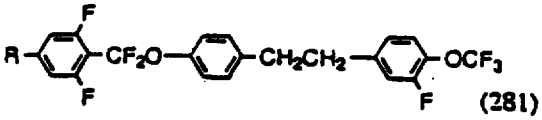

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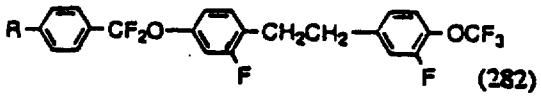

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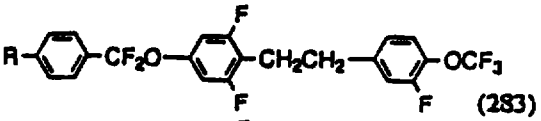

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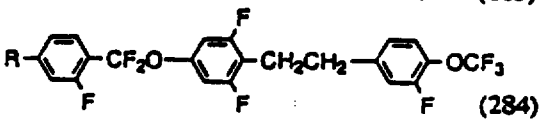

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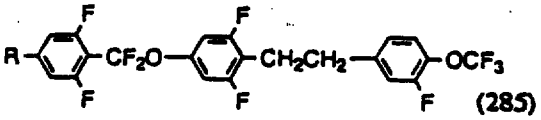

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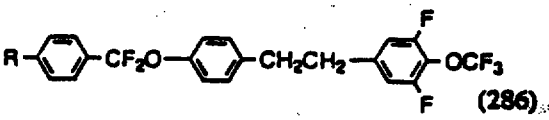

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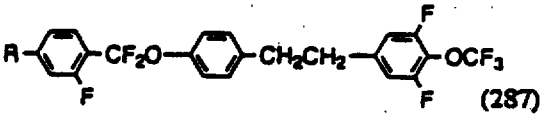

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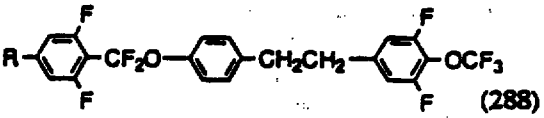

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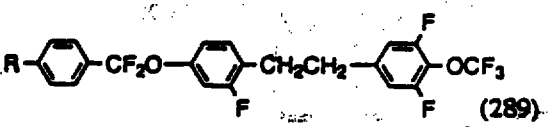

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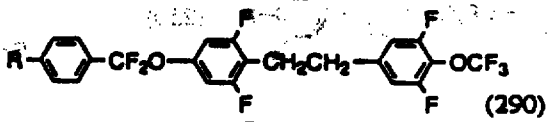

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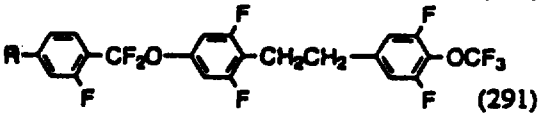

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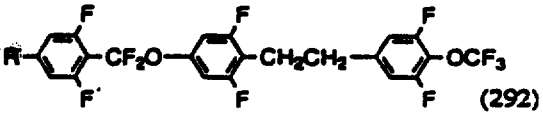

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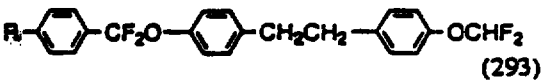

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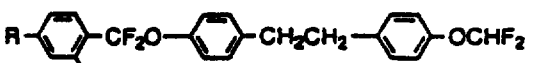

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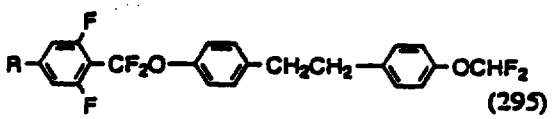

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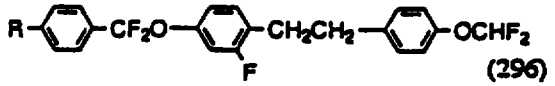

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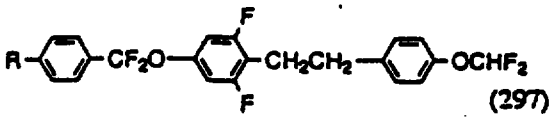

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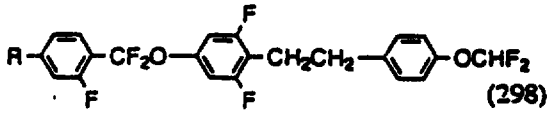

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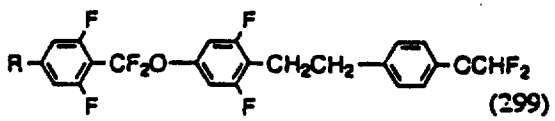

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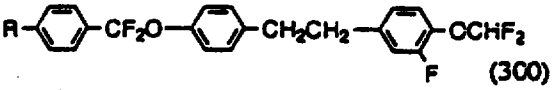

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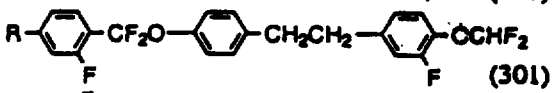

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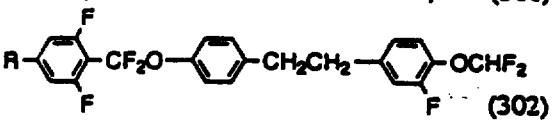

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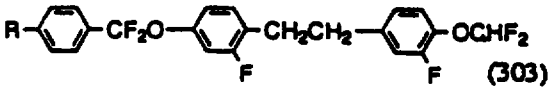

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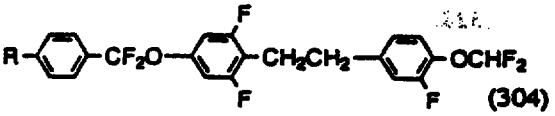

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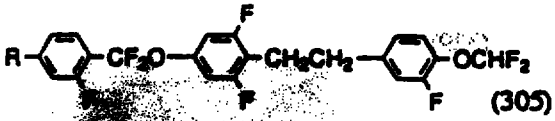

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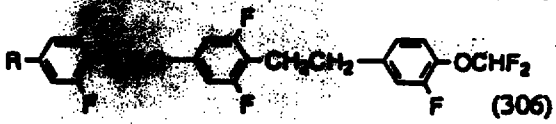

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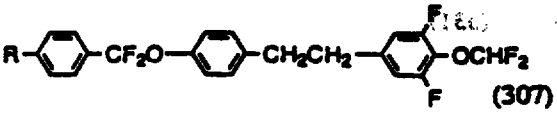

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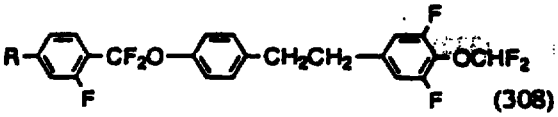

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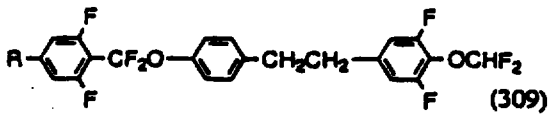

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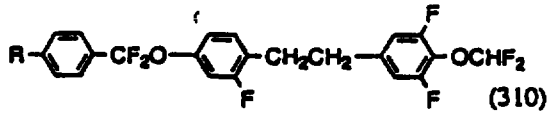

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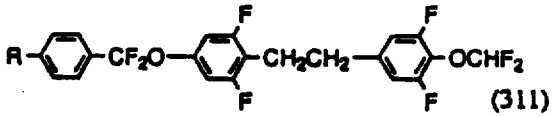

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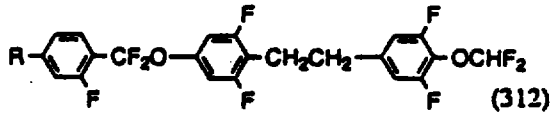

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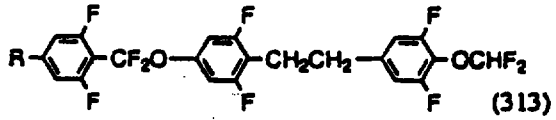

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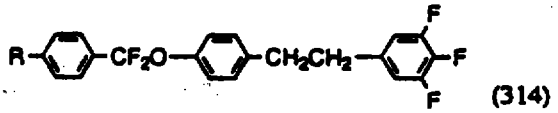

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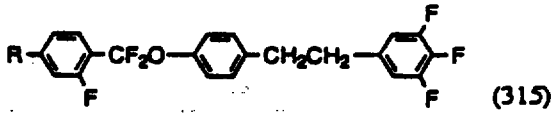

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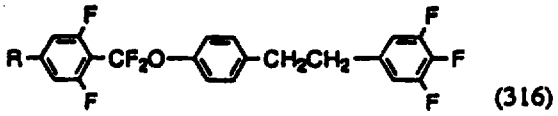

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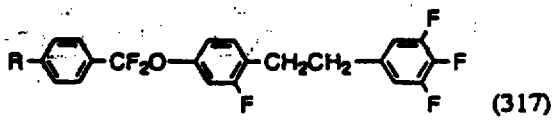

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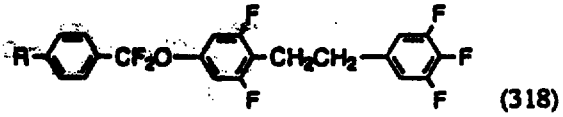

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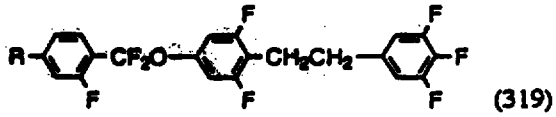

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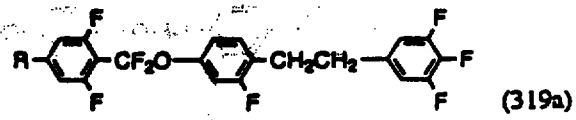

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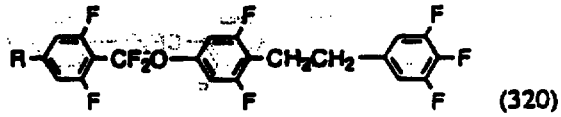

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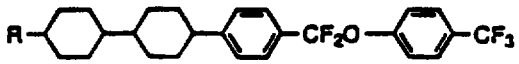

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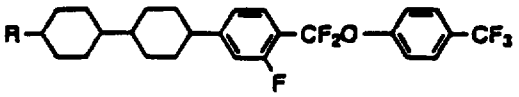

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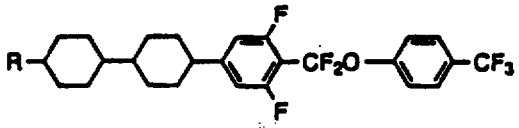

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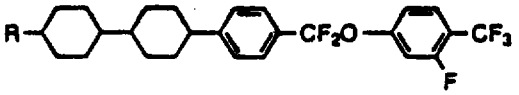

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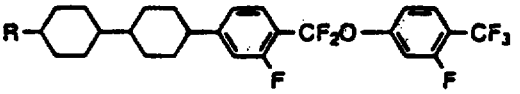

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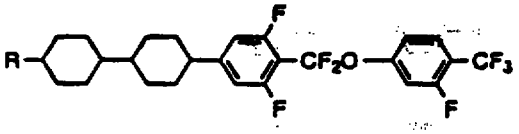

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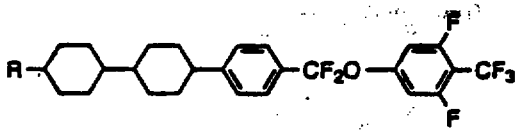

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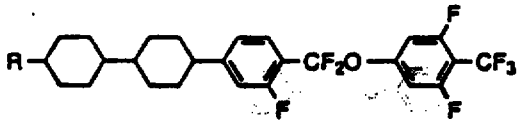

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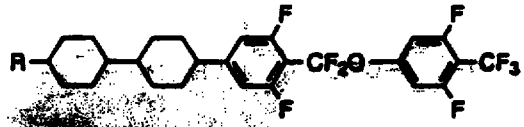

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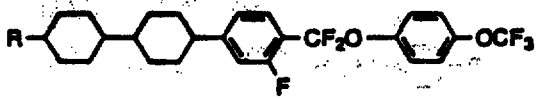

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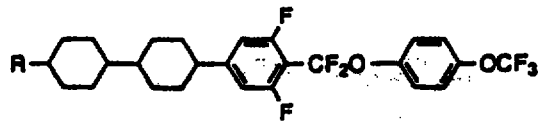

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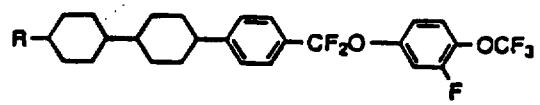

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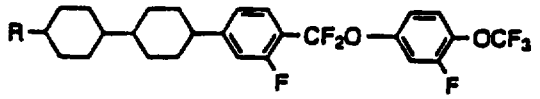

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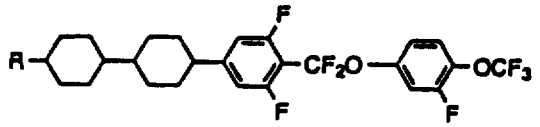

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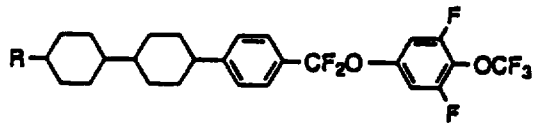

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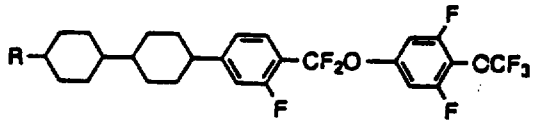

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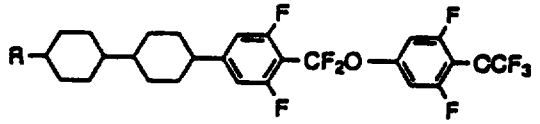

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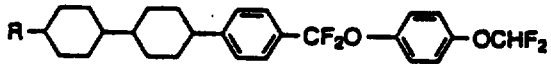

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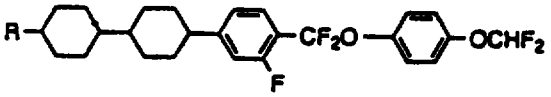

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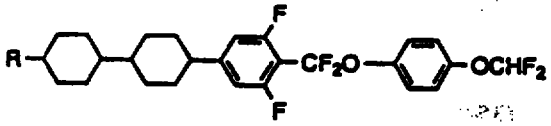

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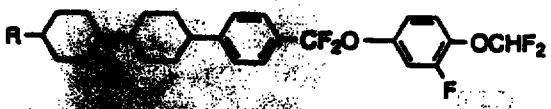

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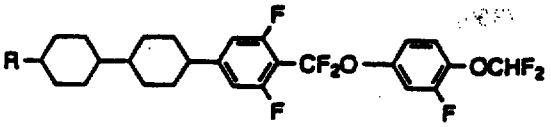

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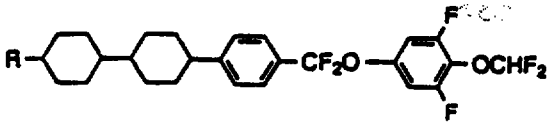

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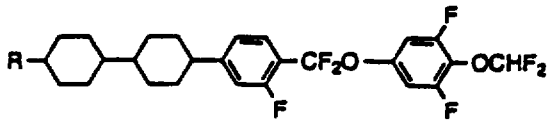

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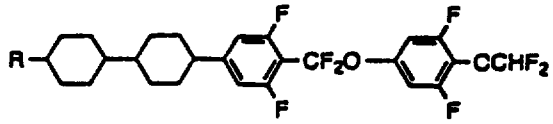

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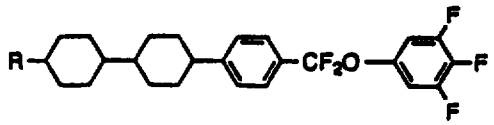

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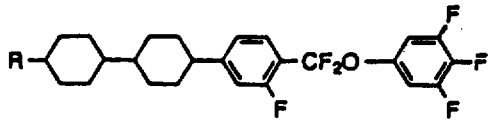

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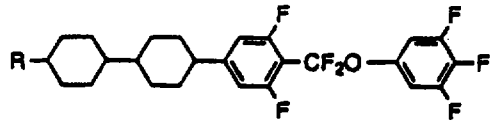

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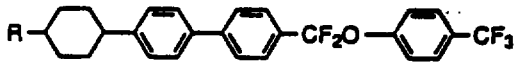

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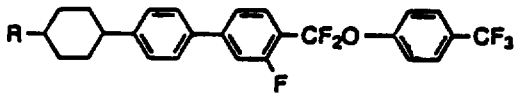

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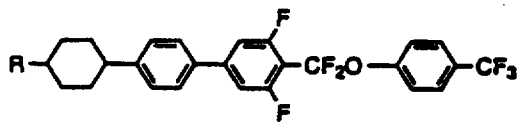

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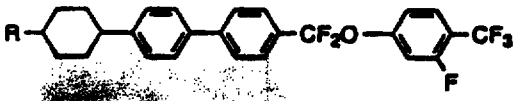

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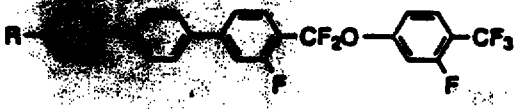

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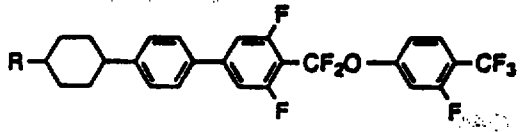

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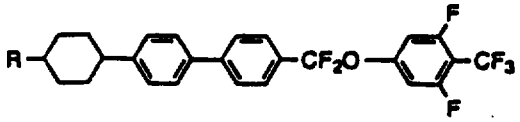

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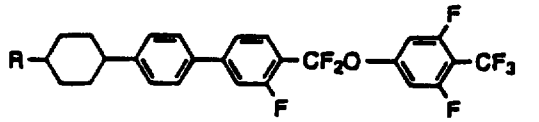

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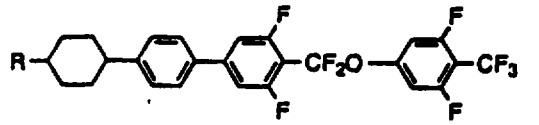

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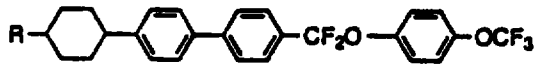

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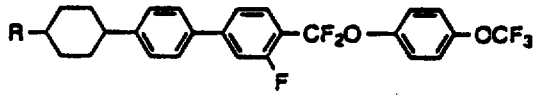

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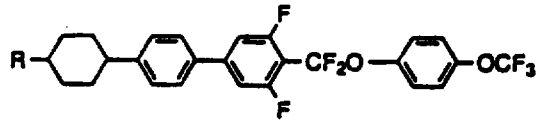

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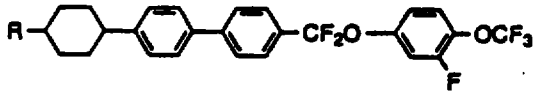

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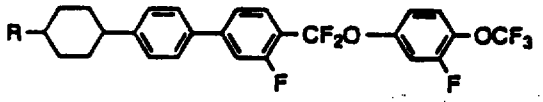

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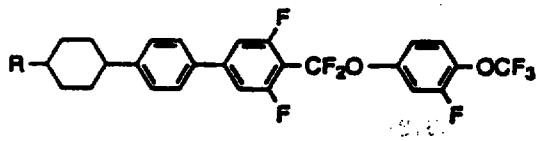

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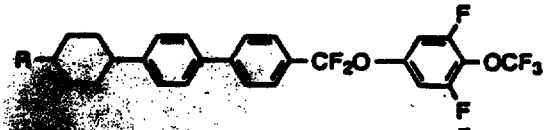

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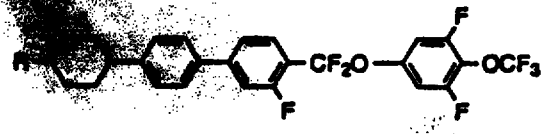

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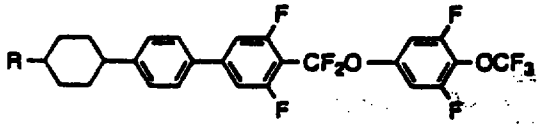

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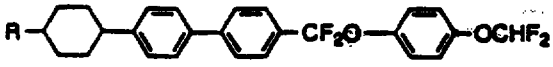

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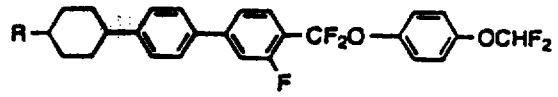

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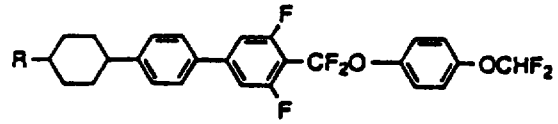

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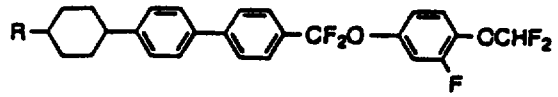

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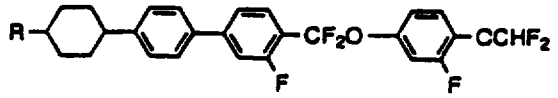

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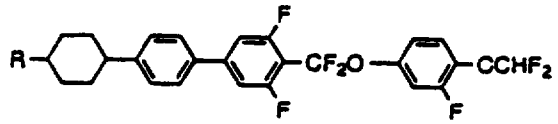

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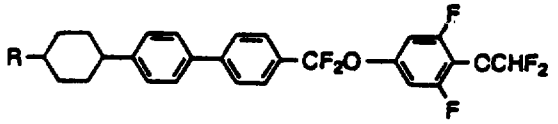

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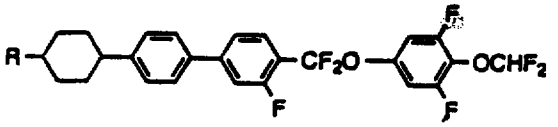

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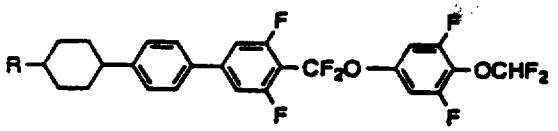

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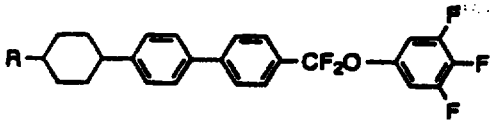

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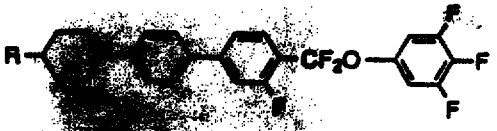

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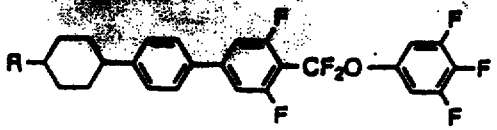

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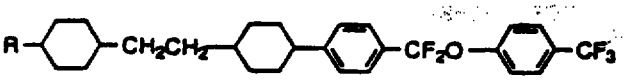

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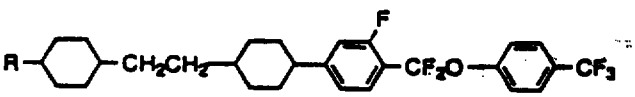

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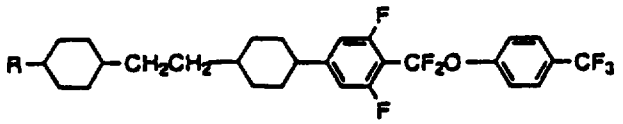

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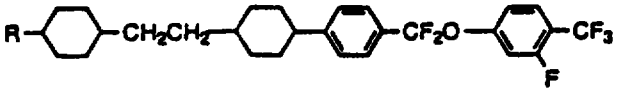

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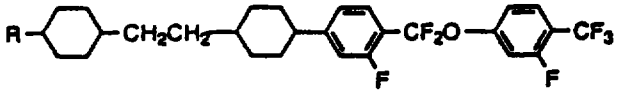

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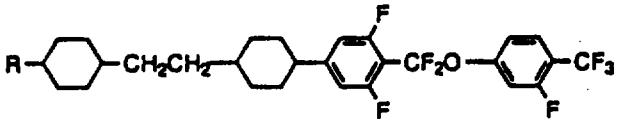

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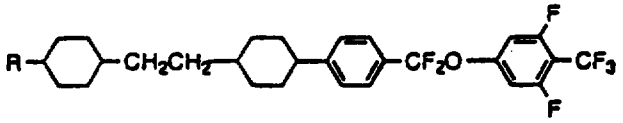

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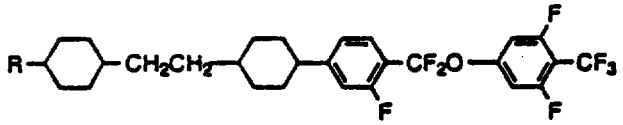

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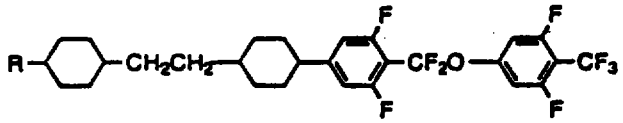

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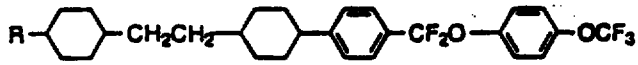

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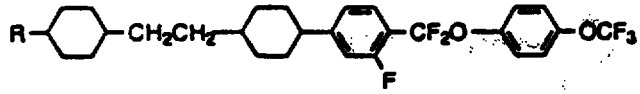

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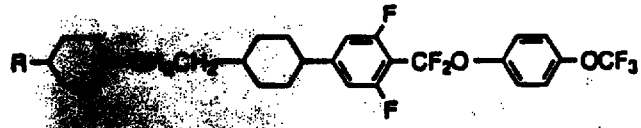

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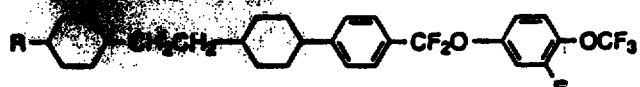

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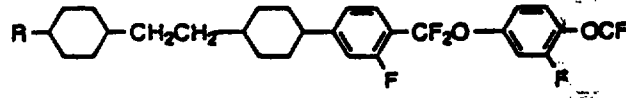

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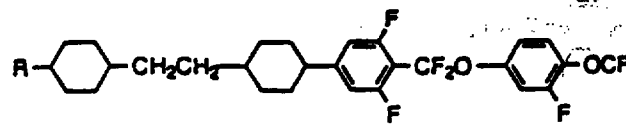

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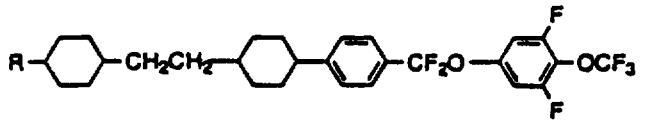

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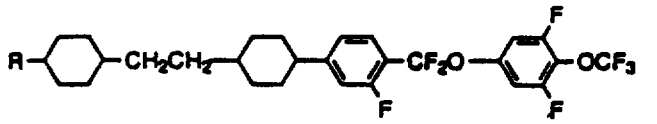

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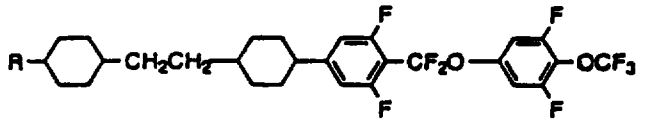

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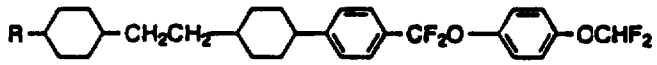

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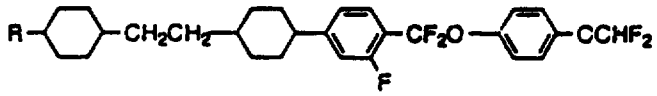

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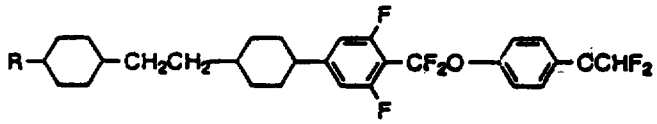

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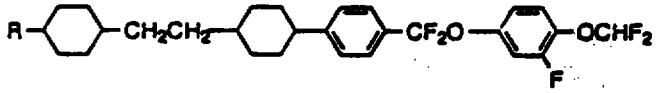

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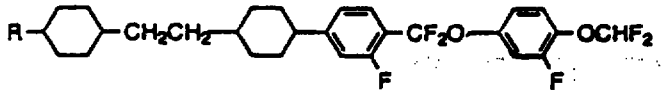

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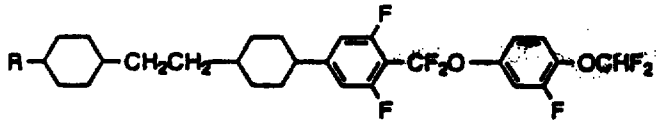

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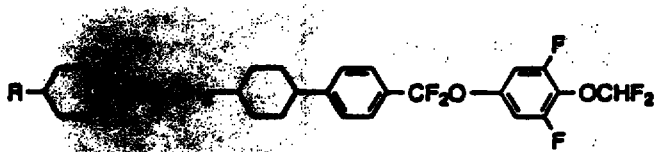

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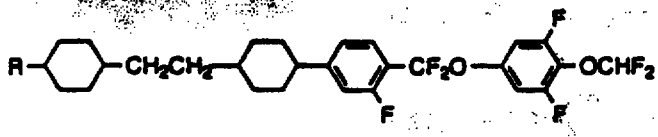

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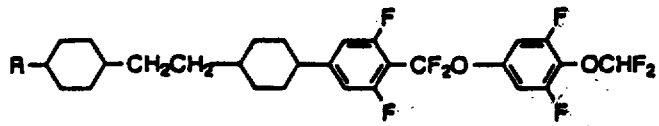

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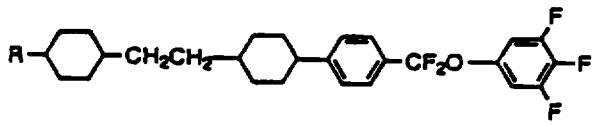

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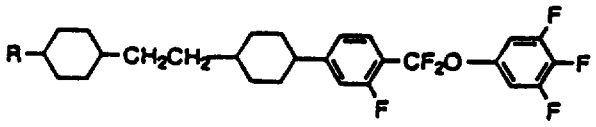

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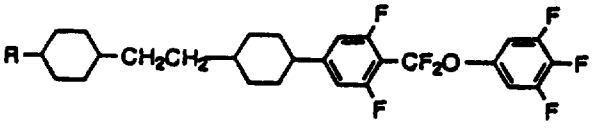

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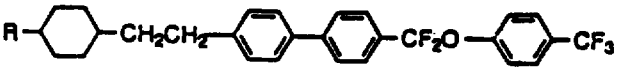

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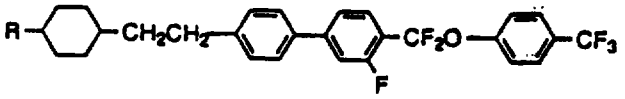

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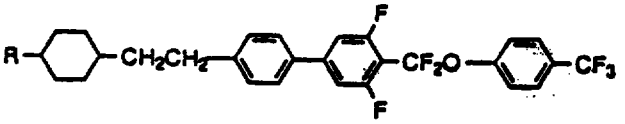

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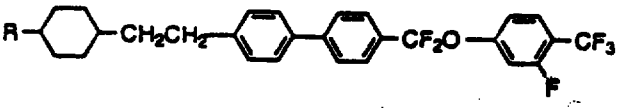

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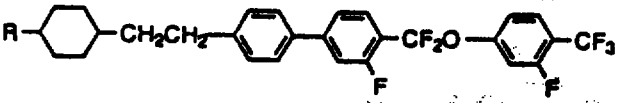

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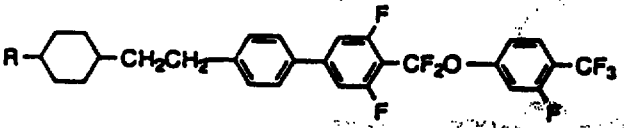

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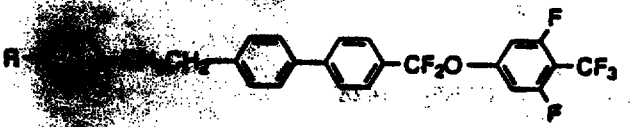

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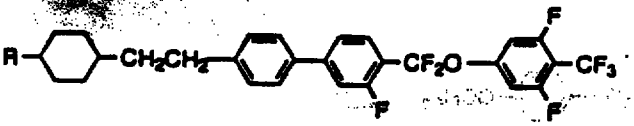

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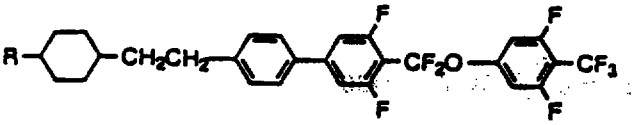

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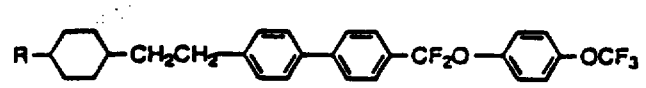

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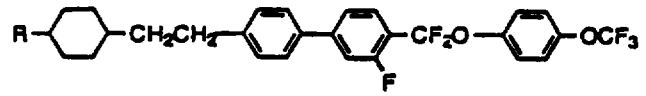

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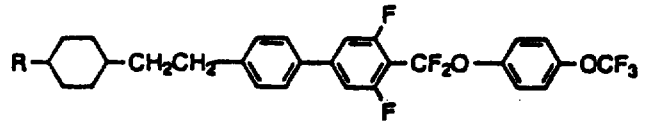

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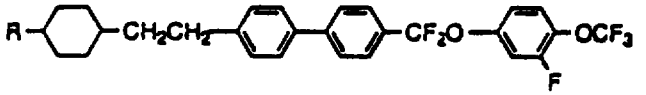

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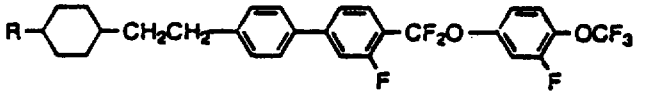

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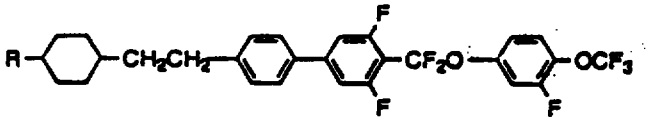

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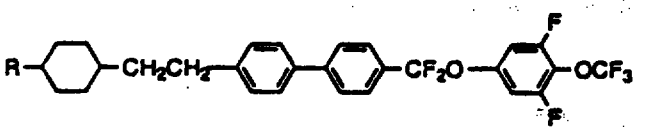

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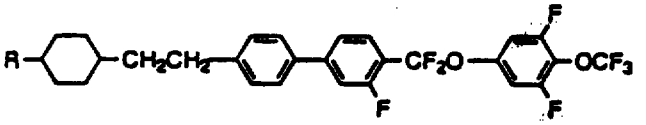

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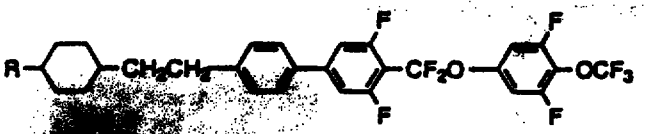

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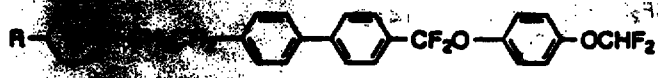

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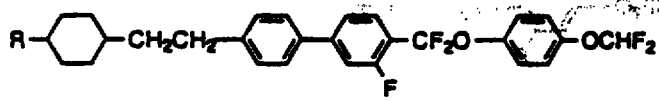

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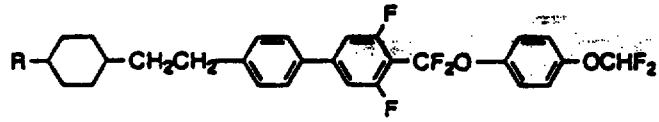

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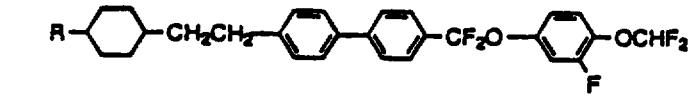

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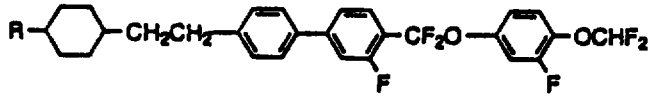

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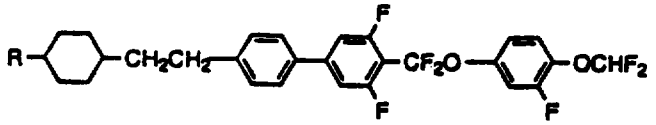

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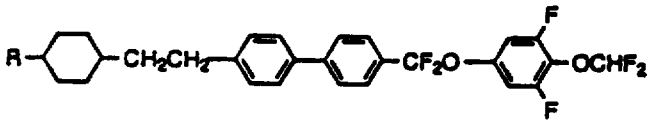

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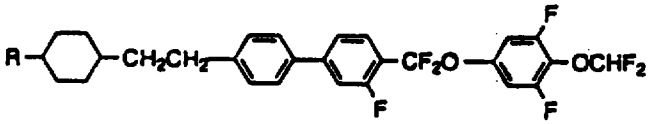

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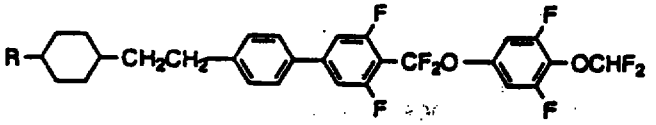

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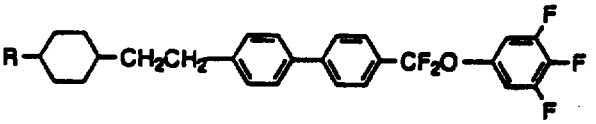

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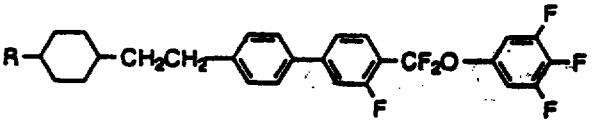

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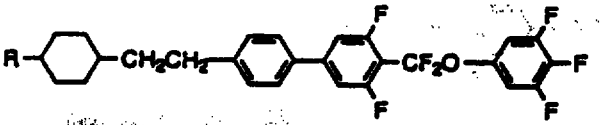

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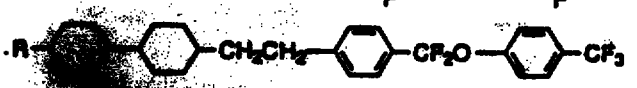

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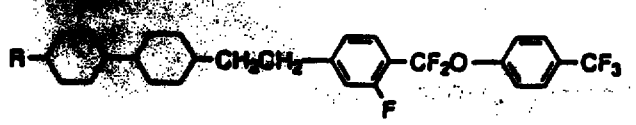

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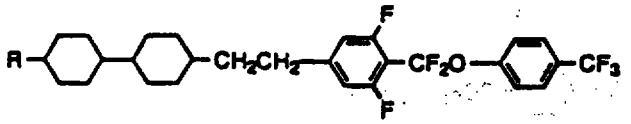

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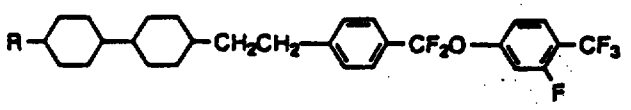

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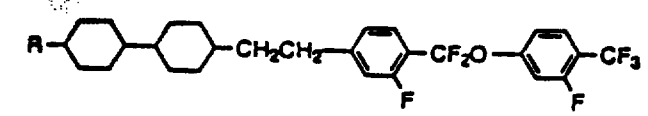

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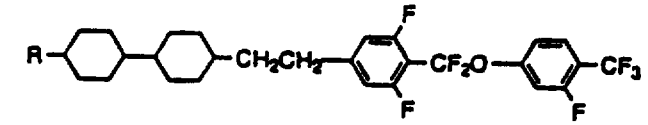

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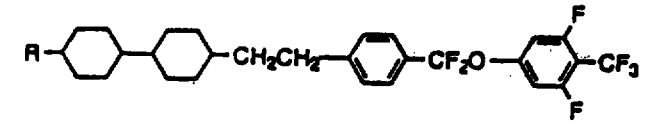

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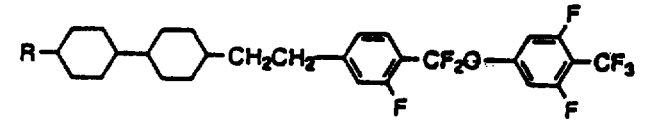

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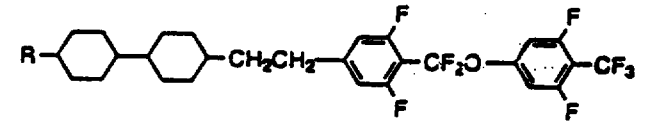

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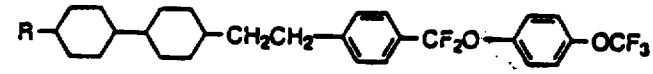

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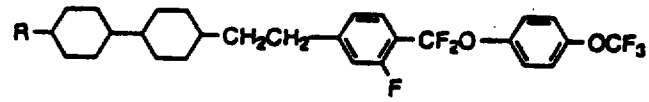

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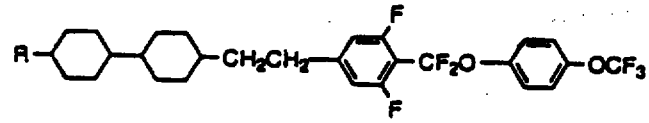

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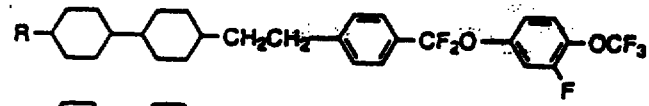

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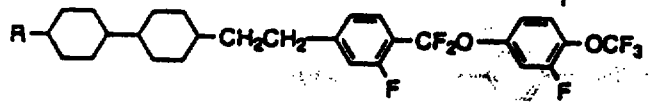

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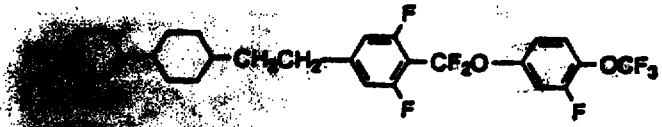

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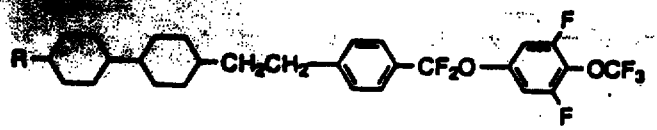

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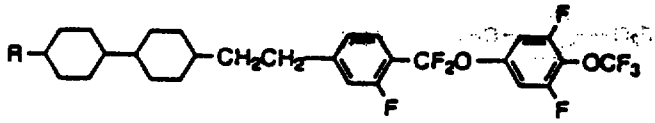

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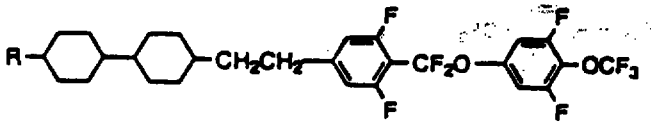

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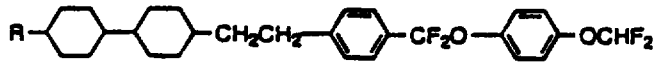

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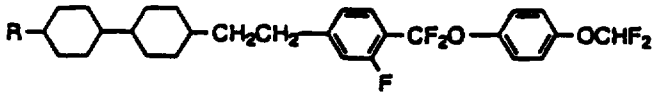

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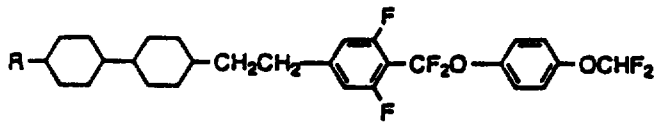

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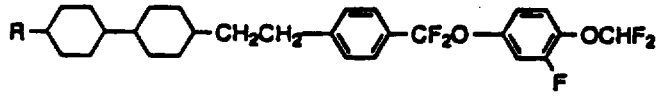

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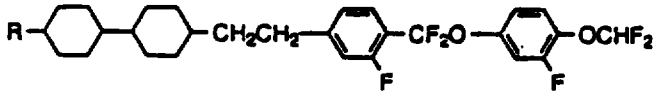

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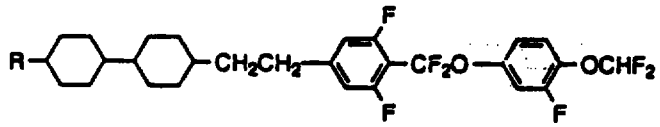

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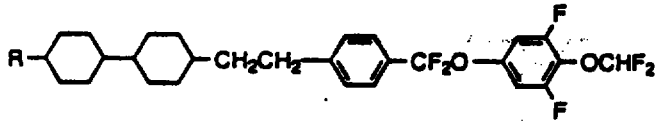

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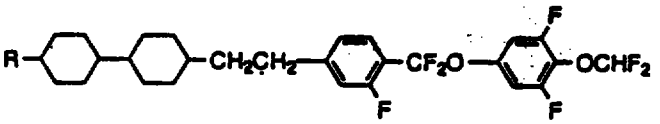

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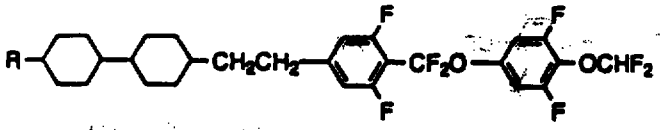

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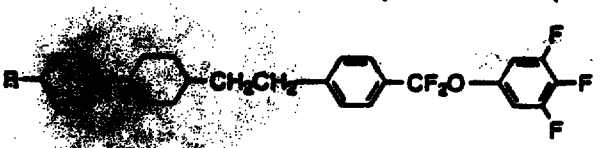

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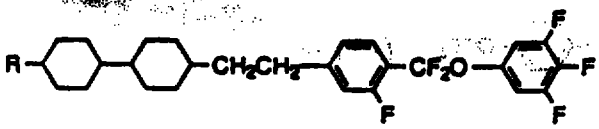

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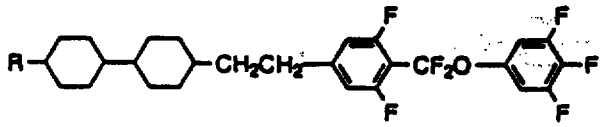

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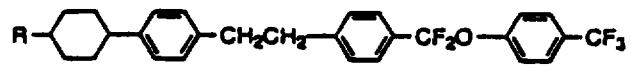

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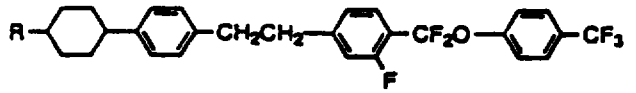

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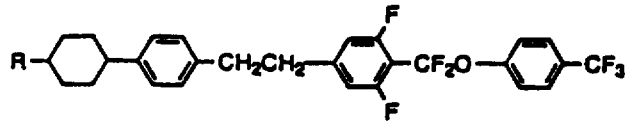

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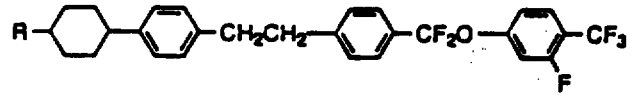

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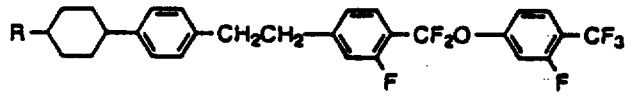

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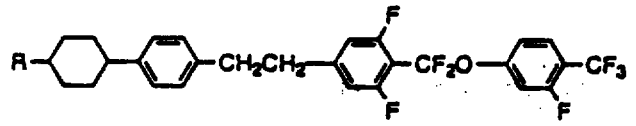

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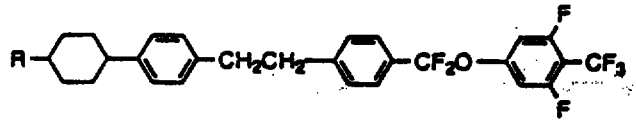

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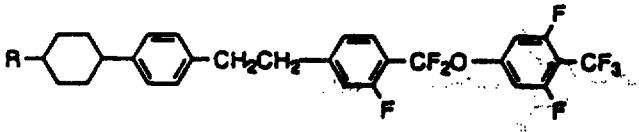

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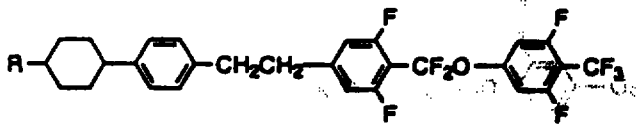

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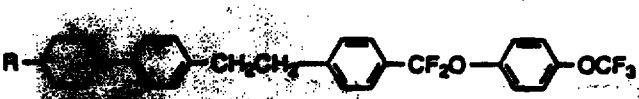

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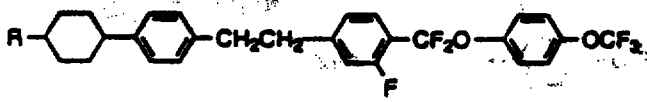

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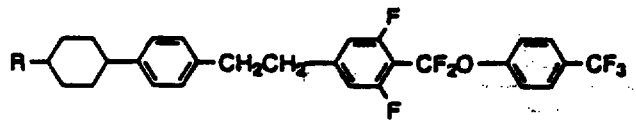

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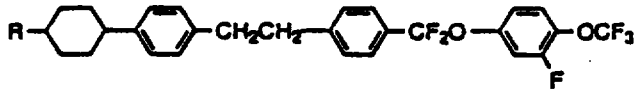

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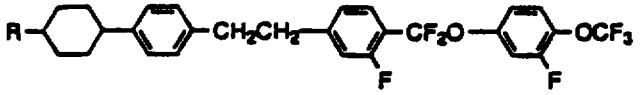

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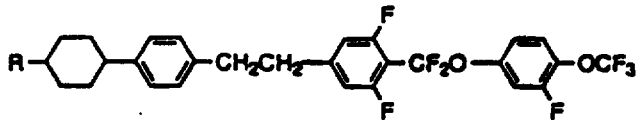

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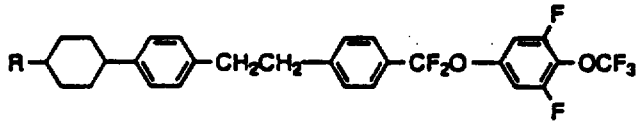

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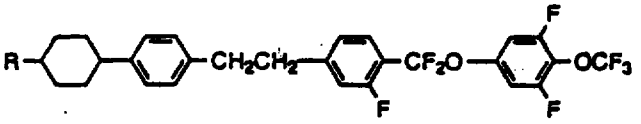

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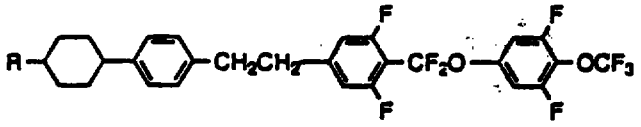

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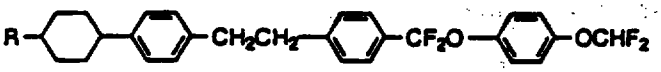

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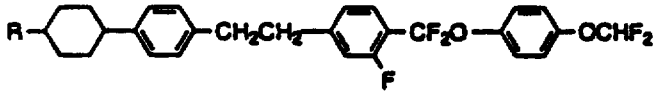

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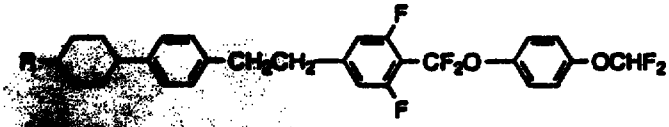

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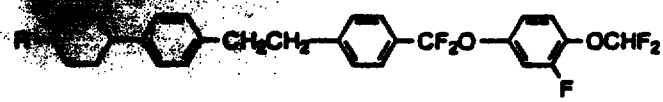

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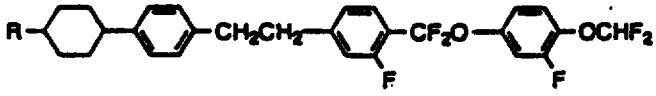

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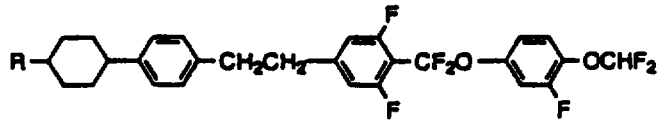

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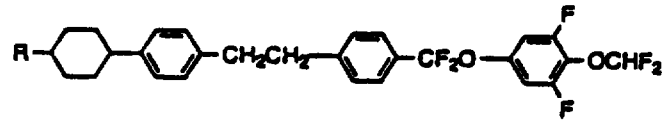

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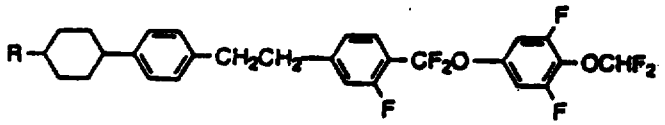

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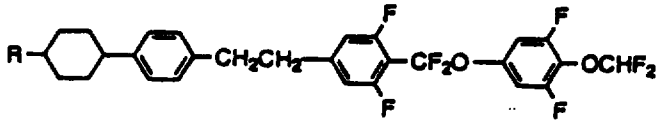

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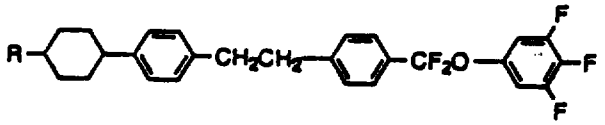

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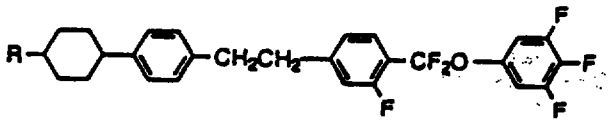

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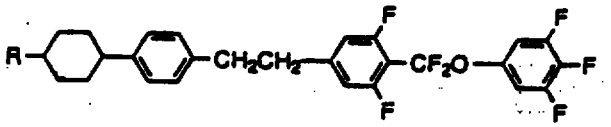

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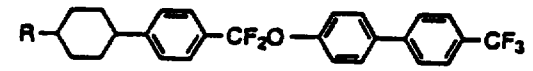

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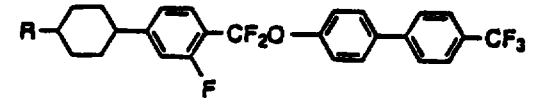

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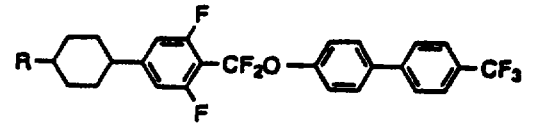

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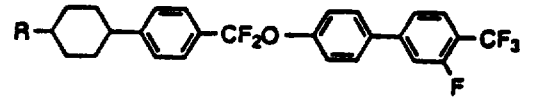

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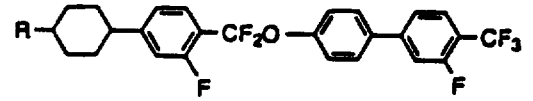

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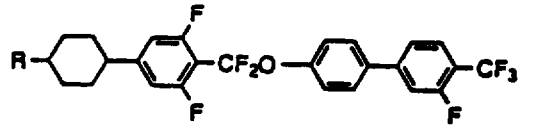

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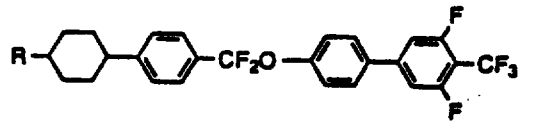

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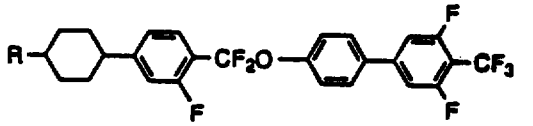

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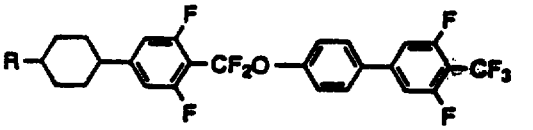

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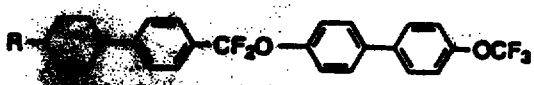

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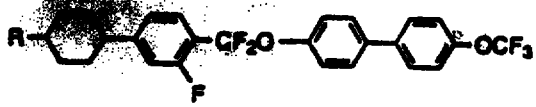

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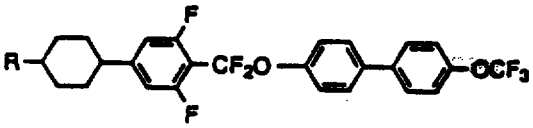

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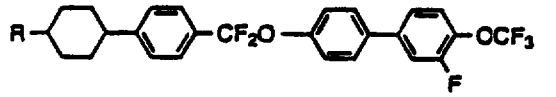

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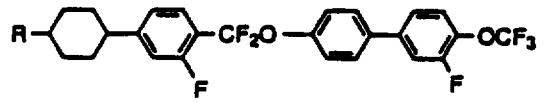

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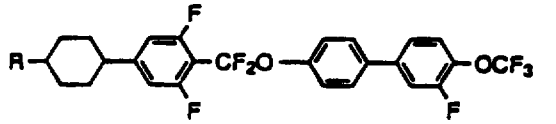

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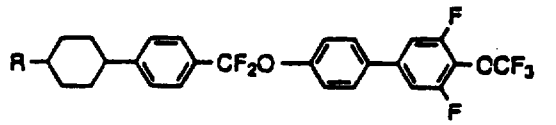

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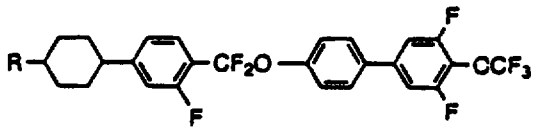

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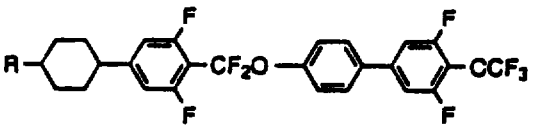

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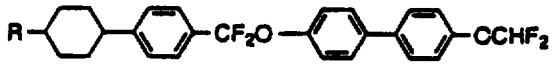

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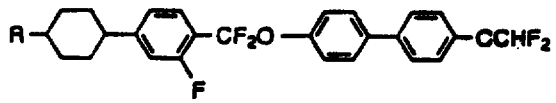

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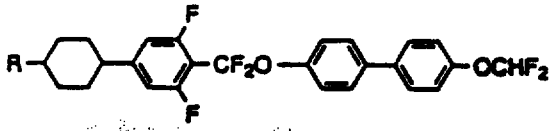

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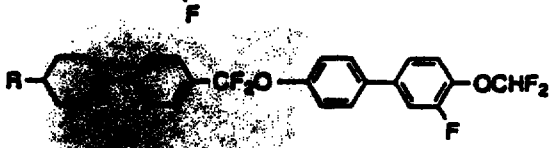

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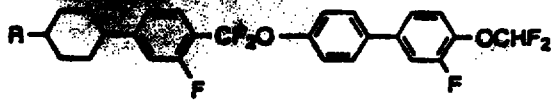

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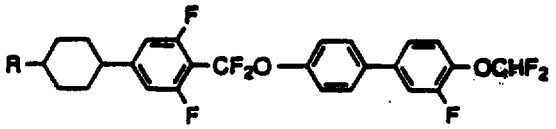

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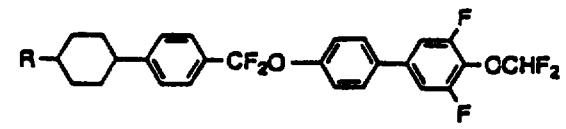

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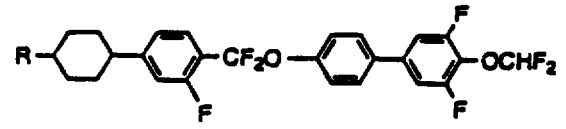

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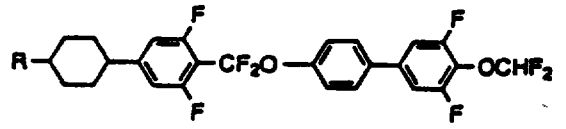

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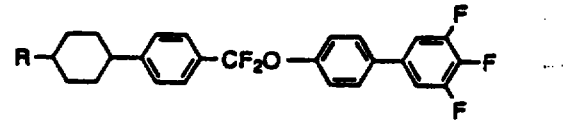

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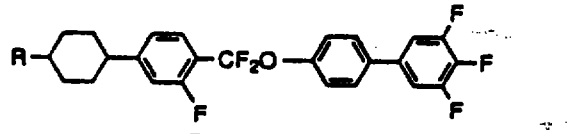

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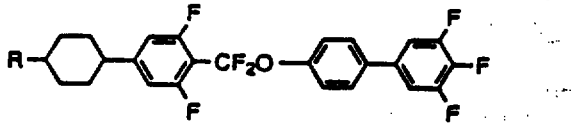

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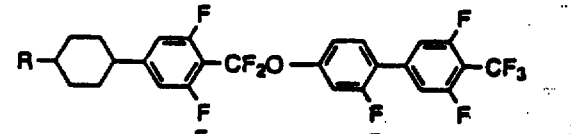

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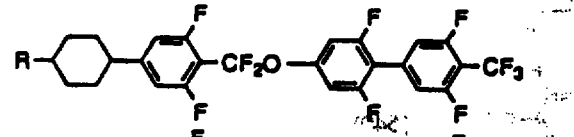

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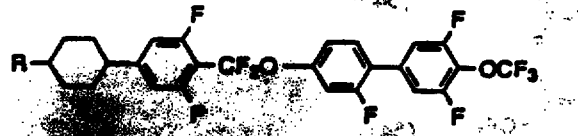

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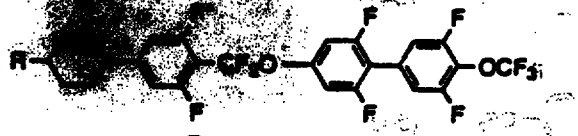

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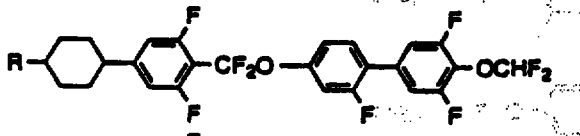

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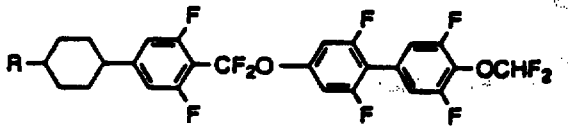

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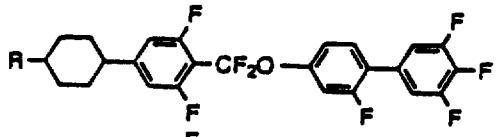

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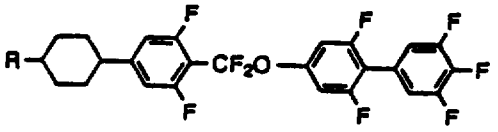

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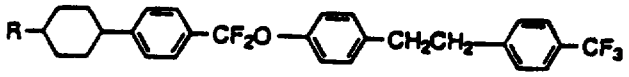

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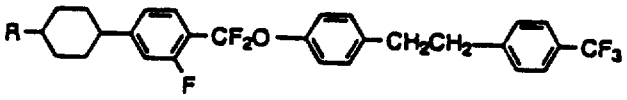

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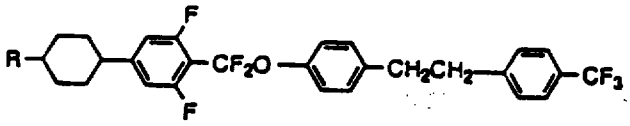

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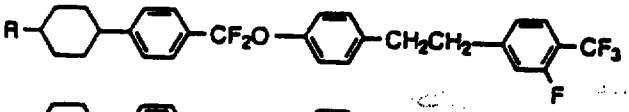

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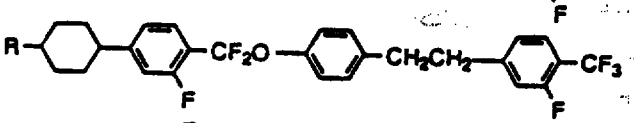

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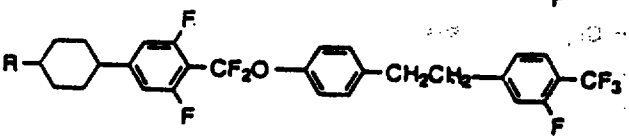

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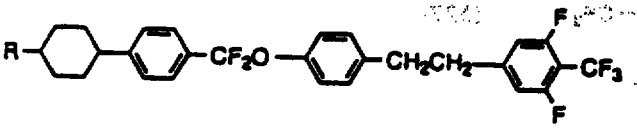

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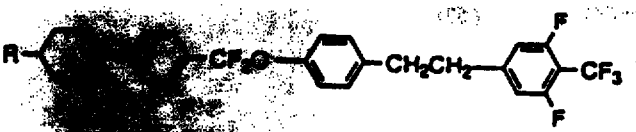

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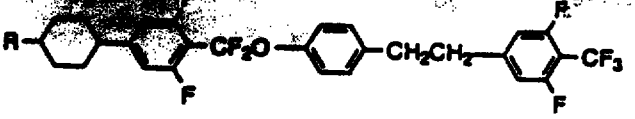

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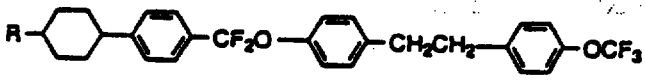

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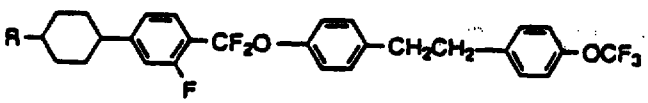

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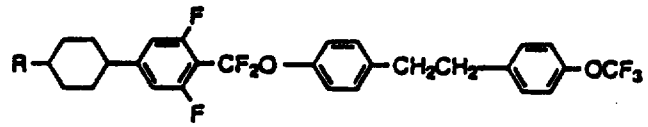

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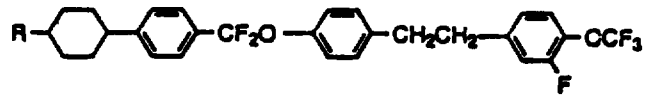

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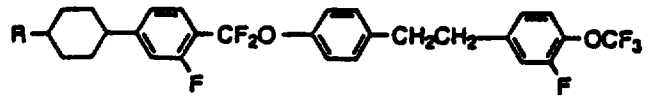

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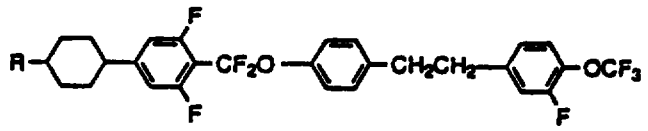

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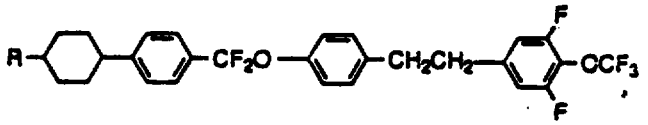

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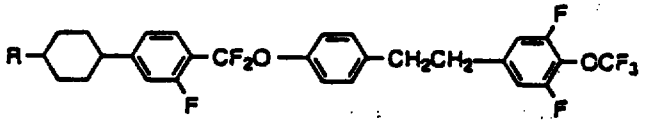

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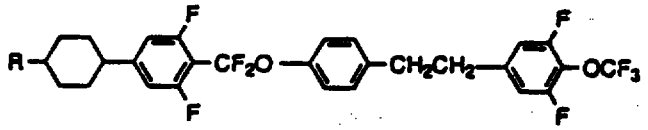

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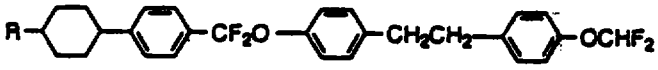

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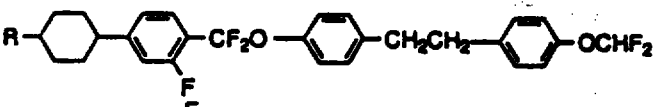

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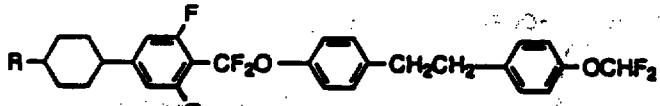

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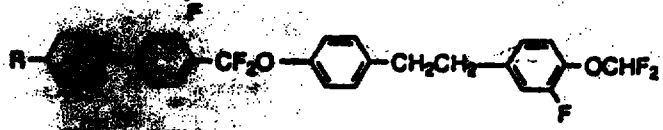

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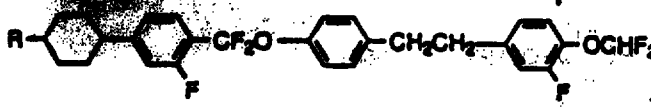

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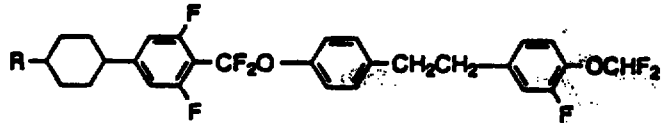

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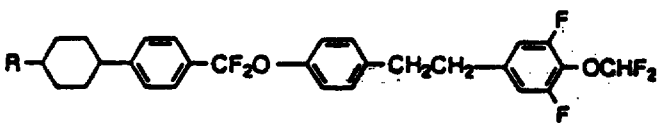

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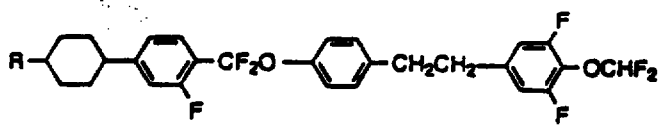

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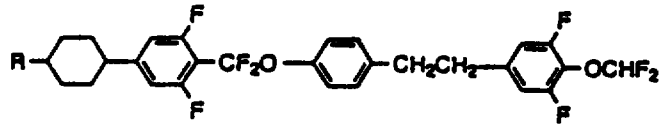

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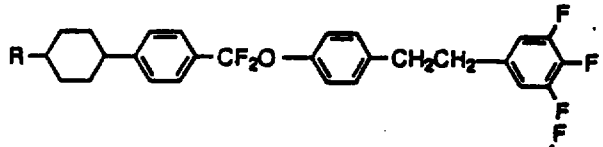

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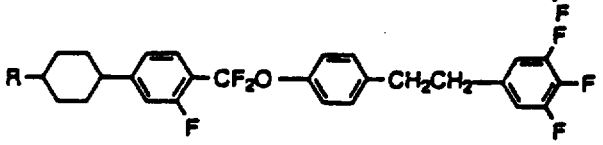

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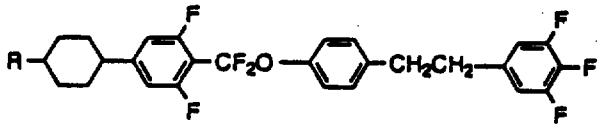

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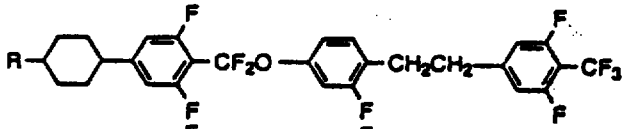

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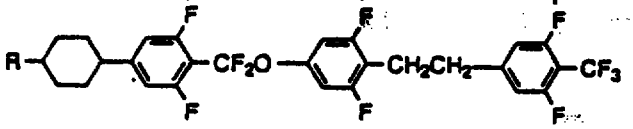

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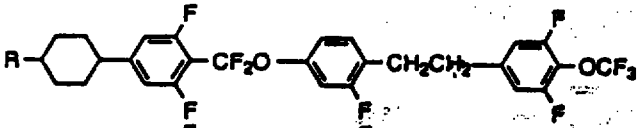

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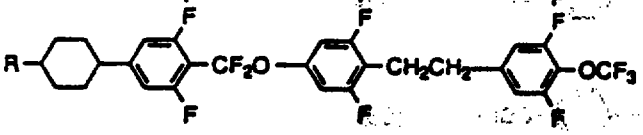

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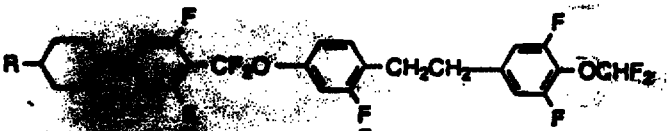

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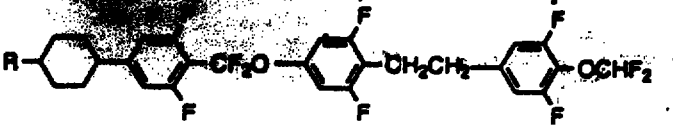

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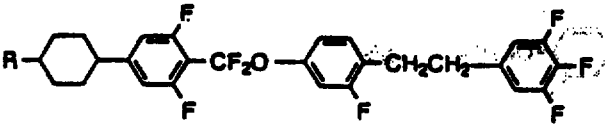

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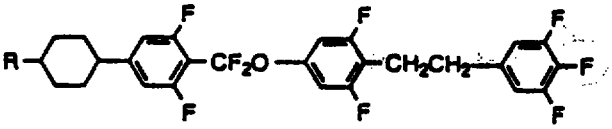

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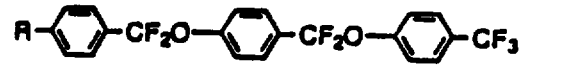

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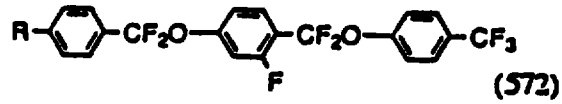

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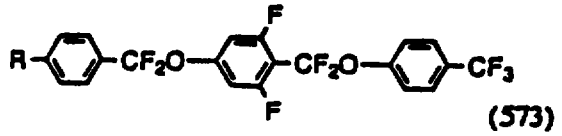

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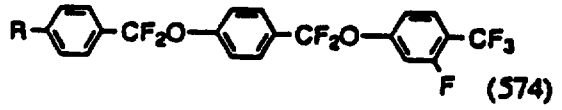

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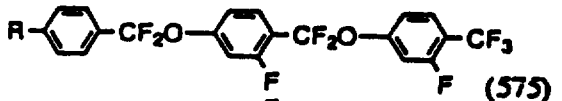

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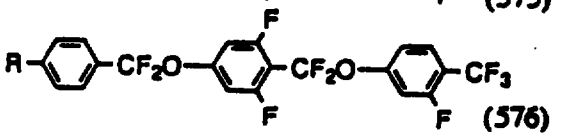

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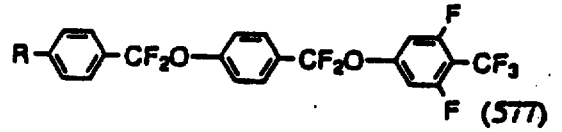

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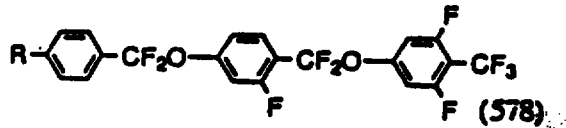

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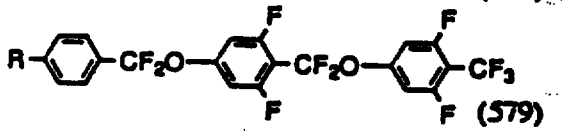

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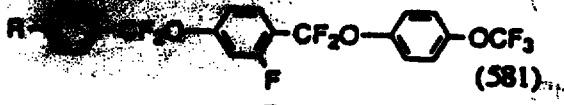

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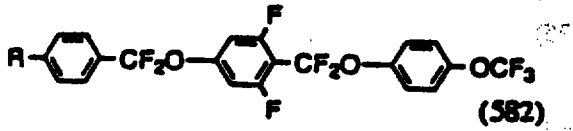

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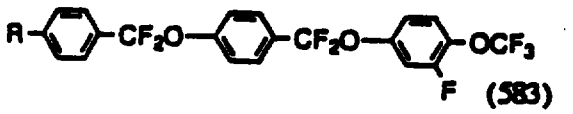

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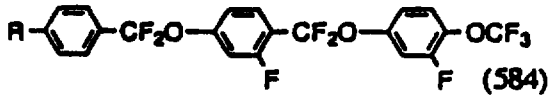

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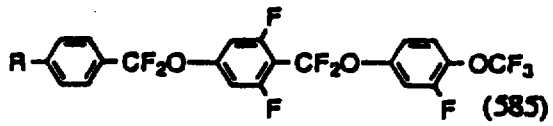

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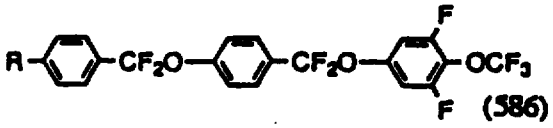

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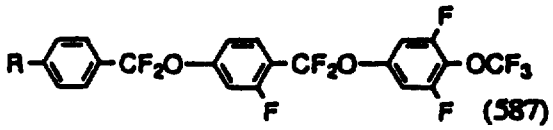

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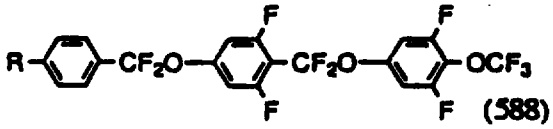

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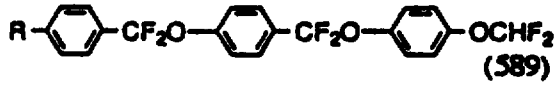

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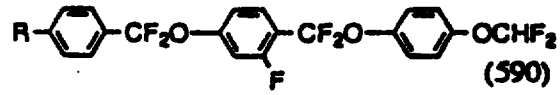

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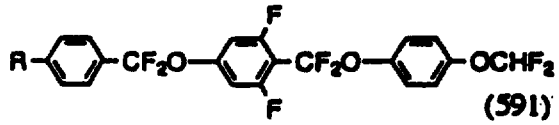

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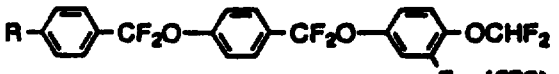

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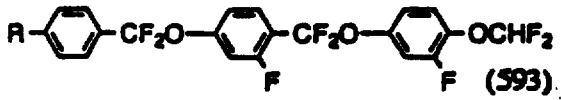

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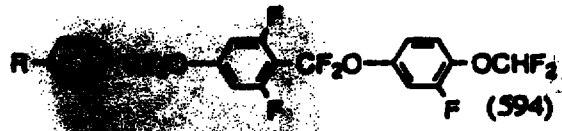

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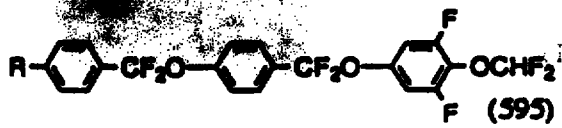

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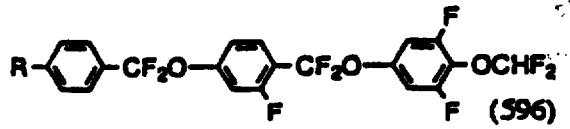

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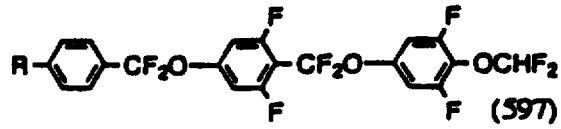

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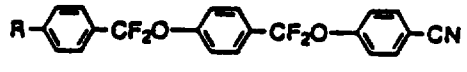

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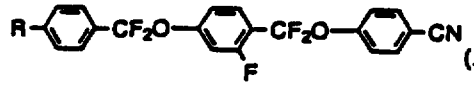

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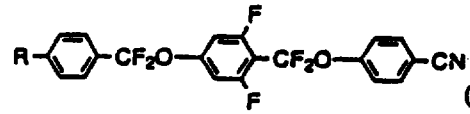

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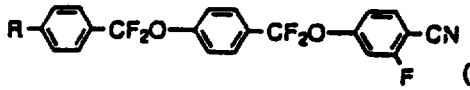

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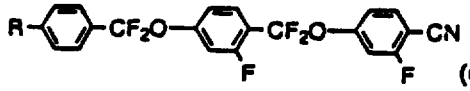

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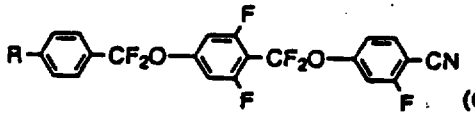

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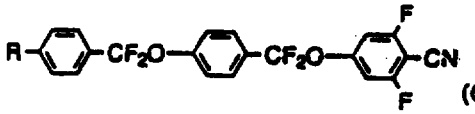

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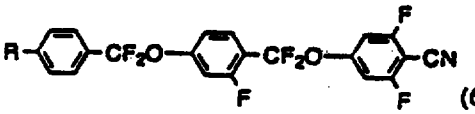

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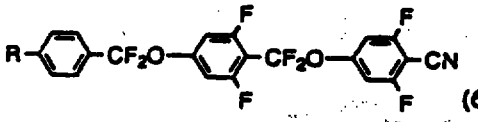

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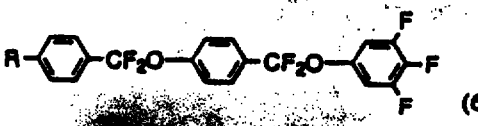

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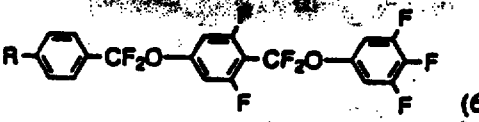

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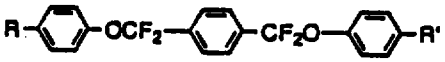

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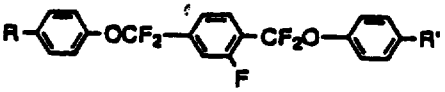

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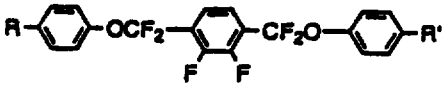

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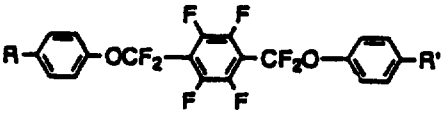

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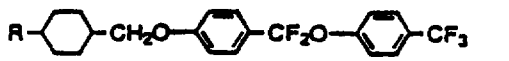

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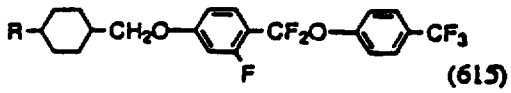

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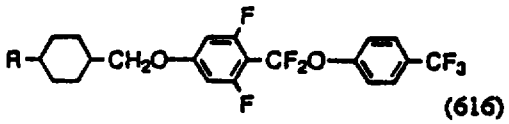

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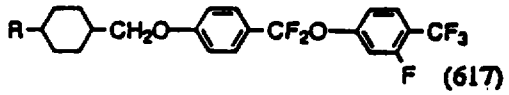

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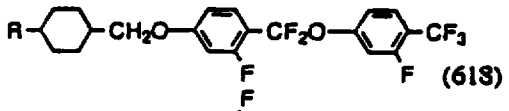

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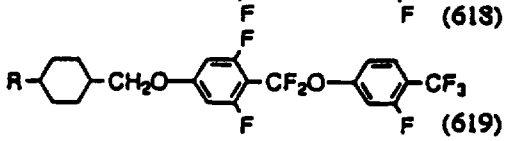

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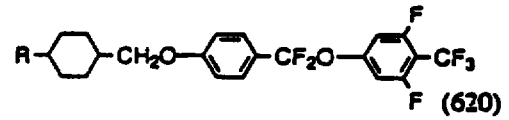

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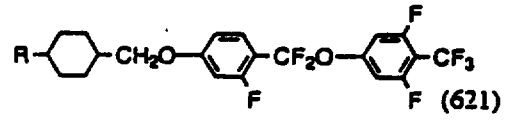

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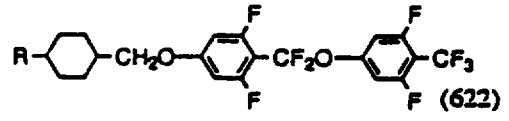

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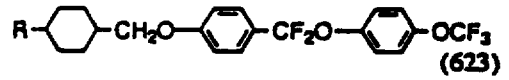

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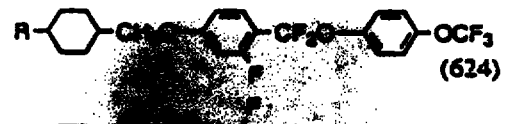

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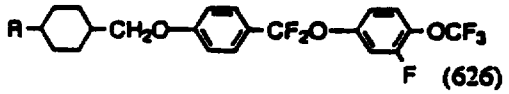

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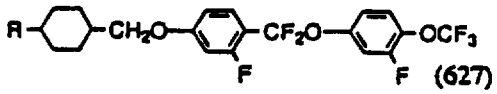

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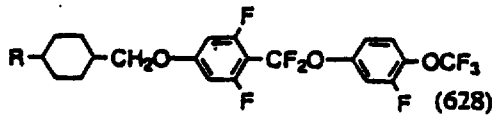

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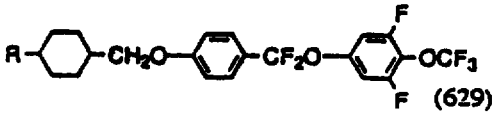

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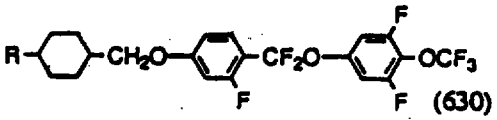

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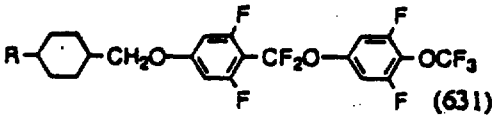

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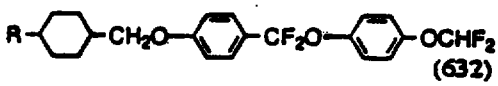

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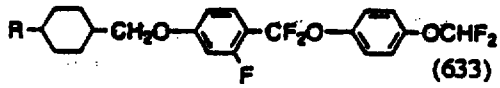

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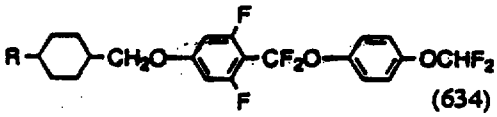

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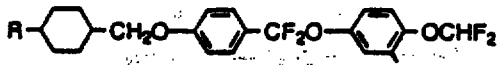

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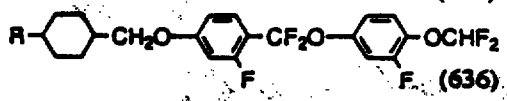

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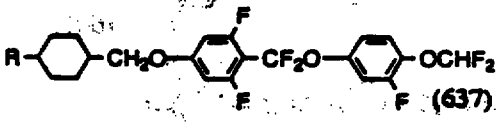

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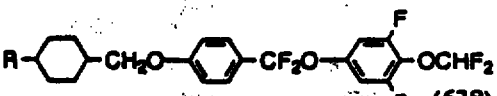

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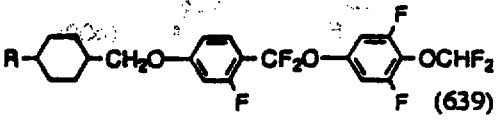

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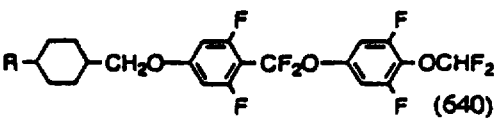

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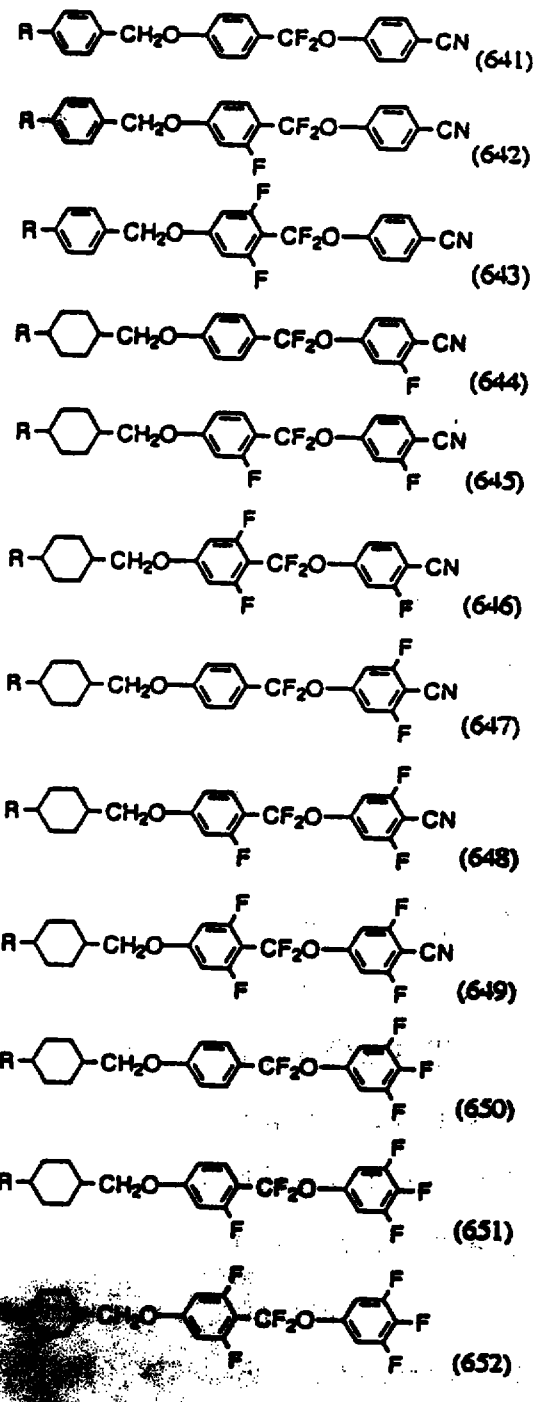

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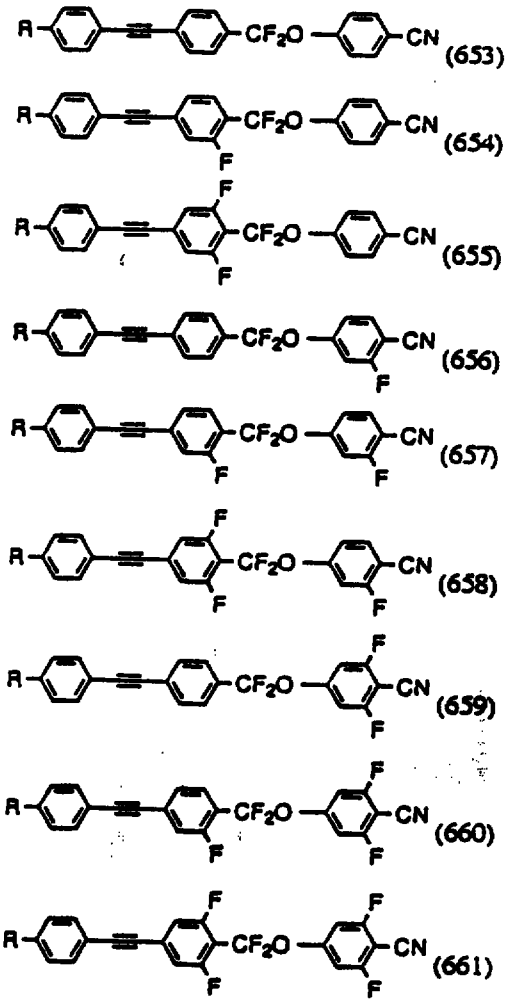

(637)


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(640)





（式中RおよびR'は、炭素数１～１０の直鎖もしくは分岐のアルキル基、アルケニル基またはアルコキシ基を表す。）

これらの化合物（１）～（６６１）は、大きな誘電率異方性を示すと共に低粘性である。特に、分子末端の置換基としてF、CF_3またはCN基を有する化合物は非常に大きな誘電率異方性を示す一方、OCF_3または$OCHF_2$基を有す化合物は、著しく低粘性である。また、化合物分子長軸に対し側方位にフッ素原子を有する化合物は、さらに大きな誘電率異方性を示すと共に、相溶性に優れた

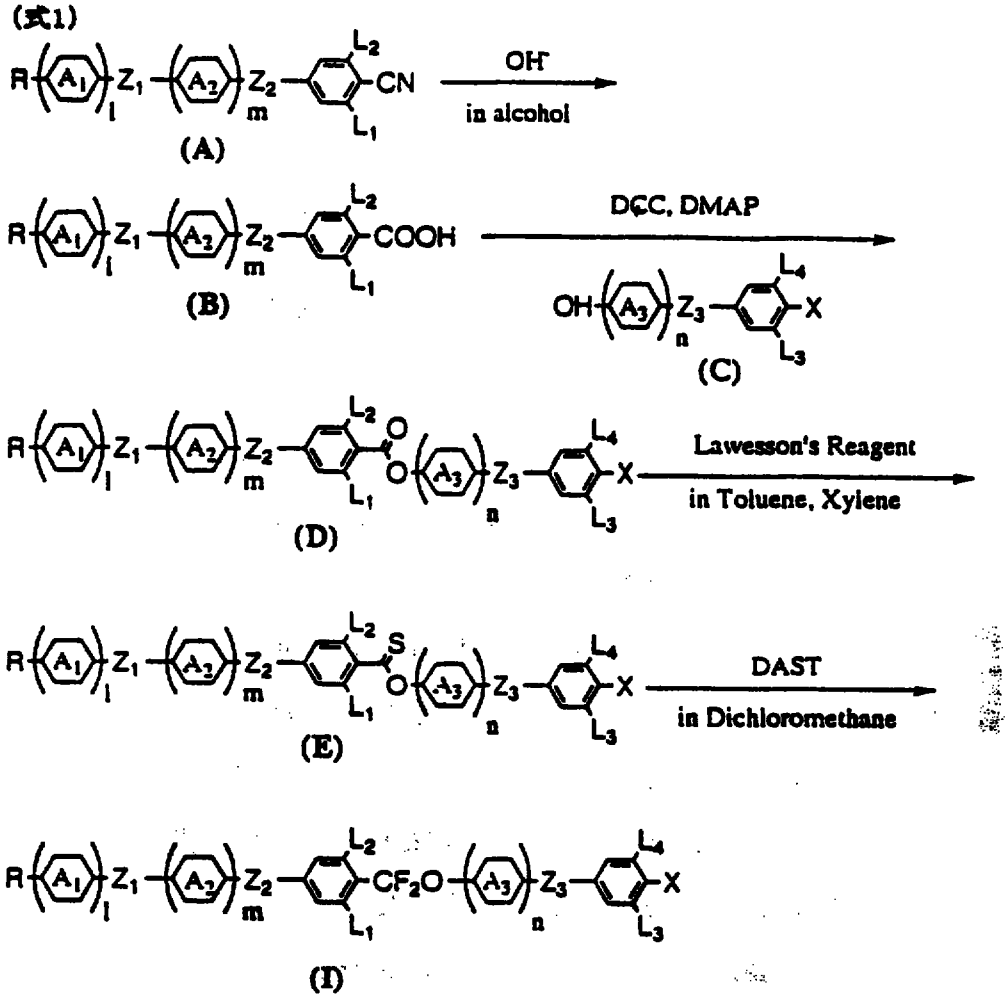
特徴を有する。化合物（５７１）から（６１３）は分子内に２つの－CF_2O－基を有しており、（６７）～（１０３）および（１４３）～（３２０）の化合物と比較した場合さらに低粘性である。また、特に（６１０）～（６１３）の化合物は減粘剤として著しく優れた特徴を有する化合物である。

（化合物の製法）

次に、本発明の化合物である一般式（Ｉ）で表されるジフルオロオキシメタン誘導体は、以下に示す製造工程により好適に製造することができる。

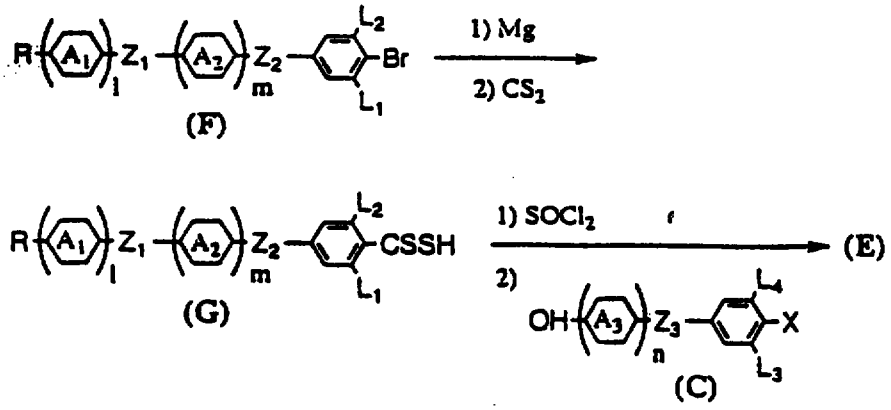
すなわち、下記の式１に示すように、一般式（Ａ）で表されるベンゾニトリル誘導体を製造原料として、エチルアルコール、エチレングリコールまたはジエチレングリコール等のアルコール溶媒中、水酸化ナトリウム、水酸化カリウム等の塩基、または塩酸、硫酸等の鉱酸を触媒として加水分解しカルボン酸誘導体（Ｂ）に導く。次にカルボン酸誘導体（Ｂ）は一般的なエステル化の方法に従い、例えば塩酸、硫酸等の鉱酸、ｐ－トルエンスルホン酸等の有機酸アンバーライト等のイオン交換樹脂を酸触媒として使用するか、またはN，N’－ジシクロヘキシルカルボジイミド（ＤＣＣ）を触媒として一般式（Ｃ）で表されるフェノール誘導体と反応させることによって一般式（Ｄ）で表されるエステル誘導体を製造する。また、（Ｂ）に塩化チオニルを作用させ酸塩化物とした後、ピリジン等の塩基の存在下（Ｃ）を作用させることでも（Ｄ）を製造することができる。次にエステル誘導体（Ｄ）はベンゼンまたはトルエンを溶媒としローソン（Lawesson）試薬［２，４－ビス（４－メトシキフェニル）－１，３－ジチアー２，４－ジフ[illegible]タン－２，４－ジスルフィド］（Bull.Soc.Chim.Belg.,87,223,229,299[illegible]78),Synthesis,941(1979),Tetrahedron,35,2433(1979),Tetrahedron Lett.,21,4061(1980)）を室温から溶媒の沸点までの任意の温度で作用させることでチオエステル（チオン型）誘導体（Ｅ）に誘導する。次にチオエステル（チオン型）誘導体（Ｅ）は、ジクロロメタン、クロロホルムを溶媒とし、ジエチルアミノサルファートリフルオリド（ＤＡＳＴ）（Synthesis,787(1973)）を室温から溶媒の沸点までの任意の温度で作用させることでチオカルボニル基のgem-フッ素化を行い、目的とするジフルオロオキシメタン誘導体を製造することができる。

(式1)

