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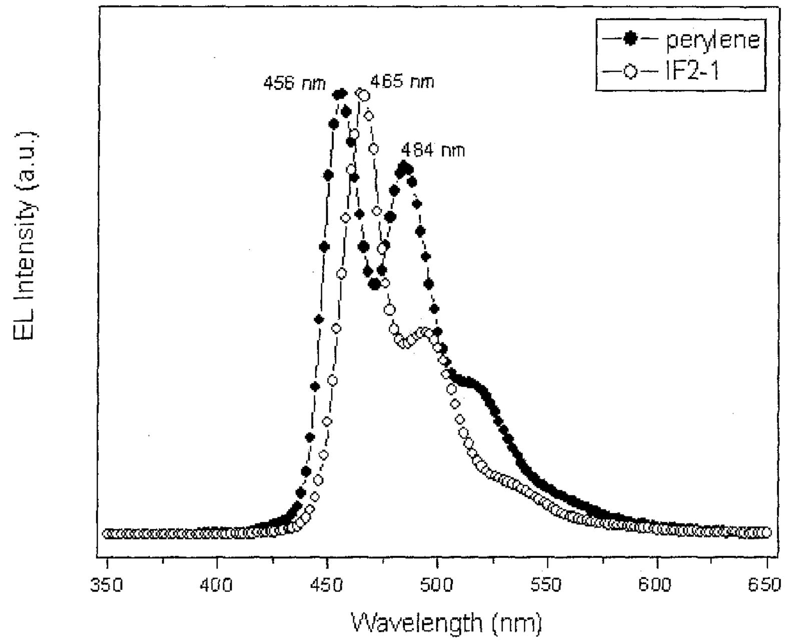
(54) Title: ORGANIC ELECTROLUMINESCENT COMPOUNDS AND DISPLAY DEVICE USING THE SAME



(57) Abstract: The present invention relates to novel organic electroluminescent compounds having an indenof luorene or a difluorene skeletal, and a display employing the same as an electroluminescent material. The organic electroluminescent compounds according to the invention exhibit good electroluminescent efficiency and excellent life property, so that an OLED device having very good operative lifetime can be advantageously prepared.

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ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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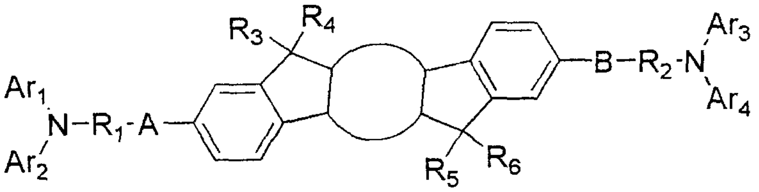
ORGANIC ELECTROLUMINESCENT COMPOUNDS AND DISPLAY DEVICE USING THE SAME

【Field of the Invention】

The present invention relates to novel organic electroluminescent compounds represented by Chemical Formula 1 and display devices employing the same as an electroluminescent material.

[Chemical Formula 1]



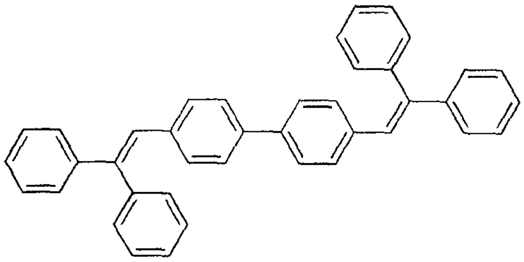
【Background of the Related Art】

The most important issue in developing an organic electroluminescent device having high efficiency and long life is development of electroluminescent material of high performance. In view of current development of electroluminescent material, it is the fact that red or blue electroluminescent materials show even lower electroluminescent property as compared to green electroluminescent materials. In order to realize a full color display, three electroluminescent materials (red, green and blue) are employed, and the material having the lowest property among the three materials eventually determines the performance of the entire panel. Thus, development of blue or red electroluminescent material having high efficient and long life is an important matter to enhance the properties of an entire organic electroluminescent device.

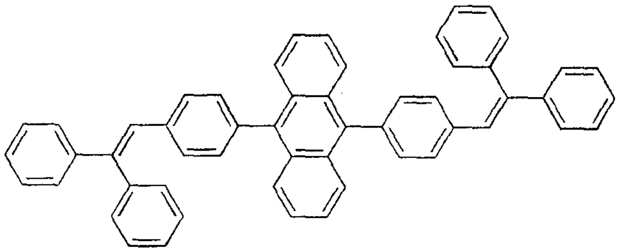
As a blue electroluminescent material, diphenylanthracene, tetraphenylbutadiene, distyrylbenzene derivatives and the like have been developed, but the compounds have been known to have low stability of thin film so that they tend to be readily crystallized. Diphenyldistyryl type blue electroluminescent materials having improved stability of thin film where the phenyl group of side chain inhibits crystallization have been developed by Idemitsu [H. Takailin, H. Higashi, C. Hosokawa, EP 388,768 (1990)]. Distyrylanthracene derivatives having improved stability of thin film due to electron withdrawers and electron donors have been developed by Kyushu University [Pro. SPIE, 1910, 180 (1993)].

In addition, DPVBi of Chemical Formula A from Idemitsu Kosan, arylethylene derivatives such as DPVDPAN of Chemical Formula B, dinaphthylanthracene of Chemical Formula C from Kodak Company and tetra(t-butyl)perylene system of Chemical Formula D, as disclosed in EP 1063869 A1 (Idemitsu Kosan Company Limited), Korean Patent Laid-Open 2000-0048006 (Eastman Kodak Company, USA) and Japanese Patent Laid-Open 1996-333569, have been widely used as blue electroluminescent materials.

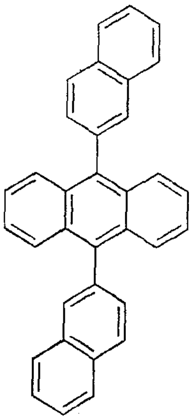
[Chemical Formula A]



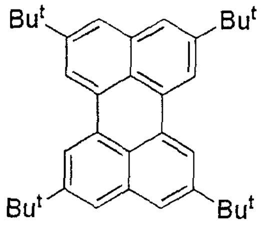
[Chemical Formula B]



[Chemical Formula C]



[Chemical Formula D]



Since DPVBi of Chemical Formula A involves problem of thermal stability having low glass transition temperature of 100℃ or less, DPVDPAN of Chemical Formula B where anthracene is incorporated inside the biphenyl of said DPVBi has improved thermal stability by raising the glass transition temperature to 105℃ The color purity and electroluminescent efficiency as a blue electroluminescent material, however, were not in a quite satisfactory level.

In the meanwhile, blue electroluminescence, when the electroluminescent wavelength is shifted from the present state to a longer wavelength, becomes advantageous in terms of electroluminescent efficiency, but it does not fulfill pure blue color so that it involves difficulties to be applied to a full-colored organic electroluminescent display requiring an electroluminescent material of pure blue color.

Thus, development of novel blue electroluminescent material is an urgent subject in order to develop a blue electroluminescent device or a full-colored electroluminescent device, because conventional blue electroluminescent compounds have lower electroluminescent efficiency than that of other colors.

【 Disclosure 】

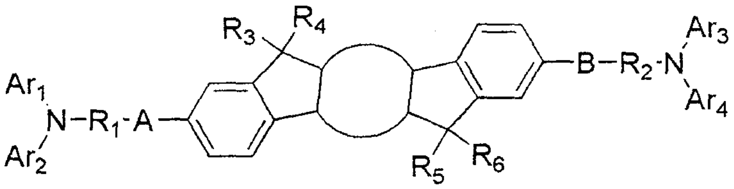
【 Technical Problem 】

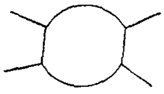
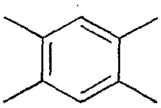
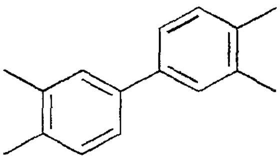
The present invention noticeably improves the properties of a host which serves as a solvent or an energy carrier in electroluminescent materials as compared to the conventional materials. The object of the invention is to provide organic electroluminescent compounds having excellent electroluminescent efficiency and very good operative life. Another object of the invention is to provide an organic electroluminescent device containing the novel organic electroluminescent compound.

【 Technical Solution 】

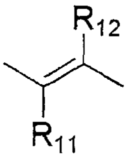
The present invention relates to a novel organic electroluminescentcompound represented by Chemical Formula 1:

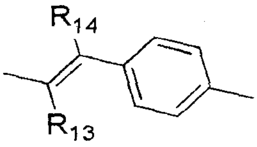
[Chemical Formula 1]



wherein,  represents  or 

A and B independently represent a chemical bond,



or, 

,

R_1 and R_2 independently represent an aromatic ring or a fused multi-cyclic aromatic ring having two or more aromatic rings,

R_3 through R_6 independently represent a linear or branched C_1-C_{20} alkyl group with or without halogen substituent(s), a C_5-C_8 cycloalkyl group, or an aromatic group with or without halogen substituent(s),

R_{11} through R_{14} independently represent a hydrogen, a C_1-C_8 alkyl group, a C_5-C_8 cycloalkyl group or an aromatic group with or without halogen substituent(s),

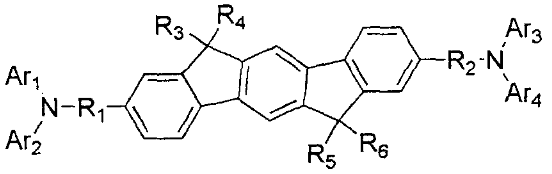
Ar_1 through Ar_4 independently represent an aromatic ring or a fused multi-cyclic aromatic ring having two or more aromatic rings: and a display device employing the same as an electroluminescent material.

In the Chemcal Formulas of the present invention, it is referred to as "chemical bond" when there is no element in A or B but R_1 or R_2 is simply connected.

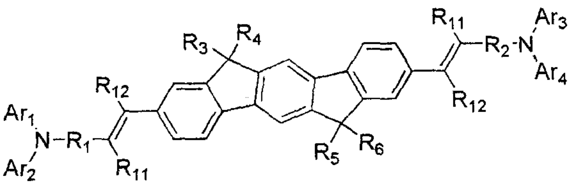
The organic electroluminescent compounds according to the present invention are advantageous in that they can be easily prepared in a high yield with high electroluminescent properties.

The compounds of Chemical Formula 1 according to the present invention include the compounds represented by Chemical Formulas 2 to 6:

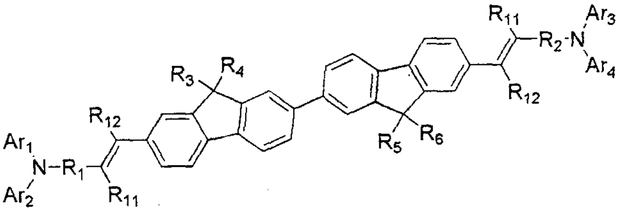
[Chemical Formula 2]



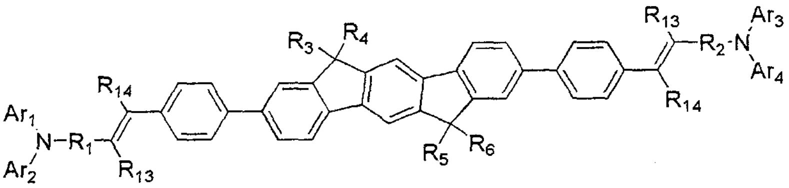
[Chemical Formula 3]



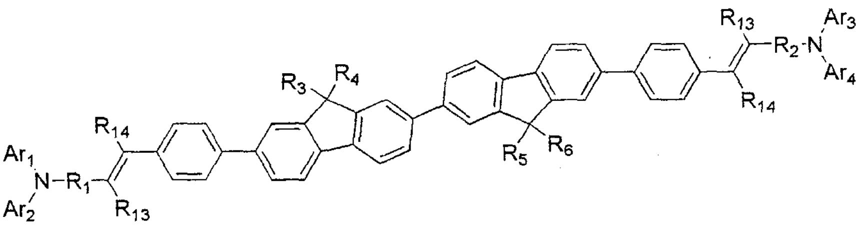
[Chemical Formula 4]



[Chemical Formula 5]

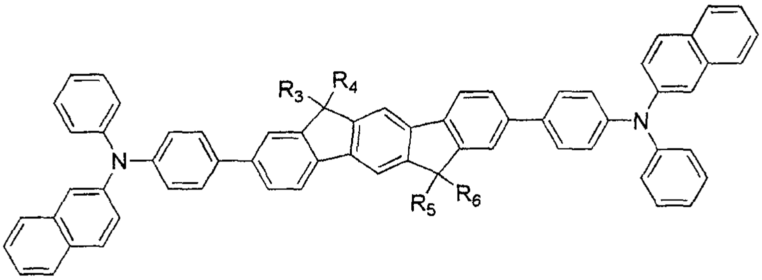


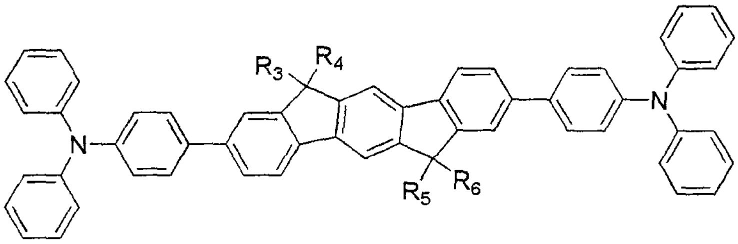
[Chemical Formula 6]

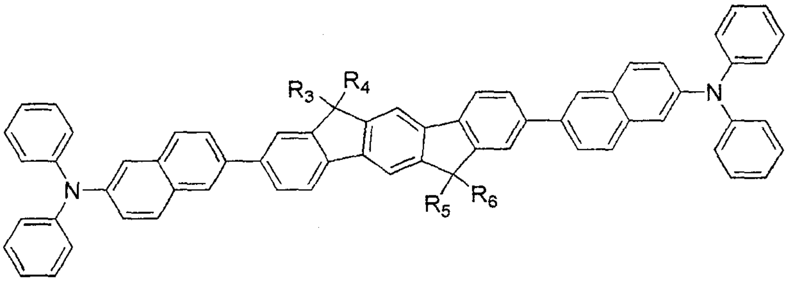


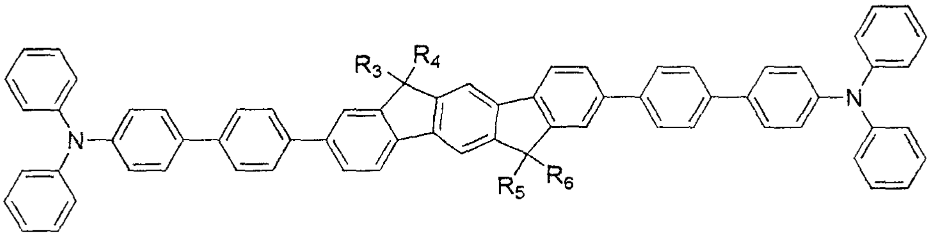
In the compounds represented by Chemical Formula 2 through Chemical Formula 6, R_1 and R_2 independently represent an aromatic group or a fused multi-cyclic aromatic ring having two or more aromatic rings, R_3 through R_6 independently represent a linear or branched C_1-C_{20} alkyl group with or without halogen substituent(s), a C_5-C_8 cycloalkyl group, or an aromatic group with or without halogen substituent(s), R_{11} through R_{14} independently represent a hydrogen, a C_1-C_8 alkyl group, a C_5-C_8 cycloalkyl group or an aromatic group with or without halogen substituent(s), and Ar_1 through Ar_4 independently represent an aromatic ring or a fused multi-cyclic aromatic ring having two or more aromatic rings.

