Claims:

1. Marking for an item or article, said marking comprising polymeric liquid crystal material having determined optical characteristics which allow for its authentication and reading by a machine, as well as its authentication by the human eye, the marking being characterized in that it is obtainable by independently applying a cholesteric liquid crystal precursor composition to a substrate by a variable information printing process, applying heat to both evaporate the solvent contained in the liquid crystal precursor composition and promote the liquid crystal state, and hardening the applied composition in the ordered liquid crystal state, said marking having the form of indicia representing a unique code, allowing for its identification.

~~2. Marking according to claim 1, wherein the precursor composition comprises UV-curable reactive monomers or oligomers, and the hardening of the applied composition takes place by UV-curing.~~

~~3. Marking according to claims 1 to 2, characterized in that at least part of the marking is invisible to the unaided human eye.~~

~~4. Marking according to one of the claims 1 to 3, wherein said polymeric liquid crystal material is a cholesteric liquid crystal material, exhibiting color and an angle-dependent change of color.~~

~~52~~. Marking according to claim ~~41~~, wherein the cholesteric liquid crystal material has a reflection band in the UV spectrum corresponding to the 200 to 400nm wavelength range.

~~63~~. Marking according to claim ~~41~~, wherein the cholesteric liquid crystal material has a reflection band in the visible spectrum corresponding to the 400 to 700nm wavelength range.

~~74~~. Marking according to claim ~~41~~, wherein the cholesteric liquid crystal material has a reflection band in the infrared spectrum corresponding to the 700 to 2500nm wavelength range, preferably in the infrared spectrum corresponding to the 700 to 1100nm wavelength range.

~~8. Marking according to one of the claims 5 to 7, wherein the cholesteric liquid crystal material has a second reflection band in the 200 to 2500nm wavelength range.~~

~~9. Marking according to one of the claims 1 to 3, wherein said polymeric liquid crystal material is a nematic liquid crystal material, exhibiting optical birefringence.~~

~~105~~. Marking according to any one of the claims 1 to ~~94~~, wherein said polymeric liquid crystal material comprises further security materials, selected from the group consisting of the inorganic luminescent compounds, the organic luminescent compounds, the IR-absorbers, the magnetic materials, and the forensic markers, and the combinations thereof.

~~11. Marking according to one of the claims 1 to 10, wherein~~

~~said substrate is selected from the group of reflecting substrates, colored substrates, and transparent substrates.~~

~~126~~. Marking according to any one of the claims 1 to ~~105~~, wherein said substrate is a patterned substrate, comprising at least two different surface areas, each selected from the group of white surface areas, black surface areas, colored surface areas, reflecting surface areas, transparent surface areas and combinations thereof.

~~13. Marking according to one of the claims 1 to 10, wherein said substrate carries indicia.~~

~~147~~. Marking according to any one of the claims 1 to ~~106~~, wherein said substrate carries at least one security element, selected from the group consisting of the inorganic luminescent compounds, the organic luminescent compounds, the IR-absorbers, the magnetic materials, the forensic markers and combinations thereof.

~~15. Marking according to claim 14, wherein said security element is present in the form of indicia.~~

~~16. Marking according to one of the claims 1 to 15, wherein said substrate is selected from the group consisting of the woven substrates, the non-woven substrates, the coated substrates, the papers, the cardboards, the wooden substrates, the glass substrates, the ceramic substrates, the metal substrates, the plastic substrates, the textiles, and the leathers.~~

~~178~~. Marking according to any one of the claims 1 to ~~167~~, wherein the variable information printing process is ~~said marking is obtainable by a process~~ selected from the

group of continuous ink-jet printing, and drop-on-demand ink-jet printing~~, and laser printing~~.

~~18~~9. Marking according to any one of the claims 1 to ~~17~~8, wherein said indicia representing a unique code are chosen from the group of: 1-dimensional barcodes, stacked 1-dimensional barcodes, and 2-dimensional barcodes.