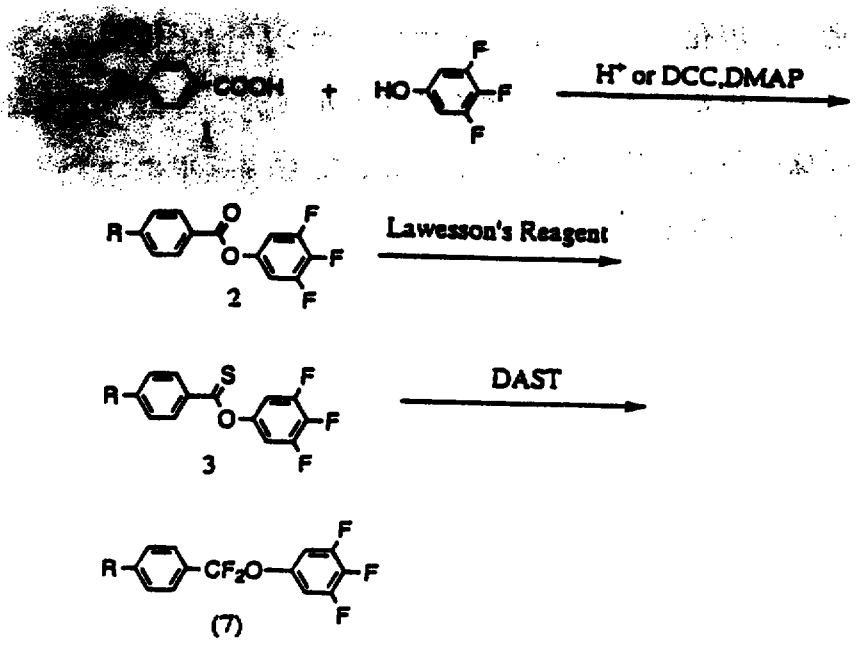


また別法として、下記の式2に示すように、ブロモベンゼン誘導体（F）からグリニャール試薬を調製し、二硫化炭素を作用させることでジチオカルボン酸誘導体（G）を製造し、塩化チオニルにてチオカルボン酸塩化物に誘導後、フェノール誘導体（C）を作用させることでチオエステル（チオン型）誘導体（E）を製造し、上記と同様にＤＡＳＴを作用させることでもジフルオロオキシメタン誘導体を製造することができる。

(式2)

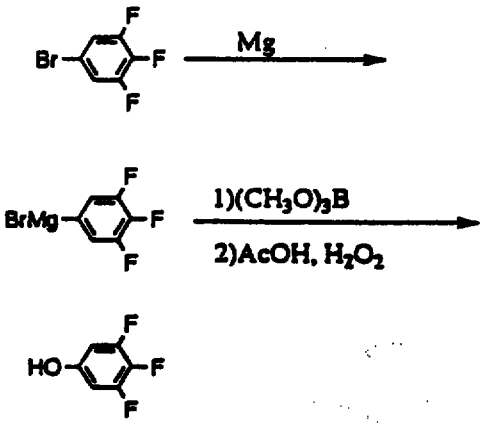


また、下記の式3に示すように、一般式（Ｉａ）で表される化合物のうち、例えば化合物（７）は、アルキル安息香酸誘導体１を一般的なエステル化の方法に従い、例えば塩酸、硫酸等の鉱酸、ｐ－トルエンスルホン酸等の有機酸、アンバーライト等のイオン交換樹脂を酸触媒として使用するか、またはN，N’－ジシクロヘキシルカルボジイミド（ＤＣＣ）を触媒として３，４，５－トリフルオフェノールとエステル化を行い、３，４，５－トリフルオロベンゾアート誘導体２を製造する。次に、２は、ローソン試薬とトルエン還流下で反応を行いチオエステル（チオン型）誘導体３とし、さらにジクロロメタン中ＤＡＳＴを作用することで（７）を製造することができる。また３，４，５－トリフルオフェノールの代わりに種々の置換基を有するフェノールを使用し、さらに種々の既知の安息香酸誘導体とから上記製造操作に準じて化合物（１）～（６）、（８）～（２７）を製造することができる。



合成原料である３，４，５－トリフルオロフェノールは、３，４，５－トリフルオロブロモベンゼンを出発物質として製造することができる。すなわち、下記の式４に示すように、S.O.Lawessonらの方法(J.Am.Chem.Soc.,81,4230(1959))に従い、３，４，５－トリフルオロブロモベンゼンから調製したグリニャール試薬にt-ブチルヒドロペルオキシドを作用させるか、またはR.L.Kidwewllらの方法(Org.Synth.,V.918(1973))に従い、３，４，５－トリフルオロブロモベンゼンから調製したグリニャール試薬をホウ酸トリアルキルで処理してホウ酸エステル誘導体とした後、過酸化水素水にて酸化処理して製造することができる。

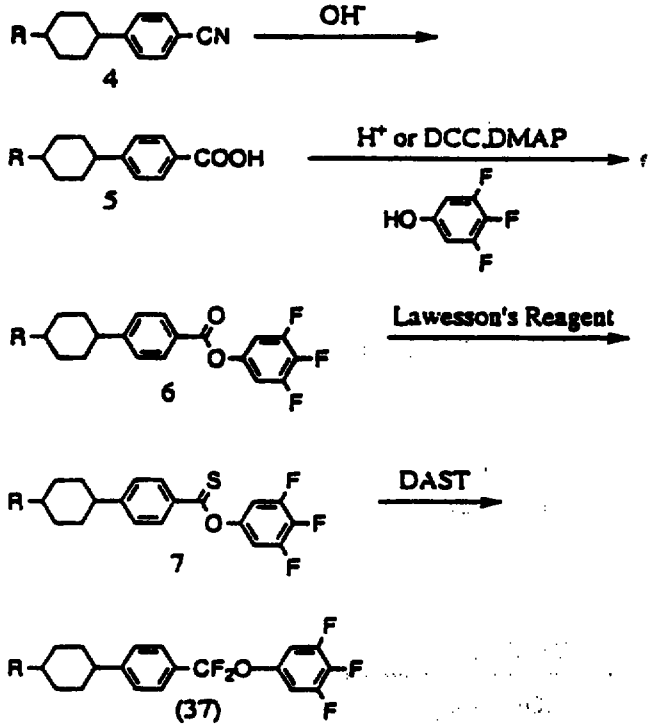
(式4)



また、下記の式５に示すように、一般式（Ｉｂ）で表される化合物のうち、例えば化合物（３７）は、２－フルオロ－４－（トランス－４－アルキルシクロヘキシル）ベンゾニトリル４をエチレングリコールまたはジエチレングリコール中水酸化ナトリウム存在下加水分解を行い、安息香酸誘導体５とした後、一般的なエステル化の方法に従い、例えば塩酸、硫酸等の鉱酸、ｐ－トルエンスルホン酸等の[illegible]アンバーライト等のイオン交換樹脂を酸触媒として使用するか、またはN,N'-ジシクロヘキシルカルボジイミド（ＤＣＣ）を触媒として３，４，５－トリフルオロフェノールとエステル化を行い、４－トリフルオロベンゾアート誘導体６を製造する。次に６はローソン試薬とトルエン還流下で反応を行いチオエステル（チオン型）誘導体７とし、さらにジクロロメタン中ＤＡＳＴを作用することで（３７）を製造することができる。また３，４，５－トリフルオロフェノールの代わりに種々の置換基を有するフェノールを使用し、さらに種々の既知の安息香酸誘導体とから上記製造操作に準じて化合物（２８）～（３６）、

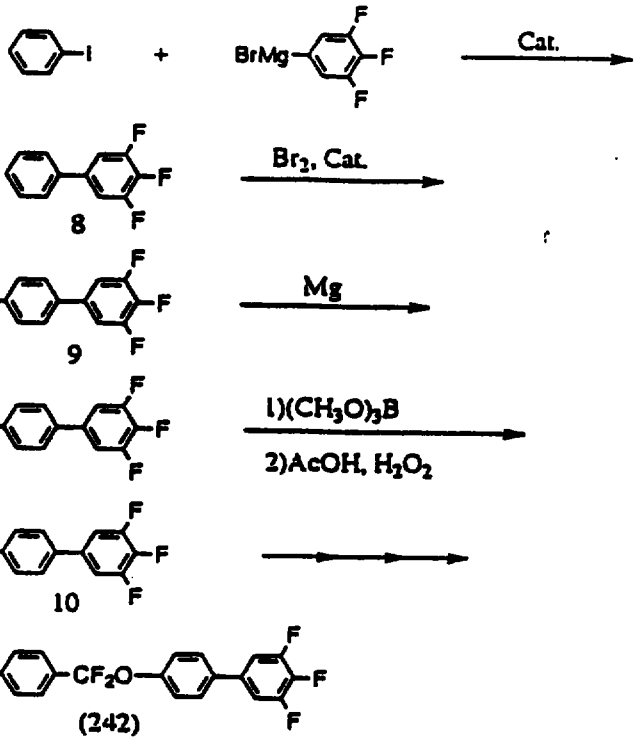
（３８）～（１８１）を製造することができる。

(式5)

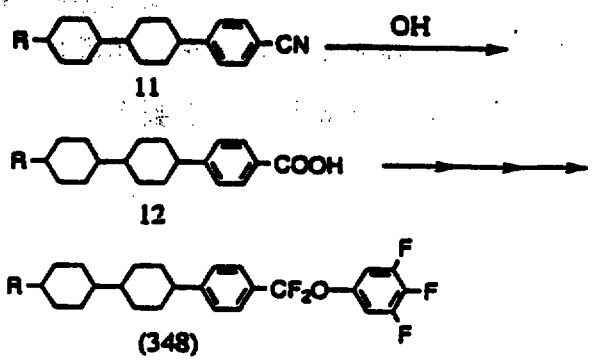


また、下記の式６に示すように、一般式（Ｉｃ）で表される化合物のうち、例えば化合物（２４２）は、次の方法で製造することができる。すなわち４－ヨードベンゼンを塩化パラジウム等の貴金属触媒存在下、３，４，５－トリフルオロブロモベンゼンから調製したグリニャール試薬とカップリングを行い、ビフェニル誘導体８とした後、８に鉄粉等の金属粉体存在下で臭素を作用させ、ブロモビフェニル誘導体９を製造する。次いでR. L. Kidwellらの報告（Org. Synth., V. 918 1973）に従い、９から調製したグリニャール試薬にホウ酸トリメチルを作用させ、[redacted]存在下で過酸化水素で酸化することによりフェニルフェノール誘導体１０を製造する。１０を（７）製造の場合と同様に処理することにより、化合物（２４２）を製造することができる。さらに、３，４，５－トリフルオロブロモベンゼンの代わりに、種々の置換基を有するブロモベンゼン誘導体を用いて製造したフェニルフェノール誘導体から、その他の一般式（Ｉｃ）で表される化合物（１８２）～（２４１）、（２４３）～（３２０）を製造することができる。

(式6)

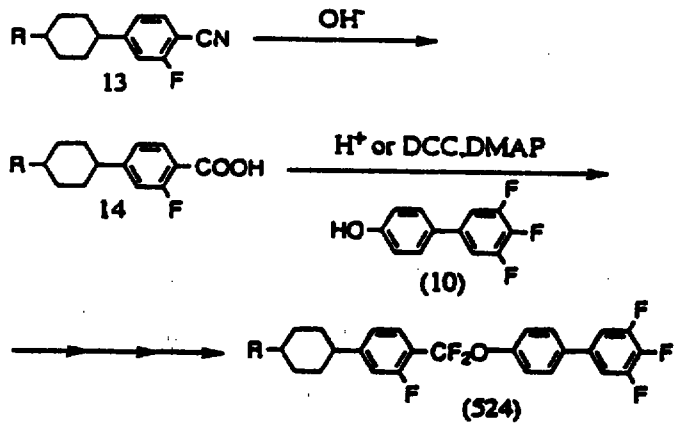


また、下記の式7に示すように、一般式（Ｉｄ）で表される化合物のうち、例えば化合物（３４８）は、４－〔トランス－４－（トランス－アルキルシクロヘキシル）シクロヘキシル〕ベンゾニトリル１１を常法に従い加水分解して得られる４－〔トランス－４－（トランス－アルキルシクロヘキシル）シクロヘキシル〕安息香酸１２を製造原料として、上述と同様な方法にて製造することができる。またその他の一般式（Ｉｄ）で表される化合物（３２１）～（３４７）、（３４９）～（４９５）に関しても、既知のカルボン酸誘導体およびフェノール誘導体を用いて上述の反応操作とそれ以外の既知の反応操作の組み合わせと選択的に製造できる。



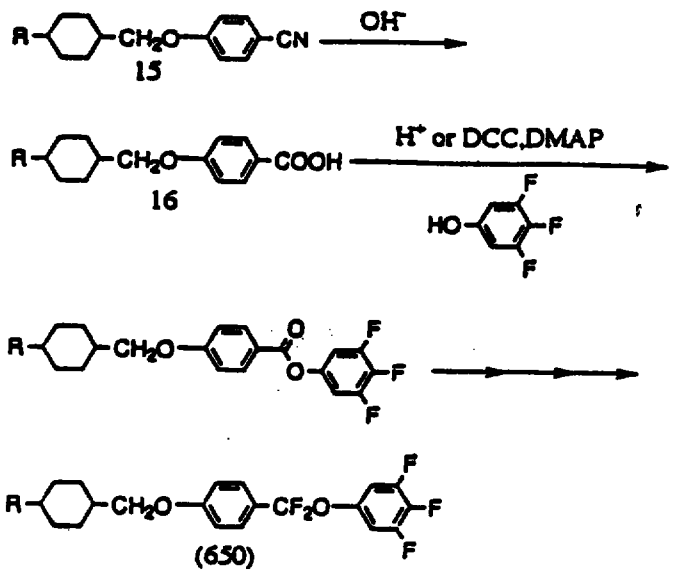
また、下記の式８に示すように、一般式（Ｉｅ）で表される化合物のうち、例えば化合物（５２４）は、２－フルオロ－４－（トランス－４－アルキルシクロヘキシル）ベンゾニトリル１３を常法に従い加水分解して得られる２－フルオロ－４－（トランス－４－アルキルシクロヘキシル）安息香酸１３を製造原料として、（Ｉｃ）の場合と同様にして製造したフェニルフェノール誘導体とから上述と同様の操作にて化合物（５２４）を製造することができる。またその他の一般式（Ｉｄ）で表される化合物（４９６）～（５２３）、（５２５）～（５７０）に関しても、既知のカルボン酸誘導体およびフェノール誘導体を用いて上述の反応操作とそれ以外の既知の反応操作の組み合わせと選択により製造できる。

(式8)



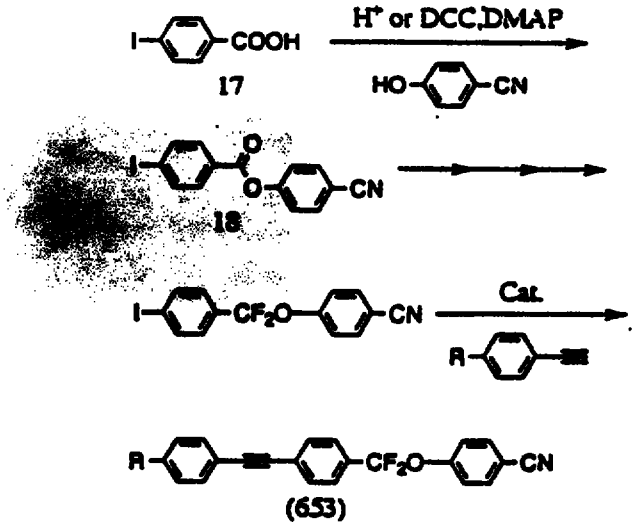
また、下記の式９に示すように、例えば化合物（６５０）は、（４－アルキルシクロヘキシル）（４－シアノフェニルオキシ）メタン１５を常法に従い加水分解して得られるカルボン酸誘導体１６を原料として、（１ｂ）と同様の方法にて製造できる。また、３，４，５－トリフルオロフェノールの代わりに種々の置換基を有するフェノール誘導体を使用し、さらに種々のフッ素置換（４－アルキルシクロヘキシル）（４－シアノフェニルオキシ）メタン誘導体を用いて化合物（６１４）～（６４９）、（６５１）、（６５２）を製造できる。

(式9)



また、下記の式１０に示すように、例えば化合物（６５３）は、４－ヨード安息香酸１７と４－シアノフェノールとから（１ａ）の製造の場合と同様の方法にてヨード体１９を製造し、さらに１９にＰｔ、Ｐｄ等の貴金属触媒存在下４－アルキルフェニルアセチレンを作用させることで製造できる。さらに４－シアノフェノールの代わりに種々の置換基を有するフェノール誘導体を使用し、また種々の既知の安息香酸誘導体を用いて化合物（６５４）～（６６１）が製造できる。

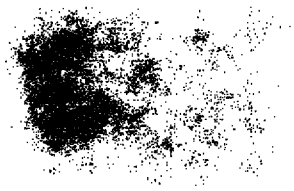
(式10)

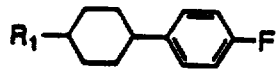


次に、本発明の液晶組成物について説明する。液晶組成物に関する以下の説明では、本発明の一般式（Ｉ）で表されるジフルオロオキシメタン誘導体をＡ群と称する。

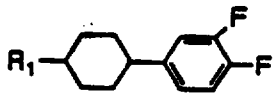
本発明の液晶組成物は、Ａ群から選ばれる２種以上の化合物のみで構成されていてもよい。また、第１成分としてＡ群の化合物を１種以上含有し、第２成分として他の化合物を１種以上含有していてもよい。第２成分を含有する場合は、Ａ群の化合物を0.1～99重量％の割合で含有することが好ましい。

本発明の液晶組成物の第２成分として、一般式（II）、（III）および（IV）で表される化合物（これらをＢ群と称する）を用いることができる。Ｂ群の化合物として、好ましくは以下のもの（II－１～ＩＸ－１４）を挙げることができる。

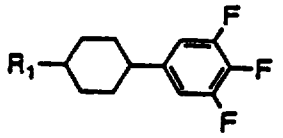




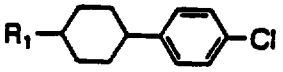
(I-1)



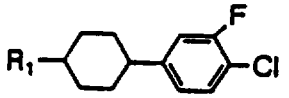
(I-2)



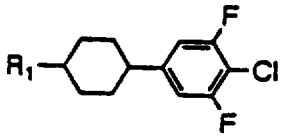
(I-3)



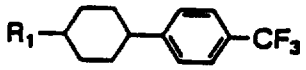
(I-4)



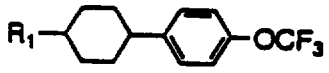
(I-5)



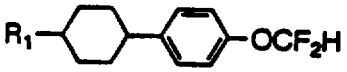
(I-6)



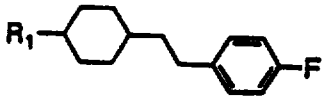
(I-7)



(I-8)



(I-9)



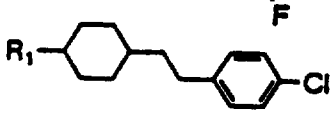
(I-10)



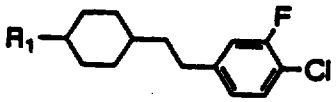
(I-11)



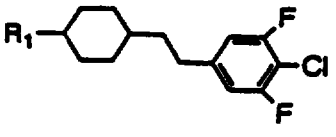
(I-12)



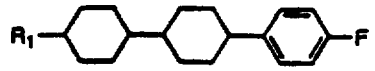
(I-13)

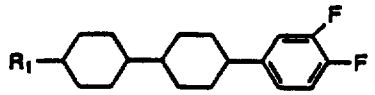


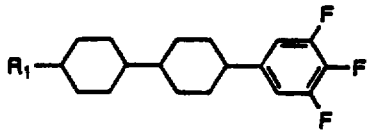
(I-14)

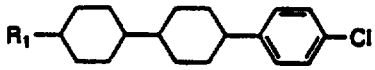


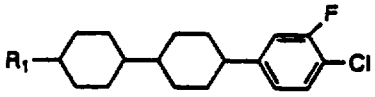
(I-15)

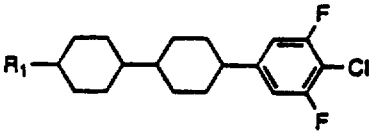

(Ⅱ-1)

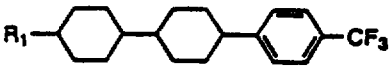

(Ⅱ-2)

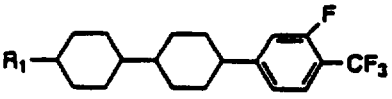

(Ⅱ-3)

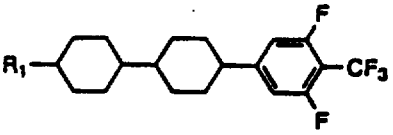

(Ⅱ-4)

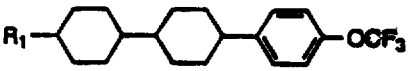

(Ⅱ-5)

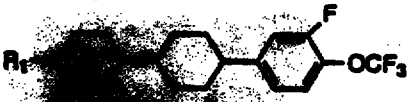

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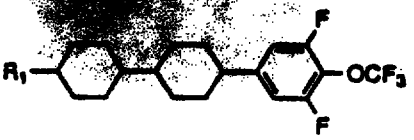

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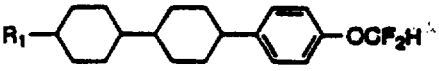

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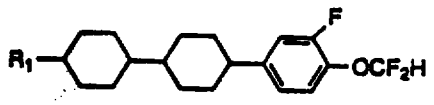

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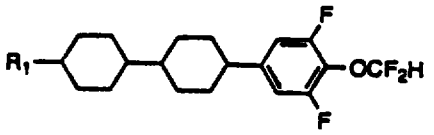

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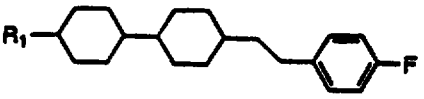

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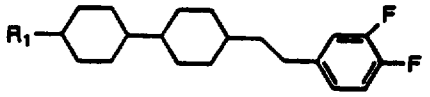

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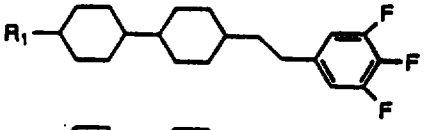

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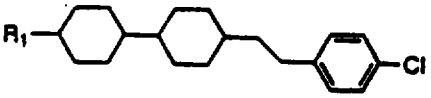

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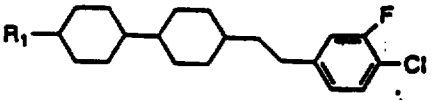

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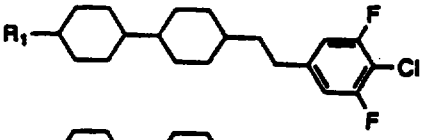

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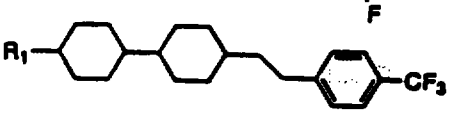

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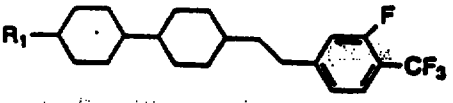

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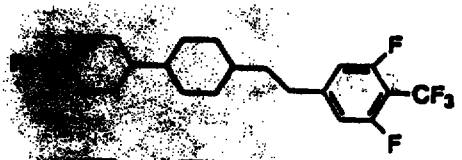

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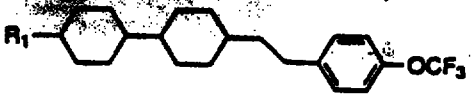

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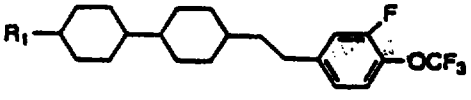

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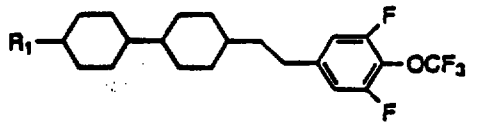

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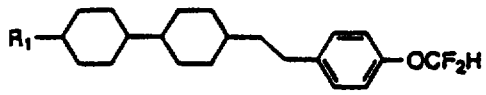

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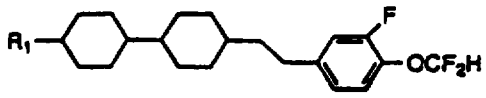

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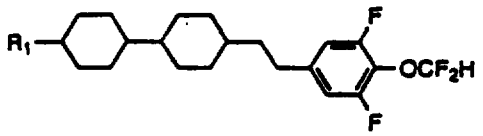

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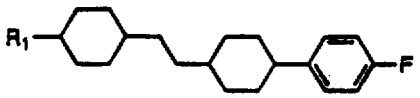

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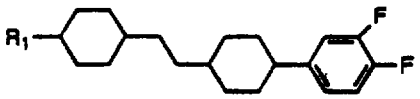

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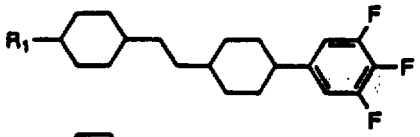

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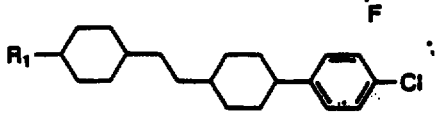

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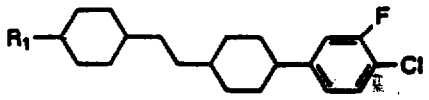

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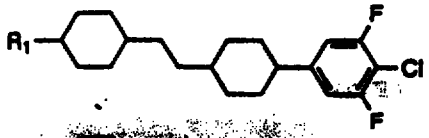

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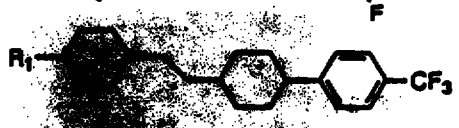

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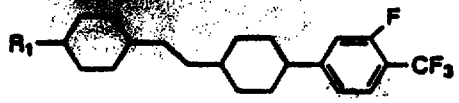

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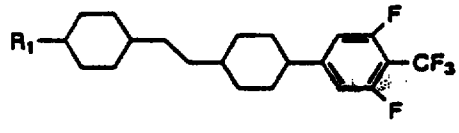

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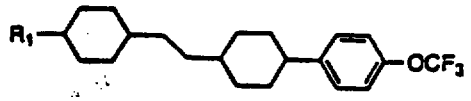

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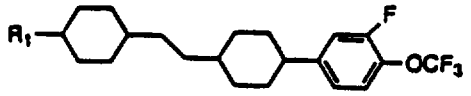

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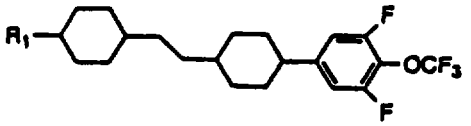

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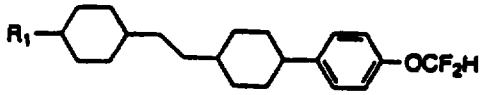

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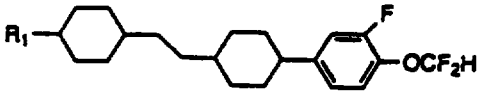

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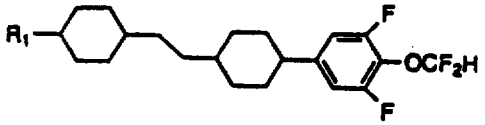

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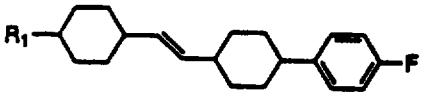

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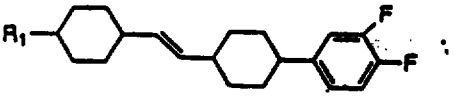

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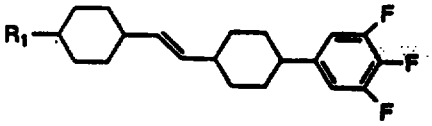

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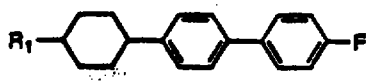

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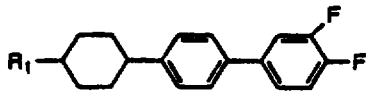

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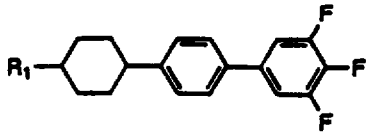

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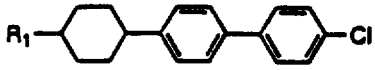

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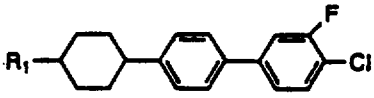

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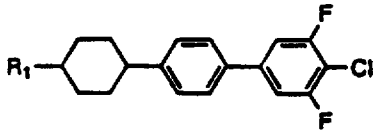

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(IV-2)

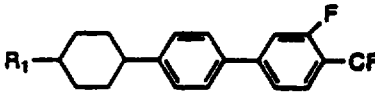

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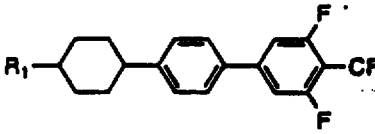

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(IV-8)

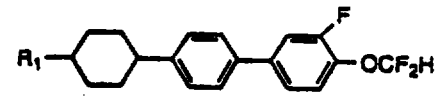

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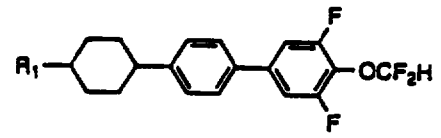

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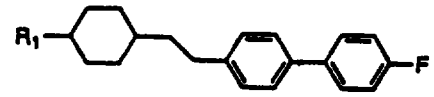

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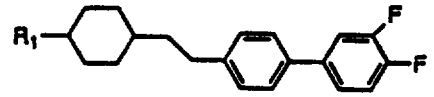

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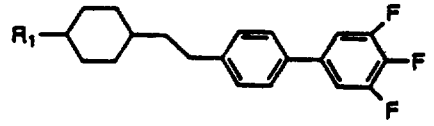

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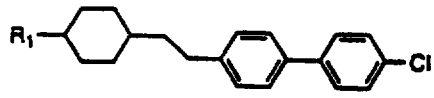

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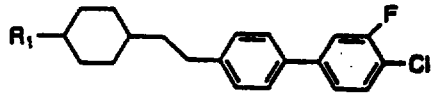

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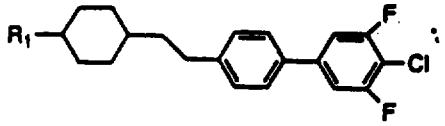

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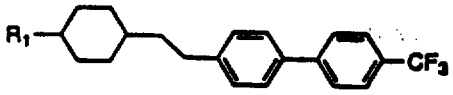

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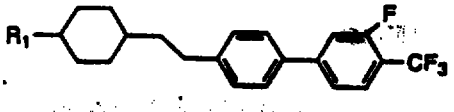

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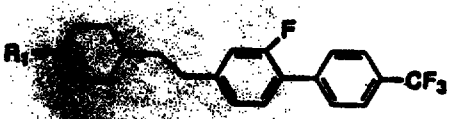

(IV-19)

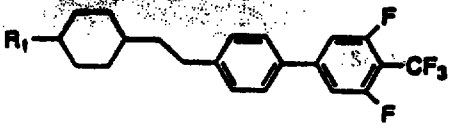

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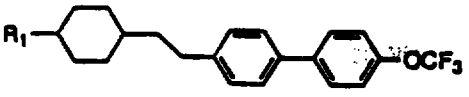

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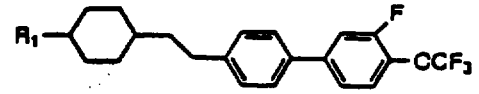

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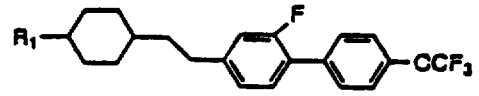

(IV-23)

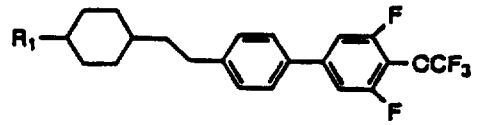

(IV-24)

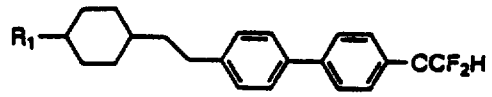

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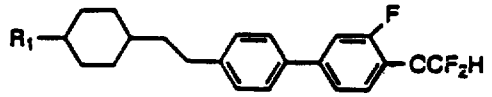

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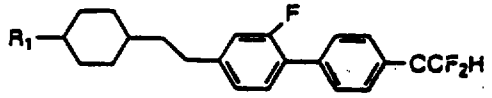

(N-27)

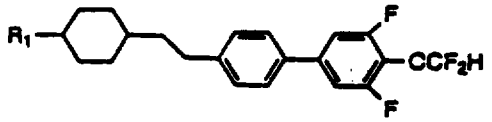

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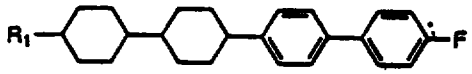

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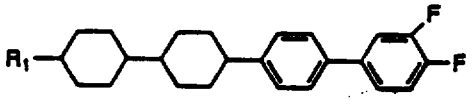

(N-30)

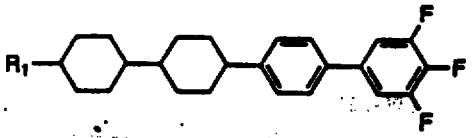

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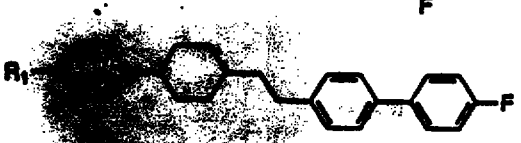

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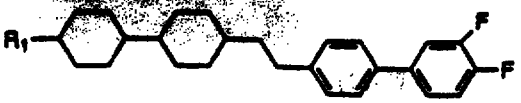

(N-33)

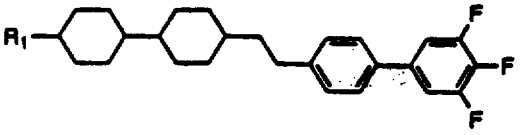

(N-34)

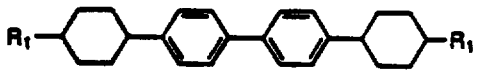

(N-35)


(N-36)

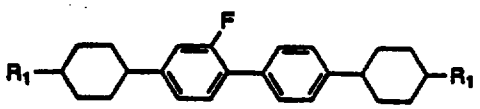

(N-37)


(N-38)


(N-39)



(IV-40)

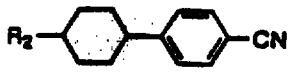


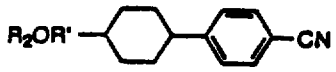
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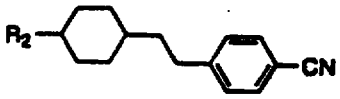
上記Ｂ群の化合物は誘電率異方性値が正の化合物であり、熱的安定性が非常に優れており、特に高い電圧保持率、または大きい非抵抗値といった特性が要求されるＴＦＴに代表されるアクティブマトリックス方式用の液晶組成物を調製する場合には有用な化合物である。

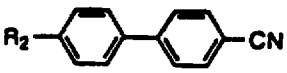
Ｂ群の化合物の使用量はＴＦＴ用の液晶組成物を調製する場合、液晶組成物の全重量に対して１～９９重量%の範囲で任意に使用できるが、好ましくは１０～９７重量%、より好ましくは４０～９５重量%が適する。

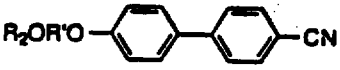
本発明の第二の第２成分として、一般式（Ｖ）～（IX）で表される化合物（これらの化合物を以下Ｃ群と称する）を用いることもできる。Ｃ群のうち一般式（Ｖ）～（VII）で表されるものとして、好ましくは以下の化合物を挙げることができる。

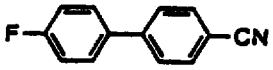

(V-1)

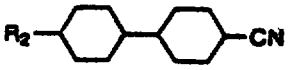

(V-2)

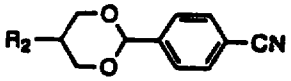

(V-3)

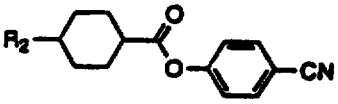

(V-4)

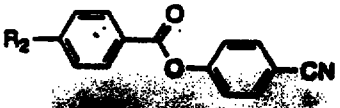

(V-5)

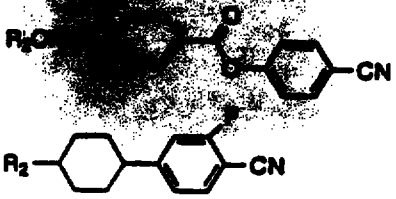

(V-6)


(V-7)

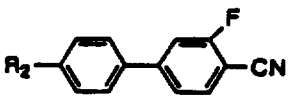

(V-8)

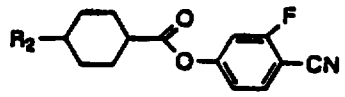

(V-9)

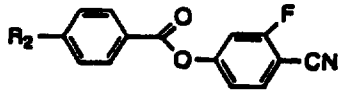

(V-10)

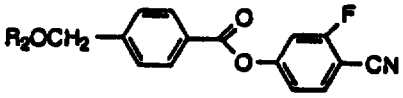

(V-11)

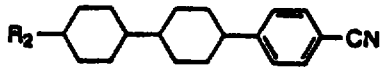
(V-12)


(V-13)

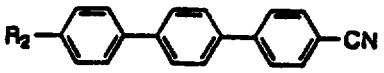

(V-14)

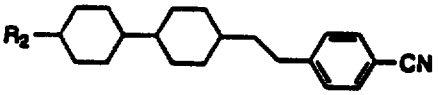

(V-15)

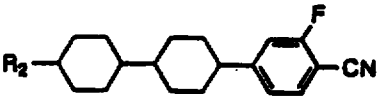

(V-16)

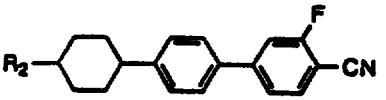

(V-17)

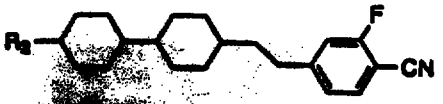

(V-18)

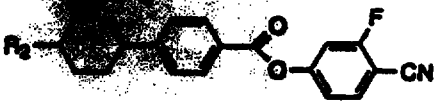

(V-19)

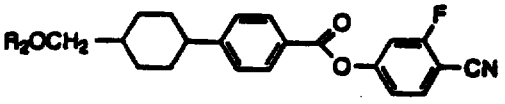

(V-20)

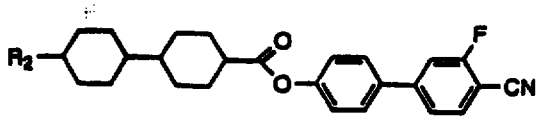

(V-21)


(V-22)

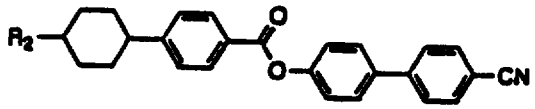

(V-23)


(V-24)


(V-25)

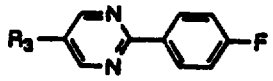


(V-26)

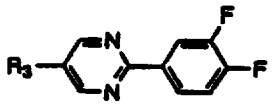


(V-27)

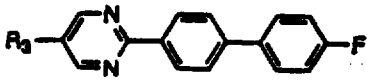
(R' はアルキレンを示す。)



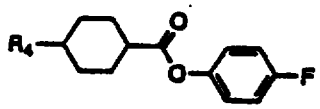
(VI-1)



(VI-2)



(VI-3)

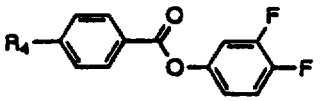


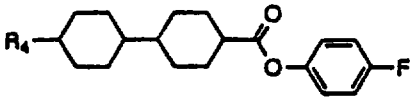
(VII-1)

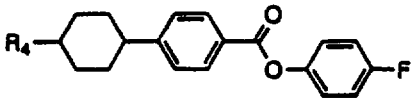


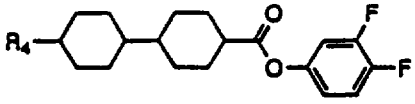
(VII-2)

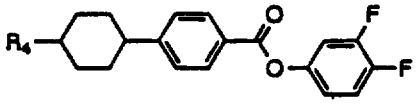
(VII-3)

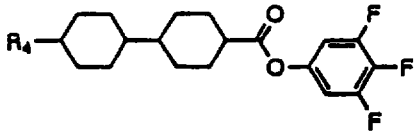

(VII-4)

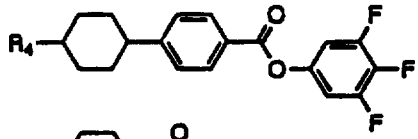

(VII-5)

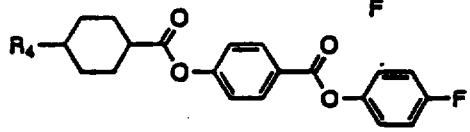

(VII-6)


(VII-7)

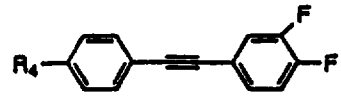

(VII-8)


(VII-9)


(VII-10)

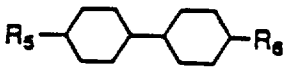

(VII-11)

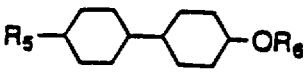

(VII-12)

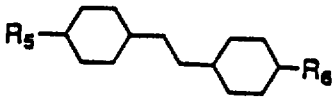

(VII-13)

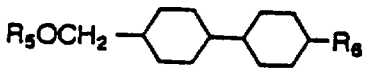
上記一般式（V）～（VII）で表される化合物は誘電率異方性値が正でその値が大きく、特にしきい値電圧を小さくする目的で使用される。また粘度調整、△n調整、透明点を高くする等のネマチックレンジを広げる目的にも使用される。さらに急峻性を改良する目的にも使用される。

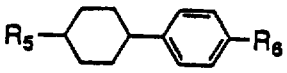
C群のうち一般式（VIII）および（IX）で表される化合物として、好ましくは以下の化合物を挙げることができる。

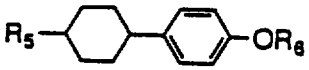

(VIII-1)

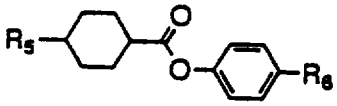

(VIII-2)

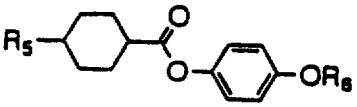

(VIII-3)

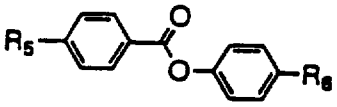

(VIII-4)

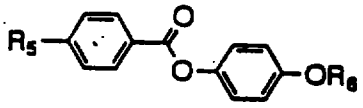

(VIII-5)


(VIII-6)

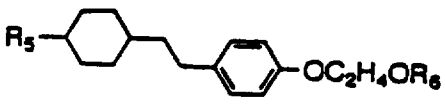

(VIII-7)


(VIII-8)


(VIII-9)

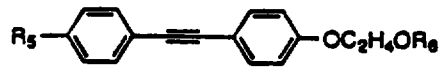

(VIII-10)

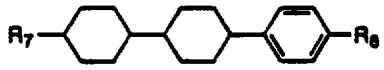

(VIII-11)

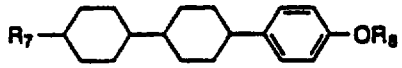

(VIII-12)

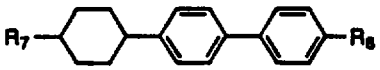

(Ⅷ-13)

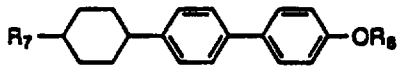

(Ⅷ-14)

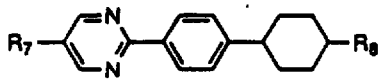

(Ⅷ-15)

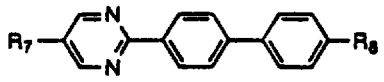

(Ⅸ-1)

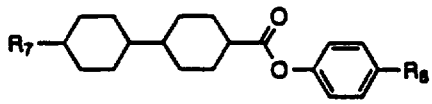

(Ⅸ-2)

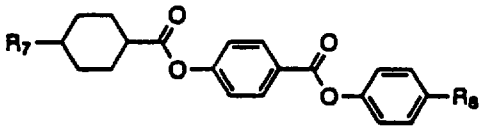

(Ⅸ-3)

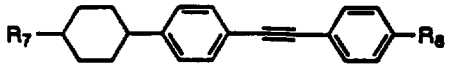

(Ⅸ-4)

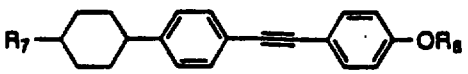

(Ⅸ-5)

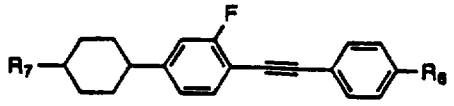

(Ⅸ-6)

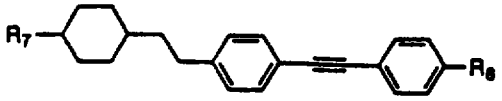

(Ⅸ-7)

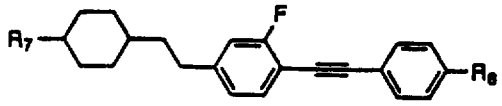

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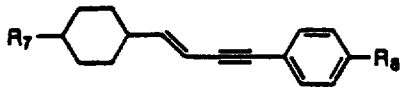

(Ⅸ-9)


(Ⅸ-10)


(IX-11)


(IX-12)


(IX-13)


(IX-14)

上記一般式（VIII）および（IX）で表される化合物は、誘電率異方性値が負かまたは弱い正の化合物である。一般式（VIII）で表される化合物は主として粘度低下および△n調整の目的で使用することができる。また（IX）で表される化合物は透明点を高くする等のネマチックレンジを広げる目的および△n調整の目的で使用することができる。

じ群の化合物は、スーパーツイストネマチック（ＳＴＮ）表示方式用の液晶組成物を調製する場合に有用な化合物であり、１～９９重量％の範囲、好ましくは１０～９７重量％、より好ましくは４０～９５重量％の範囲で使用できる。

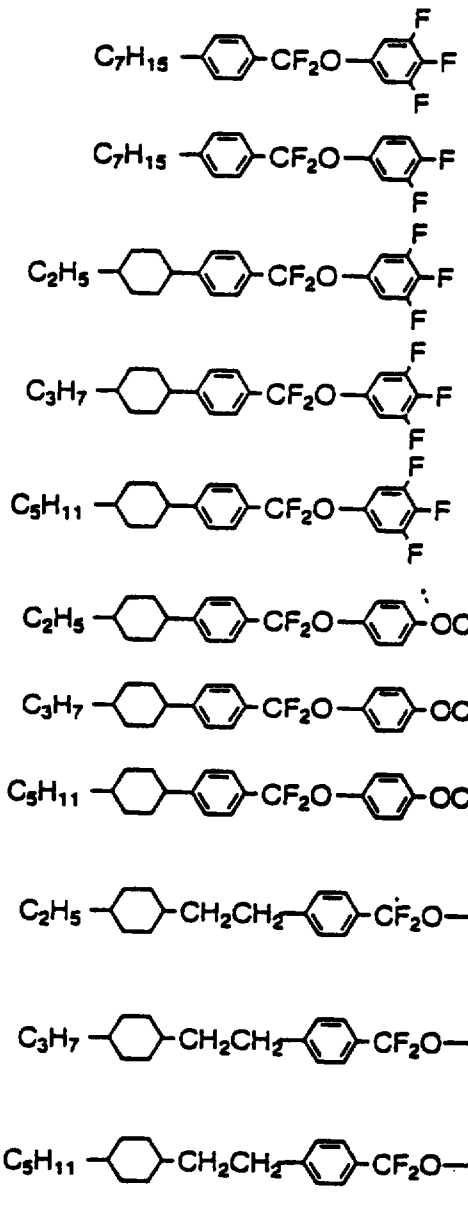
ＴＦＴ用の液晶組成物を調製する場合には、Ａ群の化合物とＢ群の化合物に加えて、さらにＣ群から選択される少なくとも１種の化合物を含有してもよい。またＳＴＮおよび汎用のＴＮ用の液晶組成物を調製する場合には、Ａ群の化合物とＣ群の化合物に加えて、さらにＢ群から選択される少なくとも１種の化合物を含有してもよい。

本発明の液晶組成物は、慣用的な方法で調製される。一般には種々の成分を高い温度で互いに溶解させる方法がとられている。また本発明の液晶組成物は、適当な添加剤を添加することによって意図する用途に応じた改良がなされ、最適化される。このような添加剤は当業者によく知られており、文献等に詳細に記載されている。通常は、液晶のらせん構造を誘起して必要なねじれ角を調整し、逆ねじれを防ぐためのキラルドープ剤等を添加する。

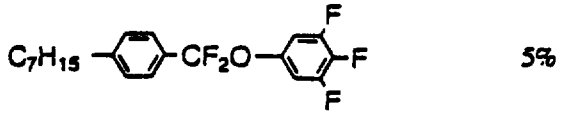
また本発明の液晶組成物は、メロシアニン系、スチリル系、アゾ系、アゾメチン系、アゾキシ系、キノフタロン系、アントラキノン系およびテトラジン系等の二色性色素を添加してゲストホスト（ＧＨ）モード用の液晶組成物としても使用できる。またはネマチック液晶をマイクロカプセル化して作製したＮＣＡＰや液晶中に三次元編み目状高分子を作製したポリマーネットワーク液晶表示素子（ＰＮＬＣＤ）に代表されるポリマー分散型液晶表示素子（ＰＤＬＣＤ）用の液晶組成物としても使用できる。その他複屈折制御（ＥＣＢ）モードや動的散乱（ＤＳ）モード用の液晶組成物としても使用できる。

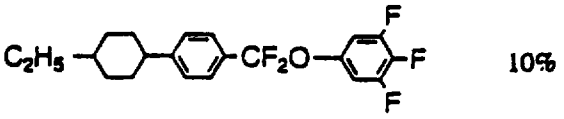
さらに本発明の液晶組成物として、以下に示すような組成例１～３９を示すことができる。

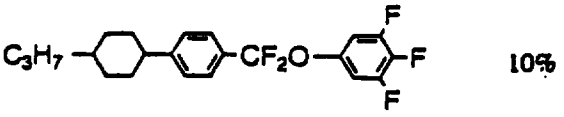
「組成例１」

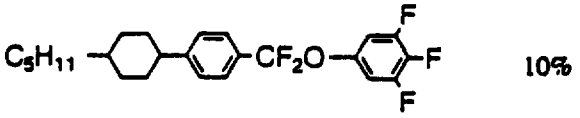

C7H15 CF2O F F F 5%
C7H15 CF2O F F 5%
C2H5 CF2O F F F 12%
C3H7 CF2O F F F 12%
C5H11 CF2O F F F 12%
C2H5 CF2O OCF3 6%
C3H7 CF2O OCF3 6%
C5H11 CF2O OCF3 6%
C2H5 CH2CH2 CF2O F F F 12%
C3H7 CH2CH2 CF2O F F F 12%
C5H11 CH2CH2 CF2O F F F 12%

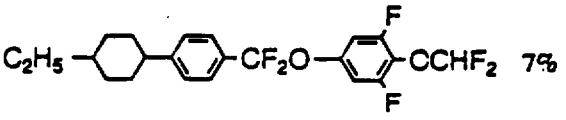
「組成例２」

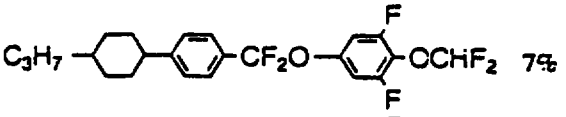

5%

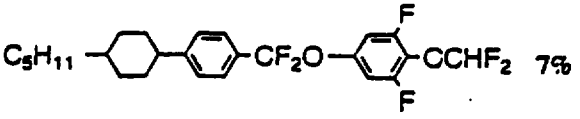

10%

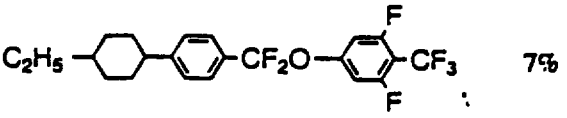

10%

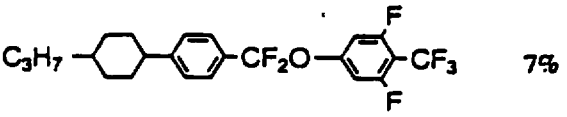

10%

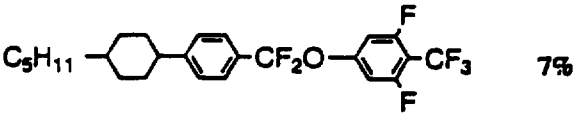

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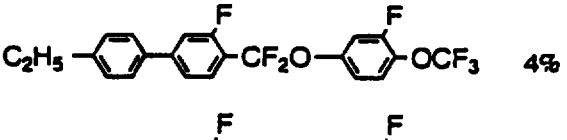

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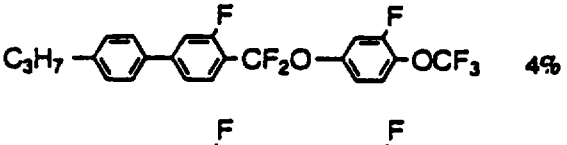

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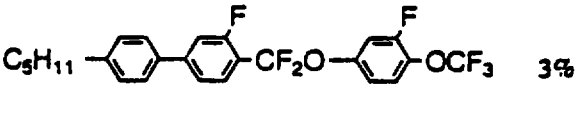

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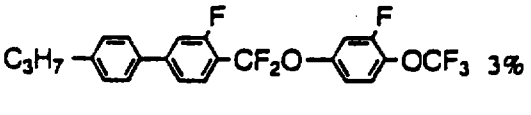

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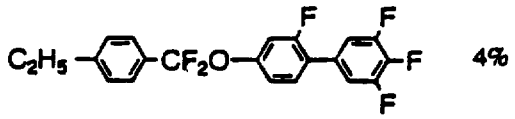

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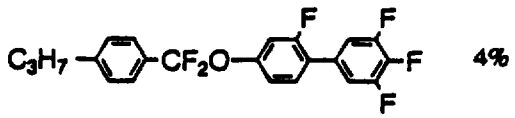

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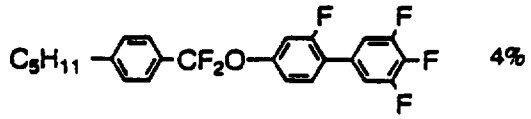

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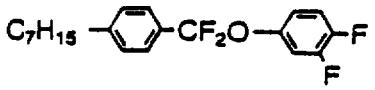

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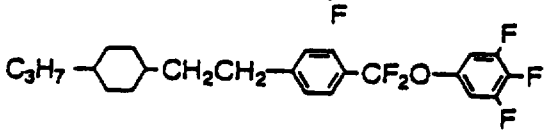

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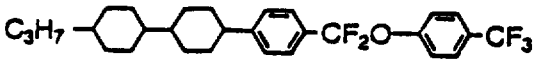

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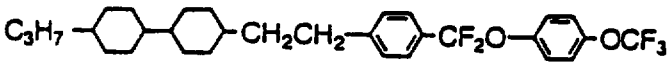

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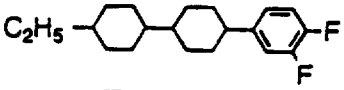
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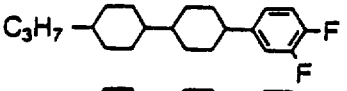

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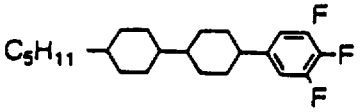

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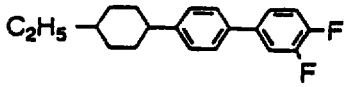

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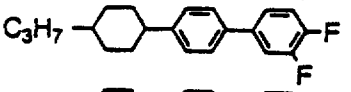

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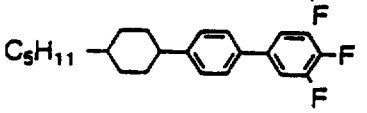

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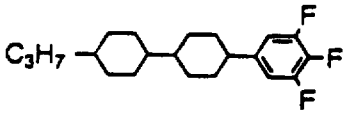

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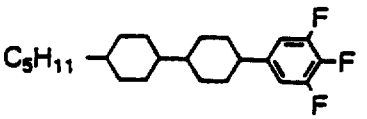

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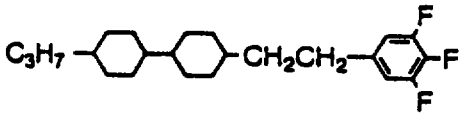

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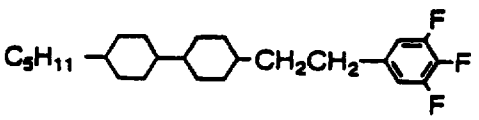

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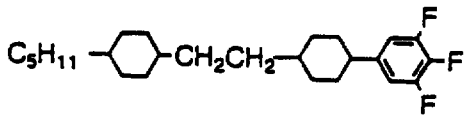

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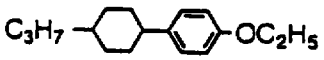

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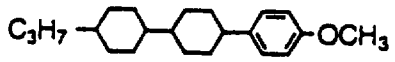

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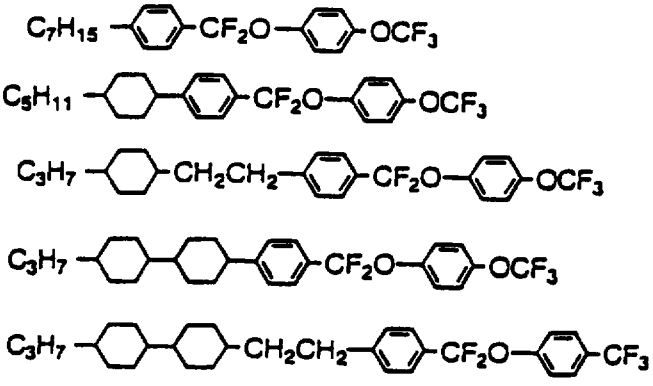

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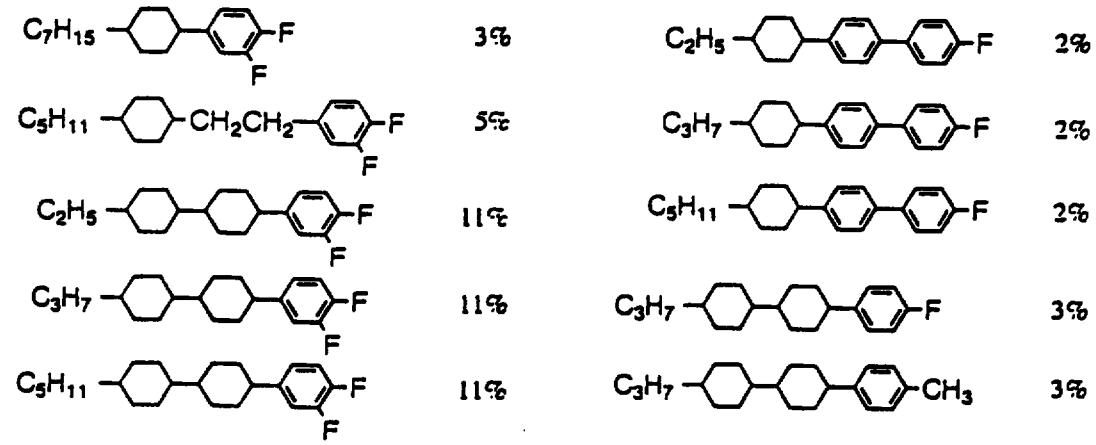

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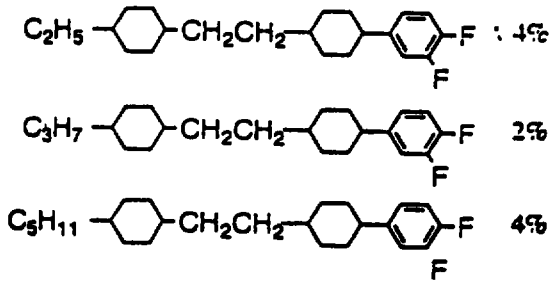

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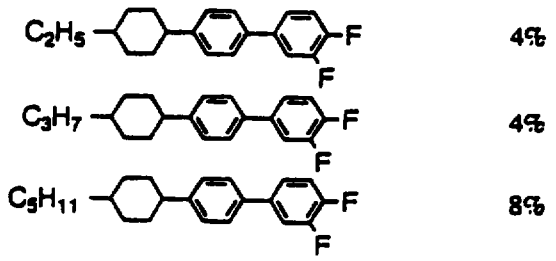

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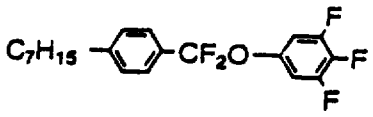

C7H15 CF2O OCF3 5%
C5H11 CF2O OCF3 6%
C3H7 CH2CH2 CF2O OCF3 6%
C3H7 CF2O OCF3 2%
C3H7 CH2CH2 CF2O CF3 2%

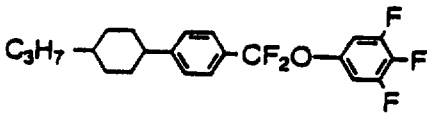

C7H15 F F 3%
C5H11 CH2CH2 F F 5%
C2H5 F F 11%
C3H7 F F 11%
C5H11 F F 11%
C2H5 F 2%
C3H7 F 2%
C5H11 F 2%
C3H7 F 3%
C3H7 CH3 3%

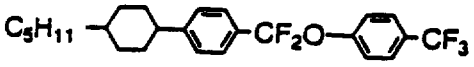

C2H5 CH2CH2 F F 4%
C3H7 CH2CH2 F F 2%
C5H11 CH2CH2 F F 4%

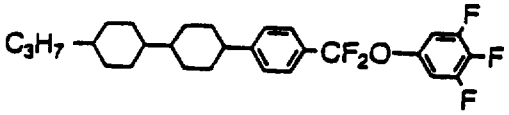

C2H5 F F 4%
C3H7 F F 4%
C5H11 F F 8%

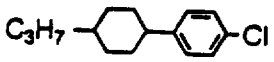
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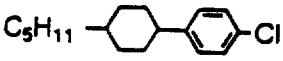

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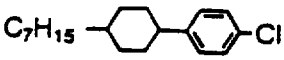

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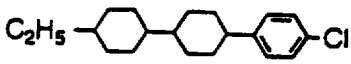

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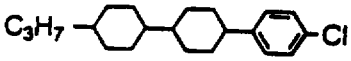

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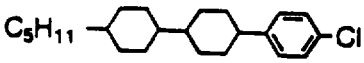

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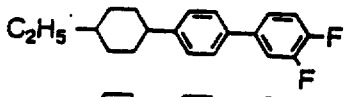

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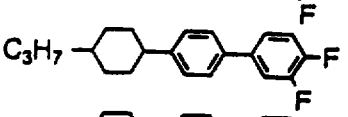

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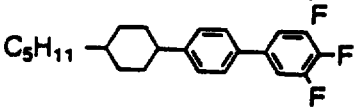

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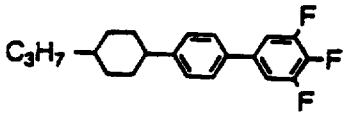

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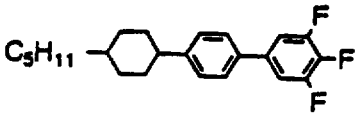

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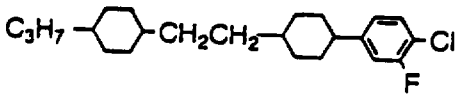

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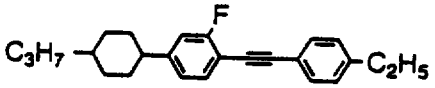

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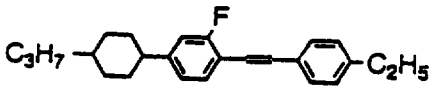

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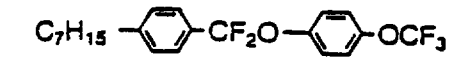

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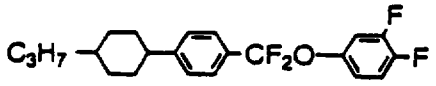

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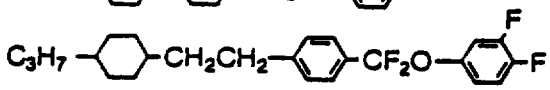

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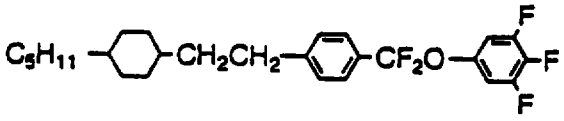

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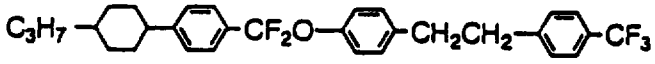
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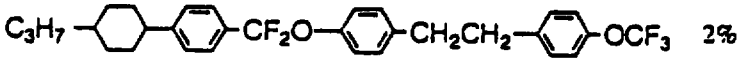

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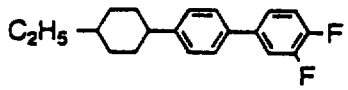

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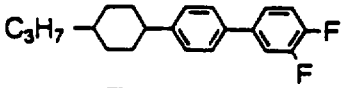

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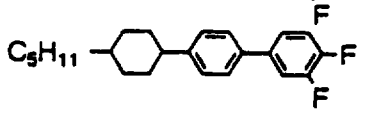

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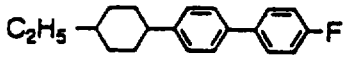

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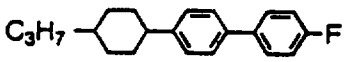

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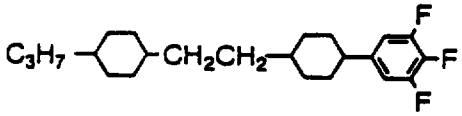

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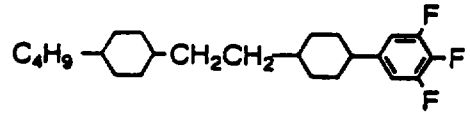

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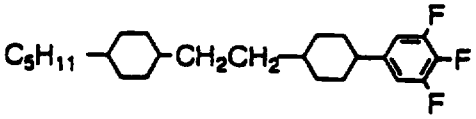

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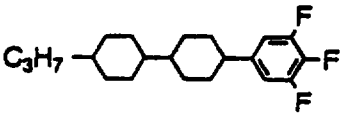

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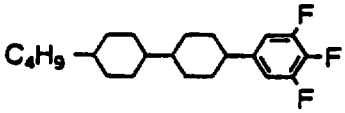

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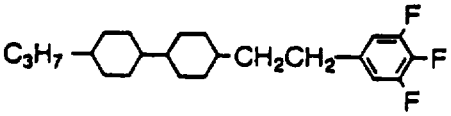

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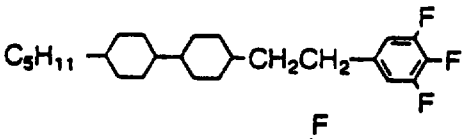

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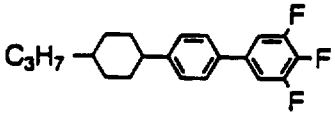

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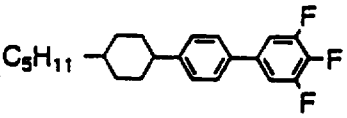

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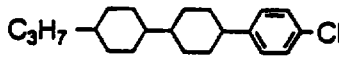

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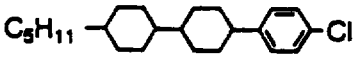

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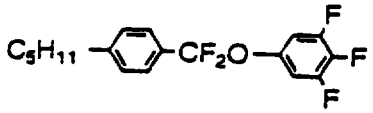

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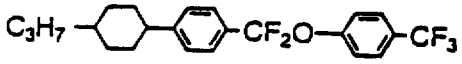

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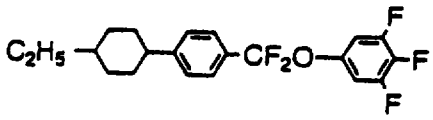

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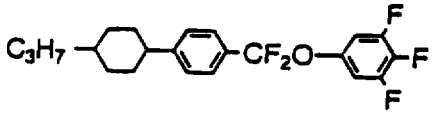

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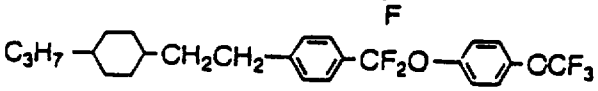
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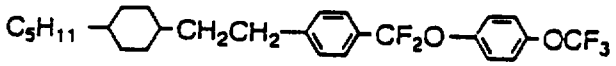

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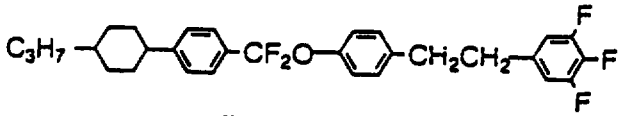

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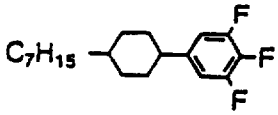

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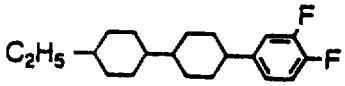

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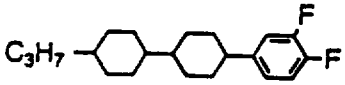

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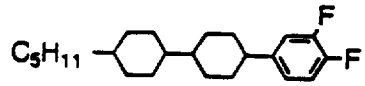

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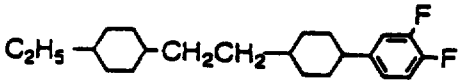

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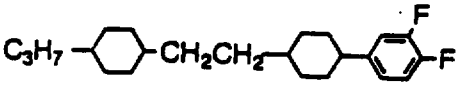

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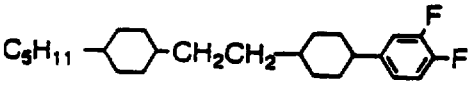

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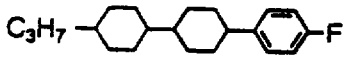

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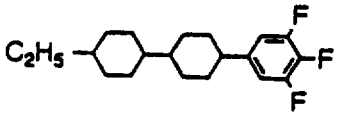

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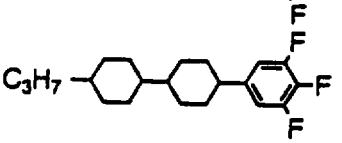

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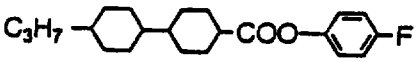

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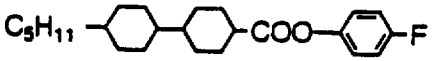

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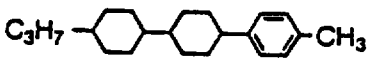

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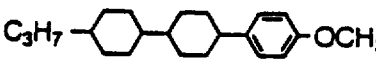

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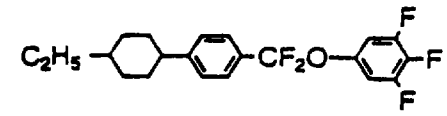

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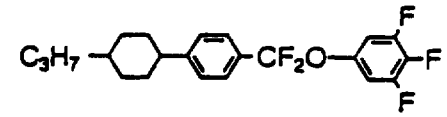

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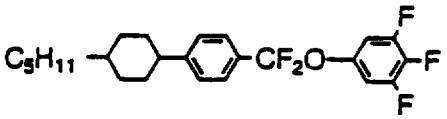

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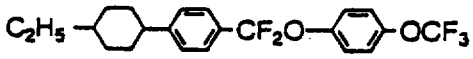

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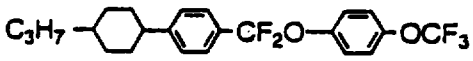
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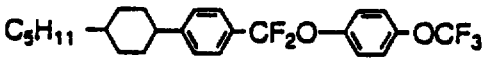

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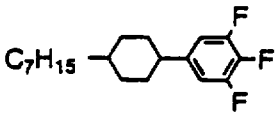

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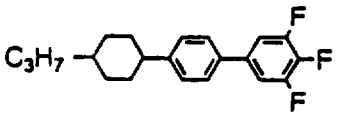

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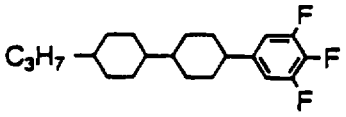

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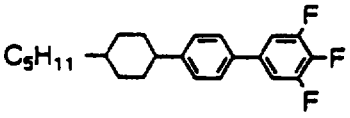

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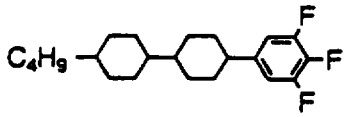

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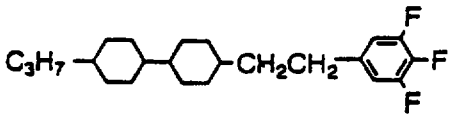

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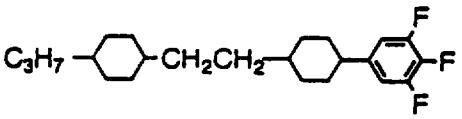

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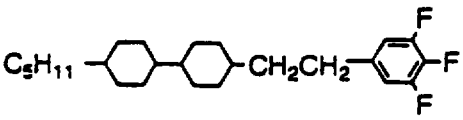

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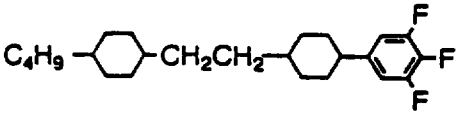

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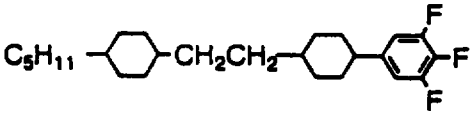

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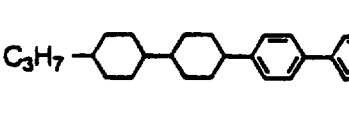

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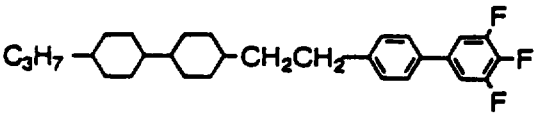

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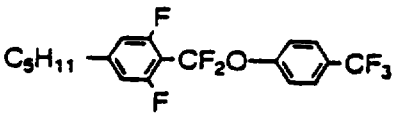

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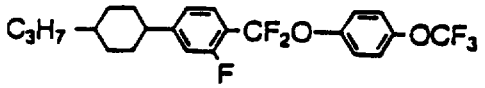

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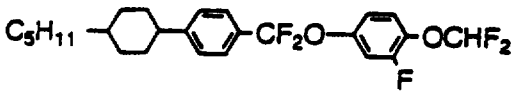

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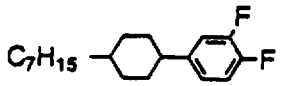

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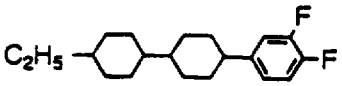
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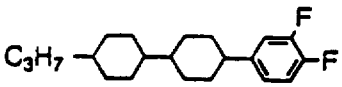

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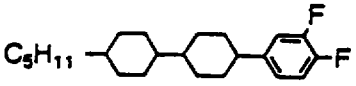

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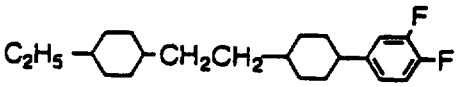

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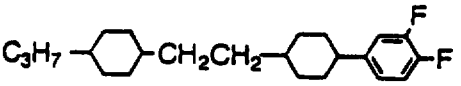

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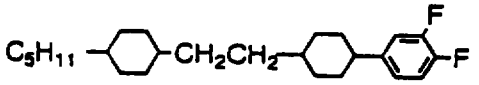

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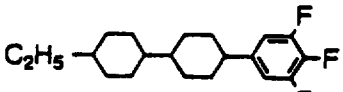

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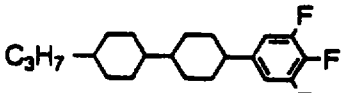

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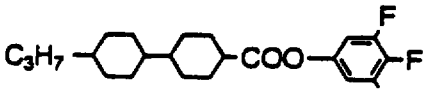

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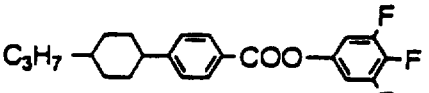

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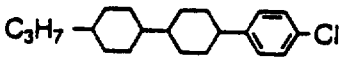

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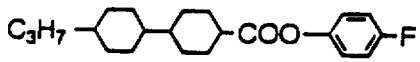

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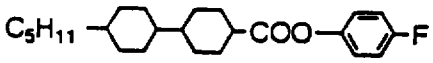

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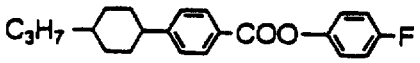

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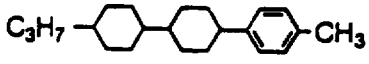

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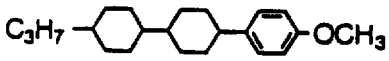

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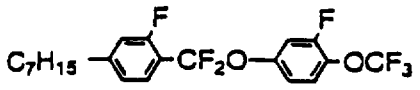

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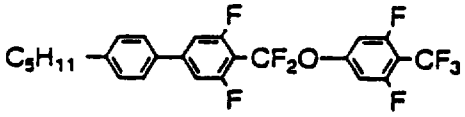

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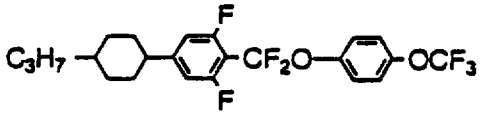

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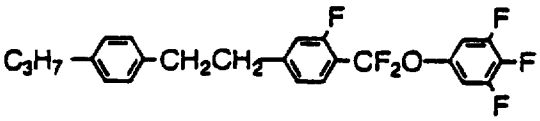

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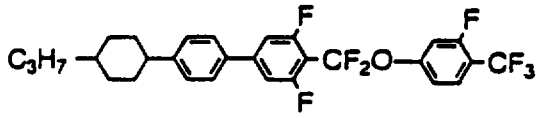
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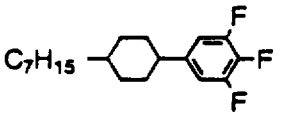

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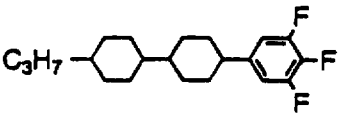

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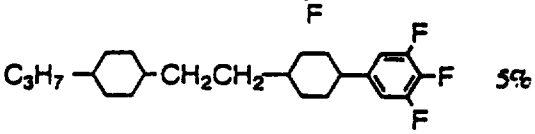

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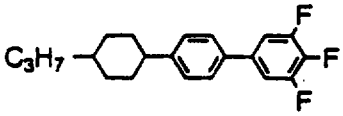

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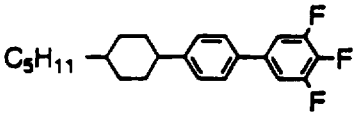

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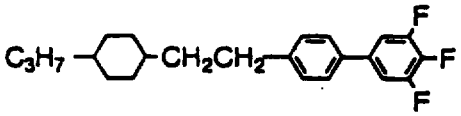

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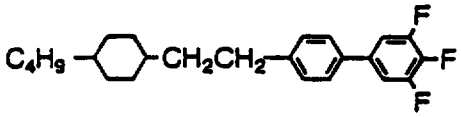

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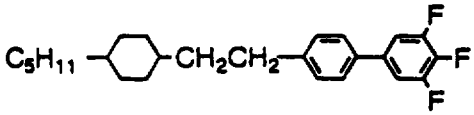

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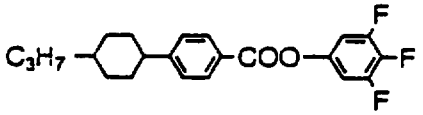

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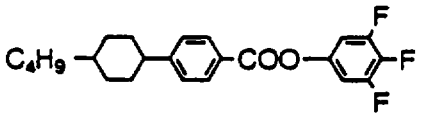

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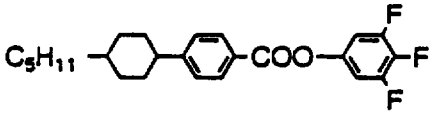

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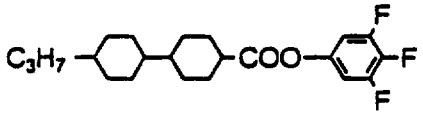

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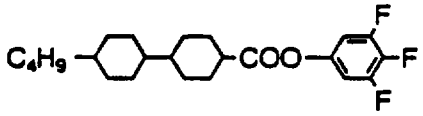

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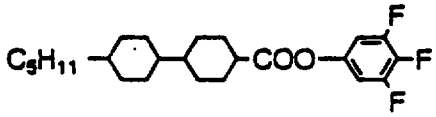

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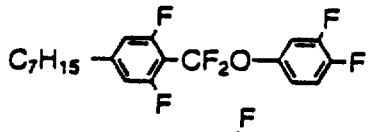

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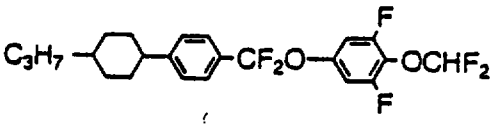

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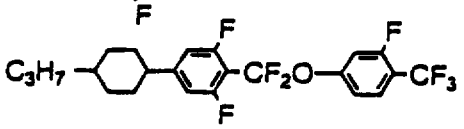

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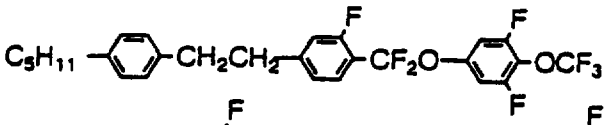

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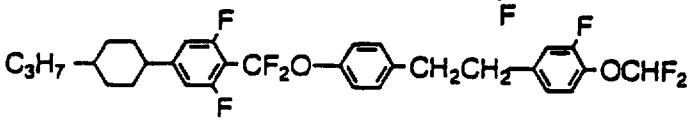
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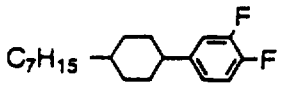

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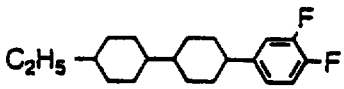

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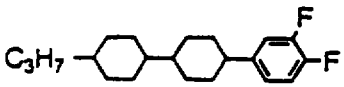

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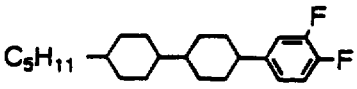

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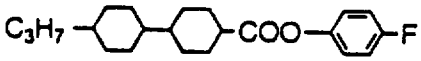

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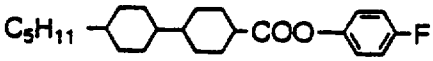

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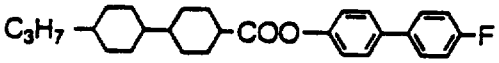

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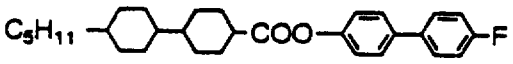

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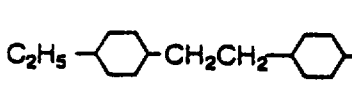

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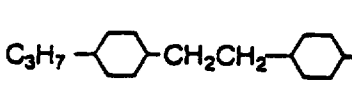

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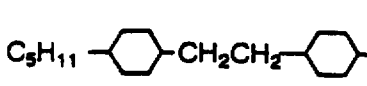

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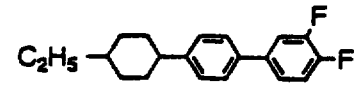

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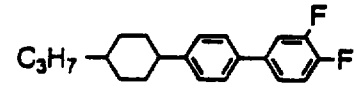

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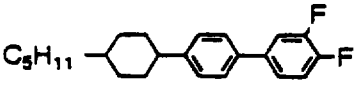

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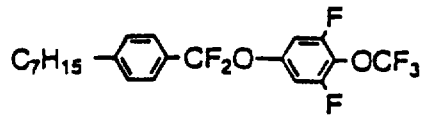

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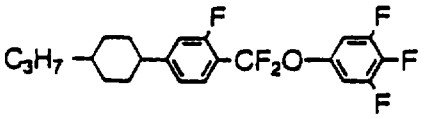

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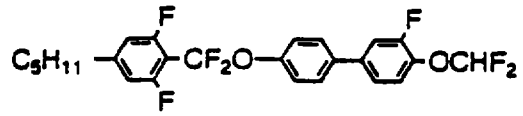

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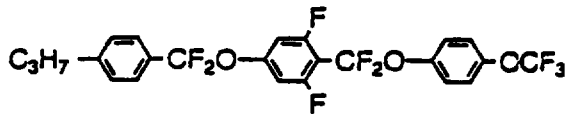

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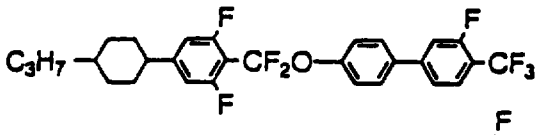
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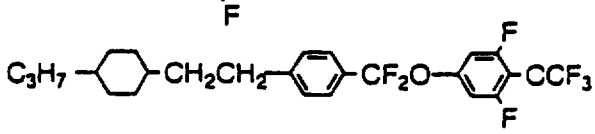

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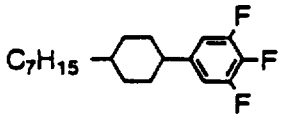

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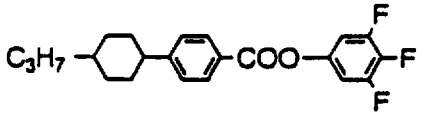

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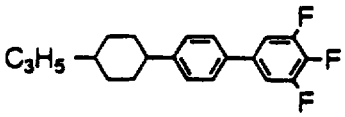

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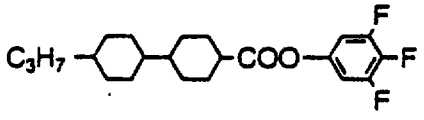

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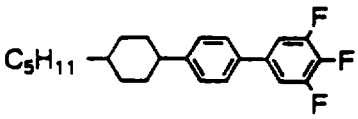

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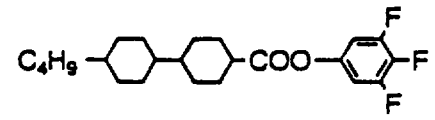

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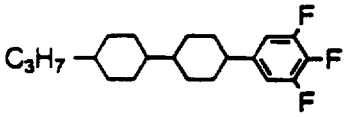

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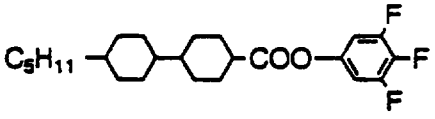

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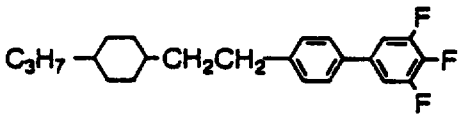

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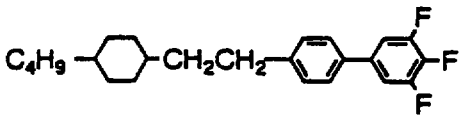

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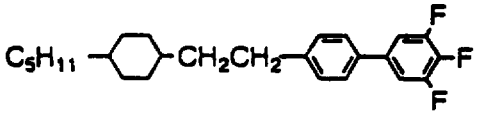

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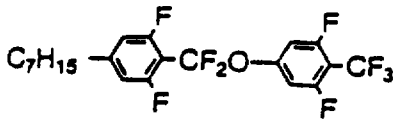

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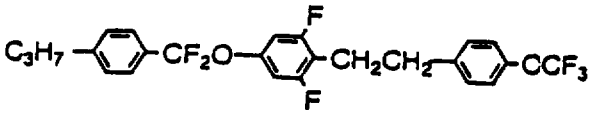

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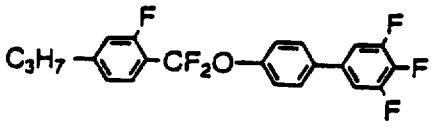

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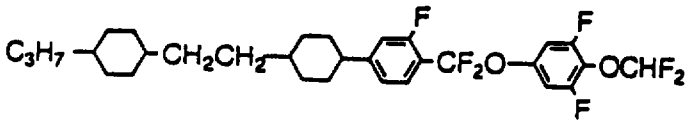

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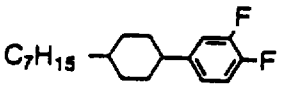
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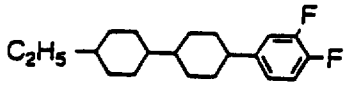

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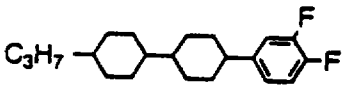

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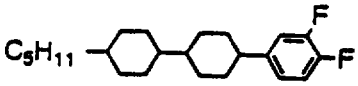

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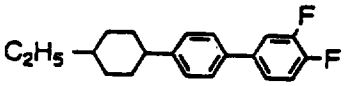

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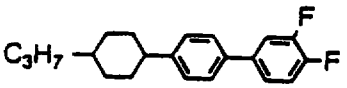

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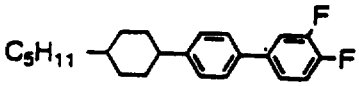

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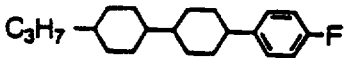

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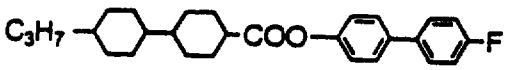

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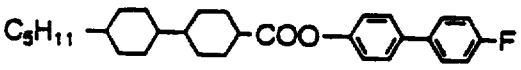

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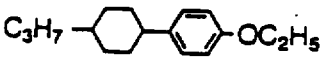

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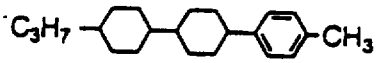

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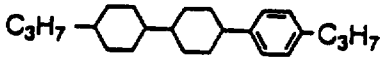

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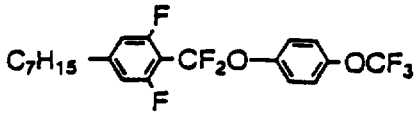

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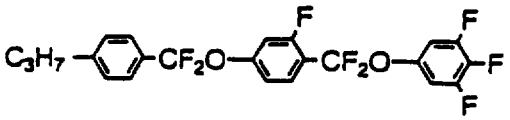

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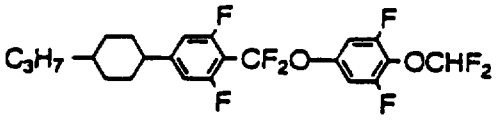

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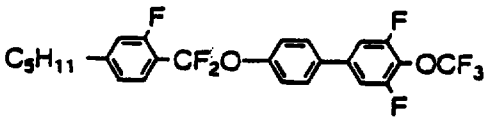

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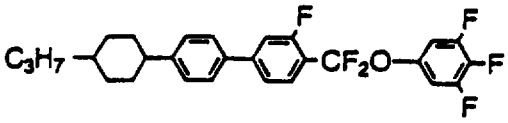
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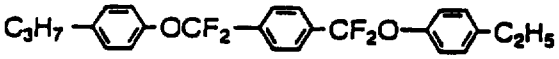

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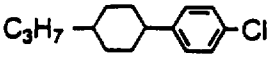

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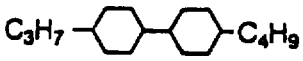

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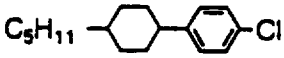

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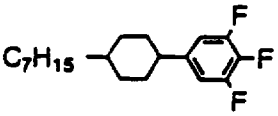

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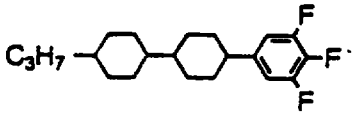

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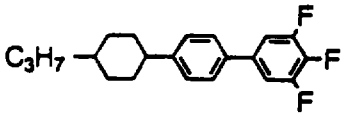

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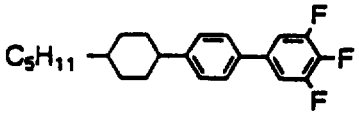

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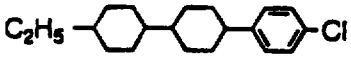

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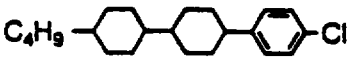

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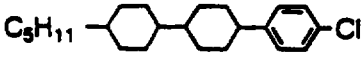

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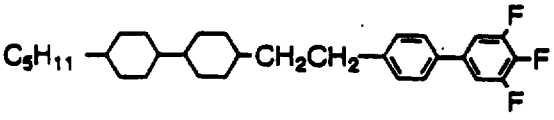

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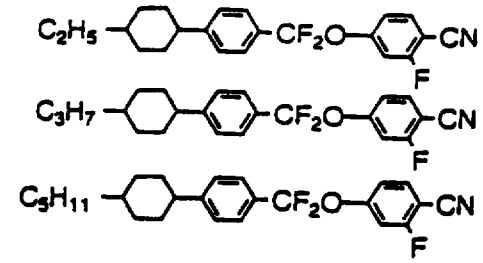

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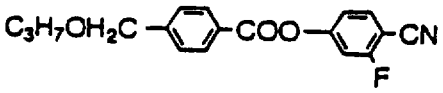

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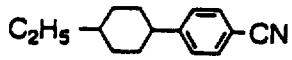

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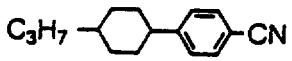

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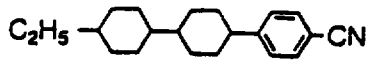
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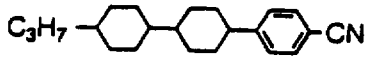

C2H5 CF2O CN F 6%
C3H7 CF2O CN F 6%
C5H11 CF2O CN F 6%

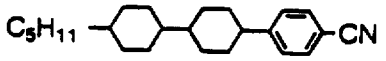

C3H7OH2C COO CN F 5%

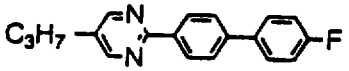

C2H5 CN 5%

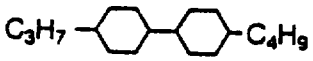

C3H7 CN 15%

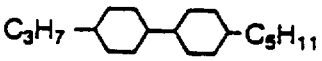

C2H5 CN 5%


C3H7 CN 5%


C5H11 CN 5%

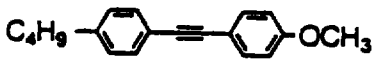

C3H7 N N F 5%


C3H7 C4H9 10%


C3H7 C5H11 3%

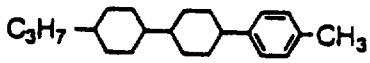

C2H5 OCH3 3%

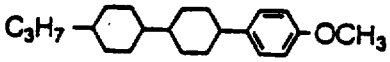

C3H7 OCH3 3%


C4H9 OCH3 3%

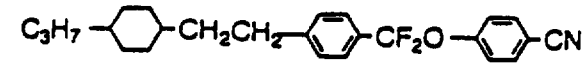

C4H9 OC2H5 3%

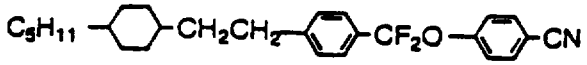

C5H11 OCH3 3%

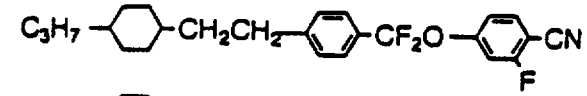

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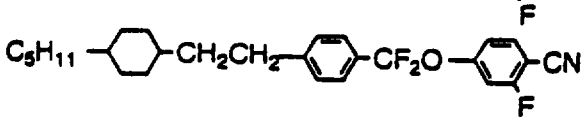

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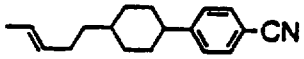
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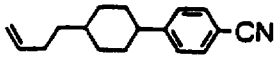

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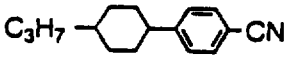

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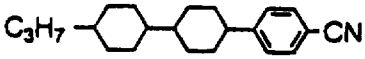

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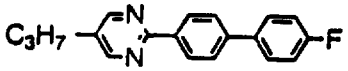

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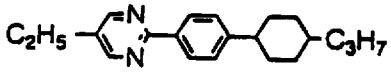

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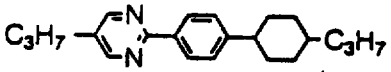

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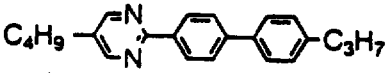

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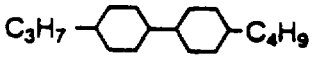

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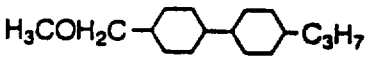

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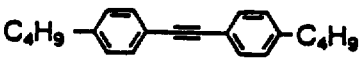

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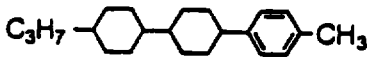

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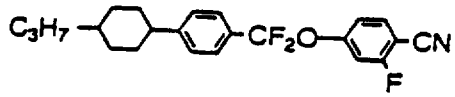

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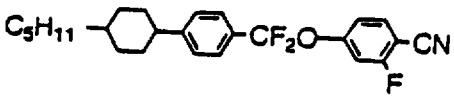

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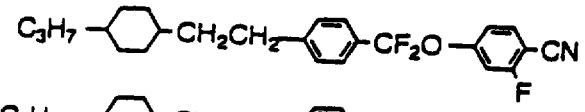

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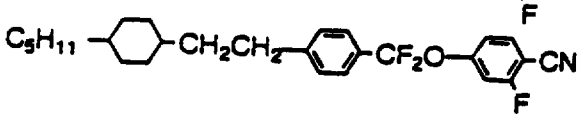

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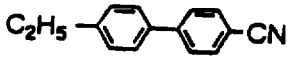
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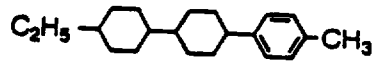

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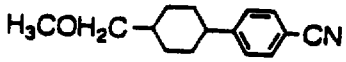

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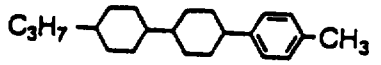

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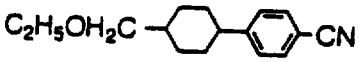

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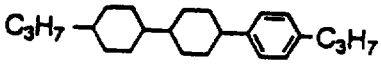

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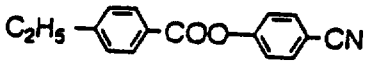

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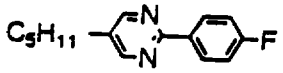

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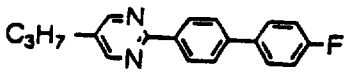

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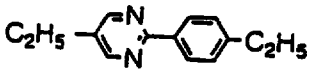

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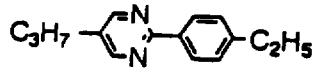

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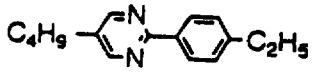

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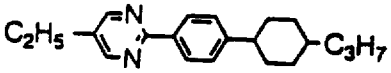

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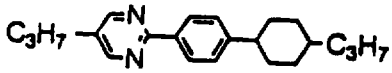

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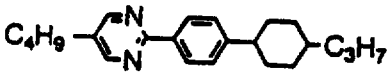

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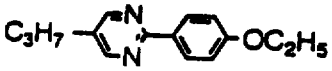

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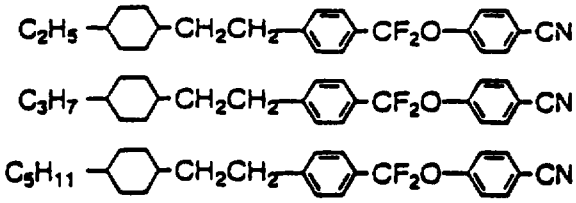

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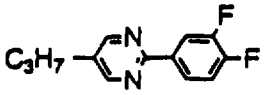

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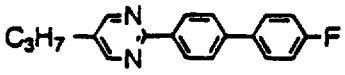
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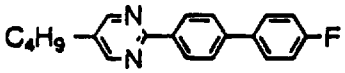

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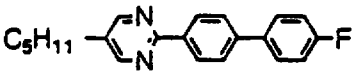
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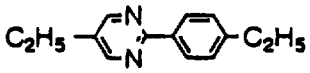
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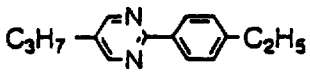

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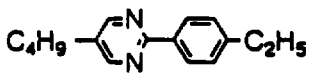

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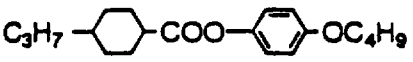

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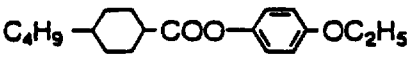

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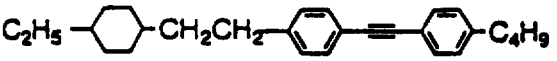

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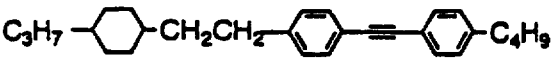

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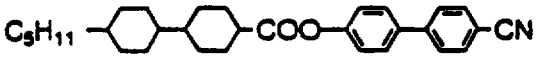