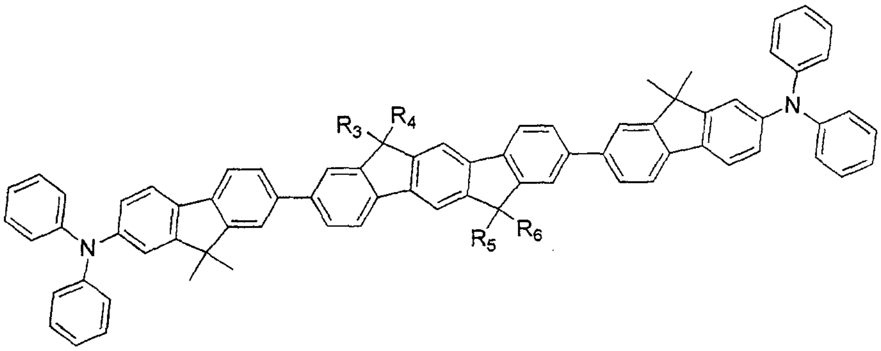
Specific examples of R_1 and R_2 in Chemical Formulas 2 through 6 include phenylene, naphthalene, anthracene, naphthacene, pyrene, fluorene and biphenyl, R_3 through R_6 are methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-amyl, n-hexyl, n-heptyl, n-octyl, 2-ethylhexyl, n-nonyl, trifluoromethyl, pentafluoroethyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, phenyl, tolyl, 1-naphthyl, 2-naphthyl, 2-fluorophenyl or 4-fluorophenyl, R_{11} through R_{14} are hydrogen, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, n-hexyl, n-heptyl, n-octyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, phenyl, tolyl, 1-naphthyl, 2-naphthyl, 2-fluorophenyl or 4-fluorophenyl, and Ar_1 through Ar_4 are phenyl, tolyl, xylyl, pyridyl, biphenyl, naphthyl, anthryl, phenanthryl, naphthacenyl, acenaphthenyl, pyrenyl, fluorenyl or perylenyl. The organic electroluminescent compounds according to each one of Chemical Formulas 2 to 6 can be specifically exemplified as the compounds having the structures as follows:







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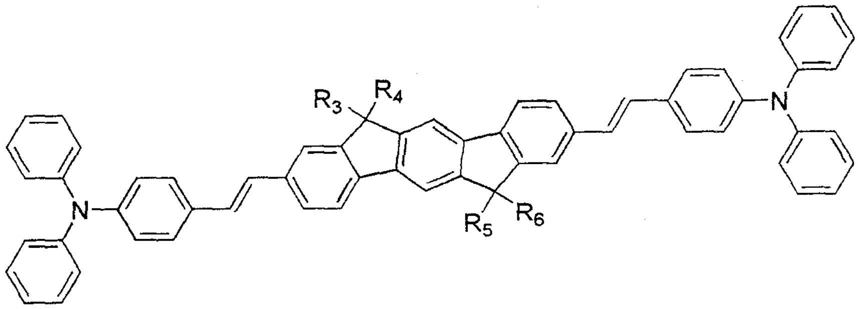
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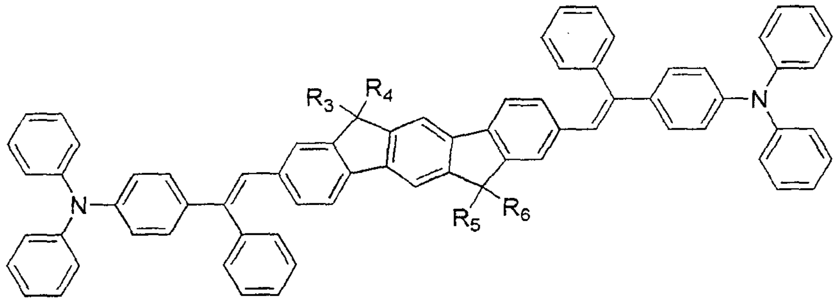
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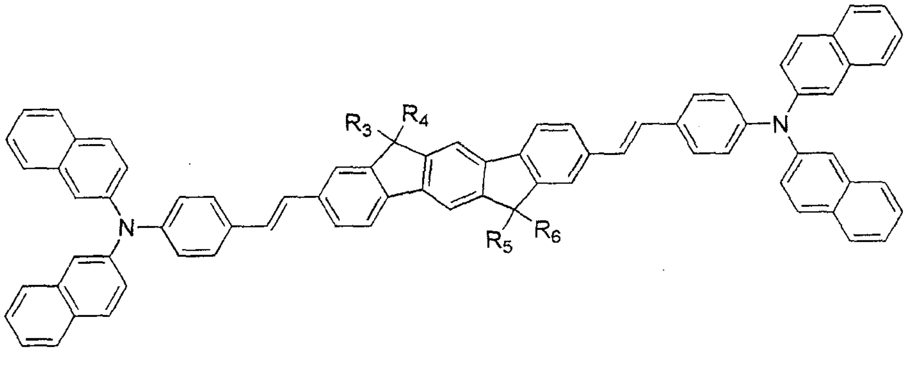
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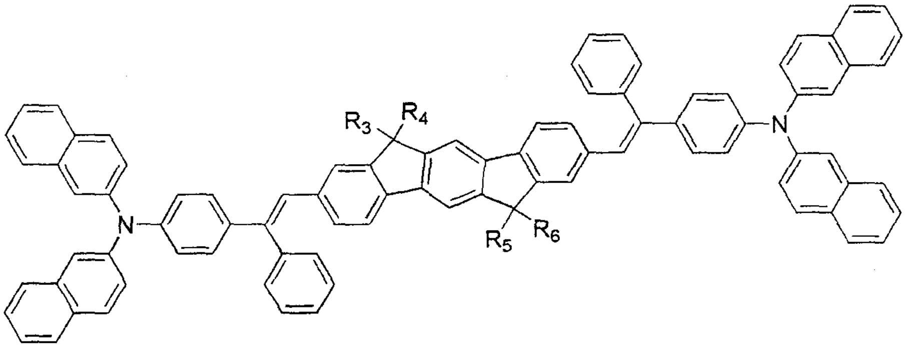
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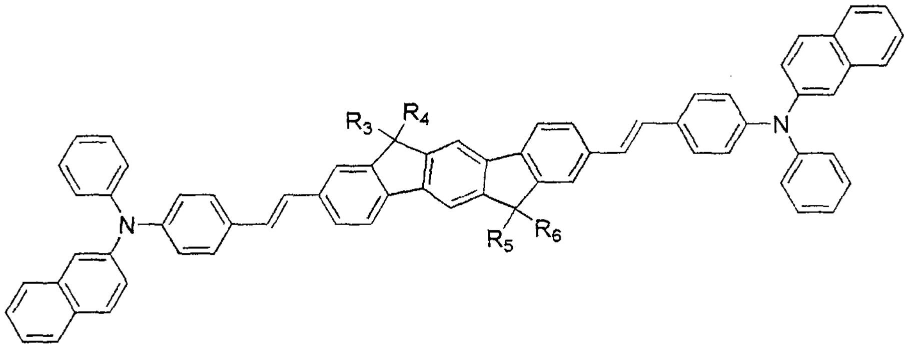
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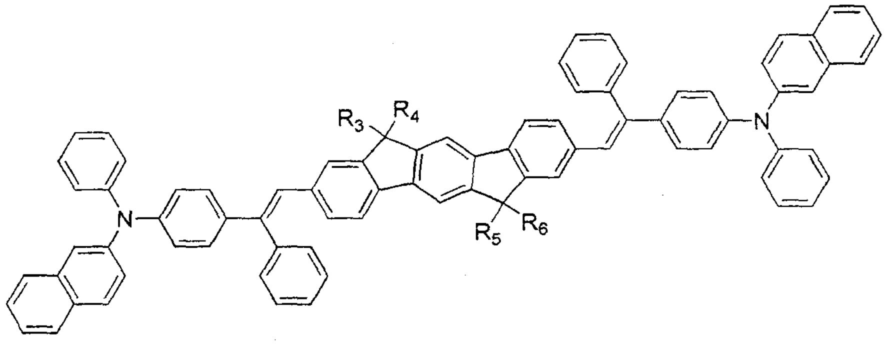
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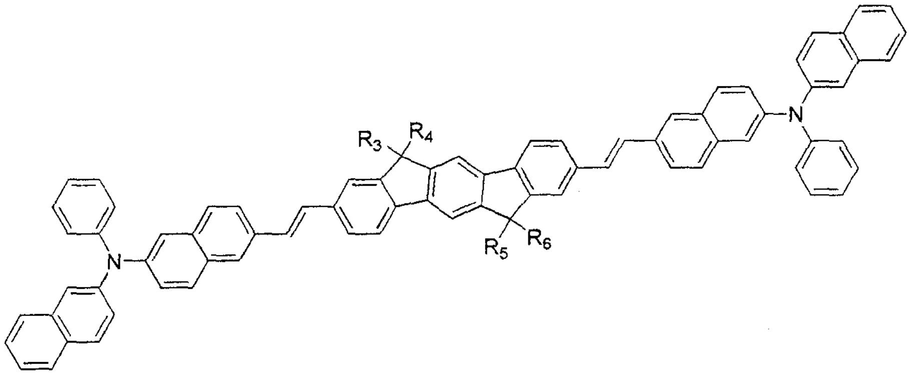
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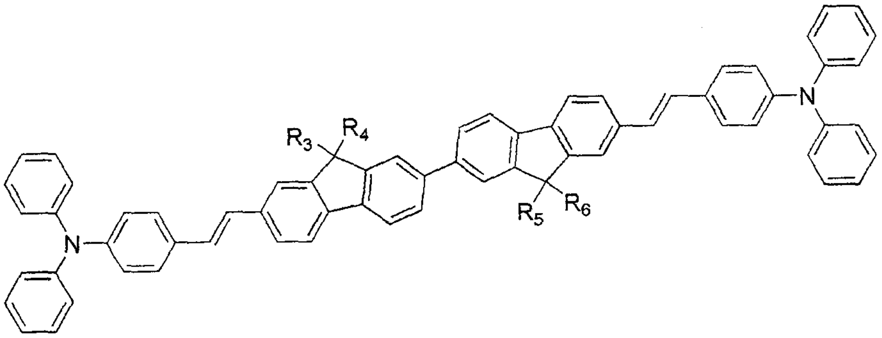
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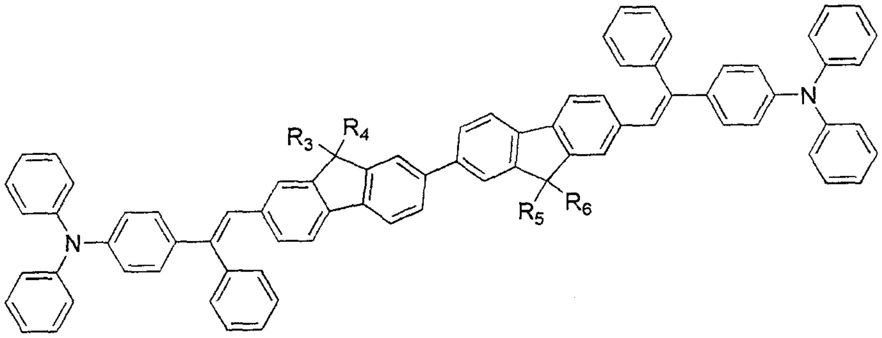
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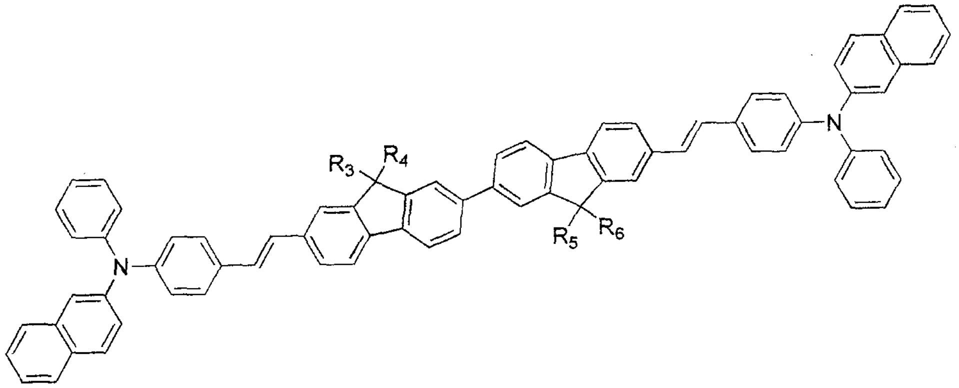
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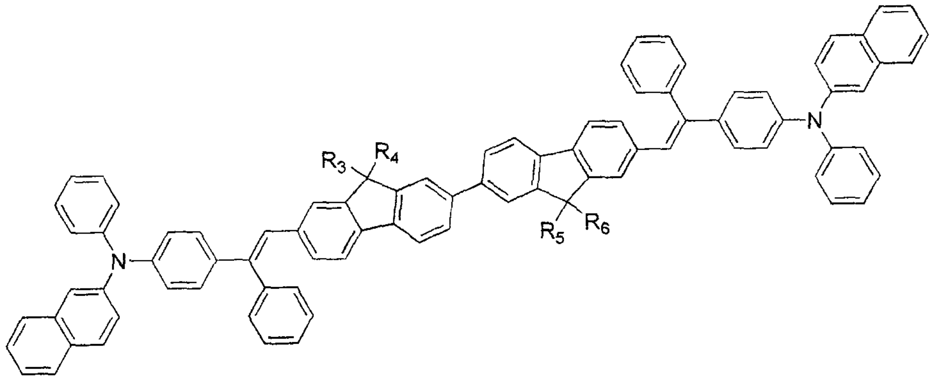
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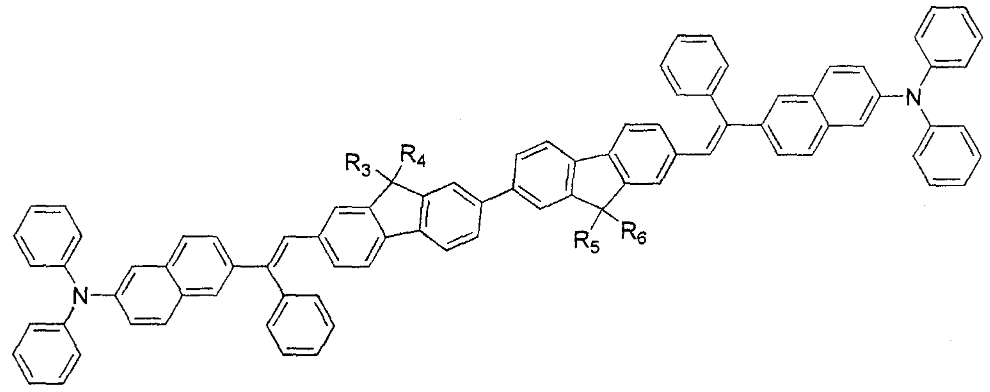
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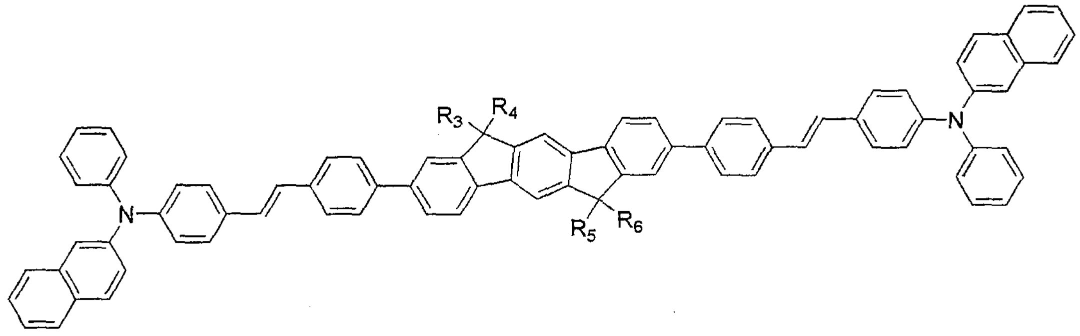
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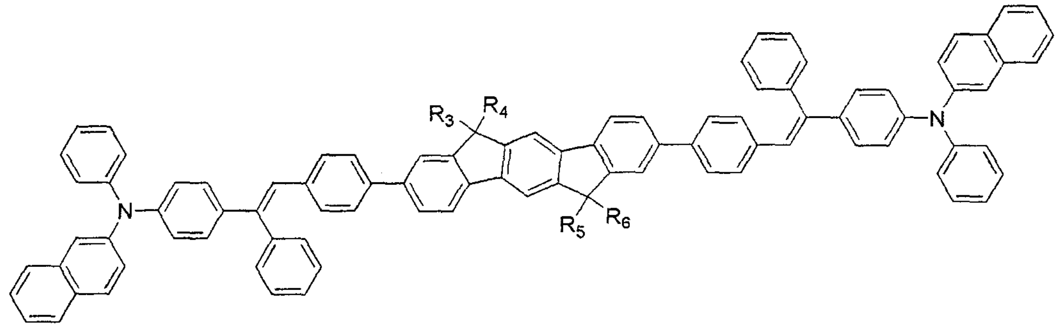
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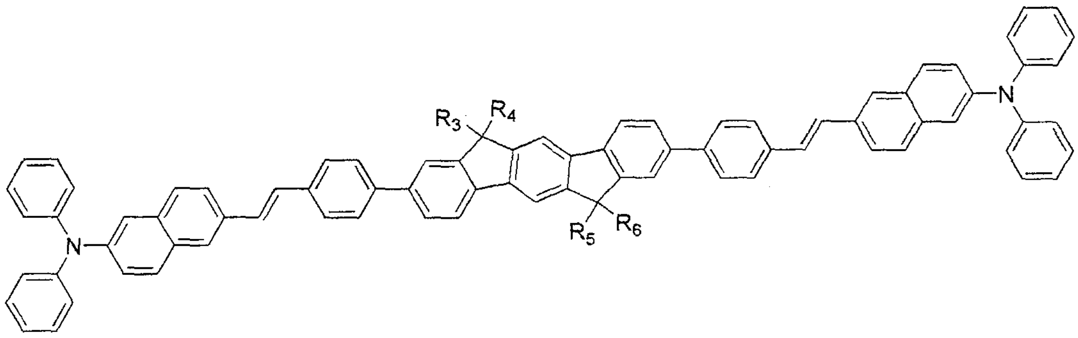
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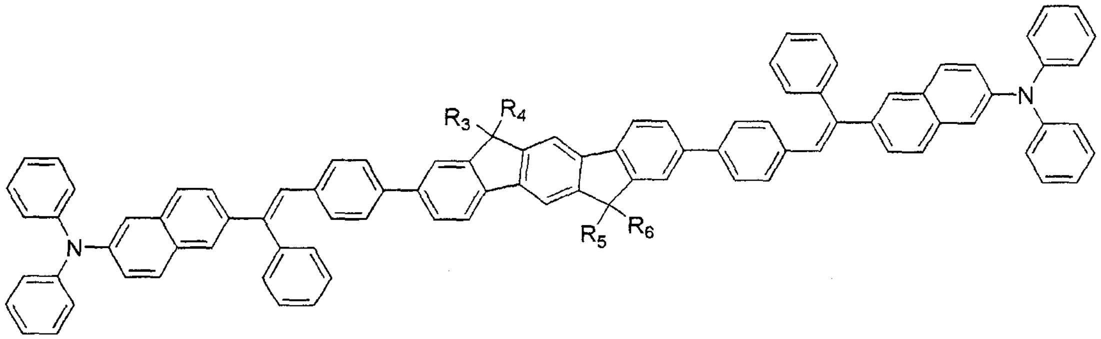
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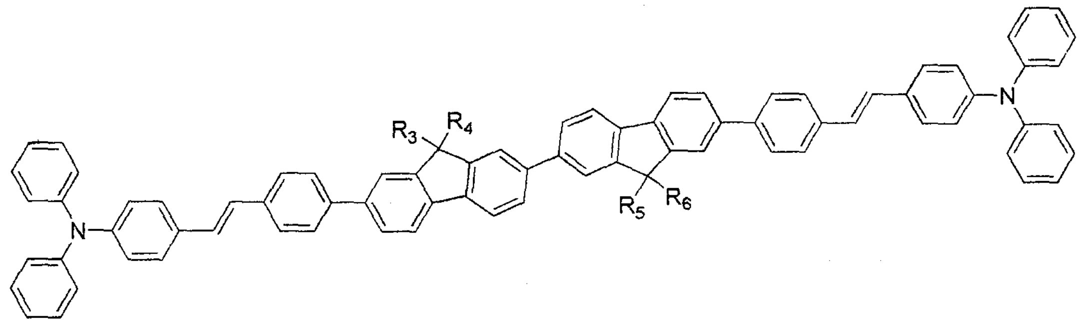
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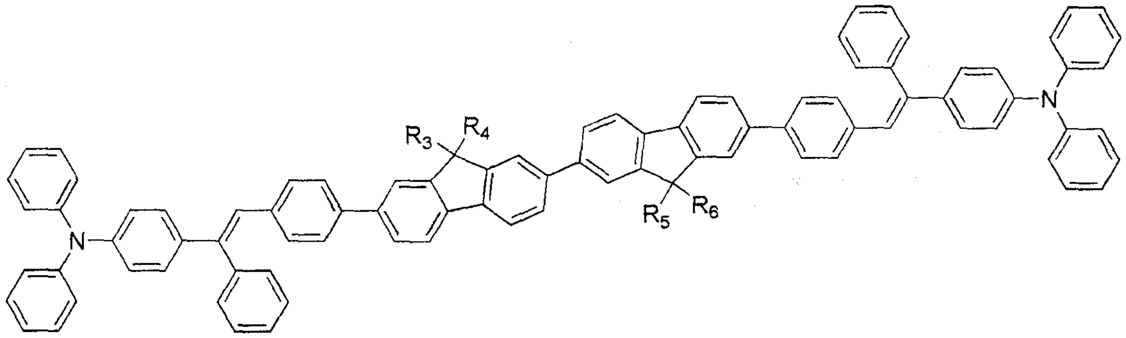
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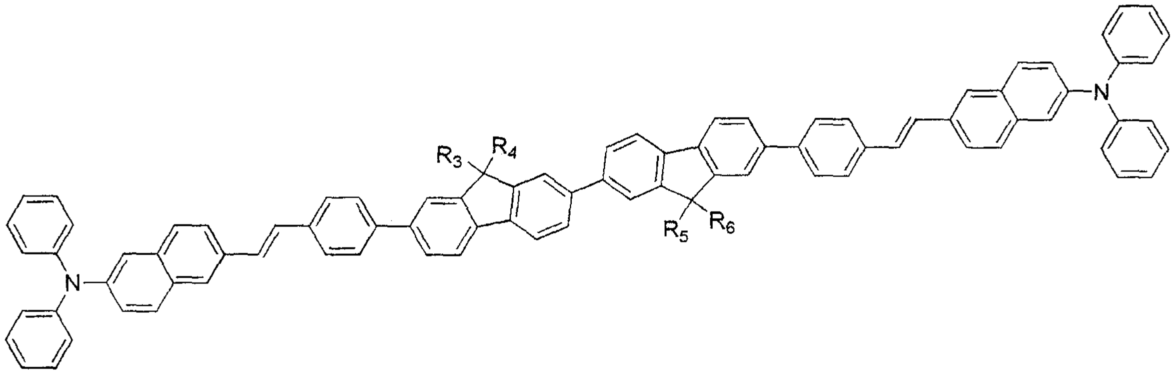
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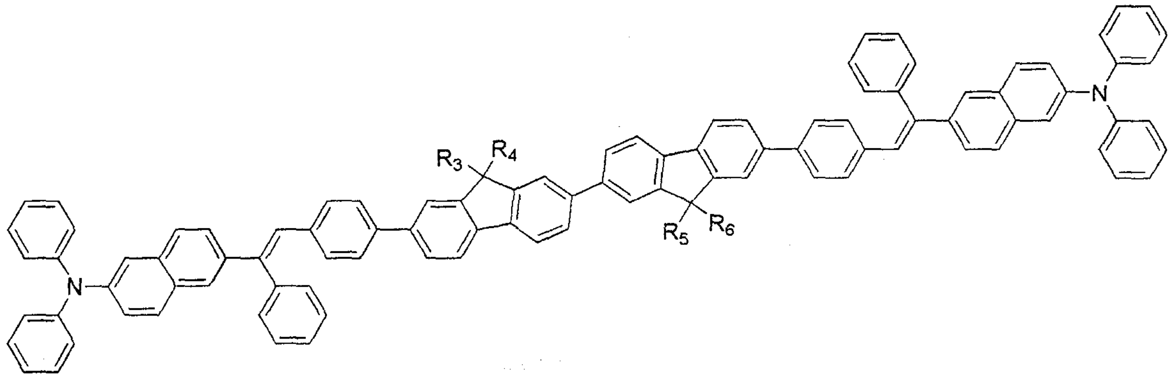
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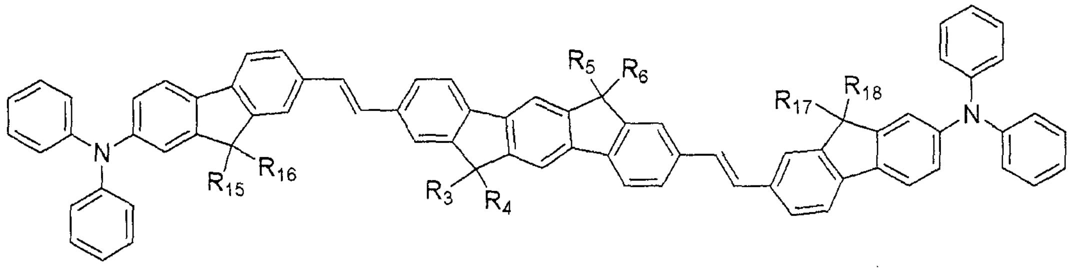
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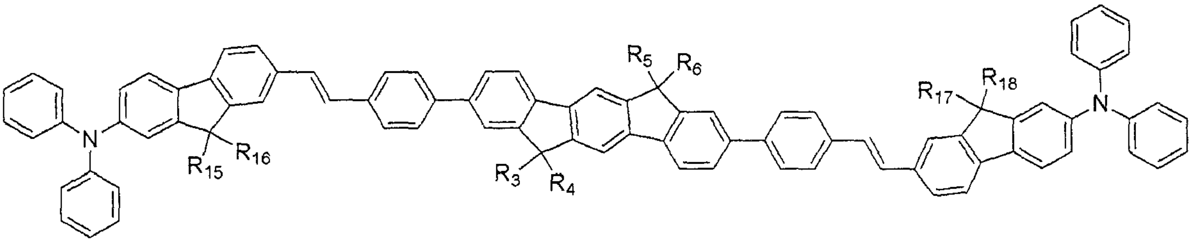
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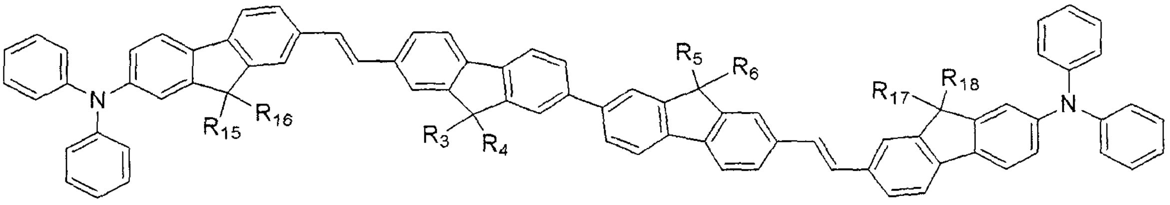
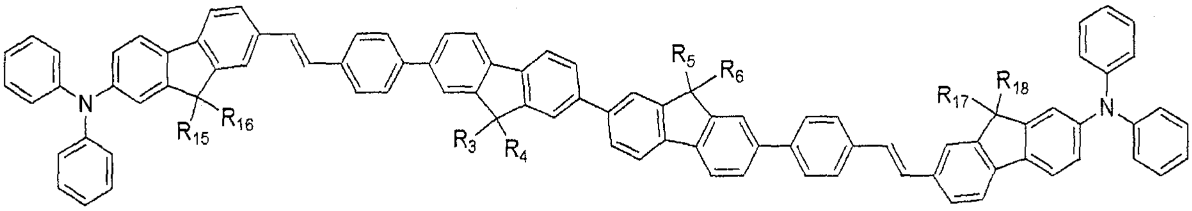
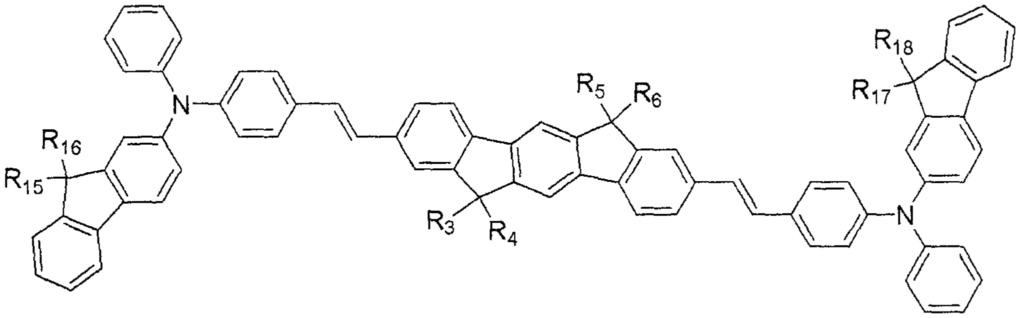
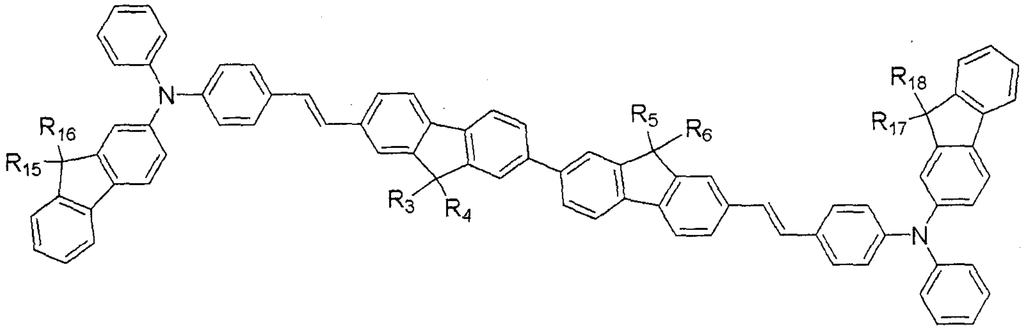
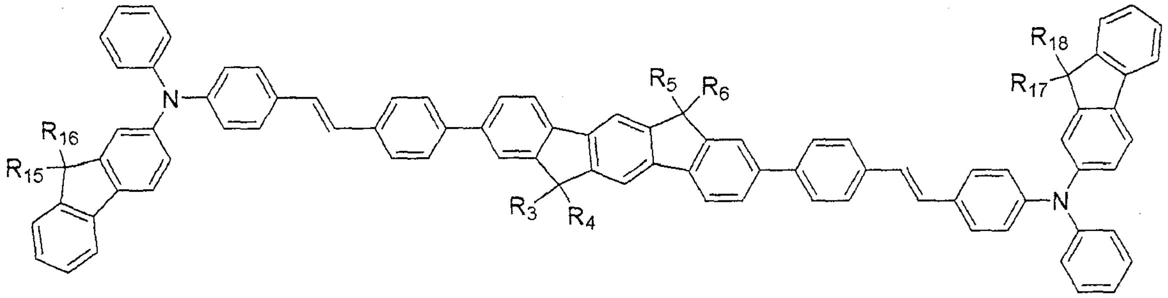
R15
R16
R5
R6
R3
R4
R17
R18
N