~~19. Marking according to claim 18, wherein said 1-dimensional barcode is selected from the group of Plessey, U. P. C, Codabar, Code 25 – Non-interleaved 2 of 5, Code 25 – Interleaved 2 of 5, Code 39, Code 93, Code 128, Code 128A, Code 128B, Code 128C, Code 11, CPC Binary, DUN 14, EAN 2, EAN 5, EAN 8, EAN 13, GS1-128 (formerly known as UCC/EAN – 128), EAN 128, UCC 128, GS1 DataBar formerly Reduced Space Symbology (RSS), ITF-14, Pharmacode, PLANET, POSTNET, OneCode, MSI, PostBar, RM4SCC / KIX, or Telepen.~~

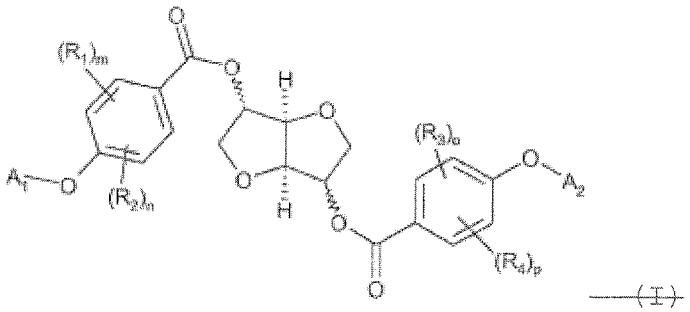
~~20. Marking according to claim 18, wherein said 2-dimensional barcode is selected from the group of 3-DI, ArrayTag, Aztec Code, Small Aztec Code, bCODE, Bullseye, Codablock, Code 1, Code, 16K, Code 49, Color code, CP Code, DataGlyphs, Datamatrix, Datastrip Code, Dot Code A, EZcode, High Capacity Color Barcode, HueCode, INTACTA.CODE, InterCode, MaxiCode, mCode, MiniCode, PDF417, Micro PDF417, PDMark, PaperDisk, Optar, QR Code, Semacode, SmartCode, Snowflake Code, ShotCode, SuperCode, Trillcode, UltraCode, VeriCode, VSCode, WaterCode, and ECC200.~~

~~21~~10. Marking according to any one of the claims 1 to ~~20~~9, wherein the polymeric liquid crystal material is present in the form of pigment flakes comprised in a suitable binder~~.~~,

~~22. Marking according to claim 21,~~ wherein the binder is chosen from the group consisting of the vinylic resins, the acrylic resins, the styrene-maleic anhydride copolymer resins, the polyacetal resins, the polyester resins, the fatty acid modified polyester resins and the mixtures thereof.

~~23. Marking according to claim 21, wherein the binder is chosen from the group consisting of the UV-cure-able monomers and oligomers of acrylates, vinyl ethers, epoxides and combinations thereof.~~

~~24. Marking according to any one of the preceding claims, wherein said polymeric liquid crystal composition is obtainable in the presence of a chiral dopant according to formula (I)~~



~~(I)~~

~~wherein~~

~~R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl, C_1-C_6 alkoxy,~~

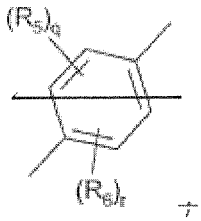
~~A_1 and A_2 denote each independently a group:~~

~~i) $[(CH_2)_y-O]_z-C(O)-CH=CH_2$,~~

ii) C(O) D_1 O [$(CH_2)_y$ O]z C(O) CH=CH_2;

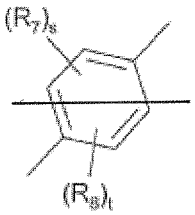
iii) C(O) D_2 O [$(CH_2)_y$ O]z C(O) CH=CH_2;

D_1 denotes a group



;

D_2 denotes a group

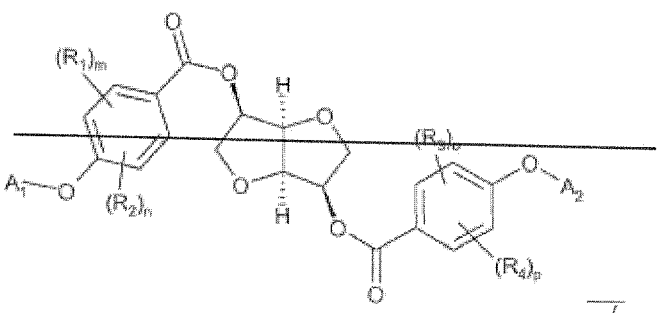


m, n, o, p, q, r, s, and t denote each independently 0, 1, 2;

y denotes 0,1,2,3,4,5,6;

z equal 0 if y equal 0 and z equal 1 if y equal 1 to 6.