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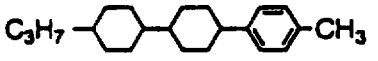

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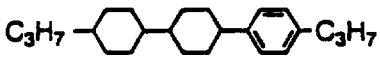

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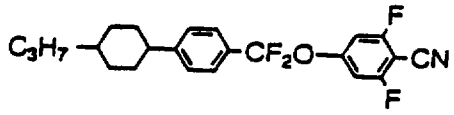

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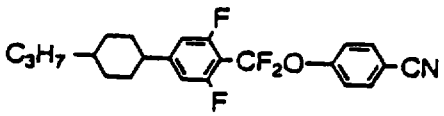

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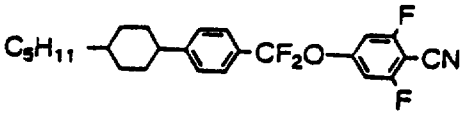

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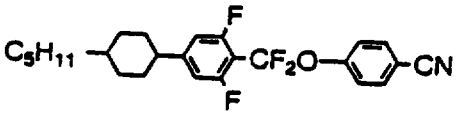

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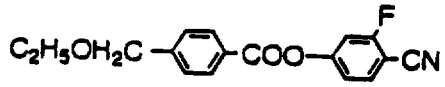
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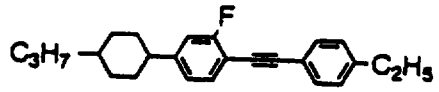

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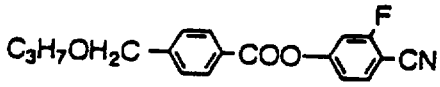

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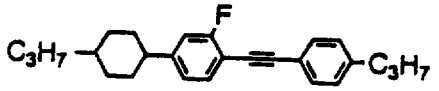

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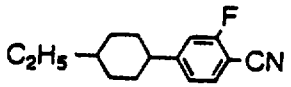

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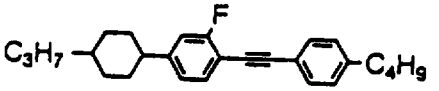

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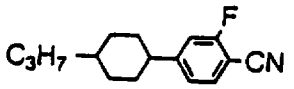

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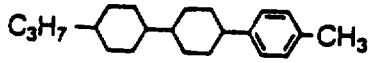

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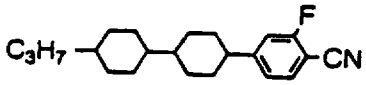

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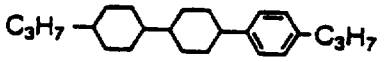

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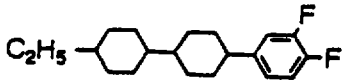

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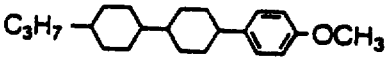

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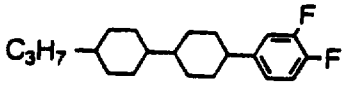

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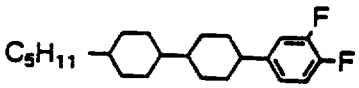

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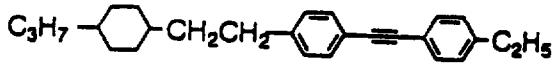

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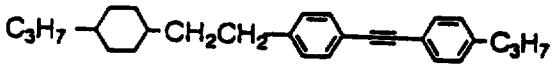

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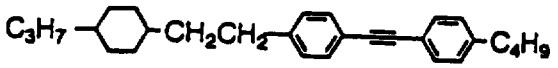

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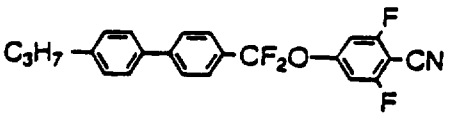

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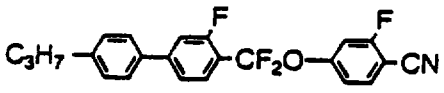

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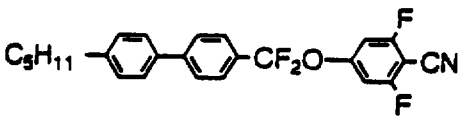

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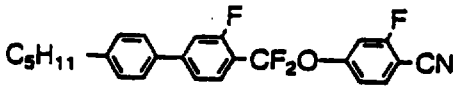

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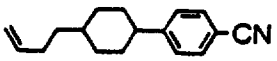
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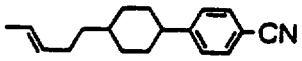

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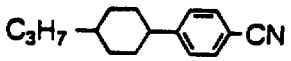

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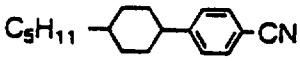

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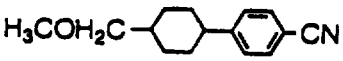

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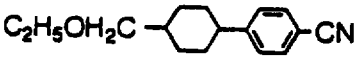

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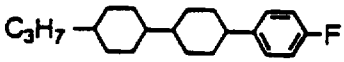

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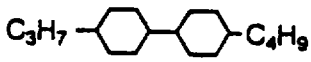

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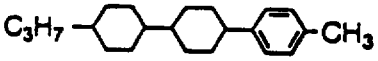

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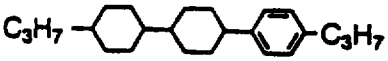

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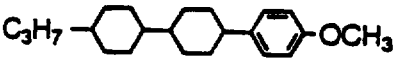

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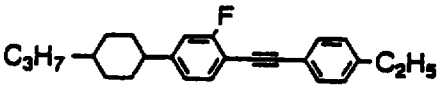

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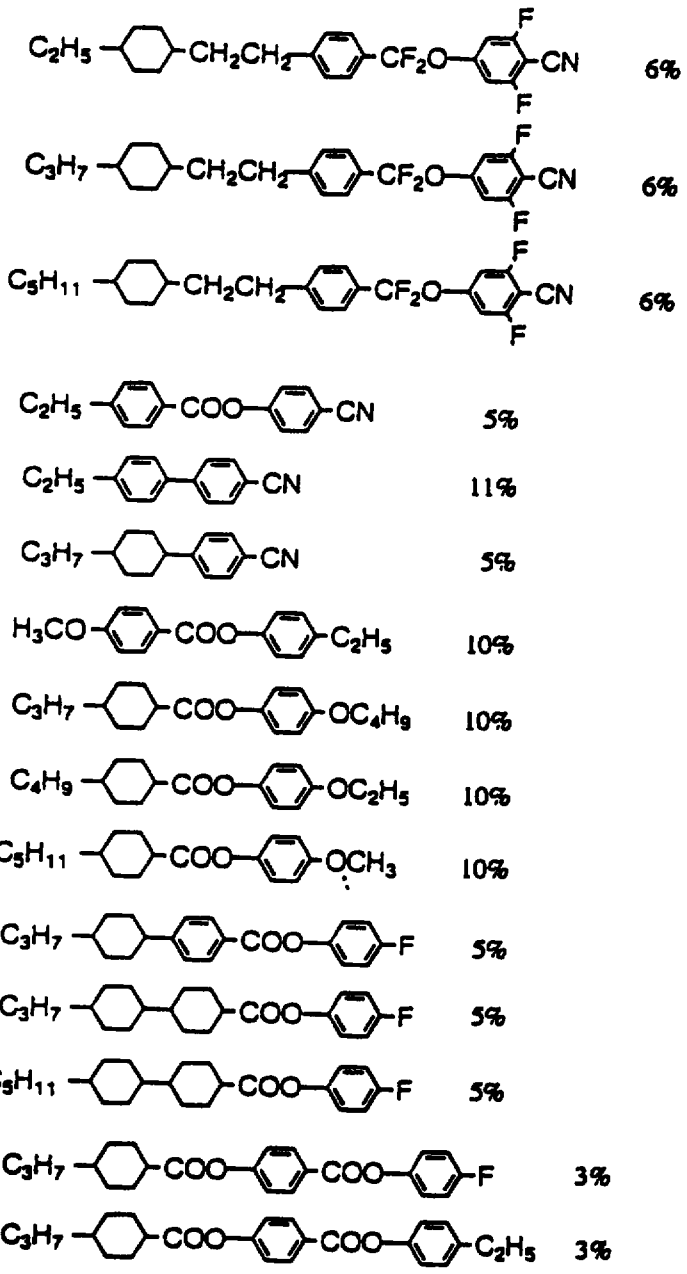

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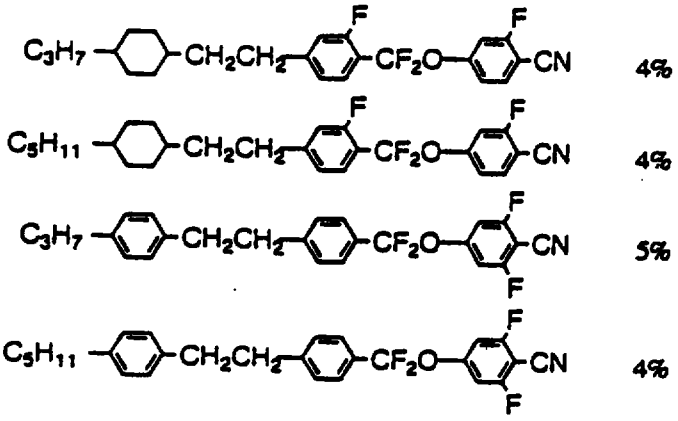

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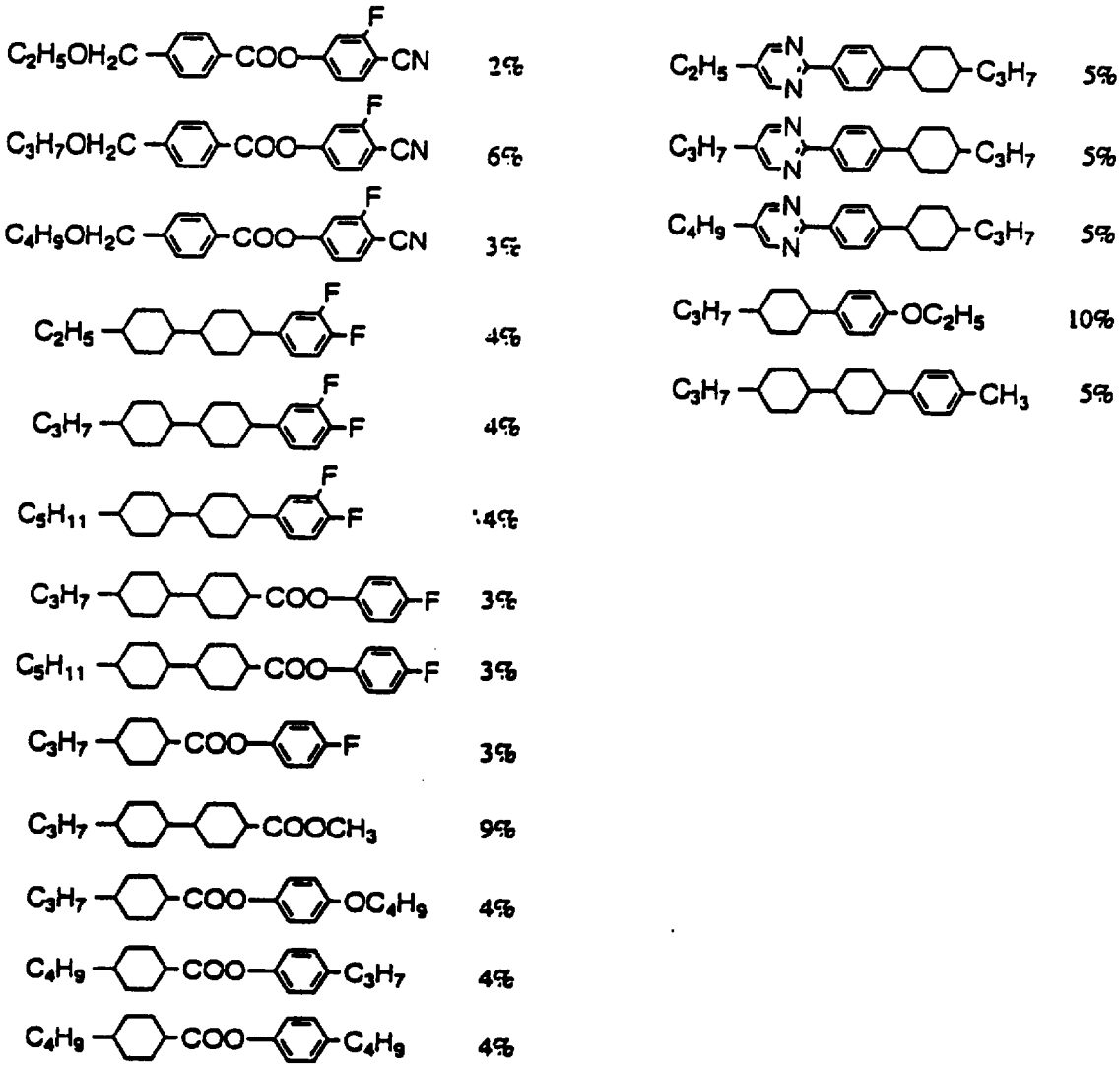

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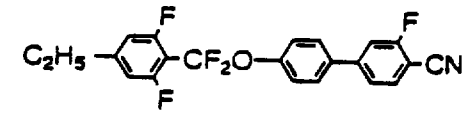

C2H5 CH2CH2 CF2O F CN F 6%
C3H7 CH2CH2 CF2O F CN F 6%
C5H11 CH2CH2 CF2O F CN F 6%
C2H5 COO CN 5%
C2H5 CN 11%
C3H7 CN 5%
H3CO COO C2H5 10%
C3H7 COO OC4H9 10%
C4H9 COO OC2H5 10%
C5H11 COO OCH3 10%
C3H7 COO F 5%
C3H7 COO F 5%
C5H11 COO F 5%
C3H7 COO COO F 3%
C3H7 COO COO C2H5 3%

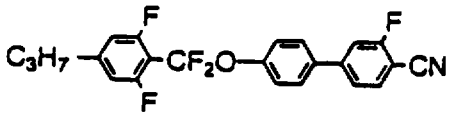
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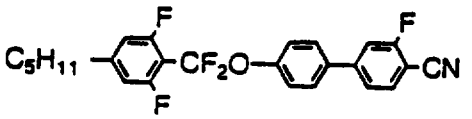

C3H7 CH2CH2 F CF2O F CN 4%
C5H11 CH2CH2 F CF2O F CN 4%
C3H7 CH2CH2 CF2O F CN F 5%
C5H11 CH2CH2 CF2O F CN F 4%

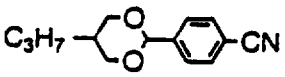

C2H5OH2C COO F CN 2%
C3H7OH2C COO F CN 6%
C4H9OH2C COO F CN 3%
C2H5 F F 4%
C3H7 F F 4%
C5H11 F F 4%
C3H7 COO F 3%
C5H11 COO F 3%
C3H7 COO F 3%
C3H7 COOCH3 9%
C3H7 COO OC4H9 4%
C4H9 COO C3H7 4%
C4H9 COO C4H9 4%
C2H5 N N C3H7 5%
C3H7 N N C3H7 5%
C4H9 N N C3H7 5%
C3H7 OC2H5 10%
C3H7 CH3 5%

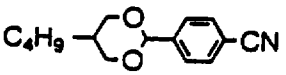
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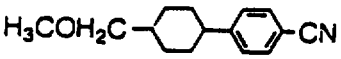

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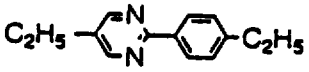

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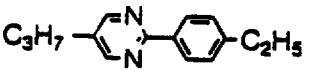

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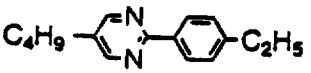

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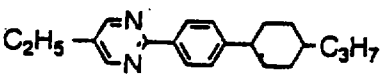

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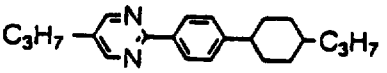

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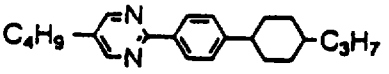

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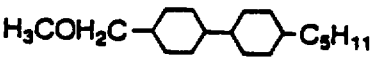

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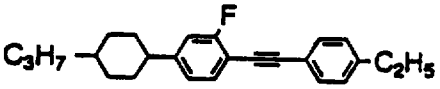

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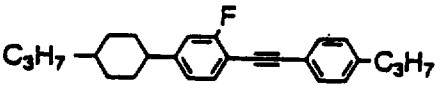

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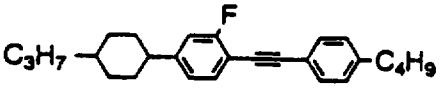

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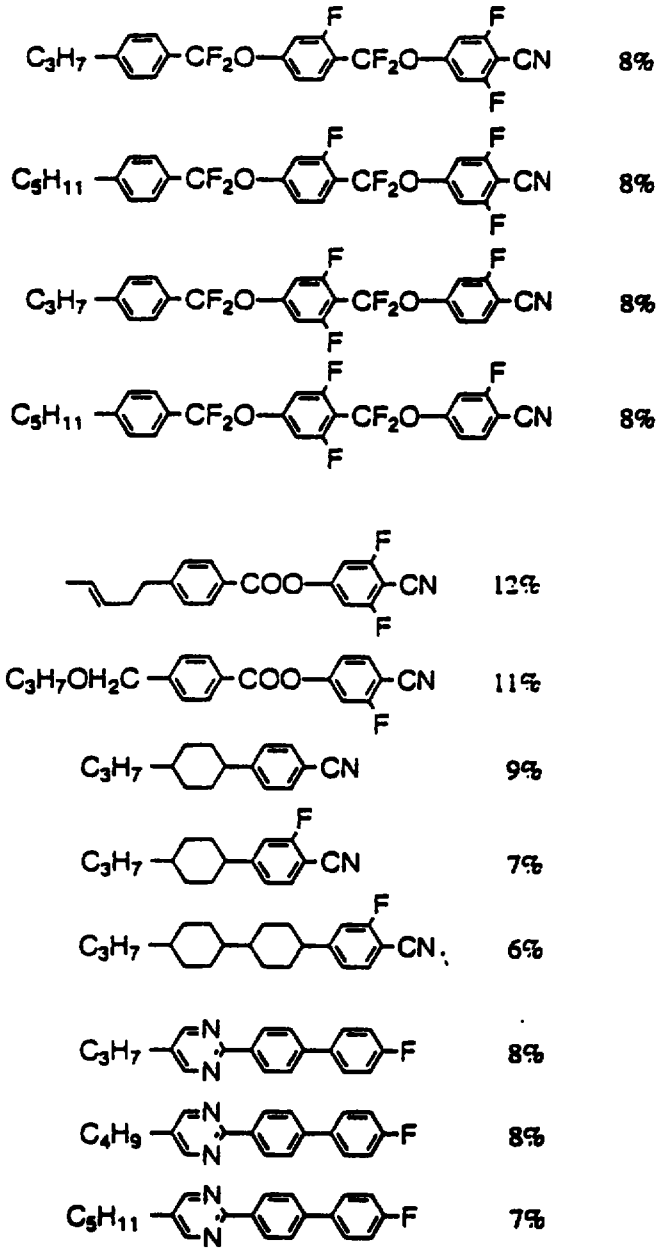

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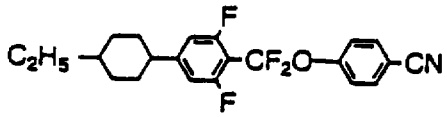

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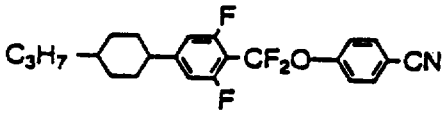

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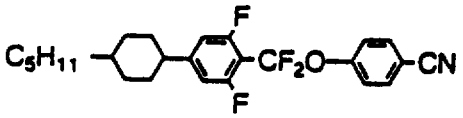
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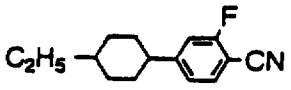

C3H7 CF2O CF2O CN F F F 8%
C5H11 CF2O CF2O CN F F F 8%
C3H7 CF2O CF2O CN F F F 8%
C5H11 CF2O CF2O CN F F F 8%
COO CN F 12%
C3H7OH2C COO CN F 11%
C3H7 CN 9%
C3H7 CN F 7%
C3H7 CN F 6%
C3H7 N N F 8%
C4H9 N N F 8%
C5H11 N N F 7%

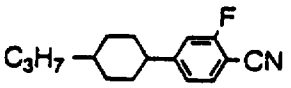
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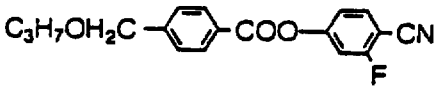

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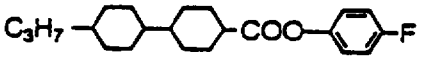

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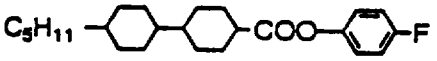

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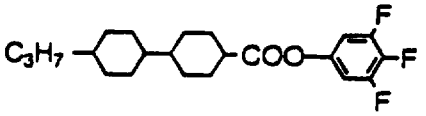

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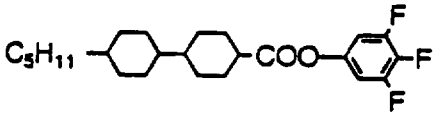

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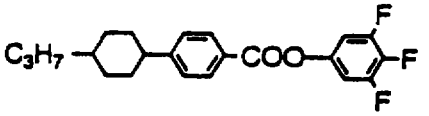

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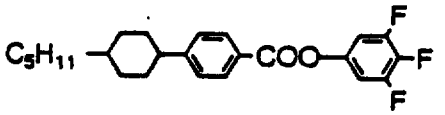

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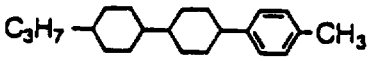

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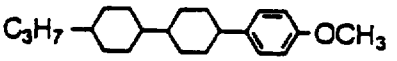

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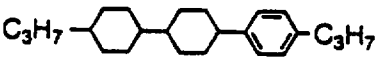

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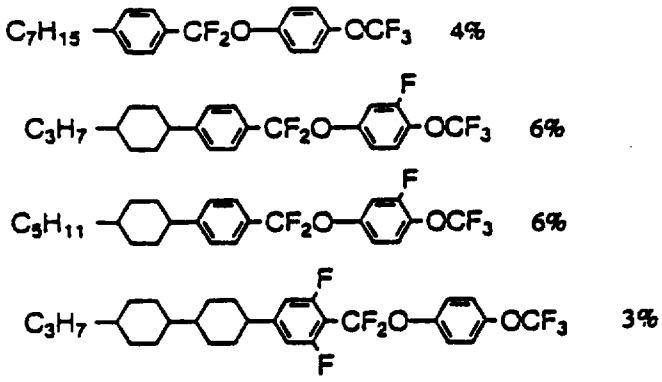

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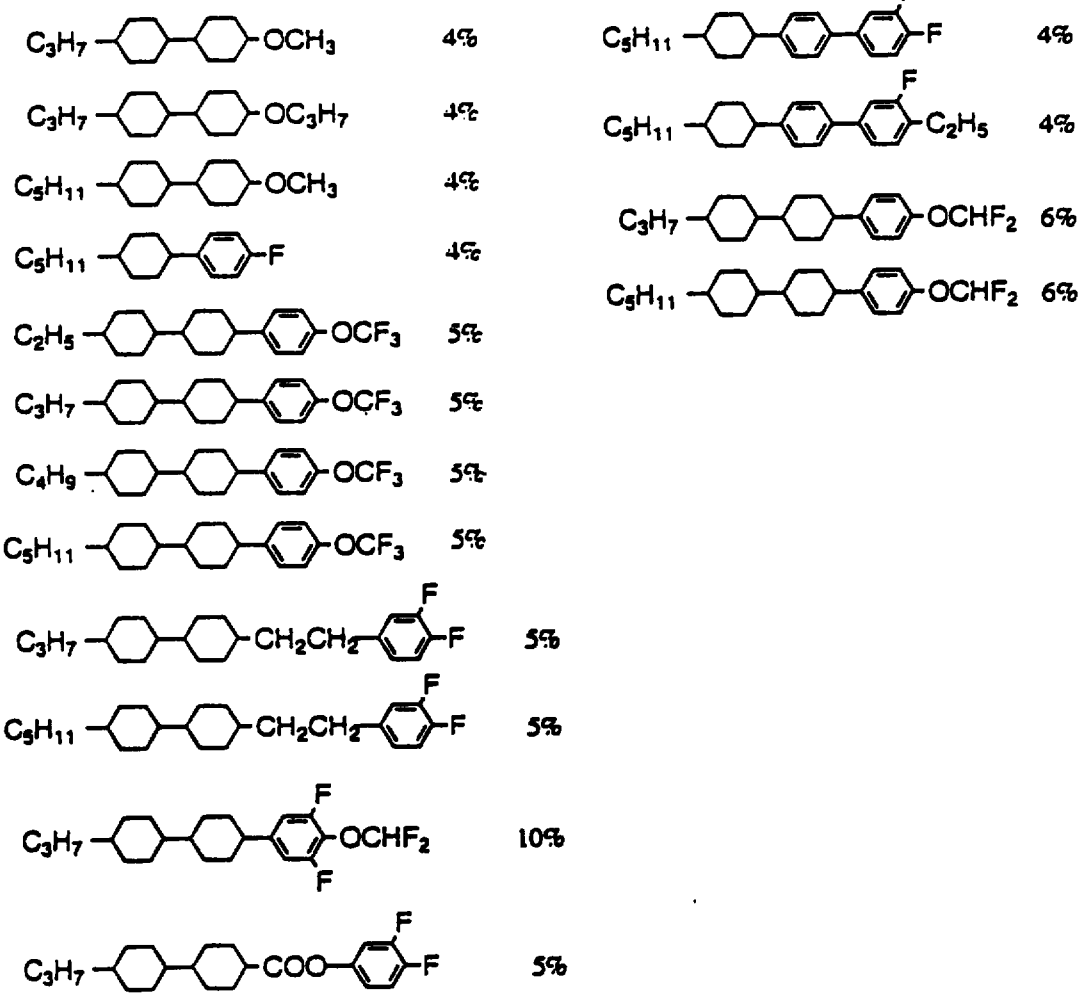

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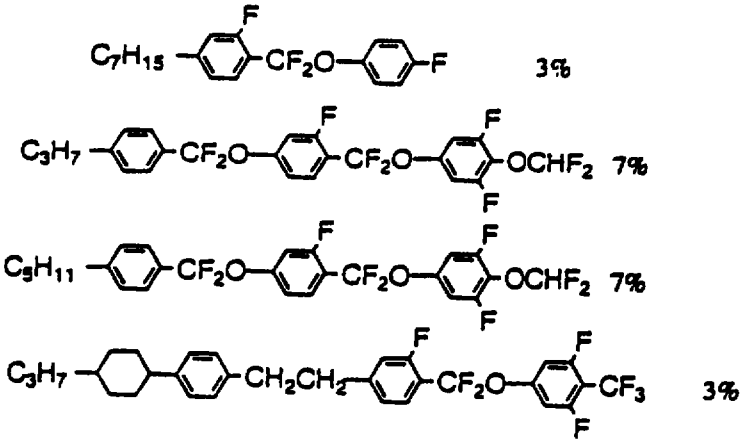

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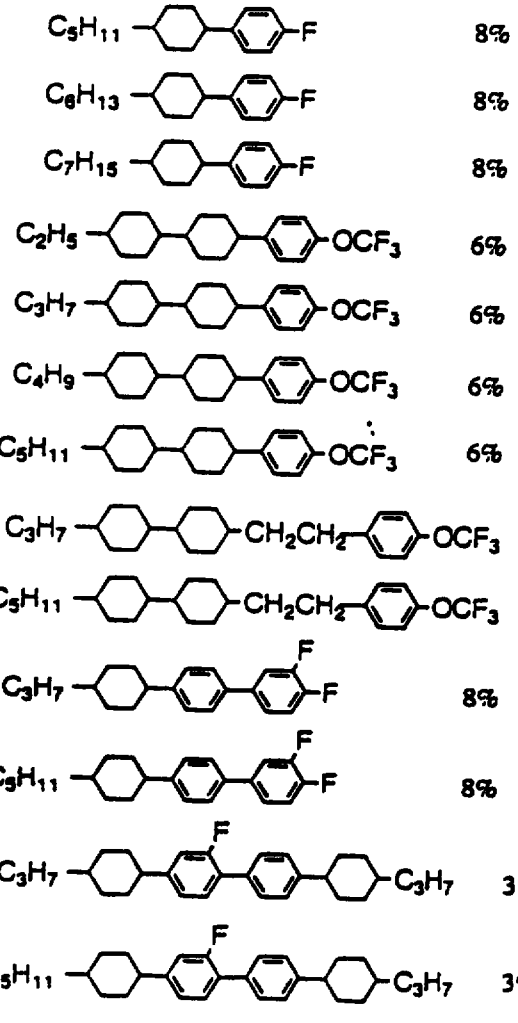
「組成例２６」


C7H15 CF2O OCF3 4%
C3H7 CF2O OCF3 6%
C5H11 CF2O OCF3 6%
C3H7 CF2O OCF3 3%

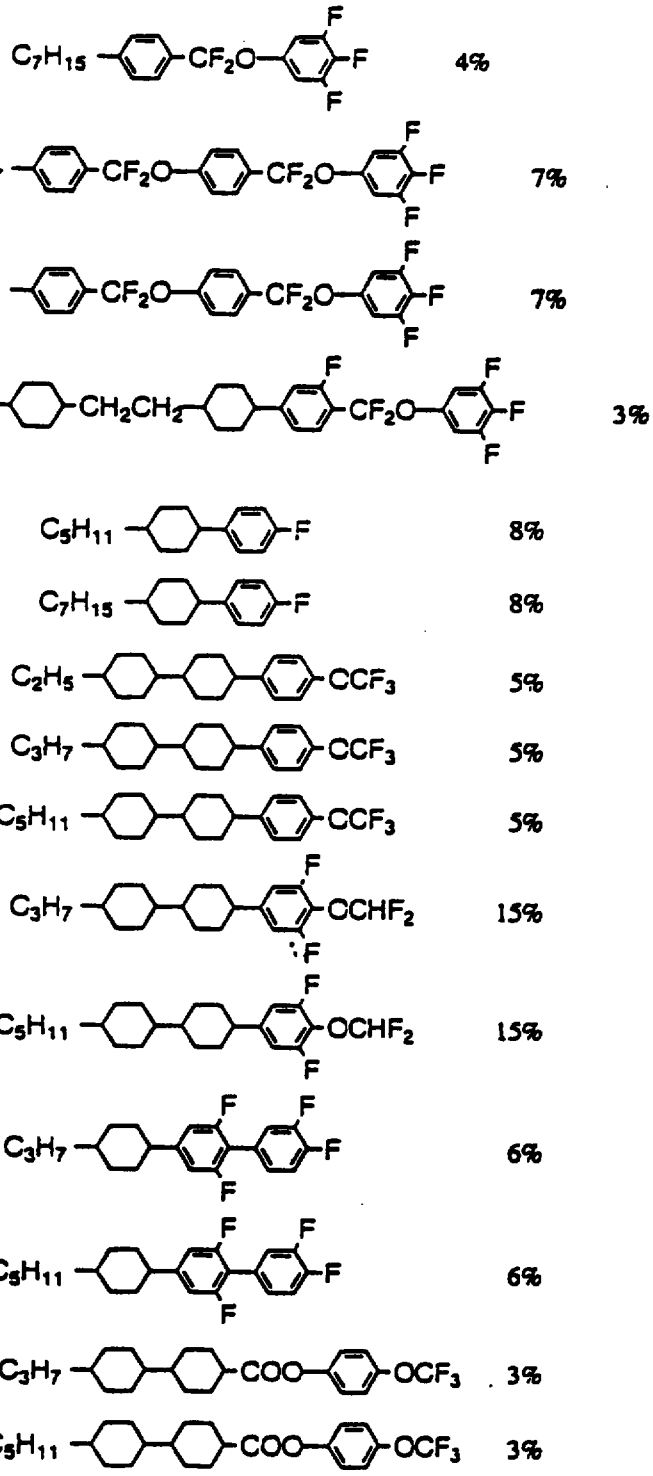

C3H7 OCH3 4%
C3H7 OC3H7 4%
C5H11 OCH3 4%
C5H11 F 4%
C2H5 OCF3 5%
C3H7 OCF3 5%
C4H9 OCF3 5%
C5H11 OCF3 5%
C3H7 CH2CH2 F 5%
C5H11 CH2CH2 F 5%
C3H7 OCHF2 10%
C3H7 COO F 5%
C5H11 F 4%
C5H11 C2H5 4%
C3H7 OCHF2 6%
C5H11 OCHF2 6%

「組成例２７」

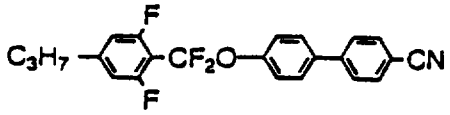

C7H15 CF2O F 3%
C3H7 CF2O CF2O OCHF2 7%
C5H11 CF2O CF2O OCHF2 7%
C3H7 CH2CH2 CF2O CF3 3%

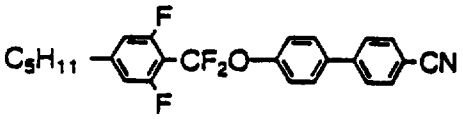

C5H11 F 8%
C6H13 F 8%
C7H15 F 8%
C2H5 OCF3 6%
C3H7 OCF3 6%
C4H9 OCF3 6%
C5H11 OCF3 6%
C3H7 CH2CH2 OCF3 5%
C5H11 CH2CH2 OCF3 5%
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C5H11 F 8%
C3H7 C3H7 3%
C5H11 C3H7 3%

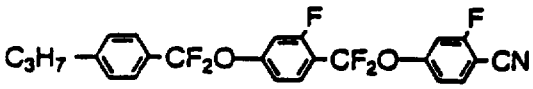
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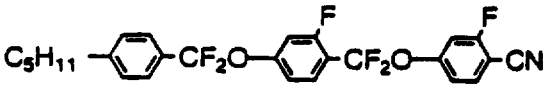

C7H15 CF2O F F F 4%
C3H7 CF2O CF2O F F F 7%
C5H11 CF2O CF2O F F F 7%
C3H7 CH2CH2 F CF2O F F F 3%
C5H11 F 8%
C7H15 F 8%
C2H5 CCF3 5%
C3H7 CCF3 5%
C5H11 CCF3 5%
C3H7 F CCHF2 F 15%
C5H11 F OCHF2 F 15%
C3H7 F F F F 6%
C5H11 F F F F 6%
C3H7 COO OCF3 3%
C5H11 COO OCF3 3%

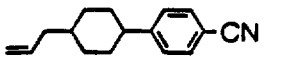
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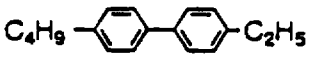

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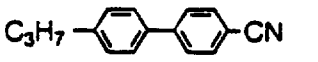

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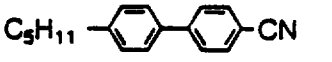

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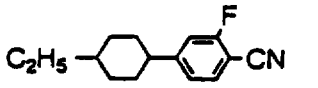

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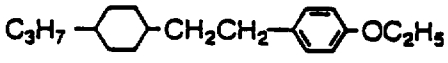

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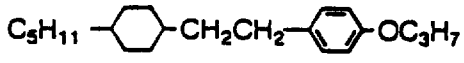

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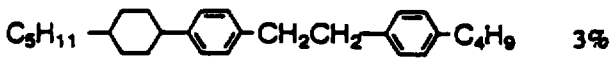

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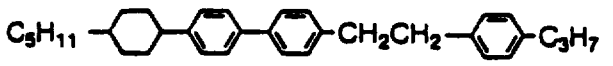

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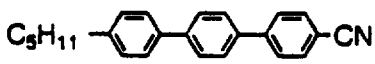

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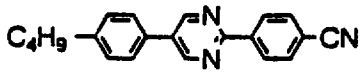

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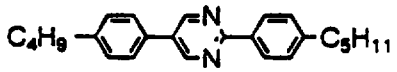

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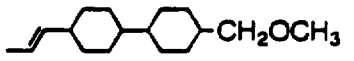

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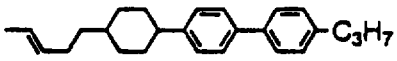

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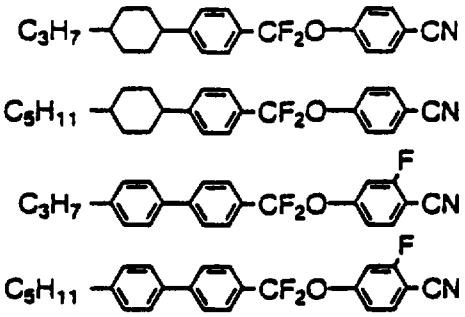

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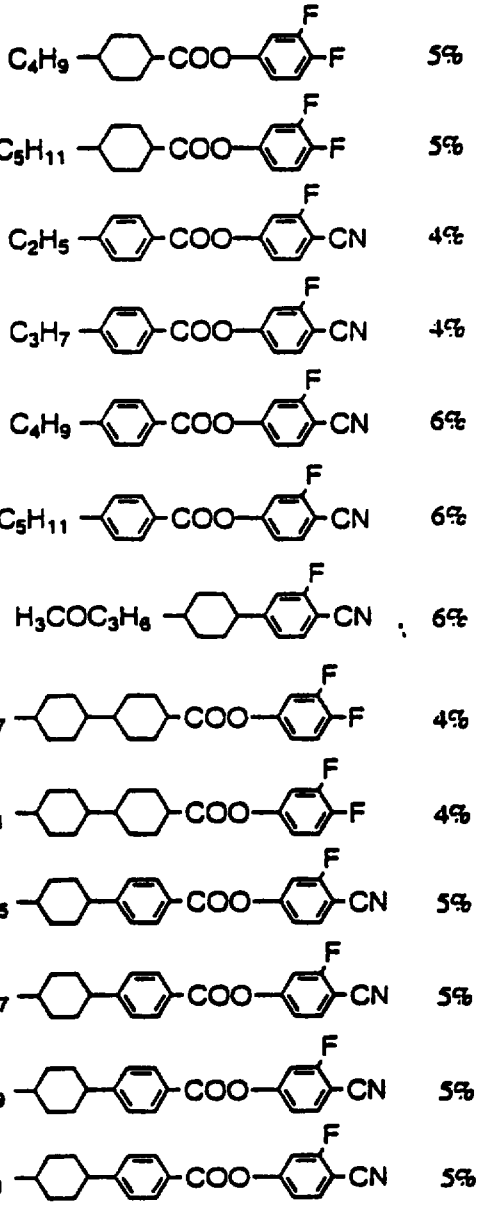

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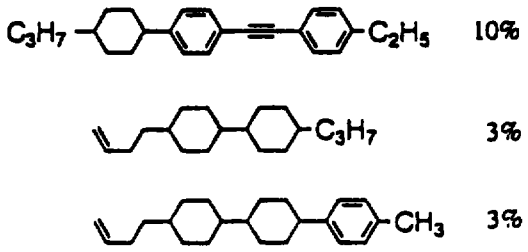

5%


5%

「組成例３０」


C3H7 CF2O CN 5%
C5H11 CF2O CN 5%
C3H7 CF2O F CN 5%
C5H11 CF2O F CN 5%


C4H9 COO F F 5%
C5H11 COO F F 5%
C2H5 COO F CN 4%
C3H7 COO F CN 4%
C4H9 COO F CN 6%
C5H11 COO F CN 6%
H3COC3H6 F CN 6%
C3H7 COO F F 4%
C5H11 COO F F 4%
C2H5 COO F CN 5%
C3H7 COO F CN 5%
C4H9 COO F CN 5%
C5H11 COO F CN 5%


C3H7 C2H5 10%
C3H7 3%
CH3 3%

本発明のジフルオロオキシメタン誘導体は「従来の技術」の項に示した類似の構造を有する化合物と比較し、非常に大きな誘電率異方性（△ε）を有すると共に、粘性に関しては同一の分子末端置換基を有する化合物と比較し著しく低粘性であり、アクティブマトリックス方式やＳＴＮ方式をはじめ種々のモードにおける低電圧用液晶性化合物として優れた特性を有する化合物である。また本発明のジフルオロオキシメタン誘導体は、他の多くの液晶性化合物、すなわちフッ素系の化合物をはじめとし、エステル系、シッフ塩基系、ビフェニル系、フェニルシクロヘキサン系、ビシクロヘキサン系、複素環系を含む既存の液晶性化合物との相溶性が良く、特に低温における相溶性に優れた特性を有する。さらに本発明の化合物を液晶組成物の成分として加えることにより粘性の向上を抑制しつつ駆動電圧（しきい値電圧）を著しく低下させることができる。

以下、実施例により本発明の化合物の製造方法および使用例についてさらに詳細に説明するが、これらの実施例は、本発明を限定するためのものではない。尚、各実施例中においてＣｒは結晶、Ｎはネマチック相、Ｓはスメクチック相、Ｉｓｏは等方性液体を表し、相転位温度の単位は全て℃である。

実施例１

ジフルオロー（４－プロピルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン〔（Ｉ）式においてＲ＝C_3H_7、１、ｍおよびｎは０でありＺ$_1$、Ｚ$_2$およびＺ$_3$は共有結合、Ｌ$_1$＝Ｌ$_2$＝Ｈ、Ｌ$_3$＝Ｌ$_4$＝Ｆ、Ｘ＝Ｆのもの〕の製造

撹拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、４－プロピル安息香酸15.0g(91.4mmol)、ジシクロヘキシルカルボジイミド（以下ＤＣＣと略す）22.6g(109.7mmol)および４－ジメチルアミノピリジン（以下ＤＭＡＰと略す）0.4g(3.3mmol)をジクロロメタン200mlに溶解し室温下撹拌しながら３，４，５－トリフルオロフェノール16.2g(109.7mmol)を５分で滴下し、滴下後18時間室温下で撹拌した。反応溶液に水100mlを添加し反応を終了した。ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、水層をさらにジクロロメタン100mlで抽出し、抽出層を混合後、水(100mlx2、「x2」は２回繰返しの意味、以下同じ)、飽和炭酸水素ナトリウム水溶液100mlお

よ水(100mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を25.8g得た。反応物はシリカゲルを充填剤にし展開溶媒としてトルエンを用いたカラムクロマト処理にて精製し無色結晶物22.8gを得た。これが3，4，5－トリフルオロー（4－プロピルフェニル）ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得た3，4，5－トリフルオロー（4－プロピルフェニル）ベンゾアート22.8g(77.6mmol)、2，4－ビス（メトキシフェニル）－1，3－ジチアー2，4－ジフォスフェタンー2，4－ジスルフィド（以下ローソン試薬と略す）62.8g(155.2mmol)をトルエン400mlに溶解し、窒素気流下攪拌しながら加熱還流を60時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン150mlで抽出した。有機層を混合し、水(200mlx2)、飽和炭酸水素ナリウム水溶液(100ml)、10%亜硫酸水素ナトリウム水溶液100mlおよび水(200mlで順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物23.9gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して黄色針状結晶物5.4gを得た。これが4－プロピルフェニルカルボチオ酸－O－3，4，5－トリフルオロフェニルである。

次に上記操作で得たチオンカルボン酸エステル誘導体はgem-フッ素化を行った。すなわち窒素導入管を備えた100mlナスフラスコ中、室温下4－プロピルフェニルカルボチオ酸－O－3，4，5－トリフルオロフェニル5.4g(17.4mmol)をジクロロメタン50mlに溶解し、ジエチルアミノサルファートリフルオリド（以下ＤＡＳＴと略す）8.4g(52.2mmol)を添加して室温にて28時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50mlx2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して淡黄色油状物4.5gを得た。反応物はシリカゲルを充填剤とし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物1.2gを得た。これがジフルオロー（4－プロピルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタンである。

上記製造方法に準じて4－プロピル安息香酸の代わりにアルキル鎖の異なる4－アルキル安息香酸を用いて以下の化合物を製造できる。

ジフルオロ（4－メチルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ（4－エチルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ（4－ブチルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ（4－ペンチルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ（4－ヘキシルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ（4－ヘプチルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ（4－オクチルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ（4－ノニルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ（4－デシルフェニル）－（3，4，5－トリフルオロフェニルオキシ）メタン

また上記製造方法に準じて3，4，5－トリフルオロフェノールの代わりに種々の既知のフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロ（4－エチルフェニル）－（4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ（4－プロピルフェニル）－（4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ（4－ブチルフェニル）－（4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ（4－ペンチルフェニル）－（4－トリフルオロメチルフェニル

オキシ）メタン

ジフルオロー（４－エチルフェニル）－（４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－プロピルフェニル）－（４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ブチルフェニル）－（４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ペンチルフェニル）－（４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－エチルフェニル）－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－プロピルフェニル）－（４－トリフルオロメトキシフェニルオキシ）メタン　　Ｃｒ　１２．１　Ｉｓｏ

ジフルオロー（４－ブチルフェニル）－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ペンチルフェニル）－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－エチルフェニル）－（３－フルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロー（４－プロピルフェニル）－（３－フルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロー（４－ブチルフェニル）－（３－フルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロー（４－ペンチルフェニル）－（３－フルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロー（４－エチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロー（４－プロピルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロー（４－ブチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロー（４－ペンチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロー（４－エチルフェニル）－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－プロピルフェニル）－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ブチルフェニル）－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ペンチルフェニル）－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－エチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－プロピルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ブチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ペンチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－エチルフェニル）－（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－プロピルフェニル）－（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ブチルフェニル）－（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－ペンチルフェニル）－（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（４－エチルフェニル）－（３，５－ジフルオロ－４－ジフルオ

ロメトキシフェニルオキシ）メタン

ジフルオロ（４－プロピルフェニル）－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ（４－ブチルフェニル）－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ（４－ペンチルフェニル）－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－エチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－プロピルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－ブチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－ペンチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－エチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－プロピルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－ブチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－ペンチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－エチルフェニル）－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－プロピルフェニル）－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ（２－フルオロ－４－ブチルフェニル）－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－（２－フルオロ－４－ペンチルフェニル）－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－（２－フルオロ－４－エチルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－（２－フルオロ－４－プロピルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－（２－フルオロ－４－ブチルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－（２－フルオロ－４－ペンチルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－プロピルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－ブチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－ペンチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－プロピルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－ブチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－ペンチルフェニル）－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－（２，６－ジフルオロ－４－プロピルフェニル）－（３，５－ジ

フルオロー４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（２，６－ジフルオロー４－ブチルフェニル）－（３，５－ジフルオロー４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（２，６－ジフルオロー４－ペンチルフェニル）－（３，５－ジフルオロー４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロー（２，６－ジフルオロー４－エチルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロー（２，６－ジフルオロー４－プロピルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロー（２，６－ジフルオロー４－ブチルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロー（２，６－ジフルオロー４－ペンチルフェニル）－（３，４，５－トリフルオロフェニルオキシ）メタン

実施例２

ジフルオロー〔４－（トランス－４－プロピルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン〔（Ｉ）式においてＲ＝C_3H_7、１＝１、ｍ、ｎ＝０であり、環Ａ１がトランス－１，４－シクロヘキシン基、Z_1、Z_2およびZ_3は共有結合、L_1＝L_2＝Ｈ、L_3＝L_4＝Ｆ、Ｘ＝Ｆのもの〕の製造

攪拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、４－（トランス－４－プロピルシクロヘキシル）安息香酸15.0g（60.9mmol）、ＤＣＣ15.1g(73.1mmol)およびＤＭＡＰ0.3g(2.2mmol)をジクロロタン250mlに溶解し、室温下攪拌しながら３，４，５－トリフルオロフェノール0.8g(73.mmol)を３分で滴下し、滴下後10時間室温下で攪拌した。反応溶液に水00mlを添加した後、ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン200mlで抽出し、抽出層を混合後、水(100ml x2、飽和炭酸水素ナトリウム水溶液100mlおよび水(100mlx2)で順次洗浄し、無水酸マグネシウムで乾燥後、減圧下濃縮して反応物を23.8g得た。反応物はシリカゲルを充填剤にし展開溶媒としてトルエンを用いたカラムクロマト処理にて精

製し、さらにヘプタン－エタノール混合溶媒から再結晶して無色結晶物13.2gを得た。これが3，4，5－トリフルオロ－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得た3，4，5－トリフルオロ－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕ベンゾアート13.2g(35.2mmol)、ローソン試薬28.5g(70.4mmol)をトルン500mlに溶解し、窒素気流下攪拌しながら加熱還流を60時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン150mlで抽出した。有機層を混合し、水(200mlx2)、飽和炭酸水素ナトリウム溶液(100ml)、10%亜硫酸水素ナトリウム水溶液100mlおよび水(200mlx2)で順浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物13.8gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して転移点Ｃｒ 127.7-128.2℃Ｉｓｏの黄色針状結晶物4.7gを得た。これが4－（トランス－4－プロピルシクロヘキシル）フェニルカルボチオ酸－Ｏ－3，4，5－トリフルオロフェニルである。

^{1}H－NMR（$CDCl_3$；δppm）0.8-2.0(16H,m)，2.57(1H,m)，6.78(2H,m)，7.29(2H,d,J=8.2Hz)，and 8.23(2H,d,J=8.2Hz)．

窒素導入管を備えた100mlナスフラスコ中、室温下4－（トランス－4－プロピルシクロヘキシル）フェニルカルボチオ酸－Ｏ－3，4，5－トリフルオロフェニル4.7g(12.1mmol)をジクロロメタン50mlに溶解し、ＤＡＳＴ5.9g(36.2mmol)を添加して室温にて34時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50mlx2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して無色結晶物4.3gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物（転移点Cr 70.5-71.4 Iso）を1.5g得た。これがジフルオロ－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタンであ

る。

^{1}H－NMR（$CDCl_3$；δppm）0.80-2.10(16H,m), 2.60(1H,m), 6.96(2H,m) 7.32(2H,d,J=8.6Hz) and 7.62(2H,d,J=8.6Hz).

^{19}F－NMR（$CDCl_3$；δppm）-66.754(2F,s,-CF_2O-), -133.521(2F,d), -164.754(1F,t).

ＧＣ－ＭＳ（ＣＩ）m/z251(100%), 379(M^++1-HF,34), and 125(27).

上記製造方法に準じて４－（トランス－４－プロピルシクロヘキシル）安息香酸の代わりにアルキル鎖の異なる４－（トランス－４－アルキルシクロヘキシル）安息香酸を用いて以下の化合物が製造できる。

ジフルオロ－〔４－（トランス－４－メチルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－（トランス－４－エチルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－（トランス－４－ブチルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－（トランス－４－ペンチルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

Cr 62.6-63.0 Iso

ジフルオロ－〔４－（トランス－４－ヘキシルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－（トランス－４－ヘプチルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－（トランス－４－オクチルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－（トランス－４－ノニルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－（トランス－４－デシルシクロヘキシル）フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

また上記製造方法に準じて３，４，５－トリフルオロフェノールの代わりに種

々の既知のフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，4－ジフルオロフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，4－ジフルオロフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，4－ジフルオロフェニルオキシ）メタン

Cr 42.9-43.4 N 66.2-67.5 Iso

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（4－トリフルオロメチルフェニルオキシ）メタン

Cr 79.6-79.9 Iso

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（4－トリフルオロメトキシフェニルオキシ）メタン

Cr 57.3-58.2 S_B 70.9-72.0 N 83.1-83.5 Iso

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（4－トリフルオロメトキシフェニルオキシ）メタン

Cr 68.1-68.3 S_B 80.5-80.8 N 90.2-90.4 Iso

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（4－シアノフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（4－シアノフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（4－シアノフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（4－シアノフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3－フルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3－フルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3－フルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3－フルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

Cr 35.9-36.3 N 61.1-61.3 Iso

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3－フルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3－フルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3－フルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3－フルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3－フルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3－フルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3－フルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3－フルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3－フルオロ－4－シアノフェニルオキシ）メタン

Cr 65.4-66.3 N 104.9-105.4 Iso

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメチルフェニルオキシ）メタン

Cr 56.9-57.5 Iso

ジフルオロ－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

実施例3

ジフルオロ－〔2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（4－トリフルオロメトキシフェニルオキシ）メタン

〔（I）式においてR＝C_3H_7、l＝1、m＝n＝0であり、環A_1がトランス－1，4－シクロヘキシレン基、Z_1、Z_2およびZ_3は共有結合、L_1＝F、L_2＝L_3＝L_4＝H、X＝OCF_3のもの〕の製造

撹拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、削り状マグネシウム1.8g(75.8mmol)およびジエチルエーテル50mlを添加し、撹拌しながら2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）ヨードベンゼン25g(72.2mmol)のジエチルエーテル溶液50mlをジエチルエーテル還流下で40分を要して滴下した。反応溶液は、さらに温浴上1時間加熱還流し熟成した。次に、反応溶液を氷冷下10℃以下まで冷却後、二硫化炭素7.5g(987mmol)を10℃以下を保ちながら滴下後、室温まで昇温し、さらに室温で3時間撹拌した。反応溶液を再び氷冷下10℃以下まで冷却し、2規定塩酸水溶液50mlを滴下し反応を終了した。反応溶液は、ジエチルエーテル層を分離後、水層をさらにジエチルエーテル200mlで抽出した。有機層を混合し、水200mlで回洗浄後、無水硫酸マグネシウムで乾燥、濃縮して濃赤紫色固体のジチオカルボン酸誘導体19.7gを得た。

冷却管を備えた300mlナス型フラスコ中上記操作で得たジチオカルボン酸誘導体19.7gをジエチルエーテル150mlに溶解し、室温下撹拌しながらチオニルクロド25.8g(217.0mmol)を15分を要して滴下した。滴下後、温浴上で加熱還流を8時間行った。反応溶液は、ジエチルエーテルを加熱留去後、アスピレーター減圧下濃縮し、チオ酸クロリド誘導体18.4gを得た。次に撹拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、4－トリフルオロメトキシフェノール6.4g(36.1mmol)およびピリジン5.7g(72.2mmol)をトルエン50mlに溶解し、室温下撹拌しながら上記操作で得たチオ酸クロリド誘導体18.4gのトルエン溶液60mlを20分を要して滴下し、さらに温浴上内温を60℃まで加熱し3時間撹拌した。室温まで冷却後、反応溶液に水300mlおよび2規定塩酸水溶液30mlを滴下し反応を終了させた後、トルエン層を分離後、水層をさらにトルエン200mlで抽出した。抽出層は水(200ml×2)、2規定水酸化ナトリウム水溶液00mlおよび水(200ml×3)で順次洗浄後無水硫酸マグネシウムで乾燥し、減圧下濃縮して赤茶褐色結晶状の反応物14.9gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてヘプタン／トルエンの混合溶媒を用いたカラムクロマト処理にて精製し、さらにヘプタンから再結晶して黄色針状結晶物6.7gを得た。これが2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニルカルボチオ

酸－Ｏ－４－トリフルオロメトキシフェニルである。

窒素導入管を備えた100mlナス型フラスコ中、室温下２－フルオロ－４－（トランス－４－プロピルシクロヘキシル）フェニルカルボチオ酸－Ｏ－４－トリフルオロメトキシフェニル6.7g(15.2mmol)をジクロロメタン50mlに溶解し、DAST4.9g(30.4mmol)を添加して室温にて28時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50ml×2)、飽和炭酸水素ナトリウム水溶液40mlおよび水(50ml×2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して無色結晶状の反応物3.2gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製し、さらにヘプタンから再結晶して無色針状結晶物1.9gを得た。これがジフルオロ－〔２－フルオロ－４－（トランス－４－プロピルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタンである。

上記製造方法に準じて２－フルオロ－４－（トランス－４－プロピルシクロヘキシル）ヨードベンゼンの代わりにアルキル鎖の異なる２－フルオロ－４－（トランス－４－アルキルシクロヘキシル）ヨードベンゼンを用いて以下の化合物を製造できる。

ジフルオロ－〔２－フルオロ－４－（トランス－４－メチルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－エチルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ブチルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ペンチルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ヘキシルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ヘプチルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－オクチルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ノニルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－デシルシクロヘキシル）フェニル〕－（４－トリフルオロメトキシフェニルオキシ）メタン

また、上記製造方法に準じて４－トリフルオロメトキシフェノールの代わりに種々の既知のフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロ－〔２－フルオロ－４－（トランス－４－エチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－プロピルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ブチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ペンチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－エチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－プロピルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ブチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔2－フルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔２－フルオロ－４－（トランス－４－ペンチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－エチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－プロピルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－ブチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－ペンチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－エチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－プロピルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－ブチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－ペンチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔２，６－ジフルオロ－４－（トランス－４－エチルシクロヘキシル）フェニル〕－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－〔2，6－ジフルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

実施例 4

ジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチ

ル〕フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン（（Ｉ）式においてＲ＝C_3H_7、ｌ＝１、ｍ、ｎ＝０であり、環Ａ１がトランス－１，４－シクロヘキシレン基、Z_1が$-CH_2CH_2-$、Z_2およびZ_3は共有結合、L_1＝L_2＝Ｈ、L_3＝L_4＝Ｆ、Ｘ＝Ｆのもの）の製造

攪拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕安息香酸15.0g(54.7mmol)、ＤＣＣ13.5g(65.6mmol)およびＤＭＡＰ0.25g(1.9mmol)をジクロロメタン250mlに溶解し、室温下攪拌しながら３，４，５－トリフルオロフェノール9.7g(65.6mmol)を３分で滴下し、滴下後15時間室温下で攪拌した。反応溶液に水100mlを添加した後、ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン200mlで抽出し、抽出層を混合後、水(100mlx2)、飽和炭酸水素ナトリウム水溶液100mlおよび水(100mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を22.5g 得た。反応物はシリカゲルを充填剤にし展開溶媒としてトルエンを用いたカラムクロマト処理にて精製し、さらにヘプタン－エタノール混合溶媒から再結晶して無色結晶物12.9gを得た。これが３，４，５－トリフルオロ－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得た３，４，５－トリフルオロ－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝ベンゾアート12.9g(31.9mmol)、ローソン試薬25.8g(63.9mmol）をトルエン500mlに溶解し、窒素気流下攪拌しながら加熱還流を65時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン150mlで抽出した。有機層を混合し、水(200mlx2)、飽和炭酸水素ナトリウム水溶液(100ml)、10%亜硫酸水素ナトリウム水溶液100mlおよび水200mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物13.3gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して黄色針状結晶物4.5gを得た。これが４－〔２－（トランス－４－プロピルシクロヘ

キシル）エチル〕フェニルカルボチオ酸－O－3，4，5－トリフルオロフェニルである。

Cr 95.5-97.6 Iso

^{1}H－NMR（$CDCl_3$；δppm）0.7-1.9(19H,m)，2.70(2H,m)，6.80(2H,m)，7.25(2H,d,J=8.3Hz)，and 8.21(2H,d,J=8.3Hz)．

窒素導入管を備えた100mlナスフラスコ中、室温下4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニルカルボチオ酸－O－3，4，5－トリフルオロフェニル4.5g(10.8mmol)をジクロロメタン50mlに溶解し、ＤＡＳＴ5.3g(32.6mmol)を添加して室温にて40時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50mlx2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して無色結晶物3.9gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物を1.5g得た。これがジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタンである。

Cr 36.8-37.5(NI 23.5-23.7) Iso

^{1}H－NMR（$CDCl_3$；δppm）0.7-2.0(19H,m)，2.68(2H,m)，6.93(2H,m)，7.27(2H,d,J=8.4Hz)，and 7.58(2H,d,J=8.4Hz)．

上記製造方法に準じて4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕安息香酸の代わりにアルキル鎖の異なる4－〔2－（トランス－4－アルキルシクロヘキシル）エチル〕安息香酸を用いて以下の化合物を製造できる。

ジフルオロ－｛4－〔2－（トランス－4－メチルシクロヘキシル）エチル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチ

ル〕フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－ヘキシルシクロヘキシル）エチル〕フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－ヘプチルシクロヘキシル）エチル〕フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－オクチルシクロヘキシル）エチル〕フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－ノニルシクロヘキシル）エチル〕フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－デシルシクロヘキシル）エチル〕フェニル〕－（３，４，５－トリフルオロフェニルオキシ）メタン

また上記製造方法に準じて３，４，５－トリフルオロフェノールの代わりに種々の既知のフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロ－〔４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル〕－（４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル〕－（４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル〕－（４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル〕－（４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル〕－（４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル〕－（４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル〕－（４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－〔４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル〕－（４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（4－トリフルオロメトキシフェニルオキシ）メタン

Cr 60.2-60.9 N 72.6-73.2 Iso

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

Cr 30.8-31.3 N 76.9-77.7 Iso

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕

フェニル｝－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル｝－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝－（３，４，５－トリフルオロフェニルオキシ）メタ

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ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－トリフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－〔2－（トランス－4－エチルシク

ロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル｝－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル｝－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛２，６－ジフルオロ－４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，４，５－トリフルオロフェニルオキシ）メタン

ジフルオロ｛2，6－ジフルオロ－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ｛2，6－ジフルオロ－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ｛2，6－ジフルオロ－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ｛2，6－ジフルオロ－4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ｛2，6－ジフルオロ－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ｛2，6－ジフルオロ－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

実施例5

ジフルオロ｛4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン〔（I）式においてRが3－ブテニル基、l＝1、m、n＝0であり、環A1がトランス－1，4－シクロヘキシレン基、Z_1、Z_2およびZ_3は共有結合、L_1＝L_2＝H、L_3＝L_4＝F、X＝Fのもの〕の製造

製造工程はベンゾニトリル誘導体の加水分解、エステル体の中間の製造、チオンエステル化、およびgem-フッ素化の4工程である。以下、各工程について詳述する。

撹拌機および温度計を備えた1000ml三口フラスコ中4－〔トランス－4－（3－ブテニル）シクロヘキシル〕ベンゾニトリル20.0g(83.6mmol)および水酸化カ

リウム11.7g(208.9mmol)をエチレングリコール500mlに溶解し、内温を150℃にちながら10時間加熱攪拌した。室温まで冷却後、水300mlおよび6規定塩酸水溶液300mlを添加し、析出した不溶物をろ取分別した。ろ取物は水で十分洗浄後、トルエン－ヘプタン混合溶媒から再結晶し、無色結晶物を16.5g得た。これが4－〔トランス－4－（3－ブテニル）シクロヘキシル〕安息香酸である。次にこの安息香酸誘導体をフェノール誘導体と反応させてエステル化した。すなわち、攪拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、上記操作で得た4－〔トランス－4－（3－ブテニル）シクロヘキシル〕安息香酸16.5g(63.8mmol)、ＤＣＣ15.8g(76.6mmol)およびＤＭＡＰ0.28g(2.3mmol)をジクロロメタン250mlに溶解し、室温下攪拌しながら3，4，5－トリフルオロフェノール11.3g(76.6mmol)を3分で滴下し、滴下後13時間室温下で攪拌した。反応溶液に水100mlを添加した後、ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン200mlで抽出し、抽出層を混合後、水(100mlx2)、飽和炭酸水素ナトリウム水溶液100mlおよび水(100mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を25.1g 得た。反応物はシリカゲルを充填剤にし、展開溶媒としてトルエンを用いたカラムクロマト処理にて精製し、さらにヘプタン－エタノール混合溶媒から再結晶して無色結晶物16.6gを得た。これが3，4，5－トリフルオロ－｛4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニル｝ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得た3，4，5－トリフルオロ－｛4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニル｝ベンゾアート16.6g(42.8mmol)、ローソン試薬34.6g(85.6mmol)をトルエン500mlに溶解し、窒素気流下攪拌しながら加熱還流を55時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン150mlで抽出した。有機層を混合し、水(200mlx2)、飽和炭酸水素ナトリウム水溶液(100ml)、10%亜硫酸水素ナトリウム水溶液100mlおよび水(200mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状物17.6gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてヘプタン

を用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して黄色針状結晶物4.5gを得た。これが4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニルカルボチオ酸－O－3，4，5－トリフルオロフェニルである。

窒素導入管を備えた100mlナスフラスコ中、室温下4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニルカルボチオ酸－O－3，4，5－トリフルオロフェニル4.5g(11.3mmol)をジクロロメタン50mlに溶解し、ＤＡＳＴ5.5g(33.8mmol)を添加して室温にて40時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50mlx2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して無色結晶物3.8gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、エタノールから再結晶して無色針状結晶物を1.1g得た。これがジフルオロ－｛4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタンである。

上記製造方法に準じて4－〔トランス－4－（3－ブテニル）シクロヘキシル〕安息香酸の代わりに鎖長および二重結合位置の異なる4－（トランス－4－アルケニルシクロヘキシル）安息香酸を用いて以下の化合物が製造できる。

ジフルオロ－｛4－［トランス－4－〔（Z）－1－ブテニル〕シクロヘキシル］フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－2－ブテニル〕シクロヘキシル］フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－1－ペンテニル〕シクロヘキシル］フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－2－ペンテニル〕シクロヘキシル］フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－3－ペンテニル〕シクロヘキシル］フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

ジフルオロ－｛4－〔トランス－4－（4－ペンテニル）シクロヘキシル〕フェニル｝－（3，4，5－トリフルオロフェニルオキシ）メタン

また上記製造方法に準じて3，4，5－トリフルオロフェノールの代わりに種々の既知のフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロ－｛4－［トランス－4－〔（Z）－1－ブテニル〕シクロヘキシル］フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－2－ブテニル〕シクロヘキシル］フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－1－ペンテニル〕シクロヘキシル］フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－2－ペンテニル〕シクロヘキシル］フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－3－ペンテニル〕シクロヘキシル］フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔トランス－4－（4－ペンテニル）シクロヘキシル〕フェニル｝－（4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－1－ブテニル〕シクロヘキシル］フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－2－ブテニル〕シクロヘキシル］フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－1－ペンテニル〕シクロヘキシル］フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－2－ペンテニル〕シクロヘキシル］フェニル｝－（3－フルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛4－［トランス－4－〔（Z）－3－ペンテニル〕シクロヘキ

シル」フェニル} －（３－フルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛４－〔トランス－４－（４－ペンテニル）シクロヘキシル〕フェニル} －（３－フルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛４－［トランス－４－〔（Ｚ）－１－ブテニル〕シクロヘキシル］フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛４－［トランス－４－〔（Ｚ）－２－ブテニル〕シクロヘキシル］フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛４－〔トランス－４－（３－ブテニル）シクロヘキシル〕フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛４－［トランス－４－〔（Ｚ）－１－ペンテニル〕シクロヘキシル］フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛４－［トランス－４－〔（Ｚ）－２－ペンテニル〕シクロヘキシル］フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛４－［トランス－４－〔（Ｚ）－３－ペンテニル〕シクロヘキシル］フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛４－〔トランス－４－（４－ペンテニル）シクロヘキシル〕フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－［トランス－４－〔（Ｚ）－１－ブテニル〕シクロヘキシル］フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－［トランス－４－〔（Ｚ）－２－ブテニル〕シクロヘキシル］フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－〔トランス－４－（３－ブテニル）シクロヘキシル〕フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛２－フルオロ－４－［トランス－４－〔（Ｚ）－１－ペンテニル〕シクロヘキシル］フェニル} －（３，５－ジフルオロ－４－シアノフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－［トランス－4－〔（Z）－2－ペンテニル〕シクロヘキシル］フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－［トランス－4－〔（Z）－3－ペンテニル〕シクロヘキシル］フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2－フルオロ－4－〔トランス－4－（4－ペンテニル）シクロヘキシル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－［トランス－4－〔（Z）－1－ブテニル〕シクロヘキシル］フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－［トランス－4－〔（Z）－2－ブテニル〕シクロヘキシル］フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－〔トランス－4－（3－ブテニル）シクロヘキシル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－［トランス－4－〔（Z）－1－ペンテニル〕シクロヘキシル］フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－［トランス－4－〔（Z）－2－ペンテニル〕シクロヘキシル］フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－［トランス－4－〔（Z）－3－ペンテニル〕シクロヘキシル］フェニル｝－（3，5－ジフルオロ－4－シアノフェニルオキシ）メタン

ジフルオロ－｛2，6－ジフルオロ－4－〔トランス－4－（4－ペンテニル）シクロヘキシル〕フェニル｝－（3，5－ジフルオロ－4－シアノフェニル

オキシ）メタン

実施例6

ジフルオロー（4－プロピルフェニル）－〔4－（3'，4'，5'－トリフルオロビフェニル）オキシ〕メタン〔（I）式においてR＝C_3H_7、l＝m＝0、n＝1であり、環A3が1，4－フェニレン基、Z_1、Z_2およびZ_3は共有結合、L_1＝L_2＝H、L_3＝L_4＝F、X＝Fのもの〕の製造

1）4－（3，4，5－トリフルオロフェニル）フェノールの製造

本化合物の製造原料である4－（3，4，5－トリフルオロフェニル）フェノールは以下の操作にて製造した。すなわち撹拌機、温度計、窒素導入管、滴下ロートおよび冷却管を備えた1000ml三口フラスコに削り状マグネシウム7.9g(324.2mmol)を添加し、3，4，5－トリフルオロブロモベンゼン65.2g(308.8mmol)をテトラヒドロフラン（以下ＴＨＦと略す）80mlに溶解した溶液を内温が50℃を保つように50分を要して滴下した。滴下終了後1時間温浴上にて同温度を保つように撹拌、熟成を行いグリニャール試薬を調製した。次に別に用意した撹拌機、温度計、窒素導入管、滴下ロートおよび冷却管を備えた1000ml三口フラスコに窒素雰囲気下ヨードベンゼン35.0g(171.6mmol)、塩化パラジウム1.64g(9.3mmol)およびＴＨＦ300mlを添加し、加熱還流させながら前記操作で調製したグリニャール試薬を50分を要して滴下した。滴下後さらに3時間加熱還流を行った後、室温まで冷却し水200mlを添加して反応を終了した。反応溶液は不溶物をろ取分別後、トルエン(300mlx2)で抽出した。抽出層は水(300mlx3)で洗浄後、無水硫酸マグシウムで乾燥、減圧下濃縮して黒褐色固形物38.4gを得た。濃縮残査はシリカゲルを充填剤、展開溶媒としてヘプタンを用いたクロマト処理操作にて精製後、ヘプタンーエタノール混合溶媒から再結晶して無色結晶物を19.0g得た。これが3，4，5－トリフルオロビフェニルである。次に得られたビフェニル誘導体はブロム化を行った。すなわち撹拌機、温度計、窒素導入管、滴下ロートを備えた100ml三口フラスコ中上記操作で得た3，4，5－トリフルオロビフェニル19.0g(91.5mmol）をジクロロメタン200mlに溶解し、撹拌しながらー5℃まで冷却後、鉄粉0.26g(4.6mmol)添加しを、さらに臭素8.8g(109.8mmol)をー5～0℃を保つように15分を要して滴下した。滴下終了後さらに同温度を保ちながら1時間撹拌し

た。反応溶液に水200mlを添加し反応を終了後、トルエン(250mlx2)にて抽出、抽出層は水(200mlx4)で洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して茶褐色油状物25.1gを得た。濃縮残査はシリカゲルを充填剤、展開溶媒としてヘプタンを用いたクロマト処理操作にて精製後、ヘプタンーエタノール混合溶媒から再結晶して無色結晶物を16.6g得た。これが4ーブロモー3', 4', 5'ートリフルオロビフェニルである。

上記操作で得たブロモビフェニル誘導体はR.L.Kidwellらの報告（Org.Synth., V,918(1973)）を参考に以下の操作でフェニルフェノール誘導体へと誘導した。すなわち攪拌機、温度計、窒素導入管、滴下ロートを備えた300ml三口フラスコ中削り状マグネシウム1.5g(60.9mmol)を添加し、4ーブロモー3', 4', 5'ートリフルオロビフェニル16.6g(58.0mmol)をＴＨＦ30mlに溶解した溶液を内温が50℃を保つように25分を要して滴下した。滴下終了後1時間温浴上にて同温度を保つように攪拌、熟成を行いグリニャール試薬を調製した。次に反応溶液をドライアイスーアセトン冷媒下-20℃まで冷却後、ほう酸トリメチル7.2gを滴下し、30分間同温度にて攪拌した。同温度にて酢酸3.5g(58.0mmol)を添加し、20℃まで昇温後、30%過酸化水素水7.9g(69.6mmol)を25℃を保つように10分を要して滴下した。反応溶液は冷媒にて再度-30℃まで冷却後、20%-チオ硫酸ナトリウム水溶液50mlを10分を要して滴下し反応を終了した。反応溶液は酢酸エチル(150mlx3)で抽出し、飽和食塩水(200mlx2)で洗浄、無水硫酸マグネシウムで乾燥後、減下濃縮して褐色固形状物14.5gを得た。濃縮残査はヘプタンートルエン混合溶媒から再結晶し無色結晶物10.9gを得た。これが4－（3，4，5－トリフルオロフェニル）フェノールである。

2）ジフルオロー（4－プロピルフェニル）－〔4－（3', 4', 5'－トリフルオロビフェニル）オキシ〕メタンの製造

攪拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、4－プロピル安息香酸6.7g(40.7mmol)、ＤＣＣ10.1g(48.8mmol)およびＤＭＡＰ0.18g(1.5mmol)をジクロロメタン150mlに溶解し、室温下攪拌しながら4－（3，4，5－トリフルオロフェニル）フェノール10.9g(48.8mmol)をジクロロメタン50mlに溶解した溶液を20分で滴下し、滴下後17時間室温下で攪

拌した。反応溶液に水100mlを添加した後、ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン200mlで抽出し、抽出層を混合後、水(100mlx2)、飽和炭酸水素ナトリウム水溶液100mlおよび水(100mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を15.3g 得た。反応物はシリカゲルを充填剤にし展開溶媒としてトルエンを用いたカラムクロマト処理にて精製し、さらにヘプタンーエタノール混合溶媒から再結晶して無色結晶物10.5gを得た。これが4－（3’，4’，5’－トリフルオロ）ビフェニル－（4－プロピル）ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナススラスコ中上記操作で得た4－（3’，4’，5’－トリフルオロ）ビフェニル－（4－プロピル）ベンゾアート10.5g(28.5mmol)、ローソン試薬23.0g(56.9mmol)をトルエン350mlに溶解し、窒素気流下攪拌しながら加熱還流を60時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン150mlで抽出した。有機層を混合し、水(200mlx2)、飽和炭酸水素ナトリウム水溶液(100ml)、10% 亜硫酸水素ナトリウム水溶液100mlおよび水(200mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物10.9gを得た。濃縮物はシリカゲルを充填剤にし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して黄色針状結晶物6.3gを得た。これが4－プロピルフェニルカルボチオ酸－O－4－（3’，4’，5’－トリフルオロ）ビフェニルである。

窒素導入管を備えた100mlナスフラスコ中、室温下4－プロピルフェニルカルボチオ酸－O－4－（3’，4’，5’－トリフルオロ）ビフェニル6.3g(16.3mmol)をジクロロメタン50mlに溶解し、ＤＡＳＴ7.9g(48.9mmol)を添加し、室温にて30時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50mlx2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して無色結晶物5.9gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物を得た。これがジフルオロー（4－プロピル

フェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタンである。

上記製造方法に準じて4－プロピル安息香酸の代わりにアルキル鎖の異なる4－アルキル安息香酸を用いて以下の化合物が製造できる。

ジフルオロー（4－メチルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（4－エチルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（4－ブチルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（4－ペンチルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（4－ヘキシルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（4－ヘプチルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（4－オクチルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（4－ノニルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（4－デシルフェニル）－〔4－（3’，4’，5’－トリフルオロビフェニル）オキシ〕メタン

また上記製造方法に準じて4－（3，4，5－トリフルオロフェニル）フェノールの代わりに種々のフェニルフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロー（4－エチルフェニル）－〔4－（4’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（4－プロピルフェニル）－〔4－（4’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－ブチルフェニル）－〔４－（４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－ペンチルフェニル）－〔４－（４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－エチルフェニル）－〔４－（４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（４－プロピルフェニル）－〔４－（４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（４－ブチルフェニル）－〔４－（４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（４－ペンチルフェニル）－〔４－（４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（４－エチルフェニル）－〔４－（４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－プロピルフェニル）－〔４－（４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－ブチルフェニル）－〔４－（４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－ペンチルフェニル）－〔４－（４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－エチルフェニル）－〔４－（４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（４－プロピルフェニル）－〔４－（４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（４－ブチルフェニル）－〔４－（４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（４－ペンチルフェニル）－〔４－（４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（４－エチルフェニル）－〔４－（３’－フルオロ－４’－トリ

フルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－プロピルフェニル）－〔４－（３’－フルオロ－４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－ブチルフェニル）－〔４－（３’－フルオロ－４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－ペンチルフェニル）－〔４－（３’－フルオロ－４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－エチルフェニル）－〔４－（３’－フルオロ－４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－プロピルフェニル）－〔４－（３’－フルオロ－４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－ブチルフェニル）－〔４－（３’－フルオロ－４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－ペンチルフェニル）－〔４－（３’－フルオロ－４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（４－エチルフェニル）－〔４－（３’－フルオロ－４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（４－プロピルフェニル）－〔４－（３’－フルオロ－４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（４－ブチルフェニル）－〔４－（３’－フルオロ－４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（４－ペンチルフェニル）－〔４－（３’－フルオロ－４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（４－エチルフェニル）－〔４－（３’－フルオロ－４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（４－プロピルフェニル）－〔４－（３’－フルオロ－４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（４－ブチルフェニル）－〔４－（３’－フルオロ－４’－シアノビフェニル）オキシ〕メタン

ジフルオロ－（４－ペンチルフェニル）－〔４－（３’－フルオロ－４’－シアノビフェニル）オキシ〕メタン

ジフルオロ－（４－エチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（４－プロピルフェニル）－〔４－（３’，５’－ジフルオロ－４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（４－ブチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（４－ペンチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（４－エチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（４－プロピルフェニル）－〔４－（３’，５’－ジフルオロ－４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（４－ブチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（４－ペンチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（４－エチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ－（４－プロピルフェニル）－〔４－（３’，５’－ジフルオロ－４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ－（４－ブチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ－（４－ペンチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ－（４－エチルフェニル）－〔４－（３’，５’－ジフルオロ－４’－シアノビフェニル）オキシ〕メタン

ジフルオロ－（４－プロピルフェニル）－〔４－（３’，５’－ジフルオロ－

4' －シアノビフェニル）オキシ〕メタン

ジフルオロ（4－ブチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －シアノビフェニル）オキシ〕メタン

ジフルオロ（4－ペンチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －シアノビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－エチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－プロピルフェニル）－〔4－（3', 5' －ジフルオロ－4' －トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－ブチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－ペンチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－エチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－プロピルフェニル）－〔4－（3', 5' －ジフルオロ－4' －ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－ブチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－ペンチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－エチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－プロピルフェニル）－〔4－（3', 5' －ジフルオロ－4' －トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－ブチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ（2－フルオロ－4－ペンチルフェニル）－〔4－（3', 5' －ジフルオロ－4' －トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロー（２－フルオロー４－エチルフェニル）－〔４－（３’，４’，５’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（２－フルオロー４－プロピルフェニル）－〔４－（３’，４’，５’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（２－フルオロー４－ブチルフェニル）－〔４－（３’，４’，５’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（２－フルオロー４－ペンチルフェニル）－〔４－（３’，４’，５’－トリフルオロビフェニル）オキシ〕メタン

ジフルオロー（２－フルオロー４－エチルフェニル）－〔４－（３’，５’－ジフルオロー４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（２－フルオロー４－プロピルフェニル）－〔４－（３’，５’－ジフルオロー４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（２－フルオロー４－ブチルフェニル）－〔４－（３’，５’－ジフルオロー４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（２－フルオロー４－ペンチルフェニル）－〔４－（３’，５’－ジフルオロー４’－シアノビフェニル）オキシ〕メタン

ジフルオロー（２，６－ジフルオロー４－エチルフェニル）－〔４－（３’，５’－ジフルオロー４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（２，６－ジフルオロー４－プロピルフェニル）－〔４－（３’，５’－ジフルオロー４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（２，６－ジフルオロー４－ブチルフェニル）－〔４－（３’，５’－ジフルオロー４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（２，６－ジフルオロー４－ペンチルフェニル）－〔４－（３’，５’－ジフルオロー４’－トリフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（２，６－ジフルオロー４－エチルフェニル）－〔４－（３’，５’－ジフルオロー４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（２，６－ジフルオロー４－プロピルフェニル）－〔４－（３’，５’－ジフルオロー４’－ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロー（２，６－ジフルオロー４－ブチルフェニル）－〔４－（３’，

5' －ジフルオロ－4' －ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－ペンチルフェニル）－〔4－（3'，5' －ジフルオロ－4' －ジフルオロメトキシビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－エチルフェニル）－〔4－（3'，5' －ジフルオロ－4' －トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－プロピルフェニル）－〔4－（3'，5' －ジフルオロ－4' －トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－ブチルフェニル）－〔4－（3'，5' －ジフルオロ－4' －トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－ペンチルフェニル）－〔4－（3'，5' －ジフルオロ－4' －トリフルオロメチルビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－エチルフェニル）－〔4－（3'，4'，5' －トリフルオロビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－プロピルフェニル）－〔4－（3'，4'，5' －トリフルオロビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－ブチルフェニル）－〔4－（3'，4'，5' －トリフルオロビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－ペンチルフェニル）－〔4－（3'，4'，5' －トリフルオロビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－エチルフェニル）－〔4－（3'，5' －ジフルオロ－4' －シアノビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－プロピルフェニル）－〔4－（3'，5' －ジフルオロ－4' －シアノビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－ブチルフェニル）－〔4－（3'，5' －ジフルオロ－4' －シアノビフェニル）オキシ〕メタン

ジフルオロ－（2，6－ジフルオロ－4－ペンチルフェニル）－〔4－（3'，5' －ジフルオロ－4' －シアノビフェニル）オキシ〕メタン

実施例7

ジフルオロ－（4－プロピルフェニル）－｛4－〔2－（3，4，5－トリフ

ルオロフェニル）エチル〕フェニルオキシ〕メタン〔（Ｉ）式においてＲ＝C_3H_7、１＝ｍ＝０、ｎ＝１であり、環Ａ3が１，４－フェニレン基、Z_1およびZ_2は共有結合、Z_3＝$-CH_2CH_2-$、L_1＝L_2＝Ｈ、L_3＝L_4＝Ｆ、Ｘ＝Ｆのもの〕の製造

１）４－〔２－（３，４，５－トリフルオロフェニル）エチル〕フェノールの製造

本化合物の製造原料である４－〔２－（４－トリフルオロメトキシフェニル）エチル〕フェノールは以下の操作にて製造した。すなわち撹拌機、温度計、窒素導入管、滴下ロートおよび冷却管を備えた300ml三口フラスコに削り状マグネシウム2.7g(108.9mmol)を添加し、３，４，５－トリフルオロブロモベンゼン21.8g(103.7mmol）をＴＨＦ30mlに溶解した溶液を内温が50℃を保つように25分を要して滴下した。滴下終了後１時間温浴上にて同温度を保つように撹拌、熟成を行いグリニャール試薬を調製した。次に別に用意した撹拌機、温度計、窒素導入管、滴下ロートおよび冷却管を備えた500ml三口フラスコに窒素雰囲気下フェニル酢酸塩化物13.4gg(86.4.mmol)をＴＨＦ200mlに溶解し、撹拌しながら０℃まで冷却後、鉄（III）アセチルアセトネート1.1g(3.1mmol)を添加、さらに上記操作で調製したグリニャール試薬を０℃を保ちながら40分を要して滴下した。滴下終了後さらに１時間同温度で撹拌した後、６Ｎ－塩酸水溶液100mlを添加して反応を終了した。反応溶液はトルエン(200mlx2)で抽出後、水(200mlx2)、飽和炭酸水素ナトリウム水溶液(100ml)および水(200mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して反応物23.4gを得た。濃縮物は減圧蒸留にて精製し無色油状物18.3gを得た。次に反応物は１Ｌオートクレーブ中トルエン150mlに溶解し5%-Pd/C1.0gを添加し、水素圧100Kg/cm^2、温度90-100℃で13時間水素還元を行った。反応溶液は触媒をろ取分離後、減圧下濃縮して反応物17.2gを得た。濃縮物はシリカゲルクロマト処理にて精製し、無色結晶物15.3gを得た。これが４－〔２－（３，４，５－トリフルオロフェニル）エチル〕ベンゼンである。４－〔２－（３，４，５－トリフルオロフェニル）エチル〕ベンゼンは前述の（実施例５）の１）に示した操作と同様に処理することで４－〔２－（３，４，５－トリフルオロフェニル）エチル〕フェノールを10.8g(43.1mmol)製造した。

2）ジフルオロー（4－プロピルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタンの製造

撹拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、4－プロピル安息香酸5.9g(35.9mmol)、ＤＣＣ8.5g(43.1mmol)およびＤＭＡＰ0.15g(1.2mmol)をジクロロメタン150mlに溶解し、室温下撹拌しながら4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェノール10.8g(43.1mmol)をジクロロメタン50mlに溶解した溶液を15分で滴下し、滴下後20時間室温下で撹拌した。反応溶液に水100mlを添加した後、ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン200mlで抽出し、抽出層を混合後、水(100mlx2)、飽和炭酸水素ナトリウム水溶液100mlおよび水(100mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を14.8g得た。反応物はシリカゲルを充填剤にし展開溶媒としてトルエンを用いたカラムクロマト処理にて精製し、さらにヘプタンーエタノール混合溶媒から再結晶して無色結晶物11.4gを得た。これが4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルー（4－プロピル）ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得た4－〔2－（3，4，5－トリフルオロシフェニル）エチル〕フェニルー（4－プロピル）ベンゾアート11.4g(28.7mmol)、ローソン試薬23.2g(57.4mmol)をトルン350mlに溶解し、窒素気流下撹拌しながら加熱還流を60時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン150mlで抽出した。有機層を混合し、水(200mlx2)、飽和炭酸水素ナトリウム水溶液(100ml)、10%亜硫酸水素ナトリウム水溶液100mlおよび水(200mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物11.4gを得た。濃縮物はシリカゲルを充填剤にし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して黄色針状結晶物5.5gを得た。これが4－プロピルフェニルカルボチオ酸－Ｏ－4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルである。

窒素導入管を備えた100mlナスフラスコ中、室温下4－プロピルフェニルカル

ボチオ酸－O－4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニル5.5g(13.3mmol)をジクロロメタン50mlに溶解し、ＤＡＳＴ6.4g(39.8mmol)を添加し、室温にて30時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50ml x2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50ml x2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して無色結晶物5.5gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物を1.1g得た。これがジフルオロ－（4－プロピルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタンである。

上記製造方法に準じて4－プロピル安息香酸の代わりにアルキル鎖の異なる4－アルキル安息香酸を用いて以下の化合物が製造できる。

ジフルオロ－（4－メチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（4－エチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（4－ブチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（4－ペンチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（4－ヘキシルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（4－ヘプチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（4－オクチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（4－ノニルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（4－デシルフェニル）－｛4－〔2－（3，4，5－トリフル

オロフェニル）エチル〕フェニルオキシ｝メタン

また上記製造方法に準じて4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェノールの代わりに1）の操作で製造できる種々のフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロー（4－エチルフェニル）－｛4－〔2－（4－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－プロピルフェニル）－｛4－〔2－（4－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－ブチルフェニル）－｛4－〔2－（4－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－ペンチルフェニル）－｛4－〔2－（4－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－エチルフェニル）－｛4－〔2－（4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－プロピルフェニル）－｛4－〔2－（4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－ブチルフェニル）－｛4－〔2－（4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－ペンチルフェニル）－｛4－〔2－（4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－エチルフェニル）－｛4－〔2－（4－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－プロピルフェニル）－｛4－〔2－（4－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－ブチルフェニル）－｛4－〔2－（4－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－ペンチルフェニル）－｛4－〔2－（4－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロー（4－エチルフェニル）－｛4－〔2－（4－シアノフェニル）

エチル〕フェニルオキシ｝メタン

ジフルオロ（４－プロピルフェニル）－｛４－〔２－（４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔２－（４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－ペンチルフェニル）－｛４－〔２－（４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－エチルフェニル）－｛４－〔２－（３－フルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－プロピルフェニル）－｛４－〔２－（３－フルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔２－（３－フルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－ペンチルフェニル）－｛４－〔２－（３－フルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－エチルフェニル）－｛４－〔２－（３－フルオロ－４－フルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－プロピルフェニル）－｛４－〔２－（３－フルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔２－（３－フルオロ－４－フルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－ペンチルフェニル）－｛４－〔２－（３－フルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－エチルフェニル）－｛４－〔２－（３－フルオロ－４－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－プロピルフェニル）－｛４－〔２－（３－フルオロ－４－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔２－（３－フルオロ－４－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔２－（３－フルオロ－４－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔２－（３－フルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔２－（３－フルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔２－（３－フルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔２－（３－フルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔２－（３，５－ジフルオロ

－４－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－エチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－プロピルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ブチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ペンチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－エチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－プロピルフェニル）－｛４－〔２－（３，

5－ジフルオロ－4－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－ブチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－ペンチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－エチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－プロピルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－ブチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－ペンチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－エチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－プロピルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－ブチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－ペンチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2－フルオロ－4－エチルフェニル）－｛4－〔2－（3，5

－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－プロピルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ブチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ペンチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－プロピルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ブチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ペンチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－トリフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－プロピルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ブチルフェニル）－｛４－〔２－（３，５－ジフルオロ－４－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ペンチルフェニル）－｛４－〔２－

（3，5－ジフルオロ－4－ジフルオロメトキシフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－エチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－プロピルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－ブチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－ペンチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－トリフルオロメチルフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－エチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－プロピルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－ブチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－ペンチルフェニル）－｛4－〔2－（3，4，5－トリフルオロフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－エチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－プロピルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－ブチルフェニル）－｛4－〔2－（3，5－ジフルオロ－4－シアノフェニル）エチル〕フェニルオキシ｝メタン

ジフルオロ－（2，6－ジフルオロ－4－ペンチルフェニル）－｛4－〔2－

（３，５－ジフルオロ－４－シアノフェニル）エチル〕フェニルオキシ｝メタン

実施例８

ジフルオロ－（４－プロピルフェニル）－｛４－〔ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン〔（Ｉ）式においてＲ＝C_3H_7、ｌ＝１、ｍ＝ｎ＝０であり、Ａ１が１，４－フェニレン基、Z_1＝-CF_2O-、Z_2およびZ_3は共有結合、L_1、L_2、L_3およびL_4は水素原子、Ｘ＝ＯＣＦ$_3$のもの〕の製造

１）４－〔ジフルオロ－（４－プロピルフェニル）メチルオキシ〕安息香酸の製造

製造原料である４－〔ジフルオロ－（４－プロピルフェニル）メチルオキシ〕安息香酸は以下の操作にて製造した。

前記（実施例１）の製造操作で得られるジフルオロ－（４－プロピルフェニル）－（４－シアノフェニルオキシ）メタンを製造原料として加水分解にて製造した。すなわち撹拌機、温度計および冷却管を備えた500ml三口フラスコ中ジフルオロ－（４－プロピルフェニル）－（４－シアノフェニルオキシ）メタン15.0g(52.2mmol)、水酸化カリウム7.3g(130.5mmol)をエチレングリコール200mlに溶解し、150℃で10時間加熱撹拌を行った。反応溶液は室温まで冷却後、水100mlおよび６規定塩酸水溶液50mlを添加し、析出した不溶物をろ取分別した。ろ取物は水で洗浄後減圧乾燥し、さらにトルエン－ヘプタン混合溶媒から再結晶して無色結晶物を14.3g得た。これが４－〔ジフルオロ－（４－プロピルフェニル）メチルオキシ〕安息香酸である。

２）ジフルオロ－（４－プロピルフェニル）－｛４－〔ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタンの製造

撹拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下　４－〔ジフルオロ－（４－プロピルフェニル）メチルオキシ〕安息香酸14.3g(　.5mmol)、ＤＣＣ11.5g(55.7mmol)およびＤＭＡＰ0.2g(1.7mmol)をジクロロメタン250mlに溶解し、室温下撹拌しながら（４－トリフルオロメトキシ）フェノール9.9g(55.7mmol)を5分で滴下し、滴下後20時間室温下で撹拌した。反応溶液に水100mlを添加した後、ジクロロメタン不溶物をろ取分別後、

ジクロロメタン層を分離、さらに水層をジクロロメタン200mlで抽出し、抽出層を混合後、水(100mlx2)、飽和炭酸水素ナトリウム水溶液100mlおよび水(100mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を25.4g得た。反応物はシリカゲルを充填剤にし展開溶媒としてトルエンを用いたカラムクロマト処理にて精製し、さらにヘプタン－エタノール混合溶媒から再結晶して無色結晶物21.8gを得た。これが4－トリフルオロメトキシフェニル－｛4－〔ジフルオロ－（4－プロピルフェニル）メチルオキシ）ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得た4－トリフルオロメトキシフェニル－｛4－〔ジフルオロ－（4－プロピルフェニル）メチルオキシ）ベンゾアート21.8g(46.8mmol)、ローソン試薬37.8g(93.6mmol）をトルエン350mlに溶解し、窒素気流下攪拌しながら加熱還流を60時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン150mlで抽出した。有機層を混合し、水(200mlx2)、飽和炭酸水素ナトリウム水溶液(100ml)、10%亜硫酸水素ナトリウム水溶液100mlおよび水(200mlx2）で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物21.9gを得た。濃縮物はシリカゲルを充填剤とし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して黄色針状結晶物8.9gを得た。これが4－〔ジフルオロ－（4－プロピルフェニル）メチルオキシ）フェニルカルボチオ酸－O－（4－トリフルオロメトキシ）フェニルである。

窒素導入管を備えた100mlナスフラスコ中、室温下4－〔ジフルオロ－（4－プロピルフェニル）メチルオキシ）フェニルカルボチオ酸－O－（4－トリフルオロメトキシ）フェニル8.9g(18.4mmol)をジクロロメタン50mlに溶解し、ＤＡＳＴ8.9g(55.3mmol)を添加し、室温にて30時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50mlx2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して無色結晶物8.5gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物を1.9g得

た。これがジフルオロ（４－プロピルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタンである。

上記製造方法に準じて４－（ジフルオロ（４－プロピルフェニル）メチルオキシ〕安息香酸の代わりにアルキル鎖の異なる４－（ジフルオロ（４－アルキルフェニル）メチルオキシ〕安息香酸を用いて以下の化合物が製造できる。

ジフルオロ（４－メチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－エチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ペンチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ヘキシルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ヘプチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－オクチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ノニルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－デシルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

また上記製造方法に準じて（４－トリフルオロメトキシ）フェノールの代わりに種々の既知のフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロ（４－エチルフェニル）－｛４－〔ジフルオロ（４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－プロピルフェニル）－｛４－〔ジフルオロ（４－ジフル

オロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔ジフルオロ（４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ペンチルフェニル）－｛４－〔ジフルオロ（４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－エチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－プロピルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ペンチルフェニル）－｛４－〔ジフルオロ（４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－エチルフェニル）－｛４－〔ジフルオロ（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－プロピルフェニル）－｛４－〔ジフルオロ（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔ジフルオロ（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ペンチルフェニル）－｛４－〔ジフルオロ（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－エチルフェニル）－｛４－〔ジフルオロ（４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－プロピルフェニル）－｛４－〔ジフルオロ（４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ブチルフェニル）－｛４－〔ジフルオロ（４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（４－ペンチルフェニル）－｛４－〔ジフルオロ（４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－エチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－プロピルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－ブチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－ペンチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－エチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－プロピルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－ブチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－ペンチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－エチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－プロピルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－ブチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－ペンチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－エチルフェニル）－｛４－〔ジフルオロー（３－フルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（４－プロピルフェニル）－｛４－〔ジフルオロー（３－フルオ

ロー４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔ジフルオロ－（３－フルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔ジフルオロ－（３－フルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（２－フルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－プロピルフェニル）－｛４－〔ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ブチルフェニル）－｛４－〔ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２－フルオロ－４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－プロピルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ブチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－ペンチルフェニル）－｛４－〔ジフルオロ－（３，５－ジフルオロ－４－トリフルオロメチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ－（２，６－ジフルオロ－４－エチルフェニル）－｛４－〔ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝

メタン

ジフルオロー（2，6－ジフルオロー4－プロピルフェニル）－｛4－〔ジフルオロー（3，4，5－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（2，6－ジフルオロー4－ブチルフェニル）－｛4－〔ジフルオロー（3，4，5－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（2，6－ジフルオロー4－ペンチルフェニル）－｛4－〔ジフルオロー（3，4，5－トリフルオロフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（2，6－ジフルオロー4－エチルフェニル）－｛4－〔ジフルオロー（3，5－ジフルオロー4－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（2，6－ジフルオロー4－プロピルフェニル）－｛4－〔ジフルオロー（3，5－ジフルオロー4－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（2，6－ジフルオロー4－ブチルフェニル）－｛4－〔ジフルオロー（3，5－ジフルオロー4－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（2，6－ジフルオロー4－ペンチルフェニル）－｛4－〔ジフルオロー（3，5－ジフルオロー4－シアノフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－エチルフェニル）－｛4－〔ジフルオロー（4－エチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－エチルフェニル）－｛4－〔ジフルオロー（4－プロピルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－エチルフェニル）－｛4－〔ジフルオロー（4－ブチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－エチルフェニル）－｛4－〔ジフルオロー

（４－ペンチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－エチルフェニル）－｛４－〔ジフルオロ－（４－ヘキシルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－プロピルフェニル）－｛４－〔ジフルオロ－（４－エチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－プロピルフェニル）－｛４－〔ジフルオロ－（４－プロピルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－プロピルフェニル）－｛４－〔ジフルオロ－（４－ブチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－プロピルフェニル）－｛４－〔ジフルオロ－（４－ペンチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－プロピルフェニル）－｛４－〔ジフルオロ－（４－ヘキシルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－ブチルフェニル）－｛４－〔ジフルオロ－（４－エチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－ブチルフェニル）－｛４－〔ジフルオロ－（４－プロピルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－ブチルフェニル）－｛４－〔ジフルオロ－（４－ブチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－ブチルフェニル）－｛４－〔ジフルオロ－（４－ペンチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－ブチルフェニル）－｛４－〔ジフルオロ－（４－ヘキシルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－ペンチルフェニル）－｛４－〔ジフルオロ－（４－エチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－ペンチルフェニル）－｛４－〔ジフルオロ－（４－プロピルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロ（ジフルオロ４－ペンチルフェニル）－｛４－〔ジフルオロ－（４－ブチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－ペンチルフェニル）－｛4－〔ジフルオロー（4－ペンチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－ペンチルフェニル）－｛4－〔ジフルオロー（4－ヘキシルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－ヘキシルフェニル）－｛4－〔ジフルオロー（4－エチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－ヘキシルフェニル）－｛4－〔ジフルオロー（4－プロピルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－ヘキシルフェニル）－｛4－〔ジフルオロー（4－ブチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－ヘキシルフェニル）－｛4－〔ジフルオロー（4－ペンチルフェニルオキシ）メチル〕フェニルオキシ｝メタン

ジフルオロー（ジフルオロー4－ヘキシルフェニル）－｛4－〔ジフルオロー（4－ヘキシルフェニルオキシ）メチル〕フェニルオキシ｝メタン

実施例9

ジフルオロー（4－プロピルフェニルオキシ）－｛4－〔ジフルオロー（4－ペンチルフェニルオキシ）メチル〕フェニル｝メタン〔（I）式においてR＝C_3H_7、l＝1、m＝n＝0であり、環A1が1，4－フェニレン基、Z_1＝-OCF_2－、Z_2およびZ_3は共有結合、L_1、L_2、L_3およびL_4は水素原子、X＝C_5H_{11}のもの〕の製造

撹拌機、滴下ロート、温度計および冷却管を備えた1000ml三口フラスコ中室温下、ジクロロメタン300mlに4－ホルミル安息香酸25.0g(166.5mmol)、ＤＣＣ41.2g(199.8mmol)およびＤＭＡＰ0.73g(5.9mmol)を溶解し、撹拌しながら4－プロピルフェノール27.2g(199.8mmol)をジクロロメタン100mlに溶解した溶液を40分を要して滴下した。滴下後、10時間撹拌を行った後、反応溶液に水200mlを添加した後、ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン300mlで抽出し、抽出層を混合後、水(300mlx2)、飽和炭酸水素ナトリウム水溶液200mlおよび水(300mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を42.1g得た。これが4－プロピル