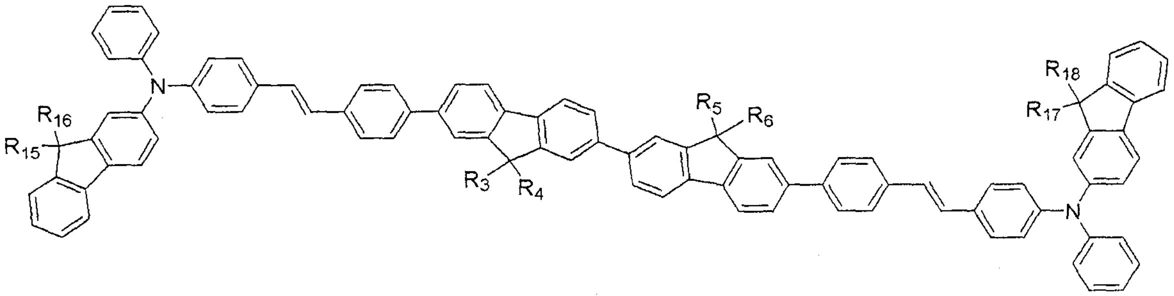

N
R15
R16
R3
R4
R5
R6
R17
R18
N


N
R15
R16
R3
R4
R5
R6
R17
R18
N





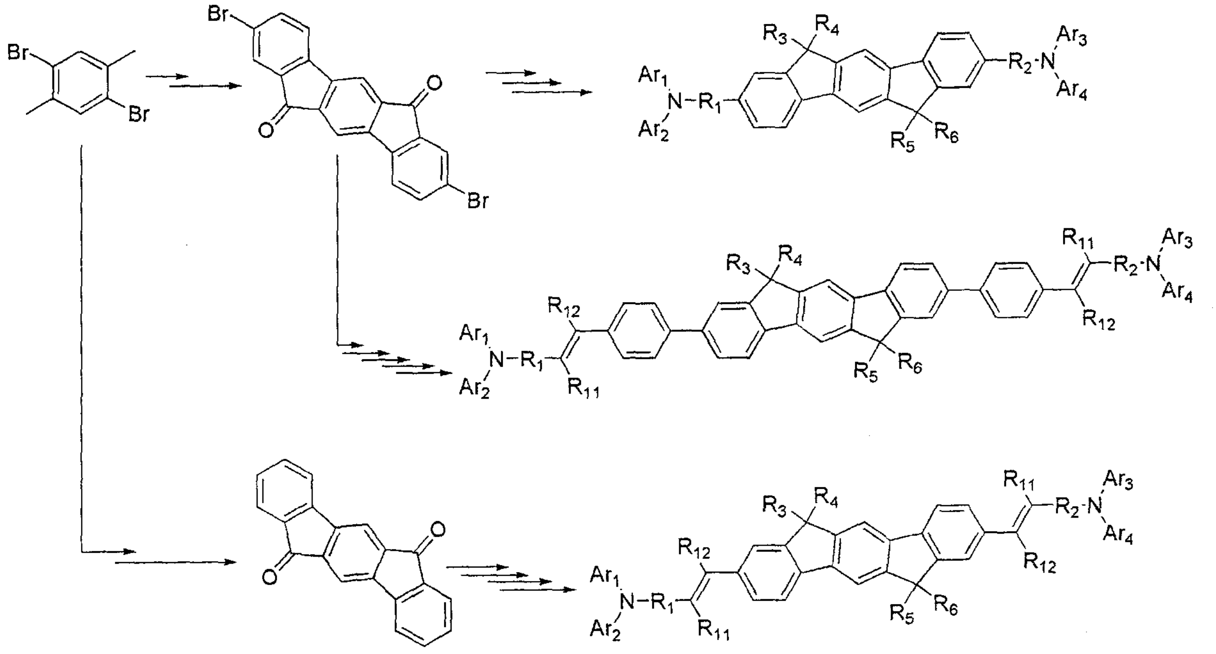




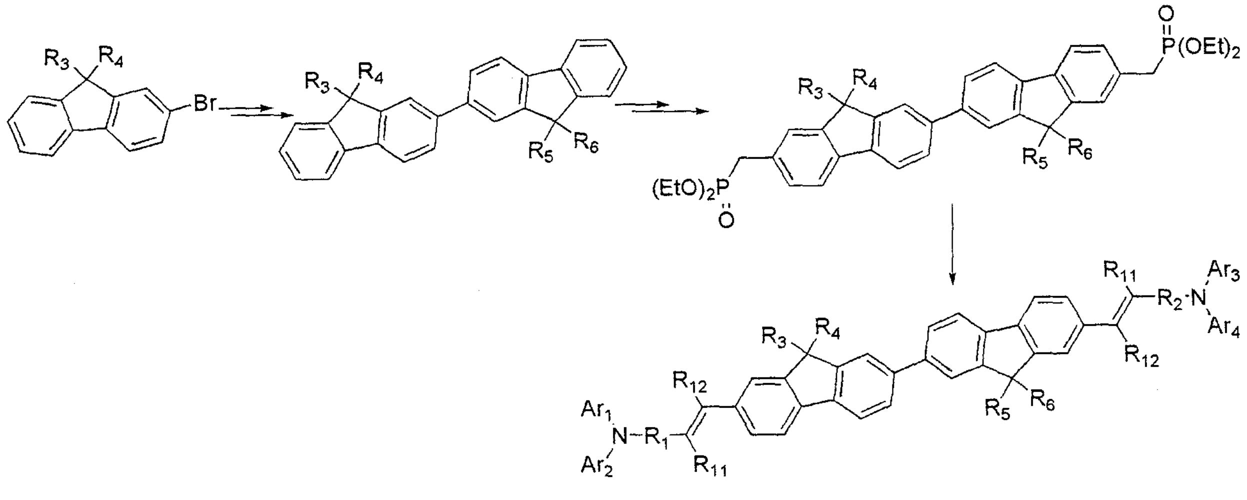
wherein, R_3 through R_6 represent methyl group or ethyl group, and R_{15} to R_{18} represent methyl group, ethyl group or phenyl group.

Each compound represented by Chemical Formulas 2, 3 or 5, as an organic electroluminescent compound can be prepared via a reaction route represented by Reaction Scheme 1, a compound of Chemical Formula 4 via a reaction route of Reaction Scheme 2, and a compound of Chemical Formula 6 via that of Reaction Scheme 3.

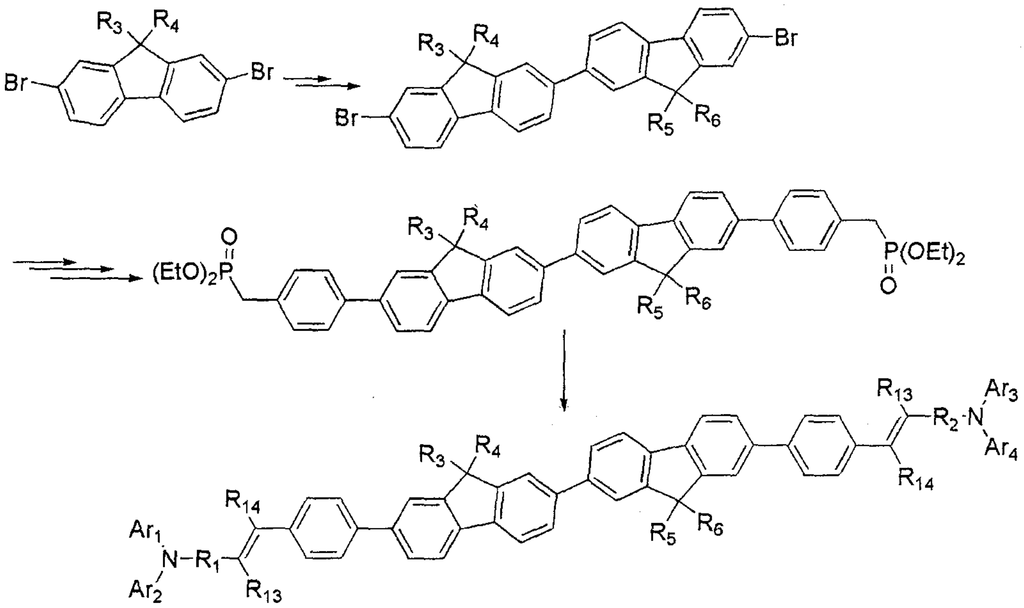
[Reaction Scheme 1]



[Reaction Scheme 2]



[Reaction Scheme 3]



【 Brief Description of Drawings 】

Fig. 1 is a graph showing the EL spectrum of an OLED employing IF2-1 as an electroluminescent material of the present invention and that of Comparative Example 1,

Fig. 2 is a graph showing the change of current density with respect to voltage of an OLED employing IF2-1 as an electroluminescent material of the present invention,

Fig. 3 is a graph showing the change of luminance with respect to the operating voltage of an OLED employing IF2-1 as an electroluminescent material of the present invention, and

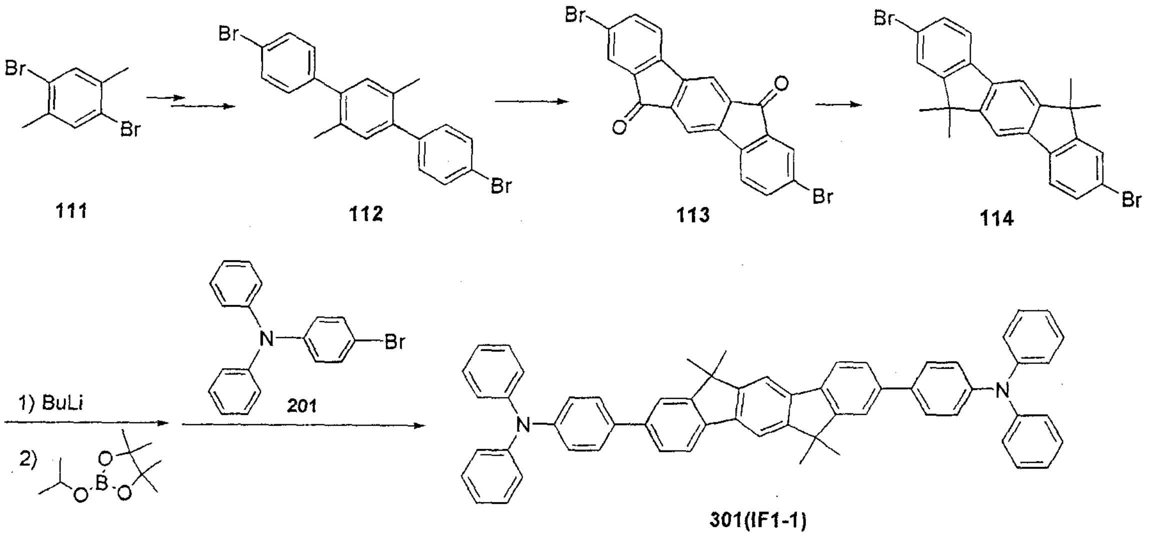
Fig. 4 is a graph showing the change of electroluminescent efficiency with respect to current density of an OLED employing IF2-1 element as an electroluminescent material of the present invention.

Other and further objects, features and advantages of the invention will appear more fully from the following description.

Examples

The present invention is further described with respect to the electroluminescent compounds according to the invention, a process for preparing the same and the electroluminescent properties of the device employing the same by referring to representative compounds according to the present invention, which are provided for illustration only and are not intended to be limiting in any way.

[Synthetic Example 1] Synthesis of IF1-1



In 50 ml of THF, 2,5-dibromoxylene (2.0 g, 7.60 mmol) as Compound (111) was dissolved and tert-butyl lithium (1.5 equivalent) was added to the THF solution of 2,5-dibromoxylene

(50 ml) at -80℃ and the resultant solution was stirred at -40℃ under nitrogen atmosphere for 12 hours. After the stirring completed, 2-isopropoxy-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (4.3 g, 23.1 mmol) was added thereto, while maintaining the temperature of the reaction mixture at -80℃ to provide a boronic ester compound of Compound (111) (2.31 g, 6.42 mmol), and the resultant boronic ester compound of Compound (111) (2.3 g) was dissolved in 50 ml of THF. To the solution, added were 1-bromo-4-iodobenzene (3.80 g, 13.4 mmol), $Pd(PPh_3)_4$ (1.5 g, 1.29 mmol) and aqueous 2M solution of calcium carbonate (20 ml), and the resultant mixture was heated under reflux for 10 hours. From the precipitate thus formed, Compound (112) (2.14 g, 5.14 mmol) was obtained.

Compound (112) (2.14 g) was dissolved in 20 ml of pyridine, and an aqueous 2M potassium permanganate solution (15 ml) was added thereto to provide a carboxylic acid at the end of Compound (112). The solid obtained from extraction of the organic layer was put into sulfuric acid, and the mixture was heated at 80℃ for 12 hours. After lowering the temperature of said sulfuric acid solution to ambient temperature, the solution was poured into crushed ice. The solid thus formed was extracted to obtain Compound (113) (1.70 g, 3.86 mmol).

Compound (113) (1.70 g) was put into diethylene glycol (30 ml), and hydrazine hydrate (0.58 g, 11.6 mmol) and potassium hydroxide (0.5 g) were added thereto, and the resultant mixture was heated under reflux for 48 hours. After completion of heating under reflux, the reaction mixture was cooled to ambient temperature and extracted from ethyl acetate to provide indinofluorene compound. After drying, the compound was dissolved in 30 ml of THF, and under nitrogen atmosphere, methyl iodide (2.20 g, 15.5 mmol) was added thereto at -78℃ and then 1.8 M solution of n-butyllithium in THF (15 ml) was slowly added thereto. After stirring the mixture for 1 hour, the temperature was raised to ambient temperature, and the mixture was again stirred and the reaction quenched by slowly adding 50 ml of water. After completion of the reaction, the reaction mixture was extracted from the organic layer and completely dried to obtain Compound (114) (1.17 g, 2.50 mmol).

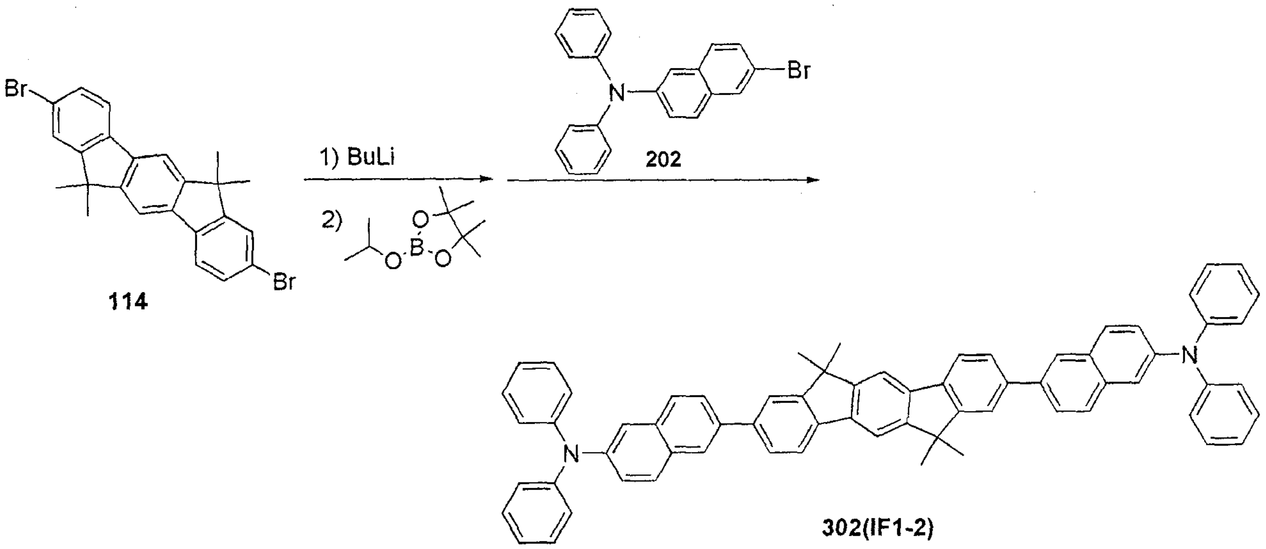
Compound (114) (1.17 g) was dissolved in THF (30 ml), and 1.5 equivalent of tert-butyl lithium was added thereto. By the use of 2-isopropoxy-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (1.4 g, 7.53 mmol), a boronic ester compound (1.33 g, 2.37 mmol) as Compound (114) was prepared. The boronic ester compound of Compound (114) (1.33 g) thus obtained was dissolved in 30 ml of THF solution, and Compound (201) (1.56 g, 4.81 mmol) and $Pd(PPh_3)_4$ (0.56 g, 0.48 mmol) and aqueous 2M solution of calcium carbonate (10 ml) were added thereto. After heating the reaction mixture under reflux for 12 hour, the precipitate thus formed was extracted with ethyl acetate. After recrystallization and drying, Compound (301, IF1-1)

(1.50 g, 1.88 mmol) was obtained as the title compound in total yield of 24.7%.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.55(m, 12H), 6.6-6.65(m, 4H), 7.0-7.05(m, 8H), 7.2-7.25(d, 4H), 7.65(d, 2H), 7.73(d, 2H), 7.80(s, 2H), 8.0-8.1(d, 2H)

MS/FAB: 796(found), 797.06(calculated)

