Patent Claims

1. A compound of formula I

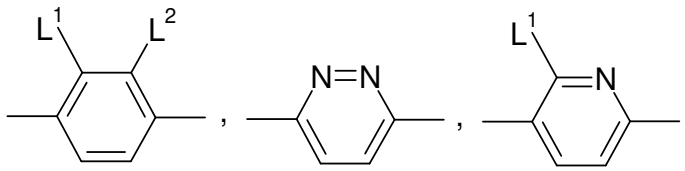
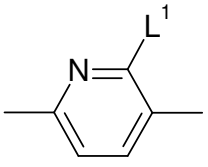
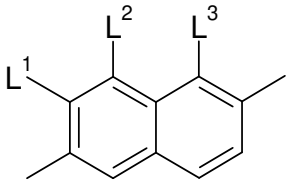
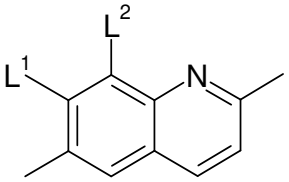
$$D^1\text{-}Z^D\text{-}(A^1\text{-}Z^1)_r\text{-}B^1\text{-}(Z^2\text{-}A^2)_s\text{-}Sp\text{-}G \qquad (I)$$

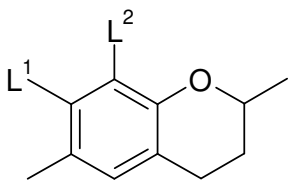
in which

D^1 denotes a diamondoid radical,

A^1, A^2 on each occurrence, identically or differently, denote an aromatic, heteroaromatic, alicyclic or heteroaliphatic ring having 4 to 25 ring atoms, which may also contain condensed rings and which may be mono- or polysubstituted by Y,

Y on each occurrence, identically or differently, denotes F, Cl, CN, SCN, SF_5 or straight-chain or branched, in each case optionally fluorinated alkyl, alkoxy, alkylcarbonyl, alkoxycarbonyl, alkylcarbonyloxy or alkoxycarbonyloxy having 1 to 12 C atoms,

B^1 denotes , , , , , ,



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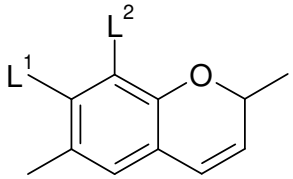

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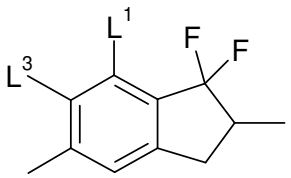

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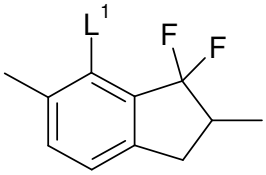

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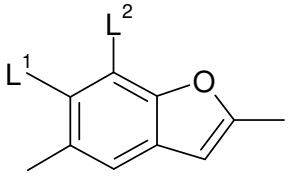

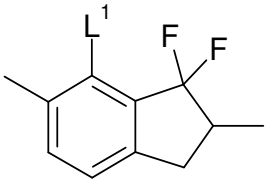

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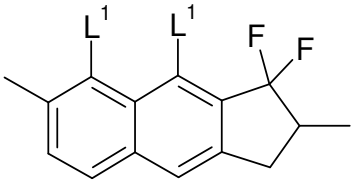

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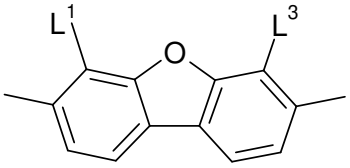

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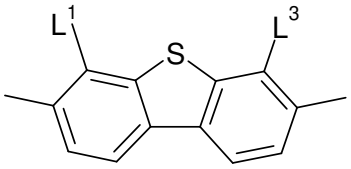

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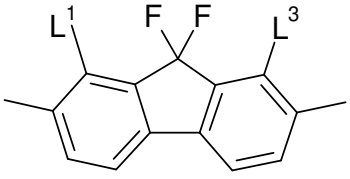

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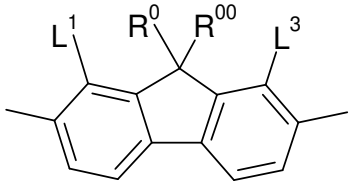

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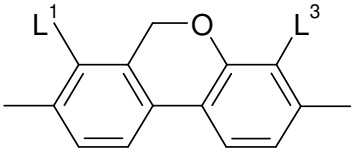

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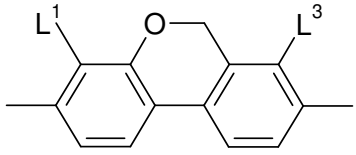