フェニルー（４－ホルミル）ベンゾアートである。４－プロピルフェニルー（４－ホルミル）ベンゾアートはそのまま次の製造工程に使用した。撹拌機、滴下ロートおよび温度計を備えた1000ml三口フラスコ中上記操作で得た４－プロピルフェニルー（４－ホルミル）ベンゾアート42.1gをアセトン450mlに溶解し、冷媒にて０まで冷却後同温度を保つように８Ｍ溶液のジョーンズ（Jones）試薬（K. Bowden, I.M. Heilbron, E.R.H. Jones, et al., J. Chem. Soc., 1946, 39 ）58.8ml(470.7mmol）を30分を要して滴下した。滴下後４時間撹拌した後、水300mlを添加して反応を終了した。反応溶液はジエチルエーテル(250mlx2)で抽出し、抽出層をさらに水(250mlx3)で洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して褐色結晶物43.1gを得た。濃縮物はトルエンから再結晶を行い無色結晶物35.2gを得た。これが４－プロピルフェニルー（４－カルボキシ）ベンゾアートである。撹拌機、滴下ロート、温度計および冷却管を備えた1000ml三口フラスコ中室温下、ジクロロメタン500mlに４－プロピルフェニルー（４－カルボキシ）ベンゾアート35.2g(123.9mmol）、ＤＣＣ30.7g(148.7mmol)およびＤＭＡＰ0.55g(4.5mmol)を溶解し、撹拌しながら４－ペンチルフェノール24.4g(148.7mmol)をジクロロメタン100mlに溶解した溶液を30分を要して滴下した。滴下後、10時間撹拌を行った後、反応溶液に水200mlを添加し反応を終了した。反応溶液はジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン300mlで抽出し、抽出層を混合後、水(300mlx2)、飽和炭酸水素ナトリウム水溶液200mおよび水(300mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を50.2g得た。反応物はシリカゲルを充填剤とし、展開溶媒としてトルエンー酢酸エチル混合溶媒を用いたカラムクロマト処理にて精製し、さらにヘプタンーエタノール混合溶媒から再結晶して無色結晶物36.8gを得た。これがテレフタル酸ー（４－プロピルフェニル）ー（４－ペンチルフェニル）である。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得たテレフタル酸ー（４－プロピルフェニル）ー（４－ペンチルフェニル）36.8g(85.5mmol)、ローソン試薬138.3g(341.9mmol)をトルエン600mlに溶解し、窒素気流下撹拌しながら加熱還流を60時間行った。反応溶液を室温まで冷却後、水200ml

を添加、トルエン層を分離後、水層をさらにトルエン400mlで抽出した。有機層を混合し、水(300mlx2)、飽和炭酸水素ナトリウム水溶液(300ml)、10%亜硫酸水素ナトリウム水溶液300mlおよび水(300mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物38.7gを得た。濃縮物はシリカゲルを充填剤とし展開溶媒としてヘプタン－トルエン混合溶媒を用いたカラムクロマト処理にて精製後、ヘプタンから再結晶してジチオカルボン酸エステル誘導体の黄色針状結晶19.8gを得た。

窒素導入管を備えた200mlナスフラスコ中、室温下上記操作で得たジチオカルボン酸エステル誘導体19.8g(42.7mmol)をジクロロメタン100mlに溶解し、ＤＡＳＴ20.7g(128.3mmol)を添加し、室温にて30時間攪拌した。反応溶液に水100mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン150mlで抽出、抽出層を混合し、水(100mlx2)、飽和炭酸水素ナトリウム水溶液100mlおよび水(100mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して褐色結晶物18.9gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物を9.1g得た。これがジフルオロ－（４－プロピルフェニルオキシ）－｛４－〔ジフルオロ－（４－ペンチルフェニルオキシ）メチル〕フェニル｝メタンである。

上記製造方法に準じて４－プロピルフェノールまたは４－ペンチルフェノールの代わりにアルキル鎖の異なるフェノール誘導体を用いて以下の化合物が製造できる。

ジフルオロ－（４－メチルフェニルオキシ）－｛４－〔ジフルオロ－（４－メチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ－（４－メチルフェニルオキシ）－｛４－〔ジフルオロ－（４－エチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ－（４－メチルフェニルオキシ）－｛４－〔ジフルオロ－（４－プロピルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ－（４－メチルフェニルオキシ）－｛４－〔ジフルオロ－（４－ブチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－メチルフェニルオキシ）－｛４－〔ジフルオロー（４－ペンチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－メチルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘキシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－メチルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘプチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－メチルフェニルオキシ）－｛４－〔ジフルオロー（４－オクチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－メチルフェニルオキシ）－｛４－〔ジフルオロー（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－メチルフェニルオキシ）－｛４－〔ジフルオロー（４－デシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－エチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－プロピルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－ブチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－ペンチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘキシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘプチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－オクチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－エチルフェニルオキシ）－｛４－〔ジフルオロー（４－デ

シルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－プロピルフェニルオキシ）－｛４－〔ジフルオロ（４－プロピルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－プロピルフェニルオキシ）－｛４－〔ジフルオロ（４－ブチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－プロピルフェニルオキシ）－｛４－〔ジフルオロ（４－ヘキシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－プロピルフェニルオキシ）－｛４－〔ジフルオロ（４－ヘプチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－プロピルフェニルオキシ）－｛４－〔ジフルオロ（４－オクチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－プロピルフェニルオキシ）－｛４－〔ジフルオロ（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－プロピルフェニルオキシ）－｛４－〔ジフルオロ（４－デシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ブチルフェニルオキシ）－｛４－〔ジフルオロ（４－ブチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ブチルフェニルオキシ）－｛４－〔ジフルオロ（４－ペンチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ブチルフェニルオキシ）－｛４－〔ジフルオロ（４－ヘキシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ブチルフェニルオキシ）－｛４－〔ジフルオロ（４－ヘプチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ブチルフェニルオキシ）－｛４－〔ジフルオロ（４－オクチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ブチルフェニルオキシ）－｛４－〔ジフルオロ（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ブチルフェニルオキシ）－｛４－〔ジフルオロ（４－デシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ペンチルフェニルオキシ）－｛４－〔ジフルオロー（４－ペンチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ペンチルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘキシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ペンチルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘプチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ペンチルフェニルオキシ）－｛４－〔ジフルオロー（４－オクチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ペンチルフェニルオキシ）－｛４－〔ジフルオロー（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ペンチルフェニルオキシ）－｛４－〔ジフルオロー（４－デシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘキシルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘキシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘキシルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘプチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘキシルフェニルオキシ）－｛４－〔ジフルオロー（４－オクチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘキシルフェニルオキシ）－｛４－〔ジフルオロー（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘキシルフェニルオキシ）－｛４－〔ジフルオロー（４－デシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘプチルフェニルオキシ）－｛４－〔ジフルオロー（４－ヘプチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘプチルフェニルオキシ）－｛４－〔ジフルオロー（４－オクチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘプチルフェニルオキシ）－｛４－〔ジフルオロー（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロー（４－ヘプチルフェニルオキシ）－｛４－〔ジフルオロー（４－

デシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－オクチルフェニルオキシ）－｛４－〔ジフルオロ（４－オクチルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－オクチルフェニルオキシ）－｛４－〔ジフルオロ（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－オクチルフェニルオキシ）－｛４－〔ジフルオロ（４－デシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ノニルフェニルオキシ）－｛４－〔ジフルオロ（４－ノニルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－ノニルフェニルオキシ）－｛４－〔ジフルオロ（４－デシルフェニルオキシ）メチル〕フェニル｝メタン

ジフルオロ（４－デシルフェニルオキシ）－｛４－〔ジフルオロ（４－デシルフェニルオキシ）メチル〕フェニル｝メタン

実施例１０

ジフルオロ（３，４，５－トリフルオロフェニルオキシ）－｛４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン〔（Ｉ）式においてＲ＝C_3H_7、１＝ｍ＝１、ｎ＝０であり、環Ａ１、Ａ２がともにトランス－１，４－シクロヘキシレン基、Z_1、Z_2およびZ_3は共有結合、L_1＝L_2＝Ｈ、L_3＝L_4＝Ｆ、Ｘ＝Ｆのもの〕の製造

攪拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml三口フラスコ中窒素雰囲気下、４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕安息香酸15.0g(45.7mmol)、ＤＣＣ11.3g(54.8mmol)およびＤＭＡＰ0.2g(1.6mmol)をジクロロメタン250mlに溶解し、室温下攪拌しながら３，４，５－トリフルオロフェノール8.1g(54.8mmol)を３分で滴下し、滴下後10時間室温下で攪拌した。反応溶液に水100mlを添加した後、ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン200mlで抽出し、抽出層を混合後、水(100mlx2)、飽和炭酸水素ナトリウム水溶液100mlおよび水(100mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物を21.9gを得た。反応物はシリカゲルを充填剤にし展開溶媒とし

てトルエンを用いたカラムクロマト処理にて精製し、さらにヘプタン－エタノール混合溶媒から再結晶して無色結晶物16.5gを得た。これが3，4，5－トリフルオロフェニル－4－〔4－トランス－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得た3，4，5－トリフルオロフェニル－4－〔4－トランス－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕ベンゾアート16.5g(33.9mmol)、ローソン試薬27.5g(67.9mmol)をトルエン500mlに溶解し、窒素気流下攪拌しながら加熱還流を60時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン150mlで抽出した。有機層を混合し、水(200ml x2)、飽和炭酸水素ナトリウム水溶液(100ml)、10%亜硫酸水素ナトリウム水溶液100mlおよび水(200mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物15.4gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して黄色針状結晶物6.4gを得た。これが4－〔トランス－4－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕フェニルカルボチオ酸－O－3，4，5－トリフルオロフェニルである。

窒素導入管を備えた100mlナスフラスコ中、室温下4－〔トランス－4－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕フェニルカルボチオ酸－O－3，4，5－トリフルオロフェニル6.4g(13.5mmol)をジクロロメタン50mlに溶解し、ＤＡＳＴ6.5g(40.5mmol)を添加して室温にて40時間攪拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50mlx2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して褐色結晶物6.4gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物を1.3g得た。これがジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタンである。

上記製造方法に準じて4－〔トランス－4－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕安息香酸の代わりにアルキル鎖の異なる4－〔トランス－4－（トランス－4－アルキルシクロヘキシル）シクロヘキシル〕安息香酸を用いて以下の化合物が製造できる。

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ヘキシルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ヘプチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－オクチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ノニルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－〔トランス－4－（トランス－4－デシルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

前記実施例に製造例を詳述した化合物をはじめとする種々の既知の安息香酸誘

導体および種々の既知のフェノール誘導体を任意に選択し、上記製造方法に準じて4－〔トランス－4－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕安息香酸または3，4，5－トリフルオロフェノールの代わりに使用することにより以下の化合物が製造できる。

ジフルオロ－（4－トリフルオロメトキシフェニルオキシ）－｛4－〔トランス－4－（トランス－4－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（4－トリフルオロメトキシフェニルオキシ）－｛4－〔トランス－4－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（4－トリフルオロメトキシフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（4－トリフルオロメトキシフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（4－ジフルオロメトキシフェニルオキシ）－｛4－〔トランス－4－（トランス－4－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（4－ジフルオロメトキシフェニルオキシ）－｛4－〔トランス－4－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（4－ジフルオロメトキシフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（4－ジフルオロメトキシフェニルオキシ）－｛4－〔トランス－4－（トランス－4－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（4－トリフルオロメチルフェニルオキシ）－｛4－〔トランス

－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－ジフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３－フルオロ－４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シク

ロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４，５－トリフルオロフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４，５－トリフルオロフェニルオキシ）－｛２－フルオロ

－４－｛トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛２－フルオロ－４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－エチルシ

クロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメトキシフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－ジフルオロメトキシフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキシ）－｛２，６－ジフルオロ－４－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ（３，４－ジフルオロ－４－トリフルオロメチルフェニルオキ

シ）－｛2，6－ジフルオロ－4－〔トランス－4－（トランス－4－ブチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4－ジフルオロ－4－トリフルオロメチルフェニルオキシ）－｛2，6－ジフルオロ－4－〔トランス－4－（トランス－4－ペンチルシクロヘキシル）シクロヘキシル〕フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロ－（3，4，5－トリフルオロフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロ－（4－トリフルオロメトキシフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロ－（4－トリフルオロメトキシフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロ－（4－トリフルオロメトキシフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロ－（4－トリフルオロメトキシフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（4－ジフルオロメトキシフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（4－ジフルオロメトキシフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（4－ジフルオロメトキシフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（4－ジフルオロメトキシフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（4－トリフルオロメチルフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（4－トリフルオロメチルフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（4－トリフルオロメチルフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（4－トリフルオロメチルフェニルオキシ）－｛4－［トランス－4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕シクロヘキシル］フェニル｝メタン

ジフルオロー（3，4，5－トリフルオロフェニルオキシ）－｛4－［2－〔トランス－4－（トランス－4－エチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロー（3，4，5－トリフルオロフェニルオキシ）－｛4－［2－〔トランス－4－（トランス－4－プロピルシクロヘキシル）シクロヘキシル〕

エチル］フェニル｝メタン

ジフルオロ（３，４，５－トリフルオロフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（３，４，５－トリフルオロフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（４－トリフルオロメトキシフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（４－トリフルオロメトキシフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（４－トリフルオロメトキシフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（４－トリフルオロメトキシフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（４－ジフルオロメトキシフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（４－ジフルオロメトキシフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（４－ジフルオロメトキシフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ（４－ジフルオロメトキシフェニルオキシ）－｛４－［２－〔ト

ランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－エチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－ブチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４－［２－〔トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル〕エチル］フェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－〔４’－（トランス－４－エチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－〔４’－（トランス－４－プロピルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－〔４’－（トランス－４－ブチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－〔４’－（トランス－４－ペンチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）－〔４’－（トランス－４－エチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）－〔４’－（トランス－４－プロピルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）－〔４’－（トランス－４－ブチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）－〔４’－（トラ

ンス－４－ペンチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－ジフルオロメトキシフェニルオキシ）－〔４’－（トランス－４－エチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－ジフルオロメトキシフェニルオキシ）－〔４’－（トランス－４－プロピルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－ジフルオロメトキシフェニルオキシ）－〔４’－（トランス－４－ブチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－ジフルオロメトキシフェニルオキシ）－〔４’－（トランス－４－ペンチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－〔４’－（トランス－４－エチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－〔４’－（トランス－４－プロピルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－〔４’－（トラ..
ス－４－ブチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－〔４’－（ト..
ス－４－ペンチルシクロヘキシル）ビフェニル〕メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛４’－〔２－（トランス－４－エチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛４’－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛４’－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（３，４，５－トリフルオロフェニルオキシ）－｛４’－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）－｛４’－〔２－（トランス－４－エチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）－｛４’－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）－｛４’－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－トリフルオロメトキシフェニルオキシ）－｛４’－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－ジフルオロメトキシフェニルオキシ）－｛４’－〔２－（トランス－４－エチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－ジフルオロメトキシフェニルオキシ）－｛４’－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－ジフルオロメトキシフェニルオキシ）－｛４’－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－ジフルオロメトキシフェニルオキシ）－｛４’－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４’－〔２－（トランス－４－エチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４’－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４’－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕ビフェニル｝メタン

ジフルオロ－（４－トリフルオロメチルフェニルオキシ）－｛４’－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕ビフェニル｝メタン

実施例１１

ジフルオロ－（３’，４’，５’－トリフルオロビフェニルオキシ）－〔４－（トランス－４－プロピルシクロヘキシル）フェニル〕メタン〔（Ｉ）式においてＲ＝C_3H_7、１＝ｎ＝１、ｍ＝０であり、環Ａ１がトランス－１，４－シクロヘキシレン基、環Ａ３が１，４－フェニレン基であり、Z_1、Z_2およびZ_3は共有結合、L_1＝L_2＝Ｈ、L_3＝L_4＝Ｆ、Ｘ＝Ｆのもの〕の製造

撹拌機、温度計、滴下ロートおよび窒素導入管を備えた500ml 三口フラスコ中窒素雰囲気下、４－（トランス－４－プロピルシクロヘキシル）安息香酸15.0g（60.9mmol）、ＤＣＣ15.1g(73.1mmol）およびＤＭＡＰ0.27g(2.2mmol)をジクロ

ロメタン300mlに溶解し、室温下撹拌しながら実施例6に記述の操作に準じて製造した3', 4', 5'－トリフルオロビフェノール16.4g(73.1mmol)をジクロロメタン80mlに溶解した溶液を20分を要して滴下し、滴下後10時間室温下で撹拌した。反応溶液に水200mlを添加した後、ジクロロメタン不溶物をろ取分別後、ジクロロメタン層を分離、さらに水層をジクロロメタン200mlで抽出し、抽出層を混合後、水(200mlx2)、飽和炭酸水素ナトリウム水溶液100mlおよび水(200mlx2)で順次洗浄し、無水硫酸マグネシウムで乾燥後、減圧下濃縮して反応物26.9gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてトルエンを用いたカラムクロマト処理にて精製し、さらにヘプタン－エタノール混合溶媒から再結晶して無色結晶物22.8gを得た。これが（3', 4', 5'－トリフルオロビフェニル）－4－（トランス－4－シクロヘキシル）ベンゾアートである。

次に窒素導入管および冷却管を備えた1000mlナスフラスコ中上記操作で得た（3', 4', 5'－トリフルオロビフェニル）－4－（トランス－4－シクロヘキシル）ベンゾアート22.8g(50.5mmol)、ローソン試薬40.9g(101.1mmol)をトルエン500mlに溶解し、窒素気流下撹拌しながら加熱還流を60時間行った。反応溶液を室温まで冷却後、水200mlを添加、トルエン層を分離後、水層をさらにトルエン200mlで抽出した。有機層を混合し、水(200mlx2)、飽和炭酸水素ナトリウム水溶液(100ml)、10%亜硫酸水素ナトリウム水溶液100mlおよび水(200mlx2)で順次洗浄後、無水硫酸マグネシウムで乾燥、減圧下濃縮して、茶褐色結晶状混合物23.4gを得た。反応物はシリカゲルを充填剤にし展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して黄色針状結晶物8.3gを得た。これが4－（トランス－4－プロピルシクロヘキシル）フェニルカルボチオ酸－O－3', 4', 5'－トリフルオロビフェニルである。

窒素導入管を備えた100mlナスフラスコ中、室温下4－（トランス－4－プロピルシクロヘキシル）フェニルカルボチオ酸－O－3', 4', 5'－トリフルオロビフェニル8.3g(17.7mmol)をジクロロメタン80mlに溶解し、ＤＡＳＴ8.5g(53.0mmol)を添加して室温にて40時間撹拌した。反応溶液に水50mlを添加し、ジクロロメタン層を分離後、水層をさらにジクロロメタン50mlで抽出、抽出層を混合し、水(50mlx2)、飽和炭酸水素ナトリウム水溶液30mlおよび水(50mlx2)で順次洗

浄後、無水硫酸マグネシウムで乾燥し、減圧下濃縮して褐色結晶物8.1gを得た。反応物はシリカゲルを充填剤とし、展開溶媒としてヘプタンを用いたカラムクロマト処理にて精製後、ヘプタンから再結晶して無色針状結晶物を1.9g得た。これがジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタンである。

上記製造方法に準じて4－（トランス－4－プロピルシクロヘキシル）安息香酸の代わりにアルキル鎖の異なる4－（トランス－4－アルキルシクロヘキシル）安息香酸を用いて以下の化合物が製造できる。

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－メチルシクロヘキシル）フェニル〕メタン

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

Cr 73.8-74.4 N 163.4-164.0 Iso

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－ヘキシルシクロヘキシル）フェニル〕メタン

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－ヘプチルシクロヘキシル）フェニル〕メタン

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－オクチルシクロヘキシル）フェニル〕メタン

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－ノニルシクロヘキシル）フェニル〕メタン

ジフルオロー（3'，4'，5'－トリフルオロビフェニルオキシ）－〔4－（トランス－4－デシルシクロヘキシル）フェニル〕メタン

前記実施例に製造例を詳述した化合物をはじめとする種々の既知の安息香酸誘導体および種々の既知のフェノール誘導体を任意に選択し、上記製造方法に準じ

て4－（トランス－4－プロピルシクロヘキシル）安息香酸または3’，4’，5’－トリフルオロビフェノールの代わりに使用することにより以下の化合物が製造できる。

ジフルオロ－（4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’－フルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェ

ニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニ

ルオキシ）－〔2－フルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔2－フルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，4’，5’－トリフルオロビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメトキシビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－ブチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－ジフルオロメトキシビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－エチルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－プロピルシクロヘキシル）フェニル〕メタン

ジフルオロ－（3’，5’－ジフルオロ－4’－トリフルオロメチルビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－ブチルシクロヘキシ

ル）フェニル〕メタン

ジフルオロ（3'，5'－ジフルオロ－4'－トリフルオロメチルビフェニルオキシ）－〔2，6－ジフルオロ－4－（トランス－4－ペンチルシクロヘキシル）フェニル〕メタン

ジフルオロ（3'，4'，5'－トリフルオロビフェニルオキシ）－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（3'，4'，5'－トリフルオロビフェニルオキシ）－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（3'，4'，5'－トリフルオロビフェニルオキシ）－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（3'，4'，5'－トリフルオロビフェニルオキシ）－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－トリフルオロメトキシビフェニルオキシ）－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－トリフルオロメトキシビフェニルオキシ）－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－トリフルオロメトキシビフェニルオキシ）－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－トリフルオロメトキシビフェニルオキシ）－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－ジフルオロメトキシビフェニルオキシ）－｛4－〔2－（トランス－4－エチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－ジフルオロメトキシビフェニルオキシ）－｛4－〔2－（トランス－4－プロピルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－ジフルオロメトキシビフェニルオキシ）－｛4－〔2－（トランス－4－ブチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－ジフルオロメトキシビフェニルオキシ）－｛4－〔2－（トランス－4－ペンチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（4'－トリフルオロメチルビフェニルオキシ）－｛4－〔2－

（トランス－４－エチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（４’－トリフルオロメチルビフェニルオキシ）－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（４’－トリフルオロメチルビフェニルオキシ）－｛４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（４’－トリフルオロメチルビフェニルオキシ）－｛４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（３’，５’－ジフルオロ－４’－トリフルオロメチルビフェニルオキシ）－｛４－〔２－（トランス－４－エチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（３’，５’－ジフルオロ－４’－トリフルオロメチルビフェニルオキシ）－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝メタン

Cr 101.8-102.1 N 134.4-135.0 Iso

ジフルオロ（３’，５’－ジフルオロ－４’－トリフルオロメチルビフェニルオキシ）－｛４－〔２－（トランス－４－ブチルシクロヘキシル）エチル〕フェニル｝メタン

ジフルオロ（３’，５’－ジフルオロ－４’－トリフルオロメチルビフェニルオキシ）－｛４－〔２－（トランス－４－ペンチルシクロヘキシル）エチル〕フェニル｝メタン

実施例１２（使用例１）

４－（トランス－４－プロピルシクロヘキシル）ベンゾニトリル　２４％（重量、以下同じ）

４－（トランス－４－ペンチルシクロヘキシル）ベンゾニトリル　３６％

４－（トランス－４－ヘプチルシクロヘキシル）ベンゾニトリル　２５％

４－（４－プロピルフェニル）ベンゾニトリル　１５％

なる組成の液晶組成物のネマチック液晶の透明点（Ｃｐ）は７２．４℃である。この液晶組成物をセル厚９μｍのＴＮセル（ねじれネマチックセル）に封入したものの動作しきい値電圧（V_{th}）は１．７８Ｖ、誘電率異方性値（△ε）は+１

1．0、屈折率異方性値（△n）は0．137、また20℃における粘度（η20）は27．0cPであった。この液晶組成物を母液晶としてその85部に実施例2に示したジフルオロ〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（4－トリフルオロメトキシフェニルオキシ）メタン15部を混合し、その物性値を測定した。その結果Cp：70．1、V_{th}：1．71、△ε：10．8、△n：0．132、η20：23．5cPであった。また、この組成物を－20℃のフリーザーに20日間放置したが結晶の析出は認められなかった。

実施例13（使用例2）

使用例1に示した組成物を母液としてその85部に実施例2に示したジフルオロ－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン15部を混合し、その物性値を測定した。その結果Cp：64．5、V_{th}：1．49、△ε：11．6、△n：0．128、η20：26．6cPであった。また、この組成物を－20℃のフリーザーに20日間放置したが結晶の析出は認められなかった。

実施例14（使用例3）

使用例1に示した組成物を母液としてその85部に実施例2に示したジフルオロ－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，4，5－トリフルオロフェニルオキシ）メタン15部を混合し、その物性値を測定した。その結果Cp：66．6、V_{th}：1．48、△ε：11．4、△n：0．126、η20：25．5cPであった。また、この組成物を－20℃のフリーザーに20日間放置したが結晶の析出は認められなかった。

実施例15（使用例4）

使用例1に示した組成物を母液としてその85部に実施例2に示したジフルオロ－〔4－（トランス－4－ペンチルシクロヘキシル）フェニル〕－（3，4－ジフルオロフェニルオキシ）メタン15部を混合し、その物性値を測定した。その結果Cp：69．3、V_{th}：1．68、△ε：10．3、△n：0．130、η20：25．0cPであった。また、この組成物を－20℃のフリーザーに20日間放置したが結晶の析出は認められなかった。

4－（トランス－4－（トランス－4－エチルシクロヘキシル）シクロヘキシ

ル）－１、２－ジフルオロベンゼン　３３．３％（重量、以下同じ）

４－（トランス－４－（トランス－４－プロピルシクロヘキシル）シクロヘキシル）－１，２－ジフルオロベンゼン　３３．３％

４－（トランス－４－（トランス－４－ペンチルシクロヘキシル）シクロヘキシル）－１，２－ジフルオロベンゼン　３３．３％

なる組成の液晶組成物のネマチック液晶の透明点（Ｃｐ）は１１２．４℃である。この液晶組成物をセル厚９μｍのＴＮセル（ねじれネマチックセル）に封入したものの誘電率異方性値（△ε）は+５．０、屈折率異方性値（△ｎ）は０．０８０、また２０℃における粘度（η20）は２４．３ｃＰであった。この液晶組成物を母液晶としてその８０部に上記ジフルオロ－〔４－（トランス－４－ペンチルシクロヘキシル）フェニル〕－（３、４－ジフルオロフェニルオキシ）メタン２０部を混合し、その物性値を測定した。その結果Ｃｐ：９９．４、△ε：５．６、△ｎ：０．０８３、η20：２１．６ｃＰであった。また、この組成物を－２０℃のフリーザーに４０日間放置したが結晶の析出は認められなかった。

実施例１６（使用例５）

使用例１に示した組成物を母液としてその８５部に実施例２に示したジフルオロ－〔４－（トランス－４－ペンチルシクロヘキシル）フェニル〕－（４－トリフルオロメチルフェニルオキシ）メタン１５部を混合し、その物性値を測定した。その結果Ｃｐ：６９．０、V_{th}：１．６５、△ε：１１．４、△ｎ：０．１３１、η20：２７．０ｃＰであった。また、この組成物を－２０℃のフリーザーに２０日間放置したが結晶の析出は認められなかった。

実施例１７（使用例６）

使用例１に示した組成物を母液としてその８５部に実施例２に示したジフルオロ－〔４－（トランス－４－プロピルシクロヘキシル）フェニル〕－（３－フルオロ－４－シアノフェニルオキシ）メタン１５部を混合し、その物性値を測定した。その結果Ｃｐ：７４．６、V_{th}：１．６４、△ε：１２．３、△ｎ：０．１４０、η20：３０．９ｃＰであった。また、この組成物を－２０℃のフリーザーに２０日間放置したが結晶の析出は認められなかった。

実施例１８（使用例７）

使用例１に示した組成物を母液としてその８５部に実施例３に示したジフルオロ－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３，４，５－トリフルオロフェニルオキシ）メタン１５部を混合し、その物性値を測定した。その結果Ｃｐ：６５．８、V_{th}：１．６１、△ε：１１．３、△ｎ：０．１２９、η20：２５．４ｃＰであった。また、この組成物を－２０℃のフリーザーに２０日間放置したが結晶の析出は認められなかった。

実施例１９（使用例８）

使用例１に示した組成物を母液としてその８５部に実施例３に示したジフルオロ－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（４－トリフルオロメトキシフェニルオキシ）メタン１５部を混合し、その物性値を測定した。その結果Ｃｐ：６９．８、V_{th}：１．７９、△ε：１０．４、△ｎ：０．１３１、η20：２４．２ｃＰであった。また、この組成物を－２０℃のフリーザーに２０日間放置したが結晶の析出は認められなかった。

実施例２０（使用例９）

使用例１に示した組成物を母液としてその８５部に実施例３に示したジフルオロ－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝－（３－フルオロ－４－トリフルオロメトキシフェニルオキシ）メタン１５部を混合し、その物性値を測定した。その結果Ｃｐ：６８．９、V_{th}：１．６９、△ε：１０．９、△ｎ：０．１３１、η20：２５．３ｃＰであった。また、この組成物を－２０℃のフリーザーに２０日間放置したが結晶の析出は認められなかった。

実施例２１（使用例１０）

使用例１に示した組成物を母液としてその８５部に実施例１０に示したジフルオロ－（３’，４’，５’－トリフルオロビフェニルオキシ）－〔４－（トランス－４－ペンチルシクロヘキシル）フェニル〕メタン１５部を混合し、その物性値を測定した。その結果Ｃｐ：８０．４、V_{th}：１．６２、△ε：１０．３、△ｎ：０．１４０、η20：２８．８ｃＰであった。また、この組成物を－２０℃のフリーザーに２０日間放置したが結晶の析出は認められなかった。

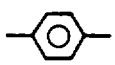
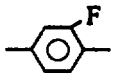
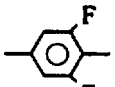
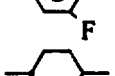
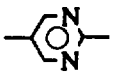
実施例２２（使用例１１）

使用例１に示した組成物を母液としてその８５部に実施例１０に示したジフルオロー（３'，５'－ジフルオロー４－トリフルオロメチルビフェニルオキシ）－｛４－〔２－（トランス－４－プロピルシクロヘキシル）エチル〕フェニル｝メタン１５部を混合し、その物性値を測定した。その結果Ｃｐ：７６．６、V_{th}：１．７５、△ε：１１．９、△ｎ：０．１３９、η20：２９．８ｃＰであった。また、この組成物を－２０℃のフリーザーに２０日間放置したが結晶の析出は認められなかった。

本発明の化合物を含有するネマチック液晶組成物としてさらに以下のもの（組成例１２～２８）を示すことができる。ただし組成物中の化合物は次表に示す取り決めに従い略号で示した。すなわち、左末端基はｓ、ｓＯ、ｓＯｔ、Ｖｓ、ｓＶｔで、結合基は2、Ｅ、Ｔ、ＣＦ２Ｏで、環構造はＢ、Ｂ（Ｆ）、Ｂ（Ｆ，Ｆ）、Ｈ、Ｐｙで、および右末端基はＦ、ＣＬ、ＯＣＦ３、ｗ、Ｏｗで示した。

表１

左末端基	記号	結合基	記号
C_sH_{2s+1}—	s —	—CH_2CH_2—	2
$C_sH_{2s+1}O$—	sO—	—COO—	E
$C_sH_{2s+1}OC_tH_{2t}$—	sOt —	—C≡C—	T
CH_2=CHC_sH_{2s}—	Vs —	—CF_2O—	CF2O
$C_sH_{2s+1}CH$=CHC_tH_{2t}—	sVt —		

環構造	記号	右末端基	記号
	B	—F	— F
	B(F)	—Cl	—CL
	B(F,F)	—CN	— C
	H	—OCF_3	—OCF3
	Py	—C_wH_{2w+1}	— w
		—OC_wH_{2w+1}	—Ow

実施例２３（使用例１２）

３－ＨＢＣＦ２ＯＢ－ＯＣＦ３	１０．０％
５－ＨＢＣＦ２ＯＢ－ＯＣＦ３	８．０％
３Ｏ１－ＢＥＢ（Ｆ）－Ｃ	５．０％
２－ＨＢ－Ｃ	５．０％
３－ＨＢ－Ｃ	１５．０％
２－ＨＨＢ－Ｃ	５．０％
３－ＨＨＢ－Ｃ	５．０％
４－ＨＨＢ－Ｃ	５．０％
３－ＰｙＢＢ－Ｆ	５．０％
３－ＨＨ－４	１０．０％
３－ＨＨ－５	３．０％
２－ＢＴＢ－Ｏ１	３．０％
３－ＢＴＢ－Ｏ１	３．０％
４－ＢＴＢ－Ｏ１	３．０％
４－ＢＴＢ－Ｏ２	３．０％
５－ＢＴＢ－Ｏ１	３．０％
３－ＨＨＢ－１	６．０％
３－ＨＨＢ－Ｏ１	３．０％

透明点（℃）	９２．２
粘度（mPa･s）	２０．９
屈折率異方性	０．１４２
誘電率異方性	８．６
しきい値電圧（Ｖ）	１．８３

実施例２４（使用例１３）

３－ＨＢＣＦ２ＯＢ－ＯＣＦ３	１０．０％
３－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	５．０％
５－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	５．０％
Ｖ２－ＨＢ－Ｃ	７．０％

1V2－HB－C	7．0％
3－HB－C	5．0％
3－HHB－C	5．0％
3－PyBB－F	8．0％
2－PyBH－3	4．0％
3－PyBH－3	4．0％
4－PyBB－3	4．0％
3－HH－4	10．0％
101－HH－3	6．0％
2－BTB－1	4．0％
1－BTB－6	8．0％
4－BTB－4	4．0％
3－HHB－1	4．0％

透明点（℃）	83．5
粘度（mPa･s）	26．8
屈折率異方性	0．148
誘電率異方性	7．0
しきい値電圧（V）	2．02

実施例25（使用例14）

3－HBCF2OB（F，F）－F	8．0％
5－HBCF2OB（F，F）－F	8．0％
2－BB－C	7．0％
101－HB－C	8．0％
201－HB－C	7．0％
2－BEB－C	4．0％
5－PyB－F	5．0％
3－PyBB－F	5．0％
2－PyB－2	3．0％
3－PyB－2	3．0％

4－ＰｙＢ－２	３．０％
２－ＰｙＢＨ－３	５．０％
３－ＰｙＢＨ－３	５．０％
４－ＰｙＢＨ－３	５．０％
３－ＰｙＢ－Ｏ２	５．０％
２－ＨＨＢ－１	４．０％
３－ＨＨＢ－１	６．０％
３－ＨＨＢ－３	９．０％

透明点（℃）	７１．５
粘度（mPa･s）	３２．５
屈折率異方性	０．１４２
誘電率異方性	１０．２
しきい値電圧（Ｖ）	１．４４

実施例２６（使用例１５）

３－ＨＢＣＦ２ＯＢ－ＯＣＦ３	１０．０％
５－ＨＢＣＦ２ＯＢ－ＣＦ３	５．０％
３－ＰｙＢ（Ｆ）－Ｆ	６．０％
３－ＰｙＢＢ－Ｆ	４．０％
４－ＰｙＢＢ－Ｆ	４．０％
５－ＰｙＢＢ－Ｆ	４．０％
２－ＰｙＢ－２	６．０％
３－ＰｙＢ－２	６．０％
４－ＰｙＢ－２	６．０％
３－ＨＥＢ－Ｏ４	６．０％
４－ＨＥＢ－Ｏ２	６．０％
５－ＨＥＢ－Ｏ１	６．０％
２－Ｈ２ＢＴＢ－４	４．０％
３－Ｈ２ＢＴＢ－４	４．０％
３－ＨＨＢ－１	７．０％

3－ＨＨＢ－３	７．０％
3－ＨＨＥＢＢ－Ｃ	３．０％
5－ＨＨＥＢＢ－Ｃ	３．０％
3－ＨＢＥＢＢ－Ｃ	３．０％

透明点（℃）	９９．３
粘度（mPa･s）	３０．１
屈折率異方性	０．１５６
誘電率異方性	５．３
しきい値電圧（Ｖ）	２．３６

実施例２７（使用例１６）

5－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－ＣＦ３	１０．０％
3－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	７．０％
5－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	７．０％
２Ｏ１－ＢＥＢ（Ｆ）－Ｃ	２．０％
３Ｏ１－ＢＥＢ（Ｆ）－Ｃ	８．０％
2－ＨＢ（Ｆ）－Ｃ	５．０％
3－ＨＢ（Ｆ）－Ｃ	７．０％
3－ＨＨＢ（Ｆ）－Ｃ	３．０％
2－ＨＨＢ（Ｆ）－Ｆ	５．０％
3－ＨＨＢ（Ｆ）－Ｆ	５．０％
5－ＨＨＢ（Ｆ）－Ｆ	５．０％
3－ＨＨＢ－１	６．０％
3－ＨＨＢ－３	３．０％
3－ＨＨＢ－Ｏ１	３．０％
3－Ｈ２ＢＴＢ－２	４．０％
3－Ｈ２ＢＴＢ－３	４．０％
3－Ｈ２ＢＴＢ－４	４．０％
3－ＨＢ（Ｆ）ＴＢ－２	４．０％
3－ＨＢ（Ｆ）ＴＢ－３	４．０％

3－ＨＢ（Ｆ）ＴＢ－４	４．０％
透明点（℃）	９４．３
粘度（mPa･s）	３２．９
屈折率異方性	０．１３７
誘電率異方性	１２．８
しきい値電圧（Ｖ）	１．４６

実施例２８（使用例１７）

3－ＨＢＣＦ２ＯＢ－ＯＣＦ３	６．０％
5－ＨＢＣＦ２ＯＢ－ＯＣＦ３	５．０％
5－ＨＢＣＦ２ＯＢ－ＣＦ３	５．０％
Ｖ２－ＨＢ－Ｃ	８．０％
１Ｖ２－ＨＢ－Ｃ	８．０％
3－ＨＢ－Ｃ	１３．０％
5－ＨＢ－Ｃ	７．０％
１Ｏ１－ＨＢ－Ｃ	４．０％
２Ｏ１－ＨＢ－Ｃ	４．０％
3－ＨＨＢ－Ｆ	４．０％
3－ＨＨ－４	４．０％
２－ＢＴＢ－Ｏ１	８．０％
3－ＨＨＢ－Ｏ１	４．０％
3－ＨＨＢ－１	６．０％
3－ＨＨＢ－３	１０．０％
3－ＨＢ（Ｆ）ＴＢ－２	４．０％
透明点（℃）	８０．５
粘度（mPa･s）	１９．４
屈折率異方性	０．１３０
誘電率異方性	８．２
しきい値電圧（Ｖ）	１．８６

（実施例２９）（使用例１８）

3－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	９．０％
5－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－ＯＣＦ３	９．０％
2－ＢＥＢ－Ｃ	５．０％
2－ＢＢ－Ｃ	１１．０％
3－ＨＢ－Ｃ	５．０％
１Ｏ－ＢＥＢ－２	１０．０％
3－ＨＥＢ－Ｏ４	１０．０％
4－ＨＥＢ－Ｏ２	１０．０％
5－ＨＥＢ－Ｏ１	１０．０％
3－ＨＢＥＢ－Ｆ	５．０％
3－ＨＨＥＢ－Ｆ	５．０％
5－ＨＨＥＢ－Ｆ	５．０％
3－ＨＥＢＥＢ－Ｆ	３．０％
3－ＨＥＢＥＢ－１	３．０％

透明点（℃）	７１．７
粘度（mPa･s）	３６．８
屈折率異方性	０．１１７
誘電率異方性	７．５
しきい値電圧（Ｖ）	１．５２

実施例３０（使用例１９）

3－ＨＢＣＦ２ＯＢ－ＯＣＦ３	６．０％
3－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	６．０％
3－Ｈ２ＢＣＦ２ＯＢＢ（Ｆ，Ｆ）－ＣＦ３	５．０％
２Ｏ１－ＢＥＢ（Ｆ）－Ｃ	２．０％
３Ｏ１－ＢＥＢ（Ｆ）－Ｃ	６．０％
４Ｏ１－ＢＥＢ（Ｆ）－Ｃ	３．０％
2－ＨＨＢ（Ｆ）－Ｆ	４．０％
3－ＨＨＢ（Ｆ）－Ｆ	４．０％
5－ＨＨＢ（Ｆ）－Ｆ	４．０％

3－ＨＨＥＢ－Ｆ	3．０％
5－ＨＨＥＢ－Ｆ	3．０％
3－ＨＥＢ－Ｆ	3．０％
3－ＨＨ－ＥＭｅ	9．０％
3－ＨＥＢ－Ｏ４	4．０％
4－ＨＥＢ－３	4．０％
4－ＨＥＢ－４	4．０％
2－ＰｙＢＨ－３	5．０％
3－ＰｙＢＨ－３	5．０％
4－ＰｙＢＨ－３	5．０％
3－ＨＢ－Ｏ２	１０．０％
3－ＨＨＰ－１	5．０％

透明点（℃）	８３．６
粘度（mPa･s）	３２．９
屈折率異方性	０．１０５
誘電率異方性	7．１
しきい値電圧（Ｖ）	１．８３

実施例３１（組成例２０）

5－ＨＢＣＦ２ＯＢ－ＣＦ３	5．０％
5－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－ＣＦ３	１０．０％
3－ＤＢ－Ｃ	4．０％
4－ＤＢ－Ｃ	4．０％
１Ｏ１－ＨＢ－Ｃ	5．０％
2－ＰｙＢ－２	9．０％
3－ＰｙＢ－２	9．０％
4－ＰｙＢ－２	9．０％
2－ＰｙＢＨ－３	7．０％
3－ＰｙＢＨ－３	6．０％
4－ＰｙＢＨ－３	6．０％

1O1－HH－5	8．0％
3－HB（F）TB－2	6．0％
3－HB（F）TB－3	6．0％
3－HB（F）TB－4	6．0％

透明点（℃） 71．0
粘度（mPa･s） 25．5
屈折率異方性 0．149
誘電率異方性 6．0
しきい値電圧（V） 1．78

実施例32（使用例21）

3－HBCF2OB（F，F）－F	14．0％
5－HBCF2OB（F，F）－F	14．0％
5－HBCF2OB（F）－OCF3	4．0％
1V2－BEB（F，F）－C	12．0％
3O1－BEB（F）－C	11．0％
3－HB－C	9．0％
3－HB（F）－C	7．0％
3－HHB（F）－C	6．0％
3－PyBB－F	8．0％
4－PyBB－F	8．0％
5－PyBB－F	7．0％

透明点（℃） 57．6
粘度（mPa･s） 52．0
屈折率異方性 0．144
誘電率異方性 24．4
しきい値電圧（V） 0．77

（実施例33）（使用例22）

3－HBCF2OB－OCF3	10．0％
5－HBCF2OB－OCF3	5．0％

2－ＨＢ（Ｆ）－Ｃ	１０．０％
3－ＨＢ（Ｆ）－Ｃ	１０．０％
３Ｏ１－ＢＥＢ（Ｆ）－Ｃ	７．０％
3－ＨＨＥＢ－Ｆ	４．０％
5－ＨＨＥＢ－Ｆ	４．０％
3－ＨＨＥＢ（Ｆ，Ｆ）－Ｆ	１５．０％
5－ＨＨＥＢ（Ｆ，Ｆ）－Ｆ	１０．０％
3－ＨＢＥＢ（Ｆ，Ｆ）－Ｆ	５．０％
5－ＨＢＥＢ（Ｆ，Ｆ）－Ｆ	５．０％
3－ＨＨＢ－１	８．０％
3－ＨＨＢ－Ｏ１	４．０％
3－ＨＨＢ－３	３．０％

透明点（℃）	８３．２
粘度（mPa･s）	３３．２
屈折率異方性	０．０９６
誘電率異方性	１３．６
しきい値電圧（Ｖ）	１．１６

実施例３４（使用例２３）

3－ＨＢＣＦ２ＯＢ－ＯＣＦ３	１０．０％
5－ＨＢＣＦ２ＯＢ－ＯＣＦ３	５．０％
１Ｖ－ＨＢ－Ｃ	９．０％
１Ｖ２－ＨＢ－Ｃ	９．０％
3－ＨＢ－Ｃ	１４．０％
2－ＨＨＢ－Ｃ	３．０％
3－ＨＨＢ－Ｃ	４．０％
Ｖ２－ＨＨ－３	１０．０％
１Ｏ１－ＨＨ－５	８．０％
2－ＢＴＢ－Ｏ１	１１．０％
Ｖ－ＨＨＢ－１	８．０％

V－HBB－2	5．0％
1V2－HBB－2	4．0％
透明点（℃）	83．6
粘度（mPa･s）	17．1
屈折率異方性	0．134
誘電率異方性	7．0
しきい値電圧（V）	2．03

実施例35（使用例24）

3－HBCF2OB（F，F）－F	10．0％
5－HBCF2OB（F，F）－F	10．0％
2－HB（F）－C	7．0％
3－HB（F）－C	10．0％
3－HHB－F	5．0％
3－HB－O2	10．0％
V－HH－5	5．0％
V2－HH－3	5．0％
2－BTB－O1	8．0％
V－HHB－1	8．0％
V－HBB－2	5．0％
1V2－HBB－2	5．0％
3－HHB－O1	4．0％
3－H2BTB－2	4．0％
3－H2BTB－3	4．0％
透明点（℃）	71．6
粘度（mPa･s）	16．9
屈折率異方性	0．121
誘電率異方性	6．1
しきい値電圧（V）	1．81

実施例36（使用例25）

3－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	５．０％
５－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	１０．０％
５－ＨＢＣＦ２ＯＢ－ＣＦ３	５．０％
５－ＨＢＣＦ２ＯＢ（Ｆ）－Ｆ	５．０％
３－ＨＢＣＦ２ＯＢ－ＯＣＦ３	５．０％
７－ＨＢ（Ｆ，Ｆ）－Ｆ	８．０％
３－ＨＨＢ（Ｆ，Ｆ）－Ｆ	６．０％
４－ＨＨＢ（Ｆ，Ｆ）－Ｆ	３．０％
３－Ｈ２ＨＢ（Ｆ，Ｆ）－Ｆ	１０．０％
４－Ｈ２ＨＢ（Ｆ，Ｆ）－Ｆ	６．０％
５－Ｈ２ＨＢ（Ｆ，Ｆ）－Ｆ	６．０％
３－ＨＨ２Ｂ（Ｆ，Ｆ）－Ｆ	１０．０％
５－ＨＨ２Ｂ（Ｆ，Ｆ）－Ｆ	５．０％
３－ＨＢＢ（Ｆ，Ｆ）－Ｆ	５．０％
５－ＨＢＢ（Ｆ，Ｆ）－Ｆ	５．０％
３－ＨＨＢＢ（Ｆ，Ｆ）－Ｆ	３．０％
３－ＨＨ２ＢＢ（Ｆ，Ｆ）－Ｆ	３．０％
透明点（℃）	６１．８
粘度（mPa･s）	２３．６
屈折率異方性	０．０８３
誘電率異方性	８．４
しきい値電圧（Ｖ）	１．５０

実施例３７（使用例２６）

3－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	５．０％
３－ＨＢＣＦ２ＯＢ－ＯＣＦ３	５．０％
３－ＨＢ－ＣＬ	４．０％
５－ＨＢ－ＣＬ	４．０％
７－ＨＢ－ＣＬ	５．０％
２－ＨＨＢ－ＣＬ	６．０％

3－ＨＨＢ－ＣＬ	7．0％
5－ＨＨＢ－ＣＬ	6．0％
2－ＨＢＢ（Ｆ）－Ｆ	6．0％
3－ＨＢＢ（Ｆ）－Ｆ	6．0％
5－ＨＢＢ（Ｆ）－Ｆ	12．0％
3－ＨＢＢ（Ｆ，Ｆ）－Ｆ	13．0％
5－ＨＢＢ（Ｆ，Ｆ）－Ｆ	13．0％
3－Ｈ2ＨＢ（Ｆ）－ＣＬ	3．0％
3－ＨＢ（Ｆ）ＴＢ－2	3．0％
3－ＨＢ（Ｆ）ＶＢ－2	2．0％

透明点（℃）	89．3
粘度（mPa･s）	21．9
屈折率異方性	0．128
誘電率異方性	6．4
しきい値電圧（Ｖ）	2．08

実施例38（使用例27）

5－ＨＢＣＦ2ＯＢ（Ｆ，Ｆ）－Ｆ	10．0％
5－ＨＢＣＦ2ＯＢ－ＣＦ3	5．0％
3－ＨＢＣＦ2ＯＢ－ＯＣＦ3	5．0％
2－ＨＢＢ（Ｆ）－Ｆ	3．0％
3－ＨＢＢ（Ｆ）－Ｆ	3．0％
5－ＨＢＢ（Ｆ）－Ｆ	6．0％
2－ＨＢＢ－Ｆ	3．0％
3－ＨＢＢ－Ｆ	3．0％
3－Ｈ2ＨＢ（Ｆ，Ｆ）－Ｆ	6．0％
4－Ｈ2ＨＢ（Ｆ，Ｆ）－Ｆ	6．0％
5－Ｈ2ＨＢ（Ｆ，Ｆ）－Ｆ	6．0％
3－ＨＨＢ（Ｆ，Ｆ）－Ｆ	3．0％
4－ＨＨＢ（Ｆ，Ｆ）－Ｆ	3．0％

3－ＨＨ２Ｂ（Ｆ，Ｆ）－Ｆ	１２．０％
5－ＨＨ２Ｂ（Ｆ，Ｆ）－Ｆ	６．０％
3－ＨＢＢ（Ｆ，Ｆ）－Ｆ	６．０％
5－ＨＢＢ（Ｆ，Ｆ）－Ｆ	６．０％
3－ＨＨＢ－ＣＬ	４．０％
5－ＨＨＢ－ＣＬ	４．０％
透明点（℃）	８２．８
粘度（mPa･s）	２４．８
屈折率異方性	０．１００
誘電率異方性	８．０
しきい値電圧（Ｖ）	１．６９

実施例３９（使用例２８）

3－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	３．０％
5－ＨＢＣＦ２ＯＢ（Ｆ，Ｆ）－Ｆ	８．０％
3－ＨＢＣＦ２ＯＢ－ＯＣＦ３	５．０％
2－ＨＢＢ（Ｆ）－Ｆ	８．０％
3－ＨＢＢ（Ｆ）－Ｆ	８．０％
5－ＨＢＢ（Ｆ）－Ｆ	１６．０％
5－ＨＢ－Ｆ	６．０％
7－ＨＢ－Ｆ	６．０％
5－ＨＨＢ－ＯＣＦ３	８．０％
3－Ｈ２ＨＢ－ＯＣＦ３	８．０％
5－Ｈ２ＨＢ－ＯＣＦ３	８．０％
3－ＨＨ２Ｂ－ＯＣＦ３	８．０％
5－ＨＨ２Ｂ－ＯＣＦ３	８．０％
透明点（℃）	８４．９
粘度（mPa･s）	１６．６
屈折率異方性	０．１０１
誘電率異方性	５．５

しきい値電圧（V）　　2．12

比較例

本発明の比較化合物として従来技術の項に示した（b－1）式および（b－4）式（USP5032313）で表されるもののうち、1，2，6－トリフルオロ－4－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕ベンゼン〔（b－1）式においてR＝C_3H_7のもの〕を取り上げ、特許記載の実施例従い実際に合成し、実施例11に示した液晶組成物を母液晶としてその85部に1，2，6－トリフルオロ－4－〔4－（トランス－4－プロピルシクロヘキシル）フェニル〕ベンゼンおよび4－（トランス－4－プロピルシクロヘキシル）フェニル－（3，4，5－トリフルオロフェニルオキシ）メタンをそれぞれ15部を混合し、その物性値を測定した。実施例11および12の結果とあわせて物性値を表2に示す。表中、かっこ内の数値は外挿値である。

表２

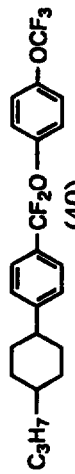
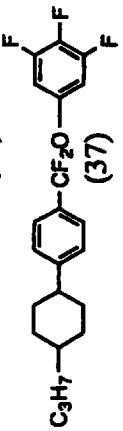
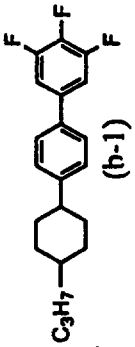
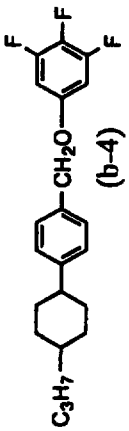
	Cp(℃)	△ε	η_{20}(cP)	V_{th}(V)
母液晶	72.4	11.0	27.0	1.78
 (40)	70.1(57.1)	10.8(9.7)	23.5(3.7)	1.71
 (37)	64.5(19.7)	11.6(15.0)	26.6(24.3)	1.49
 (b-1)	68.7(47.7)	11.1(11.7)	28.8(39.0)	1.51
 (b-4)	61.2(1.7)	10.4(7.0)	30.5(54.3)	1.61

表２から本発明化合物（３７）は同じ分子骨格を有する比較化合物（ｂ－１）と比較し、外挿値の比較で１．２８倍と大きな誘電率異方性値（△ε）を有しながら、粘性（η20）においては（ｂ－１）の約６０％と非常に小さな粘度を示し、優れた特長を有することがわかる。また、本発明化合物（３７）のベンジル位の

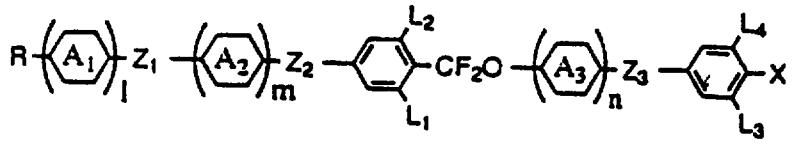
フッ素原子を水素原子で置換した化合物（ｂ－４）との比較ではその粘性（η20）において（ｂ－４）の約４０％と著しく低粘性であり、本願発明の特徴である２つのベンゼン環を架橋した－CF_2O－結合基が誘電率異方性値（$\Delta\varepsilon$）の向上と共に粘性の低下に寄与することが判る。さらに分子末端基にトリフルオロメトキシ基を有する本発明化合物（４０）においては粘度の外挿値が３．７ｃＰと非常に小さく、さらに母液晶との比較から透明点、誘電率異方性値をほとんど低下させずに粘度のみを約１３％も低下させることがわかり、粘度を低下させる減粘材としても非常に有用な化合物と言える。

産業上の利用可能性

本発明のジフルオロオキシメタン誘導体およびこれを含む液晶組成物は、例えばアクティブマトリックス方式、ＳＴＮ方式等の種々のモードにおける低電圧用液晶材料として有用である。

請求の範囲

（１）一般式（Ｉ）



(I)

（式中ｌ、ｍ、ｎは各々０または１であり、環A_1、A_2はそれぞれ独立してトランス－１，４－シクロヘキシレン基、６員環の１個以上の水素原子がハロゲン原子により置換されていてもよい１，４－フェニレン基、トランス－１，３－ジオキサン－２，５－ジイルまたはピリミジン２，５－ジイルを表し、環A_3は６員環の１個以上の水素原子がハロゲン原子により置換されていてもよい１，４－フェニレン基、トランス－１，３－ジオキサン－２，５－ジイルまたはピリミジン－２，５－ジイルを表し、Z_1、Z_2、Z_3はそれぞれ独立して共有結合、－CH_2－、－ＣＯＯ－、－CF_2O－、－OCF_2－、－CH_2O－、－ＯＣＨ、－ＣＨ＝ＣＨ－または－Ｃ≡Ｃ－であり、L_1、L_2、L_3、L_4はそれぞれして水素原子またはハロゲン原子であり、Ｘはハロゲン原子、ＣＮ、CF_3、OCF_3、$OCHF_2$、OCH_2F、炭素数１～１０の直鎖もしくは分岐のアルキ基、アルケニル基またはアルコキシ基であり、Ｒは炭素数１～１０の直鎖もしくは分岐のアルキル基またはアルケニル基であり、該Ｒ中の１つもしくは隣接しない２つ以上のCH_2基は酸素原子により置換されていてもよい。ただしZ_2が－F_2Ｏ－または－OCF_2－である場合以外は、Ｘがアルキル基、アルケニル基たはアルコキシ基であることはない。）で表されるジフルオロオキシメタン誘導体。

（２）一般式（Ｉ）においてｌ＝１、ｍ＝０、ｎは０または１であり、Z_1は共有結合または－CH_2CH_2－、Z_2およびZ_3はともに共有結合、A_1ンス－１，４－シクロヘキシレン基、A_3は１，４－フェニレン基、Ｒは炭素数１～１０の直鎖のアルキル基またはアルケニル基である請求項１に記載のジフルオロオキシメタン誘導体。

（３）L_3 およびL_4 の少なくとも一方がハロゲン原子である請求項１または２に記載のジフルオロオキシメタン誘導体。

＊ＣＬＭＳ＊

（４）一般式（Ｉ）において１＝ｍ＝ｎ＝０であり、Z_1、Z_2およびＺがともに共有結合である請求項１に記載のジフルオロオキシメタン誘導体。

（５）一般式（Ｉ）において１＝１、ｍ＝ｎ＝０であり、Z_2、Z_3がとに共有結合である請求項１に記載のジフルオロオキシメタン誘導体。

（６）一般式（Ｉ）においてL_3、L_4、Ｘがともにフッ素原子である請項１ないし５のいずれかに記載のジフルオロオキシメタン誘導体。

（７）一般式（Ｉ）においてＸがOCF_3である請求項５に記載のジフルオロオキシメタン誘導体。

（８）一般式（Ｉ）においてＸがＣＮである請求項５に記載のジフルオロオキシメタン誘導体。

（９）一般式（Ｉ）において１＝１であり、環A_1が６員環の１個以上の水素原子がハロゲン原子により置換されていてもよい１，４－フェニレン基、Z_1が－OCF_2－、Z_2、Z_3がともに共有結合、Ｘが炭素数１～１０の直鎖もは分岐のアルキル基、アルケニル基またはアルコキシ基で表される請求項１に記載のジフルオロオキシメタン誘導体。

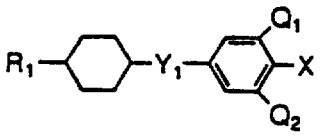
（１０）一般式（Ｉ）において１＝ｍ＝０、ｎ＝１であり、Z_1、Z_2がもに共有結合であり、環A_3が１，４－フェニレン基である請求項１に記載のジフルオロオキシメタン誘導体。

（１１）一般式（Ｉ）においてZ_3が共有結合である請求項１０に記載のジフルオロオキシメタン誘導体。

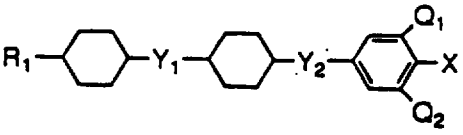
（１２）一般式（Ｉ）においてZ_3が－CH_2CH_2－である請求項１０記載のジフルオロオキシメタン誘導体。

（１３）請求項１～１２のいずれかに記載のジフルオロオキシメタン誘導体を少なくとも１種含有することを特徴とする液晶組成物。

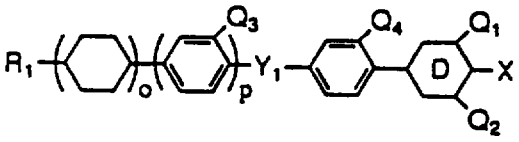
（１４）第１成分として請求項１～１２いずれかに記載のジフルオロオキシメタン誘導体を少なくとも１種含有し、第２成分として一般式（II）、（III）および（IV）



(II)



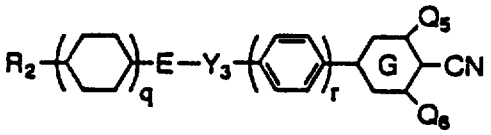
(III)



(IV)

(式中R_1は炭素数1～10のアルキル基を示し、XはF、Cl、CF_3、OCF_3、OCF_2Hまたは炭素数1～10のアルキル基を示し、Q_1、Q_2、Q_3、それぞれ独立してHまたはFを示し、oは1または2を示し、pは0または1を示す。Y_1およびY_2はそれぞれ独立して$-CH_2CH_2-$、$-CH=CH-$または共有結合を示す。環Dはトランス－1，4－シクロヘキシレン基または1，4－フェニレン基を示す。）で表される化合物群から選択される化合物を少なくとも1種含有することを特徴とする液晶組成物。

（15）第1成分として請求項1～12のいずれかに記載のジフルオロオキシメタン誘導体を少なくとも1種含有し、第2成分として一般式（V）、（VI）、（VII）、（VIII）および（IX）

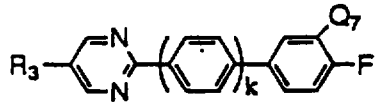


(V)

（式中R_2はフッ素原子、炭素数1～10のアルキル基または炭素数2～10のアルケニル基を示す。いずれにおいてもそのうちの1つもしくは隣接しない2つ以上のCH_2基は酸素原子によって置換されていてもよい。Y_3は$-CH_2CH-$、$-COO-$または共有結合を示し、Q_5およびQ_6はそれぞれ独立して水素またはフッ素原子を示し、Eはトランス－1，4－シクロヘキシレン、1，4－フェニ

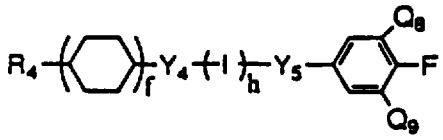
CLMS

レン、トランス－１，３－ジオキサン－２，５－ジイルを示し、環Ｇはトランス－１，４－シクロヘキシレン、１，４－フェニレンを示し、ｑ、ｒはそれぞれ独立して０または１を示す。）



（ＶＩ）

（式中R_3は炭素数１～１０のアルキル基を示し、Q_7は水素またはフッ素原子示し、ｋは０または１を示す。）

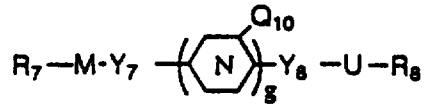


（ＶＩＩ）

（式中R_4は炭素数１～１０のアルキル基を示し、Ｉはトランス－１，４－シクロヘキシレンまたは１，４－フェニレンを示し、Q_8およびQ_9は水素またはフッ素原子を示し、Y_4は－ＣＯＯ－または－Ｃ≡Ｃ－を示し、ｆ、ｈはそれぞれ独立して０または１を示す。）

$$R_5-J-Y_6-K-R_6 \qquad (VIII)$$

（式中R_5およびR_6はそれぞれ独立して炭素数１～１０のアルキル基、アルコシ基またはアルコキシメチル基を示し、Ｊはトランス－１，４－シクロヘキシレン、１，３－ピリミジン－２，５－ジイルまたは１，４－フェニレンを示し、Ｋはトランス－１，４－シクロヘキシレンまたは１，４－フェニレンを示し、Y_6は－Ｃ≡Ｃ－、－ＣＯＯ－、$-CH_2CH_2-$または共有結合を示す。）



（ＩＸ）

（式中R_7は炭素数１～１０のアルキル基またはアルコキシ基を示す。R_8は炭素数１～１０のアルキル基を示し、そのうちの１つまたは２つ以上の隣接しないCH_2基は酸素原子により置換されてもいてよい。Ｍはトランス－１，４－シクロヘキシレンまたは１，３－ピリミジン－２，５－ジイルを示し、環ＮおよびＵは

＊ＣＬＭＳ＊

それぞれ独立してトランス－１，４－シクロヘキシレンまたは１，４－フェニレンを示し、Y_7は－CH_2CH_2－、－COO－または共有結合を示し、Y_8は≡C－、－COO－または共有結合を示し、gは０または１を示し、Q_{10}は水素またはフッ素原子を示す。）で表される化合物群から選択される１種以上の化合物を含有することを特徴とする液晶組成物。

（１６）第１成分として請求項１～１２のいずれかに記載のジフルオロオキシメタン誘導体液晶を少なくとも１種含有し、第２成分の一部分として一般式（II）、（III）および（IV）で表される化合物群から選択される１種以上の化合物を含有し、第２成分の他の部分として一般式（V）、（VI）、（VII）、（III）および（IX）で表される化合物群から選択される１種以上の化合物を含有することを特徴とする液晶組成物。

（１７）請求項１３～１６のいずれかに記載の液晶組成物を用いて構成された液晶表示素子。

SPECIFICATION

Difluorooxymethane Derivative and Liquid Crystal Composition

TECHNICAL FIELD

The present invention relates to a difluoromethane derivative as a liquid crystalline compound suitable as a liquid crystal material in several liquid crystal displays and a liquid crystal composition containing the derivative.

BACKGROUND ART

Liquid crystal display devices employ optical anisotropy and dielectric anisotropy of liquid crystal materials. As display mode, twisted nematic (TN) mode, super twisted nematic (STN) mode, dynamic scattering (DS) mode, guest-host (G-H) mode, and DAP mode are known. Further, as driving mode of the devices, static driving mode, time division driving mode, active matrix driving mode, and dual frequency driving mode are known. While the properties of liquid crystal materials used for such liquid crystal display devices are different depending on their applications, it is required to any liquid crystal material that the material is stable against external environmental factors such as moisture, air, heat, and light, that the material exhibits a liquid crystal phase at a range of temperatures as wide as possible with room temperature being at its center, that the material has a low viscosity, and that the material is low in its driving voltage. Besides, liquid crystal materials used for liquid crystal display devices are usually composed of several kinds or 10-odd kinds of liquid crystalline compounds in order to obtain optimum dielectric anisotropy ($\Delta\varepsilon$) or optical anisotropy (Δn) required to each display device. Accordingly, the miscibility with other liquid crystal compounds,

miscibility at low temperatures is desired for liquid crystal materials from the recent needs of being used under several environments in particular.

On the other hand, active matrix mode, particularly TFT (thin film transistor) mode is popularly adopted recent years as a display mode for television or viewfinder from the aspect of display performances such as contrast, display capacity, and response time. Also, STN mode which is simple in manufacturing process and less expensive in production cost while having a large display capacity is largely adopted as display for personal computers and others.

As the trend in recent years, development in this field is being advanced with miniaturization of liquid crystal display devices or their downsizing to portable dimensions being centered, as typified by televisions which are characterized in that they are small-sized, light weight, and portable, and by notebook type personal computers. From the aspect of materials, development is being carried out with liquid crystalline compounds and liquid crystal composition having a low driving voltage, that is, a low threshold voltage as its center from the aspect of withstand voltage of IC.

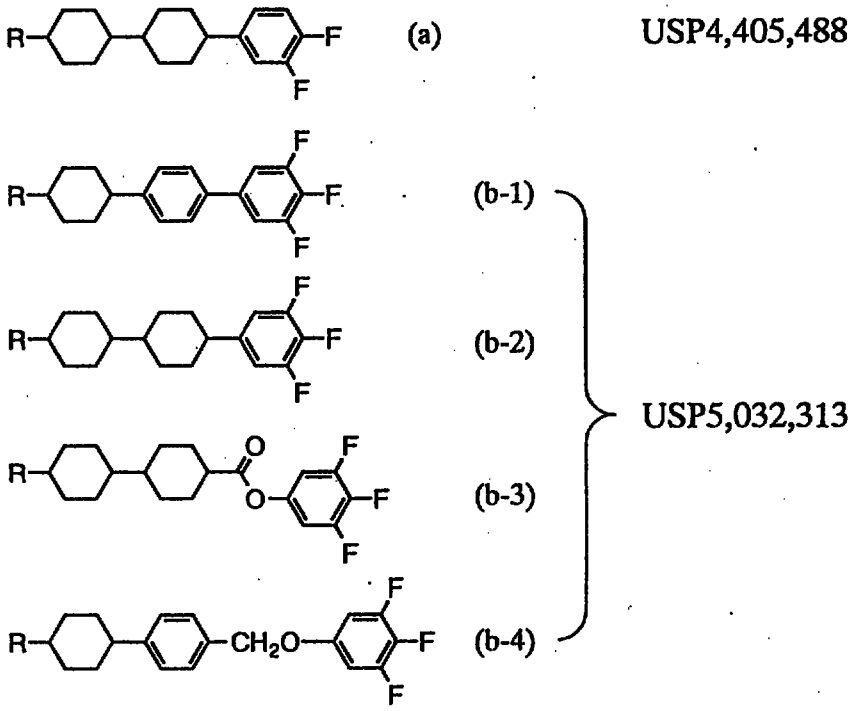
It is known that threshold voltage can be expressed by the following equation (H. J. Deuling et al., Mol. Cryst. Liq. Cryst., 27 (1975) 81):

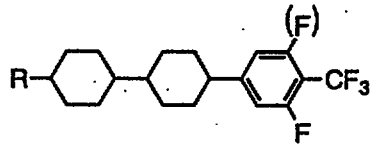
$$V_{th} = \pi (K/\varepsilon_0 \Delta\varepsilon)^{1/2}$$

wherein K is an elastic constant and ε_0 is a dielectric constant in vacuum. From the equation mentioned above, it is a common way to use a material having a large dielectric anisotropy ($\Delta\varepsilon$) in order to reduce the threshold voltage, and thus, development of compounds having a large value of dielectric anisotropy is being actively carried out.

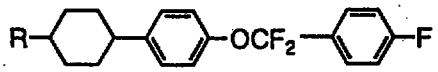
On the other hand, in liquid crystalline compounds having fluorine atom as substituent, it is known to be effective to increase the number of substitution on the molecule with fluorine atom for increasing dielectric anisotropy. However, the number of substitution on the molecule of compounds with fluorine atom has a proportional relationship with viscosity, and it is also empirically known among the person skilled in the art that when the number of substitution with fluorine atom is increased, mesomorphic range will be narrowed. Accordingly, it is considered to be difficult to increase only dielectric anisotropy while suppressing the raising of viscosity and narrowing of mesomorphic range.

As examples of conventional liquid crystalline compounds substituted with multiple number of fluorine atoms, the followings are disclosed:

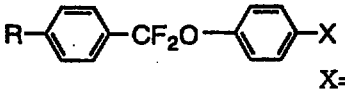




(c) DE4027840A1



(d) JP-A-2-289529



(e) JP-A-5-112778

Any of compounds (a) and (b-1) to (b-4) has several fluorine atoms at the terminal of the molecule. The value of dielectric anisotropy of the compounds are compared and arranged in the order of the value as follows:

(b-3) >> (b-1), (b-2), (b-4) > (a)

Compound (b-3) has an ester bond as bonding group between molecular skeletons. It is considered that the large polarization of an ester carbonyl group effectively contributes to the dielectric constant of major axis of compound molecule and thus the compound exhibit an extremely large dielectric anisotropy. On the other hand, however, (b-3) can not be said to be preferable compound in the aspect of response speed from the fact that the compound has a remarkably high viscosity than (a), (b-1), (b-2), and (b-4). With respect to compound (c), it can not be said to be the compound which satisfies the requirements since it has a viscosity as high as (b-3) while (c) has a comparatively high dielectric anisotropy.

In this connection, compounds having $-CF_2O-$ at a terminal of the molecule have already been disclosed in patent publications as the compounds having a partial structure of $-CF_2O-$ in the molecule in liquid crystalline compounds. However, as the compounds having a partial structure which crosslinked two

benzene rings as a bonding group in the structure of the compound, only compounds (d) and (e) shown above have been disclosed in Japanese Patent Application Laid-open Nos. 2-289529 and 5-112778, respectively. Besides, whereas the structural formula of the compounds have been described, physical data of the compounds and specific value of physical properties for evaluating the utility as liquid crystalline compound have not been disclosed in the publications. Accordingly, the properties of liquid crystalline compounds having a partial structure in which two benzene rings are bonded with $-CF_2O-$ group are not known at all. The present inventors had presumed that the dielectric constant in the direction of major axis of the molecule is offset in compound (d) since the polarization of $-CF_2O-$ group which is a bonding group in the molecule is arranged toward the direction opposite to the polarization of fluorine atom at the terminal of the molecule, and thus a large dielctric anisotropy can not be expected. Even with respect to compound (e), it was considered that a high clearing point can not be expected since it is a bicyclic compound in its skeltal structure while a comparatively large dielectric anisotropy can be expected from the contribution of polarization of $-CF_2O-$ group. As explained above, it was the actual situation that the effect of $-CF_2O-$ bonding group as well as the effect of compounds (d) and (e), particularly the knowledge on the relationship between dielectric anisotropy and viscosity were not known at all.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide a novel liquid crystalline compound having a large dielectric anisotropy and extremely low viscosity, as a liquid crystalline compound for low voltages in several modes including active matrix mode

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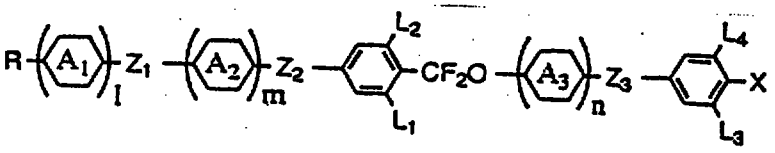
and STN mode, and to provide a liquid crystal composition containing the liquid crystalline compound.

As a result of the research by the present inventors on the physical properties of novel difluorooxymethane derivative which can be derived from a phenyl benzoate derivative, it has been found that the direction of dipole moment with polarization of two fluorine atoms in difluoromethoxy group which is a bonding group effectively contributes to the increase of dielectric constant in the direction of major axis of the molecule in the difluorooxymethane derivative, and thus the derivative has a large dielectric anisotropy, and that the derivative is extremely low in viscosity despite of the existence of fluorine atom in its molecule.

Also, it has been found that the compounds in which fluorine substituent is selected as their terminal substituent and the other compounds in which one of other substituents typified by cyano group is selected are novel, useful liquid crystalline compounds for low voltages, with the former in active matrix mode and the latter in several modes including STN mode, leading to the accomplishment of the present invention.

The invention claimed in the present application is summarized as follows:

(1) A difluorooxymethane derivative expressed by the general formula



(I)

wherein each of l, m, and n is 0 or 1, rings A_1 and A_2 independently represent trans-1,4-cyclohexylene group, 1,4-phenylene group one or more hydrogen atoms in which six-membered

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ring may be replaced by halogen atom, trans-1,3-dioxane-2,5-diyl, or pyrimidine-2,5-diyl, ring A3 represents 1,4-phenylene group one or more hydrogen atoms in which six-membered ring may be replaced by halogen atom, trans-1,3-dioxane-2,5-diyl, or pyrimidine-2,5-diyl, Z_1, Z_2, and Z_3 independently represent a covalent bond, $-CCH_2-$, $-COO-$, $-CF_2O-$, $-OCF_2-$, $-CH_2O-$, $-OCH-$, $-CH=CH-$, or $-C\equiv C-$, L_1, L_2, L_3, and L_4 represent hydrogen atom or halogen atom, respectively, X is halogen atom, CN, CF3, OCF3, $OCHF_2$, OCH_2F, or a linear or branched alky group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, and R is a linear or branched alkyl group or alkenyl group having 1 to 10 carbon atoms, one or not adjacent 2 or more CH_2 groups in the R may be replaced by oxygen atom, provided that in no case is X an alkyl group, alkenyl group, or alkoxy group except in the case where Z_2 is $-F_2O-$ or $-OCF_2-$.

(2) The difluorooxymethane derivative recited in (1) wherein ℓ = 1, m = 0, n is 0 or 1, Z_1 is covalent bond or $-CH_2CH_2-$, both Z_2 and Z_3 are covalent bond, A_1 is tra-1,4-cyclohexylene group, A_3 is 1,4-phenylene group, and R is a linear alkyl group or alkenyl group having 1 to 10 carbon atoms, in the general formula (I).

(3) The difluorooxymethane derivative recited in (1) or (2) wherein at least one of L_3 and L_4 is halogen atom.

(4) The difluorooxymethane derivative recited in (1) wherein ℓ = m = n = 0, and all of Z_1, Z_2, and Z_3 are covalent bond, in the general formula (I).

(5) The difluorooxymethane derivative recited in (1) wherein ℓ = 1, m = n = 0, and both of Z_2 and Z_3 are covalent bond, in the general formula (I).

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(6) The difluorooxymethane derivative recited in any one of (1) t (5) wherein all of L_3, L_4, and X are fluorine atom, in the general formula (I).

(7) The difluorooxymethane derivative recited in (5) wherein X is OCF_3 in the general formula (I).

(8) The difluorooxymethane derivative recited in (5) wherein X is CN, in the general formula (I).

(9) The difluorooxymethane derivative recited in (1) wherein ℓ = 1, ring A_1 is 1,4-phenylene group one or more hydrogen atom in which 6-membered ring may be replaced by halogen atom, Z_1 is $-OCF_2-$, both of Z_2 and Z_3 are valent bond, and X is a linear or branched alkyl group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, in the general formula (I).

(10) The difluorooxymethane derivative recited in (1) wherein ℓ = m = 0, n = 1, both of Z_1 and Z_2 are covalent bond, and ring A_3 is 1,4-phenylene group, in the general formula (I).

(11) The difluorooxymethane derivative recited in (10) wherein Z_3 is covalent bond, in the general formula (I).

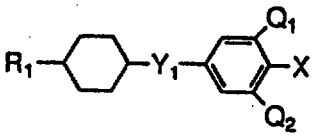
(12) The difluorooxymethane derivative recited in (10) wherein Z_3 is $-CH_2CH_2-$, in the general formula (I).

(13) A liquid crystal composition containing at least one kind of difluorooxymethane derivative recited in any one of (1) to (12).

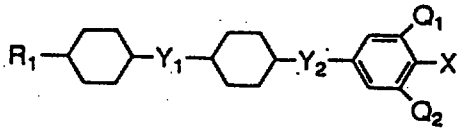
(14) A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative recited in any one of (1) to (12) and containing, as a second component, at least one kind of compound selected from the group of compounds expressed by general formula (II), (III), or (IV)

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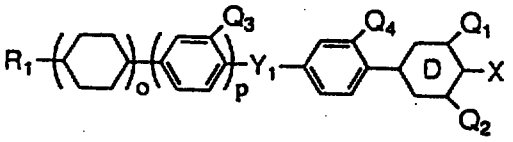




(II)



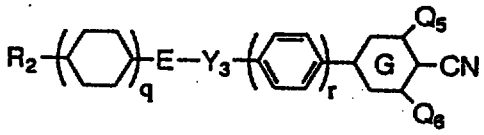
(III)



(IV)

wherein R_1 represents an alkyl group having 1 to 10 carbon atoms, X represents F, Cl, CF_3, OC_3, OCF_2H, or an alkyl group having 1 to 10 carbon atoms, Q_1, Q_2, and Q_3 independently represent H or F, o represents 1 or 2, p represents 0 or 1, Y_1 and Y_2 independently represent $-CH_2CH_2-$, -CH=CH-, or covalent bond, and ring D represents trans-1,4-cyclohexylene group or 1,4-phenylene group.

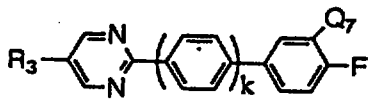
(15) A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative recited in any one of (1) to (12), containing, as a second component, at least one kind of compound selected from the group of compounds expressed by general formula (V), (VI), (VII), (VIII), or (IX)



(V)

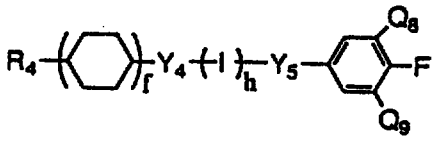
wherein R_2 represents fluorine atom, an alkyl group having 1 to 10 carbon atoms, or an alkenyl group having 2 to 10 carbon atoms, in any case, one or not adjacent two or more CH_2 groups in

the alkyl or alkenyl group may be replaced by oxygen atom, Y_3 represents $-CH_2CH-$, -COO-, or covalent bond, Q_5 and Q_6 independently represent hydrogen atom or fluorine atom, E represents trans-1,4-cyclohexylene, 1,4-phenylene, or trans-1,3-dioxane-2,5-diyl, ring G represents trans-1,4-cyclohexylene or 1,4-phenylene, and q and r independently represent 0 or 1,



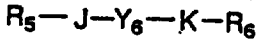
(VI)

wherein R_3 represents an alkyl group having 1 to 10 carbon atoms, Q_7 represents hydrogen atom or fluorine atom, and k represents 0 or 1,



(VII)

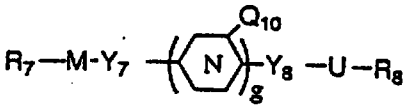
wherein R_4 represents an alkyl group having 1 to 10 carbon atoms, I represents trans-1,4-cyclohexylene or 1,4-phenylene, Q_8 and Q_9 represent hydrogen atom or fluorine atom, Y_4 represents -COO- or $-C\equiv C-$, and f and h independently represent 0 or 1,



(VIII)

wherein R_5 and R_6 independently represent an alkyl group, alko group, or alkoxymethyl group having 1 to 10 carbon atoms, J represents trans-1,4-cyclohexylene, 1,3-pyrimidine-2,5-diyl, or 1,4-phenylene, K represents trans-1,4-cyclohexylene or 1,4-

phenylene, Y_6 represents -C≡C-, -COO-, $-CH_2CH_2-$, or covalent bond,



(IX)

wherein R_7 represents an alkyl group or alkoxy group having 1 to 10 carbon atoms, R_8 represents an alkyl group having 1 to 10 carbon atoms, one or not adjacent two or more CH_2 groups in which alkyl group may be replaced by oxygen atom, M represents trans-1,4-cyclohexylene or 1,3-pyrimidine-2,5-diyl, rings N and U independently represent trans-1,4-cyclohexylene or 1,4-phenylene, Y_7 represents $-CH_2CH_2-$, -COO-, or covalent bond, Y_8 represents ≡C-, -COO-, or covalent bond, g represents 0 or 1, and Q_{10} represents hydrogen atom or fluorine atom.

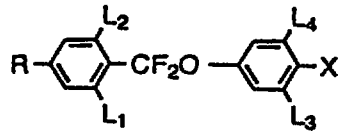
(16) A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative recited in any one of (1) to (12), containing, as a part of the second component, at least one kind of compound selected from a group of compounds expressed by the general formula (II), (III), or (IV), and containing, as other part of the second component, at least one compound selected from a group of compounds expressed by the general formula (V), (VI), (VII), (VIII), or (IX).

(17) A liquid crystal display device composed by using a liquid crystal composition recited in any one of (13) to (16).

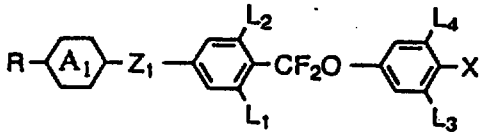
BEST MODE FOR CARRYING OUT THE INVENTION

In the present invention, preferable embodiments of difluorooxymethane derivatives expressed by the general formula (I) include compounds expressed by any one of the following

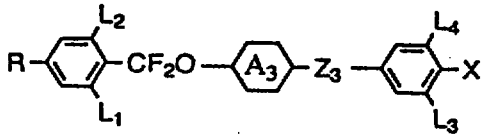
general formulas (1a) to (1e):



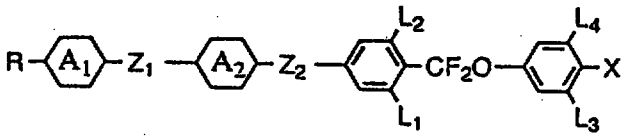
(Ia)



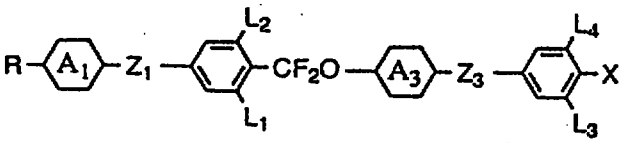
(Ib)



(Ic)

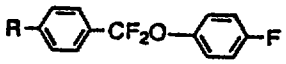


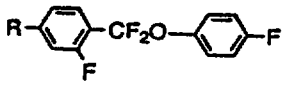
(Id)

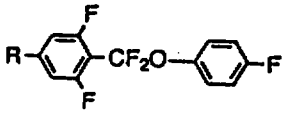


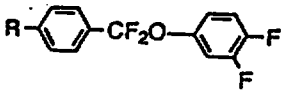
(Ie)

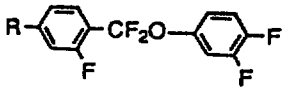
As specific examples of difluorooxymethane derivatives expressed by the general formulas (1a) to (1e), the following compounds (1) to (661) can further be mentioned:

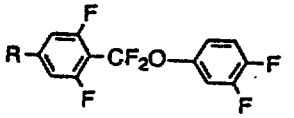

(1)

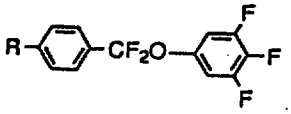

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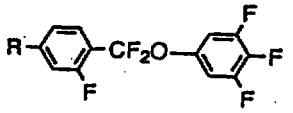

(3)

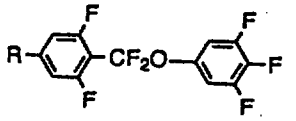

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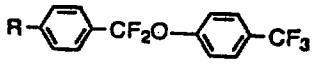

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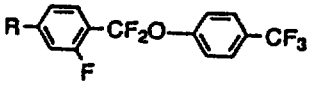

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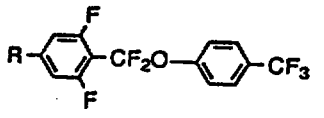

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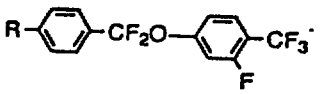

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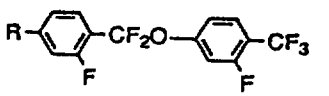

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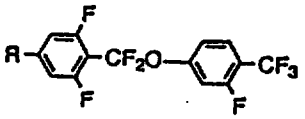

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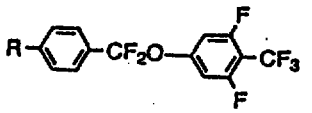

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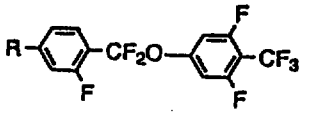

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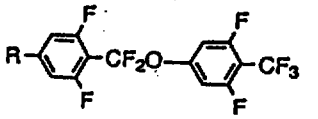

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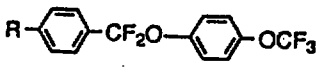

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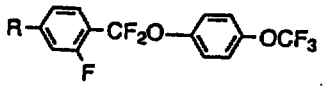

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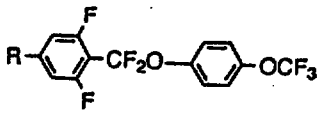

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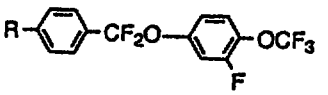

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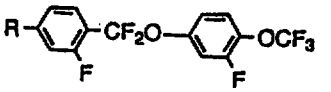

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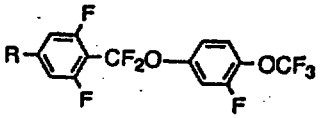

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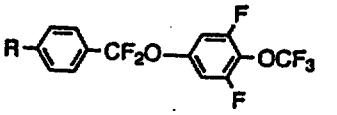

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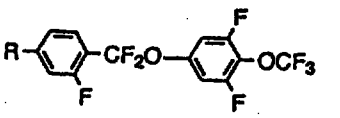

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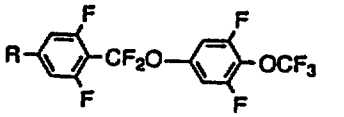

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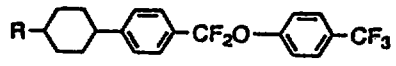

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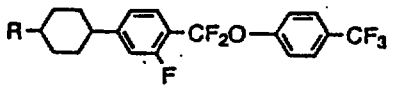

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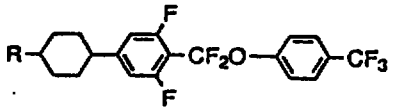

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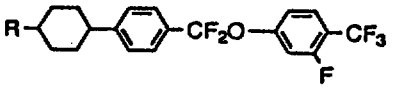

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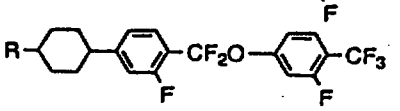

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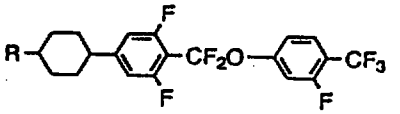

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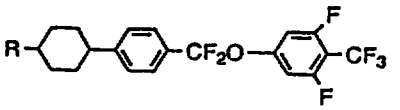

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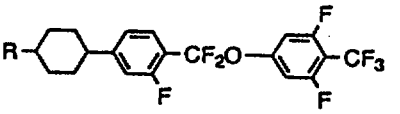

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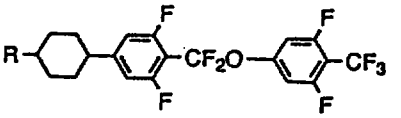

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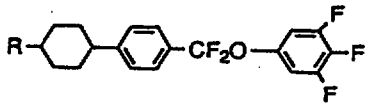

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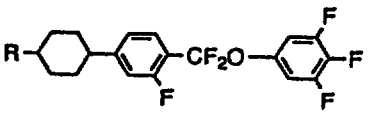

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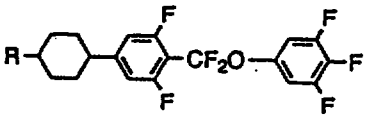

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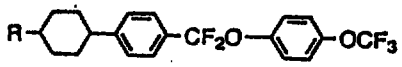

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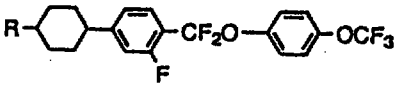

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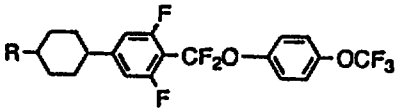

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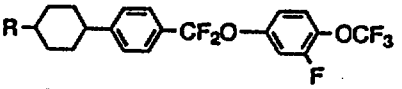

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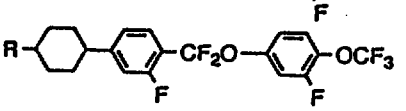

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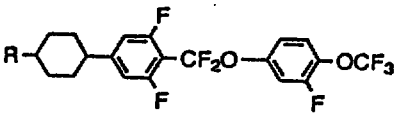

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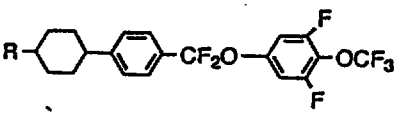

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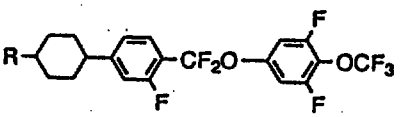

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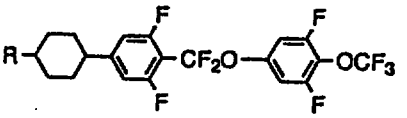

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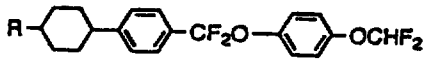

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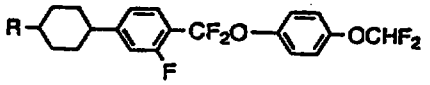

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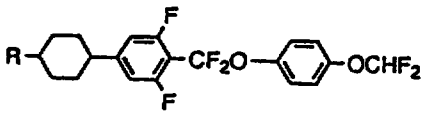

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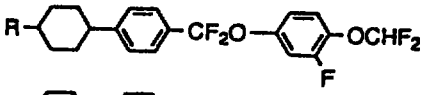

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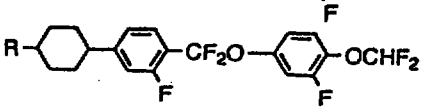

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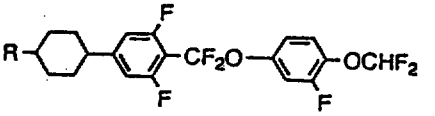

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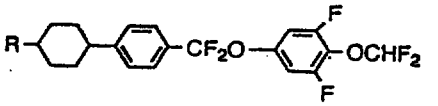

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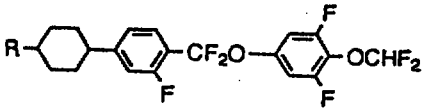

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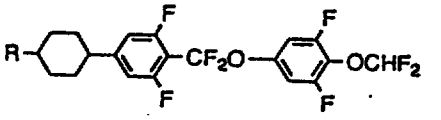

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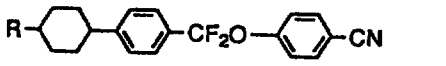

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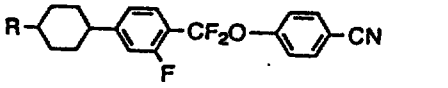

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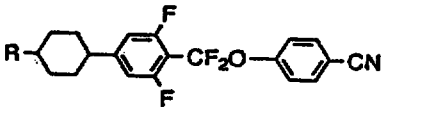

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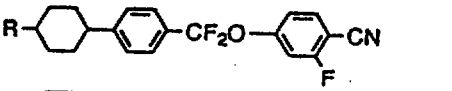

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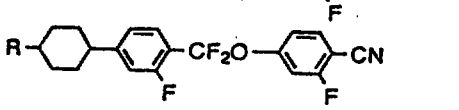

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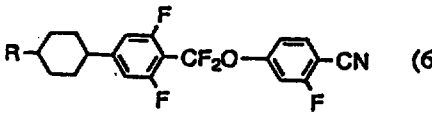

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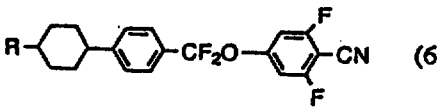

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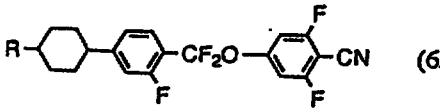

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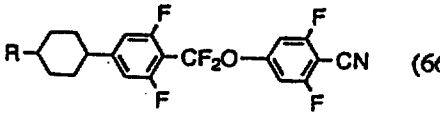

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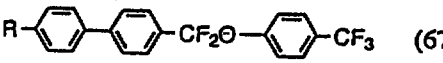

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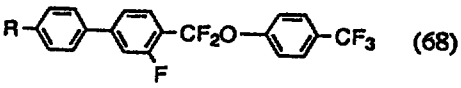

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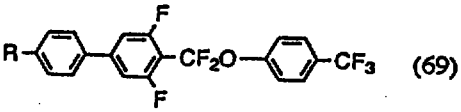

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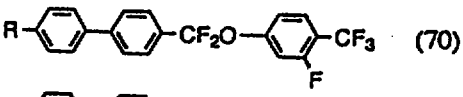

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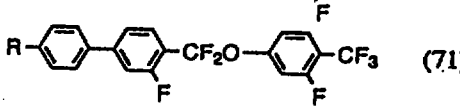

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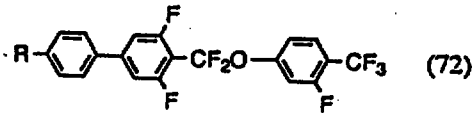

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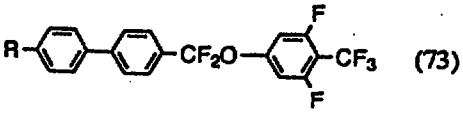

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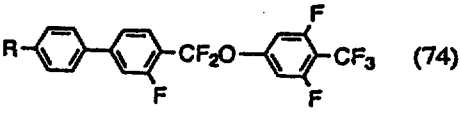

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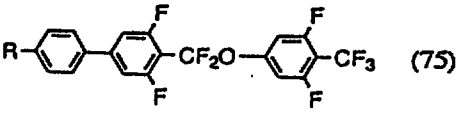

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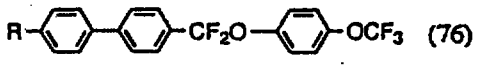

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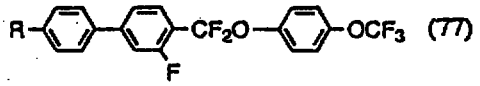

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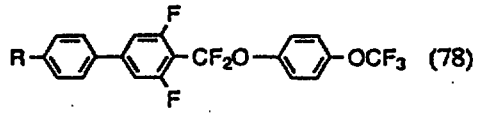

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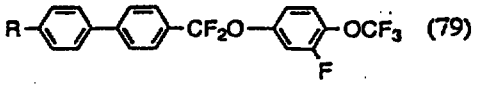

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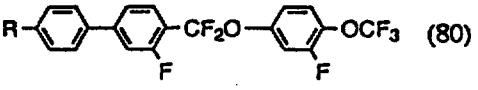

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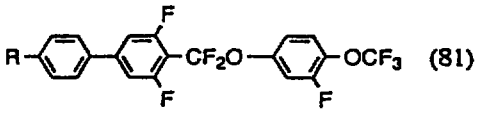

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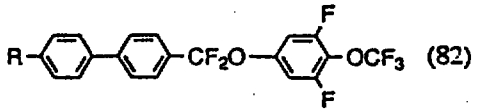

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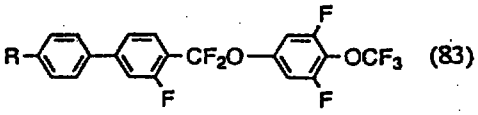

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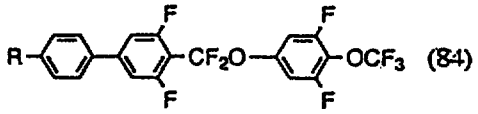

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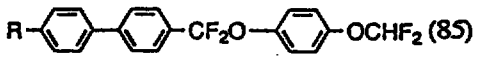

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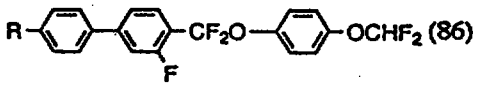

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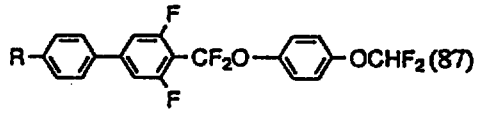

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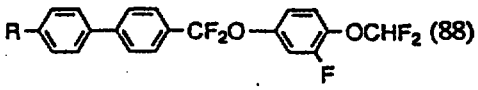

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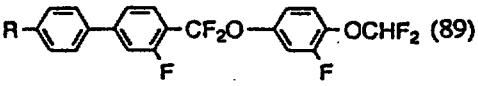

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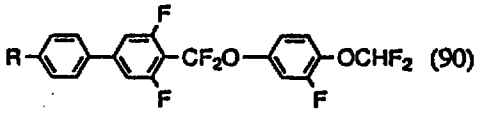

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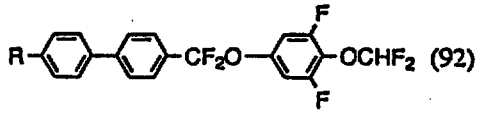

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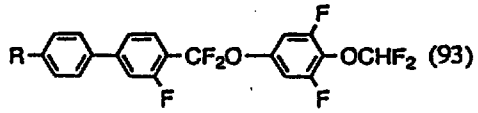

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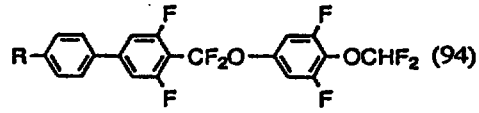

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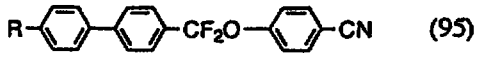

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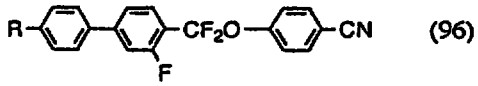

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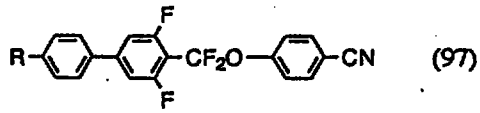

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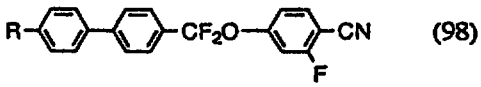

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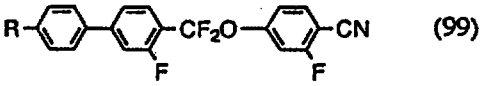

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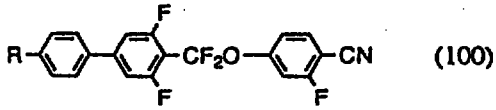

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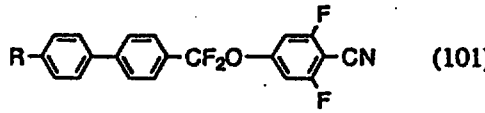

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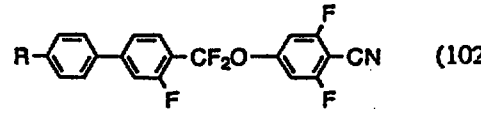