[Synthetic Example 2] Synthesis of IF1-2

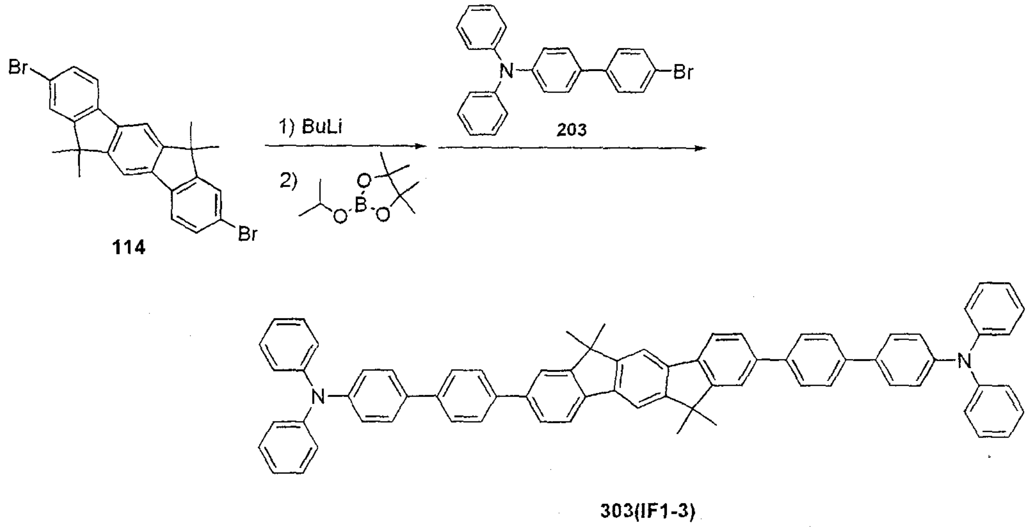


Compound (302, IF1-2) (1.16 g, 1.30 mmol) as the title compound was obtained in total yield of 19.0% according to the same procedure as Synthetic Example 1, but Compound 114 (1.0 g, 2.14 mmol), and Compound 202 (1.61 g, 4.30 mmol) instead of Compound 201 were employed.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(m, 8H), 6.6-6.65(m, 4H), 6.75-6.8(m, 4H), 7.0-7.05(m, 8H), 7.45-7.55(m, 6H), 7.65(d, 2H), 7.75-7.85(m, 6H), 8.0-8.05(d, 2H)

MS/FAB: 896(found), 897.19(calculated)

[Synthetic Example 3] Synthesis of IF1-3

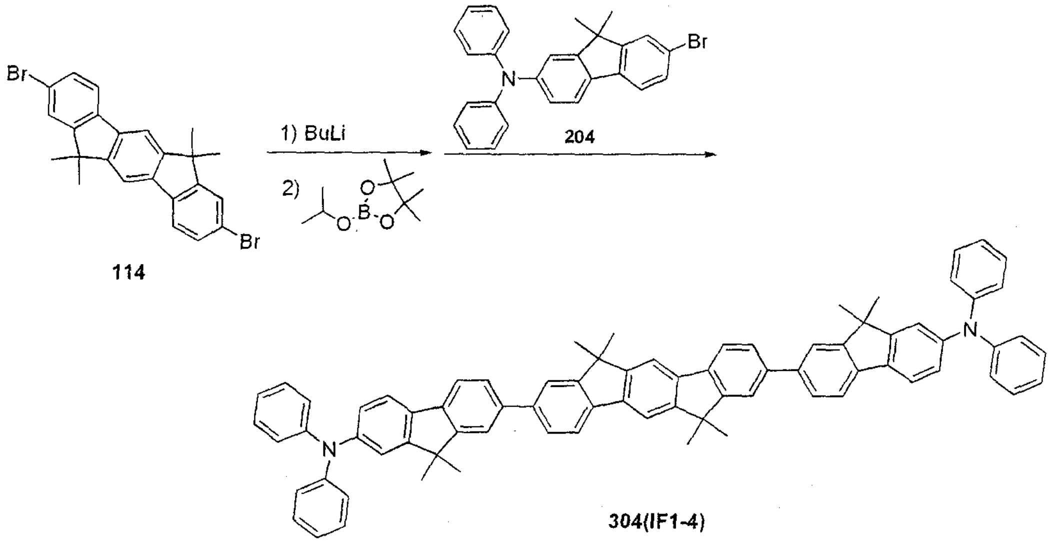


Compound (303, IF1-3) (1.12 g, 1.18 mmol) as the title compound was obtained in total yield of 17.2% according to the same procedure as Synthetic Example 1, but Compound 114 (1.0 g, 2.14 mmol), and Compound 203 (1.72 g, 4.30 mmol) instead of Compound 201 were employed.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.55(m, 12H), 6.6-6.65(m, 4H), 7.0-7.05(m, 8H), 7.2-7.25(d, 4H), 7.55-7.57(d, 8H), 7.65(d, 2H), 7.75(s, 2H), 7.8(s, 2H), 8.0-8.05(d, 2H)

MS/FAB: 948(found), 949.26(calculated)

[Synthetic Example 4] Synthesis of IF1-4

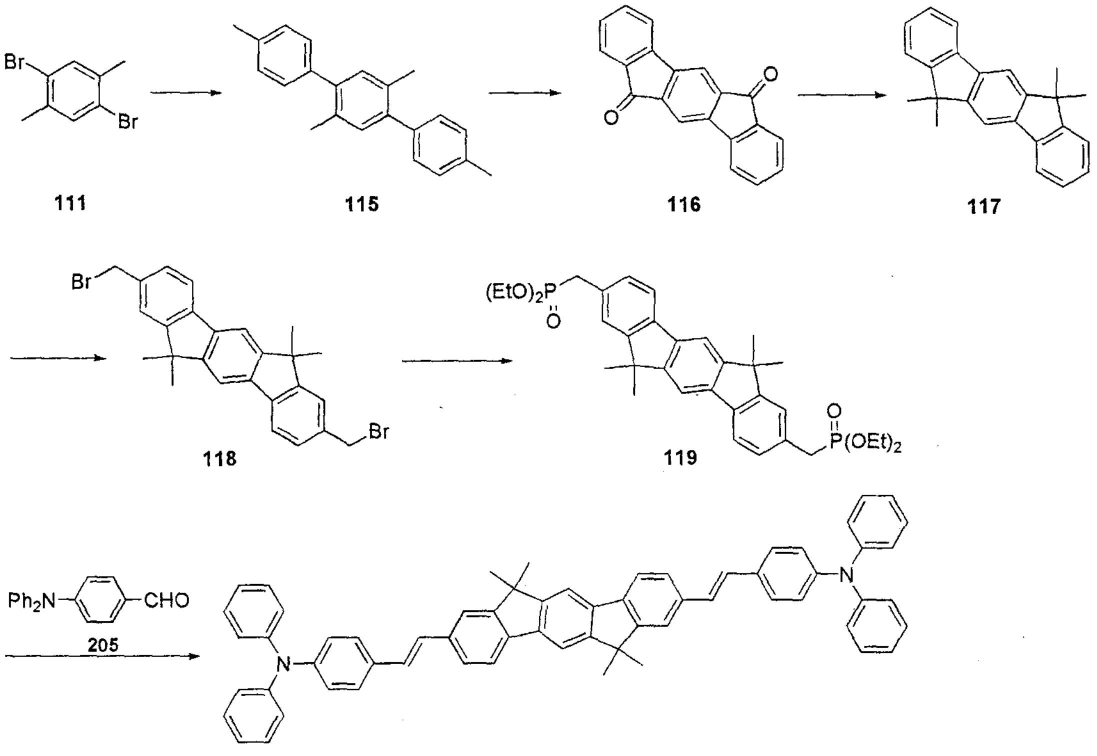


Compound (304, IF1-4) (0.95 g, 0.92 mmol) as the title compound was obtained in total yield of 13.4% according to the same procedure as Synthetic Example 1, but Compound 114 (1.0 g, 2.14 mmol), and Compound 204 (1.90 g, 4.32 mmol) instead of Compound 201 were employed.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.63-1.65(d, 24H), 6.45-6.50(d, 8H), 6.55-6.65(m, 6H), 6.75(s, 2H), 7.0-7.05(m, 8H), 7.58-7.65(m, 6H), 7.73-7.85(m, 6H), 8.0-8.05(d, 2H)

MS/FAB: 1028(found), 1029.39(calculated)

[Synthetic Example 5] Synthesis of IF2-1



305(IF2-1)

In 50 ml of THF, 2,5-dibromoxylene (2.0 g, 7.60 mmol) was dissolved, and phenyl boronic acid (1.95 g, 16.0 mmol) and $Pd(PPh_3)_4$ (1.95 g, 1.68 mmol), aqueous 2M calcium carbonate solution (25 ml) were added to the THF solution of 2,5-dibromoxylene (50 ml), and the resultant mixture was heated under reflux for 10 hours. From the precipitate thus formed, Compound (115) (1.86 g, 7.2 mmol) was obtained.

Compound (115) (1.86 g) was dissolved in 20 ml of pyridine, and an aqueous 2M potassium permanganate solution (15 ml) was added thereto to provide carboxylic acid at the end of the compound. The solid obtained from extraction of the organic layer was put into sulfuric acid, and the mixture was heated at 80℃ for 12 hours. After lowering the temperature of said sulfuric acid solution to ambient temperature, the solution was poured into crushed ice. The solid thus formed was extracted to obtain Compound (116) (1.64 g, 5.82 mmol).

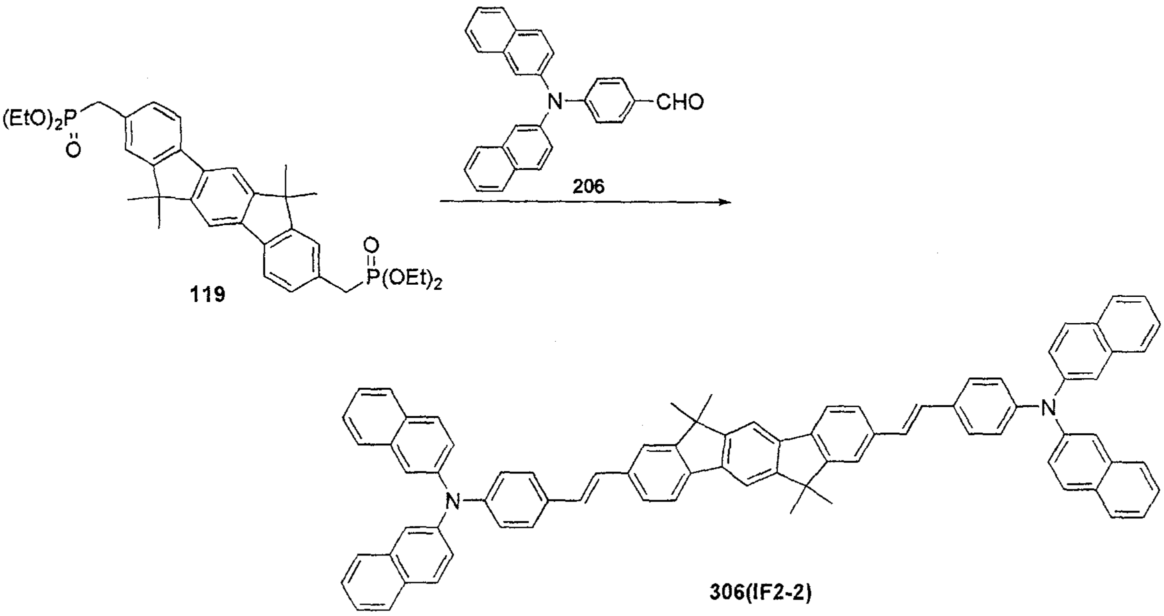
Compound (116) (1.64 g) was put into diethylene glycol (30 ml), and hydrazine hydrate (0.85 g, 17.0 mmol) and potassium hydroxide (0.8 g) were added thereto, and the resultant mixture was heated under reflux for 48 hours. After completion of heating under reflux, the reaction mixture was cooled to ambient temperature and extracted from ethyl acetate to provide indinofluorene compound. After drying, the compound was dissolved in 30 ml of THF, and under nitrogen atmosphere, methyl iodide (1.65 g, 11.6 mmol) was added thereto at -78℃ and then 1.8 M solution of n-butyllithium in THF (12 ml) was slowly added thereto. After stirring the mixture for 1 hour, the temperature was raised to ambient temperature, and the mixture was again stirred for 24 hours and the reaction was quenched by slowly adding 50 ml of water. After completion of the reaction, the reaction mixture was extracted from organic layer and completely dried to obtain Compound (117) (1.25 g, 4.03 mmol).

Compound (117) (1.25 g, 4.03 mmol) and paraformaldehyde (1.8 g) were added to 35% HBr solution in acetic acid (15 ml), and the mixture was heated at 60℃ for 24 hours. The temperature of the reaction mixture was then lowered to ambient temperature, extracted and dried to obtain Compound (118) (1.34 g, 2.70 mmol), which was charged in a reaction vessel. Triethylphosphite (2.0 g, 12.0 mmol) was added thereto at 0℃ and the mixture was heated at 150℃ for 4 hours. After completion of the reaction, residual triethylphosphite was removed by vacuum distillation, and the residue was extracted from ethyl acetate to obtain Compound (119) (1.4 g, 2.30 mmol). Compound (119) (1.4 g) and Compound (205) (1.30 g, 4.76 mmol) were dissolved in THF (30 ml), and 1.6 M solution of potassium tert-butoxide in THF (5 ml) was added dropwise to the mixed solution. The temperature was slowly raised to ambient temperature to complete the reaction. Then an excess amount of water was poured thereto to generate solid, which was then filtered. After recrystallization from THF-methanol, Compound (305, IF2-1) (1.23 g, 1.45 mmol) was obtained as the title compound in total yield of 19.1%.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(m, 12H), 6.6-6.65(m, 4H), 6.95-7.05(m, 12H), 7.15-7.2(d, 4H), 7.57-7.6(d, 2H), 7.7-7.75(d, 4H), 7.9-8.0(d, 2H)

MS/FAB: 848(found), 849.14(calculated)

[Synthetic Example 6] Synthesis of IF2-2

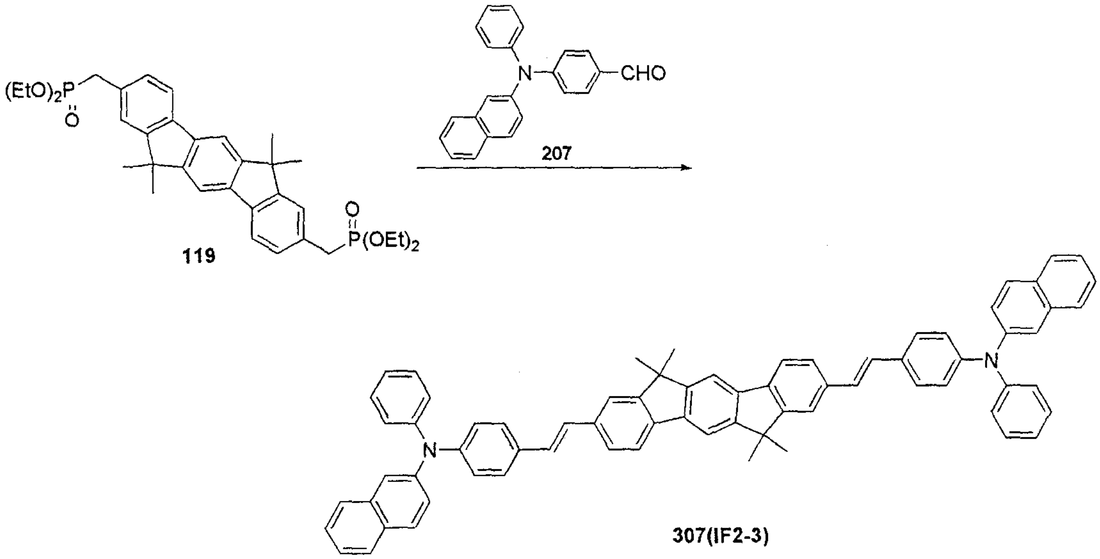


Compound (306, IF2-2) (0.95 g, 0.91 mmol) as the title compound was obtained in total yield of 16.8% according to the same procedure as Synthetic Example 5, but Compound 119 (1.0 g, 1.64 mmol), and Compound 206 (1.28 g, 3.43 mmol) instead of Compound 205 were employed.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.50(d, 4H), 6.75-6.8(m, 8H), 7.0(d, 4H), 7.15-7.3(m, 12H), 7.4-7.6(m, 14H), 7.7-7.75(d, 4H), 7.9-8.0(d, 2H)

MS/FAB: 1048(found), 1049.38(calculated)

[Synthetic Example 7] Synthesis of IF2-3

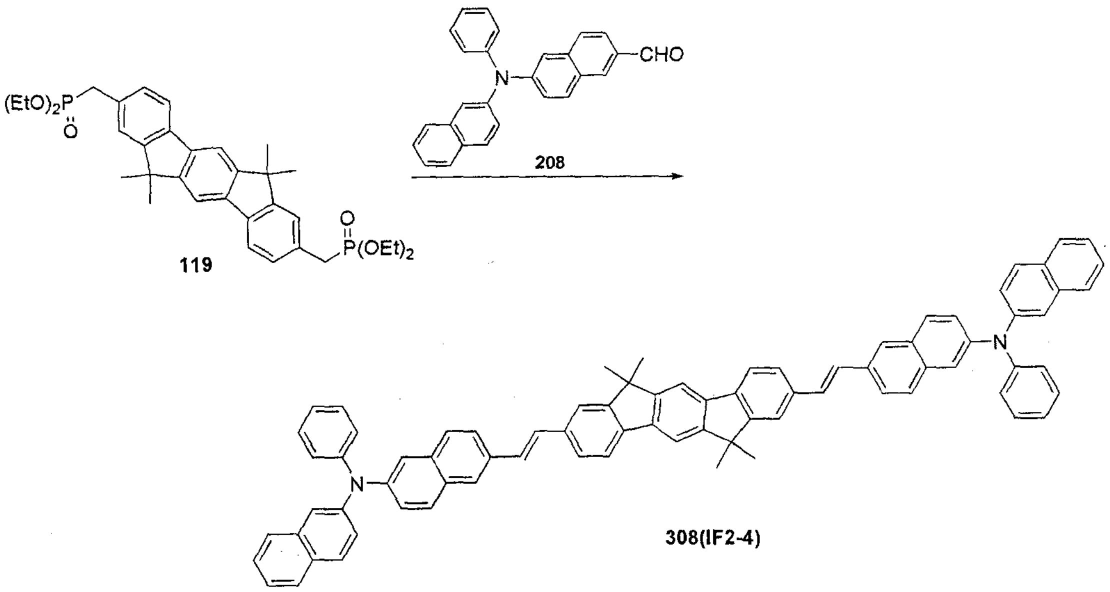


Compound (307, IF2-3) (0.92 g, 1.08 mmol) as the title compound was obtained in total yield of 20.0% according to the same procedure as Synthetic Example 5, but Compound 119 (1.0 g, 1.64 mmol), and Compound 207 (1.10 g, 3.41 mmol) instead of Compound 205 were employed.