25. Marking according to claim 24, wherein said polymeric liquid crystal composition is obtainable in the presence of a chiral dopant according to formula (IA)



.

(IA)

wherein

R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl, C_1-C_6 alkoxy;

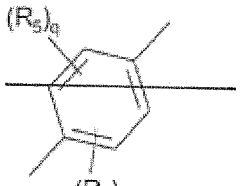
A_1 and A_2 denote each independently a group:

i) $[(CH_2)y\text{-}O]z\text{-}C(O)\text{-}CH{=}CH_2$;

ii) $C(O)\text{-}D_1\text{-}O\text{-}[(CH_2)y\text{-}O]z\text{-}C(O)\text{-}CH{=}CH_2$;

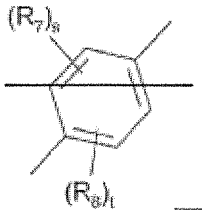
iii) $C(O)\text{-}D_2\text{-}O\text{-}[(CH_2)y\text{-}O]z\text{-}C(O)\text{-}CH{=}CH_2$;

D_1 denotes a group



;

D_2 denotes a group



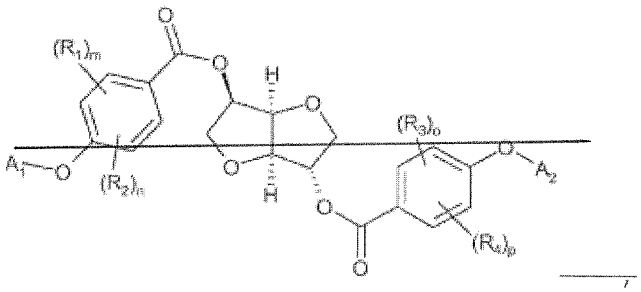
;

m, n, o, p, q, r, s, and t denote each independently 0, 1, 2;

y denotes 0,1,2,3,4,5,6;

z equal 0 if y equal 0 and z equal 1 if y equal 1 to 6.

26. Marking according to claim 24, wherein said polymeric liquid crystal composition is obtainable in the presence of a chiral dopant according to formula (IB)



(IB)

wherein

R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl, C_1-C_6 alkoxy;

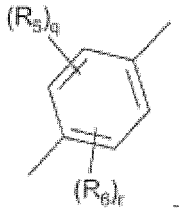
A_1 and A_2 denote each independently a group:

i) $-[(CH_2)y-O]z-C(O)-CH=CH_2$;

ii) $-C(O)-D_1-O-[(CH_2)y-O]z-C(O)-CH=CH_2$;

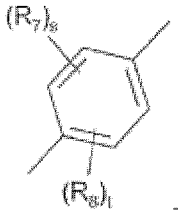
iii) $-C(O)-D_2-O-[(CH_2)y-O]z-C(O)-CH=CH_2$;

D_1 denotes a group



;

D_2 denotes a group



;

m, n, o, p, q, r, s, and t denote each independently 0, 1, 2;

~~y denotes 0,1,2,3,4,5,6;~~

~~z equal 0 if y equal 0 and z equal 1 if y equal 1 to 6.~~

~~27. Marking according to claim 25 and/or 26, wherein R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl.~~

~~28. Marking according to claim 25 and/or 26, wherein R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkoxy.~~

~~29. Marking according to claim 25 and/or 26, wherein A_1 and A_2 denote each independently i) $-[(CH_2)y-O]z-C(O)-CH=CH_2$; R_1, R_2, R_3 and R_4 denote each independently C_1-C_6 alkyl or C_1-C_6 alkoxy; and m, n, o, and p denote each independently 0, 1, 2.~~

~~30. Marking according to claim 25 and/or 26, wherein A_1 and A_2 denote each independently ii) $-C(O)-D_1-O-[(CH_2)y-O]z-C(O)-CH=CH_2$ and/or iii) $-C(O)-D_2-O-[(CH_2)y-O]z-C(O)-CH=CH_2$; and R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl or C_1-C_6 alkoxy.~~

~~31. Marking according to the claims 25 and/or 26, wherein the alkyl or alkoxy group of R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 may comprise 4 or 6 carbon atoms.~~

~~32~~11. Item or article carrying at least one marking according to ~~one of the~~ claims 1 to ~~31~~10~~.~~,

~~33. Item or article according to claim 32,~~ wherein said item or article is chosen from the group of value documents, banknotes, passports, identity documents, driving licenses, official permissions, access documents, stamps, tax stamps and banderoles, transportation tickets, event tickets,

labels, foils, packaging, spare parts, and consumer goods.