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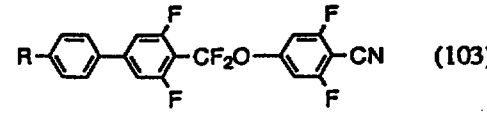

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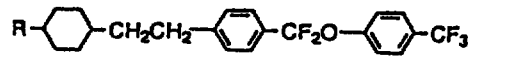

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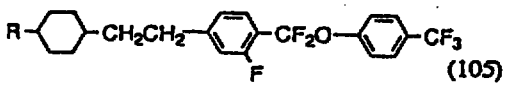

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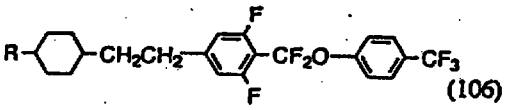

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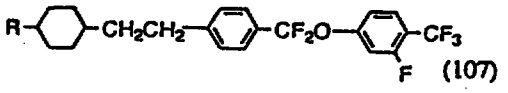

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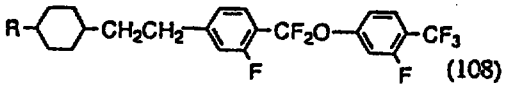

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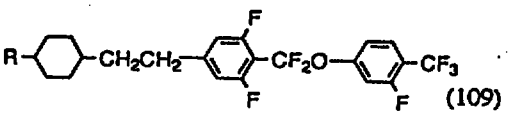

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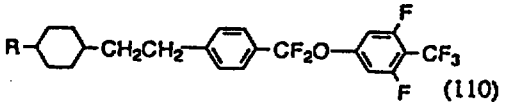

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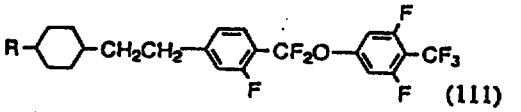

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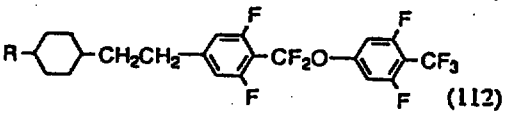

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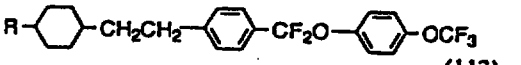

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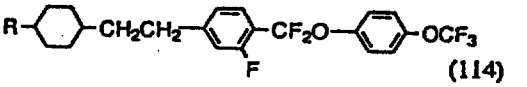

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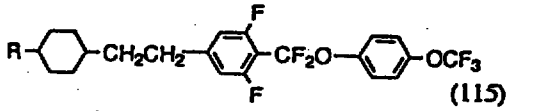

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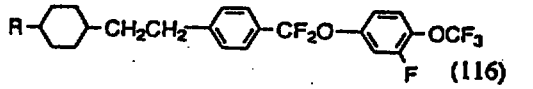

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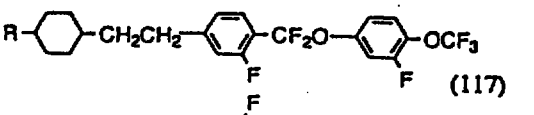

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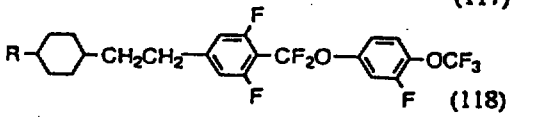

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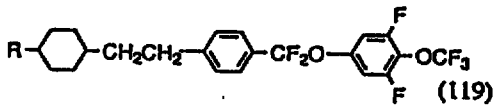

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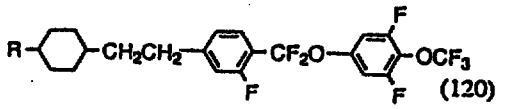

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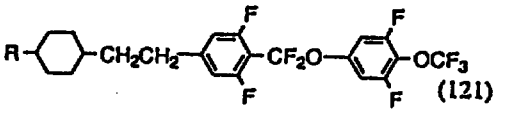

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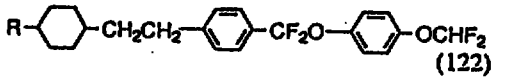

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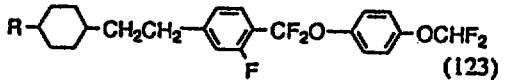

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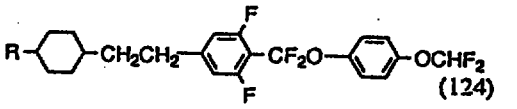

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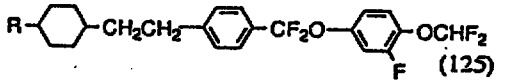

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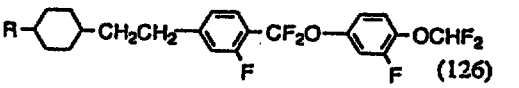

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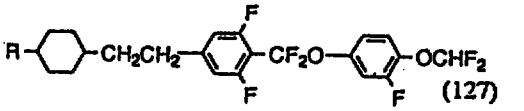

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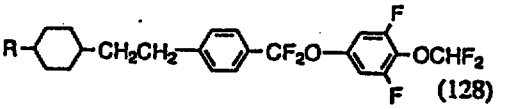

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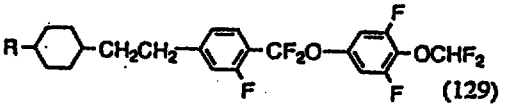

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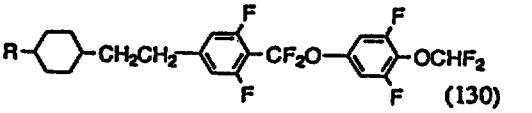

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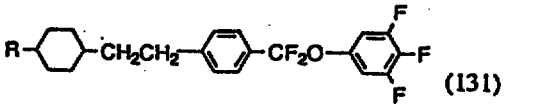

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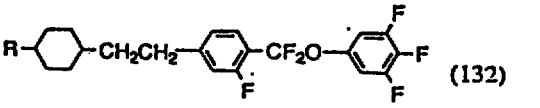

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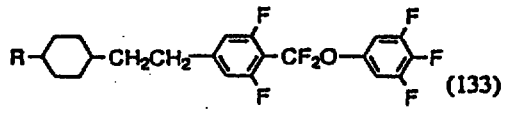

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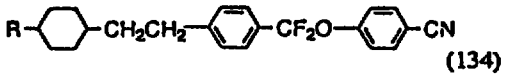

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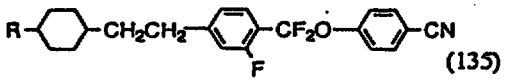

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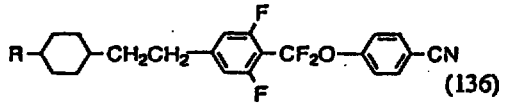

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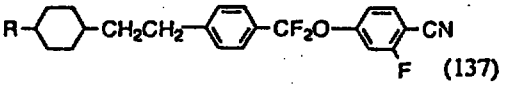

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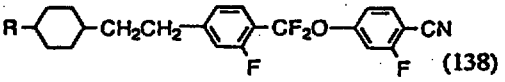

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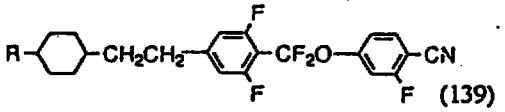

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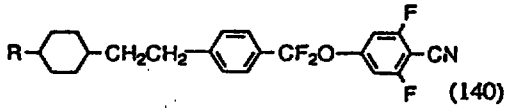

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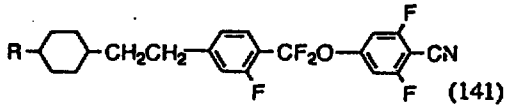

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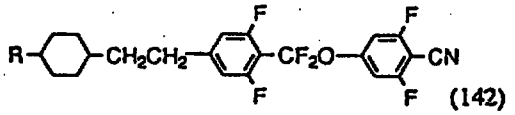

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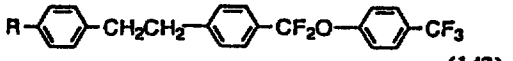

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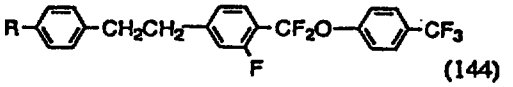

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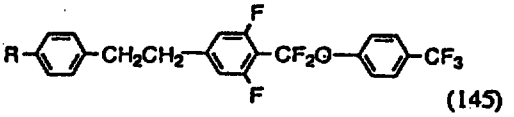

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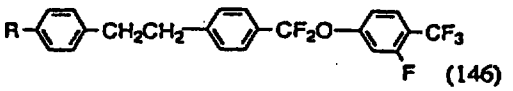

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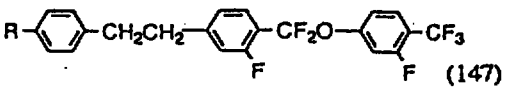

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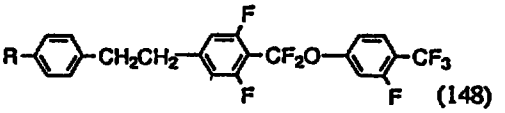

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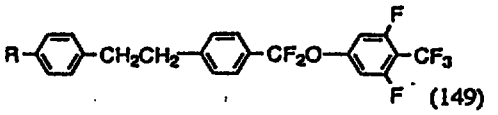

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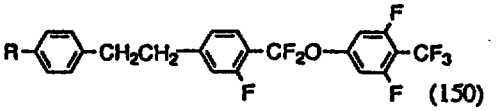

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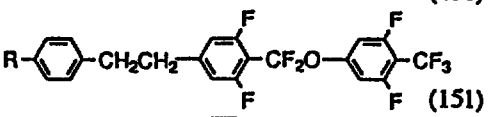

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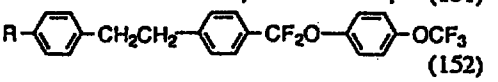

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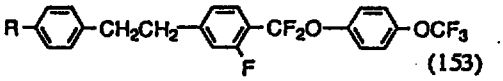

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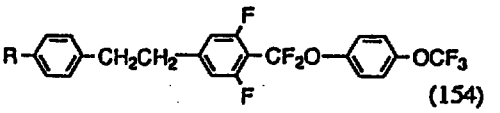

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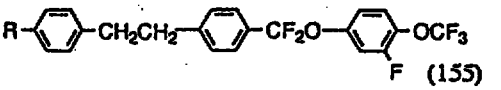

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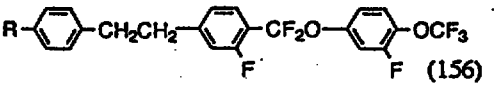

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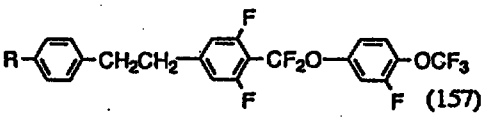

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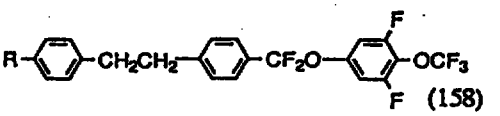

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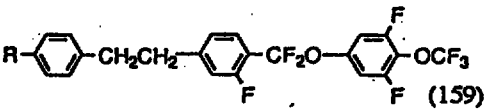

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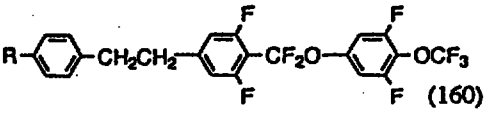

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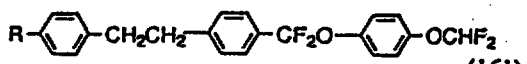

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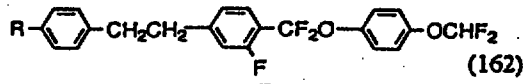

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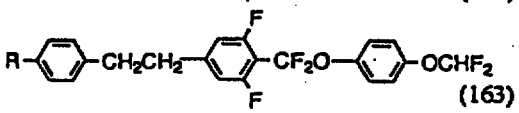

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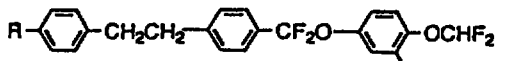

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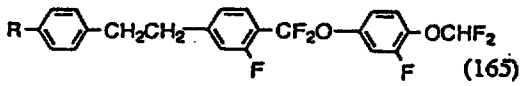

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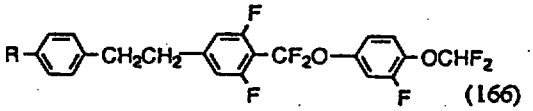

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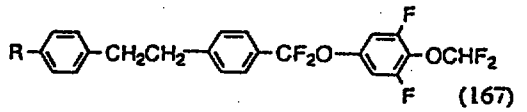

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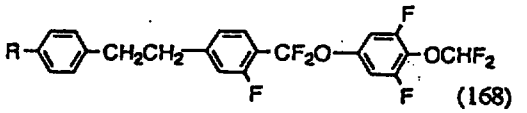

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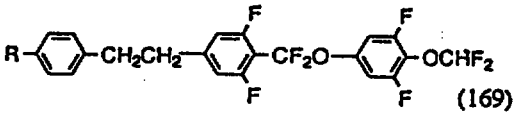

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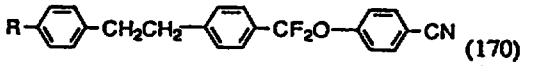

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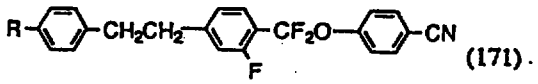

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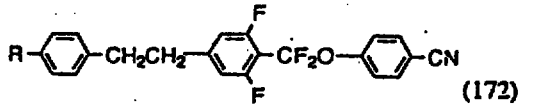

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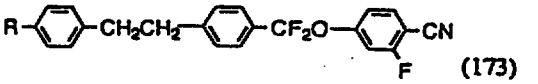

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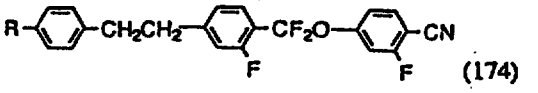

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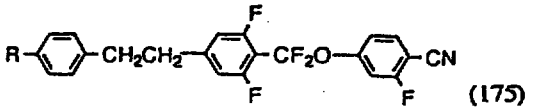

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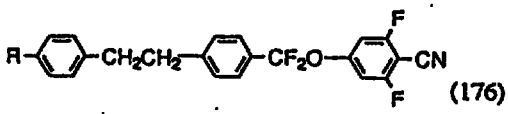

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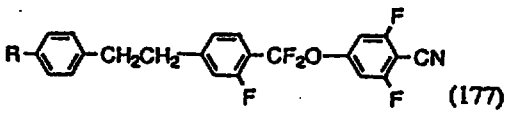

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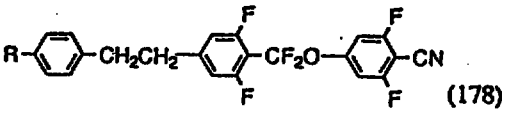

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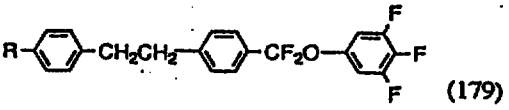

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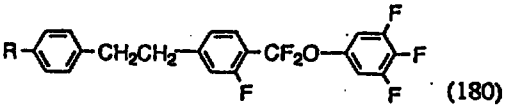

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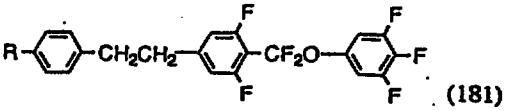

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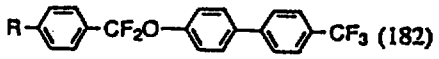

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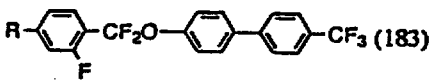

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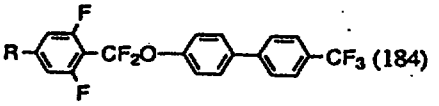

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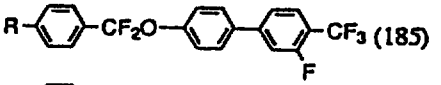

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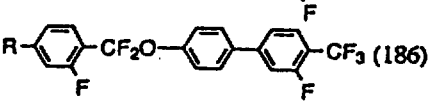

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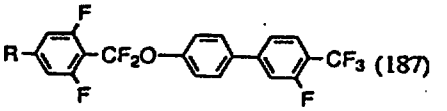

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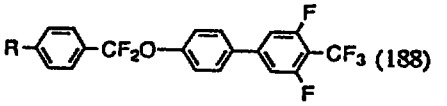

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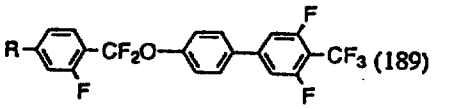

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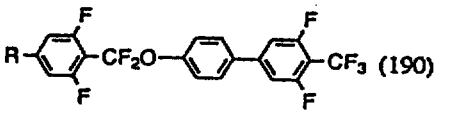

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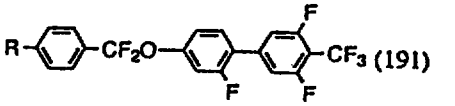

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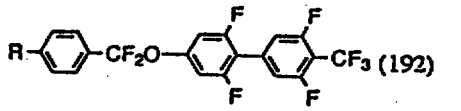

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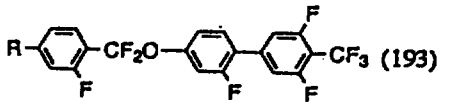

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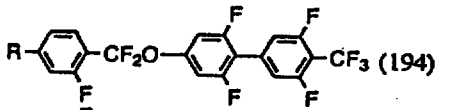

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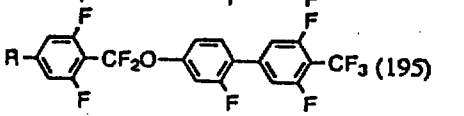

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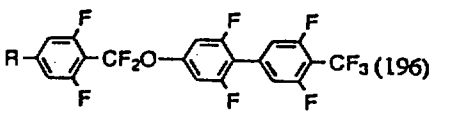

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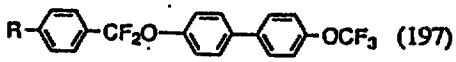

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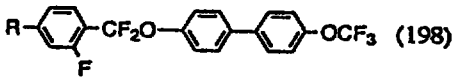

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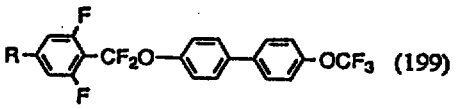

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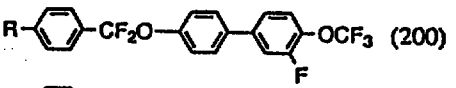

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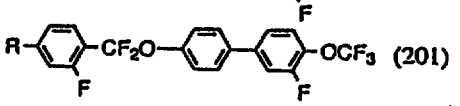

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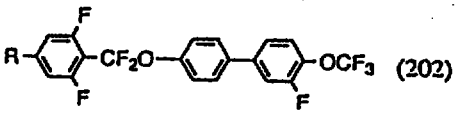

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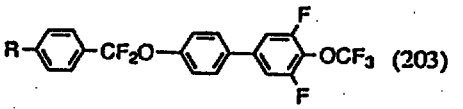

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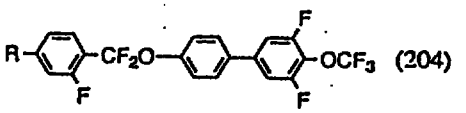

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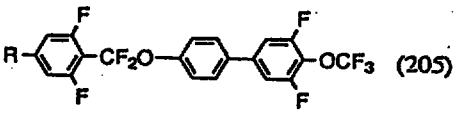

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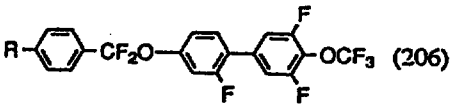

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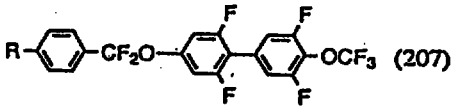

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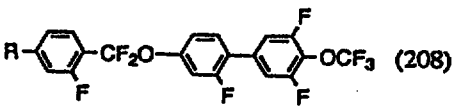

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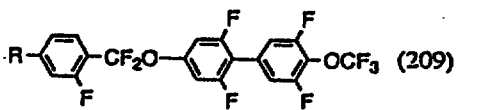

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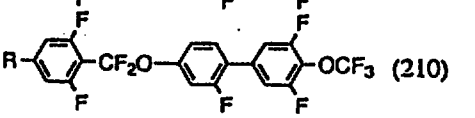

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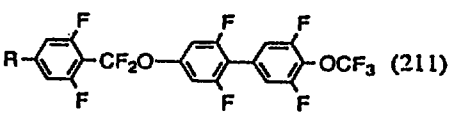

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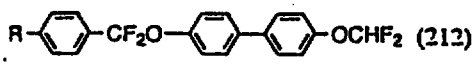

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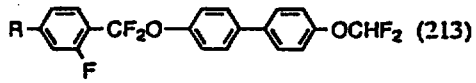

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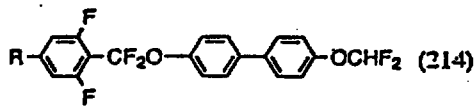

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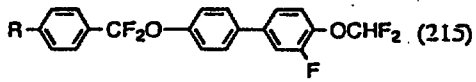

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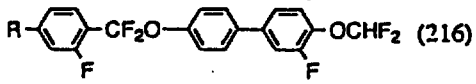

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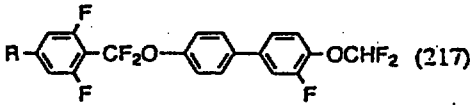

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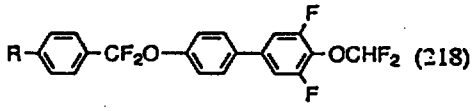

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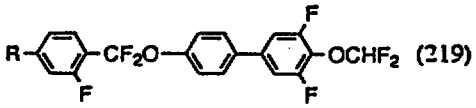

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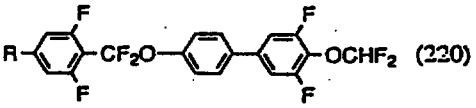

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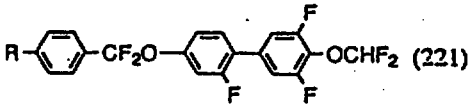

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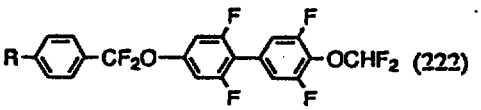

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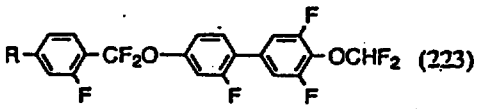

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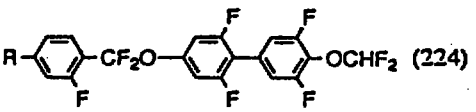

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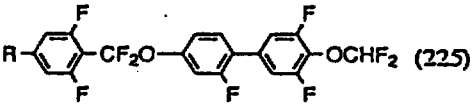

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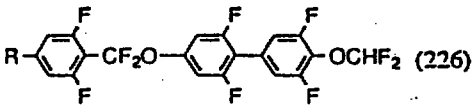

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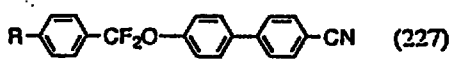

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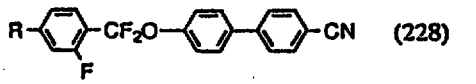

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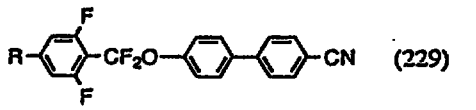

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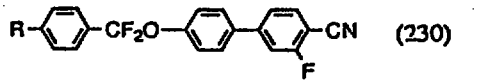

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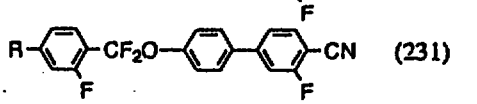

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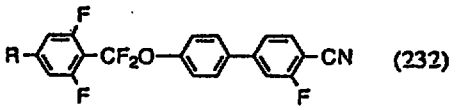

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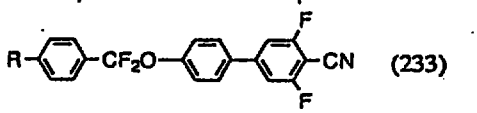

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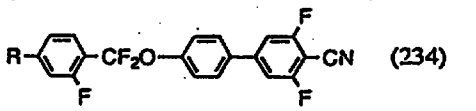

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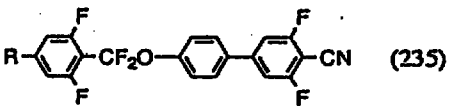

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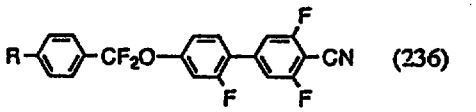

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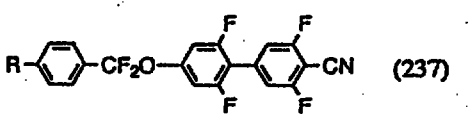

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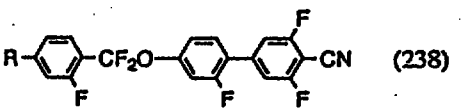

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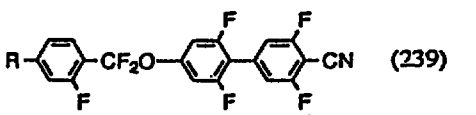

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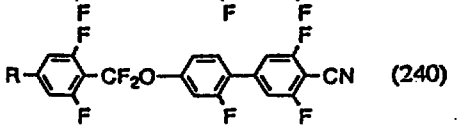

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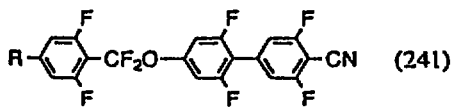

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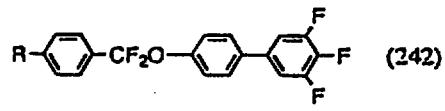

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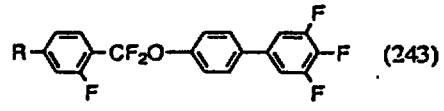

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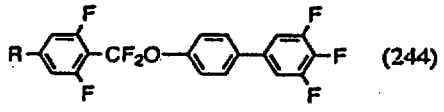

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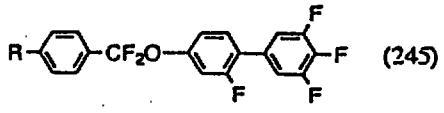

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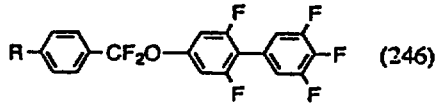

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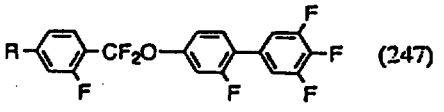

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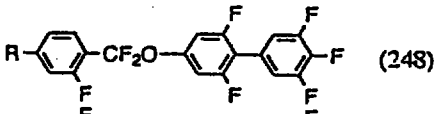

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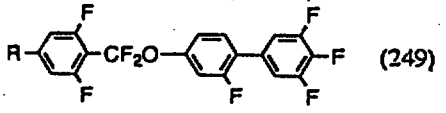

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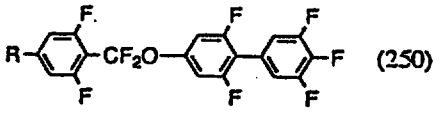

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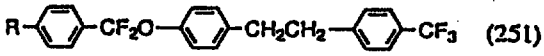

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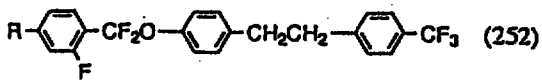

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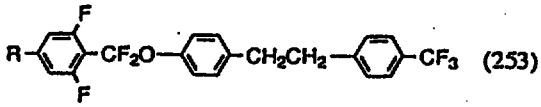

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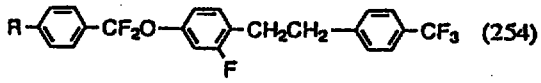

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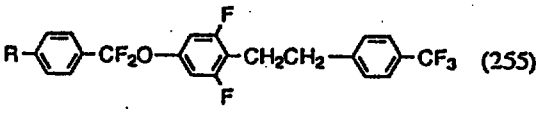

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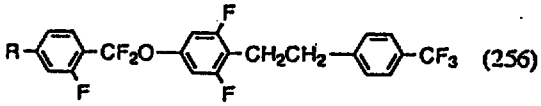

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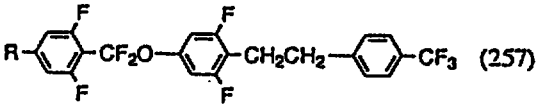

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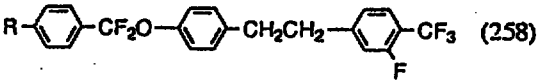

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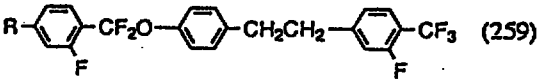

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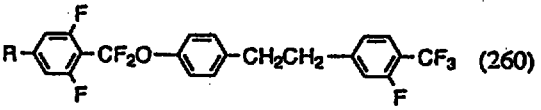

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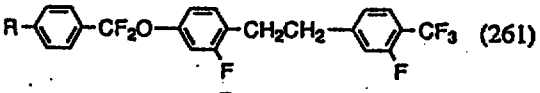

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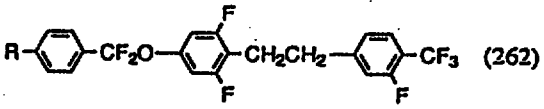

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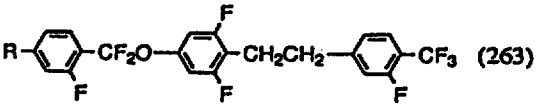

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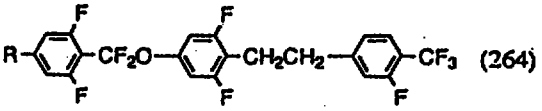

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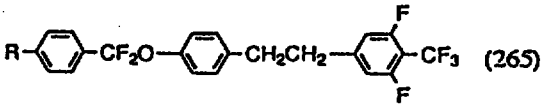

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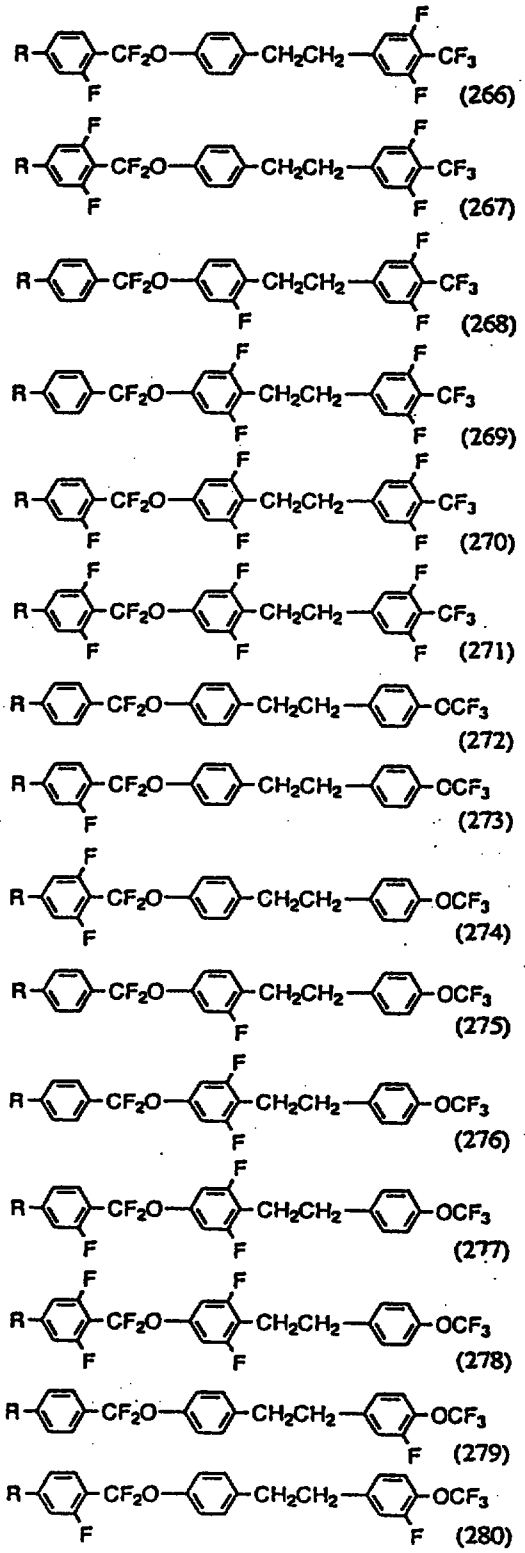

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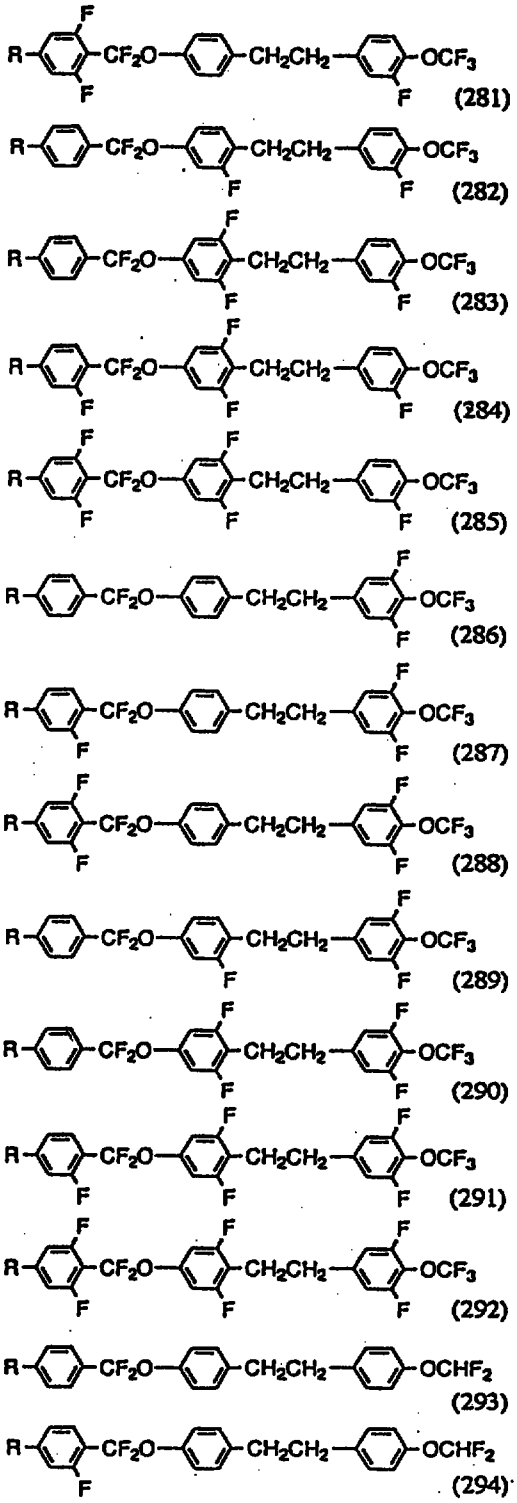

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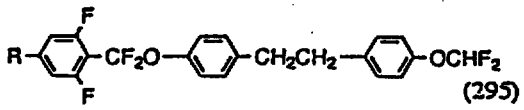

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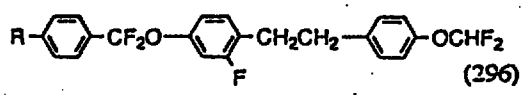

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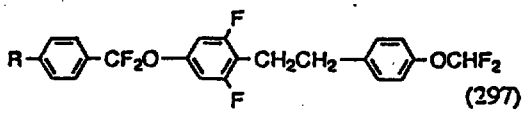

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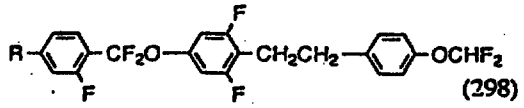

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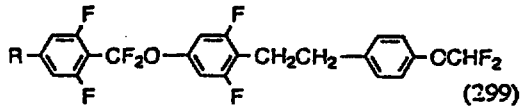

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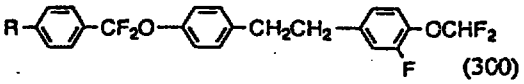

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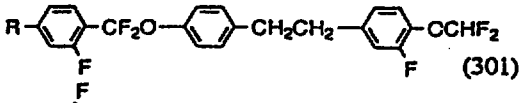

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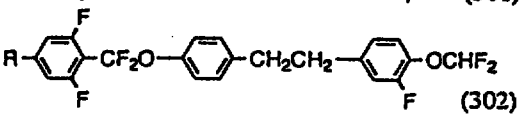

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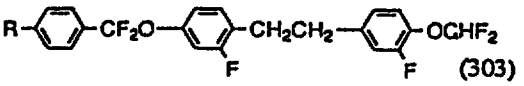

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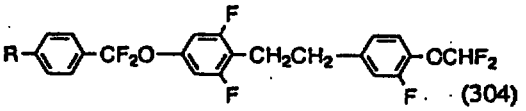

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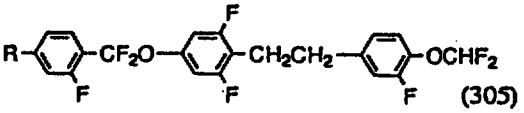

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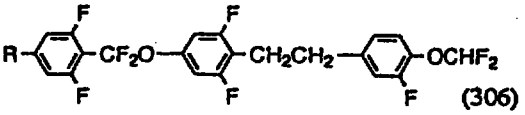

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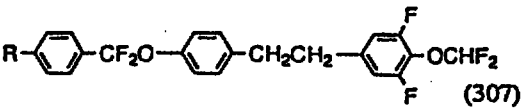

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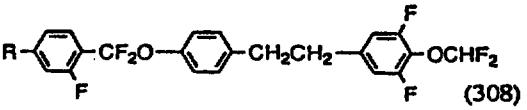

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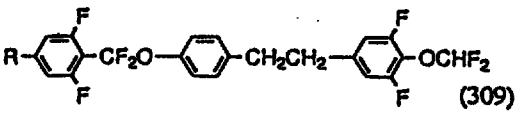

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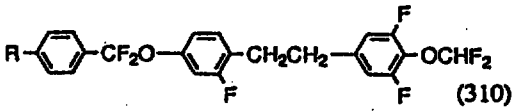

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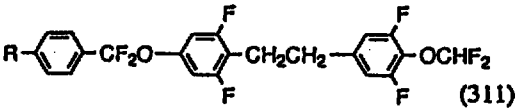

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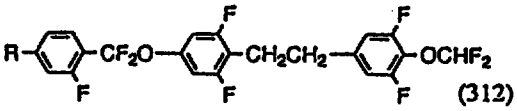

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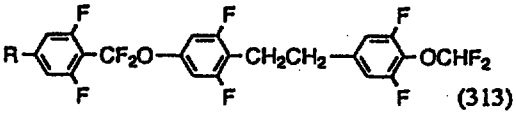

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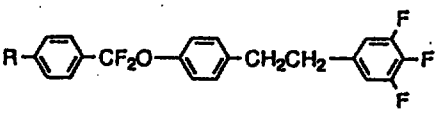

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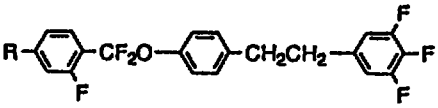

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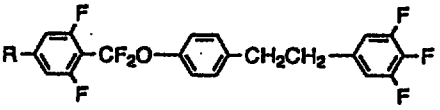

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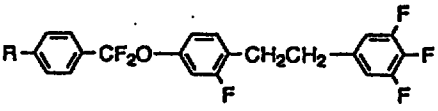

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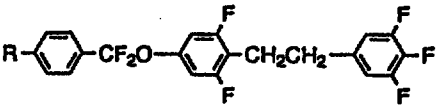

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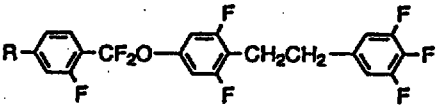

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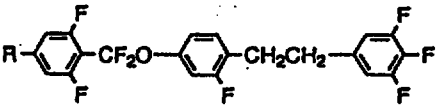

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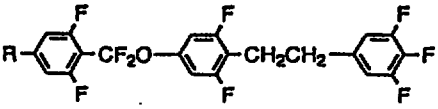

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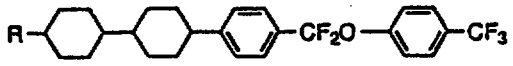

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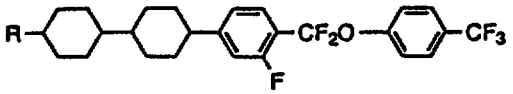

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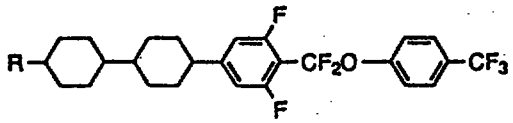

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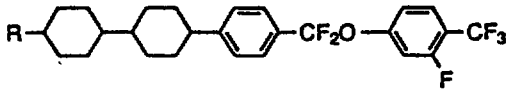

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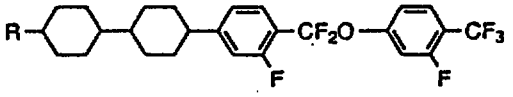

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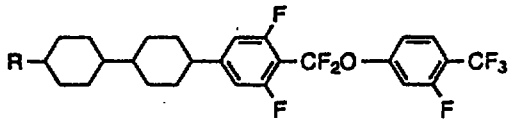

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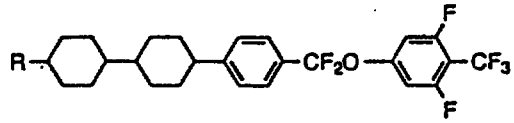

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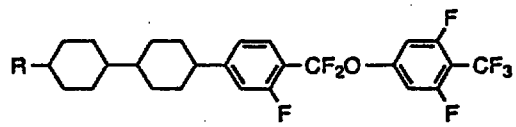

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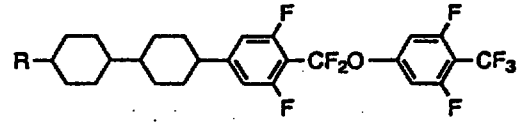

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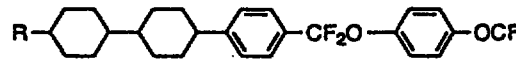

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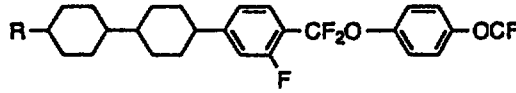

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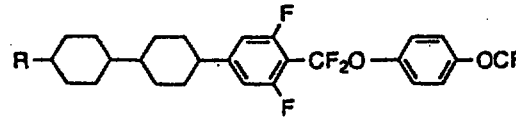

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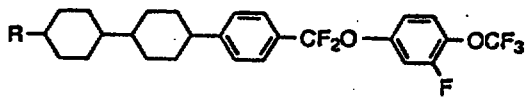

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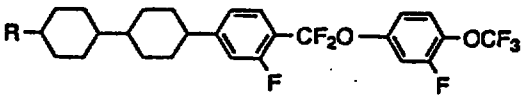

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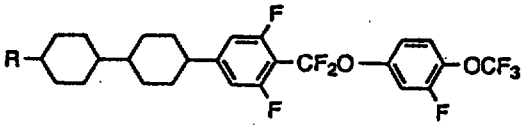

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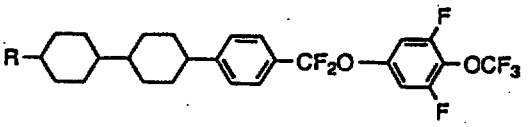

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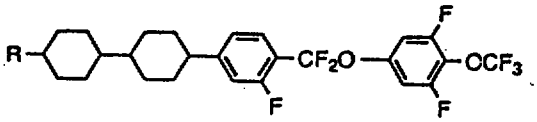

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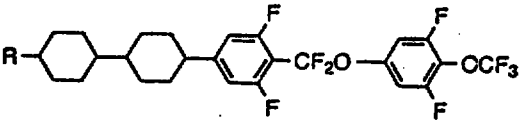

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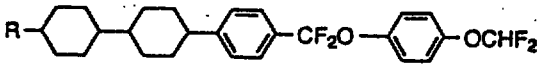

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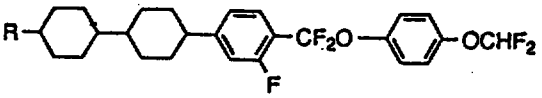

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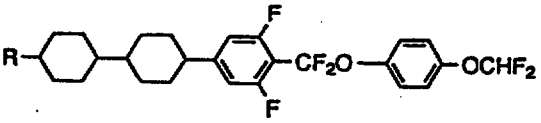

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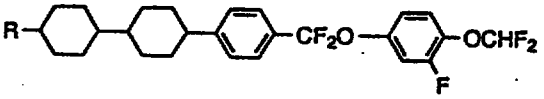

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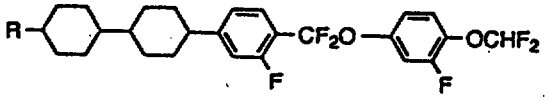

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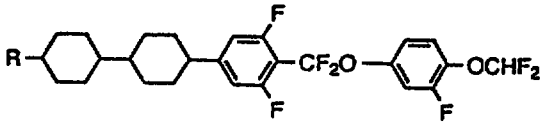

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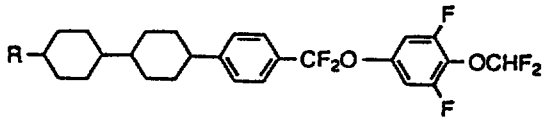

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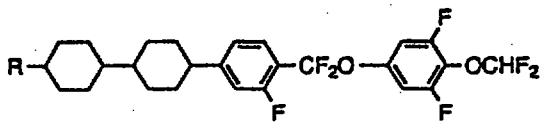

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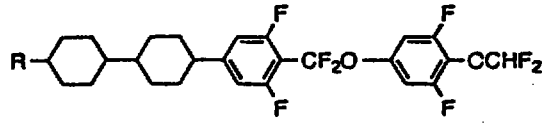

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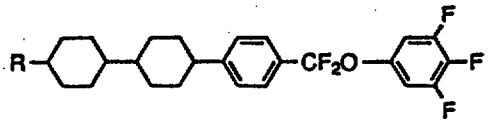

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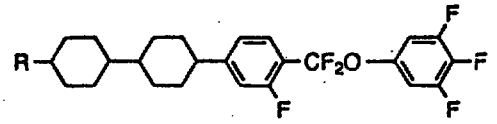

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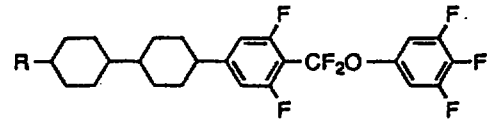

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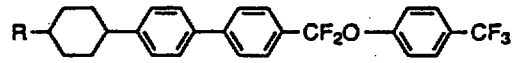

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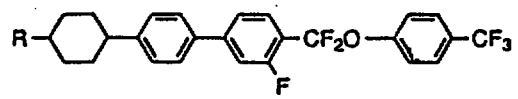

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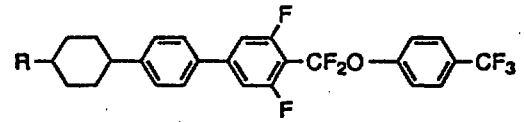

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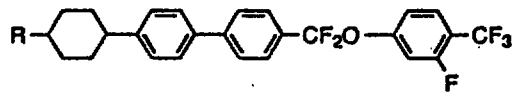

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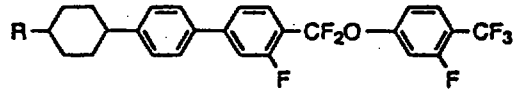

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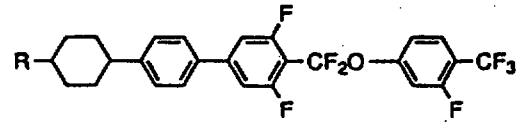

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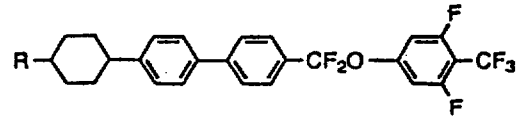

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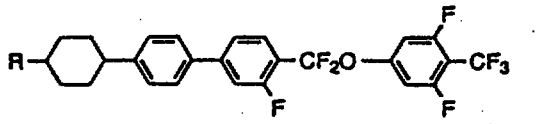

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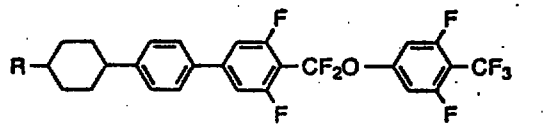

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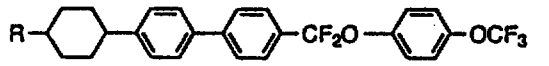

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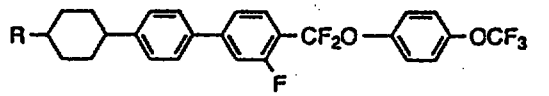

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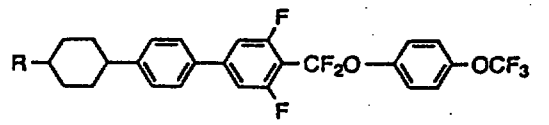

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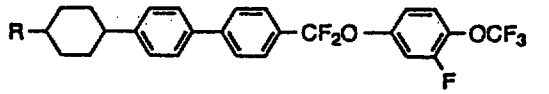

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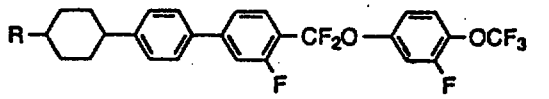

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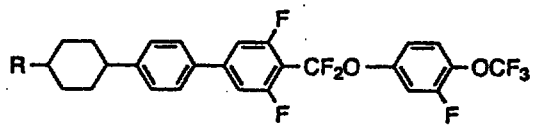

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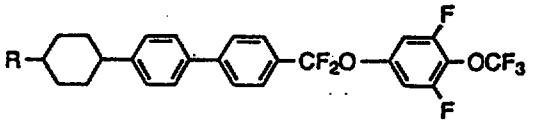

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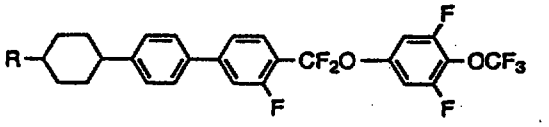

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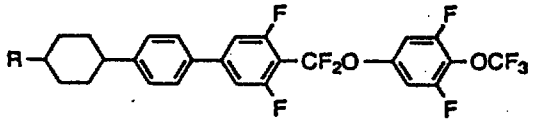

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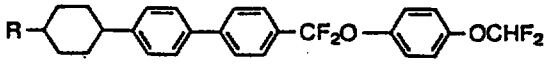

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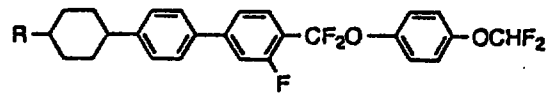

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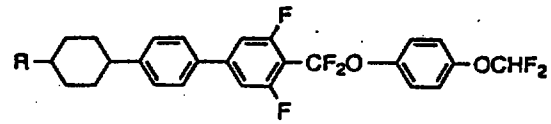

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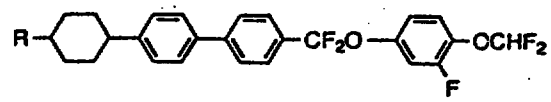

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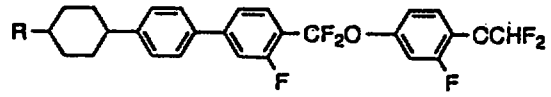

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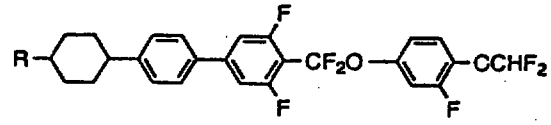

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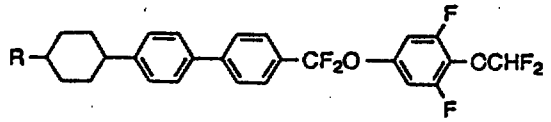

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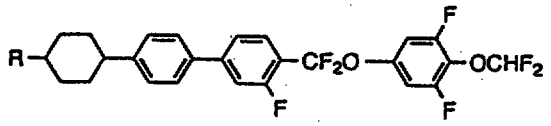

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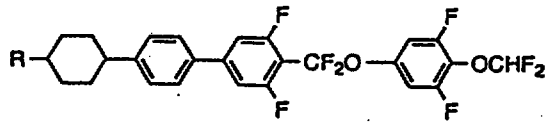

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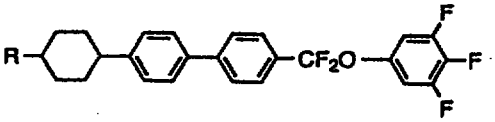

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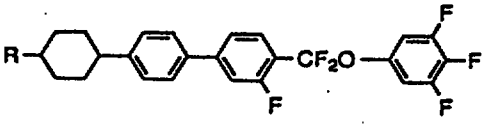

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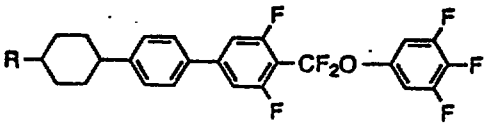

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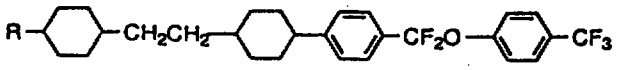

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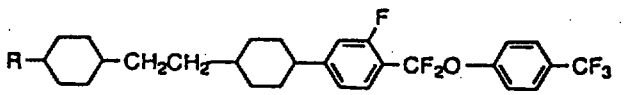

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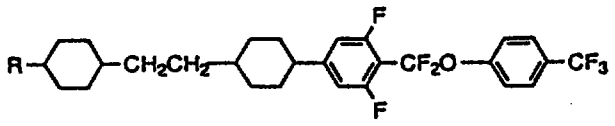

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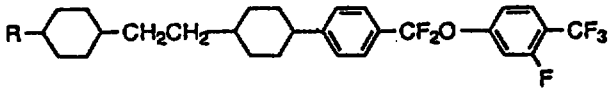

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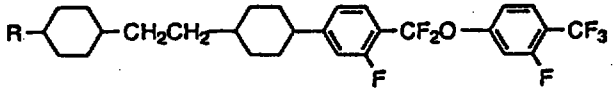

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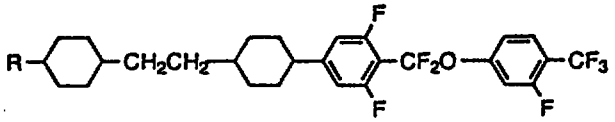

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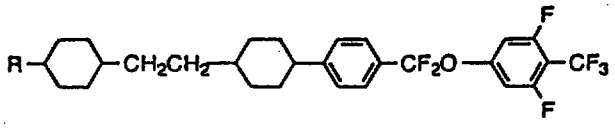

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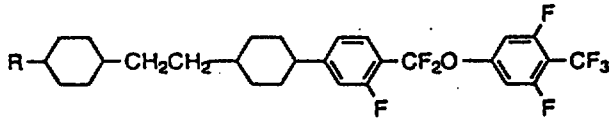

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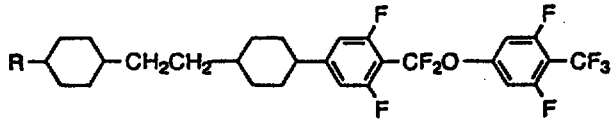

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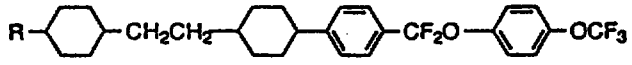

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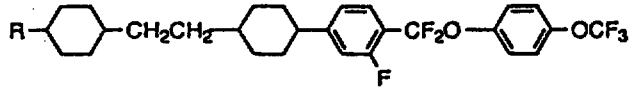

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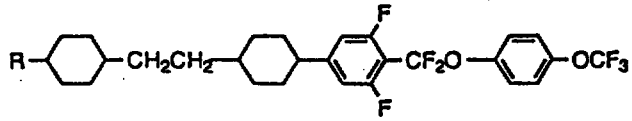

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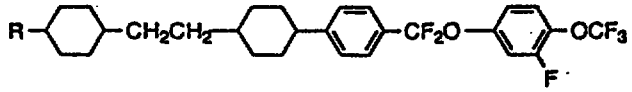

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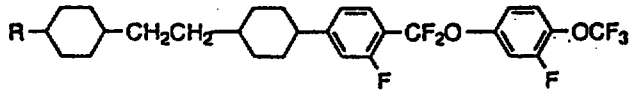

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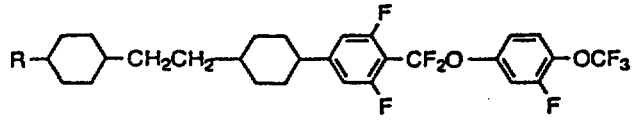

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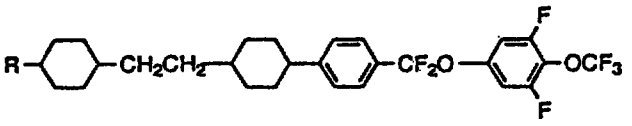

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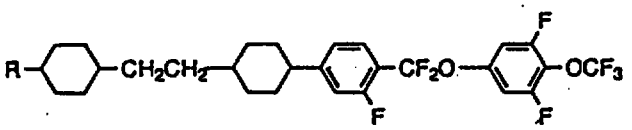

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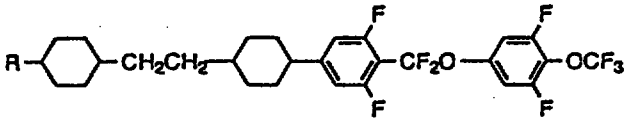

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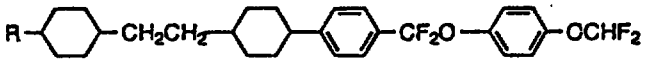

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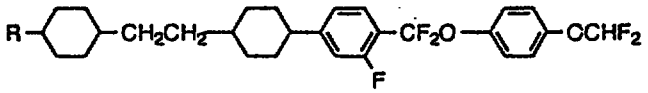

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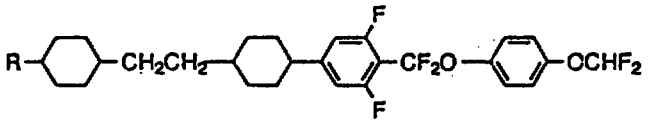

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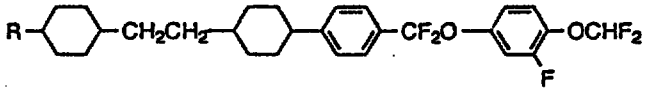

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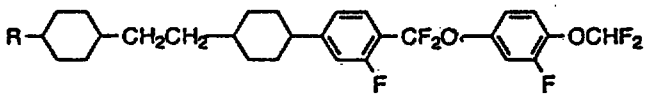

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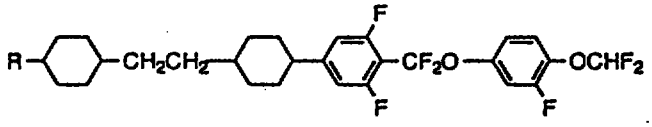

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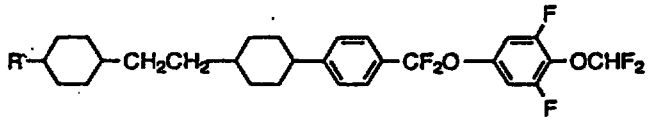

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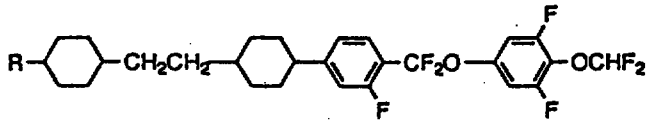

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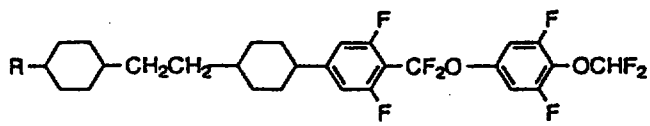

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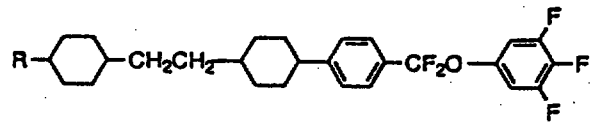

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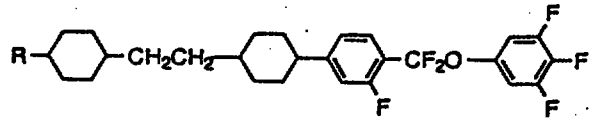

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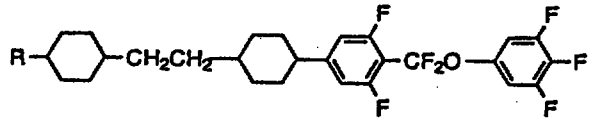

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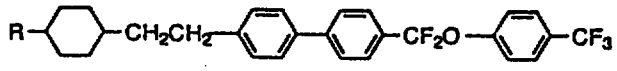

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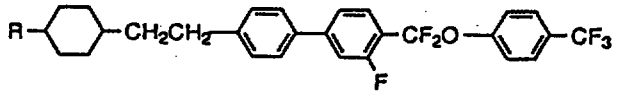

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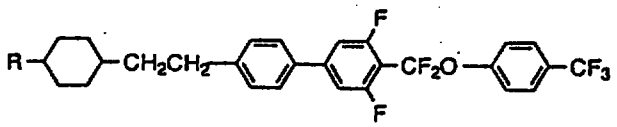

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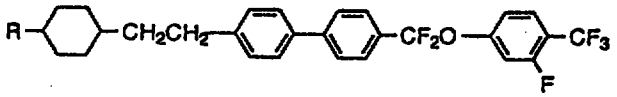

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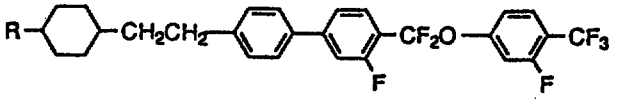

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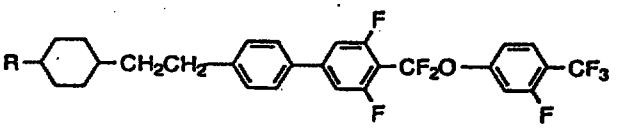

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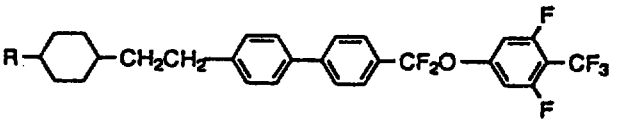

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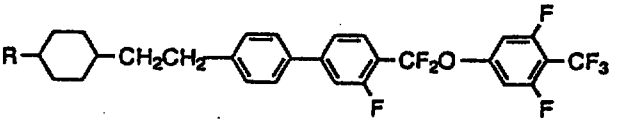

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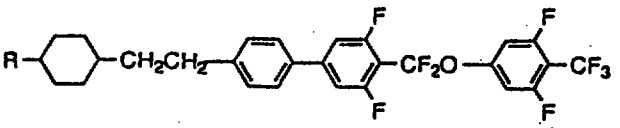

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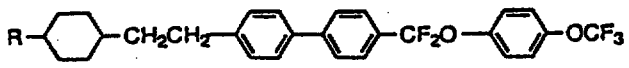

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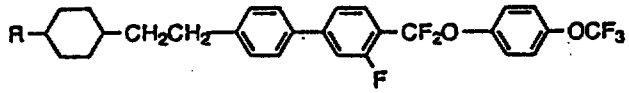

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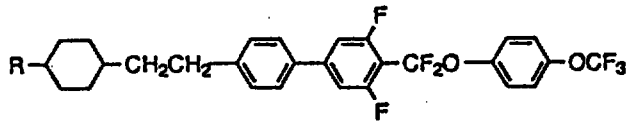

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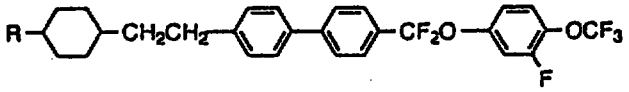

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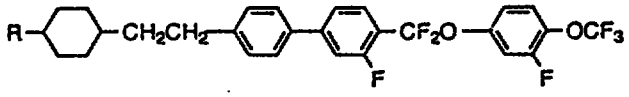

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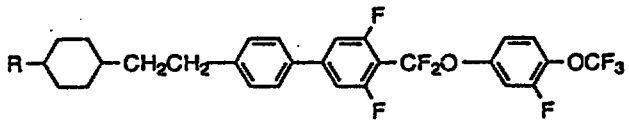

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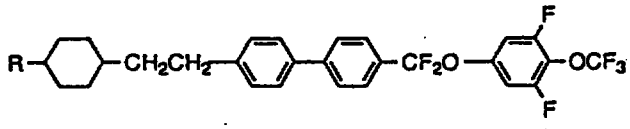

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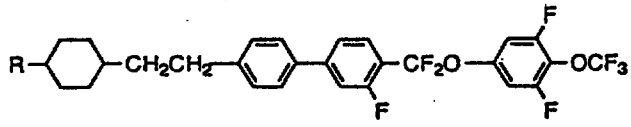

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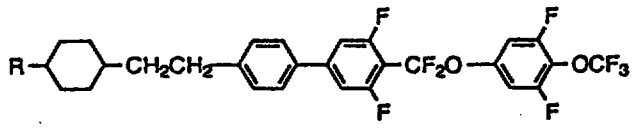

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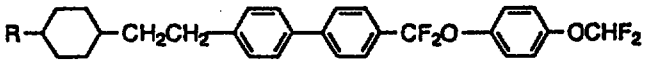

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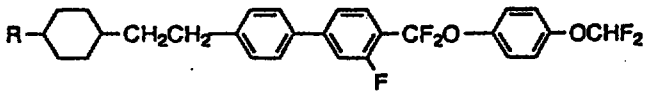

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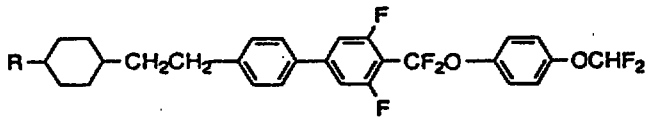

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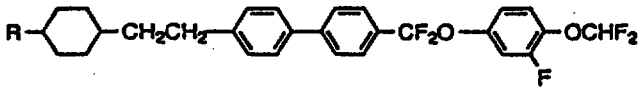

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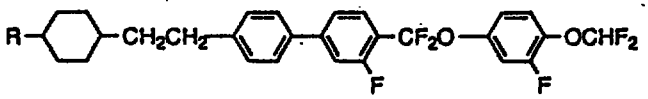

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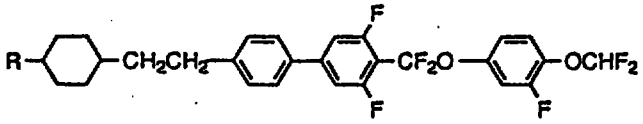

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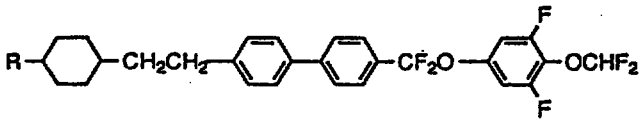

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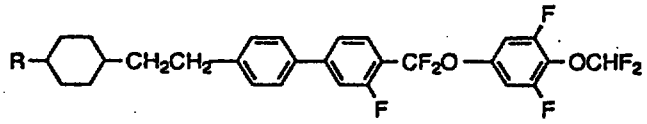

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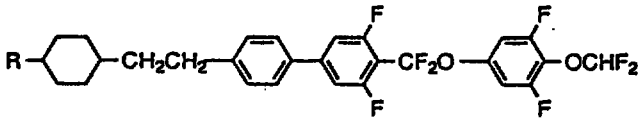

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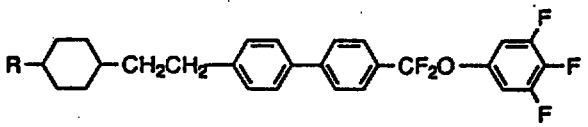

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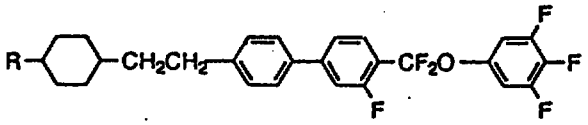

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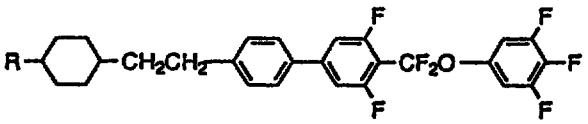

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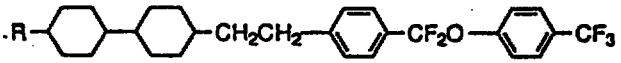

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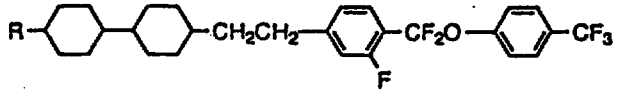

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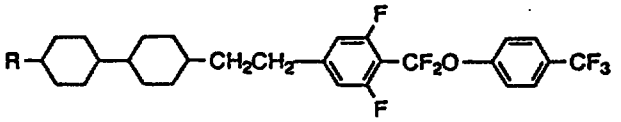

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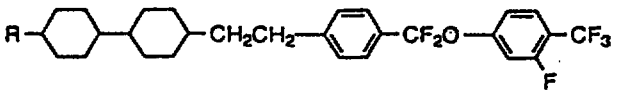

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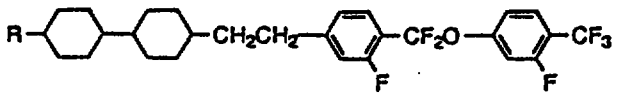

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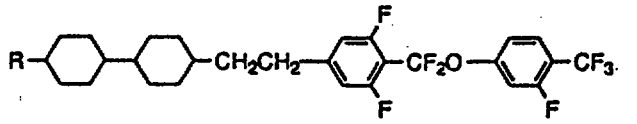

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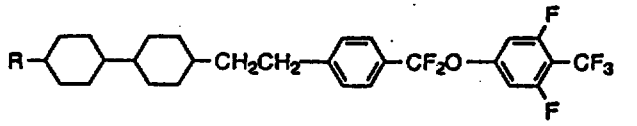

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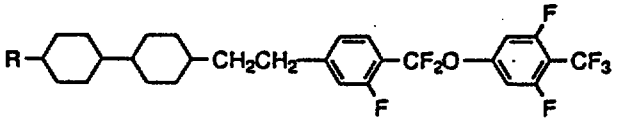

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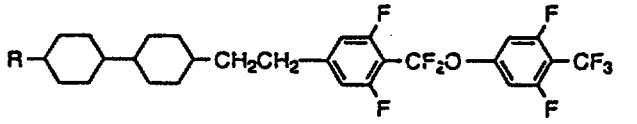

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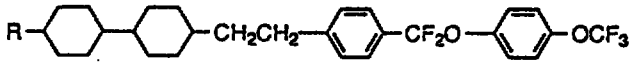

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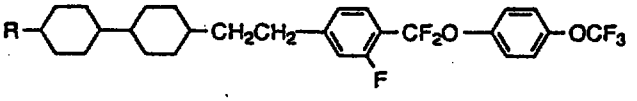

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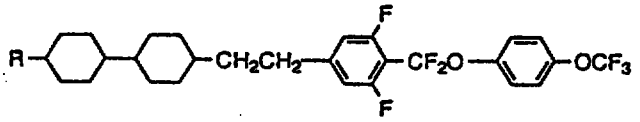

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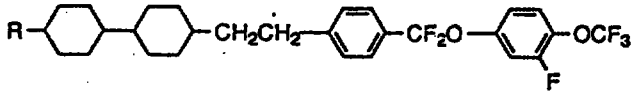

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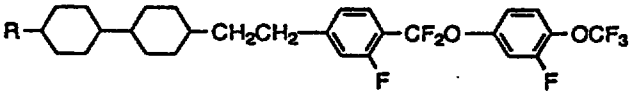

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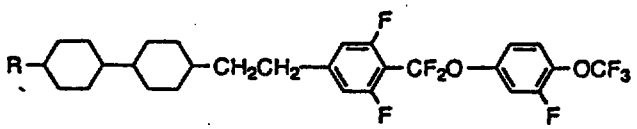

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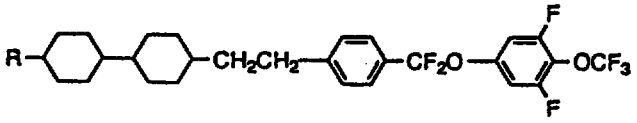

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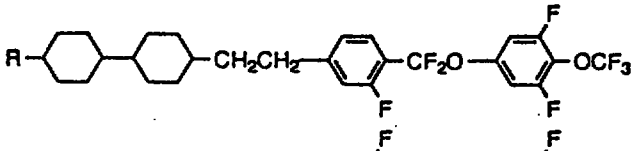

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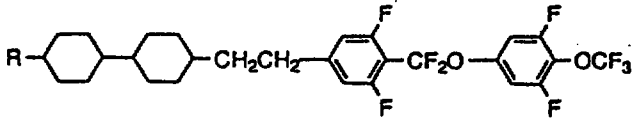

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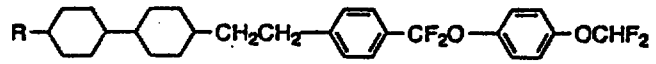

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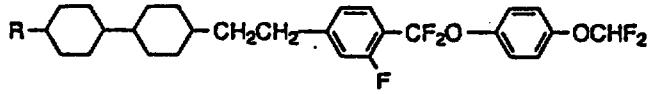

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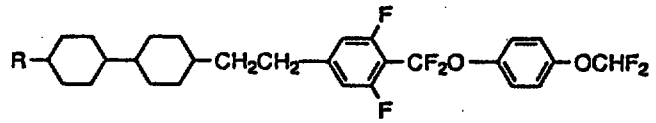

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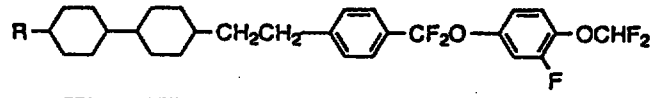

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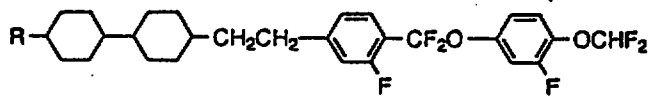

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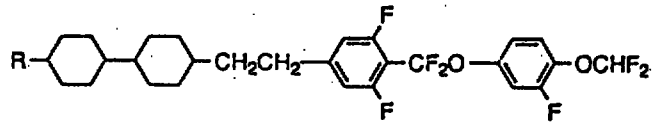

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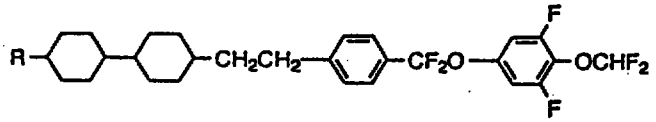

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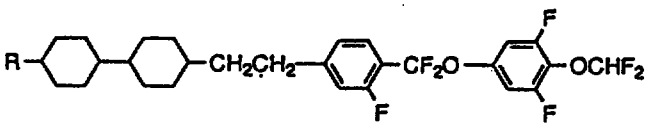

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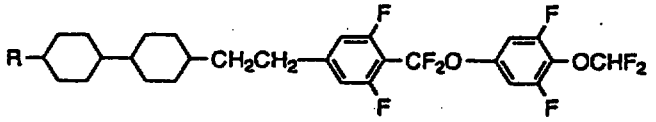

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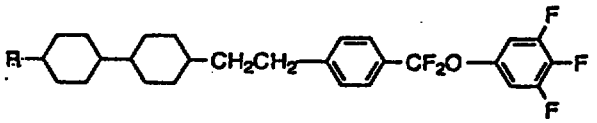

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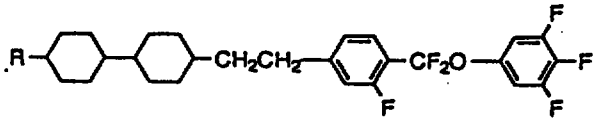

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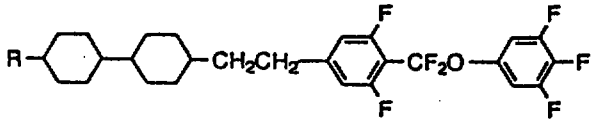

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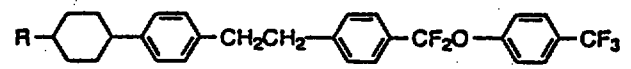

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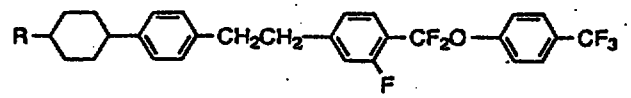

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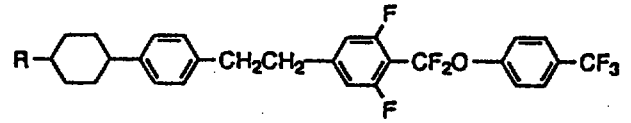

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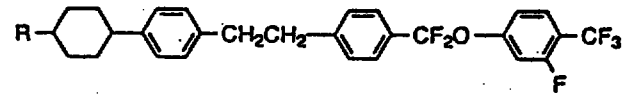

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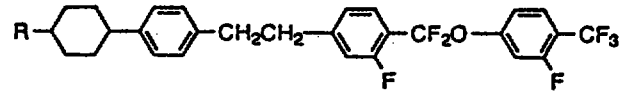

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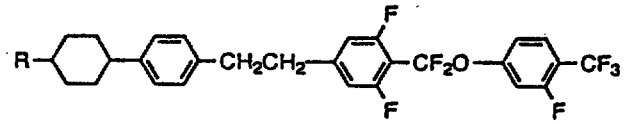

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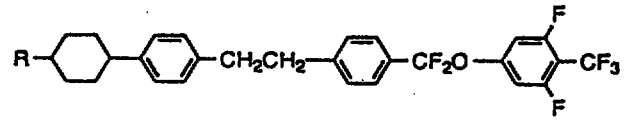

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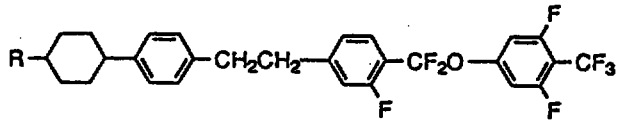

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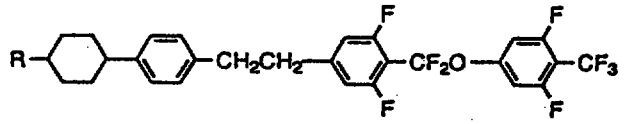

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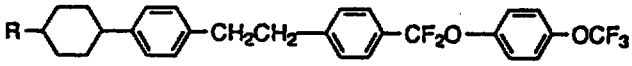

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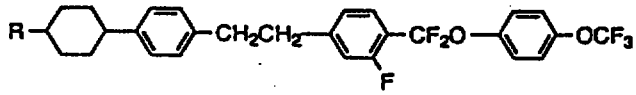

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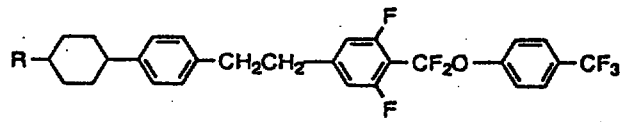

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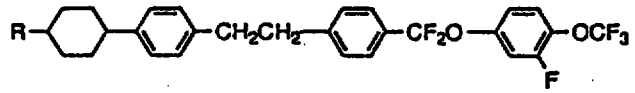

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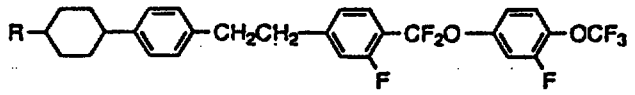

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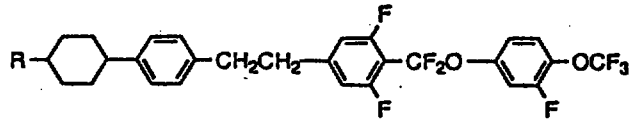

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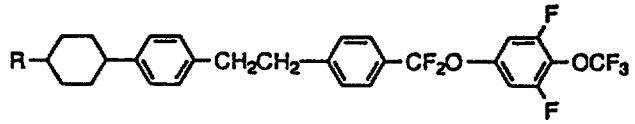

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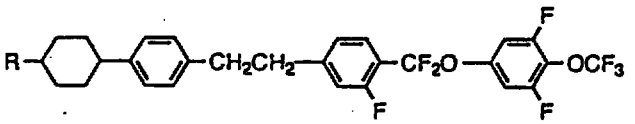

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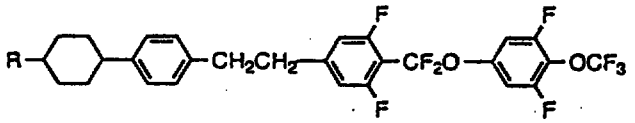

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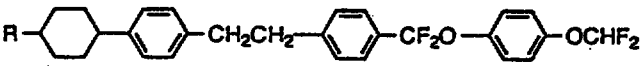

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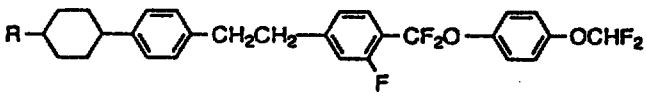

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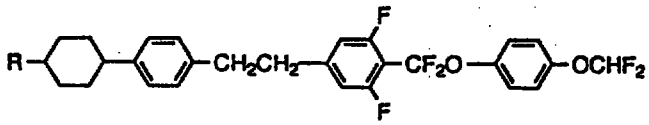

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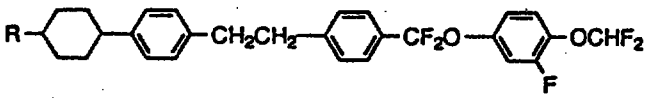

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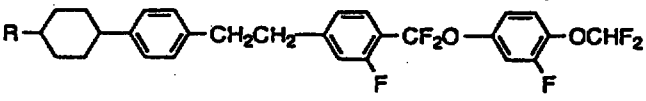

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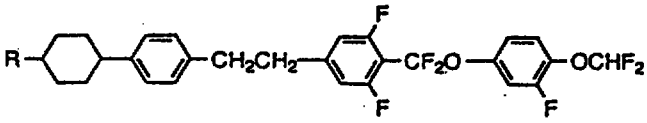

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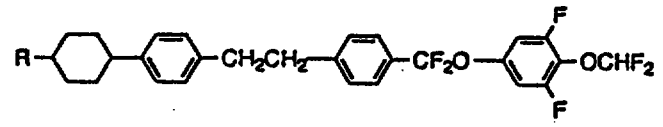

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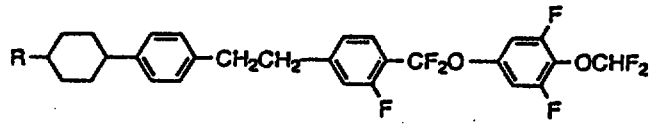

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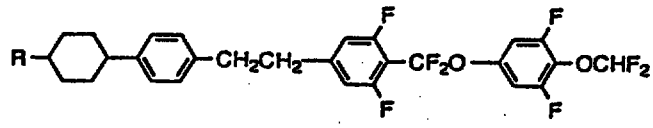

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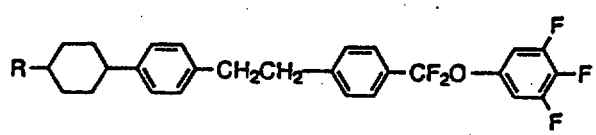

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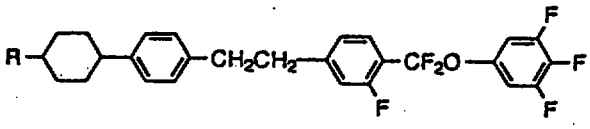

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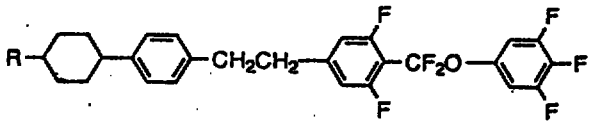

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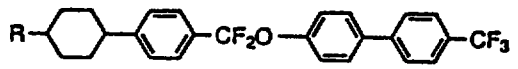

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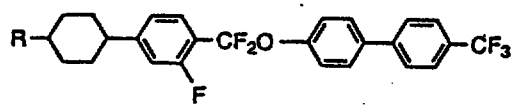

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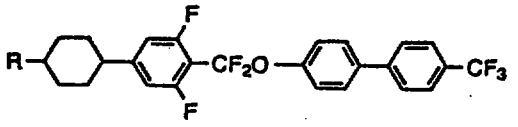

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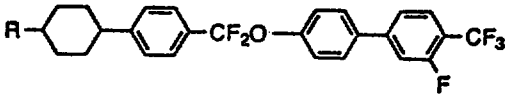

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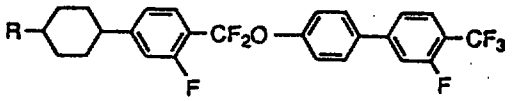

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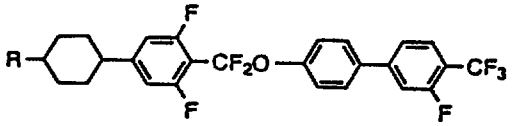

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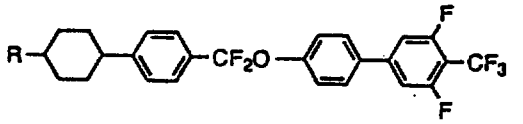

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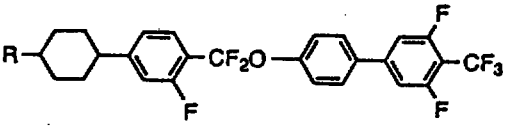

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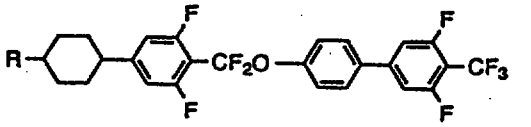

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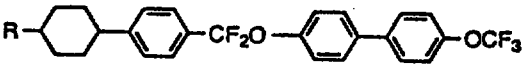

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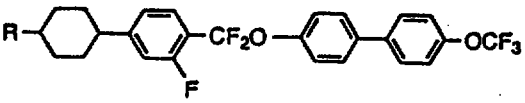

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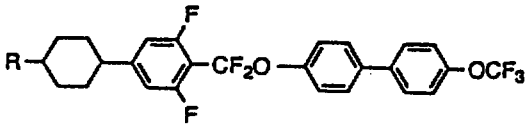

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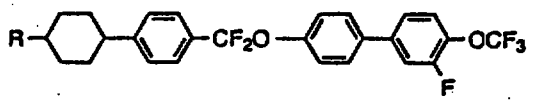

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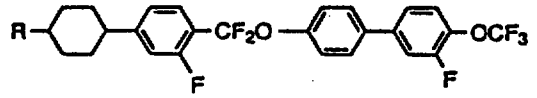

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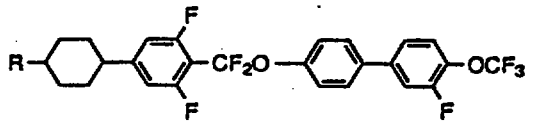

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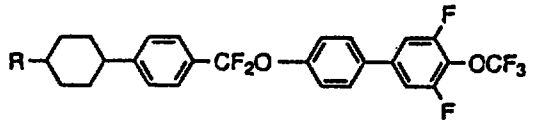

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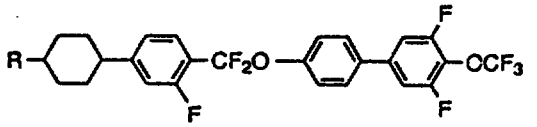

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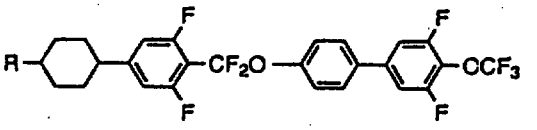

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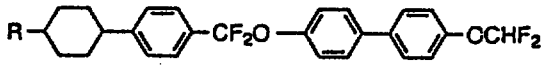

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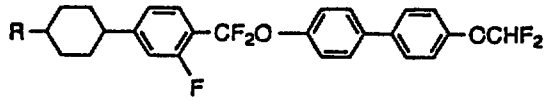

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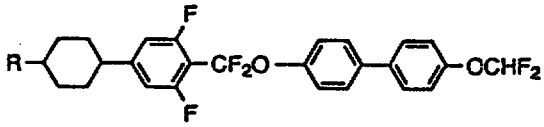

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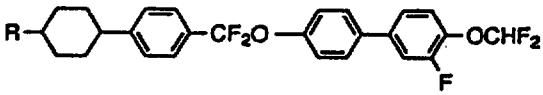

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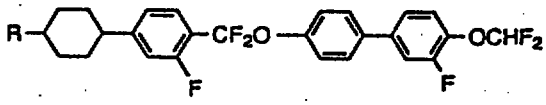

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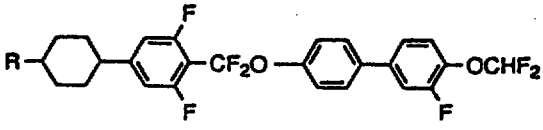

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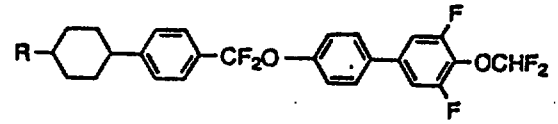

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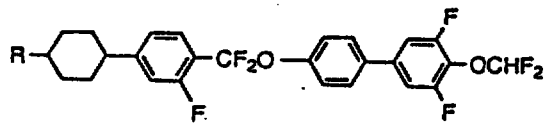

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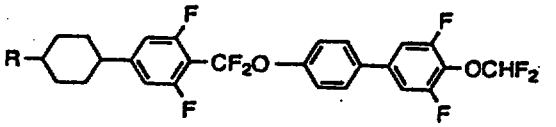

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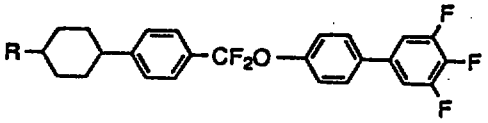

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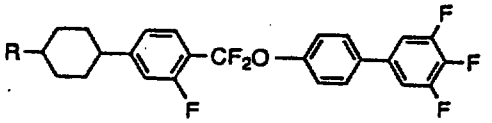

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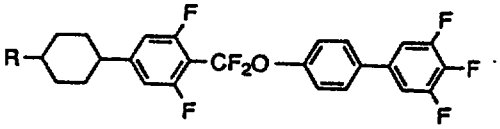

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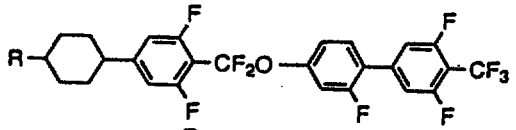

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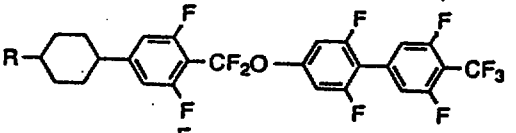

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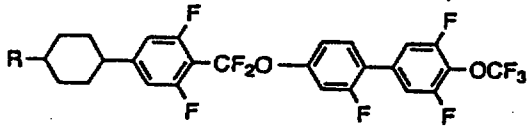

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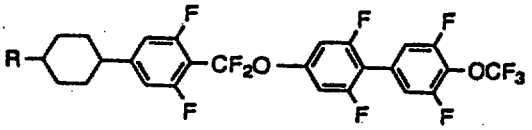

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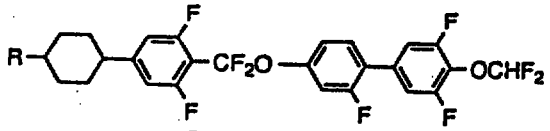

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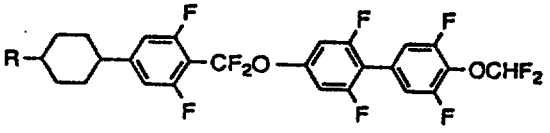

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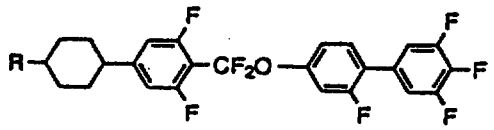

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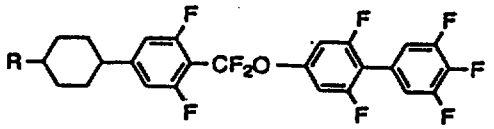

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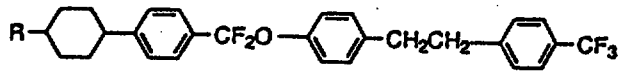

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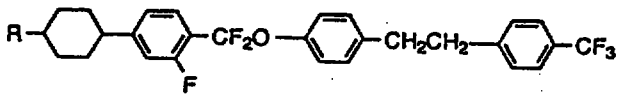

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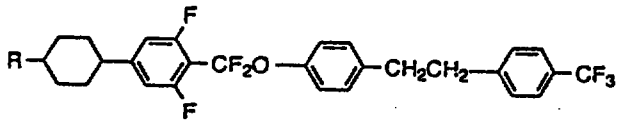

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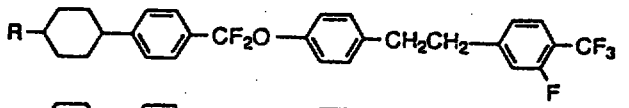

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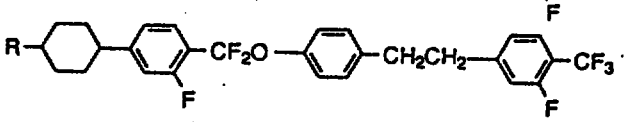

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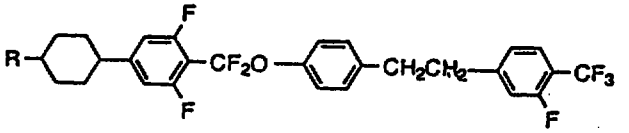

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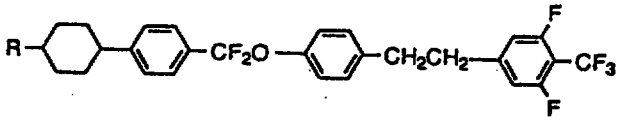

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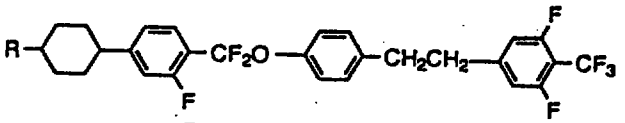

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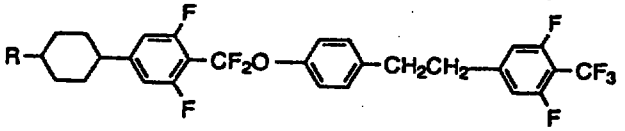

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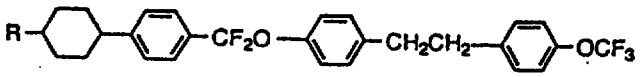

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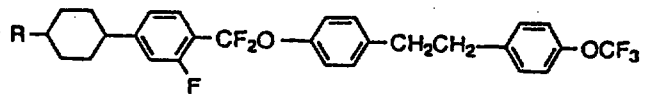

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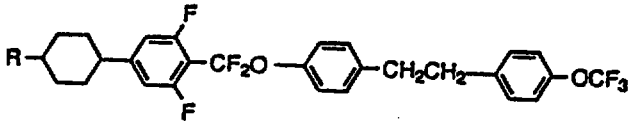

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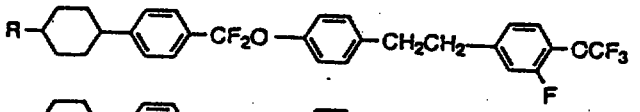

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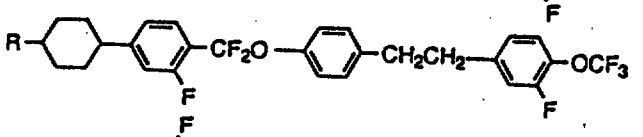

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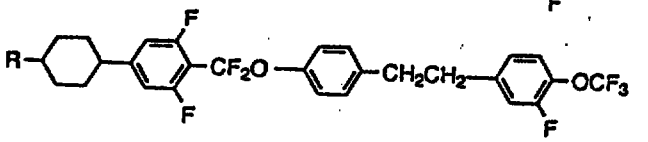

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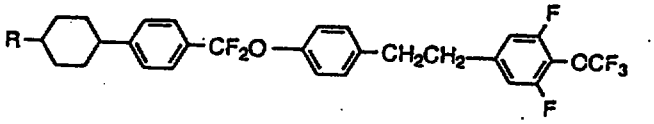

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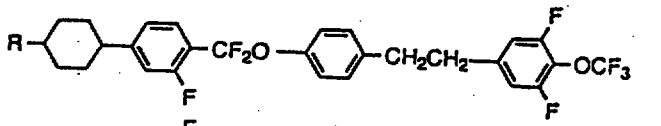

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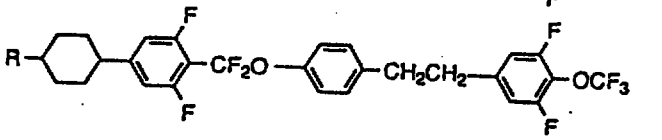

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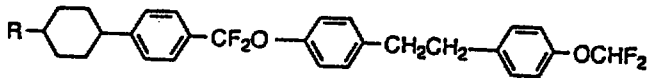

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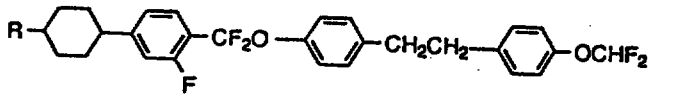

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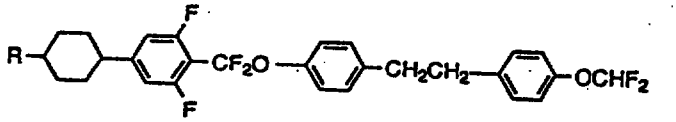

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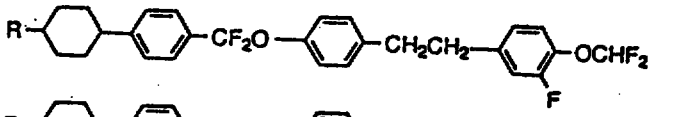

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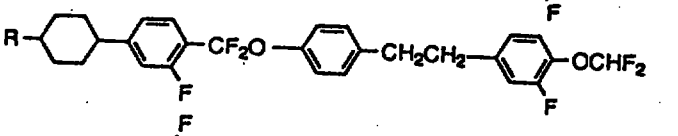

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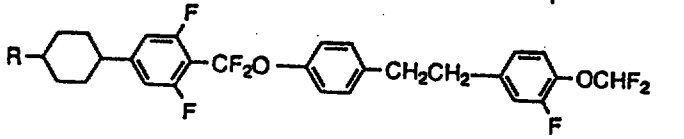

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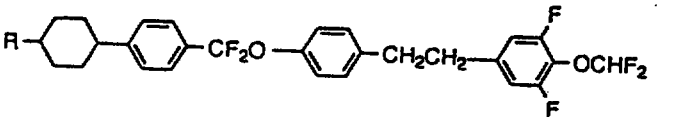

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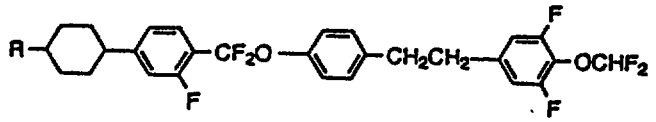

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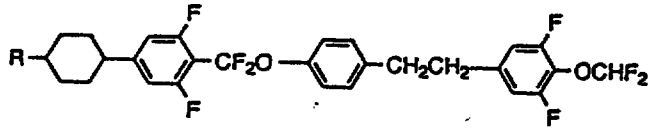

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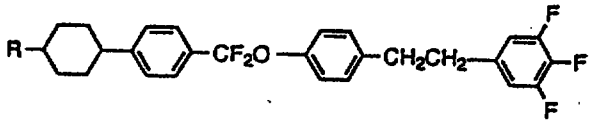