^{1}H NMR(200MHz, CDCl$_3$): δ 1.65(s, 12H), 6.45-6.5(d, 8H), 6.6-6.65(m, 2H), 6.75-6.8(m, 4H), 6.95-7.25(m, 16H), 7.4-7.6(m, 8H), 7.7-7.75(d, 4H), 7.9-8.0(d, 2H)

MS/FAB: 948(found), 949.26(calculated)

[Synthetic Example 8] Synthesis of IF2-4

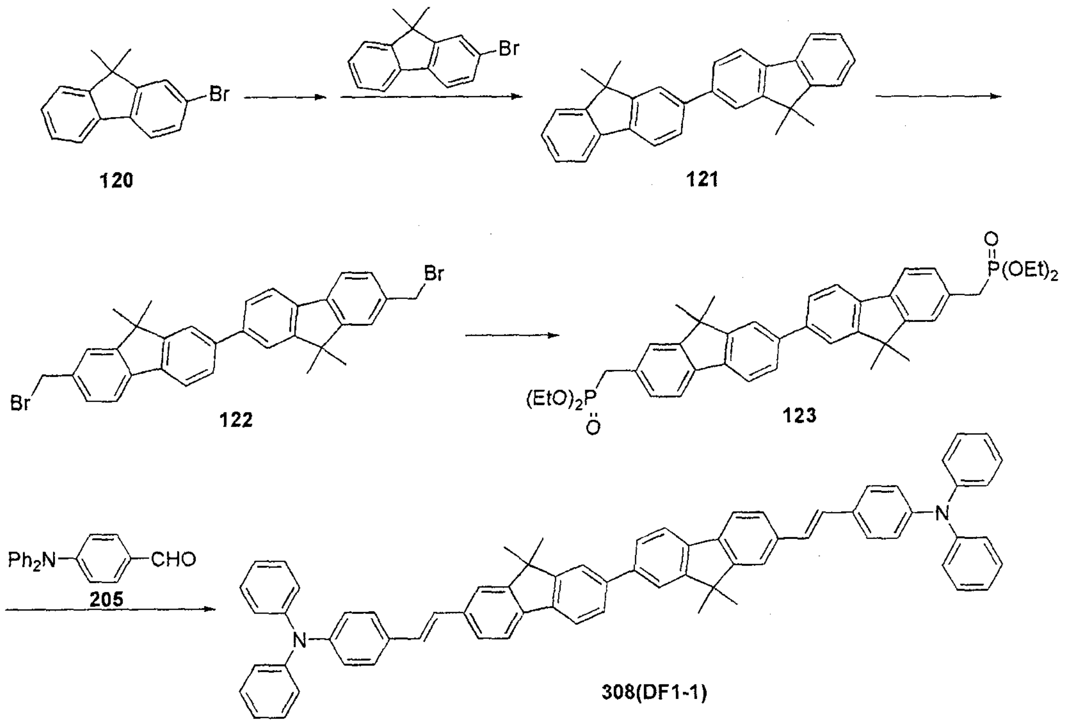


Compound (308, IF2-4) (0.71 g, 0.68 mmol) as the title compound was obtained in total yield of 12.6% according to the same procedure as Synthetic Example 5, but Compound 119 (1.0 g, 1.64 mmol), and Compound 208 (1.28 g, 3.43 mmol) instead of Compound 205 were employed.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(d, 4H), 6.6-6.65(m, 2H), 6.75-6.8(m, 8H), 6.95-7.1(m, 10H), 7.2-7.25(m, 2H), 7.35-7.6(m, 14H), 7.7-7.75(d, 6H), 7.9-8.0(d, 2H)

MS/FAB: 1048(found), 1049.38(calculated)

[Synthetic Example 9] Synthesis of DF1-1



In 50 ml of THF, 2-bromo-9,9-dimethylfluorene (2.0 g, 7.33 mmol) as Compound (120) was dissolved and tert-butyl lithium (1.5 equivalent) was added to the THF solution of 2-bromo-9,9-dimethylfluorene (50 ml) at -80℃ and the resultant solution was stirred at -40℃ under nitrogen atmosphere for 12 hours.

After the stirring completed, 2-isopropoxy-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (4.3 g, 23.1 mmol) was added thereto, while maintaining the temperature of the reaction mixture at -80℃ to provide a boronic ester compound of

Compound (120) (2.16 g, 6.75 mmol), and the resultant boronic ester compound of Compound (120) (2.16 g) was dissolved in 50 ml of THF. To the solution, 2-bromo-9,9-dimethylfluorene (1.92 g, 7.03 mmol), $Pd(PPh_3)_4$ (0.97 g, 0.84 mmol) and aqueous 2M solution of calcium carbonate (15 ml) were added and the resultant mixture was heated under reflux for 10 hours. From the precipitate thus formed, Compound (121) (2.26 g, 5.85 mmol) was obtained.

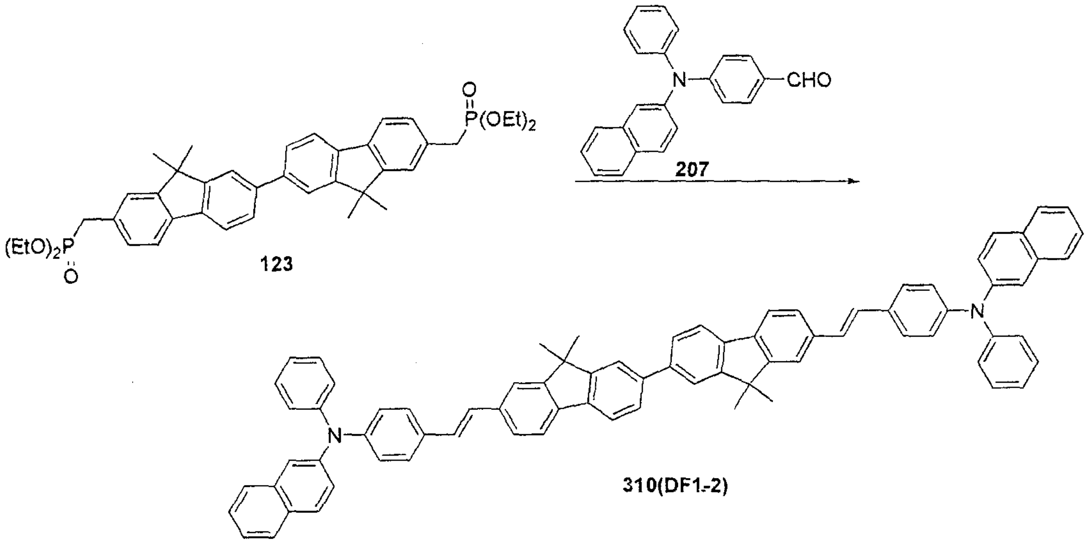
Compound (121) (2.26 g) and paraformaldehyde (2.6 g) were added to 35% HBr solution in acetic acid (20 ml), and the mixture was heated at 60℃ for 24 hours. Then the temperature of the reaction mixture was lowered to ambient temperature, extracted and dried to obtain Compound (122) (2.64 g, 4.62 mmol). Compound (122) (2.64 g) was charged to a reaction vessel. Triethylphosphite (3.42 g, 20.6 mmol) was added thereto at 0℃ and the mixture was heated at 150℃ for 4 hours. After completion of the reaction, residual triethylphosphite was removed by vacuum distillation, and the residue was extracted from ethyl acetate to obtain Compound (123) (2.13 g, 3.10 mmol).

Compound (123) (2.13 g) and Compound (205) (1.86 g, 6.81 mmol) were dissolved in THF (40 ml), and 1.6 M solution of potassium tert-butoxide in THF (10 ml) was added dropwise to the mixed solution at 0℃ The temperature was slowly raised to ambient temperature to complete the reaction. Then an excess amount of water was poured thereto to generate solid, which was then filtered. After recrystallization form THF-methanol, Compound (309, DF1-1) (1.54 g, 1.67 mmol) was obtained as the title compound in total yield of 22.8%.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(m, 12H), 6.6-6.65(m, 4H), 6.95-7.05(m, 12H), 7.15-7.2(d, 4H), 7.5-7.65(m, 4H), 7.7-7.8(m, 4H), 7.85-7.9(d, 4H)

MS/FAB: 924(found), 925.24(calculated)

[Synthetic Example 10] Synthesis of DF1-2



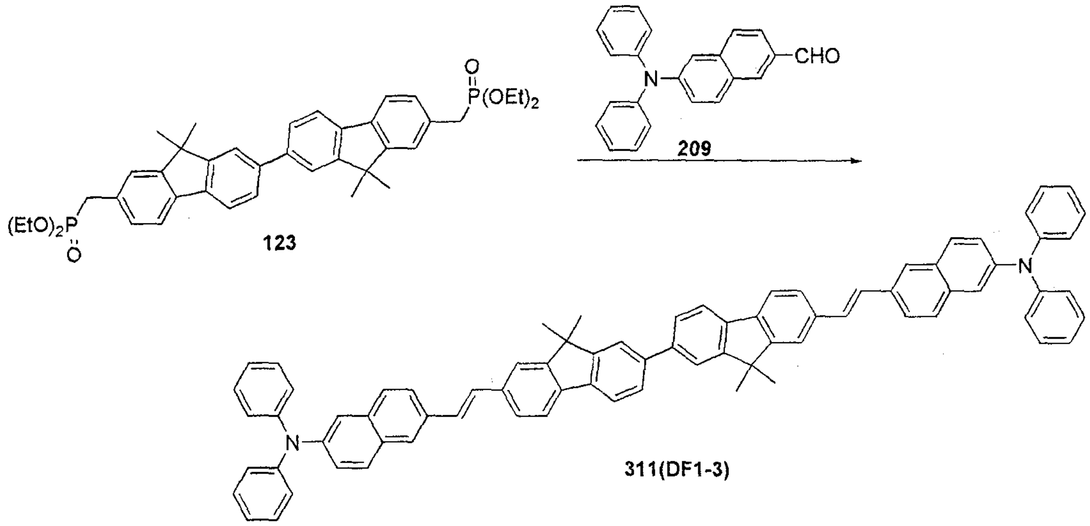
Compound (310, DF1-2) (0.88 g, 0.86 mmol) as the title compound was obtained in total yield of 24.9% according to the same procedure as Synthetic Example 9, but Compound 123 (1 g, 1.46 mmol), and Compound 207 (1.03 g, 3.19 mmol) instead of Compound 205 were employed.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(m, 8H), 6.6-6.65(m, 2H), 6.75-6.8(m, 4H), 6.95-7.25(m, 16H), 7.35-

7.6(m, 10H), 7.7-7.8(d, 4H), 7.8-7.9(d, 4H)

MS/FAB: 1024(found), 1025.36(calculated)

[Synthetic Example 11] Synthesis of DF1-3

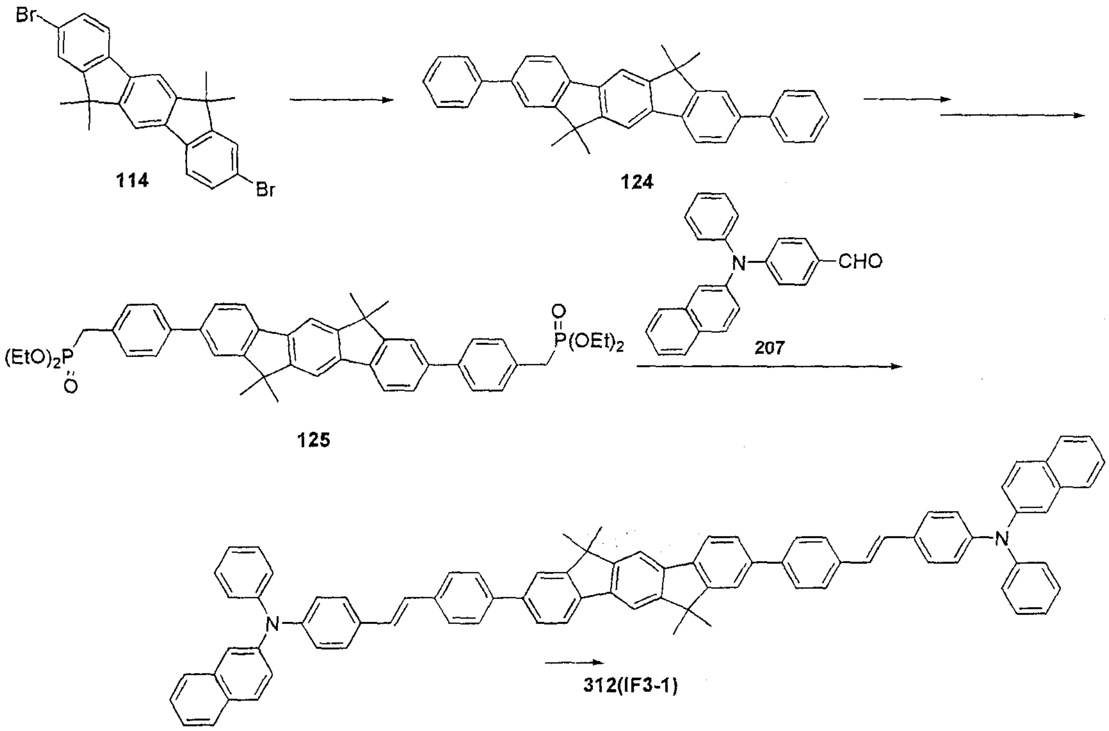


Compound (311, DF1-3) (0.56 g, 0.55 mmol) as the title compound was obtained in total yield of 15.9% according to the same procedure as Synthetic Example 9, but Compound 123 (1 g, 1.46 mmol), and Compound 209 (1.03 g, 3.19 mmol) instead of Compound 205 were employed.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(m, 8H), 6.6-6.65(m, 4H), 6.75-6.8(m, 4H), 6.95-7.05(m, 12H), 7.35-7.6(m, 10H), 7.7-7.8(t, 6H), 7.8-7.9(d, 4H)

MS/FAB: 1024(found), 1025.36(calculated)

[Synthetic Example 12] Synthesis of IF3-1



To a solution of Compound (114) (2.0 g, 4.27 mmol) in THF (50 ml), added were phenyl boronic acid (1.10 g, 9.02 mmol), $Pd(PPh_3)_4$ (1.04 g, 0.90 mmol), and aqueous 2M calcium carbonate solution (15 ml), and the resultant mixture was heated under reflux for 10 hours. From the precipitate thus formed, obtained was Compound (124) (1.80 g, 3.90 mmol).