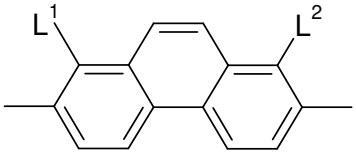

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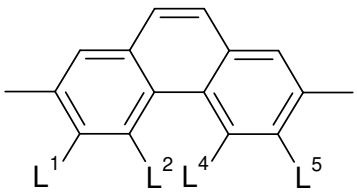


where the groups may be oriented in both directions,

L^1 to L^5, independently of one another, denote F, Cl, Br, I, CN, SF_5, CF_3 or OCF_3, preferably Cl or F, where L^3 may alternatively also denote H,

Z^1, Z^2 on each occurrence, identically or differently, denote a single bond, $-CF_2O-$, $-OCF_2-$, $-CF_2S-$, $-SCF_2-$, $-CH_2O-$, $-OCH_2-$, $-C(O)O-$, $-OC(O)-$, $-C(O)S-$, $-SC(O)-$, $-(CH_2)_{n1}-$, $-(CF_2)_{n2}-$, $-CF_2-CH_2-$, $-CH_2-CF_2-$, $-CH=CH-$, $-CF=CF-$, $-CF=CH-$, $-CH=CF-$, $-(CH_2)_{n3}O-$, $-O(CH_2)_{n4}-$, $-C\equiv C-$, $-O-$, $-S-$, $-CH=N-$, $-N=CH-$, $-N=N-$, $-N=N(O)-$, $-N(O)=N-$ or $-N=C-C=N-$,

n1, n2, n3, n4 identically or differently, are 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10,

Sp denotes Sp'-X'or a single bond, wherein:

Sp' denotes straight-chain or branched alkylene having 1 to 20, preferably 1 to 12 C atoms, which is optionally mono- or polysubstituted by F, Cl, Br, I or CN and in which, in addition, one or more non-adjacent CH_2 groups may each be replaced, independently of one another, by -O-, -S-, -NH-, $-NR^0-$, $-SiR^{00}R^{000}-$, -CO-, -COO-, -OCO-, -OCO-O-, -S-CO-, -CO-S-, $-NR^0-CO-O-$, $-O-CO-NR^0-$, $-NR^0-CO-NR^0-$, -CH=CH- or $-C\equiv C-$ in such a way that O and/or S atoms are not linked directly to one another,

X' denotes -O-, -S-, -CO-, -COO-, -OCO-, -O-COO-, $-CO-NR^{00}-$,

$-NR^{00}-CO-$, $-NR^{00}-CO-NR^{00}-$, $-OCH_2-$, $-CH_2O-$, $-SCH_2-$, $-CH_2S-$,
$-CF_2O-$, $-OCF_2-$, $-CF_2S-$, $-SCF_2-$, $-CF_2CH_2-$, $-CH_2CF_2-$, $-CF_2CF_2-$,
$-CH=N-$, $-N=CH-$, $-N=N-$, $-CH=CR^{00}-$, $-CY^x=CY^{x'}-$, $-C\equiv C-$,
-CH=CH-COO-, -OCO-CH=CH- or a single bond,

R^0, R^{00} and R^{000} each, independently of one another, denote H or alkyl having 1 to 12 C atoms, and

Y^x and $Y^{x'}$ each, independently of one another, denote H, F, Cl or CN,

Z^D has one of the meanings of Z^1 and Z^2 or of Sp,

G denotes $-CH=CH_2$, -OH, $-CH(CH_2OH)_2$, $-C(CH_2OH)_3$, -SH, $-SO_2OH$, $-OP(O)(OH)_2$, $-PO(OH)_2$, $-C(OH)(PO(OH)_2)_2$, -COOH, $-B(OH)_2$, $-Si(OR^x)_3$ or $-SiCl_3$, $-SO_2OR^V$, $-OP(O)(OR^V)_2$, $-PO(OR^V)_2$, $-C(OH)(PO(OR^V)_2)_2$, $-COOR^V$, $-Si(OR^V)_3$,

R^V denotes straight-chain or branched alkyl having 1 to 20 C atoms,

R^x denotes straight-chain or branched alkyl having 1 to 6 C atoms, and

r and s, independently of one another, denote 0, 1, 2 or 3,

where $r + s \leq 4$,

with the proviso that if Sp denotes a single bond, Z^2 is not O, S, CH_2 or CF_2.

2. The compound according to claim 1, wherein the radical D^1 is selected from the group consisting of adamantyl, diamantyl and triamantyl, in each of which one or more H atoms can be replaced by F or in each case optionally fluorinated alkyl, alkenyl or alkoxy having up to 12 C atoms.