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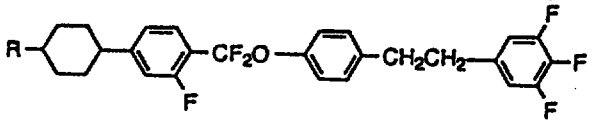

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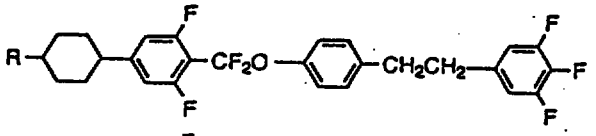

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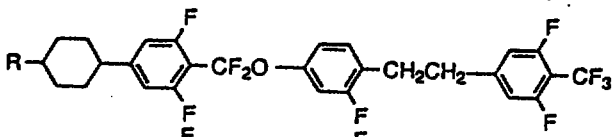

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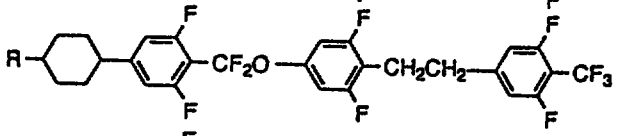

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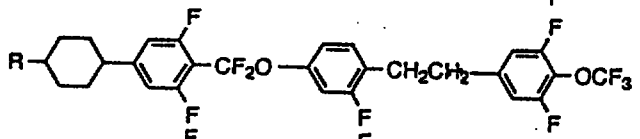

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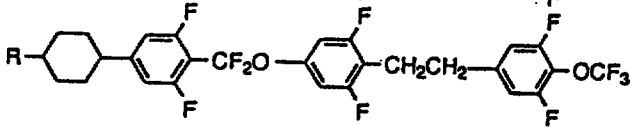

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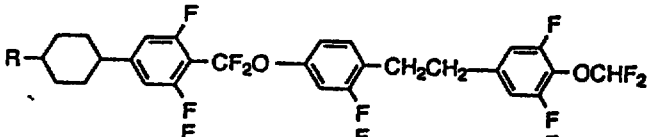

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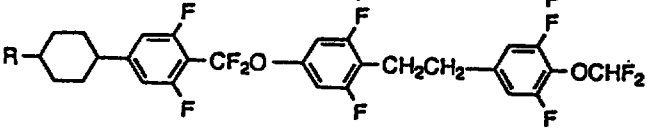

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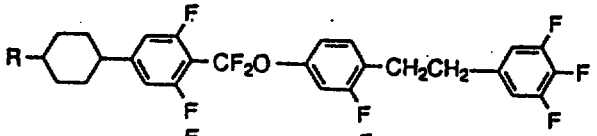

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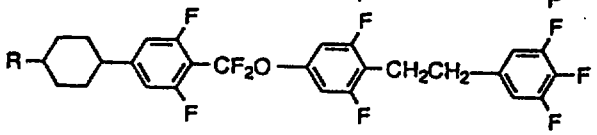

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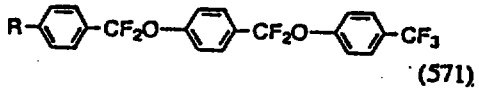

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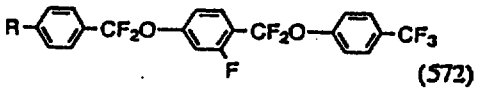

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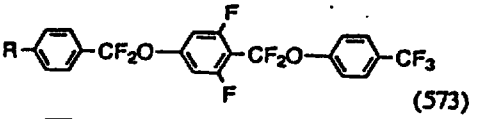

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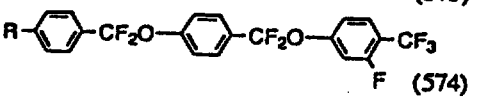

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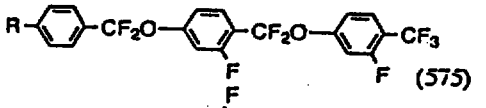

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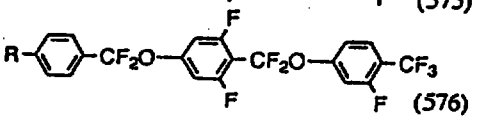

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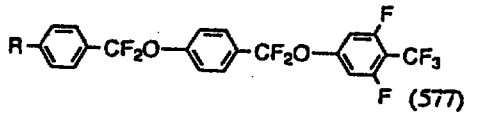

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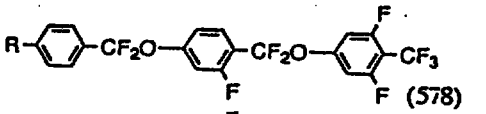

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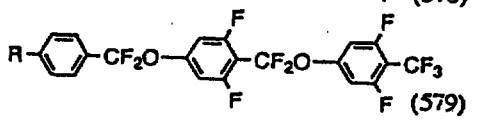

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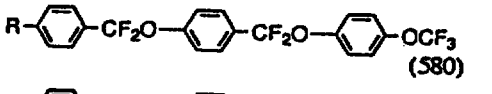

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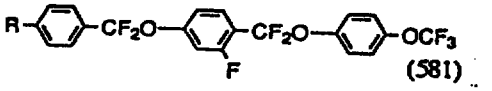

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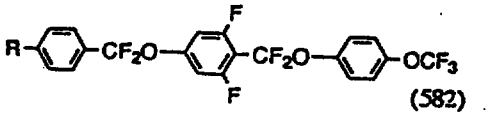

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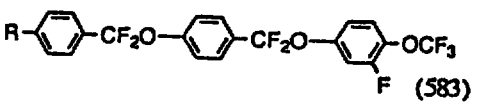

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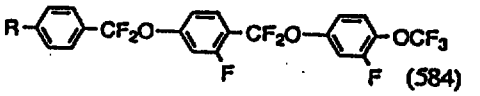

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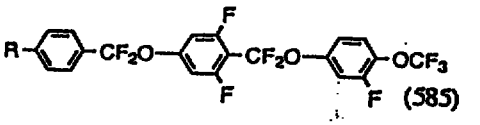

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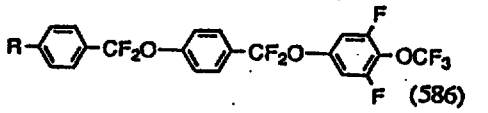

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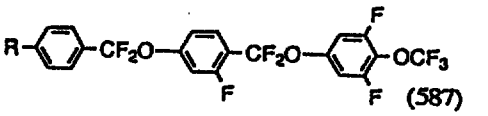

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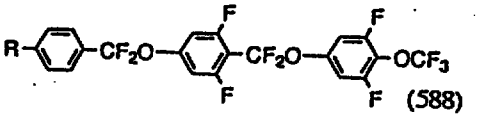

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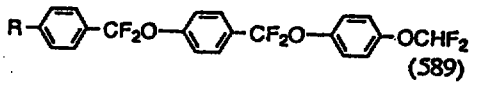

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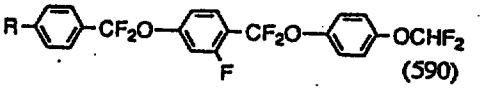

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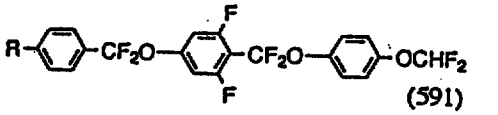

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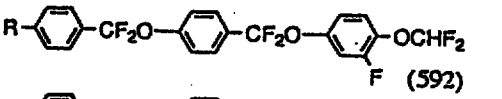

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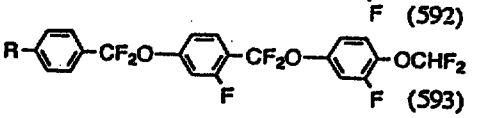

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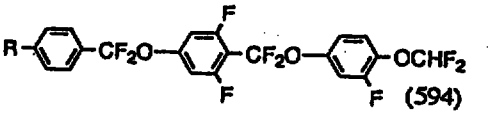

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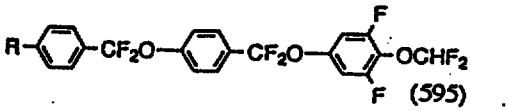

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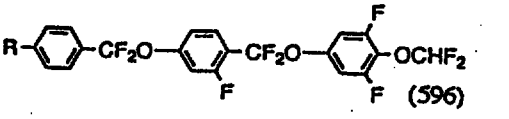

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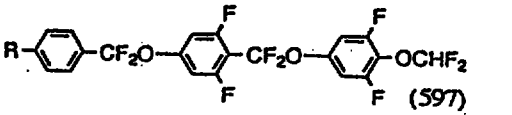

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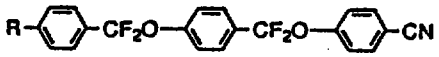

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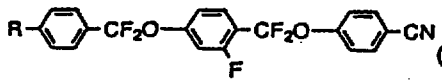

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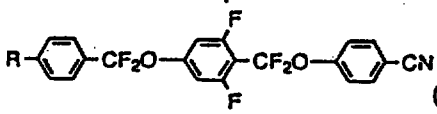

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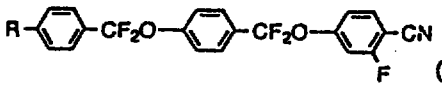

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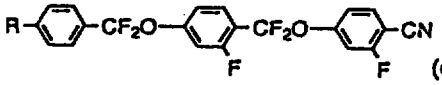

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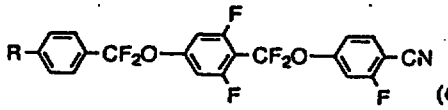

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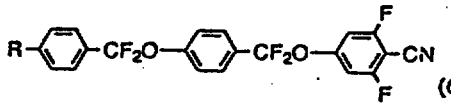

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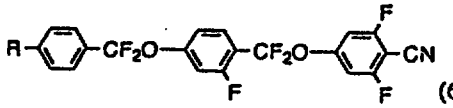

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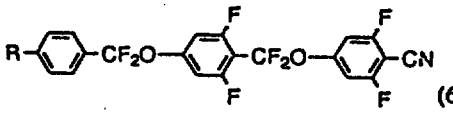

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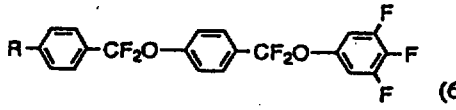

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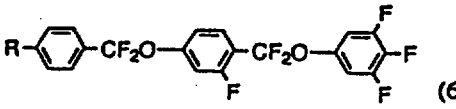

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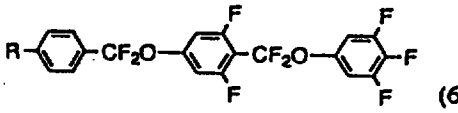

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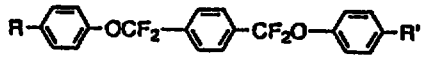

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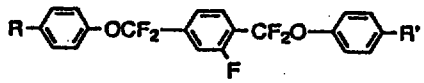

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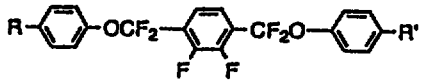

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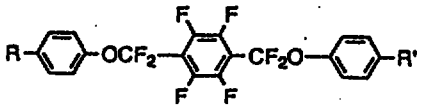

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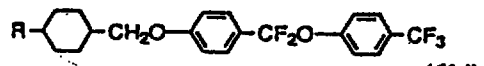

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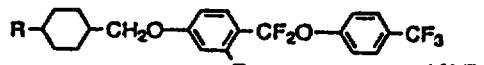

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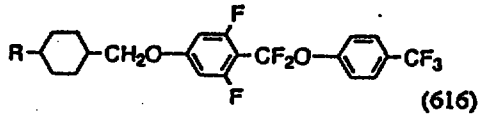

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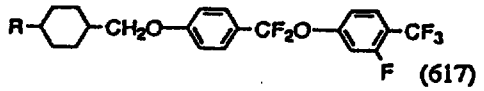

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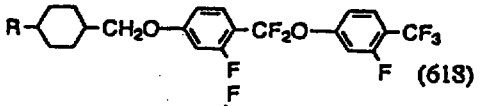

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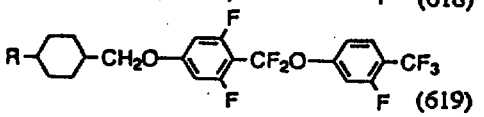

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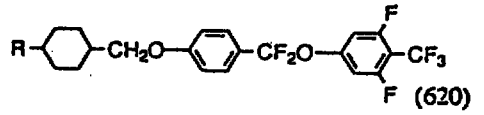

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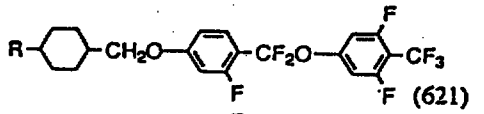

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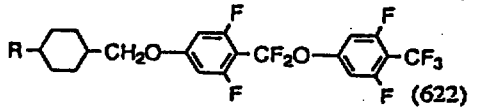

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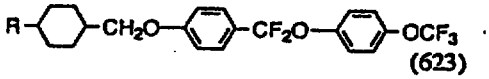

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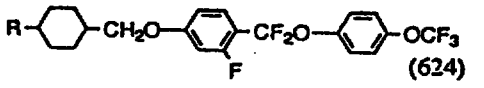

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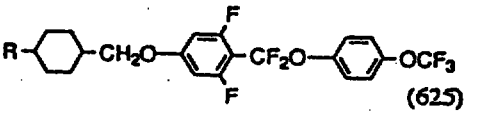

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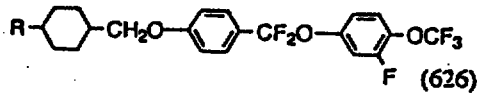

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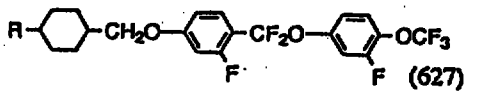

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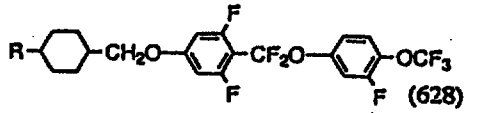

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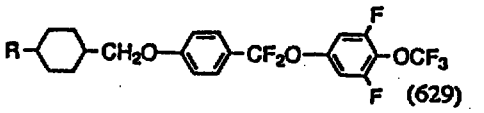

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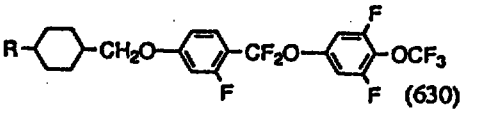

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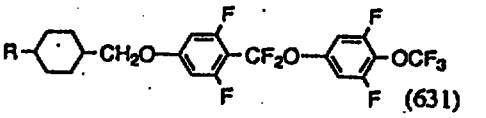

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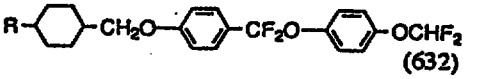

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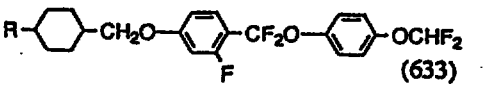

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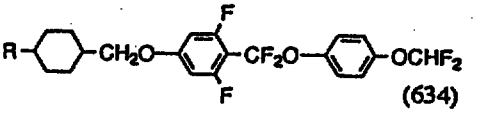

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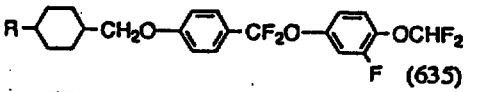

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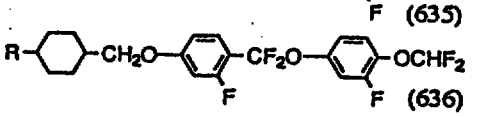

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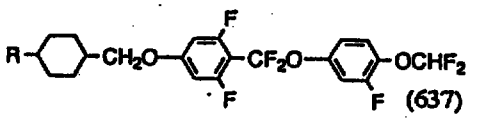

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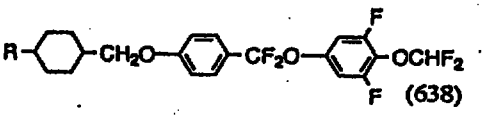

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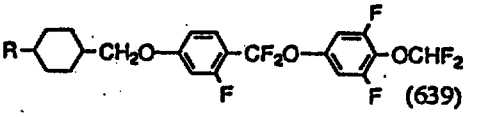

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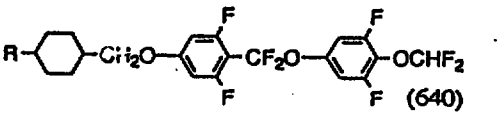

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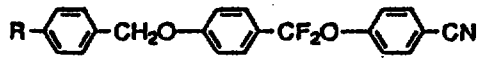

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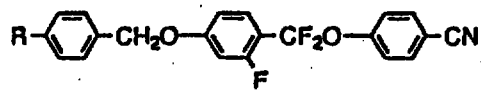

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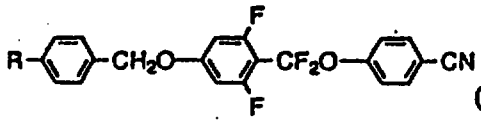

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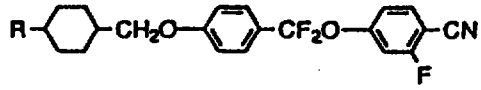

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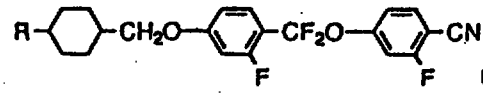
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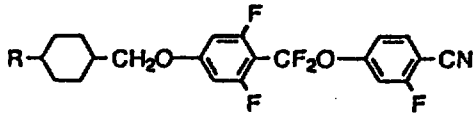

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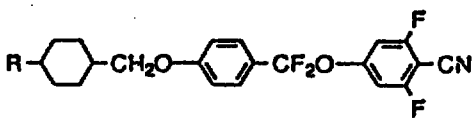

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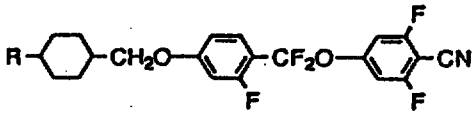

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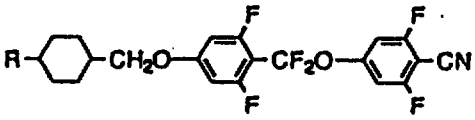

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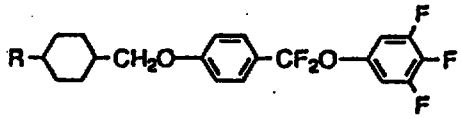

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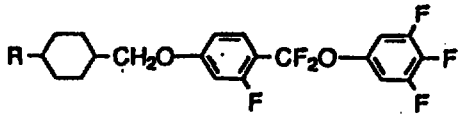

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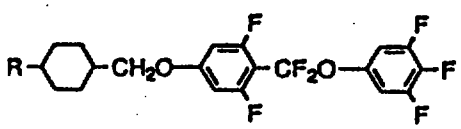

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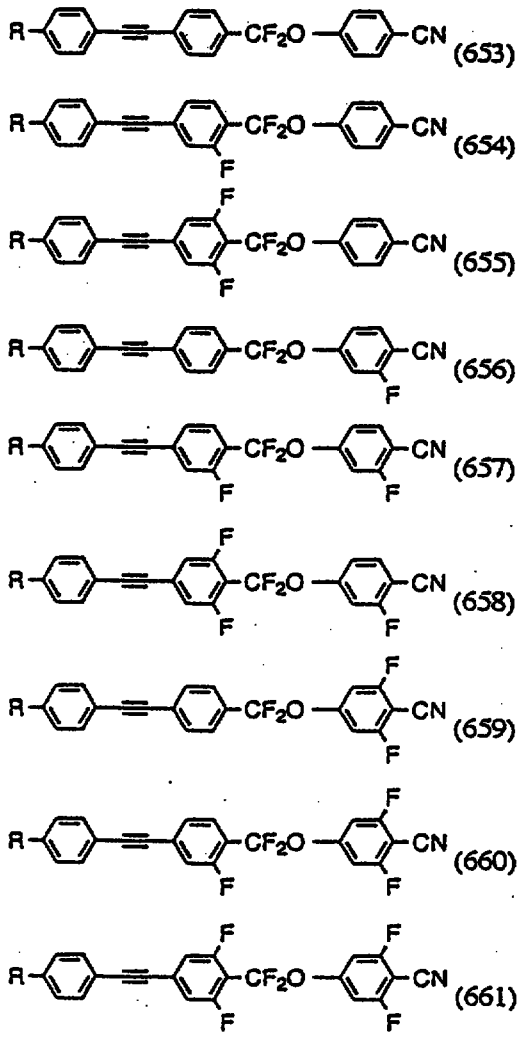

(648)


(649)


(650)


(651)


(652)



wherein R and R' represent a linear or branched alkyl group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, respectively.

These compounds (1) to (661) exhibit a large dielectric anisotropy and have a low viscosity. Particularly, the compounds having F, CF_3, or CN group as substituent at the terminal of the molecule exhibit extremely large dielectric anisotropy, while the compounds having OCF_3 or $OCHF_2$ group have a remarkably low viscosity. Further, the compounds having fluorine atom at a side position relative to the major axis of the compounds exhibit larger dielectric anisotropy and have a characteristic that they have an excellent miscibility. Compounds (571) to (613) have two $-CF_2O-$ groups in the molecule and have a lower viscosity compared with compounds (67) to (103) and (143) to (320). Particularly, compounds (610) to (613) have a characteristic that they are remarkably excellent as viscosity reducing agent.

[Method for preparing the compounds]

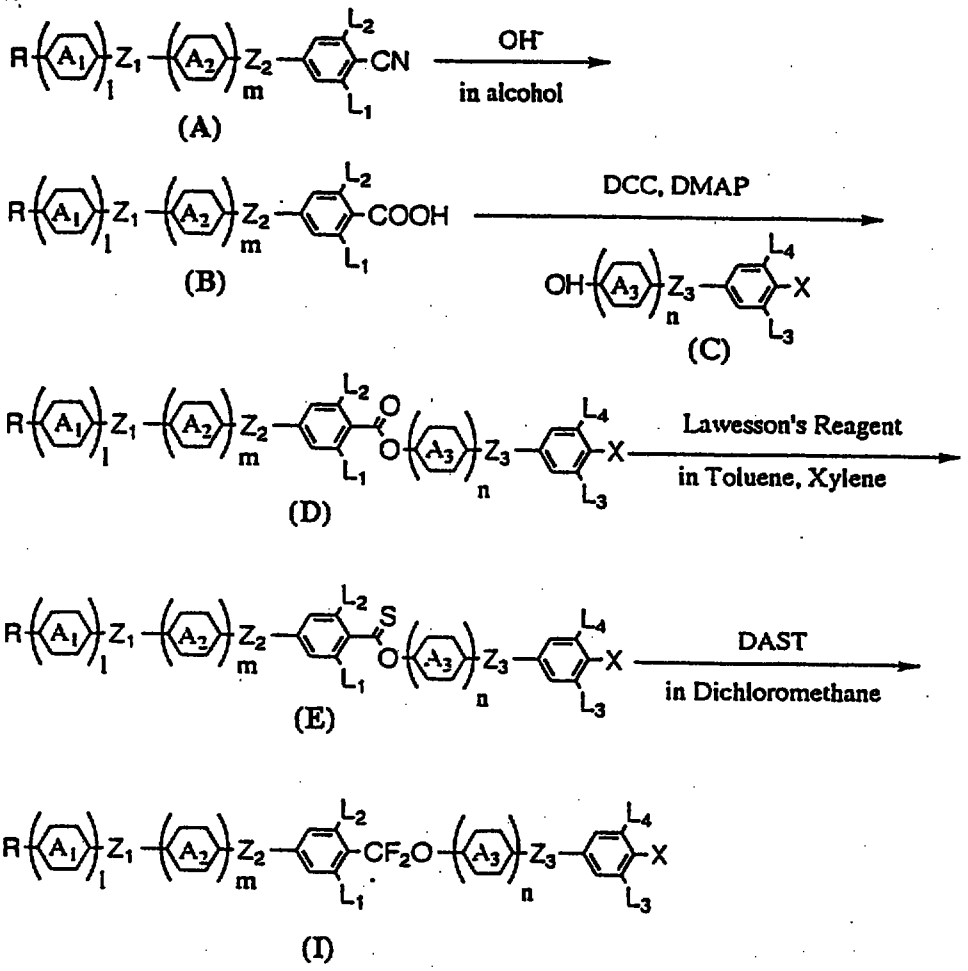
Difluorooxymethane derivatives expressed by the general formula (I), which are the compounds of the present invention, can be preferably prepared by the steps as shown below:

As shown in equation 1 below, benzonitrile expressed by general formula (A) and used as raw material for the preparation is hydrolyzed in an alcohol solvent such as ethyl alcohol, ethylene glycol, and diethylene glycol by using, as catalyst, a base such as sodium hydroxide and potassium hydroxide, or a mineral acid such as hydrochloric acid and sulfuric acid, to lead to a carboxylic acid derivative (B). Then, the carboxylic acid derivative (B) is reacted with a phenol derivative expressed by general formula (C) according to a general esterification method, for instance, by using, as acid catalyst, a mineral acid such as hydrochloric acid and sulfuric acid, an organic acid such as p-toluene sulfonic acid or an ion exchange resin such as Amberite, or by using N,N'-dicyclohexylcarbo-

diimide (DCC) as catalyst, to prepare an ester derivative expressed by general formula (D). Also, the derivative of (D) can be prepared by reacting (B) with thionyl chloride to convert into an acid chloride and then reacting with (C) in the presence of a base such as pyridine. Subsequently, the ester derivative (D) is reacted with Lawesson's reagent [2,4-bis(4-methoxyphenyl) -1,3-dithia-2,4-diphosphetane-2,4-disulfide] (Bull. Soc. Chim. Belg., 87, 223, 229, 299, 525 (1978); Synthesis, 941 (1979); Tetrahedron, 35, 2433 (1979); Tetrahedron, Lett., 21, 4061 (1980)) by using benzene or toluene as solvent at an optional temperature from room temperature to the boiling point of the solvent to lead to a thioester (thione type) derivative (E). Then, the thioester derivative (thione type) (E) is reacted with diethylaminosulfur trifluoride (DAST) (Synthesis, 787 (1973)) by using dichloromethane or chloroform as solvent at an optional temperature from room temperature to the boiling point of the solvent for conducting gem-fluorination to prepare an objective difluorooxymethane derivative.

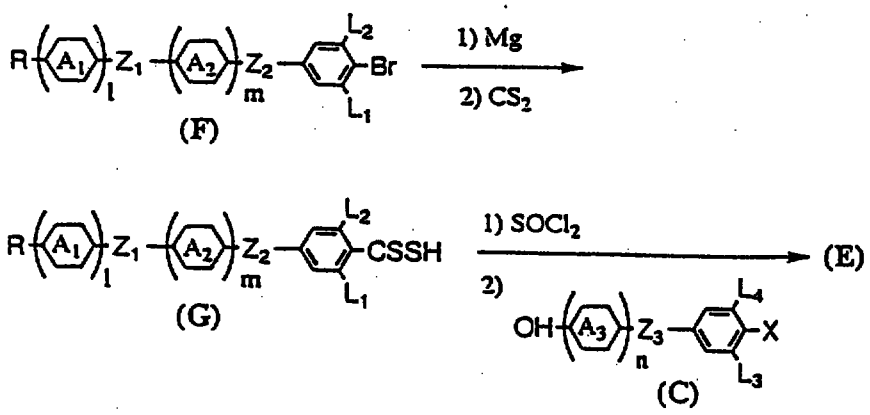
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(Equation 1)



As another method, as shown in equation 2 below, a difluorooxymethane derivative can be prepared by first preparing Grignard reagent from a bromobenzene derivative (F), reacting with carbon disulfide to form a dithiocarboxylic acid derivative (G), converting it with thionyl chloride into thiocarboxylic acid chloride, reacting with a phenol derivative (C) to prepare a thioester (thione type) derivative (E), and then reacting with DAST in the same way as mentioned above.

(Equation 2)

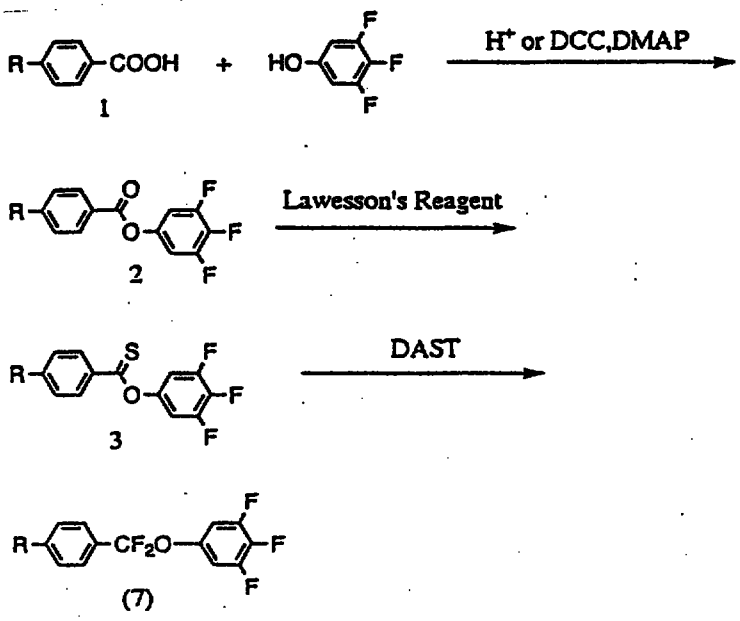


As shown in equation 3 below, for example, compound (7) among the compounds expressed by the general formula (1a) can be prepared by the method as follows:

Alkylbenzoic acid derivative 1 is subjected to an esterification with 3,4,5-trifluorophenol according to a general esterification method, for instance, by using, as acid catalyst, a mineral acid such as hydrochloric acid and sulfuric acid, an organic acid such as p-toluene sulfonic acid, or an ion exchange resin such as Amberite, or by using N,N'-dicyclohexylcarbodi-imide (DCC) as catalyst to prepare 3,4,5-trifluorobenzoate derivative 2. Subsequently, the derivative 2 is reacted with Lawesson's reagent under toluene reflux condition to convert into a thioester (thione type) derivative 3, and then reacted with DAST in dichloromethane to prepare compound (7). Besides, compounds (1) to (6) and (8) to (27) can be prepared by using a phenol having a different kind of substituent in place of 3,4,5-trifluorophenol, and further from several kinds of known benzoic acid derivatives according to the preparation procedures mentioned above.

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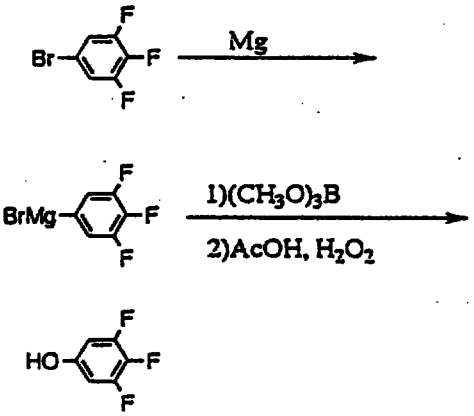
(Equation 3)



In this connection, 3,4,5-trifluorophenol which is a raw material for the preparation can be prepared by using 3,4,5-trifluorobromobenzene as starting substance. That is, as shown in equation 4 below, it can be prepared by reacting Grignard reagent prepared from 3,4,5-trifluorobromobenzene with t-butyl hydroperoxide according to the method of S. O. Lawesson et al. (J. Am. Chem. Soc. 81, 4230 (1959)) or by treating Grignard reagent prepared from 3,4,5-trifluorobromobenzene with trialkyl borate according to the method of R. L. Kidwell et al. (Org. Synth., V, 918, (1973)) to convert into a boric acid ester and then subjecting to an oxidizing treatment with hydrogen peroxide solution.

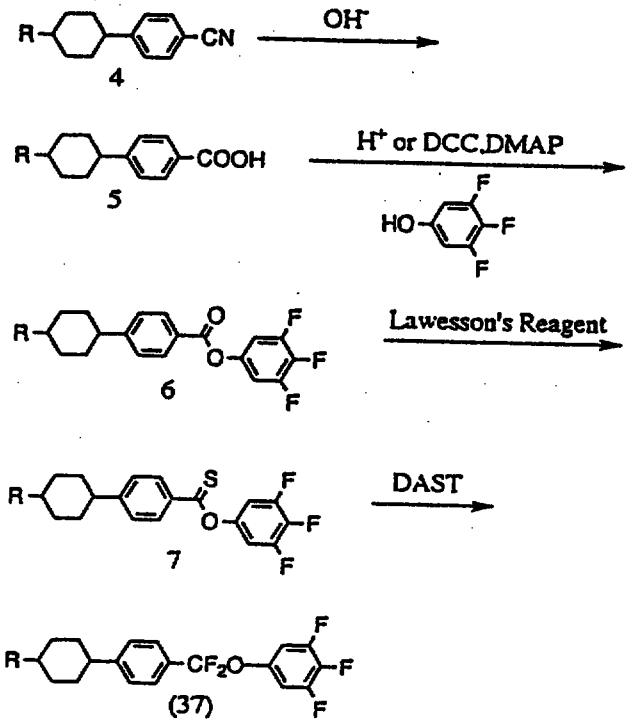
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(Equation 4)



As shown in equation 5 below, compound (37) among the compounds expressed by the general formula (1b) can be prepared by hydrolyzing 2-fluoro-4-(trans-4-alkylcyclohexyl)benzonitrile 4 in ethylene glycol or diethylene glycol in the presence of sodium hydroxide to convert into a benzoic acid derivative 5, subjecting to an esterification with 3,4,5-trifluorophenol according to a general esterification method, for instance, by using, as acid catalyst, a mineral acid such as hydrochloric acid and sulfuric acid, an organic acid such as p-toluene sulfonic acid, or an ion exchange resin such as Amberite, or by using N,N'-dicyclohexylcarbodiimide (DCC) as catalyst to prepare 4-trifluorobenzoate derivative 6. Subsequently, the derivative 6 is reacted with Lawesson's reagent under toluene reflux condition to convert into a thioester (thione type) derivative 7, and then reacting with DAST in dichloromethane to prepare compound (37). Besides, compounds (28) to (36) and (38) to (181) can be prepared by using phenol having a different kind of substituent in place of 3,4,5-trifluorophenol, and from several kinds of known benzoic acid derivatives according to the preparation procedures mentioned above.

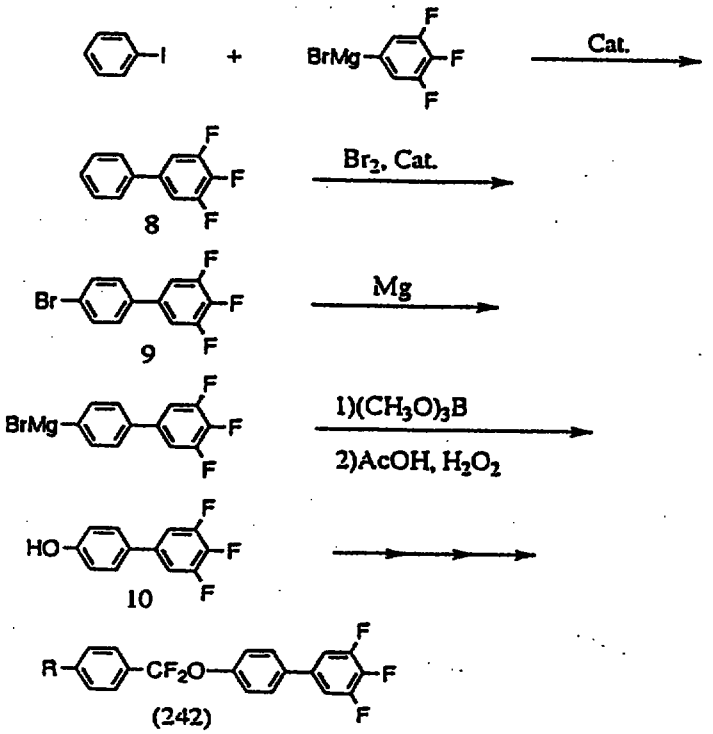
(Equation 5)



As shown in equation 6 below, compound (242) among the compounds expressed by the general formula (1c) can be prepared by the following method:

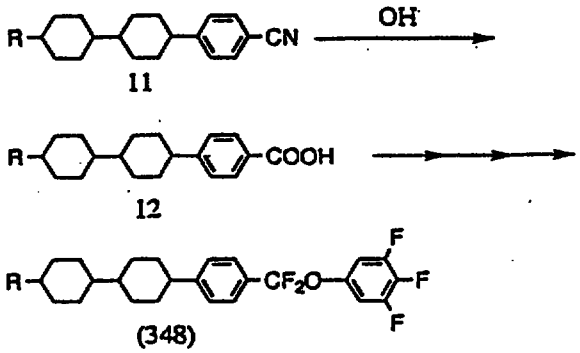
That is, 4-iodobenzene is subjected to a coupling reaction with Grignard reagent prepared from 3,4,5-trifluorobromobenzene in the presence of a novel metal catalyst such as palladium chloride to convert into a biphenyl derivative 8 and then reacted with bromine in the presence of metal powder such as iron powder to prepare a bromobiphenyl derivative 9. Subsequently, Grignard reagent prepared from the derivative 9 is reacted with trimethyl borate according to the report by R. L. Kidwell et al. (Org. Synth., V, 918 1973)), and then oxidized with hydrogen peroxide in the presence of acetic acid to prepare a phenyl phenol derivative 10. Compound (242) can be prepared

by treating the derivative 10 in the same way as in the case of the preparation of compound (7). Further, other compounds (182) to (241) and (243) to (320) expressed by the general formula (1c) can be prepared from phenyl phenol derivatives prepared by using bromobenzene derivatives having a different kind of substituent in place of 3,4,5-trifulorobromobenzene.
(Equation 6)



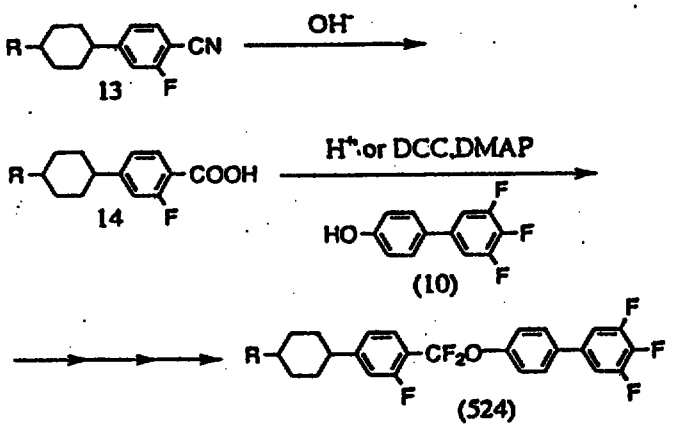
As shown in equation 7 below, for example, compound (348) among the compounds expressed by the general formula (1d) can be prepared in the same method as mentioned above by using, as raw material for the preparation, 4-[trans-4-(trans-alkylcyclohexyl) cyclohexyl]benzoic acid 12 obtained by hydrolyzing 4-[trans-4-(trans-alkylcyclohexyl)cyclohexyl]benzonitrile 11 according to a common method. Further, other compounds (321) to (347) and (349) to (495) expressed by the general formula (1d) can also be

prepared by using a known carboxylic acid derivative and phenol derivative, and by selecting the combination of the reaction procedures mentioned above with other known reaction procedures. (Equation 7)



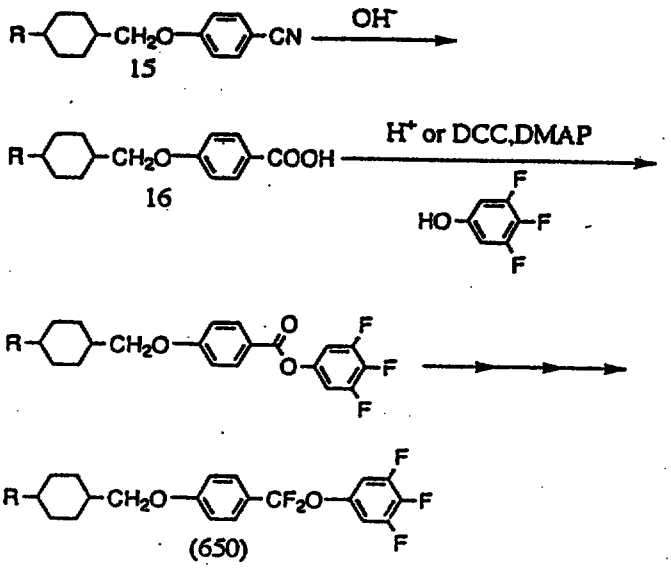
As shown in equation 8 below, for example, compound (524) among the compounds expressed by the general formula (1e) can be prepared in the same procedures as mentioned above by using, as raw material for the preparation, 2-fluoro-4-(trans-4-alkylcyclohexyl)benzoic acid 13 which is obtained by hydrolyzing 2-fluoro-4-(trans-4-alkylcyclohexyl)benzonitrile 13, and by using a phenylphenol derivative prepared in the same method as in the case of (1c). Further, other compounds (496) to (523) and (525) to (570) can also be prepared by using a known carboxylic acid derivative and phenol derivative and by selecting the combination of the reaction procedures mentioned above with other known reaction procedures.

(Equation 8)



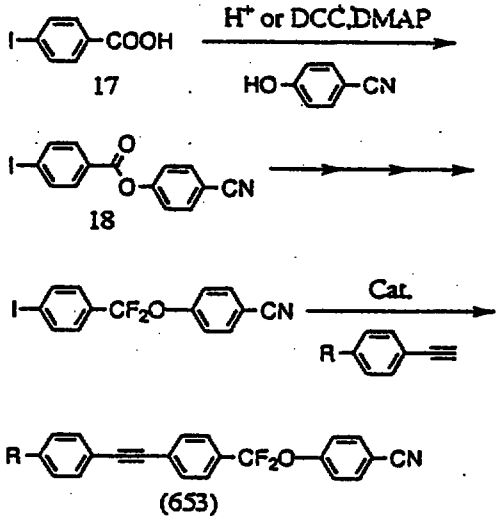
As shown in equation 9 below, for example, compound (650) can be prepared in the same method as in the case of (1b) by using, as raw material for the preparation, a carboxylic acid derivative 16 obtained by hydrolyzing (4-alkylcyclohexyl)(4-cyanophenyloxy)methane 15 according to a common method. Further, compounds (614) to (649), (651), and (652) can be prepared by using a phenol derivative having a different kind of substituent in place of 3,4,5-trifluorophenol and additionally using a different kind of fluorine substituted (4-alkylcyclohexyl)(4-cyanophenyloxy)methane derivative.

(Equation 9)



As shown in equation 10 below, for example, compound (653) can be prepared by preparing iodide isomer 19 from 4-iodobenzoic acid 17 and cyanophenol in the same method as in the case of (1a), and further reacting 19 with 4-alkylphenyl acetylene in the presence of a novel metal catalyst such as platinum and palladium. Besides, compounds (654) to (661) can be prepared by using a phenol derivative having a different kind of substituent in place of 4-cyanophenol and using a different kind of known benzoic acid derivative.

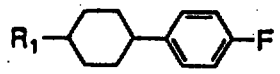
(Equation 10)

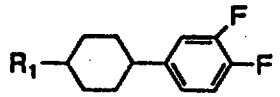


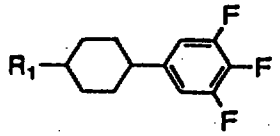
Next, the liquid crystal compositions of the present invention are explained. In the following explanation on liquid crystal compositions, difluorooxymethane derivatives of the present invention expressed by the general formula (I) are referred to as A group.

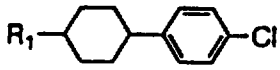
Liquid crystal compositions of the present invention may be composed only two or more compounds selected from A group. Also, the compositions may contain, as a first component, one or more compounds of A group and contain, as a second component, one or more other compounds. When the compositions contain the second component, the compound of A group is preferably contained in a ratio of 0.1 to 99 % by weight.

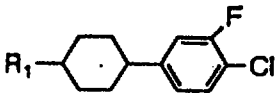
As the second component of the liquid crystal compositions of the present invention, the compounds expressed by the general formula (II), (III), or (IV) (hereinafter, these compounds are referred to as B group) may be used. As the compounds of B group, the followings (II-1 to IX-14) can be mentioned as preferable ones:

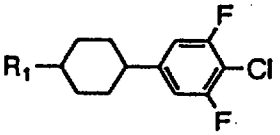

(II-1)

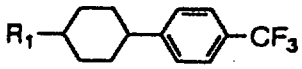

(II-2)

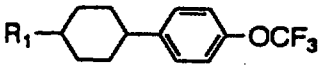

(II-3)

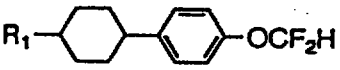

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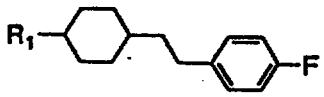

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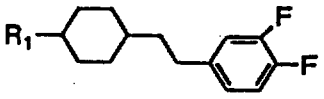

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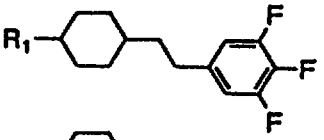

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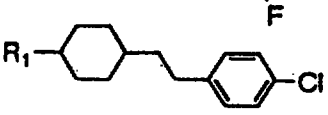

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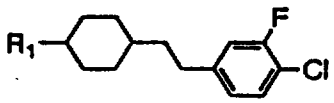

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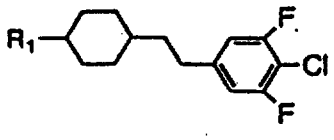

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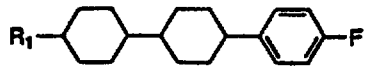

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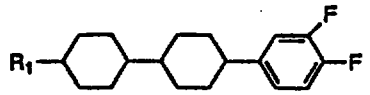

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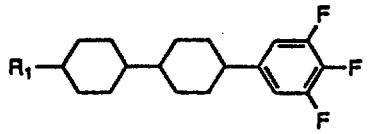

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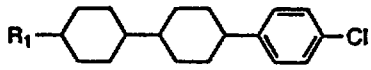

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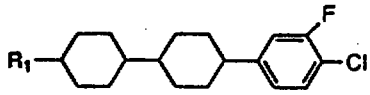

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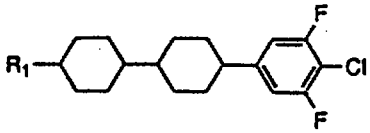

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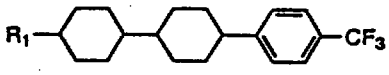

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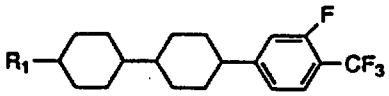

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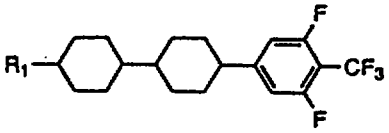

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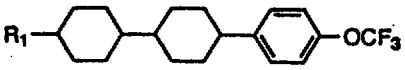

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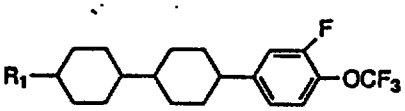

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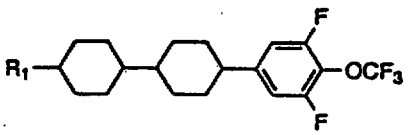

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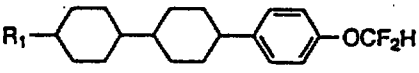

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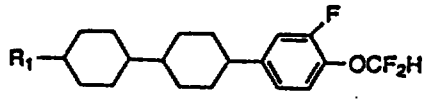

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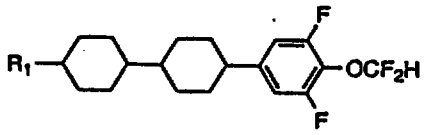

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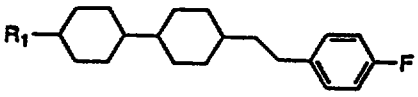

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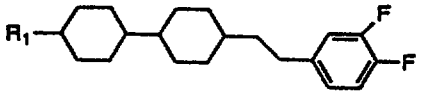

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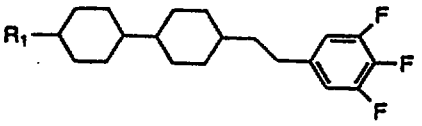

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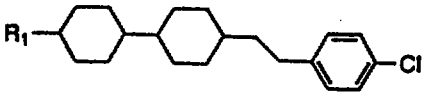

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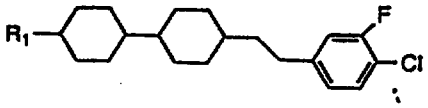

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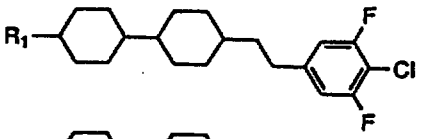

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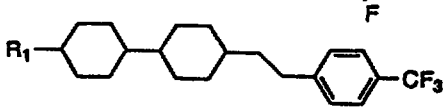

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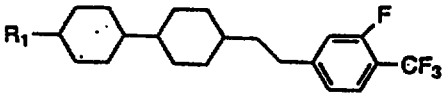

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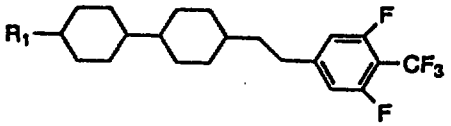

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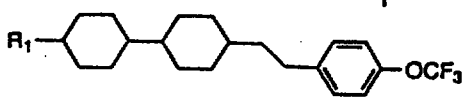

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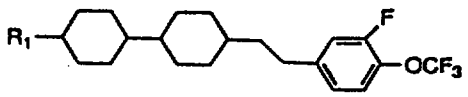

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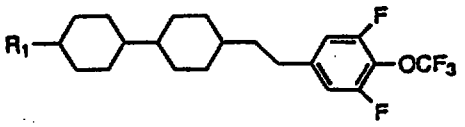

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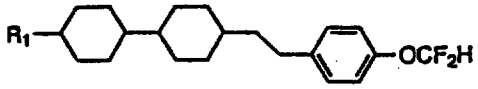

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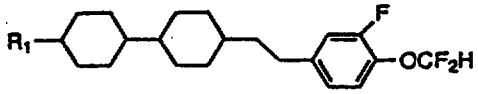

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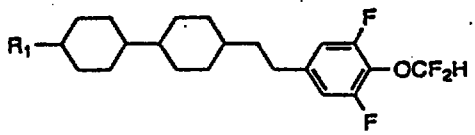

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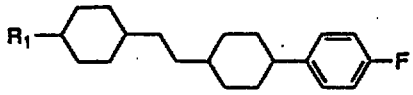
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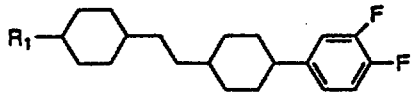

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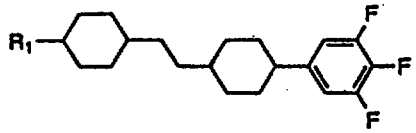

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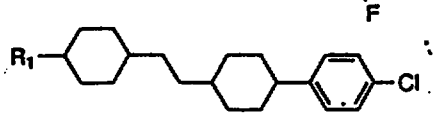

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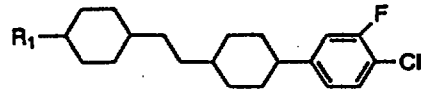

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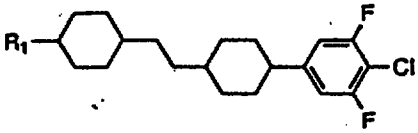

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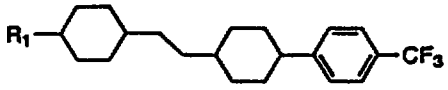

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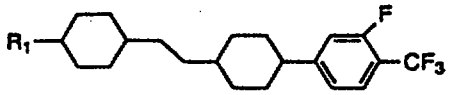

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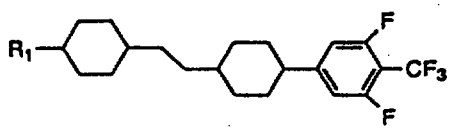

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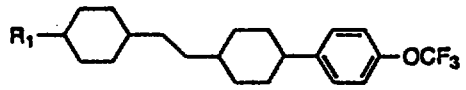

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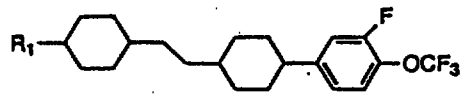

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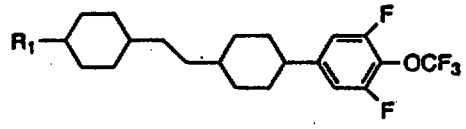

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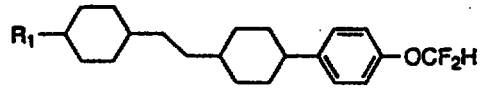

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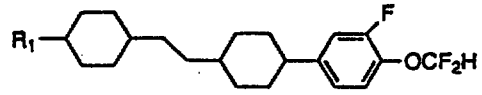

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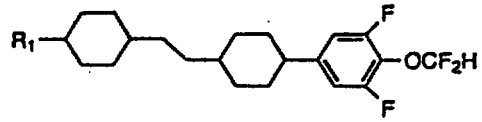

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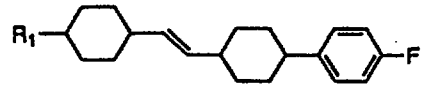

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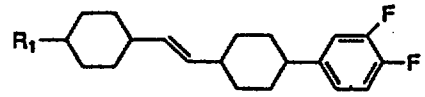

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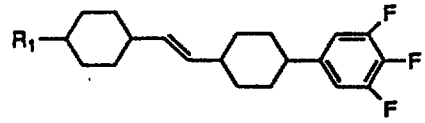

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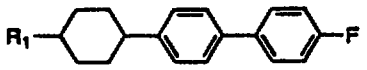

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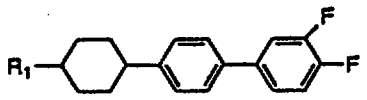

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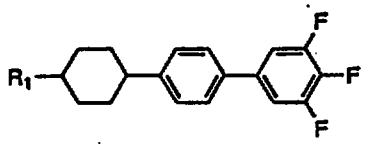

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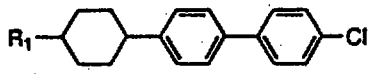

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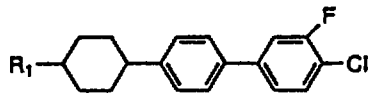

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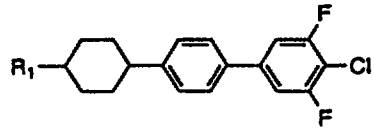

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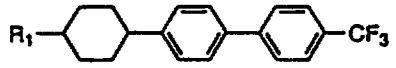

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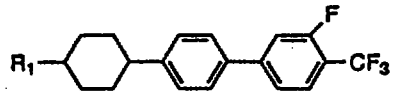

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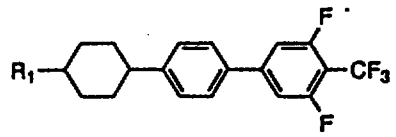

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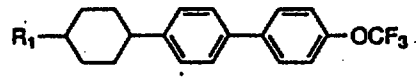

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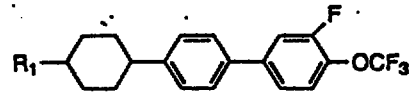

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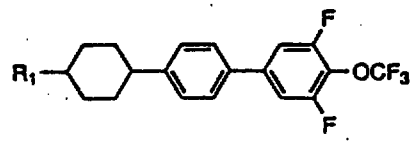

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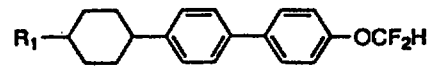

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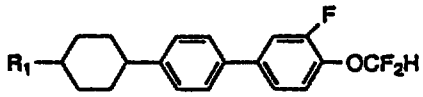

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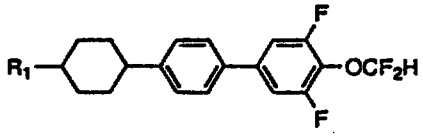

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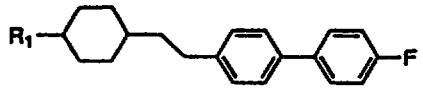

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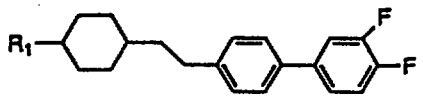

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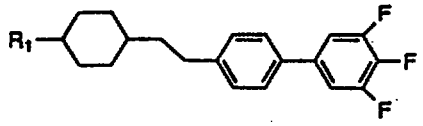

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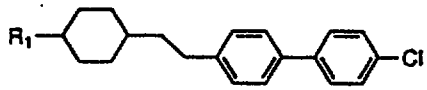

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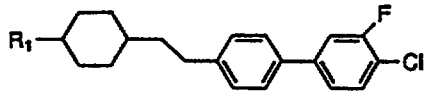

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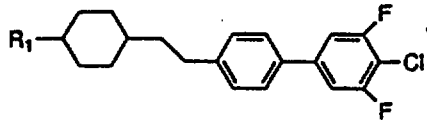

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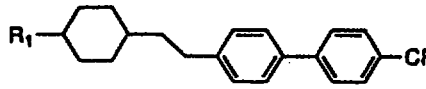

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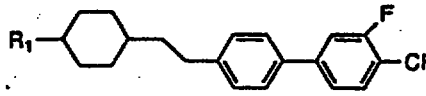

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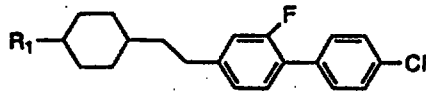

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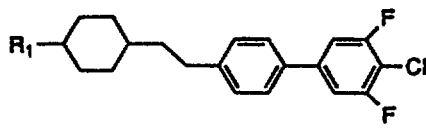

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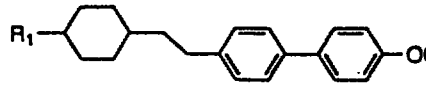

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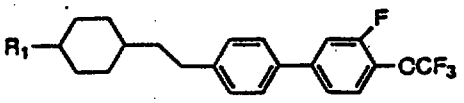

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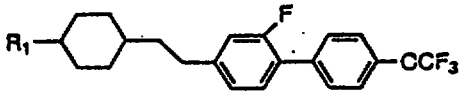

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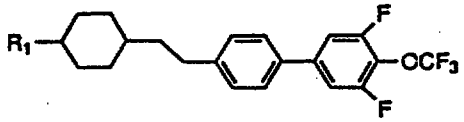

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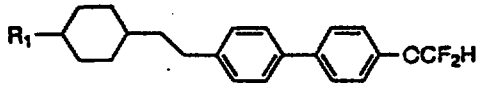

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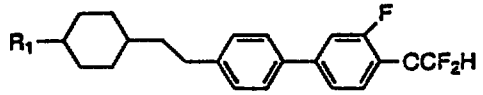

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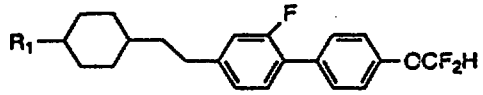

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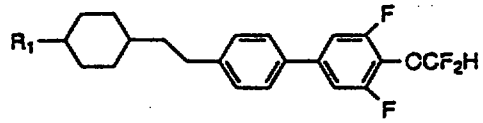

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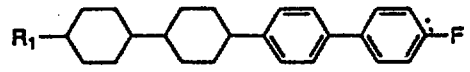

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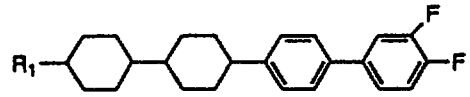

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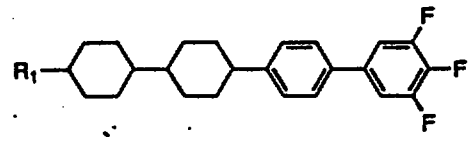

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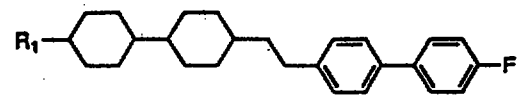

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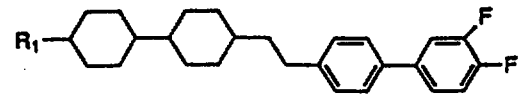

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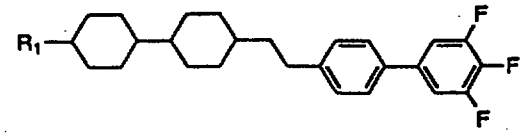

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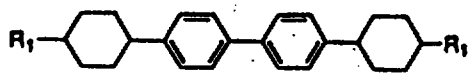

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(Ⅳ-36)

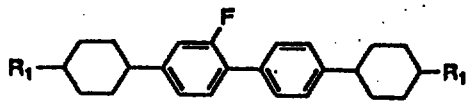

(Ⅳ-37)


(Ⅳ-38)


(Ⅳ-39)



(IV-40)

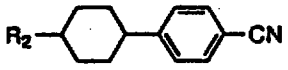


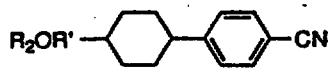
(IV-41)

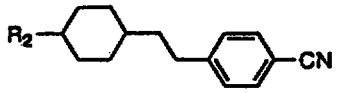
Compounds of B group mentioned above have a positive value of dielectric anisotropy and have a remarkably excellent thermal stability. Thus, the compounds are useful when liquid crystal compositions for active matrix mode typified by TFT are prepared for which such a characteristic as high voltage holding ratio or large non-resistance value is particularly required.

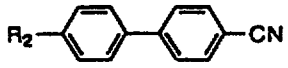
While the amount of the B group compounds to be used, when liquid crystal compositions are prepared for TFT, can arbitrarily be selected in a range of 1 to 99 % by weight based on the total weight of the liquid crystal composition, it is preferably 10 to 97 % by weight and more desirably 40 to 95 % by weight.

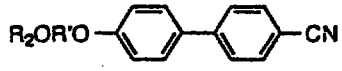
As the second component of the present invention, the compounds expressed by any one of the general formulas (V) to (IX) (hereinafter, these compounds are referred to as C group) may also be used. As the compounds expressed by any one of the general formulas (V) to (VII) among C group, the following compounds can preferably be mentioned:

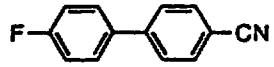

(V-1)

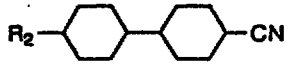

(V-2)

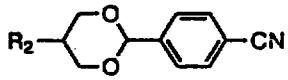

(V-3)

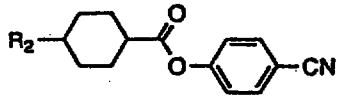

(V-4)

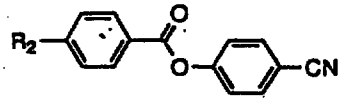

(V-5)

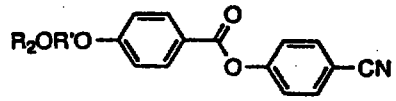

(V-6)

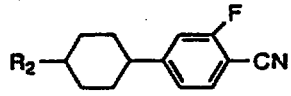

(V-7)

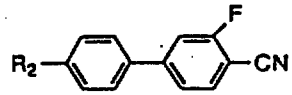

(V-8)

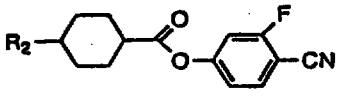

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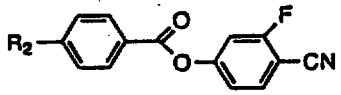

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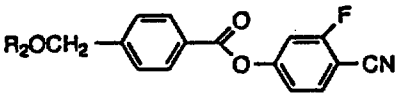

(V-11)


(V-12)


(V-13)


(V-14)

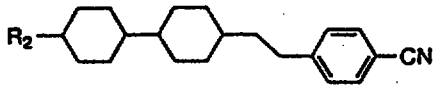

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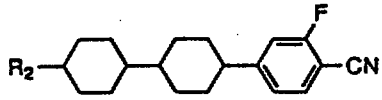

(V-16)

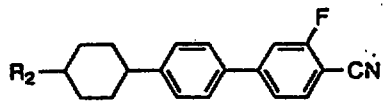

(V-17)

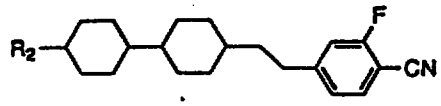

(V-18)

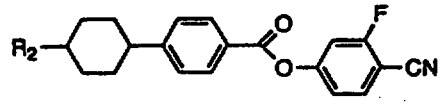

(V-19)

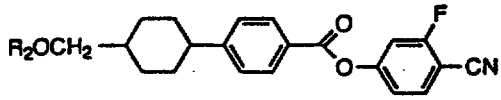

(V-20)

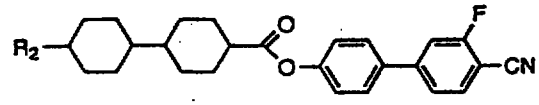

(V-21)

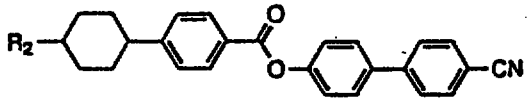

(V-22)


(V-23)


(V-24)

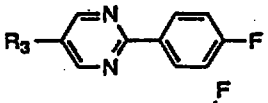

(V-25)


(V-26)

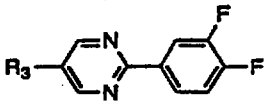


(V-27)

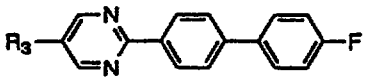
(R' represents alkylene.)



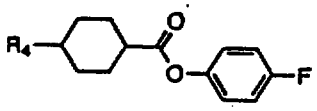
(VI-1)



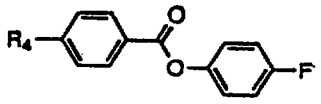
(VI-2)



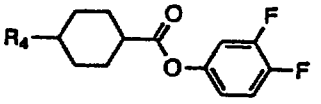
(VI-3)



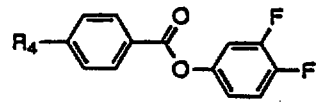
(VII-1)

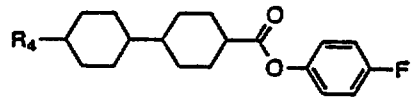


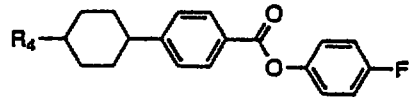
(VII-2)

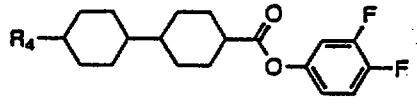


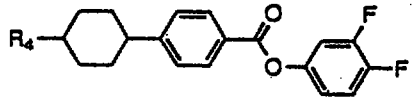
(VII-3)

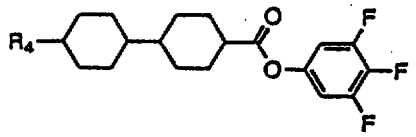

(VII-4)

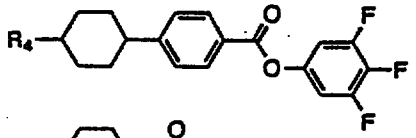

(VII-5)

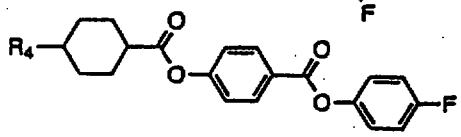

(VII-6)


(VII-7)

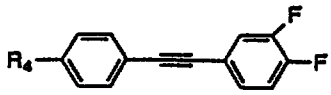

(VII-8)


(VII-9)


(VII-10)

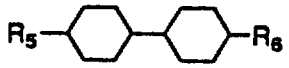

(VII-11)

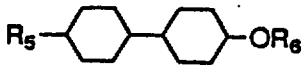

(VII-12)

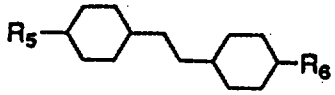

(VII-13)

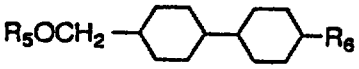
Compounds expressed by the general formulas (V) to (VII) mentioned above have a large positive value of dielectric anisotropy and are used particularly for the purpose of reducing threshold voltage. They are also used for the purposes of adjusting viscosity, adjusting Δn, and raising clearing point to widening nematic range. Further, they are used even for the purpose of improving the steepness.

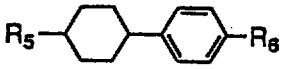
As the compounds expressed by any one of the general formulas (VIII) to (IX) among C group, the following compounds can preferably mentioned:

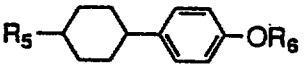

(VIII-1)

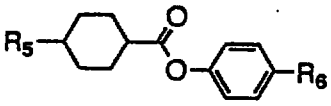

(VIII-2)

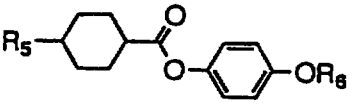

(VIII-3)

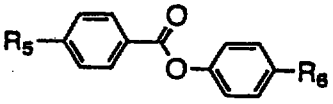

(VIII-4)

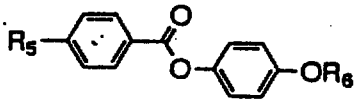

(VIII-5)


(VIII-6)

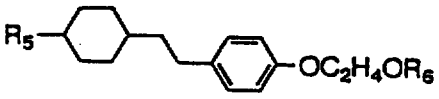

(VIII-7)


(VIII-8)


(VIII-9)

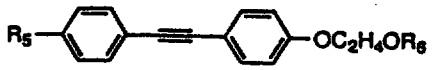

(VIII-10)

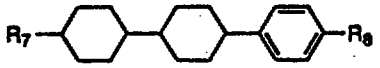

(VIII-11)

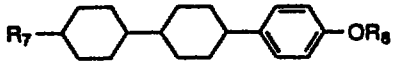

(VIII-12)

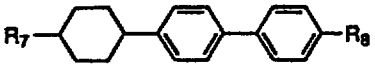

(Ⅷ-13)

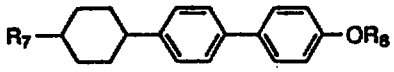

(Ⅷ-14)

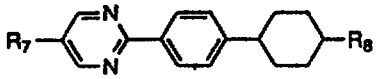

(Ⅷ-15)

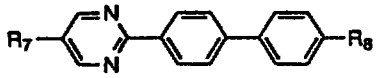

(Ⅸ-1)

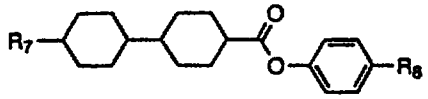

(Ⅸ-2)

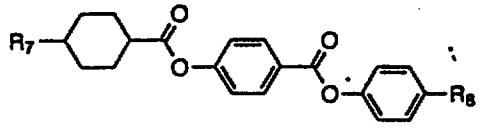

(Ⅸ-3)

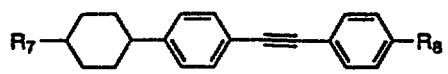

(Ⅸ-4)

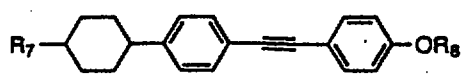

(Ⅸ-5)

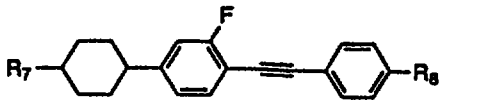

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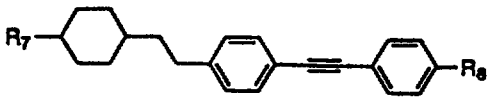

(Ⅸ-7)

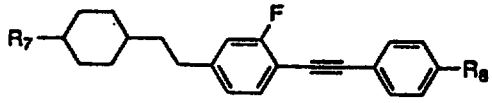

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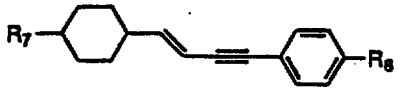

(Ⅸ-9)


(Ⅸ-10)


(IX-11)


(IX-12)


(IX-13)


(IX-14)

Compounds expressed by the general formulas (VIII) and (IX) mentioned above have a negative or a weak positive dielectric anisotropy. Compounds expressed by the general formula (VIII) can be used principally for the purposes of reducing viscosity and adjusting Δn. Compounds expressed by the general formula (IX) can be used for the purpose of raising clearing point to widening nematic range and for the purpose of adjusting Δn.

Compounds of C group are useful when liquid crystal compositions for super twist nematic (STN) display mode are prepared, and the compounds can be used in a range of 1 to 99 % by weight and preferably 10 to 97 % by weight, more desirably in a range of 40 to 95 % by weight.

When liquid crystal compositions for TFT are prepared, at least one compound selected from C group may be contained in addition to the compounds of A group and the compounds of B group. Also, when liquid crystal compositions for STN or general-purpose TN are prepared, at least one compound selected

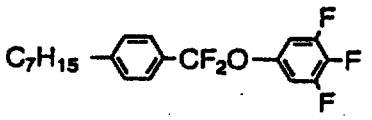
from B group may be contained in addition to the compounds of A group and the compounds of C group.

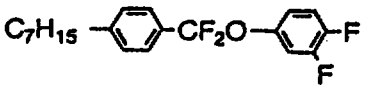
Liquid crystal compositions of the present invention are prepared by conventional methods. Generally, the method is adopted in which various components are dissolved in each other at a high temperature. Also, the liquid crystal compositions of the present invention are improved, depending on the applications intended, by adding a suitable additive, and optimized. Such additives are well known in the art and described in literatures in detail. Usually, a chiral dopant or likes are added to cause a helical structure of liquid crystal to adjust a required twisting angle, and to avoid reverse-twist.

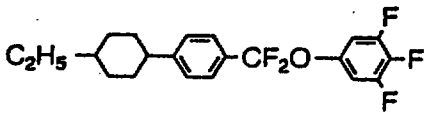
Further, the liquid crystal compositions of the present invention can be added with a dichroic dye such as merocyanine type, styryl type, azo type, azomethine type, azoxy type, quinophthalone type, anthraquinone type, and tetrazine type, and used as liquid crystal composition for guest-host (GH) mode. Alternatively, they can also be used as liquid crystal compositions for polymer dispersion type liquid crystal display devices (PDLCD) typified by NCAP which is prepared by forming a nematic liquid crystal into a microcapsule or typified by a polymer net work liquid crystal display device (PNLCD) which is prepared by forming a polymer of three-dimensional network structure in a liquid crystal. Also, the liquid crystal compositions of the present invention can be used as ones for electrically controlled birefringence (ECB) mode or dynamic scattering (DS) mode.

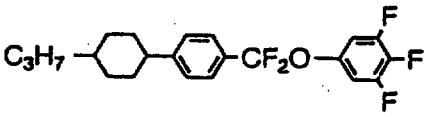
As the liquid crystal compositions of the present invention, the following composition examples 1 to 39 can be mentioned:

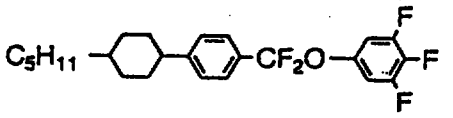
[Composition Example 1]

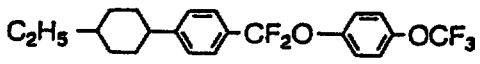

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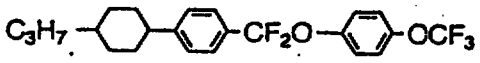

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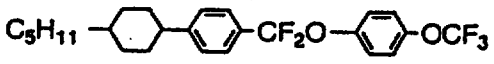

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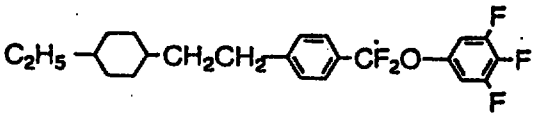

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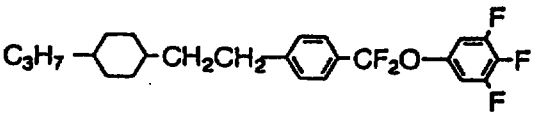

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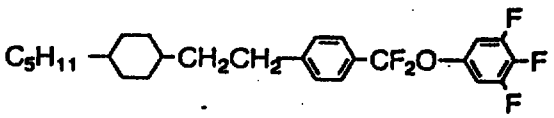

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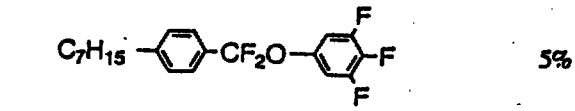

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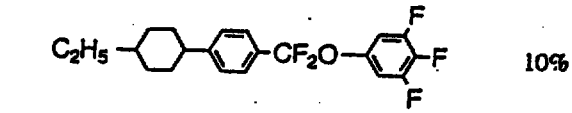

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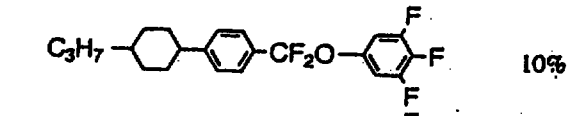

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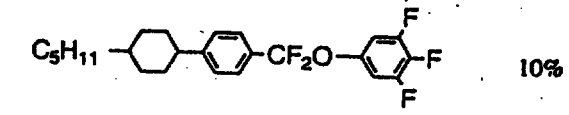

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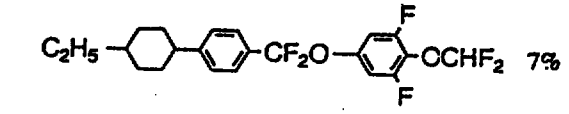
[Composition Example 2]

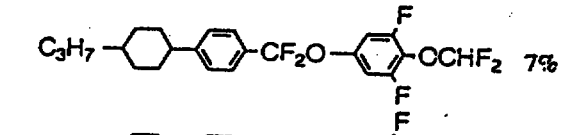

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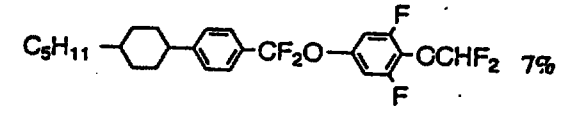

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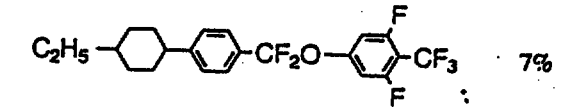

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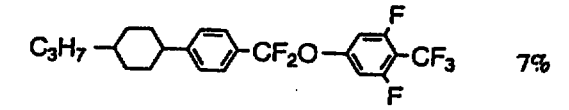

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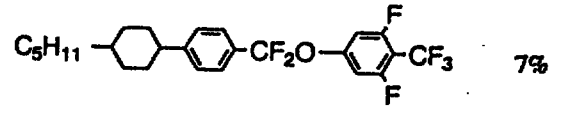

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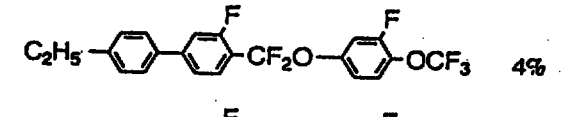

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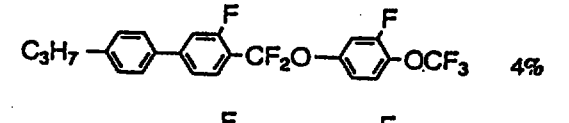

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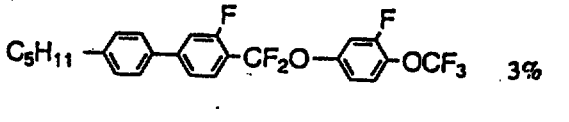

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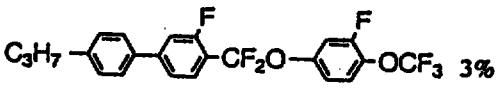

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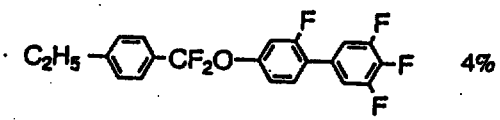

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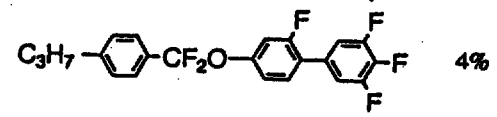

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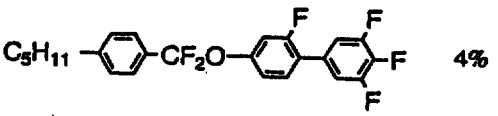

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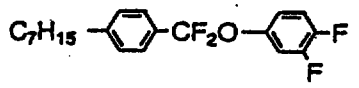

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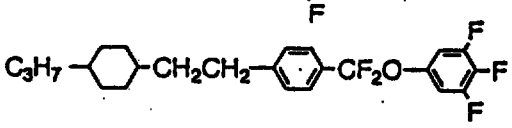

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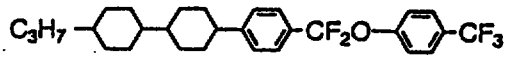

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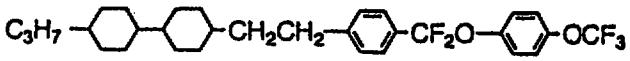

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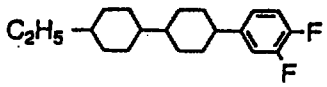
[Composition Example 3]

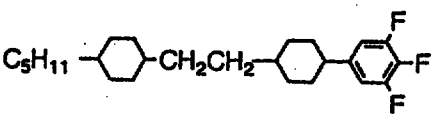

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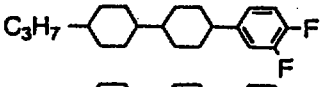

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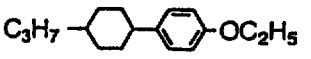

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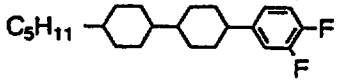

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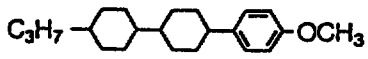

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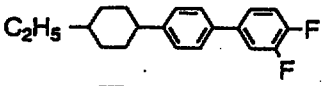

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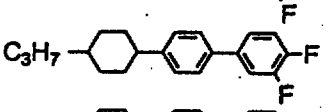

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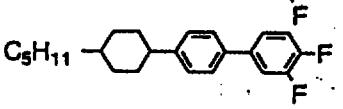

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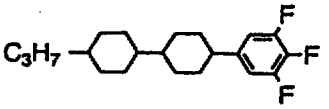

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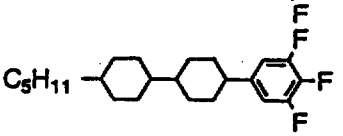

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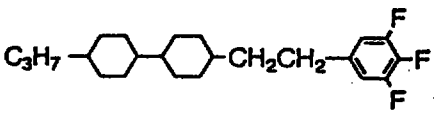

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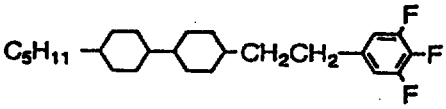

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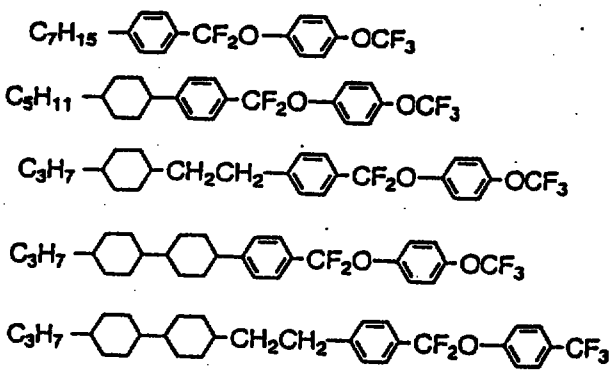

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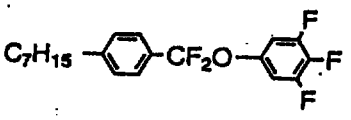

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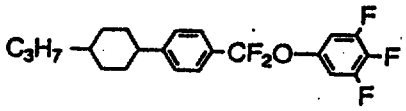

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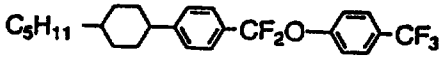
[Composition Example 4]

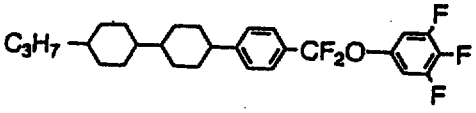


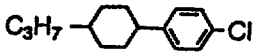
[Composition Example 5]

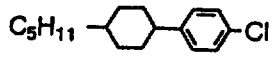

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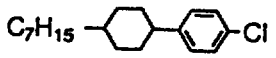

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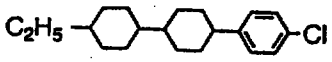

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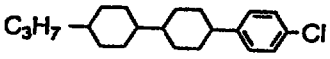

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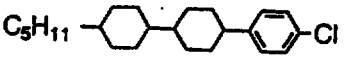

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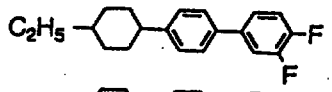

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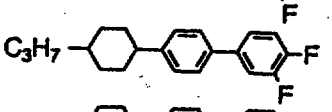

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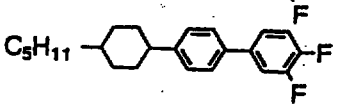

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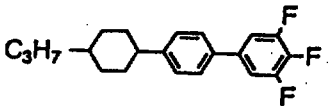

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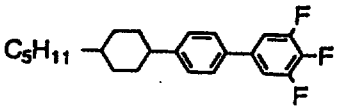

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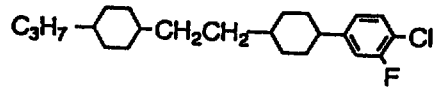

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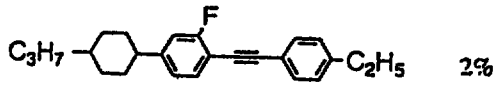

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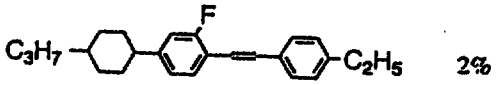

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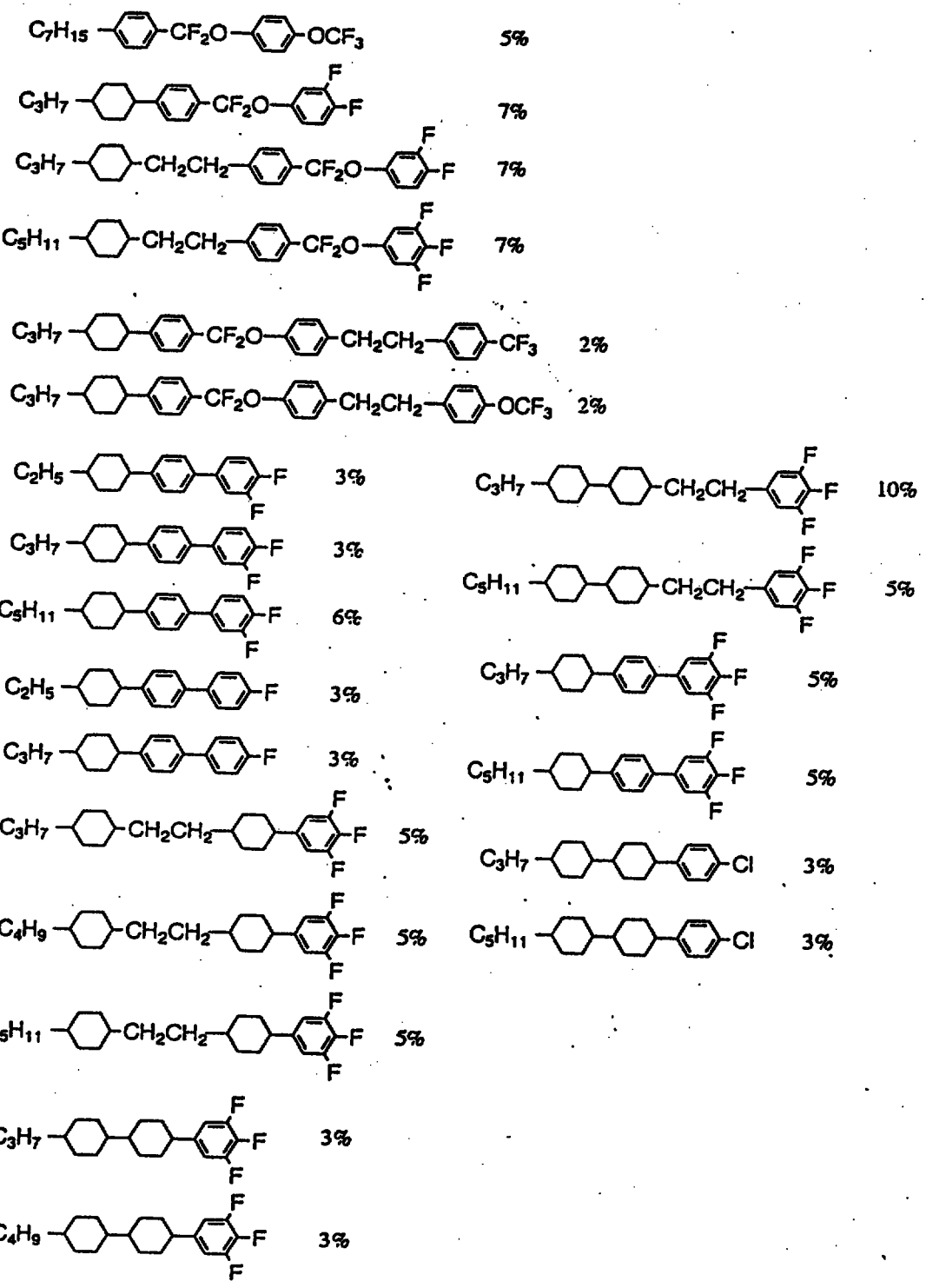

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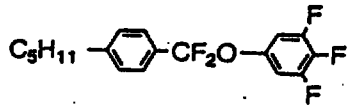

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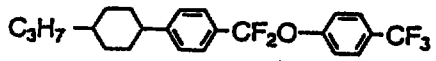

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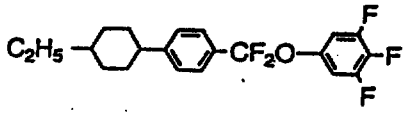
[Composition Example 6]

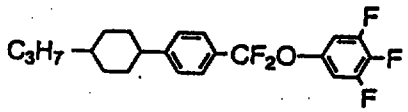


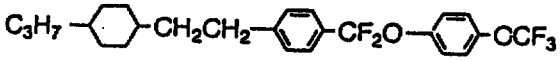
[Composition Example 7]

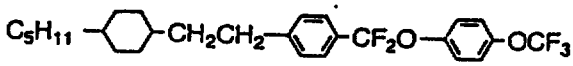

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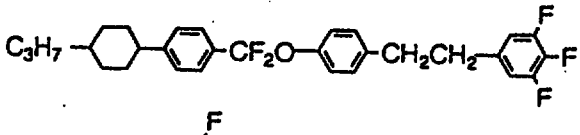

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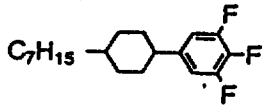

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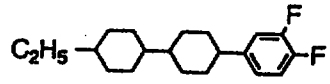

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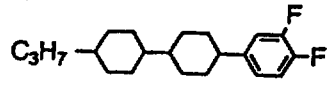

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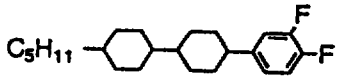

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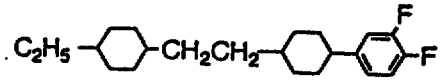

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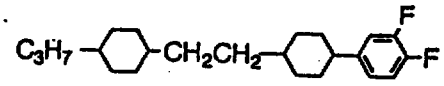

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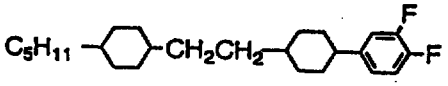

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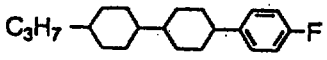

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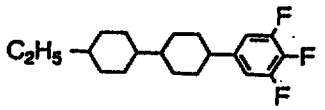

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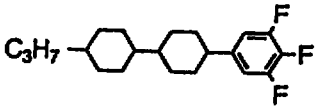

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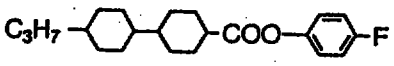

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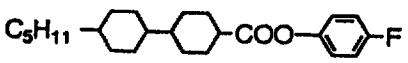

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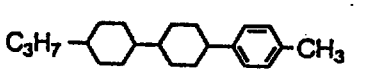

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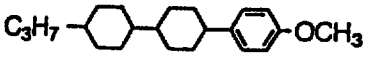

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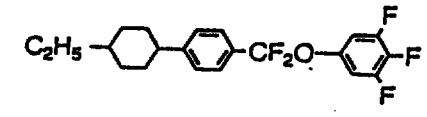

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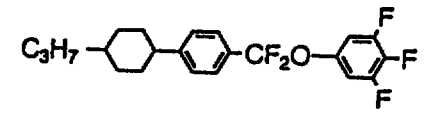

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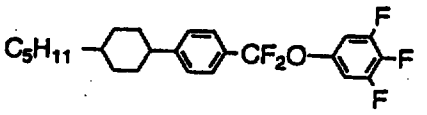

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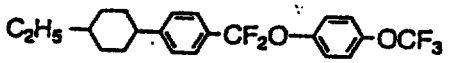

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[Composition Example 8]

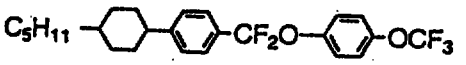

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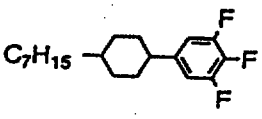

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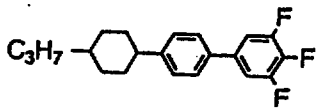

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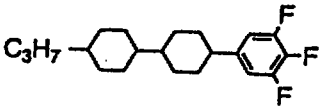

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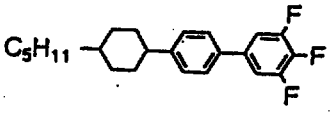

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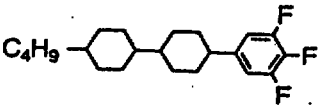

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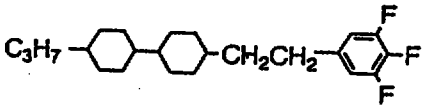

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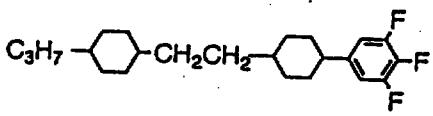

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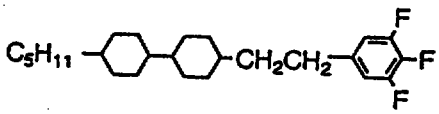

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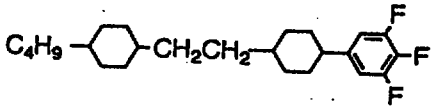

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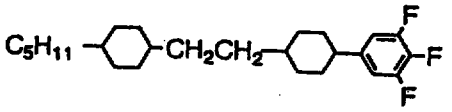

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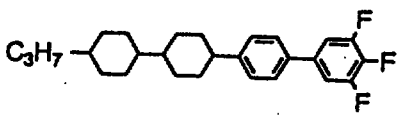

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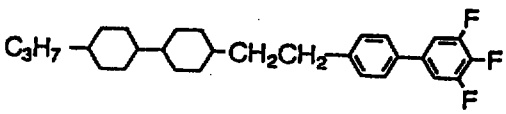

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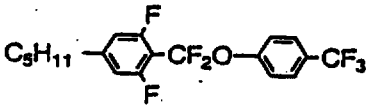

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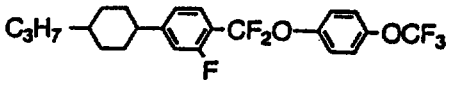

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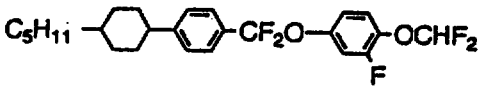

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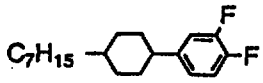

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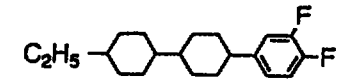
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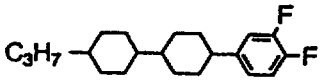

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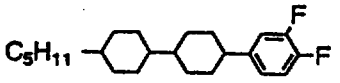

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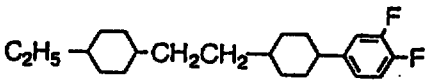

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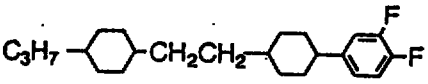

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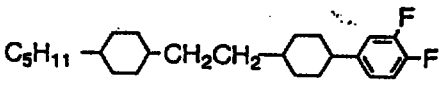

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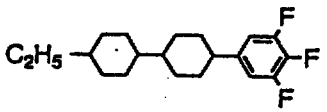

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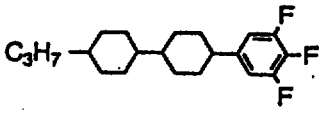

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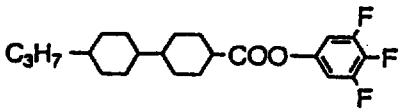

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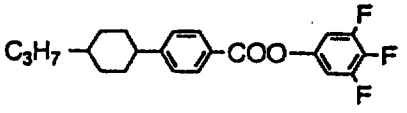

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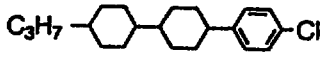

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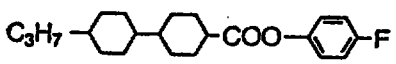

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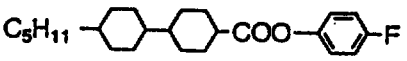

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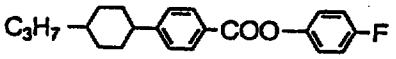

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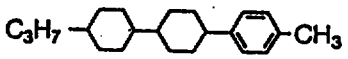

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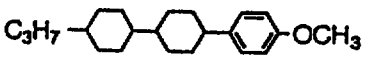

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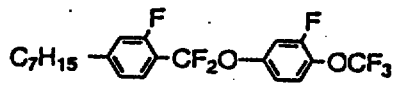

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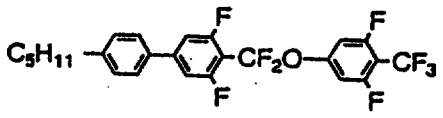

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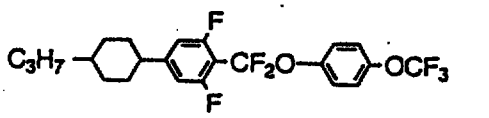

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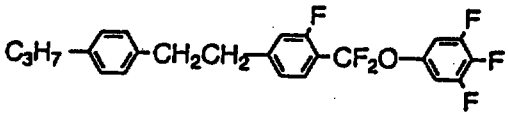

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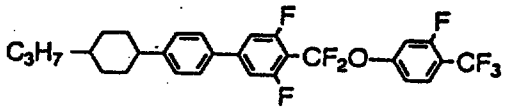
[Composition Example 10]

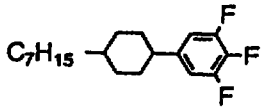

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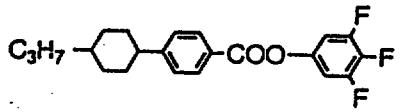

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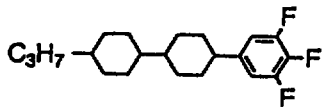

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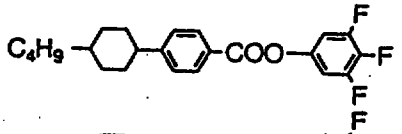

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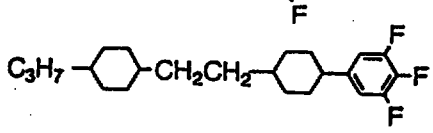

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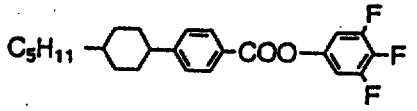

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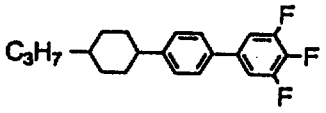

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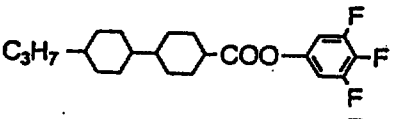

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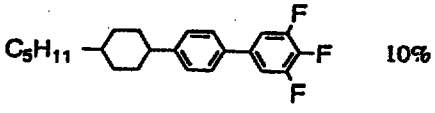