~~34~~12. Use of a marking according to one of the claims 1 to ~~31~~ 10 for tracking or tracing an item or article~~.~~,

~~35. Use according to claim 34,~~ wherein said item or article is chosen from the group of value documents, banknotes, passports, identity documents, driving licenses, official permissions, access documents, stamps, tax stamps and banderoles, transportation tickets, event tickets, labels, foils, packaging, spare parts, and consumer goods.

~~36. Method for marking an item or article, said method comprising the steps of~~

~~a) providing an item or article to be marked;~~

~~b) applying at least one marking according to one of the claims 1 to 31 onto the said item or article in the form of indicia.~~

~~37. Method according to claim 36, wherein the unique code represented by the indicia is encrypted information, the method comprising the step of encrypting said information.~~

~~38. Method for authenticating an item or article, said method comprising the steps of~~

~~a) providing an item or article carrying a marking according to one of the claims 1 to 31;~~

~~b) illuminating the marking on said article or item with at least one quality of light from at least one light source;~~

~~c) detecting the said marking's determined optical characteristics through the sensing of light reflected by the marking;~~

d) determining the item's or article's authenticity from the detected optical characteristics of the marking.

39. Method according to claim 38, wherein the marking comprises a cholesteric liquid crystal material, exhibiting spectrally selective, viewing angle dependent light reflection, the reflected light having a particular sense of circular polarization.

40. Method according to one of claims 38 to 39, wherein said light source is a spectrally selective light source.

41. Method according to claim 40, wherein said light source is chosen from the group of ambient light, incandescent light, laser diodes, light emitting diodes, and the light sources having color filters.

42. Method according to one of claims 38 to 41, wherein the light source is chosen to emit in a spectral domain of the group consisting of the visible (400-700nm wavelength), the near optical infrared (700-1100nm wavelength), the far optical infrared (1100-2500nm wavelength) and the UV (200--400nm wavelength) region of the electromagnetic spectrum.

43. Method according to one of claims 38 to 42, wherein said illuminating is performed by a light source chosen from the group consisting of the unpolarized, linear polarized, left circular polarized, and right circular polarized light sources.

44. Method according to one of claims 38 to 43, wherein at least two different said light sources are used in

~~conjunction.~~

~~45. Method according to one of claim 38 to 44, wherein said detecting is performed using at least one optical filter chosen from the group consisting of the linear polarizing, left circular polarizing, right circular polarizing filters and the electro-optic polarization switches.~~

~~46. Method according to claim 45, wherein said optical filter is combined with a color filter.~~

~~47. Method according to one of claims 45 to 46, wherein at least two different said optical filters are used in conjunction.~~

~~48. Method according to one of claims 38 to 47, wherein said detecting is performed by eye.~~

~~49. Method according to one of claims 38 to 47, wherein said detecting is performed by an electro-optic detection equipment.~~

~~50. Method according to claim 49, wherein said electro-optic detecting equipment is chosen from the group consisting of the photocells, linear CCD image sensor arrays, 2-dimensional CCD image sensor arrays, linear CMOS image sensor arrays, 2-dimensional CMOS image sensor arrays.~~

~~51~~13. Method for identifying an item or article according to claim 11, said method comprising the steps of

a) providing an item or article carrying a marking according to ~~one of the~~ claims 1 to ~~31~~10;

b) illuminating the marking on said article or item

with at least one quality of light from at least one light source;

c) reading the indicia represented by the marking, deriving corresponding information;

d) correlating the information retrieved from the indicia of the marking with information stored in a data base;

e) obtaining confirmation or denial concerning the item's or article's identity.

~~52. Method according to claim 51, comprising the further step of authenticating said item or article using the method according to one of claims 38 to 50.~~

~~53~~14. Method according to ~~one of~~ claim~~s~~ 13~~51 to 52~~, wherein the indicia are read with the help of an electro-optic image sensor array.

~~54. Method according to claims 53 wherein the electro-optic image sensor array is chosen from the group consisting of the linear CCD image sensor arrays, 2-dimensional CCD image sensor arrays, linear CMOS image sensor arrays, and 2-dimensional CMOS image sensor arrays.~~

~~55~~15. Method according to ~~one of~~ claim~~s~~ ~~51 to 54~~13 or 14, wherein information about the item or article is stored in the database.