3. The compound according to claim 1 or 2, wherein A^1 and A^2, on each occurrence, identically or differently are selected from the following groups:

a) 1,4-phenylene, in which one or two CH groups may be replaced by N and in which, in addition, one or more H atoms may be replaced by Y,

b) the group consisting of trans-1,4-cyclohexylene and 1,4-cyclohexenylene, in which one or more non-adjacent CH_2 groups may be replaced by -O- and/or -S- and in which, in addition, one or more H atoms may be replaced by Y, and

c) the group consisting of 1,3-dioxolane-2,4-diyl, tetrahydrofuran-2,5-diyl, cyclobutane-1,3-diyl, 1,4-bicyclo[2.2.2]octanediyl, piperidine-1,5-diyl and thiophene-2,5-diyl, in which one or more H atoms may be replaced by Y,

where Y has the meanings given in claim 1.

4. The compound according to one or more of claims 1 to 3, wherein the group Sp denotes Sp'-X', so that the radical G-Sp- denotes G-Sp'-X'-,

in which

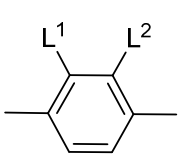
Sp' denotes straight-chain or branched alkylene having 1 to 20, preferably 1 to 12 C atoms, which is optionally mono- or polysubstituted by F, Cl, Br, I or CN and in which, in addition, one or more non-adjacent CH_2 groups may each be replaced, independently of one another, by -O-, -S-, -NH-, $-NR^0-$,$-SiR^{00}R^{000}-$, -CO-, -COO-, -OCO-, -OCO-O-, -S-CO-, -CO-S-, $-NR^0$-CO-O-, -O-CO-NR^0-, $-NR^0$-CO-NR^0-, -CH=CH- or -C≡C- in such a way that O and/or S atoms are not linked directly to one another,

X' denotes -O-, -S-, -CO-, -COO-, -OCO-, -O-COO-, -CO-NR^{00}-, $-NR^{00}$-CO-, $-NR^{00}$-CO-NR^{00}-, $-OCH_2-$, $-CH_2O-$, $-SCH_2-$, $-CH_2S-$, $-CF_2O-$, $-OCF_2-$, $-CF_2S-$, $-SCF_2-$, $-CF_2CH_2-$, $-CH_2CF_2-$, $-CF_2CF_2-$, -CH=N-, -N=CH-, -N=N-, $-CH=CR^{00}-$, $-CY^x=CY^{x'}-$, -C≡C-, -CH=CH-COO-, -OCO-CH=CH- or a single bond,

R^0, R^{00} and R^{000} each, independently of one another, denote H or alkyl having 1 to 12 C atoms, and

Y^x and $Y^{x'}$ each, independently of one another, denote H, F, Cl or CN.

5. The compound according to one or more of claims 1 to 4, wherein B^1 denotes



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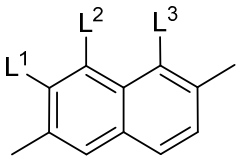

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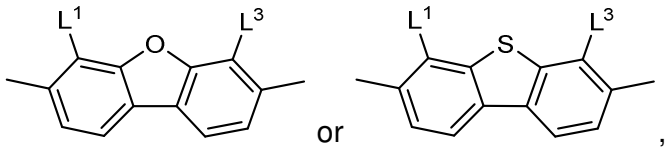

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L^1 and L^2, independently of one another, denote Cl or F, where at least one of the radicals L^1 and L^2 denotes F, and

L^3 denotes F.

6. The compound according to one or more of claims 1 to 5, wherein G denotes $-P(O)(OH)_2$, $-OP(O)(OH)_2$ or $-C(OH)(PO(OH)_2)_2$.

7. The compound according to one or more of claims 1 to 6, wherein Z^D denotes a single bond, -C≡C-, -C(O)O-, -OC(O)-, $-OCH_2-$, $-CH_2O-$, $-CH_2CH_2-$, $-CH_2CH_2CH_2-$, or $-CH_2CH_2CH_2CH_2-$.

8. A Process for the production of a switching element comprising at least the following steps:
a) production of a first electrode with a surface,
b) deposition of a molecular layer comprising one or more compounds of the formula I according to claim 1 onto the surface of the first electrode, and
c) application of a second electrode.

9. The process according to claim 8, wherein the first electrode comprises a material selected from the element semiconductors Si, Ge, C, Sn and Se, the compound semiconductors GaAs, InAs, InP, GaSb, TaN, TiN, MoN, WN and GaN, CdSe and ZnS, the metals Au, Ag, Cu, Al, W, Ta, Ti, Co, Mo, Pt, Ru and Mg and the conductive oxidic materials ITO, IGO, IGZO, AZO and FTO.

10. A switching element comprising a molecular layer sandwiched between a first electrode and a second electrode, obtainable by the process according to claim 8.

11. The switching element according to claim 10, wherein the molecular layer is a self assembled monolayer.

12. Memristive device comprising a switching element according to claim 10 or 11.