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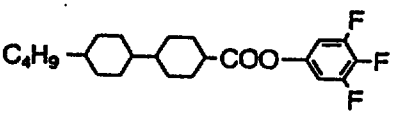

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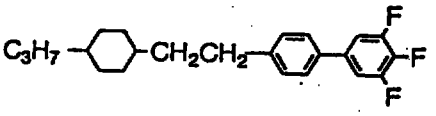

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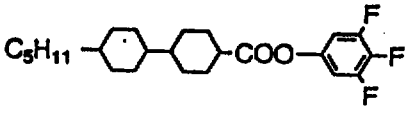

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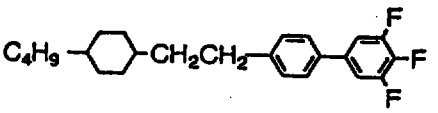

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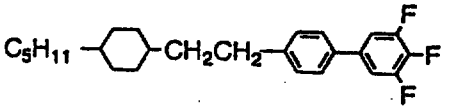

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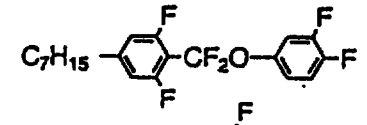

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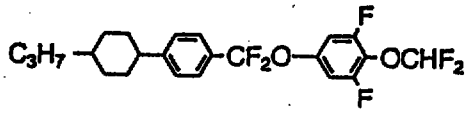

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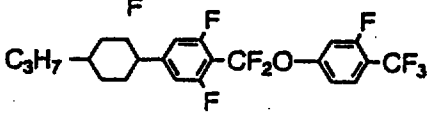

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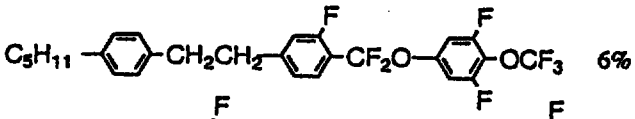

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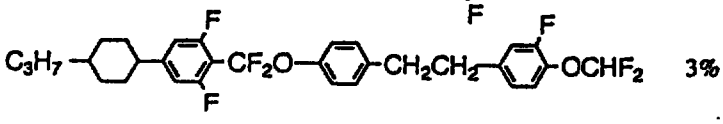
[Composition Example 11]

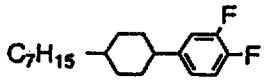

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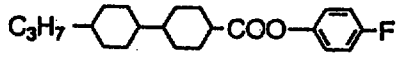

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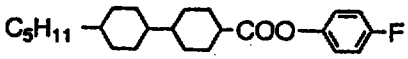

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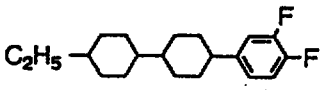

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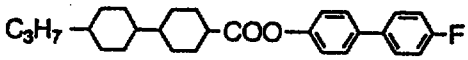

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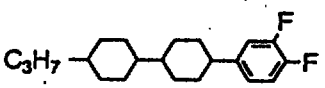

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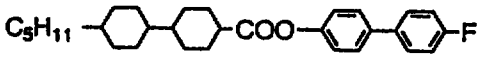

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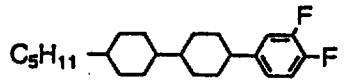

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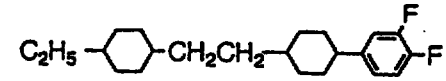

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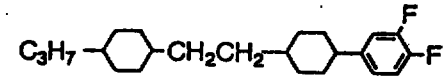

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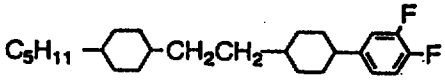

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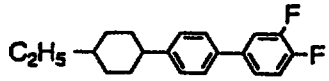

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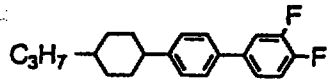

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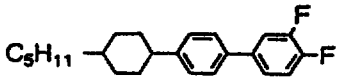

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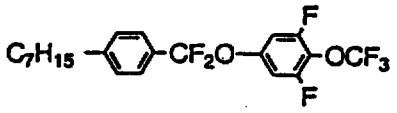

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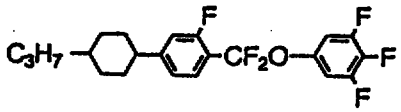

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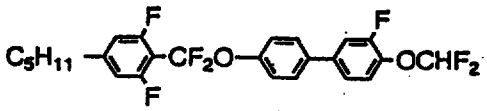

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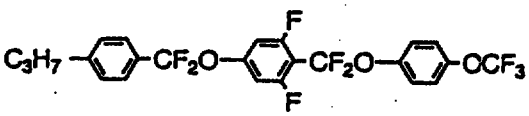

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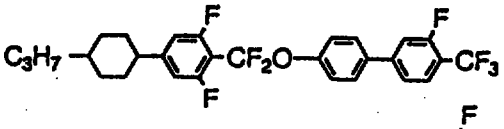
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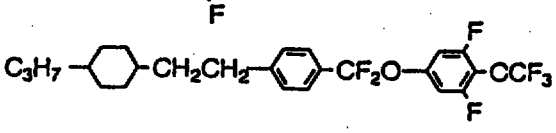

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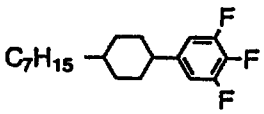

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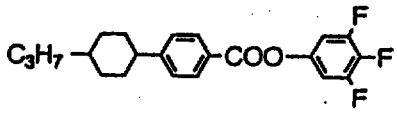

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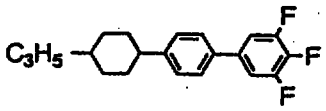

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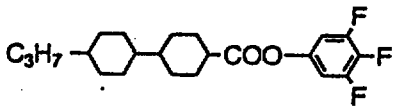

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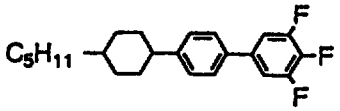

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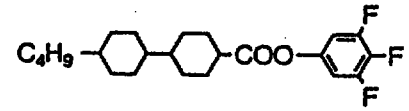

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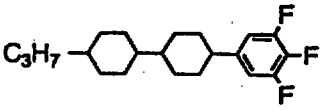

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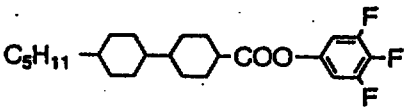

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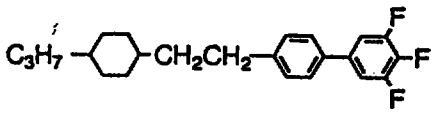

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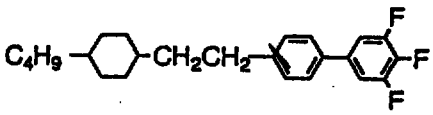

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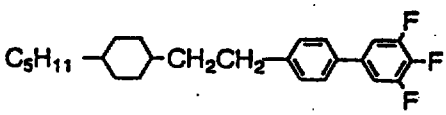

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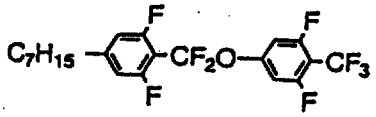

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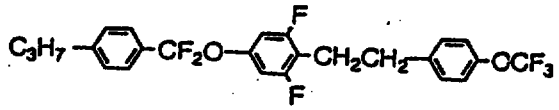

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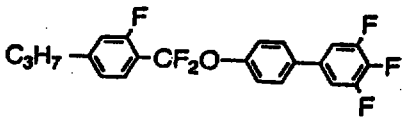

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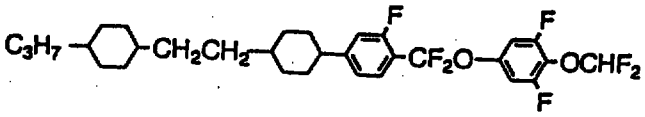

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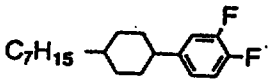
[Composition Example 13]

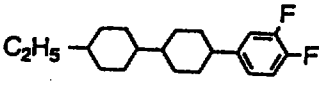

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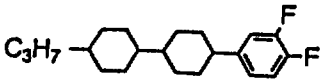

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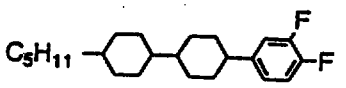

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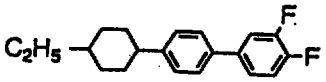

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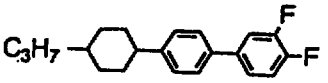

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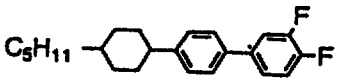

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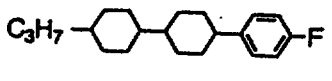

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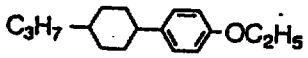

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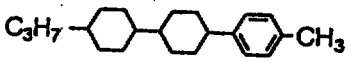

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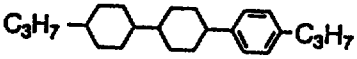

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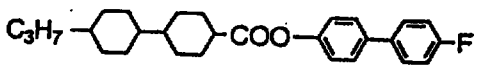

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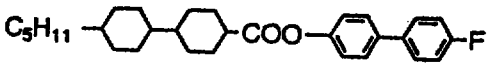

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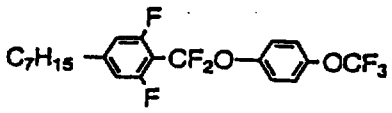

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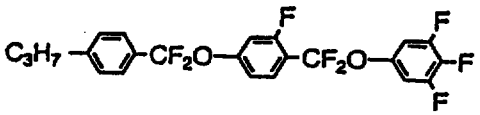

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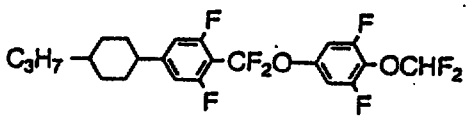

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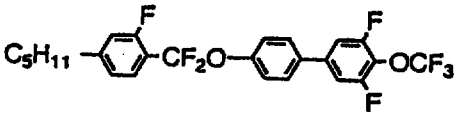

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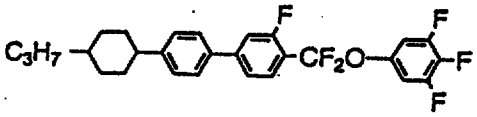
[Composition Example 14]

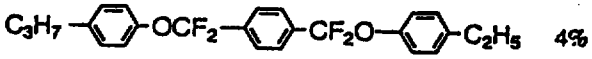

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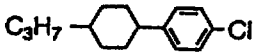

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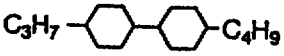

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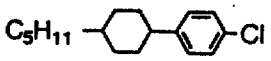

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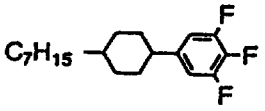

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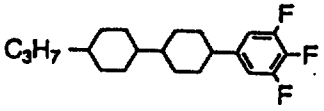

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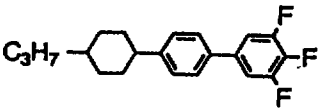

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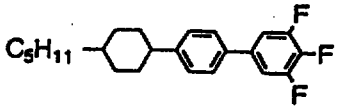

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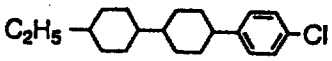

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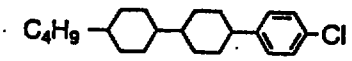

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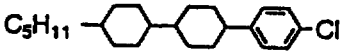

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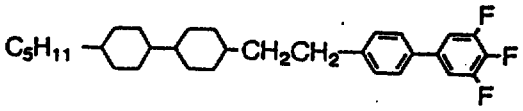

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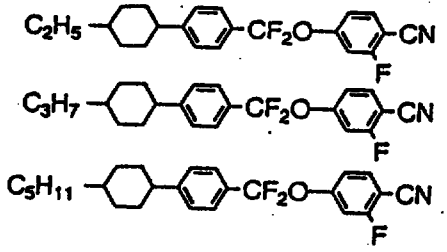

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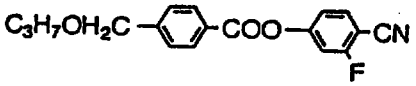
[Composition Example 15]



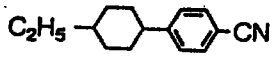
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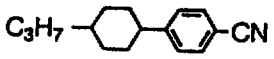
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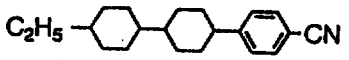
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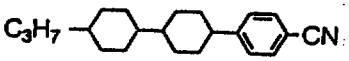
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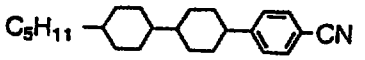
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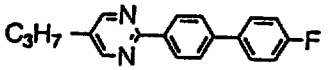
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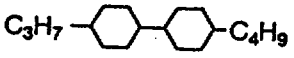
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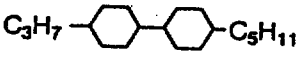
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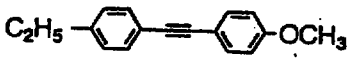
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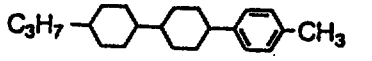
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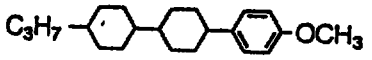
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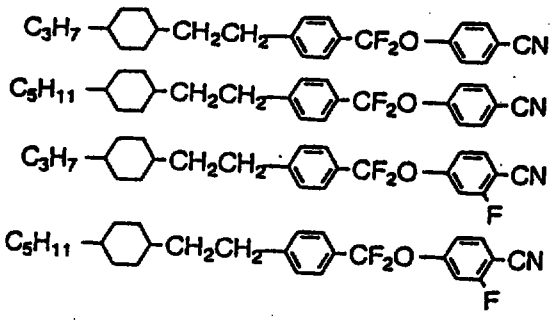


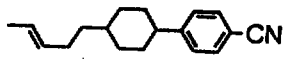
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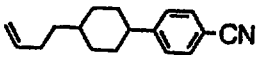


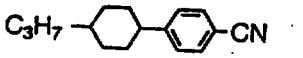
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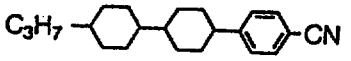
[Composition Example 16]

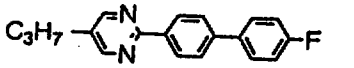


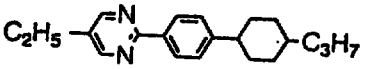


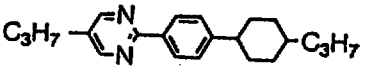


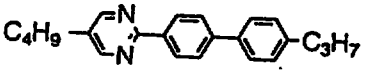


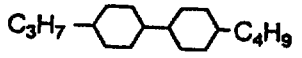


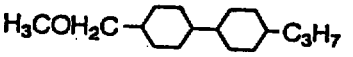




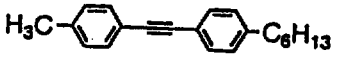




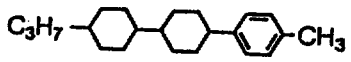




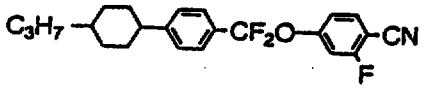


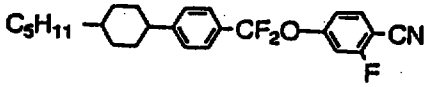


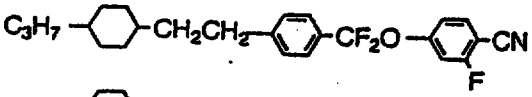


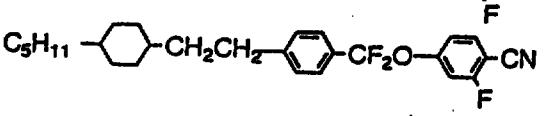


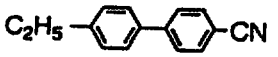
[Composition Example 17]

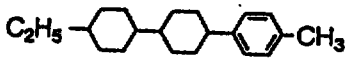

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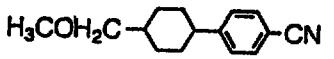

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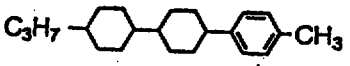

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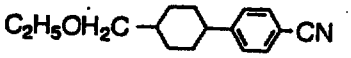

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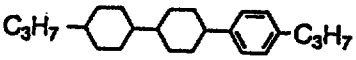

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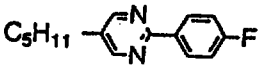

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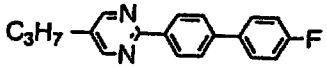

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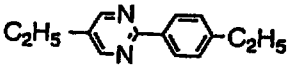

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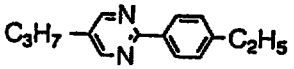

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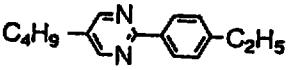

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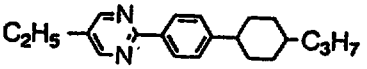

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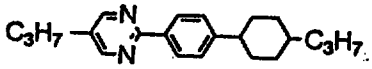

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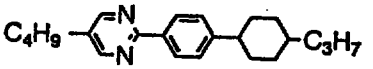

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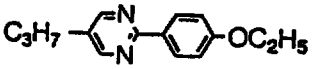

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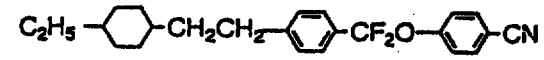

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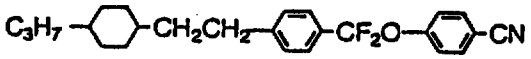

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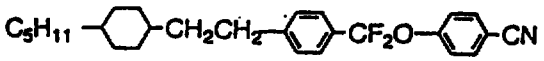

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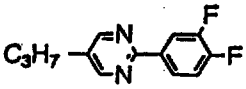

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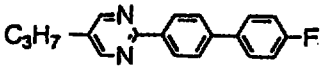
[Composition Example 18]

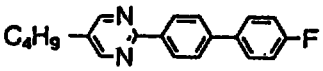

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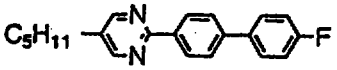

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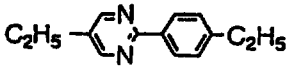

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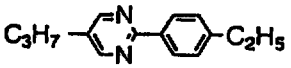

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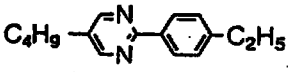

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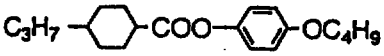

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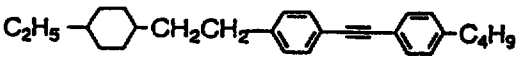

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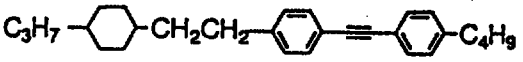

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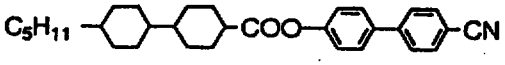

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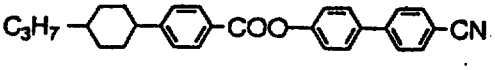

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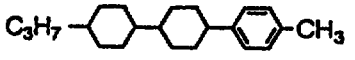

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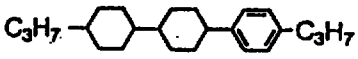

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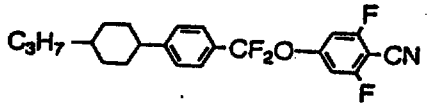

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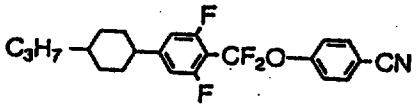

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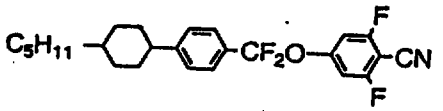

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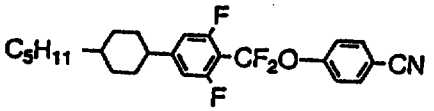

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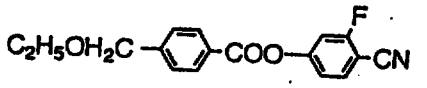
[Composition Example 19]

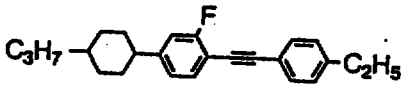

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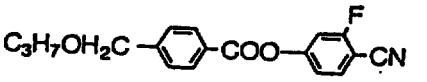

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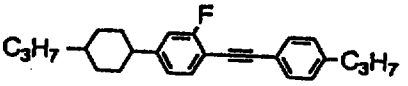

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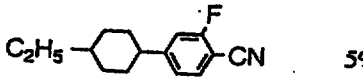

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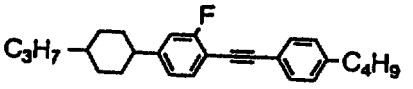

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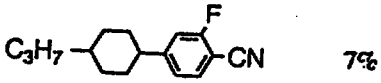

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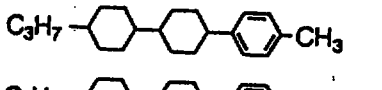

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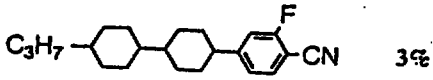

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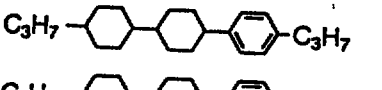

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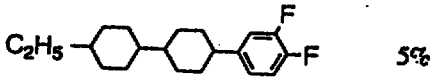

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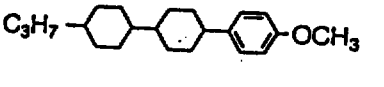

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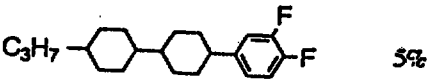

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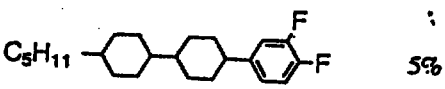

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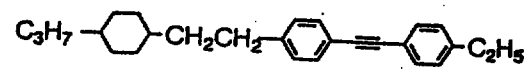

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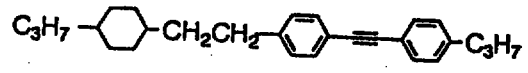

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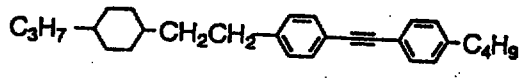

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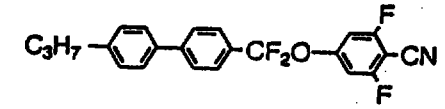

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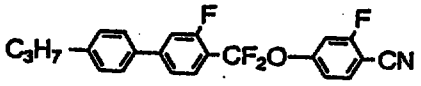

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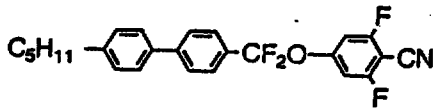

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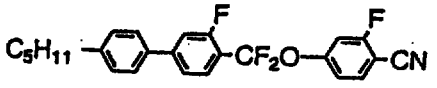

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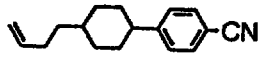
[Composition Example 20]

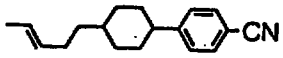

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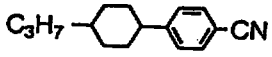

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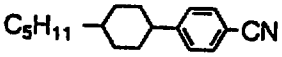

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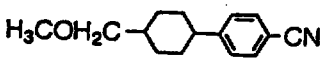

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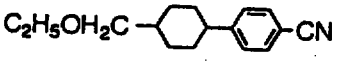

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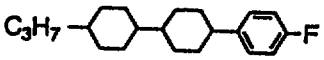

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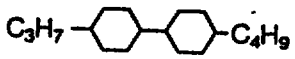

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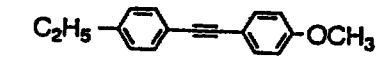

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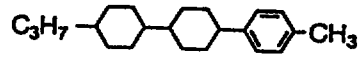

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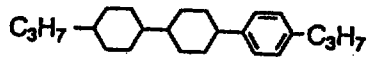

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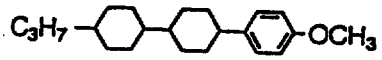

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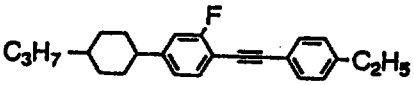

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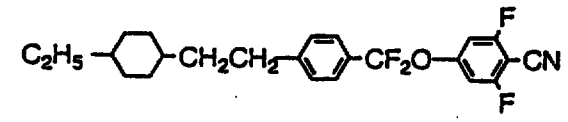

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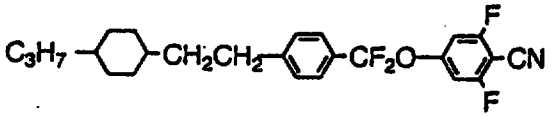

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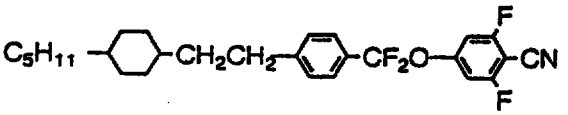

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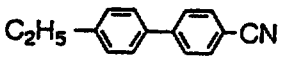
[Composition Example 21]

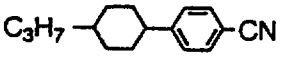

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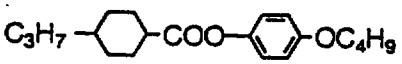

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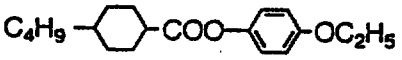

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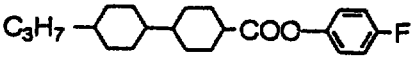

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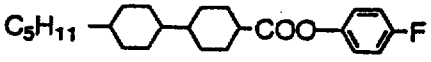

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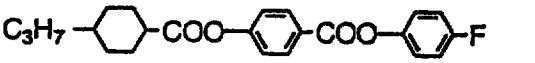

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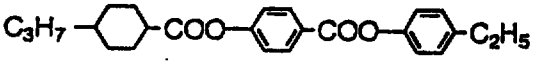

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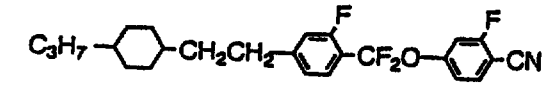

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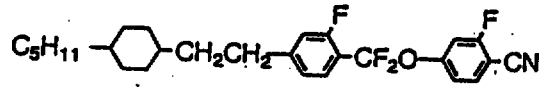

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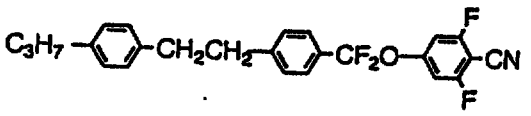

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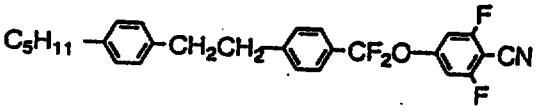

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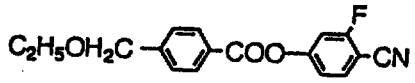
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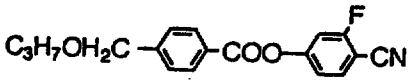

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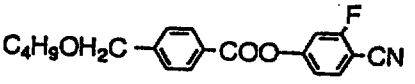

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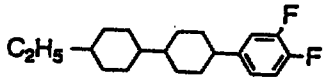

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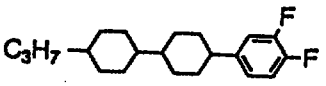

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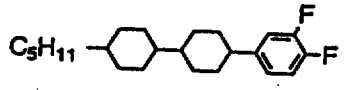

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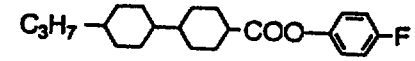

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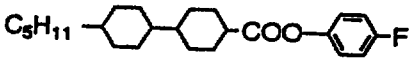

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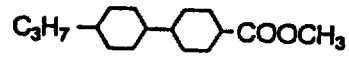

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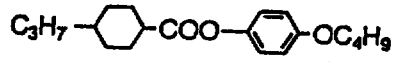

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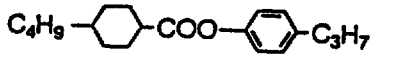

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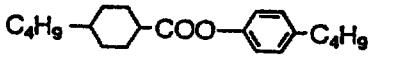

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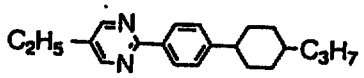

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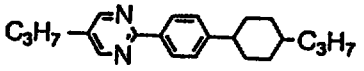

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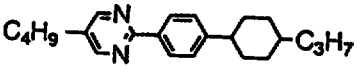

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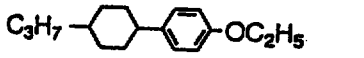

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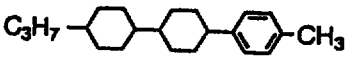

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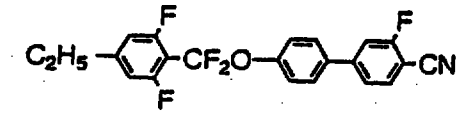

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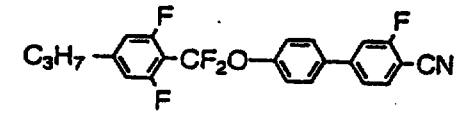

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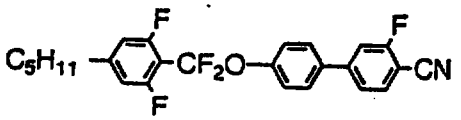

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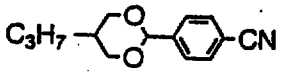

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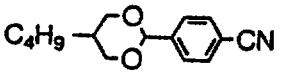
[Composition Example 23]

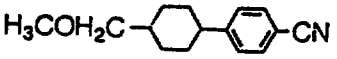

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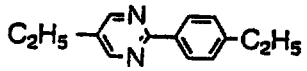

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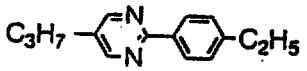

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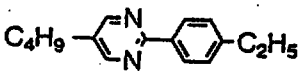

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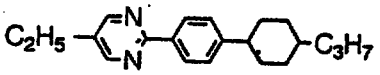

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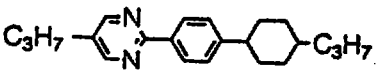

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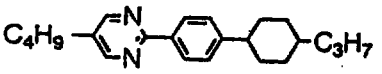

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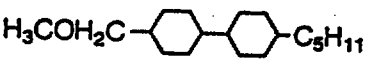

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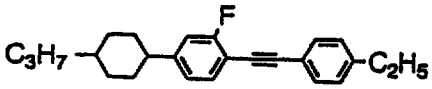

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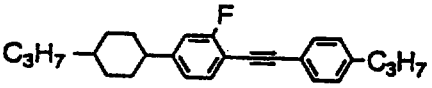

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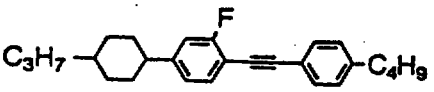

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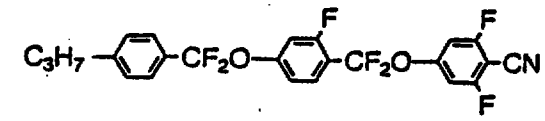

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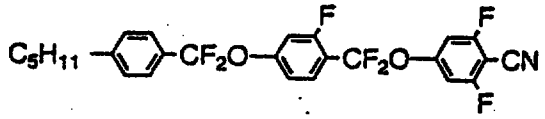

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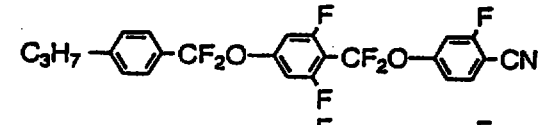

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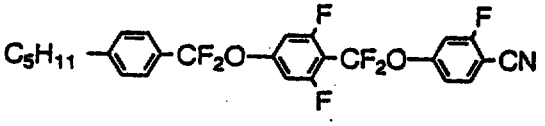

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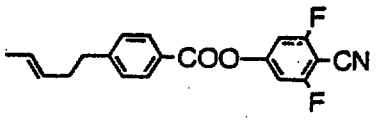
[Composition Example 24]

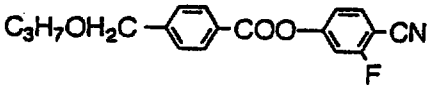

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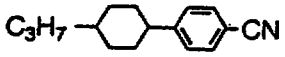

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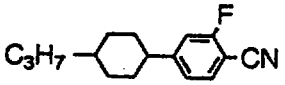

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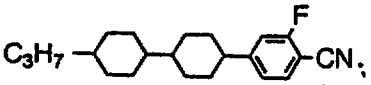

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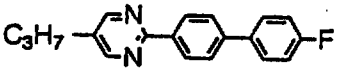

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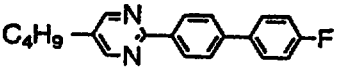

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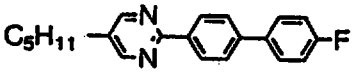

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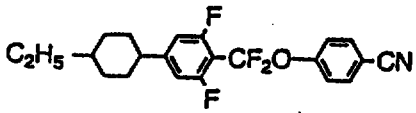

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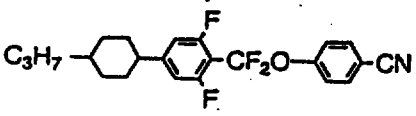

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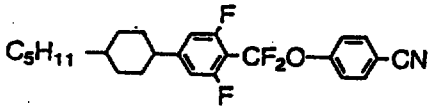
[Composition Example 25]



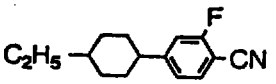
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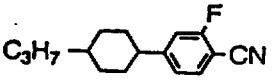
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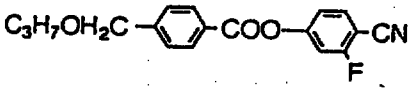
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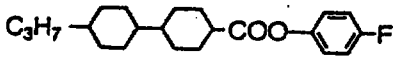
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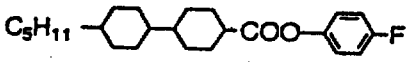
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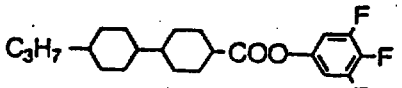
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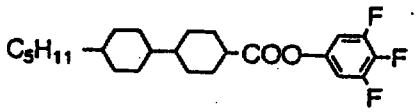
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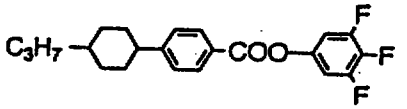
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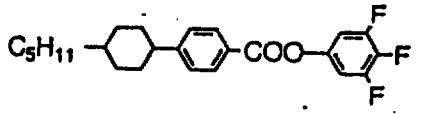
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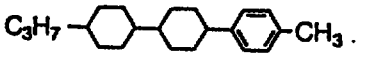
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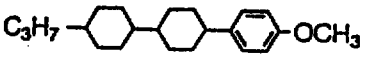
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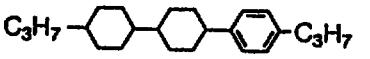
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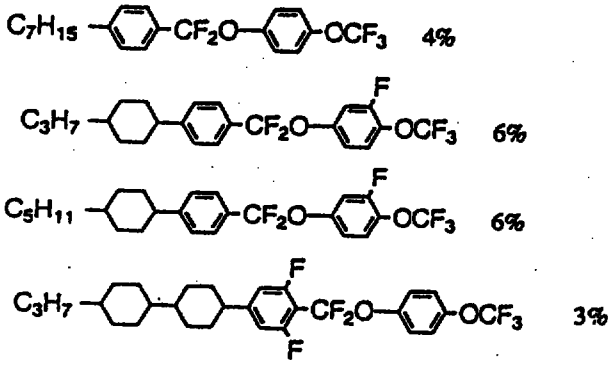


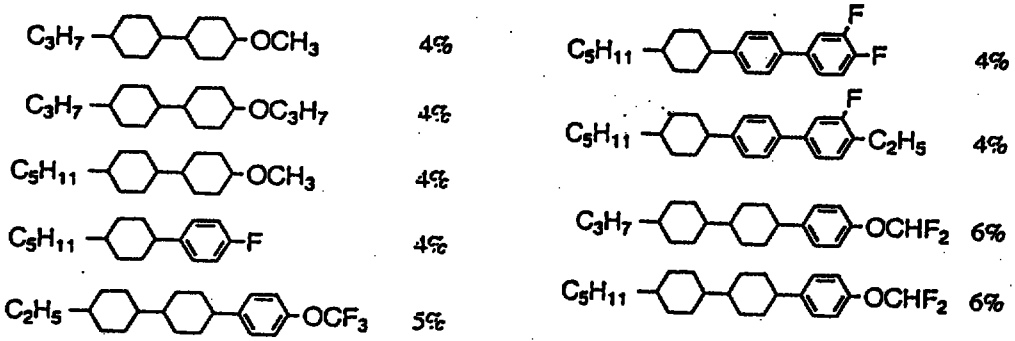
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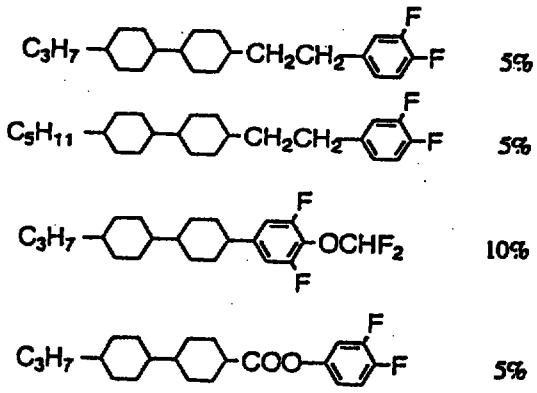


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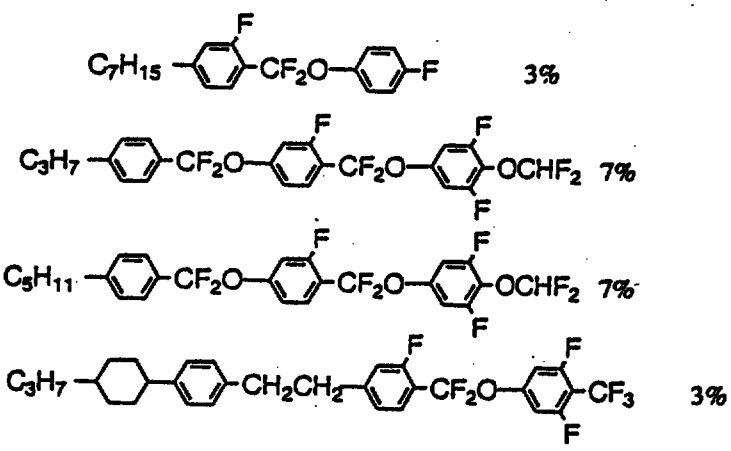
[Composition Example 26]

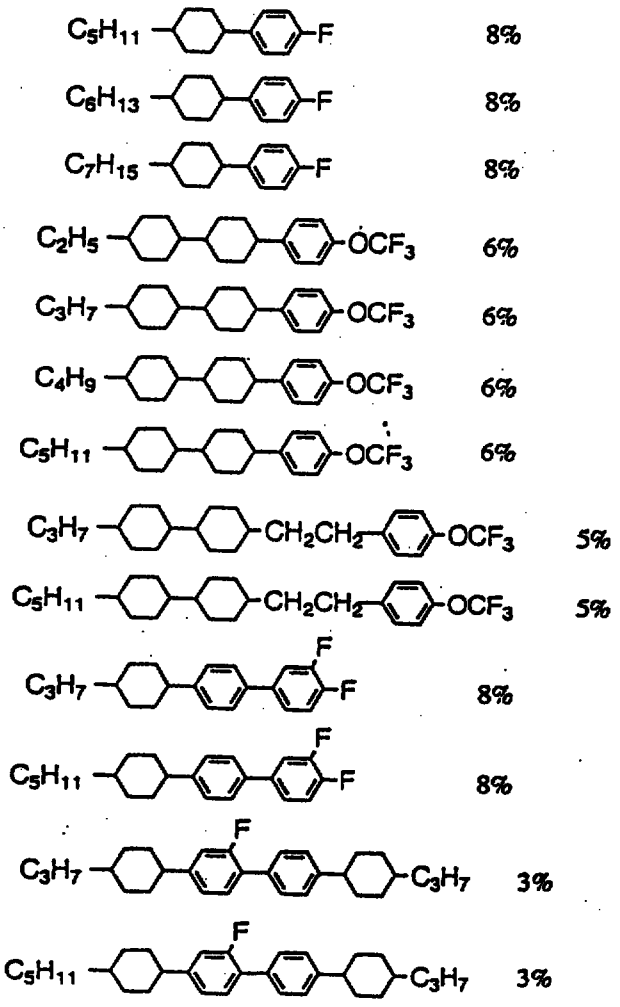




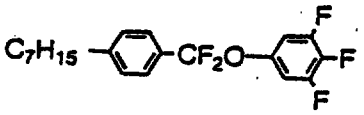


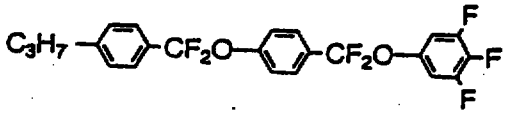
[Composition Example 27]

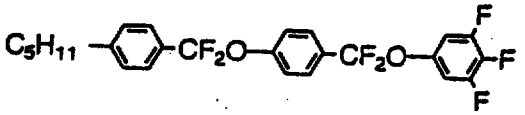


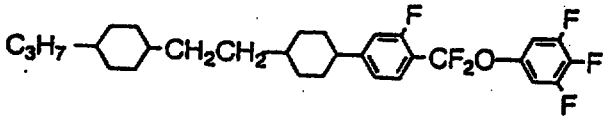


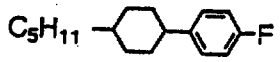
[Composition Example 28]

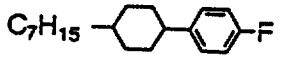

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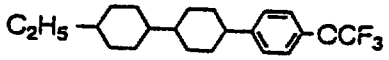

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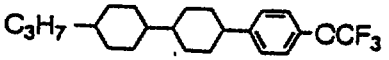

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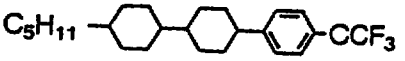

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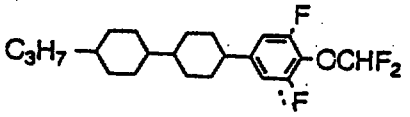

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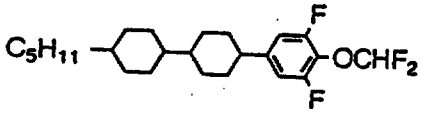

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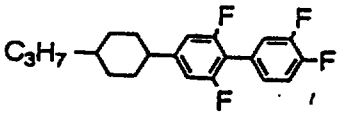

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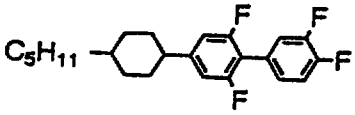

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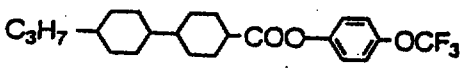

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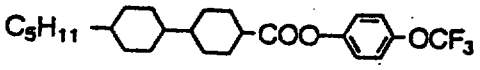

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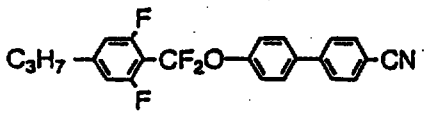

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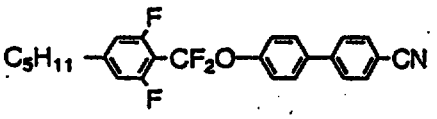

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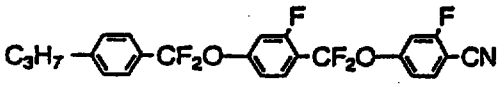

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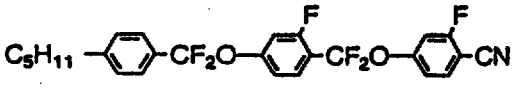

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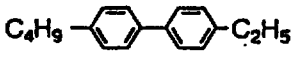

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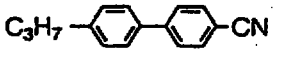

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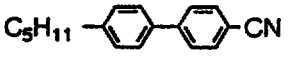

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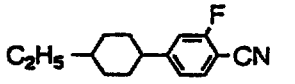

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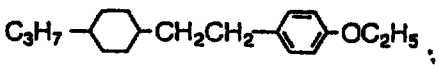

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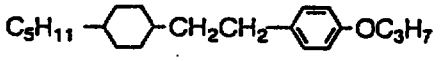

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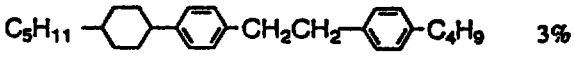

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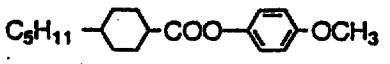

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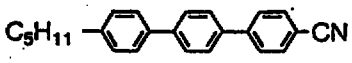

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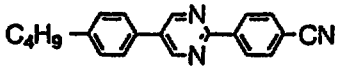

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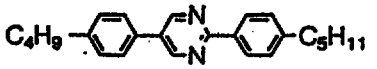

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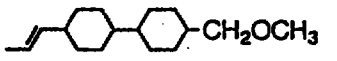

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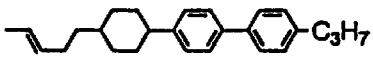

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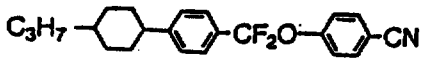

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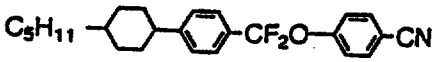

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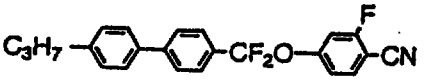

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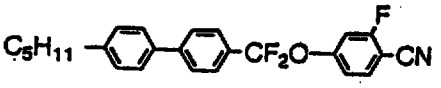

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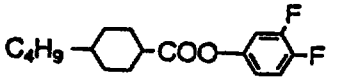
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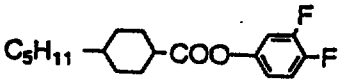

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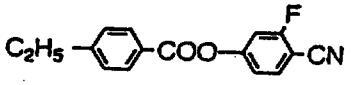

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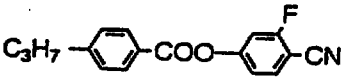

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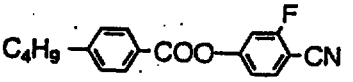

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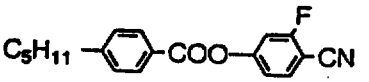

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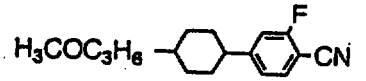

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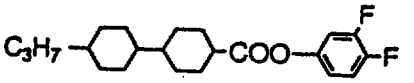

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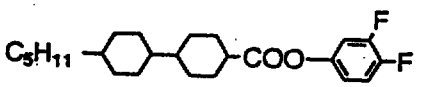

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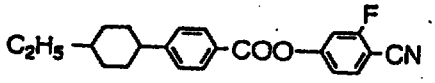

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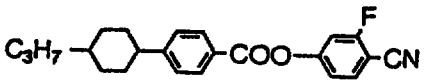

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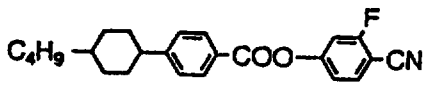

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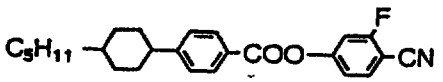

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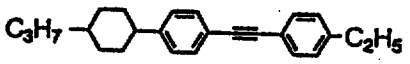

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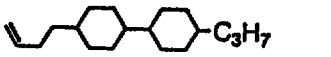

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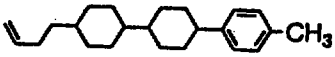

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Difluorooxymethane derivatives of the present invention have an extremely large dielectric anisotropy ($\Delta\varepsilon$) compared with the compounds which have a similar structure and are described in the paragraph of BACKGROUND ART; have an extremely low viscosity compared with the other compounds having the same substituent at the terminal of the molecule; and have excellent characteristics as liquid crystalline compounds for low voltages in various modes including active matrix mode and STN mode. Further, the difluorooxymethane derivatives of the present invention are excellent in miscibility with many other liquid crystalline compounds, that is, with existing liquid crystalline compounds including fluorine type compounds as well as ester type, Schiff base type, biphenyl type, phenylcyclohexane type, bicyclohexane type, and heterocyclic type compounds. Also, the derivatives have a characteristic that they are excellent in miscibility particularly at low temperatures. Besides, it is possible to considerably reduce driving voltage (threshold voltage) by adding the compound of the present invention as a component of liquid crystal compositions while suppressing the increase in viscosity.

Methods for preparing and using the compounds of the present invention are illustrated in more detail below with reference to Examples. However, it should be understood that the present invention is by no means restricted by such specific Examples. In each of the Examples, Cr represents crystal, N does nematic phase, S does smectic phase, Iso represents iostropic liquid, and the unit of every phase transition temperature is °C.

Example 1

Preparation of difluoro-(4-propylphenyl)-(3,4,5-trifluorophenyloxy)methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ, m, and n are 0, Z_1, Z_2, and Z_3 are covalent bond,

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$L_1 = L_2 = H$, $L_3 = L_4 = F$, and X = F)

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 15.0 g (91.4 mmol) of 4-propyl benzoic acid, 22.6 g (109.7 mmol) of dicyclohexylcarbodiimide (hereinafter abbreviated as DCC), and 0.43 g (3.3 mmol) of 4-dimethylamino-pyridine (hereinafter abbreviated as DMAP) were dissolved in 200 ml of dichloromethane under nitrogen gas atmosphere, and then 16.2 g (109.7 mmol) of 3,4,5-trifluorophenol was added dropwise to the solution in 5 min while stirring at room temperature. After the dropping, the solution was stirred for 18 hours at room temperature. Then, 100 ml of water was added to the reaction solution to terminate the reaction. After dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated and the water layer was further extracted with 100 ml of dichloromethane. Extracted layers were mixed and washed with 100 ml × 2 ("× 2" means "repeated twice", the same rule applies hereinafter) of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 25.8 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using toluene as developing solvent to obtain 22.8 g of colorless crystal product. This product was 3,4,5-trifluoro-(4-propylphenyl)benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 22.8 g (77.6 mmol) of 3,4,5-trifluoro-(4-propylphenyl)benzoate obtained by the procedures mentioned above and 62.8 g (155.2 mmol) of 2,4-bis(methoxyphenyl)-1,3-dithia-2,4-diphosphetane-2,4-

disulfide (hereinafter abbreviated as Lawesson's reagent) were dissolved in 400 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 60 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added, the toluene layer was separated, and then the water layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 23.9 g of brown crystalline mixture. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 5.4 g of yellow needle-like crystal product. This product was 4-propylphenyl carbothio acid-O-3,4,5-trifluorophenyl.

Subsequently, the thioncarboxylic acid ester derivative was subjected to a gem-fluorination. That is, in a 100 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 5.4 g (17.4 mmol) of 4-propylphenyl carbothio acid-O-3,4,5-trifluorophenyl was dissolved in 50 ml of dichloromethane, and then 8.4 g (52.2 mmol) of diethylaminosulfur trifluoride (hereinafter abbreviated as DAST) was added to the solution and then the solution was stirred at room temperature for 28 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then

concentrated under a reduced pressure to obtain 4.5 g of light yellow oily product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 1.2 g of colorless needle-like crystal product. This product was difluoro-(4-propylphenyl)-(3,4,5-trifluorophenyloxy) methane.

Following compounds can be prepared according to the preparation method mentioned above by using 4-alkylbenzoic acids having a different alkyl chain in place of 4-propylbenzoic acid:

Difluoro-(4-methylphenyl)-(3,4,5-trifluorophenyloxy)methane
Difluoro-(4-ethylphenyl)-(3,4,5-trifluorophenyloxy)methane
Difluoro-(4-butylphenyl)-(3,4,5-trifluorophenyloxy)methane
Difluoro-(4-pentylphenyl)-(3,4,5-trifluorophenyloxy)methane
Difluoro-(4-hexylphenyl)-(3,4,5-trifluorophenyloxy)methane
Difluoro-(4-heptylphenyl)-(3,4,5-trifluorophenyloxy)methane
Difluoro-(4-octylphenyl)-(3,4,5-trifluorophenyloxy)methane
Difluoro-(4-nonylphenyl)-(3,4,5-trifluorophenyloxy)methane
Difluoro-(4-decylphenyl)-(3,4,5-trifluorophenyloxy)methane

Also, the following compounds can be prepared according to the preparation method mentioned above by using several known phenol derivatives in place of 3,4,5-trifluorophenol:

Difluoro-(4-ethylphenyl)-(4-trifluoromethylphenyloxy)methane
Difluoro-(4-propylphenyl)-(4-trifluoromethylphenyloxy)methane
Difluoro-(4-butylphenyl)-(4-trifluoromethylphenyloxy)methane
Difluoro-(4-pentylphenyl)-(4-trifluoromethylphenyloxy)methane
Difluoro-(4-ethylphenyl)-(4-difluoromethoxyphenyloxy)methane
Difluoro-(4-propylphenyl)-(4-difluoromethoxyphenyloxy)methane
Difluoro-(4-butylphenyl)-(4-difluoromethoxyphenyloxy)methane
Difluoro-(4-pentylphenyl)-(4-difluoromethoxyphenyloxy)methane
Difluoro-(4-ethylphenyl)-(4-trifluoromethoxyphenyloxy)methane
Difluoro-(4-propylphenyl)-(4-trifluoromethoxyphenyloxy)methane

Cr 12.1 Iso

Difluoro-(4-butylphenyl)-(4-trifluoromethoxyphenyloxy)methane

Difluoro-(4-pentylphenyl)-(4-trifluoromethoxyphenyloxy)methane

Difluoro-(4-ethylphenyl)-(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(4-propylphenyl)-(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(4-butylphenyl)-(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(4-pentylphenyl)-(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(4-ethylphenyl)-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(4-propylphenyl)-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(4-butylphenyl)-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(4-pentylphenyl)-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(4-ethylphenyl)-(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(4-propylphenyl)-(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(4-butylphenyl)-(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(4-pentylphenyl)-(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(4-ethylphenyl)-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(4-propylphenyl)-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(4-butylphenyl)-(3,5-difluoro-4-trifluoromethoxyphenyl-

oxy)methane

Difluoro-(4-pentylphenyl)-(3,5-difluoro-4-trifluoromethoxy-phenyloxy)methane

Difluoro-(4-ethylphenyl)-(3-fluoro-4-difluoromethoxyphenyl-oxy)methane

Difluoro-(4-propylphenyl)-(3-fluoro-4-difluoromethoxyphenyl-oxy)methane

Difluoro-(4-butylphenyl)-(3-fluoro-4-difluoromethoxyphenyl-oxy)methane

Difluoro-(4-pentylphenyl)-(3-fluoro-4-difluoromethoxyphenyl-oxy)methane

Difluoro-(4-ethylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyl-oxy)methane

Difluoro-(4-propylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyl-oxy)methane

Difluoro-(4-butylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyl-oxy)methane

Difluoro-(4-pentylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyl-oxy)methane

Difluoro-(2-fluoro-4-ethylphenyl)-(3,5-difluoro-4-trifluoro-methylphenyloxy)methane

Difluoro-(2-fluoro-4-propylphenyl)-(3,5-difluoro-4-trifluoro-methylphenyloxy)methane

Difluoro-(2-fluoro-4-butylphenyl)-(3,5-difluoro-4-trifluoro-methylphenyloxy)methane

Difluoro-(2-fluoro-4-pentylphenyl)-(3,5-difluoro-4-trifluoro-methylphenyloxy)methane

Difluoro-(2-fluoro-4-ethylphenyl)-(3,5-difluoro-4-trifluoro-methoxyphenyloxy)methane

Difluoro-(2-fluoro-4-propylphenyl)-(3,5-difluoro-4-trifluoro-methoxyphenyloxy)methane

Difluoro-(2-fluoro-4-butylphenyl)-(3,5-difluoro-4-trifluoro-

methoxyphenyloxy)methane

Difluoro-(2-fluoro-4-pentylphenyl)-(3,5-difluoro-4-trifluoro-methoxyphenyloxy)methane

Difluoro-(2-fluoro-4-ethylphenyl)-(3,5-difluoro-4-difluoro-methoxyphenyloxy)methane

Difluoro-(2-fluoro-4-propylphenyl)-(3,5-difluoro-4-difluoro-methoxyphenyloxy)methane

Difluoro-(2-fluoro-4-butylphenyl)-(3,5-difluoro-4-difluoro-methoxyphenyloxy)methane

Difluoro-(2-fluoro-4-pentylphenyl)-(3,5-difluoro-4-difluoro-methoxyphenyloxy)methane

Difluoro-(2-fluoro-4-ethylphenyl)-(3,4,5-trifluorophenyl-oxy)methane

Difluoro-(2-fluoro-4-propylphenyl)-(3,4,5-trifluorophenyl-oxy)methane

Difluoro-(2-fluoro-4-butylphenyl)-(3,4,5-trifluorophenyl-oxy)methane

Difluoro-(2-fluoro-4-pentylphenyl)-(3,4,5-trifluorophenyl-oxy)methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(2,6-difluoro-4-propylphenyl)-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(2,6-difluoro-4-butylphenyl)-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-propylphenyl)-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-butylphenyl)-(3,5-difluoro-4-

trifluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-propylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-butylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-(3,4,5-trifluoro-phenyloxy)methane

Difluoro-(2,6-difluoro-4-propylphenyl)-(3,4,5-trifluoro-phenyloxy)methane

Difluoro-(2,6-difluoro-4-butylphenyl)-(3,4,5-trifluoro-phenyloxy)methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-(3,4,5-trifluoro-phenyloxy)methane

Example 2

Preparation of difluoro-[4-(trans-4-propylcyclohexyl) phenyl]-(3,4,5-trifluorophenyloxy)methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = 1, m and n are 0, ring A_1 is trans-1,4-cyclohexyne group, Z_1, Z_2, and Z_3 are covalent bond, $L_1 = L_2 = H$, $L_3 = L_4 = F$, and X = F)

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 15.0 g (60.9 mmol) of 4-(trans-4-propyl-cyclohexyl)benzoic acid, 15.1 g (73.1 mmol) of DCC, and 0.3 g (2.2 mmol) of DMAP were dissolved in 250 ml of dichloromethane

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under nitrogen gas atmosphere, and then 0.8 g (73. mmol) of 3,4,5-trifluorophenol was added dropwise in 3 min while stirring at room temperature. After the dropping, the solution was stirred for 10 hours at room temperature. Then, 00 ml of water was added to the reaction solution. After dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, the water layer was further extracted with 200 ml of dichloromethane. Extracted layers were mixed and washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 23.8 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using toluene as developing solvent, and then recrystallized from a mixed solvent of heptane-ethanol to obtain 13.2 g of colorless crystal product. This product was 3,4,5-trifluoro-[4-(trans-4-propylcyclohexyl)phenyl]benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 13.2 g (35.2 mmol) of 3,4,5-trifluoro-[4-(trans-4-propylcyclohexyl) phenyl]benzoate obtained by the procedures mentioned above and 28.5 g (70.4 mmol) of Lawesson's reagent were dissolved in 500 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 60 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added, the toluene layer was separated, and then the water layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and

then concentrated under a reduced pressure to obtain 13.8 g of brown crystalline mixture. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 4.7 g of yellow needle-like crystal product having a phase transition point of Cr 127.7-128.2°C Iso. This product was 4-(trans-4-propylcyclohexyl)phenylcarbothio acid-O-3,4,5-trifluorophenyl.

^{1}H-NMR ($CDCl_3$; δ ppm) 0.8-2.0(16H,m), 2.57(1H,m), 6.78(2H,m), 7.29(2H,d,J=8,2Hz), and 8.23(2H d,J=8,2Hz).

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 4.7 g (12.1 mmol) of 4-(trans-4-propylcyclohexyl)phenylcarbothio acid-O-3,4,5-trifluoro phenyl was dissolved in 50 ml of dichloromethane at room temperature, and then 5.9 g (36.2 mmol) of DAST was added to the solution and the solution was stirred at room temperature for 34 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 4.3 g of colorless crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 1.5 g of colorless needle-like crystal product (phase transition point: Cr 70.5-71.4 Iso). This product was difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3,4,5-trifluoro-phenyloxy)methane.

^{1}H-NMR ($CDCl_3$; δ ppm) 0.8-2.10(16H,m), 2.60(1H,m), 6.96(2H,m), 7.32(2H,d,J=8,6Hz), and 7.62(2H,d,J=8,6Hz).

^{19}F-NMR ($CDCl_3$; δ ppm) -66.754(2F,s,-C$\underline{F}_2$O-), -133.521(2F,d), -164.754(1F,t).

GC-MS (CI) m/z251(100%), 379(M^++1-HF,34), and 125(27).

Following compounds can be prepared according to the preparation method mentioned above by using 4-(trans-4-alkylcyclohexyl)benzoic acids having a different alkyl chain in place of 4-(trans-4-propylcyclohexyl)benzoic acid:

Difluoro-[4-(trans-4-methylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Cr 62.6-63.0 Iso

Difluoro-[4-(trans-4-hexylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[4-(trans-4-heptylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[4-(trans-4-octylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[4-(trans-4-nonylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[4-(trans-4-decylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Following compounds can be prepared according to the preparation method mentioned above by using several known phenol derivatives in place of 3,4,5-trifluorophenol:

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3,4-difluorophenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3,4-difluorophenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,4-difluorophenyloxy)methane

Cr 42.9-43.4 N 66.2-67.5 Iso

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(4-trifluoromethylphenyloxy)methane

Cr 79.6-79.9 Iso

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Cr 57.3-58.2 S_B 70.9-72.0 N 83.1-83.5 Iso

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(4-trifluoro-

methoxyphenyloxy)methane

Cr 68.1-68.3 SB 80.5-80.8 N 90.2-90.4 Iso

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Cr 35.9-36.3 N 61.1-61.3 Iso

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3-fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3-fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3-fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3-fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3-fluoro-4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3-fluoro-4-cyanophenyloxy)methane

Cr 65.4-66.3 N 104.9-105.4 Iso

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3-fluoro-4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3-fluoro-4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Cr 56.9-57.5 Iso

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Example 3

Preparation of difluoro-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = 1, m and n are 0, ring A_1 is trans-1,4-cyclohexylene group, Z_1, Z_2, and Z_3 are covalent bond, L_1 = F, L_2 = L_3 = L_4 = H, and X = OCF_3)

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 1.8 g (75.8 mmol) of magnesium turnings and 50 ml of diethyl ether were added under nitrogen gas atmosphere and then a solution of 25 g (72.2 mmol) of 2-fuloro-4-(trans-4-propylcyclohexyl)iodobenzene in 50 ml of diethyl ether was added dropwise while stirring under reflux condition in 40 min. Reaction solution was further refluxed on a hot water bath for 1 hour to age. Subsequently, the reaction solution was cooled down with ice to lower than 10°C, 7.5 g (987 mmol) of carbon disulfide was added dropwise while keeping the temperature at

lower than 10°C, raised up to room temperature, and then further stirred at room temperature for 3 hours. Reaction solution was cooled again down with ice to lower than 10°C and added dropwise with 50 ml of 2N aqueous solution of hydrochloric acid to terminate the reaction. From the reaction solution, the diethyl ether layer was separated and then the water layer was further extracted with 200 ml of diethyl ether. The organic layers were mixed, washed with 200 ml of water times, dried over anhydrous magnesium sulfate, and then concentrated to obtain 19.7 g of dark purplish red solid of dithiocarboxylic acid derivative.

Subsequently, in a 300 ml egg-plant type flask provided with a cooling pipe, 19.7 g of dithiocarboxylic acid derivative obtained by the procedures mentioned above was dissolved in 150 ml of diethyl ether, and then 25.8 g (217.0 mmol) of thionyl chloride was added dropwise to the solution while stirring at room temperature in 15 min. After the dropping, reflux was conducted on a hot water bath for 8 hours. After the reaction solution was heated to distill off diethyl ether, the solution was concentrated under a reduced pressure with an aspirator to obtain 18.4 g of thio acid chloride derivative. Subsequently, in a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 6.4 g (36.1 mmol) of 4-trifluoromethoxyphenol and 5.7 g (72.2 mmol) of pyridine were dissolved in 50 ml of toluene under nitrogen gas atmosphere, added dropwise with 18.4 g of the thio acid chloride derivative obtained by the procedures mentioned above at room temperature while stirring in 20 min. Then, the internal temperature on the hot water bath was heated to 60°C and stirred for 3 hours. After cooled down to room temperature, the reaction solution was added dropwise with 300 ml of water and 30 ml of 2N aqueous solution of hydrochloric acid to terminate the reaction, the toluene layer

was separated, and the water layer was further extracted with 200 ml of toluene. The extracted layer was washed with 200 ml × 2 of water, 00 ml of 2N aqueous solution of sodium hydroxide, and 200 ml × 3 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 14.9 g of reddish brown crystalline reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane/toluene mixed solvent as developing solvent, and then recrystallized from heptane to obtain 6.7 g of yellow needle-like crystal product. This product was 2-fluoro-4-(trans-4-propylcyclohexyl)phenycarbothio acid-O-4-trifluoromethoxyphenyl.

In a 100 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 6.7 g (15.2 mmol) of 2-fluoro-4-(trans-4-propylcyclohexyl)phenylcarbothio acid-O-4-trifluoromethoxyphenyl was dissolved in 50 ml of dichloromethane at room temperature, and then 4.9 g (30.4 mmol) of DAST was added to the solution and the solution was stirred at room temperature for 28 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 40 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 3.2 g of colorless crystalline reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 1.9 g of colorless needle-like crystal product. This product was difluoro-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]-(4-trif luoromethoxyphenyloxy) methane.

Following compounds can be prepared according to the preparation method mentioned above by using 2-fluoro-4-(trans-4-alkylcyclohexyl)iodobenzenes having a different alkyl chain in place of 2-fluoro-4-(trans-4-propylcyclohexyl)iodobenzene:

Difluoro-[2-fluoro-4-(trans-4-methylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-hexylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-heptylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-octylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-nonylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-decylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane

Also, the following compounds can be prepared according to the preparation method mentioned above by using several known phenol derivatives in place of 4-trifluoromethoxyphenol:

Difluoro-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]-(3,5-difluoro-4-cyanophenyloxy)methane

Example 4

Preparation of difluoro-{4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl}-(3,4,5-trifluorophenyloxy)methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = 1, m and n are 0, ring A_1 is trans-1,4-cyclohexylene group, Z_1 is $-CH_2CH_2-$, Z_2 and Z_3 are covalent bond, $L_1 = L_2 = H$, $L_3 = L_4 = F$, and X = F)

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 15.0 g (54.7 mmol) of 4-[2-(trans-4-propylcyclohexyl)ethyl]benzoic acid, 13.5 g (65.6 mmol) of DCC, and 0.25 g (1.9 mmol) of DMAP were dissolved in 250 ml of dichloromethane under nitrogen gas atmosphere, and then 9.7 g (65.6 mmol) of 3,4,5-trifluorophenol was added dropwise to the solution in 3 min while stirring at room temperature. After the dropping, the solution was stirred for 15 hours at room temperature. Then, 100 ml of water was added to the reaction solution. After dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and the water layer was further extracted with 200 ml of dichloromethane. Extracted layers were mixed and washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium

hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 22.5 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using toluene as developing solvent, and then recrystallized from a mixed solvent of heptane-ethanol to obtain 12.9 g of colorless crystal product. This product was 3,4,5-trifluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 12.9 g (31.9 mmol) of 3,4,5-trifluoro- {4-[2-(trans-4-propylcyclohexyl) ethyl]phenyl} benzoate obtained by the procedures mentioned above and 25.8 g (63.9 mmol) of Lawesson's reagent were dissolved in 500 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 65 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added, the toluene layer was separated, and then the water layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 13.3 g of brown crystalline mixture. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 4.5 g of yellow needle-like crystal product. This product was 4-[2-(trans-4-propylcyclohexyl) ethyl]phenylcarbothio acid-O-3,4,5-trifluorophenyl.

Cr 95.5-97.6 Iso

^{1}H-NMR ($CDCl_3$; δ ppm) 0.7-1.9(19H,m), 2.70(2H,m), 6.80(2H,m), 7.25(2H,d,J=8,3Hz), and 8.21(2H d,J=8,3Hz).

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 4.5 g (10.8 mmol) of 4-[2-(trans-4-propylcyclohexyl)ethyl]phenylcarbothio acid-O-3,4,5-trifluorophenyl was dissolved in 50 ml of dichloromethane at room temperature, and then 5.3 g (32.6 mmol) of DAST was added to the solution and then the solution was stirred at room temperature for 40 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 3.9 g of colorless crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 1.5 g of colorless needle-like crystal product. This product was difluoro-{4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl}-(3,4,5-trifluorophenyloxy)methane.

Cr 36.8-37.5 (NI 23.5-23.7) Iso

^{1}H-NMR ($CDCl_3$; δ ppm) 0.7-2.0(19H,m), 2.68(2H,m), 6.93(2H,m), 7.27(2H,d,J=8,4Hz), and 7.58(2H,d,J=8,4Hz).

The following compounds can be prepared according to the preparation method mentioned above by using 4-[2-(trans-4-alkylcyclohexyl)ethyl]benzoic acids having a different alkyl chain in place of 4-[2-(trans-4-propylcyclohexyl)ethyl]benzoic acid:

Difluoro-{4-[2-(trans-4-methylcyclohexyl)ethyl]phenyl}-(3,4,5-

trifluorophenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[2-(trans-4-hexylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[2-(trans-4-heptylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[2-(trans-4-octylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[2-(trans-4-nonylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[2-(trans-4-decylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Also, the following compounds can be prepared according to the preparation method by using several known phenol derivatives in place of 3,4,5-trifluorophenol:

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(4-

difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(4-trifluoromethoxyphenyloxy)methane

Cr 60.2-60.9 N 72.6-73.2 Iso

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Cr 30.8-31.3 N 76.9-77.7 Iso

This Sheet Has Been Replaced



Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,5-

difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-propylcyclohexyl)ethyl] phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-pentylcyclohexyl)ethyl] phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-propylcyclohexyl)ethyl] phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-pentylcyclohexyl)ethyl] phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-propylcyclohexyl)ethyl] phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-pentylcyclohexyl)ethyl] phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -

(3,4,5-trifluorophenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-propylcyclohexyl)ethyl] phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-pentylcyclohexyl)ethyl] phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-propylcyclohexyl)ethyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[2-(trans-4-pentylcyclohexyl)ethyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-ethylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-propylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-butylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-pentylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-trifluoromethoxyphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-ethylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-propylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-butylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-pentylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-trifluoromethylphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-ethylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-propylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-butylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-pentylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-ethylcyclohexyl) ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-propylcyclohexyl) ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-butylcyclohexyl) ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-pentylcyclohexyl) ethyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-ethylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-propylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-butylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[2-(trans-4-pentylcyclohexyl) ethyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Example 5

Preparation of difluoro- {4-[trans-4-(3-butenyl)cyclohexyl]phenyl} -(3,4,5-trifluorophenyloxy)methane (Compound expressed by the formula (I) wherein R is 3-butenyl group, ℓ = 1, m and n are 0, ring A_1 is trans-1,4-cyclohexylene group, Z_1, Z_2 and Z_3 are covalent bond, $L_1 = L_2 = H$, $L_3 = L_4 = F$, and X = F)

Preparation of the compound includes four steps of hydrolysis of a benzonitrile derivative, preparation of an ester intermediate, thionesterification, and gem-fluorination. Each of the steps is illustrated in detail below.

In a 1000 ml three neck distillation flask provided with a stirrer and thermometer, 20.0 g (83.6 mmol) of 4-[trans-4-(3-butenyl)cyclohexyl]benzonitrile and 11.7 g (208.9 mmol) of potassium hydroxide were dissolved in 500 ml of ethylene glycol, and the solution was heated while stirring and while internal temperature at 150°C for 10 hours. After cooled down to room temperature, 300 ml of water and 300 ml of 6N aqueous solution of hydrochloric acid were added to the solution, and the precipitated insoluble matter was filtered to separate. Separated precipitate was sufficiently washed with water and then recrystallized from a mixed solvent of toluene-heptane to obtain 16.5 g of colorless crystal product. This product was 4-[trans-4-(3-butenyl)cyclohexyl]benzoic acid. Subsequently, this benzoic acid derivative was reacted with a phenol derivative to esterify. That is, in a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 16.5 g (63.8 mmol) of 4-[trans-4-(3-butenyl)cyclohexyl]benzoic acid obtained by the procedures

mentioned above, 15.8 g (76.6 mmol) of DCC, and 0.28 g (2.3 mmol) of DMAP were dissolved in 250 ml of dichloromethane, and then 11.3 g (76.6 mmol) of 3,4,5-trifluorophenol was added dropwise to the solution in 3 min while stirring at room temperature. After the dropping, the solution was stirred at room temperature for 13 hours. Reaction solution was added with 100 ml of water, dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and then the water was further extracted with 200 ml of dichloromethane. Extracted layers were mixed, washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 25.1 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using toluene as developing solvent, and further recrystallized from a mixed solvent of heptane-ethanol to obtain 16.6 g of colorless crystal product. This product was 3,4,5-trifluoro- {4-[trans-4-(3-butenyl)cyclohexyl)phenyl} benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 16.6 g (42.8 mmol) of 3,4,5-trifluoro- {4-[trans-4-(3-butenyl)cyclohexyl)phenyl} benzoate obtained by the procedures mentioned above and 34.6 g (85.6 mmol) of Lawesson's reagent were dissolved in 500 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 55 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added, the toluene layer was separated, and then the water layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of

water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 17.6 g of brown crystalline product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 4.5 g of yellow needle-like crystal product. This product was 4-[trans-4-(3-butenyl)cyclohexyl]phenylcarbothio acid-O-3,4,5-trifluorophenyl.

In a 100 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 4.5 g (11.3 mmol) of 4-[trans-4-(3-butenyl)cyclohexyl]phenylcarbothio acid-O-3,4,5-trifluorophenyl was dissolved in 50 ml of dichloromethane at room temperature, and then 5.5 g (33.8 mmol) of DAST was added to the solution and the solution was stirred at room temperature for 40 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 3.8 g of colorless crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from ethanol to obtain 1.1 g of colorless needle-like crystal product. This product was difluoro-{4-[trans-4-(3-butenyl)cyclohexyl]phenyl}-(3,4,5-trifluorophenyloxy)methane.

The following compounds can be prepared according to the preparation method mentioned above by using 4-[trans-4-alkenyl-

cyclohexyl)benzoic acids having a different chain length and different position of double bond in place of 4-[trans-4-(3-butenyl)cyclohexyl]benzoic acid:

Difluoro- {4-[trans-4-[(Z)-1-butenyl]cyclohexyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-2-butenyl]cyclohexyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[trans-4-(3-butenyl)cyclohexyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-1-pentenyl]cyclohexyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-2-pentenyl]cyclohexyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-3-pentenyl]cyclohexyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Difluoro- {4-[trans-4-(4-pentenyl)cyclohexyl]phenyl} -(3,4,5-trifluorophenyloxy)methane

Also, the following compounds can be prepared according to the preparation method mentioned above by using several known phenol derivatives in place of 3,4,5-trifluorophenol:

Difluoro- {4-[trans-4-[(Z)-1-butenyl]cyclohexyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-2-butenyl]cyclohexyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-(3-butenyl)cyclohexyl]phenyl} -(4-cyano-phenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-1-pentenyl]cyclohexyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-2-pentenyl]cyclohexyl]phenyl} -(4-

cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-3-pentenyl]cyclohexyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-(4-pentenyl)cyclohexyl]phenyl} -(4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-1-butenyl]cyclohexyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-2-butenyl]cyclohexyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-(3-butenyl)cyclohexyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-1-pentenyl]cyclohexyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-2-pentenyl]cyclohexyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-3-pentenyl]cyclohexyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-(4-pentenyl)cyclohexyl]phenyl} -(3-fluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-1-butenyl]cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-2-butenyl]cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-(3-butenyl)cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-1-pentenyl]cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-2-pentenyl]cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-[(Z)-3-pentenyl]cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {4-[trans-4-(4-pentenyl)cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[trans-4-[(Z)-1-butenyl]cyclohexyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[trans-4-[(Z)-2-butenyl]cyclohexyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[trans-4-(3-butenyl)cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[trans-4-[(Z)-1-pentenyl]cyclohexyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[trans-4-[(Z)-2-pentenyl]cyclohexyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[trans-4-[(Z)-3-pentenyl]cyclohexyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2-fluoro-4-[trans-4-(4-pentenyl)cyclohexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[trans-4-[(Z)-1-butenyl]cyclo-hexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[trans-4-[(Z)-2-butenyl]cyclo-hexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[trans-4-(3-butenyl)cyclohexyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[trans-4-[(Z)-1-pentenyl]cyclo-hexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[trans-4-[(Z)-2-pentenyl]cyclo-

hexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[trans-4-[(Z)-3-pentenyl]cyclo-hexyl]phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Difluoro- {2,6-difluoro-4-[trans-4-(4-pentenyl)cyclohexyl] phenyl} -(3,5-difluoro-4-cyanophenyloxy)methane

Example 6

Preparation of difluoro-(4-propylphenyl)-[4-(3',4',5'-trifuorobiphenyl)oxy]methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = m = 0, n = 1, ring A_3 is 1,4-phenylene group, Z_1, Z_2 and Z_3 are covalent bond, L_1 = L_2 = H, L_3 = L_4 = F, and X = F)

1) Preparation of 4-(3,4,5-trifluorophenyl)phenol

By the following procedures, 4-(3,4,5-trifluorophenyl)phenol was prepared which is a raw material for the preparation of the subject compounds of this Example. That is, in a 1000 ml three neck distillation flask provided with a stirrer, thermometer, nitrogen gas introducing pipe, dropping funnel, and cooling pipe, 7.9 g (324.2 mmol) of magnesium turnings were added, and then a solution of 65.2 g (308.8 mmol) of 3,4,5-trifluorobromobenzene in 80 ml of tetrahydrofuran (hereinafter abbreviated as THF) was added dropwise in 50 min so that the internal temperature was maintained at 50°C. After completion of the dropping, the solution was stirred on a hot water bath while keeping the same temperature for 1 hour for ageing to prepare a Grignard reagent. Then, in a 1000 ml three neck distillation flask provided with a stirrer, thermometer, nitrogen gas introducing pipe, dropping funnel, and a cooling pipe, separately provided for, 35.0 g (171.6 mmol) of iodobenzene, 1.64 g (9.3 mmol) of palladium chloride, and 300 ml of THF were added under nitrogen gas atmosphere, and added dropwise with the

Grignard reagent prepared by the procedures mentioned above in 50 min while refluxing. After the dropping, the solution was further refluxed for 3 hours, cooled down to room temperature, and then added with 200 ml of water to terminate the reaction. After insoluble matter was filtered off the reaction solution, the solution was extracted with 300 ml × 2 of toluene. Extracted layer was washed with 300 ml × 3 of water, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 38. 4 g of dark brown solid. Concentration residue was purified by a chromatography using silica gel as a filler and using heptane as developing solvent, and then recrystallized from a mixed solvent of heptane-ethanol to obtain 19.0 g of colorless crystal product. This product was 3,4,5-trifluorobiphenyl. Subsequently, the biphenyl derivative was subjected to bromination. That is, in a 100 ml three neck distillation flask provided with a stirrer, thermometer, nitrogen gas introducing pipe, and dropping funnel, 19.0 g (91.5 mmol) of the 3,4,5-trifluorobiphenyl prepared by the procedures mentioned above was dissolved in 200 ml of dichoromethane, and the solution was cooled down to -5°C while stirring, added with 0.26 g (4.6 mmol) of iron powder, and then added dropwise with 8.8 g (109.8 mmol) of bromine in 15 min so that the temperature of -5 to 0°C was maintained. After the dropping, the solution was further stirred for 1 hour while maintaining the same temperature. Reaction solution was added with 200 ml of water to terminate the reaction, and then extracted with 250 ml × 2 of toluene. Extracted layer was washed with 200 ml × 4 of water, dried over anhydrous magnesium sulfate, and concentrated under a reduced pressure to obtain 25.1 g of brown oily product. Concentration residue was purified by a chromatography using silica gel as filler and using heptane as developing solvent,

and recrystallized from a mixed solvent of heptane-ethanol to obtain 16.6 of colorless crystal product. This product was 4-bromo-3',4',5'-trifluorobiphenyl.

With reference to the report by R. L. Kidwell et al. (Org. Synth., V, 918 (1973)), the bromobiphenyl derivative obtained by the procedures mentioned above was led to a phenylphenol derivative by the following procedures. That is, in a 300 ml three neck distillation flask provided with a stirrer, thermometer, nitrogen gas introducing pipe, and dropping funnel, 1.5 g (60.9 mmol) of magnesium turnings were added, and a solution of 16.6 g (58.0 mmol) of 4-bromo-3',4',5'-trifluoro-biphenyl in 30 ml of THF was added dropwise in 25 min so that the internal temperature was maintained at 50°C. After completion of the dropping, the solution was stirred on a hot water bath for 1 hour while keeping the same temperature for ageing to prepare a Grignard reagent. Then, the reaction solution was cooled with dry ice-acetone coolant down to -20°C, added dropwise with 7.2 g of trimethyl borate, and stirred at the same temperature for 30 min. The solution was added with 3.5 g (58.0 mmol) of acetic acid at the same temperature, raised up to 20°C, and added dropwise with 7.9 g (69.6 mmol) of 30 % aqueous solution of hydrogen peroxide in 10 min so that temperature of 25°C was maintained. Reaction solution was cooled again with the coolant down to -30°C and added dropwise with 50 ml of 20 % aqueous solution of sodium thiosulfate in 10 min to terminate the reaction. Reaction solution was extracted with 150 ml × 3 of ethyl acetate, washed with 200 ml × 2 of saturated brine, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 14.5 g of brown solid product. Concentrated residue was recrystallized from a mixed solvent of heptane-toluene to obtain 10.9 g of colorless crystal

product. This product was 4-(3,4,5-trifluorophenyl)phenol.

2) Preparation of difluoro-(4-propylphenyl)-[4-(3',4',5'-trifluorobiphenyl)oxy]methane

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 6.7 g (40.7 mmol) of 4-propylbenzoic acid, 10.1 g (48.8 mmol) of DCC, and 0.18 g (1.5 mmol) of DMAP were dissolved in 150 ml of dichloromethane, and then a solution of 10.9 g (48.8 mmol) of 4-(3,4,5-trifluorophenyl)phenol in 50 ml of dichloromethane was added dropwise at room temperature in 20 min while stirring. After the dropping, the solution was stirred at room temperature for 17 hours. After the reaction solution was added with 100 ml of water, the dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and the water layer was extracted with 200 ml of dichoromethane. Extracted layers were mixed, washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 15.3 g of reaction product. The reaction product was purified by a chromatograhy using silica gel as filler and using toluene as developing solvent, and further recrystallized from a mixed solvent of heptane-ethanol to obtain 10.5 g of colorless crystal product. This product was 4-(3',4',5'-trifluoro)biphenyl-(4-propyl)benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 10.5 g (28.5 mmol) of 4-(3',4',5'-trifluoro)biphenyl-(4-propyl)benzoate obtained by the procedures mentioned above and 23.0 g (56.9 mmol) of Lawesson's reagent were dissolved in 350 ml of toluene, and the solution was refluxed while stirring under nitrogen gas

stream for 60 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added, the toluene layer was separated, and then the water layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 10.5 g of brown crystalline mixture.

Concentrated product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 6.3 g of yellow needle-like crystal product. This product was 4-propyl-phenylcarbothio acid-O-4-(3',4',5'-trifluoro)biphenyl.

In a 100 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 6.3 g (16.3 mmol) of 4-propylphenyl-carbothio acid-O-4-(3',4',5'-trifluoro)biphenyl was dissolved in 50 ml of dichloromethane at room temperature, and then 7.9 g (48.9 mmol) of DAST was added to the solution and the solution was stirred at room temperature for 30 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 5.9 g of colorless crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from

heptane to obtain colorless needle-like crystal product. This product was difluoro-(4-propylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane.

Following compounds can be prepared according to the preparation method mentioned above by using 4-alkylbenzoic acids having a different alkyl chain in place of 4-propylbenzoic acid:

Difluoro-(4-methylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Difluoro-(4-ethylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Difluoro-(4-butylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Difluoro-(4-pentylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Difluoro-(4-hexylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Difluoro-(4-heptylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Difluoro-(4-octylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Difluoro-(4-nonylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Difluoro-(4-decylphenyl)-[4-(3',4',5'-trifluorobiphenyl) oxy]methane

Also, the following compounds can be prepared according to the preparation method mentioned above by using several known phenol derivatives in place of 4-(3,4,5-trifluorophenyl)phenol:

Difluoro-(4-ethylphenyl)-[4-(4'-difluoromethoxybiphenyl) oxy]methane

Difluoro-(4-propylphenyl)-[4-(4'-difluoromethoxybiphenyl) oxy]methane

Difluoro-(4-butylphenyl)-[4-(4'-difluoromethoxybiphenyl)

oxy]methane

Difluoro-(4-pentylphenyl)-[4-(4'-difluoromethoxybiphenyl) oxy]methane

Difluoro-(4-ethylphenyl)-[4-(4'-trifluoromethylbiphenyl) oxy]methane

Difluoro-(4-propylphenyl)-[4-(4'-trifluoromethylbiphenyl) oxy]methane

Difluoro-(4-butylphenyl)-[4-(4'-trifluoromethylbiphenyl) oxy]methane

Difluoro-(4-pentylphenyl)-[4-(4'-trifluoromethylbiphenyl) oxy]methane

Difluoro-(4-ethylphenyl)-[4-(4'-trifluoromethoxybiphenyl) oxy]methane

Difluoro-(4-propylphenyl)-[4-(4'-trifluoromethoxybiphenyl) oxy]methane

Difluoro-(4-butylphenyl)-[4-(4'-trifluoromethoxybiphenyl) oxy]methane

Difluoro-(4-pentylphenyl)-[4-(4'-trifluoromethoxybiphenyl) oxy]methane

Difluoro-(4-ethylphenyl)-[4-(4'-cyanobiphenyl)oxy]methane

Difluoro-(4-propylphenyl)-[4-(4'-cyanobiphenyl)oxy]methane

Difluoro-(4-butylphenyl)-[4-(4'-cyanobiphenyl)oxy]methane

Difluoro-(4-pentylphenyl)-[4-(4'-cyanobiphenyl)oxy]methane

Difluoro-(4-ethylphenyl)-[4-(3'-fluoro-4'-trifluoromethoxy-biphenyl)oxy]methane

Difluoro-(4-propylphenyl)-[4-(3'-fluoro-4'-trifluoromethoxy-biphenyl)oxy]methane

Difluoro-(4-butylphenyl)-[4-(3'-fluoro-4'-trifluoromethoxy-biphenyl)oxy]methane

Difluoro-(4-pentylphenyl)-[4-(3'-fluoro-4'-trifluoromethoxy-biphenyl)oxy]methane

Difluoro-(4-ethylphenyl)-[4-(3'-fluoro-4'-difluoromethoxy-

biphenyl)oxy]methane
Difluoro-(4-propylphenyl)-[4-(3'-fluoro-4'-difluoromethoxy-biphenyl)oxy]methane
Difluoro-(4-butylphenyl)-[4-(3'-fluoro-4'-difluoromethoxy-biphenyl)oxy]methane
Difluoro-(4-pentylphenyl)-[4-(3'-fluoro-4'-difluoromethoxy-biphenyl)oxy]methane
Difluoro-(4-ethylphenyl)-[4-(3'-fluoro-4'-trifluoromethyl-biphenyl)oxy]methane
Difluoro-(4-propylphenyl)-[4-(3'-fluoro-4'-trifluoromethyl-biphenyl)oxy]methane
Difluoro-(4-butylphenyl)-[4-(3'-fluoro-4'-trifluoromethyl-biphenyl)oxy]methane
Difluoro-(4-pentylphenyl)-[4-(3'-fluoro-4'-trifluoromethyl-biphenyl)oxy]methane
Difluoro-(4-ethylphenyl)-[4-(3'-fluoro-4'-cyanobiphenyl) oxy]methane
Difluoro-(4-propylphenyl)-[4-(3'-fluoro-4'-cyanobiphenyl) oxy]methane
Difluoro-(4-butylphenyl)-[4-(3'-fluoro-4'-cyanobiphenyl) oxy]methane
Difluoro-(4-pentylphenyl)-[4-(3'-fluoro-4'-cyanobiphenyl) oxy]methane
Difluoro-(4-ethylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxy-biphenyl)oxy]methane
Difluoro-(4-propylphenyl)-[4-(3',5'-difluoro-4'-trifluoro-methoxybiphenyl)oxy]methane
Difluoro-(4-butylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxy-biphenyl)oxy]methane
Difluoro-(4-pentylphenyl)-[4-(3',5'-difluoro-4'-trifluoro-methoxybiphenyl)oxy]methane
Difluoro-(4-ethylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxy-

biphenyl)oxy]methane
Difluoro-(4-propylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxy-biphenyl)oxy]methane
Difluoro-(4-butylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxy-biphenyl)oxy]methane
Difluoro-(4-pentylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxy-biphenyl)oxy]methane
Difluoro-(4-ethylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethyl-biphenyl)oxy]methane
Difluoro-(4-propylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethyl-biphenyl)oxy]methane
Difluoro-(4-butylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethyl-biphenyl)oxy]methane
Difluoro-(4-pentylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethyl-biphenyl)oxy]methane
Difluoro-(4-ethylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane
Difluoro-(4-propylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane
Difluoro-(4-butylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane
Difluoro-(4-pentylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane
Difluoro-(2-fluoro-4-ethylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxybiphenyl)oxy]methane
Difluoro-(2-fluoro-4-propylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxybiphenyl)oxy]methane
Difluoro-(2-fluoro-4-butylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxybiphenyl)oxy]methane
Difluoro-(2-fluoro-4-pentylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxybiphenyl)oxy]methane
Difluoro-(2-fluoro-4-ethylphenyl)-[4-(3',5'-difluoro-4'-

difluoromethoxybiphenyl)oxy]methane

Difluoro-(2-fluoro-4-propylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxybiphenyl)oxy]methane

Difluoro-(2-fluoro-4-butylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxybiphenyl)oxy]methane

Difluoro-(2-fluoro-4-pentylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxybiphenyl)oxy]methane

Difluoro-(2-fluoro-4-ethylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethylbiphenyl)oxy]methane

Difluoro-(2-fluoro-4-propylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethylbiphenyl)oxy]methane

Difluoro-(2-fluoro-4-butylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethylbiphenyl)oxy]methane

Difluoro-(2-fluoro-4-pentylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethylbiphenyl)oxy]methane

Difluoro-(2-fluoro-4-ethylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane

Difluoro-(2-fluoro-4-propylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane

Difluoro-(2-fluoro-4-butylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane

Difluoro-(2-fluoro-4-pentylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane

Difluoro-(2-fluoro-4-ethylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane

Difluoro-(2-fluoro-4-propylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane

Difluoro-(2-fluoro-4-butylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane

Difluoro-(2-fluoro-4-pentylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-[4-(3',5'-difluoro-4'-

trifluoromethoxybiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-propylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxybiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-butylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxybiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethoxybiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxybiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-propylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxybiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-butylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxybiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-[4-(3',5'-difluoro-4'-difluoromethoxybiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethylbiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-propylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethylbiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-butylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethylbiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-[4-(3',5'-difluoro-4'-trifluoromethylbiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-propylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-butylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-[4-(3',4',5'-trifluoro-biphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-propylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-butylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-[4-(3',5'-difluoro-4'-cyanobiphenyl)oxy]methane

Example 7

Preparation of difluoro-(4-propylphenyl)-{4-[2-(3,4,5-trifuorophenyl)ethyl]phenyloxy} methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = m = 0, n = 1, ring A_3 is 1,4-phenylene group, Z_1 and Z_2 are covalent bond, Z_3 = $-CH_2CH_2-$, L_1 = L_2 = H, L_3 = L_4 = F, and X = F)

1) Preparation of 4-[2-(3,4,5-trifluorophenyl)ethyl]phenol

By the following procedures, 4-[2-(4-trifluoromethoxyphenyl) ethyl]phenol was prepared which is a raw material for the preparation of the subject compounds of this Example. That is, in a 300 ml three neck distillation flask provided with a stirrer, thermometer, nitrogen gas introducing pipe, dropping funnel, and cooling pipe, 2.7 g (108.9 mmol) of magnesium turnings were added, and then a solution of 21.8 g (103.7 mmol) of 3,4,5-trifluorobromobenzene in 30 ml of THF was added dropwise in 25 min so that the internal temperature was maintained at 50°C. After completion of the dropping, the solution was stirred on a hot water bath while keeping the same temperature for 1 hour for ageing to prepare a Grignard reagent. Then, in a 500 ml three neck distillation flask provided with a stirrer, thermometer, nitrogen gas introducing pipe, dropping funnel, and a cooling pipe, separately provided for, 13.4 g

(86.4 mmol) of phenyl acetic acid chloride was dissolved in 200 ml of THF. Solution was cooled down to 0°C while stirring, added with 1.1 g (3.1 mmol) of iron (III) acetyl acetonate, and added further with the Grignard reagent prepared by the procedures mentioned above in 40 min while maintaining 0°C. After completion of the dropping, the solution was further stirred at the same temperature for 1 hour and then 100 ml of 6N aqueous solution of hydrochloric acid was added to terminate the reaction. Reaction solution was extracted with 200 ml × 2 of toluene, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 23.4 g of reaction product. Concentrated product was purified by a reduced-pressure distillation to obtain 18.3 g of colorless oily product. Subsequently, the reaction product was dissolved in 150 ml of toluene in a 1 liter autoclave, added with 1.0 g of 5 %-Pd/C, and then subjected to a reduction with hydrogen at a temperature of 90 to 100°C under a hydrogen pressure of 100 Kg/cm^2 for 13 hours. From the reaction solution, catalyst was filtered off, and the solution was concentrated under a reduced pressure to obtain 17.2 g of reaction product. Concentrated product was purified by a chromatography to obtain 15.3 g of colorless crystal product. This product was 4-[2-(3,4,5-trifluorophenyl)ethyl]benzene. By treating the 4-[2-(3,4,5-trifluorophenyl)ethyl]benzene by the same procedures as shown in Example 5, 1) mentioned above, 10.8 g (43.1 mmol) of 4-[2-(3,4,5-trifluorophenyl)ethyl]phenol was prepared.

2) Preparation of difluoro-(4-propylphenyl)-{4-[2-(3,4,5-trifluorophenyl)ethyl]phenyloxy} methane

In a 500 ml three neck distillation flask provided with a

stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 5.9 g (35.9 mmol) of 4-propylbenzoic acid, 8.5 g (43.1 mmol) of DCC, and 0.15 g (1.2 mmol) of DMAP were dissolved in 150 ml of dichloromethane, and then a solution of 10.8 g (43.1 mmol) of 4-[2-(3,4,5-trifluorophenyl)ethyl]phenol in 50 ml of dichloromethane was added dropwise at room temperature in 15 min while stirring. After the dropping, the solution was stirred at room temperature for 20 hours. After the reaction solution was added with 100 ml of water, the dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and the water layer was further extracted with 200 ml of dichoromethane. Extracted layers were mixed, washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 14.8 g of reaction product. The reaction product was purified by a chromatograhy using silica gel as filler and using toluene as developing solvent, and further recrystallized from a mixed solvent of heptane-ethanol to obtain 11.4 g of colorless crystal product. This product was 4-[2-(3,4,5-trifluorophenyl) ethyl]phenyl-(4-propyl)benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 11.4 g (28.7 mmol) of 4-[2-(3,4,5-trifluorophenyl)ethyl]phenyl-(4-propyl)benzoate obtained by the procedures mentioned above and 23.2 g (57.4 mmol) of Lawesson's reagent were dissolved in 350 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 60 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added, the toluene layer was separated, and then the water

layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 11.4 g of brown crystalline mixture. Concentrated product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 5.5 g of yellow needle-like crystal product. This product was 4-propylphenylcarbothio acid-O-4-[2-(3,4,5-trifluorophenyl)ethyl]phenyl.

In a 100 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 5.5 g (13.3 mmol) of 4-propylphenyl-carbothio acid-O-4-[2-(3,4,5-trifluorophenyl)ethyl]phenyl was dissolved in 50 ml of dichloromethane at room temperature, and then 6.4 g (39.8 mmol) of DAST was added to the solution and the solution was stirred at room temperature for 30 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 5.5 g of colorless crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 1.1 g of colorless needle-like crystal product. This product was difluoro-(4-propylphenyl)- {4-[2-(3,4,5-trifluorophenyl)ethyl]phenyloxy} methane.

Following compounds can be prepared according to the preparation method by using 4-alkylbenzoic acids having a different alkyl chain in place of 4-propylbenzoic acid:

Difluoro-(4-methylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Difluoro-(4-hexylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Difluoro-(4-heptylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Difluoro-(4-octylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Difluoro-(4-nonylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Difluoro-(4-decylphenyl)- {4-[2-(3,4,5-trifluorophenyl) ethyl]phenyloxy} methane

Also, the following compounds can be prepared according to the preparation method mentioned above by using several phenol derivatives which can be prepared by the procedures in 1) above in place of 4-[2-(3,4,5-trifluorophenyl)ethyl]phenol:

Difluoro-(4-ethylphenyl)- {4-[2-(4-difluoromethoxyphenyl) ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(4-difluoromethoxyphenyl) ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(4-difluoromethoxyphenyl) ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(4-difluoromethoxyphenyl) ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(4-trifluoromethylphenyl) ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(4-trifluoromethylphenyl) ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(4-trifluoromethylphenyl) ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(4-trifluoromethylphenyl) ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(4-trifluoromethoxyphenyl) ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(4-trifluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(4-trifluoromethoxyphenyl) ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(4-trifluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(3-fluoro-4-trifluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(3-fluoro-4-trifluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(3-fluoro-4-trifluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(3-fluoro-4-trifluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(3-fluoro-4-difluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(3-fluoro-4-difluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(3-fluoro-4-difluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(3-fluoro-4-difluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(3-fluoro-4-trifluoromethyl-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(3-fluoro-4-trifluoromethyl-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(3-fluoro-4-trifluoromethyl-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(3-fluoro-4-trifluoromethyl-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(3-fluoro-4-cyanophenyl) ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(3-fluoro-4-cyanophenyl) ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(3-fluoro-4-cyanophenyl) ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(3-fluoro-4-cyanophenyl) ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(3,5-difluoro-4-trifluoro-methoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(3,5-difluoro-4-trifluoro-methoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxy-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)-{4-[2-(3,5-difluoro-4-trifluoromethyl-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)-{4-[2-(3,5-difluoro-4-trifluoromethyl-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)-{4-[2-(3,5-difluoro-4-trifluoromethyl-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)-{4-[2-(3,5-difluoro-4-trifluoromethyl-phenyl)ethyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)-{4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(4-propylphenyl)-{4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(4-butylphenyl)-{4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)-{4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)-{4-[2-(3,5-difluoro-4-trifluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)-{4-[2-(3,5-difluoro-4-trifluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)-{4-[2-(3,5-difluoro-4-trifluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)-{4-[2-(3,5-difluoro-4-trifluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)-{4-[2-(3,5-difluoro-4-difluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethylphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethylphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethylphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethylphenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)- {4-[2-(3,4,5-trifluorophenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[2-(3,4,5-trifluoro-phenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[2-(3,4,5-trifluoro-phenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[2-(3,4,5-trifluoro-phenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)- {4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[2-(3,5-difluoro-4-difluoromethoxyphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethylphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethylphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethylphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[2-(3,5-difluoro-4-trifluoromethylphenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[2-(3,4,5-trifluorophenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[2-(3,4,5-trifluorophenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[2-(3,4,5-trifluorophenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[2-(3,4,5-trifluorophenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[2-(3,5-difluoro-4-cyanophenyl)ethyl]phenyloxy} methane

Example 8

Preparation of difluoro-(4-propylphenyl)- {4-[difluoro-(4-trifuoromethoxyphenyloxy)methyl]phenyloxy} methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = 1, m = n = 0, ring A_1 is 1,4-phenylene group, Z_1 = $-CF_2O-$, Z_2 and Z_3 are covalent bond, L_1, L_2, L3, and L_4 are hydrogen atom, and X = OCF_3)

1) Preparation of 4-[difluoro-(4-propylphenyl)methyloxy]benzoic acid

By the following procedures, 4-[difluoro-(4-propylphenyl) methyloxy]benzoic acid was prepared which is a raw material for the preparation of the subject compounds of this Example.