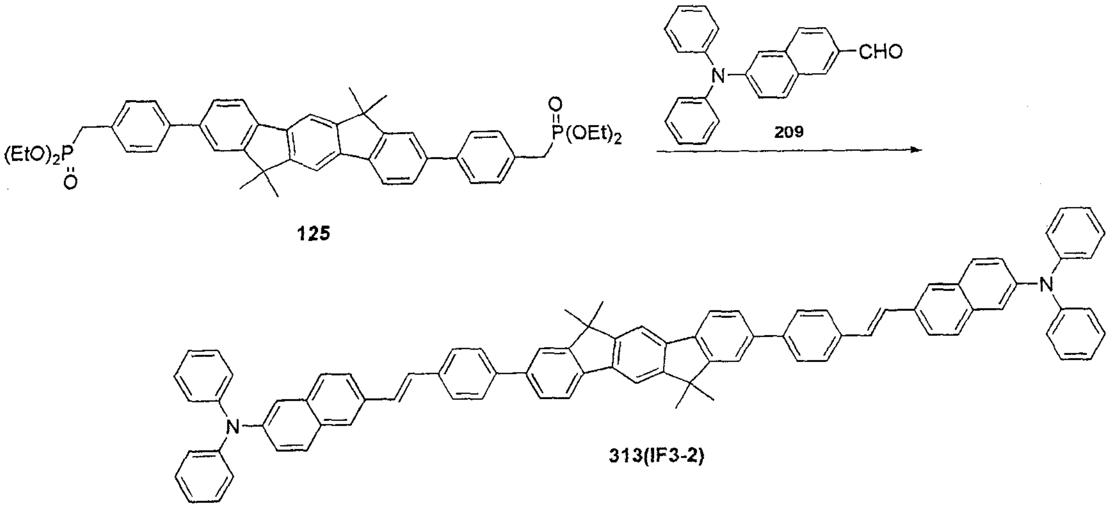
Compound (124) (1.80 g) and paraformaldehyde (1.7 g) were added to 35% HBr solution in acetic acid (20 ml), and the mixture was heated at 60℃ for 24 hours. Then the temperature of the reaction mixture was lowered to ambient temperature, extracted and dried to obtain a bromomethyl derivative, which was then charged to a reaction vessel. Triethylphosphite (2.57 g, 15.5 mmol) was added thereto at 0℃ and the mixture was heated at 150℃ for 4 hours. After completion of the reaction, residual triethylphosphite was removed by vacuum distillation, and the residue was extracted from ethyl acetate to obtain Compound (125) (1.66 g, 2.18 mmol).

Compound (125) (1.66 g) and Compound (207) (1.48 g, 4.58 mmol) were dissolved in THF (50 ml), and 1.6 M solution of potassium tert-butoxide in THF (8 ml) was added dropwise to the mixed solution at 0℃ The temperature was slowly raised to ambient temperature to complete the reaction. Then an excess amount of water was poured thereto to generate solid, which was then filtered. After recrystallization from ethanol, Compound (312, IF3-1) (1.65 g, 1.65 mmol) was obtained as the title compound in total yield of 38.6%.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(m, 8H), 6.6-6.65(m, 2H), 6.75-6.8(m, 4H), 6.95-7.3(m, 16H), 7.4-7.6(m, 14H), 7.65(d, 2H), 7.75(s, 2H), 7.8(s, 2H), 7.95-8.05(d, 2H)

MS/FAB: 1100(found), 1101.46(calculated)

[Synthetic Example 13] Synthesis of IF3-2

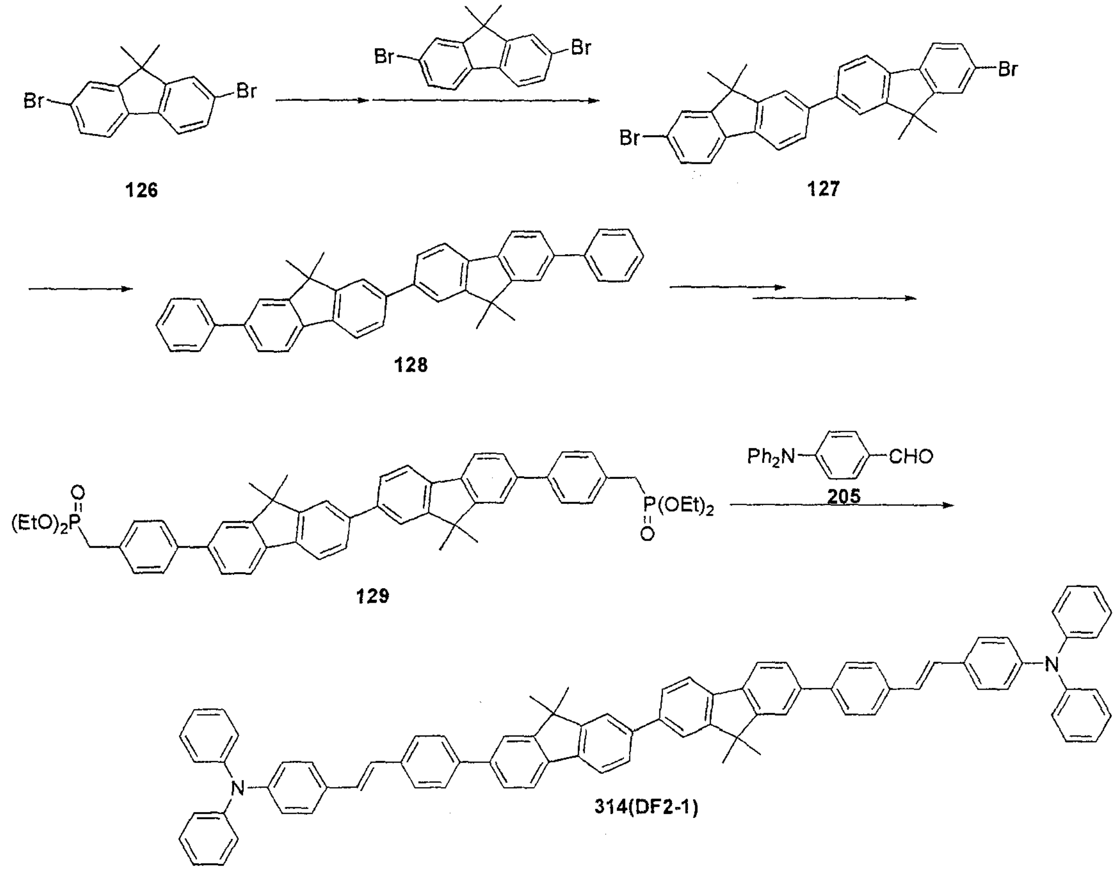


Compound (313, IF3-2) (0.86 g, 0.78 mmol) as the title compound was obtained in total yield of 30.4% according to the same procedure as Synthetic Example 12, but Compound 125 (1 g, 1.31 mmol), and Compound 209 (0.90 g, 2.79 mmol) instead of Compound 207 were employed.

^{1}H NMR(200MHz, CDCl$_3$): δ 1.65(s, 12H), 6.45-6.5(m, 8H), 6.6-6.65(m, 4H), 6.75-6.8(m, 4H), 6.95-7.05(m, 12H), 7.4-7.55(m, 14H), 7.65(d, 2H), 7.7-7.75(d, 4H), 7.8(s, 2H), 7.95-8.05(d, 2H)

MS/FAB: 1100(found), 1101.46(calculated)

[Synthetic Example 14] Synthesis of DF2-1



To a solution of 2,7-dibromo-9,9-dimethylfluorene (2.0 g, 5,68 mmol) as Compound (126) in THF (50 ml), added was 1.5 equivalent of tert-butyl lithium at -80℃ and the resultant solution was stirred at -40℃ under nitrogen atmosphere for 12 hours.

After the stirring completed, 2-isopropoxy-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (0.95 g, 5.11 mmol) was added thereto, while maintaining the temperature of the reaction mixture at -80℃ to provide a boronic ester compound of

Compound (126) (1.86 g, 4.66 mmol), and the resultant boronic ester compound of Compound (126) (1.86 g) was dissolved in 50 ml of THF. To the solution, added were 2,7-dibromo-9,9-dimethylfluorene (1.56 g, 4.43 mmol), $Pd(PPh_3)_4$ (0.67 g, 0.58 mmol) and aqueous 2M solution of calcium carbonate (10 ml), and the resultant mixture was heated under reflux for 10 hours. From the precipitate thus formed, obtained was Compound (127) (2.12 g, 3.90 mmol).

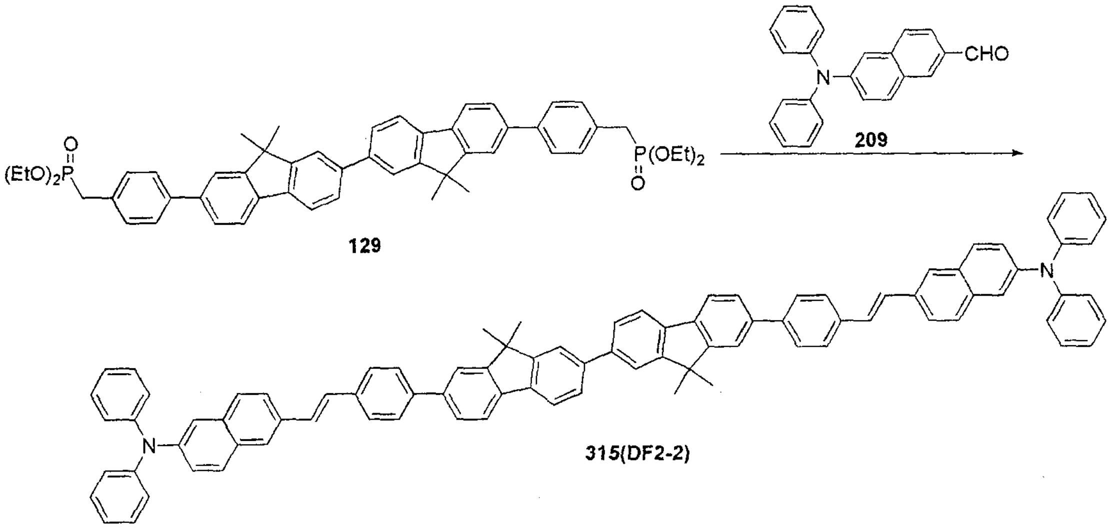
To a solution of Compound (127) (2.12 g, 4.27 mmol) in THF (50 ml), added were phenyl boronic acid (1.00 g, 8.20 mmol), $Pd(PPh_3)_4$ (1.18 g, 1.02 mmol) and aqueous 2M calcium carbonate solution (20 ml), and the resultant mixture was heated under reflux for 10 hours. From the precipitate thus formed, obtained was Compound (128) (1.87 g, 3.48 mmol).

Compound (128) (1.87 g) and paraformaldehyde (1.8 g) were added to 35% HBr solution in acetic acid (15 ml), and the mixture was heated at 60℃ for 24 hours. Then the temperature of the reaction mixture was lowered to ambient temperature, extracted and dried to obtain a bromethyl derivative, which was then charged to a reaction vessel. Triethylphosphite (2.30 g, 13.9 mmol) was added dropwise thereto at 0℃ and the mixture was heated at 150℃ for 4 hours. After completion of the reaction, residual triethylphosphite was removed by vacuum distillation, and the residue was extracted from ethyl acetate to obtain Compound (129) (1.32 g, 1.57 mmol).

Compound (129) (1.32 g) and Compound (205) (0.90 g, 3.30 mmol) were dissolved in THF (30 ml), and 1.6 M solution of potassium tert-butoxide in THF (6 ml) was added to the mixed solution dropwise at 0℃ The temperature was slowly raised to ambient temperature to complete the reaction. Then an excess amount of water was poured thereto to generate solid, which was then filtered. After recrystallization from ethanol, Compound (314, DF2-1) (1.28 g, 1.19 mmol) was obtained as the title compound in total yield of 21.0%.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(m, 12H), 6.6-6.65(m, 4H), 6.95-7.05(m, 12H), 7.15-7.2(m, 4H), 7.45-7.5(d, 8H), 7.55-7.6(m, 4H), 7.75-7.8(d, 4H), 7.85-7.9(d, 4H)

[Synthetic Example 15] Synthesis of DF2-2



Compound (315, DF2-2) (0.86 g, 0.73 mmol) as the title compound was obtained in total yield of 17.0% according to the same procedure as Synthetic Example 14, but Compound 129 (1.0

g, 1.19 mmol), and Compound 209 (0.93 g, 2.88 mmol) instead of Compound 205 were employed.

^{1}H NMR(200MHz, $CDCl_3$): δ 1.65(s, 12H), 6.45-6.5(m, 8H), 6.6-6.8(m, 8H), 6.95-7.05(m, 12H), 7.35-7.6(m, 18H), 7.7-7.8(t, 6H), 7.85-7.9(d, 4H)

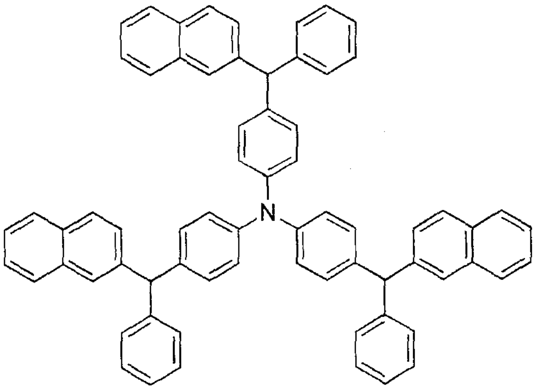
MS/FAB: 1176(found), 1177.56(calculated)

[Example 1] Manufacture of OLED device by using the compound according to the present invention

An OLED device having the structure employing the electroluminescent material was manufactured.

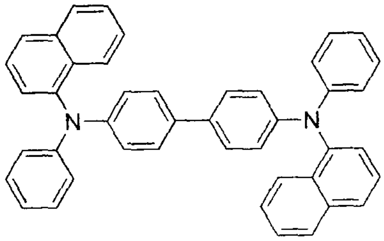
First, a transparent electrode ITO thin film (15 Ω/□) obtained from a glass for OLED was subjected to ultrasonic washing by trichloroethylene, acetone, ethanol and distilled water, subsequently, and stored in isopronanol before use.

Then, an ITO substrate was equipped in a substrate folder of vacuum vapor deposition equipment, and 4,4′,4″-tris(N,N-(2-naphthyl)-phenylamino)triphenylamine (2-TNATA) represented by following structural formula was placed in a cell of the vacuum vapor deposition equipment, which was then ventilated up to 10^{-6} torr of vacuum in the chamber. Electric current was applied to the cell to evaporate 2-TNATA to vapor-deposit a hole injection layer having 60 nm of thickness on the ITO substrate.



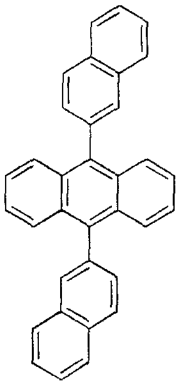
2-TNATA

Then, to another cell of the vacuum vapor deposition equipment, charged was N,N'-bis(α-naphthyl)-N,N'-diphenyl-4,4'-diamine (NPB), and electric current was applied to the cell to evaporate NPB to vapor-deposit a hole transport layer of 20 nm of thickness on the hole injection layer.