~~56. Method according to one of claims 51 to 55, wherein the information exchange with the database takes place in encrypted form.~~

~~57. Method according to one of claims 51 to 56, wherein the~~

~~unique code represented by the indicia of the marking is encrypted information, the method comprising the step of decrypting said information.~~

~~58~~16. Method for the secure tracking or tracing of an item or article according to claim 11, using a marking according to ~~one of the~~ claim~~s~~ 1 to ~~3~~10, comprising the first commutable steps of

a) applying a said marking to the item or article according to ~~one of the~~ claim~~s~~ ~~36 to 37~~11;

b) storing information related to the marked item or article in a data base;

and the second commutable steps of

c) authenticating the item or article ~~according to one of the claims 38 to 50~~;

d) identifying the item or article, ~~according to one of the claims 51 to 57,~~ using the information stored in the data base;

and the optional step of

e) updating the data base with new information elements related to the item or article.

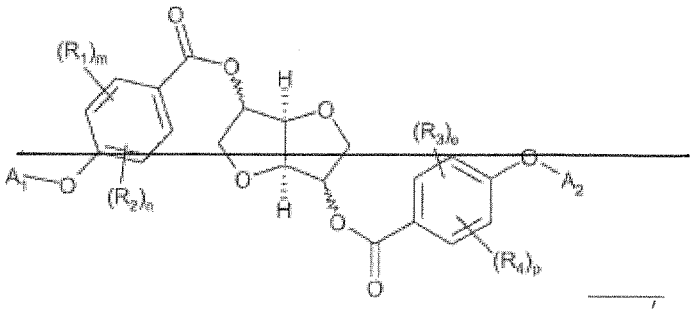
~~59~~17. Method according to claim ~~58~~13 to 16, wherein said item or article is chosen from the group of value documents, banknotes, passports, identity documents, driving licenses, official permissions, access documents, stamps, tax stamps and banderoles, transportation tickets, event tickets, labels, foils, packaging, pharmaceutical products, spare parts, and consumer goods.

~~60. Intermediate in the liquid crystal state obtainable by independently applying a liquid crystal precursor composition to a substrate by a variable information printing process and applying heat to both evaporate the~~

~~solvent contained in the liquid crystal precursor composition and promote the liquid crystal state.~~

~~61. Intermediate according to claim 60 comprising a chiral dopant according to formula (I).~~

~~62. A chiral dopant according to formula (I)~~



~~(I)~~

~~wherein~~

~~R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl, C_1-C_6 alkoxy;~~

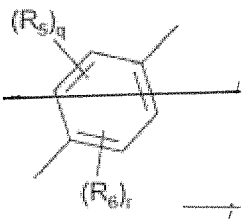
~~A_1 and A_2 denote each independently a group:~~

~~i) $-[(CH_2)y-O]z-C(O)-CH=CH_2$;~~

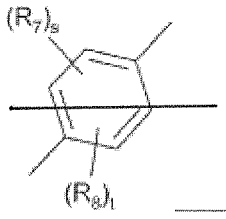
~~ii) $-C(O)-D_1-O-[(CH_2)y-O]z-C(O)-CH=CH_2$;~~

~~iii) $-C(O)-D_2-O-[(CH_2)y-O]z-C(O)-CH=CH_2$;~~

~~D_1 denotes a group~~



~~D_2 denotes a group~~

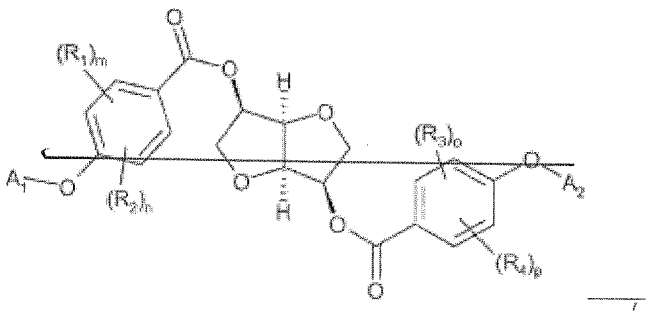


m, n, o, p, q, r, s, and t denote each independently 0, 1, 2,

y denotes 0,1,2,3,4,5,6,

z equal 0 if y equal 0 and z equal 1 if y equal 1 to 6.