It was prepared by using difluoro-(4-propylphenyl)-(4-cyanophenyloxy)methane (prepared in Example 1) as a raw material for the preparation and subjecting it to a hydrolysis. That is, in a 500 ml three neck distillation flask provided with a stirrer, thermometer, and cooling pipe, 15.0 g (52.2 mmol) of difluoro-(4-propylphenyl)-(4-cyanophenyloxy)methane and 7.3 g (130.5 mmol) of potassium hydroxide were dissolved in 200 ml of ethylene glycol and the solution was heated at 150°C for 10 hours while stirring. Reaction solution was cooled down to room temperature and added with 100 ml of water and 50 ml of 6N aqueous solution of hydrochloric acid. Precipitated insoluble matter was filtered off, and the precipitate was washed with water, dried under a reduced pressure, and further recrystallized from a mixed solvent of toluene-heptane to obtain 14.3 g of colorless crystal product. This product was 4-[difluoro-(4-propylphenyl)methyloxy]benzoic acid.

2) Preparation of difluoro-(4-propylphenyl)-{4-[difluoro-(4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 14.3 g (46.5 mmol) of 4-[difluoro(4-propylphenyl)methyloxy]benzoic acid, 11.5 g (55.7 mmol) of DCC, and 0.2 g (1.7 mmol) of DMAP were dissolved in 250 ml of dichloromethane, and then 9.9 g (55.7 mmol) of (4-trifluoromethoxy)phenol was added to the solution while stirring at room temperature in 5 min, and then stirred at room temperature for 20 hours. After the reaction solution was added with 100 ml of water, dichoromethane insoluble matter was filtered off, the

dichloromethane layer was separated, and the water layer was further extracted with 200 ml of dichloromethane. Extracted layers were mixed, washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 25.4 g of reaction product. The reaction product was purified by a chromatograhy using silica gel as filler and using toluene as developing solvent, and further recrystallized from a mixed solvent of heptane-ethanol to obtain 21.8 g of colorless crystal product. This product was 4-trifluoromethoxyphenyl- {4-[difluoro-(4-propylphenyl)methyloxy)benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 21.8 g (46.8 mmol) of 4-trifluoromethoxyphenyl- {4-[difluoro-(4-propyl-phenyl)methyloxy)benzoate obtained by the procedures mentioned above and 37.8 g (93.6 mmol) of Lawesson's reagent were dissolved in 350 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 60 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added, the toluene layer was separated, and the water layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 21.9 g of brown crystalline product. Concentrated product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 8.9 g of yellow needle-

like crystal product. This product was 4-[difluoro-(4-propylphenyl)methyloxy]phenylcarbothio acid-O-(4-trifluoromethoxy)phenyl.

In a 100 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 8.9 g (18.4 mmol) of 4-[difluoro-(4-propylphenyl)methyloxy]phenylcarbothio acid-O-(4-trifluoromethoxy)phenyl was dissolved in 50 ml of dichloromethane at room temperature, and then 8.9 g (55.3 mmol) of DAST was added to the solution and the solution was stirred at room temperature for 30 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 8.5 g of colorless crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 1.9 g of colorless needle-like crystal product. This product was difluoro-(4-propylphenyl)- {4-[difluoro(4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane.

Following compounds can be prepared according to the preparation method mentioned above by using 4-[difluoro(4-alkylphenyl)methyloxy]benzoic acid having a different alkyl chain in place of 4-[difluoro(4-propylphenyl)methyloxy]benzoic acid:

Difluoro-(4-methylphenyl)- {4-[difluoro-(4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(4-trifluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(4-trifluoromethoxy-phenyloxy)methyl]phenyloxy} methane

Difluoro-(4-hexylphenyl)- {4-[difluoro-(4-trifluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-heptylphenyl)- {4-[difluoro-(4-trifluoromethoxy-phenyloxy)methyl]phenyloxy} methane

Difluoro-(4-octylphenyl)- {4-[difluoro-(4-trifluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-nonylphenyl)- {4-[difluoro-(4-trifluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-decylphenyl)- {4-[difluoro-(4-trifluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Also, the following compounds can be prepared according to the preparation method mentioned above by using several known phenol derivatives in place of (4-trifluoromethoxy)phenol:

Difluoro-(4-ethylphenyl)- {4-[difluoro-(4-difluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(4-difluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(4-difluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(4-difluoromethoxyphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(4-trifluoromethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(4-trifluoromethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(4-trifluoromethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(4-trifluoromethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy) methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy) methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(4-cyanophenyloxy) methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(4-cyanophenyloxy) methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(4-cyanophenyloxy) methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(4-cyanophenyloxy) methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3-fluoro-4-trifluoro-methoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3-fluoro-4-trifluoro-methoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3-fluoro-4-trifluoro-methoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3-fluoro-4-trifluoro-methoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3-fluoro-4-difluoro-methoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3-fluoro-4-difluoro-methoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3-fluoro-4-difluoro-methoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3-fluoro-4-difluoro-methoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3-fluoro-4-trifluoro-methylphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3-fluoro-4-trifluoro-methylphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3-fluoro-4-trifluoro-methylphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3-fluoro-4-trifluoro-methylphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3-fluoro-4-cyanophenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3-fluoro-4-cyanophenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3-fluoro-4-cyanophenyl-oxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3-fluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[difluoro-(3,4,5-trifluoro-phenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(2-fluoro-4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-difluoromethoxyphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-trifluoromethylphenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[difluoro-(3,4,5-trifluorophenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-ethylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-propylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-butylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(2,6-difluoro-4-pentylphenyl)- {4-[difluoro-(3,5-difluoro-4-cyanophenyloxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-ethylphenyl)- {4-[difluoro-(4-ethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-ethylphenyl)- {4-[difluoro-(4-propylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-ethylphenyl)- {4-[difluoro-(4-butylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-ethylphenyl)- {4-[difluoro-(4-pentylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-ethylphenyl)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-propylphenyl)- {4-[difluoro-(4-ethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-propylphenyl)- {4-[difluoro-(4-propylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-propylphenyl)- {4-[difluoro-(4-butylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-propylphenyl)- {4-[difluoro-(4-pentylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-propylphenyl)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-butylphenyl)- {4-[difluoro-(4-ethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-butylphenyl)- {4-[difluoro-(4-propylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-butylphenyl)- {4-[difluoro-(4-butylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-butylphenyl)- {4-[difluoro-(4-pentylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-butylphenyl)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-pentylphenyl)- {4-[difluoro-(4-ethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-pentylphenyl)- {4-[difluoro-(4-propylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-pentylphenyl)- {4-[difluoro-(4-butylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-pentylphenyl)- {4-[difluoro-(4-pentylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-pentylphenyl)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-hexylphenyl)- {4-[difluoro-(4-ethylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-hexylphenyl)- {4-[difluoro-(4-propylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-hexylphenyl)- {4-[difluoro-(4-butylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-hexylphenyl)- {4-[difluoro-(4-pentylphenyl-oxy)methyl]phenyloxy} methane

Difluoro-(difluoro-4-hexylphenyl)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyloxy} methane

Example 9

Preparation of difluoro-(4-propylphenyloxy)- {4-[difluoro-(4-pentylphenyloxy)methyl]phenyl} methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = 1, m = n = 0, ring A_1 is 1,4-phenylene group, Z_1 = $-OCF_2-$, Z_2 and Z_3 are covalent bond, L_1, L_2, L_3, and L_4 are hydrogen atom, and X = C_5H_{11}.)

In a 1000 ml three neck distillation flask provided with a stirrer, dropping funnel, thermometer, and cooling pipe, 25.0 g (166.5 mmol) of 4-forlmylbenzoic acid, 41.2 g (199.8 mmol) of DCC, and 0.73 g (5.9 mmol) of DMAP were dissolved in 300 ml of dichloromethane at room temperature, and then a solution of 27.2 g (199.8 mmol) of 4-propylphenol in 100 ml of dichloromethane was added dropwise in 40 min while stirring. After the dropping, the solution was stirred for 10 hours. Reaction solution was added with 200 ml of water, and dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and the water layer was further extracted with 300 ml of dichloromethane. Extracted layers were mixed, washed with 300 ml × 2 of water, 200 ml of saturated aqueous solution of sodium hydrogencarbonate, and 300 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a

reduced pressure to obtain 42.1 g of reaction product. This product was 4-propylphenyl-(4-formyl)benzoate. This 4-propylphenyl-(4-formyl)benzoate which was used for next preparation step as it is.

In a 1000 ml three neck distillation flask provided with a stirrer, dropping funnel, and thermometer, 42.1 g of 4-propylphenyl-(4-formyl)benzoate obtained by the procedures mentioned above was dissolved in 450 ml of acetone, and the solution was cooled down with a coolant to 0°C. Then, 58.8 ml (470.7 mmol) of 8M solution of Jones reagent (K. Bowden, I. M. Heilbron, E. R. Jones, et al., J. Chem. Soc., 1946, 39) was added dropwise in 30 min so that the solution was maintained at the same temperature. After the dropping, the solution was stirred for 4 hours and then added with 300 m of water to terminate the reaction. Reaction solution was extracted with 250 ml × 2 of diethyl ether, and the extracted layer was further washed with 250 ml × 3 of water, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 43.1 g of brown crystal product. Concentrated product was recrystallized from toluene to obtain 35.2 g of colorless crystal product. This product was 4-propylphenyl-(carboxy)benzoate.

In a 1000 ml three neck distillation flack provided with a stirrer, dropping funnel, thermometer, and cooling pipe, 35.2 g (123.9 mmol) of 4-propylphenyl-(4-carboxy)benzoate, 30.7 g (148.7 mmol) of DCC and 0.55 g (4.5 mmol) of DMAP were dissolved in 500 ml of dichloromethane at room temperature, and then a solution of 24.4 g (148.7 mmol) of 4-pentylphenol in 100 ml of dichloromethane was added dropwise at room temperature in 30 min while stirring. After the dropping, the reaction solution was stirred for 10 hours and added with 200 ml of water to terminate

the reaction. From the reaction solution, dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and the water layer was further extracted with 300 m of dichloromethane. Extracted layers were mixed, and washed with 300 ml × 2 of water, 200 ml of saturated aqueous solution of sodium hydrogencarbonate, and 300 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 50.2 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using a mixed solvent of toluene-ethyl acetate as developing solvent, and further recrystallized from a mixed solvent of heptane-ethanol to obtain 36.8 g of colorless crystal product. This product was terephthalic acid-(4-propylphenyl)-(4-pentylphenyl).

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 36.8 g (85.5 mmol) of terephthalic acid-(4-propylphenyl)-(4-pentylphenyl) obtained by the procedures mentioned above and 138.3 g (341.9 mmol) of Lawesson's reagent were dissolved in 600 ml of toluene, and the reflux was conducted under nitrogen gas stream for 60 hours while stirring. Reaction solution was cooled down to room temperature and added with 200 ml of water.

Toluene layer was separated and the water layer was further extracted with 400 ml of toluene. Organic layers were mixed, washed with 300 ml × 2 of water, 300 ml of saturated aqueous solution of sodium hydrogencarbonate, 300 ml of 10 % aqueous solution of sodium hydrogensulfite, and 300 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 38.7 g of brown crystalline mixture. Concentrated product was purified by a column chromatography using silica gel as filler and using a

mixed solvent of heptane-toluene as developing solvent, and then recrystallized from heptane to obtain 19.8 g of yellow needle-like crystal of a derivative of dithiocaroxylic acid ester.

In a 200 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 19.8 g (42.7 mmol) of the derivative of dithiocarboxyic acid ester obtained by the procedures mentioned above was dissolved in 100 ml of dichoromethane at room temperature, and then the solution was added with 20.7 g (128.3 mmol) of DAST and stirred at room temperature for 30 hours. Reaction solution was added with 100 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 150 ml of dichloromethane. Extracted layers were mixed, and washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of ;water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 18.9 g of brown crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 9.1 g of colorless needle-like crystal product. This product was difluoro-(4-propylphenyloxy)- {4-[difluoro(4-pentylphenyloxy)methyl]phenyl} methane.

Following compounds can be prepared according to the preparation method mentioned above by using phenol derivatives having a different alkyl chain in place of 4-propylphenol or 4-pentylphenol:

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-methyl-phenyloxy)methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-ethylphenyloxy) methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-propylphenyloxy)methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-butylphenyloxy)methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-pentylphenyloxy)methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-hexylphenyloxy)methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-heptylphenyloxy)methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-octylphenyloxy)methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-nonylphenyloxy)methyl]phenyl} methane

Difluoro-(4-methylphenyloxy)- {4-[difluoro-(4-decylphenyloxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-ethylphenyloxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-propylphenyloxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-butylphenyloxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-pentylphenyloxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-hexylphenyloxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-heptylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-octylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-nonylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-ethylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-propylphenyloxy)- {4-[difluoro-(4-propylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-propylphenyloxy)- {4-[difluoro-(4-butylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-propylphenyloxy)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-propylphenyloxy)- {4-[difluoro-(4-heptylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-propylphenyloxy)- {4-[difluoro-(4-octylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-propylphenyloxy)- {4-[difluoro-(4-nonylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-propylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-butylphenyloxy)- {4-[difluoro-(4-butylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-butylphenyloxy)- {4-[difluoro-(4-pentylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-butylphenyloxy)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-butylphenyloxy)- {4-[difluoro-(4-heptylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-butylphenyloxy)- {4-[difluoro-(4-octylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-butylphenyloxy)- {4-[difluoro-(4-nonylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-butylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-pentylphenyloxy)- {4-[difluoro-(4-pentylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-pentylphenyloxy)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-pentylphenyloxy)- {4-[difluoro-(4-heptylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-pentylphenyloxy)- {4-[difluoro-(4-octylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-pentylphenyloxy)- {4-[difluoro-(4-nonylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-pentylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-hexylphenyloxy)- {4-[difluoro-(4-hexylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-hexylphenyloxy)- {4-[difluoro-(4-heptylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-hexylphenyloxy)- {4-[difluoro-(4-octylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-hexylphenyloxy)- {4-[difluoro-(4-nonylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-hexylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-heptylphenyloxy)- {4-[difluoro-(4-heptylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-heptylphenyloxy)- {4-[difluoro-(4-octylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-heptylphenyloxy)- {4-[difluoro-(4-nonylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-heptylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-octylphenyloxy)- {4-[difluoro-(4-octylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-octylphenyloxy)- {4-[difluoro-(4-nonylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-octylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-nonylphenyloxy)- {4-[difluoro-(4-nonylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-nonylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Difluoro-(4-decylphenyloxy)- {4-[difluoro-(4-decylphenyl-oxy)methyl]phenyl} methane

Example 10

Preparation of difluoro-(3,4,5-trifluorophenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = m = 1, n = 0, both rings A_1 and A_2 are trans-1,4-cyclohexylene group, Z_1, Z_2 and Z_3 are covalent bond, L_1 = L_2 = H, L_3 = L_4 = F, and X = F.)

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 15.0 g (45.7 mmol) of 4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]benzoic acid, 11.3 g (54.8 mmol) of DCC, and 0.2 g (1.6 mmol) of DMAP were dissolved in 250 ml of dichloromethane under nitrogen gas atmosphere, and then 8.1 g (54.8 mmol) of 3,4,5-trifluorophenol was added dropwise to the solution at room temperature in 3 min while stirring. After the dropping, the solution was stirred at room temperature for 10 hours. Reaction solution was added with 100 ml of water, and dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and the water layer was further extracted with 200 ml of dichloromethane. Extracted layers were mixed, washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 21.9 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using toluene as developing solvent, and further recrystallized from a mixed solvent of heptane-ethanol to obtain 16.5 g of colorless crystal product. This product was 3,4,5-trifluorophenyl-4-[4-trans-(trans-4-propylcyclohexyl)cyclohexyl]benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 16.5 g (33.9 mmol) of the 3,4,5-trifluorophenyl-4-[4-trans-(trans-4-propylcyclohexyl)cyclohexyl]benzoate obtained by the procedures mentioned above and 27.5 g (67.9 mmol) of Lawesson reagent were dissolved in 500 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 60 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added to the reaction solution, the toluene layer was separated, and then the water layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 15.4 g of brown crystalline mixture. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 6.4 g of yellow needle-like crystal product. This product was 4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenylcarbothio acid-O-3,4,5-trifluorophenyl.

In a 100 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 6.4 g (13.5 mmol) of 4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenylcarbothio acid-O-3,4,5-trifluorophenyl was dissolved in 50 ml of dichloromethane at room temperature, and then 6.5 g (40.5 mmol) of DAST was added to the solution and the solution was stirred at room temperature for 40 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted

layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 6.4 g of brown crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 1.3 g of colorless needle-like crystal product. This product was difluoro-(3,4,5-trifluorophenyloxy)-{4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane.

Following compounds can be prepared according to the preparation method mentioned above by using 4-[trans-4-(trans-4-alkylcyclohexyl)cyclohexyl]benzoic acids having a different alkyl chain in place of 4-[trans-4-(trans-4-propylcyclohexyl) cyclohexyl]benzoic acid:

Difluoro-(3,4,5-trifluorophenyloxy)-{4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)-{4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)-{4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)-{4-[trans-4-(trans-4-hexylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)-{4-[trans-4-(trans-4-heptylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)-{4-[trans-4-(trans-4-octylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)-{4-[trans-4-(trans-4-

nonylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[trans-4-(trans-4-decylcyclohexyl)cyclohexyl]phenyl} methane

Following compounds can be prepared according to the preparation method mentioned above by selectively using several known benzoic acid derivatives and several known phenol derivatives, including the compounds preparation examples of which are described in detail in the Examples mentioned above, in place of 4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl] benzoic acid or 3,4,5-trifluorophenol:

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-

ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-trifluoromethylphenyloxy)- {4-[trans-4-

(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3-fluoro-4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {4-[trans-4-

(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {2-fluoro-4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {2-fluoro-4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {2-fluoro-4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {2-fluoro-4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {2-fluoro-4-

[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro(3,4-difluoro-4-trifluoromethylphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {2-fluoro-4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {2,6-difluoro-4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {2,6-difluoro-4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {2,6-difluoro-4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {2,6-difluoro-4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {2,6-difluoro-4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {2,6-difluoro-4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {2,6-difluoro-4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethoxyphenyloxy)- {2,6-

difluoro-4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {2,6-difluoro -4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {2,6-difluoro -4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {2,6-difluoro -4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-difluoromethoxyphenyloxy)- {2,6-difluoro -4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {2,6-difluoro -4-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {2,6-difluoro -4-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {2,6-difluoro -4-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4-difluoro-4-trifluoromethylphenyloxy)- {2,6-difluoro -4-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[trans-4-[2-(trans-4-ethylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[trans-4-[2-(trans-4-propylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[trans-4-[2-(trans-4-butylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[trans-4-[2-(trans-4-pentylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[trans-4-[2-(trans-4-ethylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[trans-4-[2-(trans-4-propylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[trans-4-[2-(trans-4-butylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[trans-4-[2-(trans-4-pentylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[trans-4-[2-(trans-4-ethylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[trans-4-[2-(trans-4-propylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[trans-4-[2-(trans-4-butylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[trans-4-[2-(trans-4-pentylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[trans-4-[2-(trans-4-ethylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[trans-4-[2-(trans-4-propylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[trans-4-[2-(trans-4-butylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[trans-4-[2-(trans-4-pentylcyclohexyl)ethyl]cyclohexyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[2-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[2-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[2-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4-[2-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[2-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[2-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[2-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4-[2-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[2-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[2-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[2-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4-[2-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[2-[trans-4-(trans-4-ethylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[2-[trans-4-(trans-4-propylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[2-[trans-4-(trans-4-butylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4-[2-[trans-4-(trans-4-pentylcyclohexyl)cyclohexyl]ethyl]phenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)-[4'-(trans-4-ethylcyclohexyl) biphenyl]methane

Difluoro-(3,4,5-trifluorophenyloxy)-[4'-(trans-4-propylcyclohexyl)biphenyl]methane

Difluoro-(3,4,5-trifluorophenyloxy)-[4'-(trans-4-butylcyclohexyl) biphenyl]methane

Difluoro-(3,4,5-trifluorophenyloxy)-[4'-(trans-4-pentylcyclohexyl)biphenyl]methane

Difluoro-(4-trifluoromethoxyphenyloxy)-[4'-(trans-4-ethylcyclohexyl)biphenyl]methane

Difluoro-(4-trifluoromethoxyphenyloxy)-[4'-(trans-4-propylcyclohexyl)biphenyl]methane

Difluoro-(4-trifluoromethoxyphenyloxy)-[4'-(trans-4-butylcyclohexyl)biphenyl]methane

Difluoro-(4-trifluoromethoxyphenyloxy)-[4'-(trans-4-pentylcyclohexyl)biphenyl]methane

Difluoro-(4-difluoromethoxyphenyloxy)-[4'-(trans-4-ethylcyclohexyl)biphenyl]methane

Difluoro-(4-difluoromethoxyphenyloxy)-[4'-(trans-4-propylcyclohexyl)biphenyl]methane

Difluoro-(4-difluoromethoxyphenyloxy)-[4'-(trans-4-butylcyclohexyl)biphenyl]methane

Difluoro-(4-difluoromethoxyphenyloxy)-[4'-(trans-4-pentylcyclohexyl)biphenyl]methane

Difluoro-(4-trifluoromethylphenyloxy)-[4'-(trans-4-ethylcyclohexyl)biphenyl]methane

Difluoro-(4-trifluoromethylphenyloxy)-[4'-(trans-4-propylcyclohexyl)biphenyl]methane

Difluoro-(4-trifluoromethylphenyloxy)-[4'-(trans-4-butylcyclohexyl)biphenyl]methane

Difluoro-(4-trifluoromethylphenyloxy)-[4'-(trans-4-pentylcyclohexyl)biphenyl]methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4'-[2-(trans-4-ethylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4'-[2-(trans-4-propylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4'-[2-(trans-4-butylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(3,4,5-trifluorophenyloxy)- {4'-[2-(trans-4-pentylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4'-[2-(trans-4-ethylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4'-[2-(trans-4-propylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4'-[2-(trans-4-butylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-trifluoromethoxyphenyloxy)- {4'-[2-(trans-4-pentylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4'-[2-(trans-4-ethylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4'-[2-(trans-4-

propylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4'-[2-(trans-4-butylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-difluoromethoxyphenyloxy)- {4'-[2-(trans-4-pentylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4'-[2-(trans-4-ethylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4'-[2-(trans-4-propylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4'-[2-(trans-4-butylcyclohexyl)ethyl]biphenyl} methane

Difluoro-(4-trifluoromethylphenyloxy)- {4'-[2-(trans-4-pentylcyclohexyl)ethyl]biphenyl} methane

Example 11

Preparation of difluoro-(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-propylcyclohexyl]phenyl]methane (Compound expressed by the formula (I) wherein R = C_3H_7, ℓ = n = 1, m = 0, ring A_1 is trans-1,4-cyclohexylene group, ring A_3 is 1,4-phenylene group, Z_1, Z_2 and Z_3 are covalent bond, L_1 = L_2 = H, L_3 = L_4 = F, and X = F.)

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 15.0 g (60.9 mmol) of 4-(trans-4-propylcyclohexyl)benzoic acid, 15.1 g (73.1 mmol) of DCC, and 0.27 g (2.2 mmol) of DMAP were dissolved in 300 ml of dichloromethane under nitrogen gas atmosphere, and then the solution which was prepared by dissolving 16.4 g (73.1 mmol) of the 3',4',5'-trifluorobiphenol prepared according to the procedures described

in Example 6 in 80 ml of dichloromethane was added dropwise in the flask at room temperature in 20 min while stirring. After the dropping, the solution was stirred at room temperature for 10 hours. Reaction solution was added with 200 ml of water, and dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and the water layer was further extracted with 200 ml of dichloromethane. Extracted layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 26.9 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using toluene as developing solvent, and further recrystallized from a mixed solvent of heptane-ethanol to obtain 22.8 g of colorless crystal product. This product was (3',4',5'-trifluorobiphenyl)-4-(trans-4-cyclohexyl)benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 22.8 g (50.5 mmol) of the (3',4',5'-trifluorobiphenyl)-4-(trans-4-cyclohexyl)benzoate obtained by the procedures mentioned above and 40.9 g (101.1 mmol) of Lawesson's reagent were dissolved in 500 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 60 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added to the reaction solution, the toluene layer was separated, and then the water layer was further extracted with 200 ml of toluene. Organic layers were mixed, and washed with 200 ml × 2 of water, 100 ml of saturated sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over

anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 23.4 g of brown crystalline mixture. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 8.3 g of yellow needle-like crystal product. This product was 4-(trans-4-propylcyclohexyl)phenylcarbothio acid-O-3',4',5'-trifluoro-biphenyl.

In a 100 ml egg-plant type flask provided with a nitrogen gas introducing pipe, 8.3 g (17.7 mmol) of 4-(trans-4-propyl-cyclohexyl)phenylcarbothio acid-O-3',4',5'-trifluorobiphenyl was dissolved in 80 ml of dichloromethane at room temperature, and then 8.5 g (53.0 mmol) of DAST was added to the solution and the solution was stirred at room temperature for 40 hours. Reaction solution was added with 50 ml of water, the dichloromethane layer was separated, and the water layer was further extracted with 50 ml of dichloromethane. Extracted layers were mixed, washed with 50 ml × 2 of water, 30 ml of saturated aqueous solution of sodium hydrogencarbonate, and 50 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 8.1 g of brown crystal product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent, and then recrystallized from heptane to obtain 1.9 g of colorless needle-like crystal product. This product was difluoro-(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane.

Following compounds can be prepared according to the preparation method mentioned above by using 4-(trans-4-alkyl-cyclohexyl)benzoic acids having a different alkyl chain in place of 4-(trans-4-propylcyclohexyl)benzoic acid:

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-methylcyclohexyl)phenyl]methane

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Cr 73.8-74.4 N 163.4-164.0 Iso

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-hexylcyclohexyl)phenyl]methane

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-heptylcyclohexyl)phenyl]methane

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-octylcyclohexyl)phenyl]methane

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-nonylcyclohexyl)phenyl]methane

Difluoro(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-decylcyclohexyl)phenyl]methane

Following compounds can be prepared according to the preparation method mentioned above by selectively using several known benzoic acid derivatives and several known phenol derivatives, including the compounds preparation examples of which are described in detail in the Examples mentioned above, in place of 4-(trans-4-propylcyclohexyl)benzoic acid or 3',4',5'-trifluorobiphenol:

Difluoro-(4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(4'-difluoromethoxybiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(4'-difluoromethoxybiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(4'-difluoromethoxybiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(4'-difluoromethoxybiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(4'-trifluoromethylbiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(4'-trifluoromethylbiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(4'-trifluoromethylbiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(4'-trifluoromethylbiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-difluoromethoxybiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-difluoromethoxybiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-difluoromethoxybiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-difluoromethoxybiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-trifluoromethylbiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-trifluoromethylbiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-trifluoromethylbiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3'-fluoro-4'-trifluoromethylbiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[2-fluoro-4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[2-fluoro-4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[2-fluoro-4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[2-fluoro-4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethoxybiphenyloxy)-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-difluoromethoxybiphenyloxy)-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[2,6-difluoro-4-(trans-4-ethylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[2,6-difluoro-4-(trans-4-propylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[2,6-difluoro-4-(trans-4-butylcyclohexyl)phenyl]methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)-[2,6-difluoro-4-(trans-4-pentylcyclohexyl)phenyl]methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} methane

Difluoro-(3',4',5'-trifluorobiphenyloxy)- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-trifluoromethoxybiphenyloxy)- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-trifluoromethoxybiphenyloxy)- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-trifluoromethoxybiphenyloxy)- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-trifluoromethoxybiphenyloxy)- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-difluoromethoxybiphenyloxy)- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-difluoromethoxybiphenyloxy)- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-difluoromethoxybiphenyloxy)- {4-[2-(trans-4

-butylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-difluoromethoxybiphenyloxy)- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-trifluoromethylbiphenyloxy)- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-trifluoromethylbiphenyloxy)- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-trifluoromethylbiphenyloxy)- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} methane

Difluoro-(4'-trifluoromethylbiphenyloxy)- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)- {4-[2-(trans-4-ethylcyclohexyl)ethyl]phenyl} methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} methane

Cr 101.8-102.1 N 134.4-135.0 Iso

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)- {4-[2-(trans-4-butylcyclohexyl)ethyl]phenyl} methane

Difluoro-(3',5'-difluoro-4'-trifluoromethylbiphenyloxy)- {4-[2-(trans-4-pentylcyclohexyl)ethyl]phenyl} methane

Example 12 (Use Example 1)

Clearing point (Cp) of the nematic liquid crystal composition having the following chemical composition was 72.4°C:

4-(trans-4-propylcyclohexyl)benzonitrile	24 %

(Symbol % is by weight. This rule applies even hereinafter.)

4-(trans-4-pentylcyclohexyl)benzonitrile	36 %
4-(trans-4-heptylcyclohexyl)benzonitrile	25 %

4-(4-propylphenyl)benzonitrile 15 %

This liquid crystal composition enclosed in a TN cell (twisted nematic cell) of 9 μm cell thickness had a driving threshold voltage (Vth) of 1.78 V, value of dielectric anisotropy (Δε) of +11.0, optical anisotropy (Δn) of 0.137, and viscosity at 20°C (η_{20}) of 27.0 cP. This liquid crystal composition, as mother liquid crystal, in an amount of 85 parts was mixed with 15 parts of difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(4-trifluoromethoxyphenyloxy)methane shown in Example 2, and physical properties of the mixture were determined. The results were as follows:

Cp: 70.1, Vth: 1.71, Δε: 10.8, Δn: 0.132,

η_{20}: 23.5 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 13 (Use Example 2)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3,4,5-trifluoro-phenyloxy)methane shown in Example 2, and physical properties of the mixture were determined. The results were as follows:

Cp: 64.5, Vth: 1.49, Δε: 11.6, Δn: 0.128,

η_{20}: 26.6 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 14 (Use Example 3)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,4,5-trifluoro-phenyloxy)methane shown in Example 2, and physical properties of the mixture were determined. The results were as follows:

Cp: 66.6, Vth: 1.48, $\Delta\varepsilon$: 11.4, Δn: 0.126,

η_{20}: 25.5 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 15 (Use Example 4)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,4-difluorophenyloxy)methane shown in Example 2, and physical properties of the mixture were determined. The results were as follows:

Cp: 69.3, Vth: 1.68, $\Delta\varepsilon$: 10.3, Δn: 0.130,

η_{20}: 25.0 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Clearing point (Cp) of the nematic liquid crystal composition having the following chemical composition was 112.4°C:

4-(trans-4-(trans-4-ethylcyclohexyl)cyclohexyl)-1,2-difluorobenzene 33.3 %

(Symbol % is by weight. This rule applies even hereinafter.)

4-(trans-4-(trans-4-propylcyclohexyl)cyclohexyl)-1,2-difluorobenzene 33.3 %

4-(trans-4-(trans-4-pentylcyclohexyl)cyclohexyl)-1,2-difluorobenzene 33.3 %

This liquid crystal composition enclosed in a TN cell (twisted nematic cell) of 9 μm cell thickness had a value of dielectric anisotropy ($\Delta\varepsilon$) of +5.0, optical anisotropy (Δn) of 0.080, and viscosity at 20°C (η_{20}) of 24.3 cP. This liquid crystal composition, as mother liquid crystal, in an amount of 80 parts was mixed with 20 parts of difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(3,4-difluorophenyloxy)methane

mentioned above, and physical properties of the mixture were determined. The results were as follows:

Cp: 99.4, $\Delta\varepsilon$: 5.6, Δn: 0.083, η_{20}: 21.6 cP.

While this composition was left in a freezer at -20°C for 40 days, separation of crystal was not observed.

Example 16 (Use Example 5)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro-[4-(trans-4-pentylcyclohexyl)phenyl]-(4-trifluoromethyl-phenyloxy)methane shown in Example 2, and physical properties of the mixture were determined. The results were as follows:

Cp: 69.0, V_{th}: 1.65, $\Delta\varepsilon$: 11.4, Δn: 0.131,

η_{20}: 27.0 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 17 (Use Example 6)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3-trifluoro-4-cyanophenyloxy)methane shown in Example 2, and physical properties of the mixture were determined. The results were as follows:

Cp: 74.6, V_{th}: 1.64, $\Delta\varepsilon$: 12.3, Δn: 0.140,

η_{20}: 30.9 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 18 (Use Example 7)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro-{4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl}-(3,4,5-trifluorophenyloxy)methane shown in Example 3, and physical

properties of the mixture were determined. The results were as follows:

Cp: 65.8, Vth: 1.61, $\Delta\varepsilon$: 11.3, Δn: 0.129,

η_{20}: 25.4 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 19 (Use Example 8)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(4-trifluoromethoxyphenyloxy)methane shown in Example 3, and physical properties of the mixture were determined. The results were as follows:

Cp: 69.8, Vth: 1.79, $\Delta\varepsilon$: 10.4, Δn: 0.131,

η_{20}: 24.2 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 20 (Use Example 9)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro- {4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} -(3-fluoro-4-trifluoromethoxyphenyloxy)methane shown in Example 3, and physical properties of the mixture were determined. The results were as follows:

Cp: 68.9, Vth: 1.69, $\Delta\varepsilon$: 10.9, Δn: 0.131,

η_{20}: 25.3 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 21 (Use Example 10)

Liquid crystal composition shown in Use Example 1, as mother

liquid, in an amount of 85 parts was mixed with 15 parts of difluoro-(3',4',5'-trifluorobiphenyloxy)-[4-(trans-4-pentyl-cyclohexyl)phenyl]methane shown in Example 10, and physical properties of the mixture were determined. The results were as follows:

Cp: 80.4, Vth: 1.62, $\Delta\varepsilon$: 10.3, Δn: 0.140,

η_{20}: 28.8 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

Example 22 (Use Example 11)

Liquid crystal composition shown in Use Example 1, as mother liquid, in an amount of 85 parts was mixed with 15 parts of difluoro-(3',5'-difluoro-4-trifluoromethylbiphenyloxy)-{4-[2-(trans-4-propylcyclohexyl)ethyl]phenyl} methane shown in Example 10, and physical properties of the mixture were determined. The results were as follows:

Cp: 76.6, Vth: 1.75, $\Delta\varepsilon$: 11.9, Δn: 0.139,

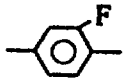
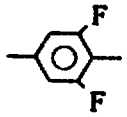
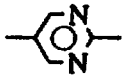
η_{20}: 29.8 cP.

While this composition was left in a freezer at -20°C for 20 days, separation of crystal was not observed.

As the nematic liquid crystal compositions containing the compounds of the present invention, the followings (Composition Examples 12 to 28) can be mentioned. In the following lists, compounds in the compositions are indicated by the abbreviations according to the rules shown in the following Table. That is, left side terminal groups are indicated by s, sO, sOt, Vs, or sVt, bonding groups by 2, E, T, or CF2O, ring structures by B, B(F), B(F,F), H, or Py, and right side terminal groups are indicated by F, CL, OCF3, w, or Ow.

Table 1

Left side terminal group	Symbol	Bonding group	Symbol
C_sH_{2s+1}—	s —	—CH_2CH_2—	2
$C_sH_{2s+1}O$—	sO—	—COO—	E
$C_sH_{2s+1}OC_tH_{2t}$—	sOt —	—C≡C—	T
CH_2=CHC_sH_{2s}—	Vs —	—CF_2O—	CF2O
$C_sH_{2s+1}CH$=CHC_tH_{2t}—	sVt —		

Ring structure	Symbol	Right-side terminal group	Symbol
	B	—F	— F
	B(F)	—Cl	— CL
	B(F,F)	—CN	— C
		—OCF_3	— OCF3
	H	—C_wH_{2w+1}	— w
	Py	—OC_wH_{2w+1}	— Ow

Example 23 (Use Example 12)

3-HBCF2OB-OCF3	10.0 %
5-HBCF2OB-OCF3	8.0 %
3O1-BEB(F)-C	5.0 %
2-HB-C	5.0 %
3-HB-C	15.0 %
2-HHB-C	5.0 %
3-HHB-C	5.0 %
4-HHB-C	5.0 %
3-PyBB-F	5.0 %
3-HH-4	10.0 %
3-HH-5	3.0 %
2-BTB-O1	3.0 %
3-BTB-O1	3.0 %
4-BTB-O1	3.0 %
4-BTB-O2	3.0 %
5-BTB-O1	3.0 %
3-HHB-1	6.0 %
3-HHB-O1	3.0 %
Clearing point (°C)	92.2
Viscosity (mPa·s)	20.9
Optical anisotropy	0.142
Dielectric anisotropy	8.6
Threshold voltage (V)	1.83

Example 24 (Use Example 13)

3-HBCF2OB-OCF3	10.0 %
3-HBCF2OB-(F,F)-F	5.0 %
5-HBCF2OB-(F,F)-F	5.0 %
V2-HB-C	7.0 %

1V2-HB-C	7.0 %
3-HB-C	5.0 %
3-HHB-C	5.0 %
3-PyBB-F	8.0 %
2-PyBH-3	4.0 %
3-PyBH-3	4.0 %
4-PyBB-3	4.0 %
3-HH-4	10.0 %
1O1-HH-3	6.0 %
2-BTB-1	4.0 %
1-BTB-6	8.0 %
4-BTB-4	4.0 %
3-HHB-1	4.0 %
Clearing point (°C)	83.5
Viscosity (mPa·s)	26.8
Optical anisotropy	0.148
Dielectric anisotropy	7.0
Threshold voltage (V)	2.02

Example 25 (Use Example 14)

3-HBCF2OB(F,F)-F	8.0 %
5-HBCF2OB(F,F)-F	8.0 %
2-BB-C	7.0 %
1O1-HB-C	8.0 %
2O1-HB-C	7.0 %
2-BEB-C	4.0 %
5-PyB-F	5.0 %
3-PyBB-F	5.0 %
2-PyB-2	3.0 %
3-PyB-2	3.0 %
4-PyB-2	3.0 %

2-PyBH-3	5.0 %
3-PyBH-3	5.0 %
4-PyBH-3	5.0 %
3-PyB-O2	5.0 %
2-HHB-1	4.0 %
3-HHB-1	6.0 %
3-HHB-3	9.0 %
Clearing point (°C)	71.5
Viscosity (mPa·s)	32.5
Optical anisotropy	0.142
Dielectric anisotropy	10.2
Threshold voltage (V)	1.44

Example 26 (Use Example 15)

3-HBCF2OB-OCF3	10.0 %
5-HBCF2OB-CF3	5.0 %
3-PyB(F)-F	6.0 %
3-PyBB-F	4.0 %
4-PyBB-F	4.0 %
5-PyBB-F	4.0 %
2-PyB-2	6.0 %
3-PyB-2	6.0 %
4-PyB-2	6.0 %
3-HEB-O4	6.0 %
4-HEB-O2	6.0 %
5-HEB-O1	6.0 %
2-H2BTB-4	4.0 %
3-H2BTB-4	4.0 %
3-HHB-1	7.0 %
3-HHB-3	7.0 %
3-HHEBB-C	3.0 %

5-HHEBB-C		3.0 %
3-HBEBB-C		3.0 %
Clearing point (°C)	99.3	
Viscosity (mPa·s)	30.1	
Optical anisotropy	0.156	
Dielectric anisotropy	5.3	
Threshold voltage (V)	2.36	

Example 27 (Use Example 16)

5-HBCF2OB(F,F)-CF3	10.0 %
3-HBCF2OB(F,F)-F	7.0 %
5-HBCF2OB(F,F)-F	7.0 %
2O1-BEB(F)-C	2.0 %
3O1-BEB(F)-C	8.0 %
2-HB(F)-C	5.0 %
3-HB(F)-C	7.0 %
3-HHB(F)-C	3.0 %
2-HHB(F)-F	5.0 %
3-HHB(F)-F	5.0 %
5-HHB(F)-F	5.0 %
3-HHB-1	6.0 %
3-HHB-3	3.0 %
3-HHB-O1	3.0 %
3-H2BTB-2	4.0 %
3-H2BTB-3	4.0 %
3-H2BTB-4	4.0 %
3-HB(F)TB-2	4.0 %
3-HB(F)TB-3	4.0 %
3-HB(F)TB-4	4.0 %
Clearing point (°C)	94.3
Viscosity (mPa·s)	32.9

Optical anisotropy	0.137
Dielectric anisotropy	12.8
Threshold voltage (V)	1.46

Example 28 (Use Example 17)

3-HBCF2OB-OCF3	6.0 %
5-HBCF2OB-OCF3	5.0 %
5-HBCF2OB-CF3	5.0 %
V2-HB-C	8.0 %
1V2-HB-C	8.0 %
3-HB-C	13.0 %
5-HB-C	7.0 %
101-HB-C	4.0 %
201-HB-C	4.0 %
3-HHB-F	4.0 %
3-HH-4	4.0 %
2-BTB-01	8.0 %
3-HHB-01	4.0 %
3-HHB-1	6.0 %
3-HHB- 3	10.0 %
3-HB(F)TB-2	4.0 %
Clearing point (°C)	80.5
Viscosity (mPa·s)	19.4
Optical anisotropy	0.130
Dielectric anisotropy	8.2
Threshold voltage (V)	1.86

Example 29 (Use Example 18)

3-HBCF2OB(F,F)-F	9.0 %
5-HBCF2OB(F,F)-OCF3	9.0 %
2-BEB-C	5.0 %
2-BB-C	11.0 %

3-HB-C	5.0 %
10-BEB-2	10.0 %
3-HEB-O4	10.0 %
4-HEB-O2	10.0 %
5-HEB-O1	10.0 %
3-HBEB-F	5.0 %
3-HHEB-F	5.0 %
5-HHEB-F	5.0 %
3-HEBEB-F	3.0 %
3-HEBEB-1	3.0 %
Clearing point (°C)	71.7
Viscosity (mPa·s)	36.8
Optical anisotropy	0.117
Dielectric anisotropy	7.5
Threshold voltage (V)	1.52

Example 30 (Use Example 19)

3-HBCF2OB-OCF3	6.0 %
3-HBCF2OB(F,F)-F	6.0 %
3-H2BCF2OBB(F,F)-CF3	5.0 %
2O1-BEB(F)-C	2.0 %
3O1-BEB(F)-C	6.0 %
4O1-BEB(F)-C	3.0 %
2-HHB(F)-F	4.0 %
3-HHB(F)-F	4.0 %
5-HHB(F)-F	4.0 %
3-HHEB-F	3.0 %
5-HHEB-F	3.0 %
3-HEB-F	3.0 %
3-HH-EMe	9.0 %
3-HEB-O4	4.0 %
4-HEB-3	4.0 %

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4-HEB-4	4.0 %
2-PyBH-3	5.0 %
3-PyBH-3	5.0 %
4-PyBH-3	5.0 %
3-HB-O2	10.0 %
3-HHP-1	5.0 %
Clearing point (°C)	83.6
Viscosity (mPa·s)	32.9
Optical anisotropy	0.105
Dielectric anisotropy	7.1
Threshold voltage (V)	1.83

Example 31 (Use Example 20)

5-HBCF2OB-CF3	5.0 %
5-HBCF2OB(F,F)-CF3	10.0 %
3-DB-C	4.0 %
4-DB-C	4.0 %
101-HB-C	5.0 %
2-PyB-2	9.0 %
3-PyB-2	9.0 %
4-PyB-2	9.0 %
2-PyBH-3	7.0 %
3-PyBH-3	6.0 %
4-PyBH-3	6.0 %
101-HH-5	8.0 %
3-HB(F)TB-2	6.0 %
3-HB(F)TB-3	6.0 %
3-HB(F)TB-4	6.0 %
Clearing point (°C)	71.0
Viscosity (mPa·s)	25.5
Optical anisotropy	0.149
Dielectric anisotropy	6.0
Threshold voltage (V)	1.78

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Example 32 (Use Example 21)

3-HBCF2OB(F,F)-F	14.0 %
5-HBCF2OB(F,F)-F	14.0 %
5-HBCF2OB(F)-OCF3	4.0 %
1V2-BEB(F,F)-C	12.0 %
3O1-BEB(F)-C	11.0 %
3-HB-C	9.0 %
3-HB(F)-C	7.0 %
3-HHB(F)-C	6.0 %
3-PyBB-F	8.0 %
4-PyBB-F	8.0 %
5-PyBB-F	7.0 %
Clearing point (°C)	57.6
Viscosity (mPa·s)	52.0
Optical anisotropy	0.144
Dielectric anisotropy	24.4
Threshold voltage (V)	0.77

Example 33 (Use Example 22)

3-HBCF2OB-OCF3	10.0 %
5-HBCF2OB-OCF3	5.0 %
2-HB(F)-C	10.0 %
3-HB(F)-C	10.0 %
3O1-BEB(F)-C	7.0 %
3-HHEB-F	4.0 %
5-HHEB-F	4.0 %
3-HHEB(F,F)-F	15.0 %
5-HHEB(F,F)-F	10.0 %
3-HBEB(F,F)-F	5.0 %
5-HBEB(F,F)-F	5.0 %
3-HHB-1	8.0 %
3-HHB-O1	4.0 %
3-HHB-3	3.0 %

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Clearing point (°C)	83.2
Viscosity (mPa·s)	33.2
Optical anisotropy	0.096
Dielectric anisotropy	13.6
Threshold voltage (V)	1.16

Example 34 (Use Example 23)

3-HBCF2OB-OCF3	10.0 %
5-HBCF2OB-OCF3	5.0 %
1V-HB-C	9.0 %
1V2-HB-C	9.0 %
3-HB-C	14.0 %
2-HHB-C	3.0 %
3-HHB-C	4.0 %
V2-HH-3	10.0 %
101-HH-5	8.0 %
2-BTB-01	11.0 %
V-HHB-1	8.0 %
V-HBB-2	5.0 %
1V2-HBB-2	4.0 %
Clearing point (°C)	83.6
Viscosity (mPa·s)	17.1
Optical anisotropy	0.134
Dielectric anisotropy	7.0
Threshold voltage (V)	2.03

Example 35 (Use Example 24)

3-HBCF2OB(F,F)-F	10.0 %
5-HBCF2OB(F,F)-F	10.0 %
2-HB(F)-C	7.0 %
3-HB(F)-C	10.0 %
3-HHB-F	5.0 %
3-HB-O2	10.0 %
V-HH-5	5.0 %

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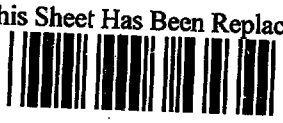


V2-HH-3	5.0 %
2-BTB-O1	8.0 %
V-HHB-1	8.0 %
V-HBB-2	5.0 %
1V2-HBB-2	5.0 %
3-HHB-O1	4.0 %
3-H2BTB-2	4.0 %
3-H2BTB-3	4.0 %
Clearing point (°C)	71.6
Viscosity (mPa·s)	16.9
Optical anisotropy	0.121
Dielectric anisotropy	6.1
Threshold voltage (V)	1.81

Example 36 (Use Example 25)

3-HBCF2OB(F,F)-F	5.0 %
5-HBCF2OB(F,F)-F	10.0 %
5-HBCF2OB-CF3	5.0 %
5-HBCF2OB(F)-F	5.0 %
3-HBCF2OB-OCF3	5.0 %
7-HB(F,F)-F	8.0 %
3-HHB(F,F)-F	6.0 %
4-HHB(F,F)-F	3.0 %
3-H2HB(F,F)-F	10.0 %
4-H2HB(F,F)-F	6.0 %
5-H2HB(F,F)-F	6.0 %
3-HH2B(F,F)-F	10.0 %
5-HH2B(F,F)-F	5.0 %
3-HBB(F,F)-F	5.0 %
5-HBB(F,F)-F	5.0 %
3-HHBB(F,F)-F	3.0 %
3-HH2BB(F,F)-F	3.0 %
Clearing point (°C)	61.8

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Viscosity (mPa·s)	23.6
Optical anisotropy	0.083
Dielectric anisotropy	8.4
Threshold voltage (V)	1.50

Example 37 (Use Example 26)

3-HBCF2OB(F,F)-F	5.0 %
3-HBCF2OB-OCF3	5.0 %
3-HB-CL	4.0 %
5-HB-CL	4.0 %
7-HB-CL	5.0 %
2-HHB-CL	6.0 %
3-HHB-CL	7.0 %
5-HHB-CL	6.0 %
2-HBB(F)-F	6.0 %
3-HBB(F)-F	6.0 %
5-HBB(F)-F	12.0 %
3-HBB(F,F)-F	13.0 %
5-HBB(F,F)-F	13.0 %
3-H2HB(F)-CL	3.0 %
3-HB(F)TB-2	3.0 %
3-HB(F)VB-2	2.0 %
Clearing point (°C)	89.3
Viscosity (mPa·s)	21.9
Optical anisotropy	0.128
Dielectric anisotropy	6.4
Threshold voltage (V)	2.08

Example 38 (Use Example 27)

5-HBCF2OB(F,F)-F	10.0 %
5-HBCF2OB-CF3	5.0 %
3-HBCF2OB-OCF3	5.0 %
2-HBB(F)-F	3.0 %
3-HBB(F)-F	3.0 %

5-HBB(F)-F	6.0 %
2-HBB-F	3.0 %
3-HBB-F	3.0 %
3-H2HB(F,F)-F	6.0 %
4-H2HB(F,F)-F	6.0 %
5-H2HB(F,F)-F	6.0 %
3-HHB(F,F)-F	3.0 %
4-HHB(F,F)-F	3.0 %
3-HH2B(F,F)-F	12.0 %
5-HH2B(F,F)-F	6.0 %
3-HBB(F,F)-F	6.0 %
5-HBB(F,F)-F	6.0 %
3-HHB-CL	4.0 %
5-HHB-CL	4.0 %
Clearing point (°C)	82.8
Viscosity (mPa·s)	24.8
Optical anisotropy	0.100
Dielectric anisotropy	8.0
Threshold voltage (V)	1.69

Example 39 (Use Example 28)

3-HBCF2OB(F,F)-F	3.0 %
5-HBCF2OB(F,F)-F	8.0 %
3-HBCF2OB-OCF3	5.0 %
2-HBB(F)-F	8.0 %
3-HBB(F)-F	8.0 %
5-HBB(F)-F	16.0 %
5-HB-F	6.0 %
7-HB-F	6.0 %
5-HHB-OCF3	8.0 %
3-H2HB-OCF3	8.0 %
5-H2HB-OCF3	8.0 %
3-HH2B-OCF3	8.0 %

5-HH2B-OCF3		8.0 %
Clearing point (°C)	84.9	
Viscosity (mPa·s)	16.6	
Optical anisotropy	0.101	
Dielectric anisotropy	5.5	
Threshold voltage (V)	2.12	

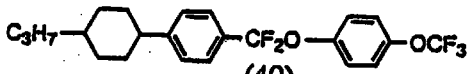
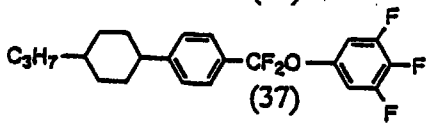
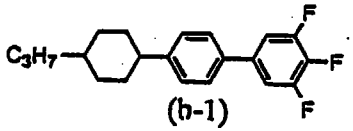
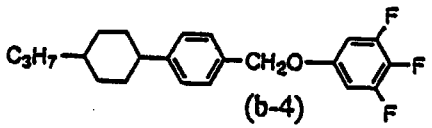
Comparative Example

Among the compounds expressed by the formula (b-1) or (b-4) (USP 5,032,313) described in the paragraph of BACKGROUND ART, 1,2,6-trifluoro-4-[4-(trans-4-propylcyclohexyl)phenyl]benzene (compound expressed by the formula (b-1) wherein R = C_3H_7) was selected as comparative compound to the present invention.

This compound was actually synthesized according to the Example described in the USP 5,032,313.

Liquid crystal composition shown in Example 11 in an amount of 85 parts, as mother liquid crystal, was mixed with 15 parts of the 1,2,6-trifluoro-4-[4-(trans-4-propylcyclohexyl) phenyl]benzene or 4-(trans-4-propylcyclohexyl)phenyl-(3,4,5-trifulorophenyloxy)methane, and physical properties of the mixtures were determined. The physical properties are shown in Table 2 together with the results of Examples 11 and 12. In the Table, numerical values in parentheses are ones obtained by extrapolation.

Table 2

	Cp(℃)	△ε	η_{20} (cP)	V_{th}(V)
Mother liquid crystal	72.4	11.0	27.0	1.78
 (40)	70.1(57.1)	10.8(9.7)	23.5(3.7)	1.71
 (37)	64.5(19.7)	11.6(15.0)	26.6(24.3)	1.49
 (b-1)	68.7(47.7)	11.1(11.7)	28.8(39.0)	1.51
 (b-4)	61.2(1.7)	10.4(7.0)	30.5(54.3)	1.61

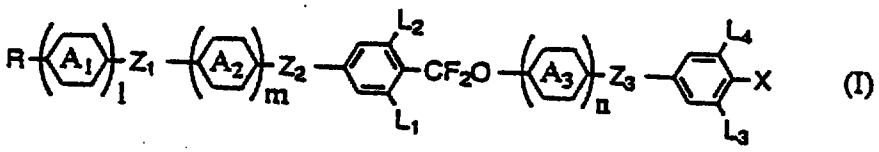
From Table 2, it can be seen that compound (37) of the present invention has excellent characteristics compared with comparative compound (b-1) having the same molecular skeleton in that the inventive compound exhibits an extremely low viscosity (η_{20}) as low as about 60 % of the compound (b-1) whereas the inventive compound has a value of dielectric anisotropy ($\Delta\varepsilon$) 1.28 times as large as the compound (b-1) when compared based on extrapolated values. Also, in comparison between compound (37) of the present invention and the compound (b-4) in which fluorine atoms at benzyl position in compound (37) were substituted with hydrogen atoms, the inventive compound has an extremely low viscosity (η_{20}) as low as about 40 % of the compound (b-4). From this fact, it can be seen that the $-CF_2O-$ bonding group which crosslinked two benzene rings, as a characteristic of the present invention, contributes to the increase of the value of dielectric anisotropy ($\Delta\varepsilon$) as well as to the reduction of viscosity. Further, it is seen that compound (40) of the present invention having a trifluoromethoxy group at the terminal of its molecule is as extremely low as 3.7 cP in the extrapolated value of viscosity and that the compound reduces only viscosity by even about 13 % without lowering clearing point or the value of dielectric anisotropy, compared with the mother liquid crystal. Thus, the present compound can be said to be highly useful even as viscosity reducing agent.

INDUSTRIAL APPLICABILITY

Difluorooxymethane derivatives of the present invention and liquid crystal compositions containing the compound are useful, as liquid crystal material for low voltages in several modes, for example, active matrix mode and STN mode.

Claims:

1. A difluorooxymethane derivative expressed by the general formula (I)



(I)

wherein each of ℓ, m, and n is 0 or 1, rings A_1 and A_2 independently represent trans-1,4-cyclohexylene group, 1,4-phenylene group one or more hydrogen atoms in which six-membered ring may be replaced by halogen atom, trans-1,3-dioxane-2,5-diyl, or pyrimidine-2,5-diyl, ring A_3 represents 1,4-phenylene group one or more hydrogen atoms in which six-membered ring may be replaced by halogen atom, trans-1,3-dioxane-2,5-diyl, or pyrimidine-2,5-diyl, Z_1, Z_2, and Z_3 independently represent a covalent bond, $-CCH_2-$, $-COO-$, $-CF_2O-$, $-OCF_2-$, $-CH_2O-$, $-OCH-$, $-CH=CH-$, or $-C\equiv C-$, L_1, L_2, L_3, and L_4 represent hydrogen atom or halogen atom, respectively, X is halogen atom, CN, CF_3, OCF_3, $OCHF_2$, OCH_2F, or a linear or branched alky group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, and R is a linear or branched alkyl group or alkenyl group having 1 to 10 carbon atoms, one or not adjacent 2 or more CH_2 groups in the R may be replaced by oxygen atom, provided that in no case is X an alkyl group, alkenyl group, or alkoxy group except in the case where Z_2 is $-F_2O-$ or $-OCF_2-$.

2. The difluorooxymethane derivative according to claim 1 wherein ℓ = 1, m = 0, n is 0 or 1, Z_1 is covalent bond or $-CH_2CH_2-$, both Z_2 and Z_3 are covalent bond, A_1 ns-1,4-cyclohexylene group, A_3 is 1,4-phenylene group, and R is a linear

* C L M S *

alkyl group or alkenyl group having 1 to 10 carbon atoms, in the general formula (I).

3. The difluorooxymethane derivative according to claim 1 or 2 wherein at least one of L_3 and L_4 is halogen atom.

4. The difluorooxymethane derivative according to claim 1 wherein $\ell = m = n = 0$, and all of Z_1, Z_2, and Z_3 are covalent bond, in the general formula (I).

5. The difluorooxymethane derivative according to claim 1 wherein $\ell = 1$, $m = n = 0$, and both of Z_2 and Z_3 are covalent bond, in the general formula (I).

6. The difluorooxymethane derivative according to any one of claims 1 to 5 wherein all of L_3, L_4, and X are fluorine atom, in the general formula (I).

7. The difluorooxymethane derivative according to claim 5 wherein X is OCF_3, in the general formula (I).

8. The difluorooxymethane derivative according to claim 5 wherein X is CN, in the general formula (I).

9. The difluorooxymethane derivative according to claim 1 wherein $\ell = 1$, ring A_1 is 1,4-phenylene group one or more hydrogen atom in which 6-membered ring may be replaced by halogen atom, Z_1 is $-OCF_2-$, both of Z_2 and Z_3 are covalent bond, and X is a linear or branched alkyl group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, in the general formula (I).

10. The difluorooxymethane derivative according to claim 1 wherein $\ell = m = 0$, $n = 1$, both of Z_1 and Z_2 are covalent bond, and ring A_3 is 1,4-phenylene group, in the general formula (I).

11. The difluorooxymethane derivative according to claim 10 wherein Z_3 is covalent bond, in the general formula (I).

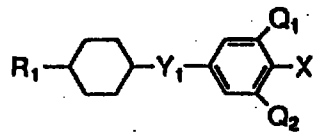
12. The difluorooxymethane derivative according to claim 10

* C L M S *

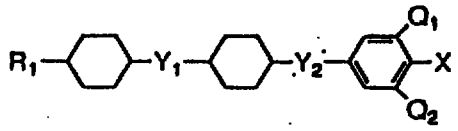
wherein Z_3 is $-CH_2CH_2-$, in the general formula (I).

13. A liquid crystal composition containing at least one kind of difluorooxymethane derivative defined in any one of claims 1 to 12.

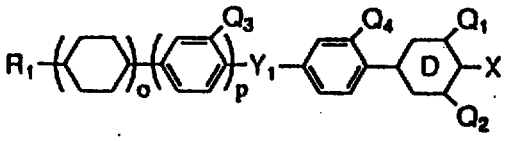
14. A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative defined in any one of claims 1 to 12 and containing, as a second component, at least one kind of compound selected from the group of compounds expressed by general formula (II), (III), or (IV)



(II)



(III)



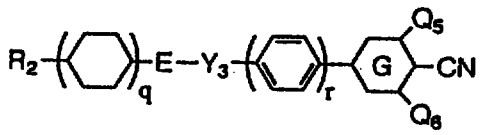
(IV)

wherein R_1 represents an alkyl group having 1 to 10 carbon atoms, X represents F, Cl, CF_3, OC_3, OCF_2H, or an alkyl group having 1 to 10 carbon atoms, Q_1, Q_2, Q_3 independently represent H or F, o represents 1 or 2, p represents 0 or 1, Y_1 and Y_2 independently represent $-CH_2CH_2-$, $-CH=CH-$, or covalent bond, and ring D represents trans-1,4-cyclohexylene group or 1,4-phenylene group.

15. A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative defined in any one of claims 1 to 12, containing, as a second

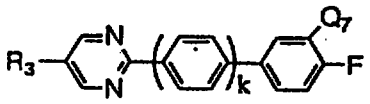
* C L M S *

component, at least one kind of compound selected from the group of compounds expressed by general formula (V), (VI), (VII), (VIII), or (IX)



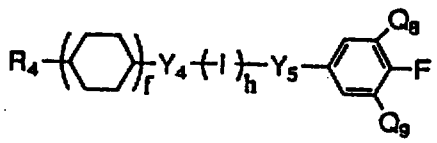
(V)

wherein R_2 represents fluorine atom, an alkyl group having 1 to 10 carbon atoms, or an alkenyl group having 2 to 10 carbon atoms, in any case, one or not adjacent two or more CH_2 groups in the alkyl or alkenyl group may be replaced by oxygen atom, Y_3 represents $-CH_2CH-$, -COO-, or covalent bond, Q_5 and Q_6 independently represent hydrogen atom or fluorine atom, E represents trans-1,4-cyclohexylene, 1,4-phenylene, or trans-1,3-dioxane-2,5-diyl, ring G represents trans-1,4-cyclohexylene or 1,4-phenylene, and q and r independently represent 0 or 1,



(VI)

wherein R_3 represents an alkyl group having 1 to 10 carbon atoms, Q_7 represents hydrogen atom or fluorine atom, and k represents 0 or 1,

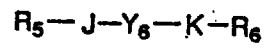


(VII)

wherein R_4 represents an alkyl group having 1 to 10 carbon atoms,

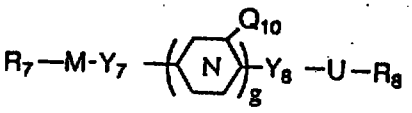
* C L M S *

I represents trans-1,4-cyclohexylene or 1,4-phenylene, Q_8 and Q_9 represent hydrogen atom or fluorine atom, Y_4 represents -COO- or -C≡C-, and f and h independently represent 0 or 1,



(Ⅷ)

wherein R_5 and R_6 independently represent an alkyl group, alkosy group, or alkoxymethyl group having 1 to 10 carbon atoms, J represents trans-1,4-cyclohexylene, 1,3-pyrimidine-2,5-diyl, or 1,4-phenylene, K represents trans-1,4-cyclohexylene or 1,4-phenylene, Y_6 represents -C≡C-, -COO-, $-CH_2CH_2-$, or covalent bond,



(Ⅸ)

wherein R_7 represents an alkyl group or alkoxy group having 1 to 10 carbon atoms, R_8 represents an alkyl group having 1 to 10 carbon atoms, one or not adjacent two or more CH_2 groups in which alkyl group may be replaced by oxygen atom, M represents trans-1,4-cyclohexylene or 1,3-pyrimidine-2,5-diyl, rings N and U independently represent trans-1,4-cyclohexylene or 1,4-phenylene, Y_7 represents $-CH_2CH_2-$, -COO-, or covalent bond, Y_8 represents ≡C-, -COO-, or covalent bond, g represents 0 or 1, and Q_{10} represents hydrogen atom or fluorine atom.

16. A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative defined in any one of claims 1 to 12, containing, as a part of the second component, at least one kind of compound selected

* C L M S *

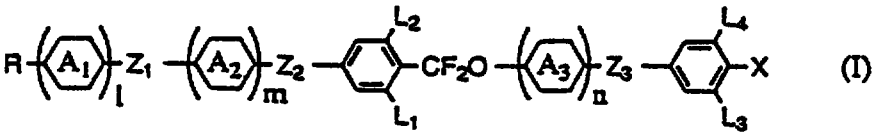
from a group of compounds expressed by the general formula (II), (III), or (IV), and containing, as other part of the second component, at least one compound selected from a group of compounds expressed by the general formula (V), (VI), (VII), (VIII), or (IX).

17. A liquid crystal display device composed by using a liquid crystal composition defined in any one of claims 13 to 16.

* C L M S *

ABSTRACT

In order to provide novel compounds which are useful as liquid crystal materials for low voltages in several liquid crystal displays, have a large dielectric anisotropy, and are low in viscosity; and to improve characteristics of liquid crystal compositions, difluorooxymethane derivatives expressed by the following general formula (I) and liquid crystal compositions containing the compound are proposed



(I)

wherein each of ℓ, m, and n is 0 or 1, rings A_1 to A_3 independently represent six-membered rings such as trans-1,4-cyclohexylene and 1,4-phenylene, Z_1 to Z_3 independently represent a bonding group such as covalent bond and $-CH_2CH_2-$, L_1 to L_4 independently represent hydrogen atom or halogen atom, and X represents a group such as halogen atom and OCF3.

They are useful as liquid crystal materials for low voltages in several modes such as active matrix mode and STN mode.

T. Kawakita

dioxane-2,5-diyl, or pyrimidine-2,5-diyl, ring A3 represents 1,4-phenylene group one or more hydrogen atoms in which six-membered ring may be replaced by halogen atom, trans-1,3-dioxane -2,5-diyl, or pyrimidine-2,5-diyl, Z_1, Z_2, and Z_3 independently represent a covalent bond, $-CH_2CH_2-$, $-COO-$, $-CF_2O-$, $-OCF_2-$, $-CH_2O-$, $-OCH_2-$, $-CH=CH-$, or $-C\equiv C-$, L_1, L_2, L_3, and L_4 independently represent hydrogen atom or halogen atom, respectively, X is halogen atom, CN, CF3, OCF3, $OCHF_2$, OCH_2F, or a linear or branched alkyl group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, and R is a linear or branched alkyl group or alkenyl group having 1 to 10 carbon atoms, one or not adjacent 2 or more CH_2 groups in the R may be replaced by oxygen atom, provided that in no case is X an alkyl group, alkenyl group, or alkoxy group except in the case where Z_1, Z_2, or Z_3 is $-CF_2O-$ or $-OCF_2-$; that in no case all of Z_1, Z_2, and Z_3 are covalent bond, and rings A1, A2, and A3 are 1,4- cyclohexylene group or 1,4-phenylene group which is not replaced by a halogen atom in one of the cases where ℓ, m, and n are 0, where ℓ and m are 0, and n is 1, where ℓ and n are 0, and m is 1, and where ℓ and n are 1, and m is 0; that in no case all of L_1, L_2, L_3, and L_4 are hydrogen atom, and X is fluorine atom or CN; that in no case all of Z_1, Z_2, and Z_3 are covalent bond, and rings A_1, A_2, and A_3 are 1,4-cyclohexylene group or 1,4-phenylene group which is not replaced by a halogen atom in one of the cases where ℓ, m, and n are 0, where ℓ and m are 0, and n is 1, and where ℓ and n are 1, and m is 0; and that in no case all of L_1, L_2, L_3, and L_4 are hydrogen atom, and X is CF_3 or OCF_3.

(2) The difluorooxymethane derivative recited in (1) wherein ℓ = 1, m = 0, n is 0 or 1, Z_1 is covalent bond or $-CH_2CH_2-$, both Z_2 and Z_3 are covalent bond, A_1 is trans-1,4-cyclohexylene group, A_3 is 1,4-phenylene group, and R is a linear alkyl group or alkenyl group having 1 to 10 carbon atoms, in the general formula (I).

(3) The difluorooxymethane derivative recited in (1) or (2) wherein at least one of L_3 and L_4 is halogen atom.

(4) The difluorooxymethane derivative recited in (1) wherein ℓ = m = n = 0, and all of Z_1, Z_2, and Z_3 are covalent bond, in the general formula (I).

(5) The difluorooxymethane derivative recited in (1) wherein ℓ = 1, m = n = 0, and both of Z_2 and Z_3 are covalent bond, in the general formula (I).

(6) The difluorooxymethane derivative recited in any one of (1) to (5) wherein all of L_3, L_4, and X are fluorine atom, in the general formula (I).

(7) The difluorooxymethane derivative recited in (5) wherein X is OCF_3 in the general formula (I).

(8) The difluorooxymethane derivative recited in (5) wherein X is CN, in the general formula (I).

(9) The difluorooxymethane derivative recited in (1) wherein ℓ = 1, ring A_1 is 1,4-phenylene group one or more hydrogen atom in which 6-membered ring may be replaced by halogen atom, Z_1 is $-OCF_2-$, both of Z_2 and Z_3 are covalent bond, and X is a linear or branched alkyl group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, in the general formula (I).

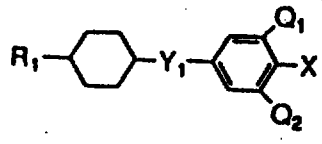
(10) The difluorooxymethane derivative recited in (1) wherein ℓ = m = 0, n = 1, both of Z_1 and Z_2 are covalent bond, and ring A_3 is 1,4-phenylene group, in the general formula (I).

(11) The difluorooxymethane derivative recited in (10) wherein Z_3 is covalent bond, in the general formula (I).

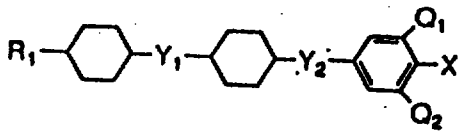
(12) The difluorooxymethane derivative recited in (10) wherein Z_3 is $-CH_2CH_2-$, in the general formula (I).

(13) A liquid crystal composition containing at least one kind of difluorooxymethane derivative recited in any one of (1) to (12).

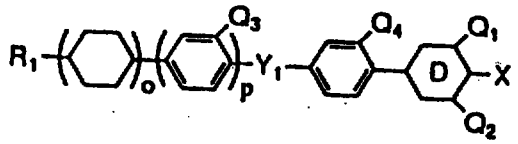
(14) A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative recited in any one of (1) to (12) and containing, as a second component, at least one kind of compound selected from the group of compounds expressed by general formula (II), (III), or (IV)



(II)



(III)

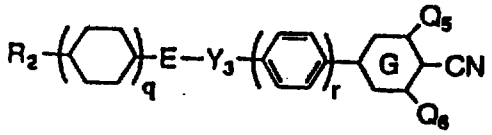


(IV)

wherein R_1 represents an alkyl group having 1 to 10 carbon

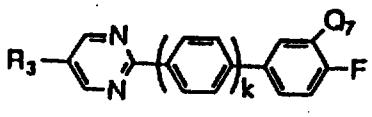
atoms, X represents F, Cl, CF_3, OCF_3, OCF_2H, or an alkyl group having 1 to 10 carbon atoms, Q_1, Q_2, Q_3, Q_4 independently represent H or F, o represents 1 or 2, p represents 0 or 1, Y_1 and Y_2 independently represent $-CH_2CH_2-$, -CH=CH-, or covalent bond, and ring D represents trans-1,4-cyclohexylene group or 1,4-phenylene group.

(15) A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative recited in any one of (1) to (12), containing, as a second component, at least one kind of compound selected from the group of compounds expressed by general formula (V), (VI), (VII), (VIII), or (IX)



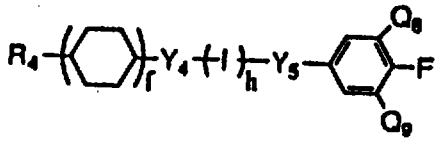
(V)

wherein R_2 represents fluorine atom, an alkyl group having 1 to 10 carbon atoms, or an alkenyl group having 2 to 10 carbon atoms, in any case, one or not adjacent two or more CH_2 groups in the alkyl or alkenyl group may be replaced by oxygen atom, Y_3 represents $-CH_2CH_2-$, -COO-, or covalent bond, Q_5 and Q_6 independently represent hydrogen atom or fluorine atom, E represents trans-1,4-cyclohexylene, 1,4-phenylene, or trans-1,3-dioxane-2,5-diyl, ring G represents trans-1,4-cyclohexylene or 1,4-phenylene, and q and r independently represent 0 or 1,



(VI)

wherein R_3 represents an alkyl group having 1 to 10 carbon atoms, Q_7 represents hydrogen atom or fluorine atom, and k represents 0 or 1,

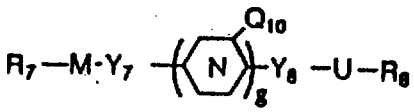


(VII)

wherein R_4 represents an alkyl group having 1 to 10 carbon atoms, I represents trans-1,4-cyclohexylene or 1,4-phenylene, Q_8 and Q_9 represent hydrogen atom or fluorine atom, Y_4 represents -COO- or -C≡C-, and f and h independently represent 0 or 1,

$$R_5 - J - Y_6 - K - R_6 \qquad \text{(VIII)}$$

wherein R_5 and R_6 independently represent an alkyl group, alkoxy group, or alkoxymethyl group having 1 to 10 carbon atoms, J represents trans-1,4-cyclohexylene, 1,3-pyrimidine-2,5-diyl, or 1,4-phenylene, K represents trans-1,4-cyclohexylene or 1,4-phenylene, Y_6 represents -C≡C-, -COO-, $-CH_2CH_2-$, or covalent bond,



(IX)

wherein R_7 represents an alkyl group or alkoxy group having 1 to

have a characteristic that they have an excellent miscibility. Compounds (571) to (613) have two $-CF_2O-$ groups in the molecule and have a lower viscosity compared with compounds (67) to (103) and (143) to (320). Particularly, compounds (610) to (613) have a characteristic that they are remarkably excellent as viscosity reducing agent.

[Method for preparing the compounds]

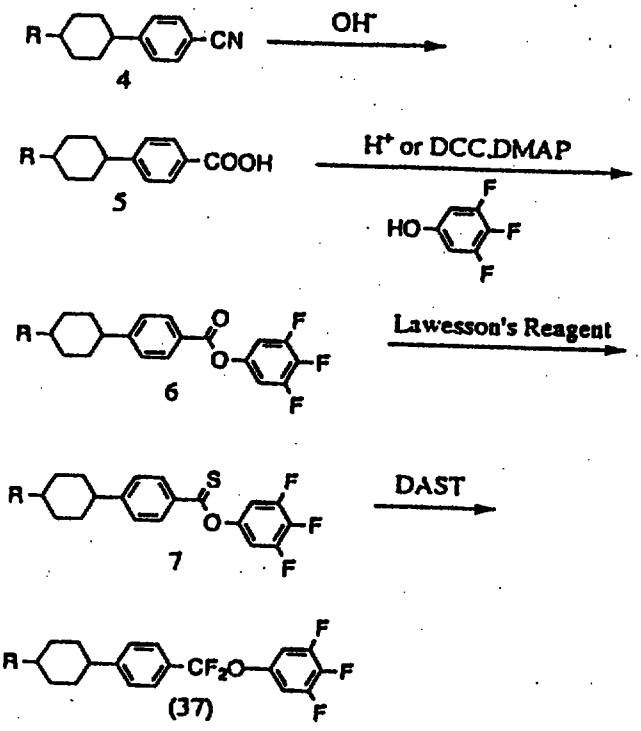
Difluorooxymethane derivatives expressed by the general formula (I), which are the compounds of the present invention, can be preferably prepared by the steps as shown below:

As shown in equation 1 below, benzonitrile expressed by general formula (A) and used as raw material for the preparation is hydrolyzed in an alcohol solvent such as ethyl alcohol, ethylene glycol, and diethylene glycol by using, as catalyst, a base such as sodium hydroxide and potassium hydroxide, or a mineral acid such as hydrochloric acid and sulfuric acid, to lead to a carboxylic acid derivative (B). Then, the carboxylic acid derivative (B) is reacted with a phenol derivative expressed by general formula (C) according to a general esterification method, for instance, by using, as acid catalyst, a mineral acid such as hydrochloric acid and sulfuric acid, an organic acid such as p-toluene sulfonic acid, or an ion exchange resin such as Amberite, or by using N,N'-dicyclohexylcarbodiimide (DCC) as catalyst, to prepare an ester derivative expressed by general formula (D). Also, the derivative of (D) can be prepared by reacting (B) with thionyl chloride to convert into an acid chloride and then reacting with (C) in the presence

of a base such as pyridine. Subsequently, the ester derivative (D) is reacted with Lawesson's reagent [2,4-bis(4-methoxyphenyl) -1,3-dithia-2,4-diphosphetane-2,4-disulfide] (Bull. Soc. Chim. Belg., 87, 223, 229, 299, 525 (1978); Synthesis, 941 (1979); Tetrahedron, 35, 2433 (1979); Tetrahedron, Lett., 21, 4061 (1980)) by using benzene or toluene as solvent at an optional temperature from room temperature to the boiling point of the solvent to lead to a thioester (thione type) derivative (E). Then, the thioester derivative (thione type) (E) is reacted with diethylaminosulfur trifluoride (DAST) (Synthesis, 787 (1973)) by using dichloromethane or chloroform as solvent at an optional temperature from room temperature to the boiling point of the solvent for conducting gem-fluorination to prepare an objective difluorooxymethane derivative.

(38) to (181) can be prepared by using phenol having a different kind of substituent in place of 3,4,5-trifluorophenol, and from several kinds of known benzoic acid derivatives according to the preparation procedures mentioned above.

(Equation 5)



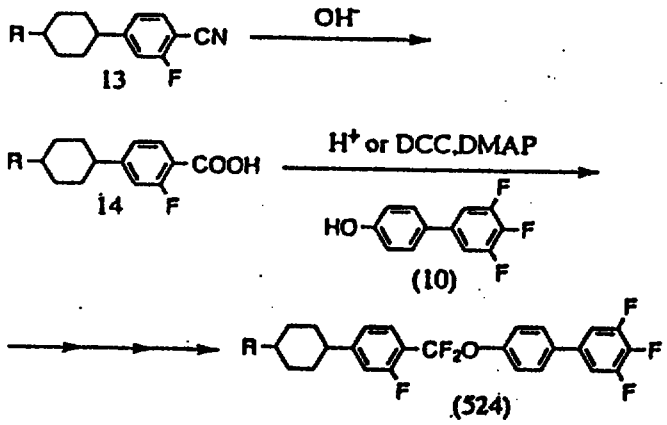
As shown in equation 6 below, compound (242) among the compounds expressed by the general formula (1c) can be prepared by the following method:

That is, 4-iodobenzene is subjected to a coupling reaction with Grignard reagent prepared from 3,4,5-trifluorobromobenzene in the presence of a novel metal catalyst such as palladium chloride to convert into a biphenyl derivative 8 and then

reacted with bromine in the presence of metal powder such as iron powder to prepare a bromobiphenyl derivative 9. Subsequently, Grignard reagent prepared from the derivative 9 is reacted with trimethyl borate according to the report by R. L. Kidwell et al. (Org. Synth., V, 918 (1973)), and then oxidized with hydrogen peroxide in the presence of acetic acid to prepare a phenyl phenol derivative 10. Compound (242) can be prepared by treating the derivative 10 in the same way as in the case of the preparation of compound (7). Further, other compounds (182) to (241) and (243) to (320) expressed by the general formula (1c) can be prepared from phenyl phenol derivatives prepared by using bromobenzene derivatives having a different kind of substituent in place of 3,4,5-trifulorobromobenzene.

As shown in equation 8 below, for example, compound (524) among the compounds expressed by the general formula (1e) can be prepared in the same procedures as mentioned above by using, as raw material for the preparation, 2-fluoro-4-(trans-4-alkylcyclohexyl)benzoic acid 14 which is obtained by hydrolyzing 2-fluoro-4-(trans-4-alkylcyclohexyl)benzonitrile 13, and by using a phenylphenol derivative prepared in the same method as in the case of (1c). Further, other compounds (496) to (523) and (525) to (570) can also be prepared by using a known carboxylic acid derivative and phenol derivative and by selecting the combination of the reaction procedures mentioned above with other known reaction procedures.

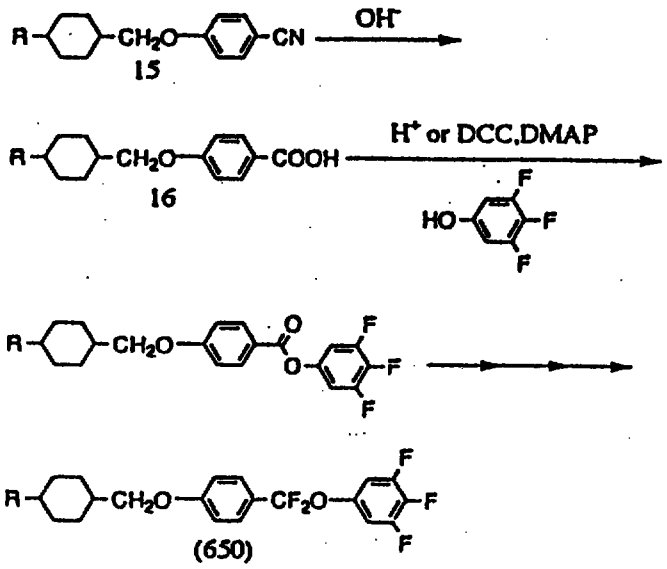
(Equation 8)



As shown in equation 9 below, for example, compound (650) can be prepared in the same method as in the case of (1b) by using, as raw material for the preparation, a carboxylic acid derivative 16 obtained by hydrolyzing (4-alkylcyclohexyl)(4-cyanophenyloxy)methane 15 according to a common method.

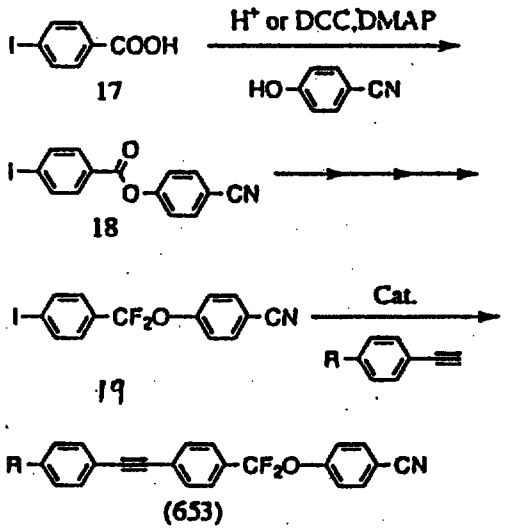
Further, compounds (614) to (649), (651), and (652) can be prepared by using a phenol derivative having a different kind of substituent in place of 3,4,5-trifluorophenol and additionally using a different kind of fluorine substituted (4-alkylcyclohexyl)(4-cyanophenyloxy)methane derivative.

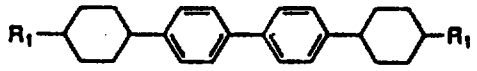
(Equation 9)



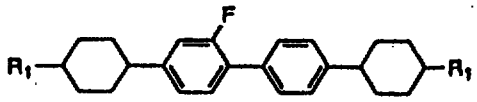
As shown in equation 10 below, for example, compound (653) can be prepared by preparing iodide isomer 19 from 4-iodobenzoic acid 17 and cyanophenol in the same method as in the case of (1a), and further reacting 19 with 4-alkylphenyl acetylene in the presence of a novel metal catalyst such as platinum and palladium. Besides, compounds (654) to (661) can be prepared by using a phenol derivative having a different kind of substituent in place of 4-cyanophenol and using a different kind of known benzoic acid derivative.

(Equation 10)





(N-40)



(N-41)

Compounds of B group mentioned above have a positive value of dielectric anisotropy and have a remarkably excellent thermal stability. Thus, the compounds are useful when liquid crystal compositions for active matrix mode typified by TFT are prepared for which such a characteristic as high voltage holding ratio or large resistivity is particularly required.

While the amount of the B group compounds to be used, when liquid crystal compositions are prepared for TFT, can arbitrarily be selected in a range of 1 to 99 % by weight based on the total weight of the liquid crystal composition, it is preferably 10 to 97 % by weight and more desirably 40 to 95 % by weight.

As the second component of the present invention, the compounds expressed by any one of the general formulas (V) to (IX) (hereinafter, these compounds are referred to as C group) may also be used. As the compounds expressed by any one of the general formulas (V) to (VII) among C group, the following compounds can preferably be mentioned:

fluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-butylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-(3,5-difluoro-4-difluoromethoxyphenyloxy)methane

Difluoro-(2,6-difluoro-4-ethylphenyl)-(3,4,5-trifluorophenyloxy)methane

Difluoro-(2,6-difluoro-4-propylphenyl)-(3,4,5-trifluorophenyloxy)methane

Difluoro-(2,6-difluoro-4-butylphenyl)-(3,4,5-trifluorophenyloxy)methane

Difluoro-(2,6-difluoro-4-pentylphenyl)-(3,4,5-trifluorophenyloxy)methane

Example 2

Preparation of difluoro-[4-(trans-4-propylcyclohexyl)phenyl]-(3,4,5-trifluorophenyloxy)methane (Compound expressed by the formula (I) wherein R = C_3H_7, Q = 1, m and n are 0, ring A_1 is trans-1,4-cyclohexylene group, Z_1, Z_2, and Z_3 are covalent bond, $L_1 = L_2 = H$, $L_3 = L_4 = F$, and X = F)

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 15.0 g (60.9 mmol) of 4-(trans-4-propylcyclohexyl)benzoic acid, 15.1 g (73.1 mmol) of DCC, and 0.3 g (2.2 mmol) of DMAP were dissolved in 250 ml of dichloromethane under nitrogen gas atmosphere, and then 10.8 g (73. mmol) of 3,4,5-trifluorophenol was added dropwise in 3 min while stirring at room temperature. After the dropping, the solution was

stirred for 10 hours at room temperature. Then, 100 ml of water was added to the reaction solution. After dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, the water layer was further extracted with 200 ml of dichloromethane. Extracted layers were mixed and washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 23.8 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using toluene as developing solvent,

In a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 1.8 g (75.8 mmol) of magnesium turnings and 50 ml of diethyl ether were added under nitrogen gas atmosphere and then a solution of 25 g (72.2 mmol) of 2-fuloro-4-(trans-4-propylcyclohexyl)iodobenzene in 50 ml of diethyl ether was added dropwise while stirring under reflux condition in 40 min. Reaction solution was further refluxed on a hot water bath for 1 hour to age. Subsequently, the reaction solution was cooled down with ice to lower than 10°C, 7.5 g (987 mmol) of carbon disulfide was added dropwise while keeping the temperature at lower than 10°C, raised up to room temperature, and then further stirred at room temperature for 3 hours. Reaction solution was cooled again down with ice to lower than 10°C and added dropwise with 50 ml of 2N aqueous solution of hydrochloric acid to terminate the reaction. From the reaction solution, the diethyl ether layer was separated and then the water layer was further extracted with 200 ml of diethyl ether. The organic layers were mixed, washed with 200 ml of water twice, dried over anhydrous magnesium sulfate, and then concentrated to obtain 19.7 g of dark purplish red solid of dithiocarboxylic acid derivative.

Subsequently, in a 300 ml egg-plant type flask provided with a cooling pipe, 19.7 g of dithiocarboxylic acid derivative obtained by the procedures mentioned above was dissolved in 150 ml of diethyl ether, and then 25.8 g (217.0 mmol) of thionyl chloride was added dropwise to the solution while stirring at room temperature in 15 min. After the dropping, reflux was

conducted on a hot water bath for 8 hours. After the reaction solution was heated to distill off diethyl ether, the solution was concentrated under a reduced pressure with an aspirator to obtain 18.4 g of thio acid chloride derivative. Subsequently, in a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 6.4 g (36.1 mmol) of 4-trifluoromethoxyphenol and 5.7 g (72.2 mmol) of pyridine were dissolved in 50 ml of toluene under nitrogen gas atmosphere, added dropwise with 18.4 g of the thio acid chloride derivative obtained by the procedures mentioned above at room temperature while stirring in 20 min. Then, the internal temperature on the hot water bath was heated to 60°C and stirred for 3 hours. After cooled down to room temperature, the reaction solution was added dropwise with 300 ml of water and 30 ml of 2N aqueous solution of hydrochloric acid to terminate the reaction, the toluene layer was separated, and the water layer was further extracted with 200 ml of toluene. The extracted layer was washed with 200 ml × 2 of water, 100 ml of 2N aqueous solution of sodium hydroxide, and 200 ml × 3 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 14.9 g of reddish brown crystalline reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane /toluene mixed solvent as developing solvent, and then recrystallized from heptane to obtain 6.7 g of yellow needle-like crystal product. This product was 2-fluoro-4-(trans-4-

propylcyclohexyl)phenycarbothio

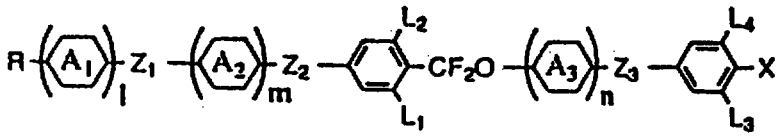
11.7 g (208.9 mmol) of potassium hydroxide were dissolved in 500 ml of ethylene glycol, and the solution was heated while stirring and while keeping internal temperature at 150°C for 10 hours. After cooled down to room temperature, 300 ml of water and 300 ml of 6N aqueous solution of hydrochloric acid were added to the solution, and the precipitated insoluble matter was filtered to separate. Separated precipitate was sufficiently washed with water and then recrystallized from a mixed solvent of toluene-heptane to obtain 16.5 g of colorless crystal product. This product was 4-[trans-4-(3-butenyl)cyclohexyl]benzoic acid. Subsequently, this benzoic acid derivative was reacted with a phenol derivative to esterify. That is, in a 500 ml three neck distillation flask provided with a stirrer, thermometer, dropping funnel, and nitrogen gas introducing pipe, 16.5 g (63.8 mmol) of 4-[trans-4-(3-butenyl)cyclohexyl]benzoic acid obtained by the procedures mentioned above, 15.8 g (76.6 mmol) of DCC, and 0.28 g (2.3 mmol) of DMAP were dissolved in 250 ml of dichloromethane, and then 11.3 g (76.6 mmol) of 3,4,5-trifluorophenol was added dropwise to the solution in 3 min while stirring at room temperature. After the dropping, the solution was stirred at room temperature for 13 hours. Reaction solution was added with 100 ml of water, dichloromethane insoluble matter was filtered off, the dichloromethane layer was separated, and then the water was further extracted with 200 ml of dichloromethane. Extracted layers were mixed, washed with 100 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, and 100 ml × 2 of water in turn, dried

over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 25.1 g of reaction product. Reaction product was purified by a column chromatography using silica gel as filler and using toluene as developing solvent, and further recrystallized from a mixed solvent of heptane-ethanol to obtain 16.6 g of colorless crystal product. This product was 3,4,5-trifluoro- {4-[trans-4-(3-butenyl)cyclohexyl)phenyl} benzoate.

Subsequently, in a 1000 ml egg-plant type flask provided with a nitrogen gas introducing pipe and cooling pipe, 16.6 g (42.8 mmol) of 3,4,5-trifluoro- {4-[trans-4-(3-butenyl)cyclohexyl)phenyl} benzoate obtained by the procedures mentioned above and 34.6 g (85.6 mmol) of Lawesson's reagent were dissolved in 500 ml of toluene, and the solution was refluxed while stirring under nitrogen gas stream for 55 hours. After the reaction solution was cooled down to room temperature, 200 ml of water was added, the toluene layer was separated, and then the water layer was further extracted with 150 ml of toluene. Organic layers were mixed, washed with 200 ml × 2 of water, 100 ml of saturated aqueous solution of sodium hydrogencarbonate, 100 ml of 10 % aqueous solution of sodium hydrogensulfite, and 200 ml × 2 of water in turn, dried over anhydrous magnesium sulfate, and then concentrated under a reduced pressure to obtain 17.6 g of brown crystalline product. Reaction product was purified by a column chromatography using silica gel as filler and using heptane as developing solvent,

Claims:

1. (After amendment) A difluorooxymethane derivative expressed by the general formula (I)



(I)

wherein each of ℓ, m, and n is 0 or 1, rings A_1 and A_2 independently represent trans-1,4-cyclohexylene group, 1,4-phenylene group one or more hydrogen atoms in which six-membered ring may be replaced by halogen atom, trans-1,3-dioxane-2,5-diyl, or pyrimidine-2,5-diyl, ring A_3 represents 1,4-phenylene group one or more hydrogen atoms in which six-membered ring may be replaced by halogen atom, trans-1,3-dioxane-2,5-diyl, or pyrimidine-2,5-diyl, Z_1, Z_2, and Z_3 independently represent a covalent bond, $-CH_2CH_2-$, $-COO-$, $-CF_2O-$, $-OCF_2-$, $-CH_2O-$, $-OCH_2-$, $-CH=CH-$, or $-C\equiv C-$, L_1, L_2, L_3, and L_4 independently represent hydrogen atom or halogen atom, respectively, X is halogen atom, CN, CF_3, OCF_3, $OCHF_2$, OCH_2F, or a linear or branched alkyl group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, and R is a linear or branched alkyl group or alkenyl group having 1 to 10 carbon atoms, one or not adjacent 2 or more CH_2 groups in the R may be replaced by oxygen atom, provided that in no case is X an alkyl group, alkenyl group, or alkoxy group except in the case where Z_1, Z_2, or Z_3 is $-CF_2O-$ or $-OCF_2-$; that in no case all of Z_1, Z_2, and Z_3 are covalent bond, and rings A1, A2, and A3 are 1,4- cyclohexylene group or 1,4-phenylene group which is

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not replaced by a halogen atom in one of the cases where ℓ, m, and n are 0, where ℓ and m are 0, and n is 1, where ℓ and n are 0, and m is 1, and where ℓ and n are 1, and m is 0; that in no case all of L_1, L_2, L_3, and L_4 are hydrogen atom, and X is fluorine atom or CN; that in no case all of Z_1, Z_2, and Z_3 are covalent bond, and rings A_1, A_2, and A_3 are 1,4-cyclohexylene group or 1,4-phenylene group which is not replaced by a halogen atom in one of the cases where ℓ, m, and n are 0, where ℓ and m are 0, and n is 1, and where ℓ and n are 1, and m is 0; and that in no case all of L_1, L_2, L_3, and L_4 are hydrogen atom, and X is CF_3 or OCF_3.

2. The difluorooxymethane derivative according to claim 1 wherein ℓ = 1, m = 0, n is 0 or 1, Z_1 is covalent bond or $-CH_2CH_2-$, both Z_2 and Z_3 are covalent bond, A_1 is trans-1,4-cyclohexylene group, A_3 is 1,4-phenylene group, and R is a linear alkyl group or alkenyl group having 1 to 10 carbon atoms, in the general formula (I).

3. The difluorooxymethane derivative according to claim 1 or 2 wherein at least one of L_3 and L_4 is halogen atom.

4. The difluorooxymethane derivative according to claim 1 wherein ℓ = m = n = 0, and all of Z_1, Z_2, and Z_3 are covalent bond, in the general formula (I).

5. The difluorooxymethane derivative according to claim 1 wherein ℓ = 1, m = n = 0, and both of Z_2 and Z_3 are covalent bond, in the general formula (I).

6. The difluorooxymethane derivative according to any one of claims 1 to 5 wherein all of L_3, L_4, and X are fluorine atom, in

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the general formula (I).

7. The difluorooxymethane derivative according to claim 5 wherein X is OCF_3, in the general formula (I).

8. The difluorooxymethane derivative according to claim 5 wherein X is CN, in the general formula (I).

9. The difluorooxymethane derivative according to claim 1 wherein ℓ = 1, ring A_1 is 1,4-phenylene group one or more hydrogen atom in which 6-membered ring may be replaced by halogen atom, Z_1 is $-OCF_2-$, both of Z_2 and Z_3 are covalent bond, and X is a linear or branched alkyl group, alkenyl group, or alkoxy group having 1 to 10 carbon atoms, in the general formula (I).

10. The difluorooxymethane derivative according to claim 1 wherein ℓ = m = 0, n = 1, both of Z_1 and Z_2 are covalent bond, and ring A_3 is 1,4-phenylene group, in the general formula (I).

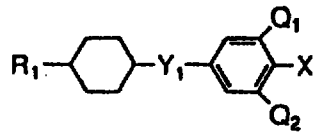
11. The difluorooxymethane derivative according to claim 10 wherein Z_3 is covalent bond, in the general formula (I).

12. The difluorooxymethane derivative according to claim 10 wherein Z_3 is $-CH_2CH_2-$, in the general formula (I).

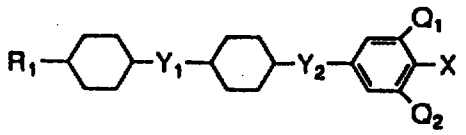
13. A liquid crystal composition containing at least one kind of difluorooxymethane derivative defined in any one of claims 1 to 12.

14. A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative defined in any one of claims 1 to 12 and containing, as a second component, at least one kind of compound selected from the group of compounds expressed by general formula (II), (III), or (IV)

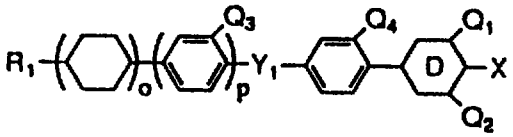
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(II)



(III)

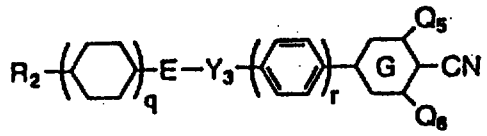


(IV)

wherein R_1 represents an alkyl group having 1 to 10 carbon atoms, X represents F, Cl, CF_3, OCF_3, OCF_2H, or an alkyl group having 1 to 10 carbon atoms, Q_1, Q_2, Q_3, and Q_4 independently represent H or F, o represents 1 or 2, p represents 0 or 1, Y_1 and Y_2 independently represent $-CH_2CH_2-$, -CH=CH-, or covalent bond, and ring D represents trans-1,4-cyclohexylene group or 1,4-phenylene group.

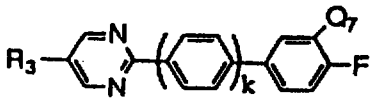
15. A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative defined in any one of claims 1 to 12, containing, as a second component, at least one kind of compound selected from the group of compounds expressed by general formula (V), (VI), (VII), (VIII), or (IX)

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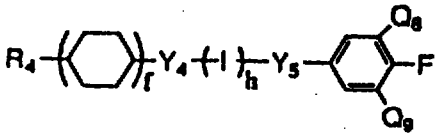
(V)

wherein R_2 represents fluorine atom, an alkyl group having 1 to 10 carbon atoms, or an alkenyl group having 2 to 10 carbon atoms, in any case, one or not adjacent two or more CH_2 groups in the alkyl or alkenyl group may be replaced by oxygen atom, Y_3 represents $-CH_2CH_2-$, -COO-, or covalent bond, Q_5 and Q_6 independently represent hydrogen atom or fluorine atom, E represents trans-1,4-cyclohexylene, 1,4-phenylene, or trans-1,3-dioxane-2,5-diyl, ring G represents trans-1,4-cyclohexylene or 1,4-phenylene, and q and r independently represent 0 or 1,



(VI)

wherein R_3 represents an alkyl group having 1 to 10 carbon atoms, Q_7 represents hydrogen atom or fluorine atom, and k represents 0 or 1,

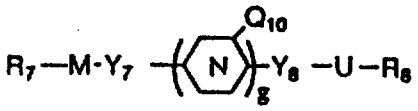


(VII)

wherein R_4 represents an alkyl group having 1 to 10 carbon atoms, I represents trans-1,4-cyclohexylene or 1,4-phenylene, Q_8 and Q_9 represent hydrogen atom or fluorine atom, Y_4 represents -COO- or $-C\equiv C-$, and f and h independently represent 0 or 1,



wherein R_5 and R_6 independently represent an alkyl group, alkoxy group, or alkoxymethyl group having 1 to 10 carbon atoms, J represents trans-1,4-cyclohexylene, 1,3-pyrimidine-2,5-diyl, or 1,4-phenylene, K represents trans-1,4-cyclohexylene or 1,4-phenylene, Y_6 represents $-C\equiv C-$, $-COO-$, $-CH_2CH_2-$, or covalent bond,



(IX)

wherein R_7 represents an alkyl group or alkoxy group having 1 to 10 carbon atoms, R_8 represents an alkyl group having 1 to 10 carbon atoms, one or not adjacent two or more CH_2 groups in which alkyl group may be replaced by oxygen atom, M represents trans-1,4-cyclohexylene or 1,3-pyrimidine-2,5-diyl, rings N and U independently represent trans-1,4-cyclohexylene or 1,4-phenylene, Y_7 represents $-CH_2CH_2-$, $-COO-$, or covalent bond, Y_8 represents $-C\equiv C-$, $-COO-$, or covalent bond, g represents 0 or 1, and Q_{10} represents hydrogen atom or fluorine atom.

16. A liquid crystal composition containing, as a first component, at least one kind of difluorooxymethane derivative defined in any one of claims 1 to 12, containing, as a part of the second component, at least one kind of compound selected from a group of compounds expressed by the general formula (II), (III), or (IV), and containing, as other part of the second component, at least one compound selected from a group of compounds expressed by the general formula (V), (VI), (VII), (VIII), or (IX).

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17. A liquid crystal display device composed by using a liquid crystal composition defined in any one of claims 13 to 16.

* C L M S *

T. Kawakita