63. A chiral dopant according to formula (IA)



(IA)

wherein

R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl, C_1-C_6 alkoxy,

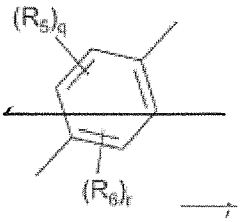
A_1 and A_2 denote each independently a group:

i) $-[(CH_2)y-O]z-C(O)-CH=CH_2$,

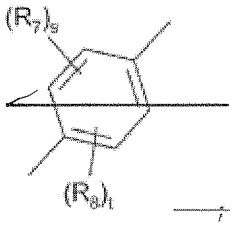
ii) $-C(O)-D_1-O-[(CH_2)y-O]z-C(O)-CH=CH_2$,

iii) $-C(O)-D_2-O-[(CH_2)y-O]z-C(O)-CH=CH_2$,

D_1 denotes a group



~~D_2 denotes a group~~

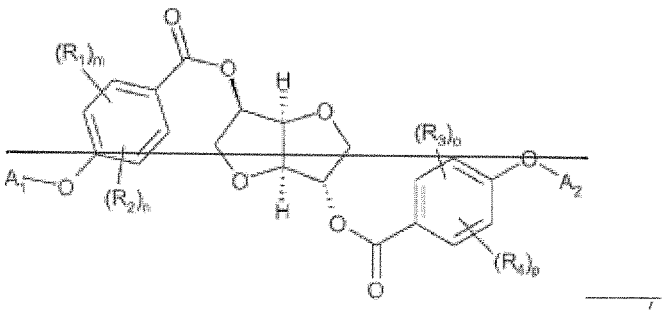


~~m, n, o, p, q, r, s, and t denote each independently 0, 1, 2;~~

~~y denotes 0,1,2,3,4,5,6;~~

~~z equal 0 if y equal 0 and z equal 1 if y equal 1 to 6.~~

~~64. A chiral dopant according to formula (IB)~~



~~(IB)~~

~~wherein~~

~~R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl, C_1-C_6 alkoxy;~~

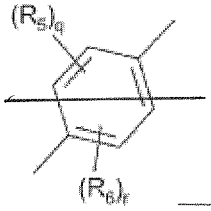
~~A_1 and A_2 denote each independently a group:~~

i) $[(CH_2)y\text{-}O]z\text{-}C(O)\text{-}CH=CH_2$;

ii) $C(O)\text{-}D_1\text{-}O\text{-}[(CH_2)y\text{-}O]z\text{-}C(O)\text{-}CH=CH_2$;

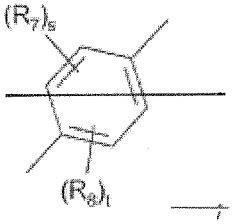
iii) $C(O)\text{-}D_2\text{-}O\text{-}[(CH_2)y\text{-}O]z\text{-}C(O)\text{-}CH=CH_2$;

D_1 denotes a group



,

D_2 denotes a group



,

m, n, o, p, q, r, s, and t denote each independently 0, 1, 2;

y denotes 0,1,2,3,4,5,6;

z equal 0 if y equal 0 and z equal 1 if y equal 1 to 6.

65. A chiral dopant according to claim 63 or 64, wherein R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl.

66. A chiral dopant according to claim 63 or 64, wherein R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkoxy.

67. A chiral dopant according to claim 63 or 64, wherein A_1 and A_2 denote each independently i) $[(CH_2)y\text{-}O]z\text{-}C(O)\text{-}CH=CH_2$; R_1,

~~R_2, R_3 and R_4 denote each independently C_1-C_6 alkyl or C_1-C_6 alkoxy; and m, n, o, and p denote each independently 0, 1, 2.~~

~~68. A chiral dopant according to claim 63 or 64, wherein A_1 and A_2 denote each independently ii) —C(O)-D_1-O-[$(CH_2)_y$-O]z-C(O)-$CH=CH_2$ and/or iii) —C(O)-D_2-O-[$(CH_2)_y$-O]z-C(O)-$CH=CH_2$; and R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 denote each independently C_1-C_6 alkyl or C_1-C_6 alkoxy.~~

~~69. A chiral dopant according to claim 63 or 64, wherein the alkyl or alkoxy group of R_1, R_2, R_3, R_4, R_5, R_6, R_7 and R_8 may comprise 4 or 6 carbon atoms.~~