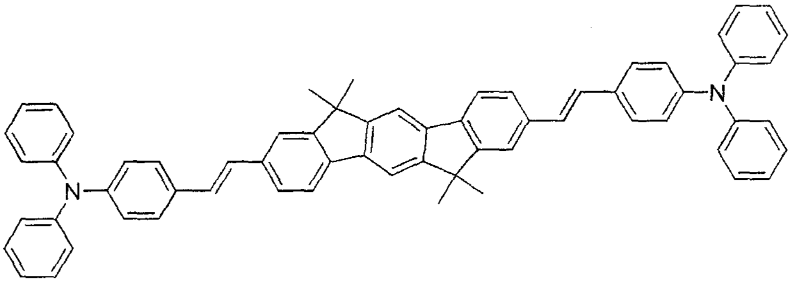


NPB

After forming the hole injection layer and hole transport layer, an electroluminescent layer was vapor-deposited thereon as follows. In one cell of the vacuum vapor deposition equipment, charged was dinaphthylanthracene (DNA) represented by following structural formula, and in another cell, an electroluminescent material of a compound according to the present invention (ex. Compound IF2-1), and an electroluminescent layer having 30 nm of thickness was vapor-deposited on said hole transport layer with the vapor deposition rate of 100:1.



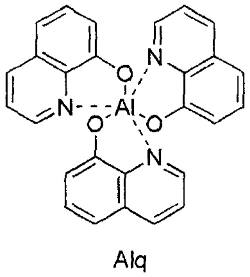
DNA



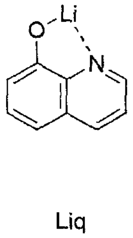
IF2-1

Then, tris(8-hydroxyquinoline)aluminum (III) (Alq) represented by following structural formula was vapor-deposited as an electron transport layer having 20 nm of thickness, and lithium quinolate (Liq) represented by following structural formula was vapor-deposited as an electron injection layer having from 1 to 2 nm of thickness.

Thereafter, an Al cathode was vapor-deposited with 150 nm of thickness by using another vapor-deposit device to manufacture an OLED.



Alq

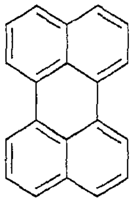


Liq

Each material employed in the OLED device was purified by vacuum sublimation under 10^{-6} torr, and employed as an electroluminescent material for OLED.

[Comparative Example 1] Preparation of an OLED employing conventional electroluminescent material

A hole injection layer and hole transport layer were created according to the same procedure as described in Example 1, and dinaphthylanthracene (DNA) as a blue electroluminescent material was charged in one cell of said vapor deposition equipment, while perylene having the following structural formula in another cell as another blue electroluminescent material. Then, an electroluminescent layer with 30 nm thickness was vapor-deposited on said hole transport layer with the vapor deposition rate of 100:1.



perylene

Then, an electron transport layer and an electron injection layer were vapor-deposited according to the same procedure as described in Example 1, and an Al cathode was vapor-deposited by using another vacuum vapor deposition equipment with a thickness of 150 nm, to manufacture an OLED.

[Example 2] Electroluminescent properties of the OLED manufactured

Electroluminescent efficiencies of OLEDs comprising the organic electroluminescent compound according to the invention prepared from Example 1 and the conventional electroluminescent compound prepared from Comparative Example 1 were measured at 500 cd/m^2 and 2,000 cd/m^2, respectively, of which the results are shown in Table 1. Since the luminescent properties in the range of low luminance and those applied on a panel are very important in case of blue electroluminescent material, in particular, the data of luminance of about 2,000 cd/m^2 was established as the standard in order to reflect those properties.

[Table 1]

No.	EL Material 1	EL Material 2	EL peak (nm)	EL Efficiency (cd/A)		Color coordinate		EL Efficiency/Y
				@500 cd/m^2	@2,000 cd/m^2	X	Y	
1	DNA	IF1-1	451	3.67	2.89	0.155	0.137	26.8

2	DNA	IF1-2	435	2.90	2.04	0.151	0.092	31.5
3	DNA	IF1-3	435	3.01	2.32	0.151	0.094	32.0
4	DNA	IF1-4	438	2.95	2.20	0.151	0.093	31.7
5	DNA	IF2-1	465	11.27	12.81	0.154	0.195	65.7
6	DNA	IF2-2	465	11.71	12.37	0.166	0.202	61.2
7	DNA	IF2-3	465	10.33	12.87	0.169	0.208	61.9
8	DNA	IF2-4	461	8.02	10.90	0.158	0.192	56.8
9	DNA	DF1-1	456	7.70	8.35	0.149	0.146	57.2
10	DNA	DF1-2	456	7.07	8.41	0.158	0.155	54.3
11	DNA	DF1-3	455	6.73	7.81	0.147	0.128	61.0
12	DNA	IF3-1	453	6.61	6.76	0.155	0.132	51.2
13	DNA	IF3-2	452	5.60	5.80	0.150	0.126	44.5
14	DNA	DF2-1	450	5.11	5.09	0.168	0.104	49.1
15	DNA	DF2-2	448	4.50	4.62	0.157	0.103	44.8
Comp.1	DNA	Perylene	456, 484	4.45	3.62	0.160	0.200	22.3

As can be seen from Table 1, the OLED device employing the organic electroluminescent compounds as the electroluminescent material was compared to the OLED device of Comparative Example which employs widely known DNA:perylene as a conventional electroluminescent material, on the basis of "luminous efficiency/Y" value which shows similar tendency to proton efficiency. As the result, the OLED device employing the organic electroluminescent compound according to the present invention showed higher "luminous efficiency/Y" value than that of Comparative Example.

In view of the fact that the organic electroluminescent compound according to the invention showed higher "luminous efficiency/Y" value, it is found that indenofluorene which is the basic skeletal of the organic electroluminescent compounds of the present invention is a material having high proton efficiency. In addition, it is found that the organic electroluminescent compounds of the present invention can realize higher efficiency and color purity as compared to conventional electroluminescent compounds. In particular, in case of the series of IF2, DF1 and IF3, the "luminous efficiency/Y" value was enhanced 3-folds or more as compared to conventional electroluminescent compound.

In general, in case of a structure comprising a double bond primarily based on stilbene, noticeable enhancement of performances was confirmed. It is assumed that the enhancement of performances in case that the molecular structure wherein the chemical bonds are formed via double bond(s) rather than those wherein only aromatics are simply connected is due to improvement of overlaps between the orbitals of respective aromatic ring in the molecular structure.

From Table 1, it is confirmed that "luminous efficiency/Y" value of the compounds of the invention showed at least two-folds of improvement of the performance as compared to conventional materials, and this comes from the effect of indenofluorene and difluorene skeletal of the present invention to improve by far the valuable properties.

As described above, the organic electroluminescent compounds according to the present invention can be employed as a blue electroluminescent material of high efficiency, thereby having great advantages in terms of luminance of OLED, power consumption and life as compared to conventional ones.

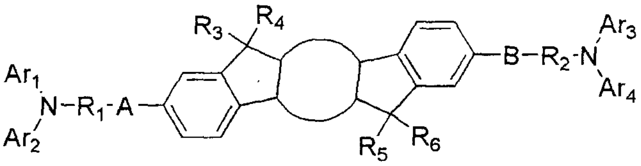
【 Industrial Applicability 】

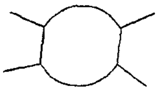
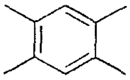
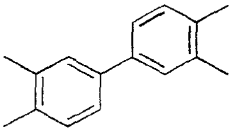
The organic electroluminescent compounds according to the present invention have good electroluminescent efficiency and excellent life properties, thereby providing OLED having very long lifetime of operation.

【 What is claimed is: 】

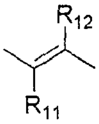
1. An organic electroluminescent compound represented by Chemical Formula 1:

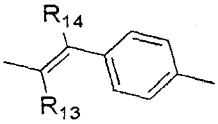
[Chemical Formula 1]



wherein,  represents  or  ,

A and B independently represent a chemical bond,



or


,

R_1 and R_2 independently represent an aromatic ring or a fused multi-cyclic aromatic ring having two or more aromatic rings,

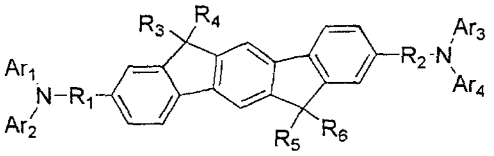
R_3 through R_6 independently represent a linear or branched C_1-C_{20} alkyl group with or without halogen substituent(s), a C_5-C_8 cycloalkyl group, or an aromatic group with or without halogen substituent(s),

R_{11} through R_{14} independently represent a hydrogen, a C_1-C_8 alkyl group, a C_5-C_8 cycloalkyl group or an aromatic group with or without halogen substituent(s),

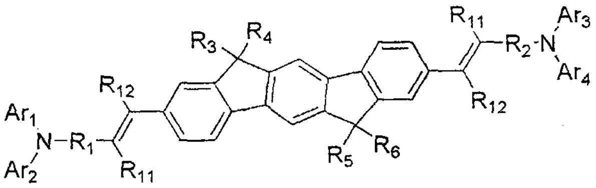
Ar_1 through Ar_4 independently represent an aromatic ring or a fused multi-cyclic aromatic ring having two or more aromatic rings.

2. An organic electroluminescent compound according to claim 1, which is represented by one of Chemical Formulas 2 to 6:

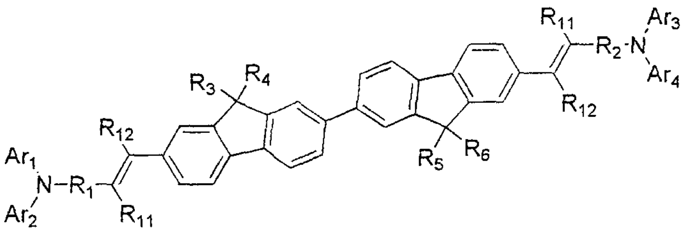
[Chemical Formula 2]



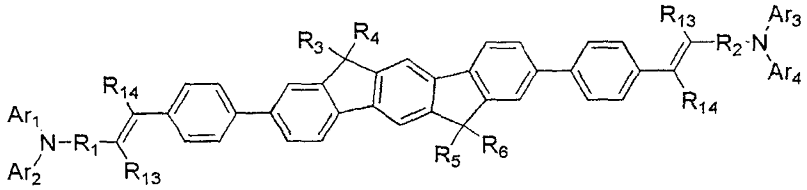
[Chemical Formula 3]



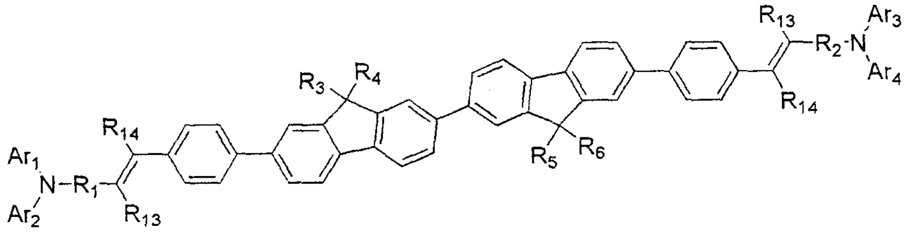
[Chemical Formula 4]



[Chemical Formula 5]



[Chemical Formula 6]



wherein, R_1 and R_2 independently represent an aromatic group or a fused multi-cyclic aromatic ring having two or more aromatic rings,

R_3 through R_6 independently represent a linear or branched C_1-C_{20} alkyl group with or without halogen substituent(s), a C_5-C_8 cycloalkyl group, or an aromatic group with or without halogen substituent(s),

R_{11} through R_{14} independently represent hydrogen, a C_1-C_8 alkyl group, a C_5-C_8 cycloalkyl group or an aromatic group with or without halogen substituent(s), and

Ar_1 through Ar_4 independently represent an aromatic ring or a fused multi-cyclic aromatic ring having two or more aromatic rings.

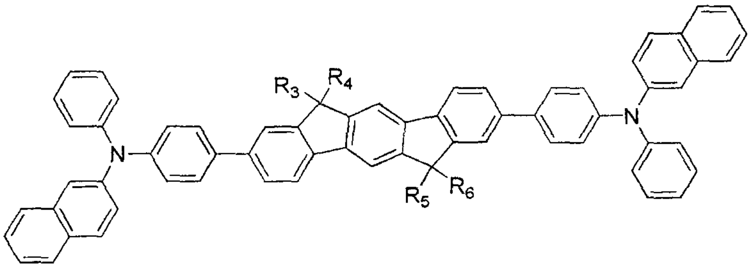
3. An organic electroluminescent compound according to claim 2, wherein R_1 and R_2 in Chemical Formulas 2 through 6 are selected from phenylene, naphthalene, anthracene, naphthacene, pyrene, fluorene and biphenyl,

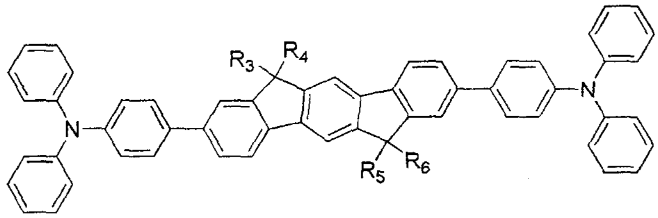
R_3 through R_6 represent methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-amyl, n-hexyl, n-heptyl, n-octyl, 2-ethylhexyl, n-nonyl, trifluoromethyl, pentafluoroethyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, phenyl, tolyl, 1-naphthyl, 2-naphthyl, 2-fluorophenyl or 4-fluorophenyl,

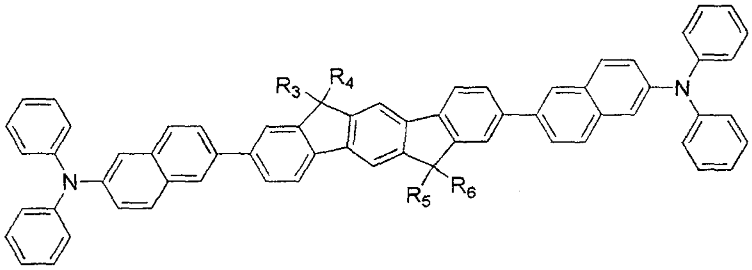
R_{11} through R_{14} represent a hydrogen, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, n-hexyl, n-heptyl, n-octyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, phenyl, tolyl, 1-naphthyl, 2-naphthyl, 2-fluorophenyl or 4-fluorophenyl, and

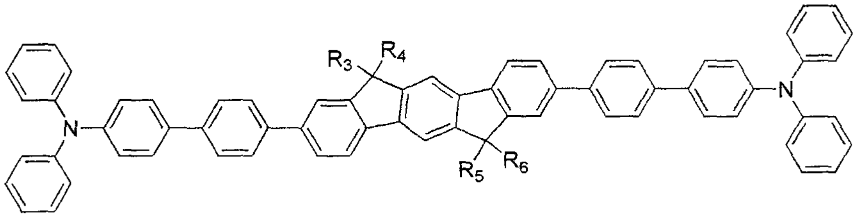
Ar_1 through Ar_4 represent phenyl, tolyl, xylyl, pyridyl, biphenyl, naphthyl, anthryl, phenanthryl, naphthacenyl, acenaphthenyl, pyrenyl, fluorenyl or perylenyl.

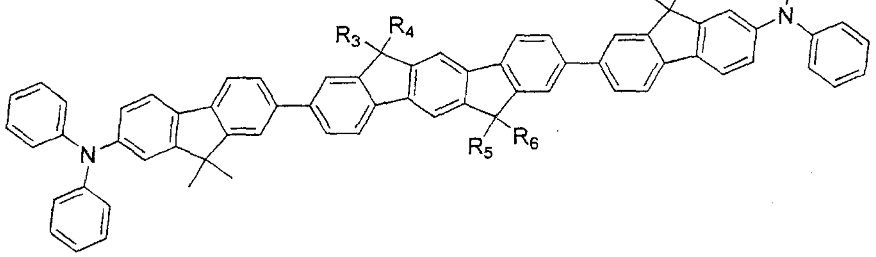
4. An organic electroluminescent compound according to claim 3, which is selected from the compounds represented by following chemical formulas:

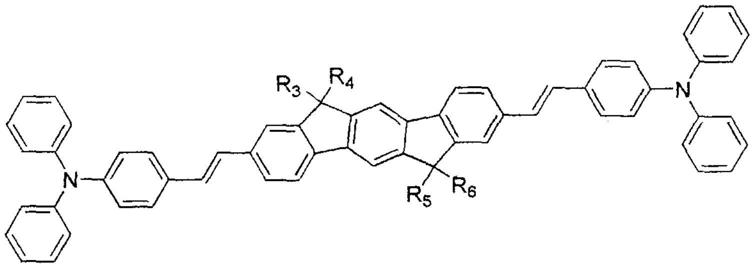

R3
R4
R5
R6
N
N


R3
R4
R5
R6
N
N

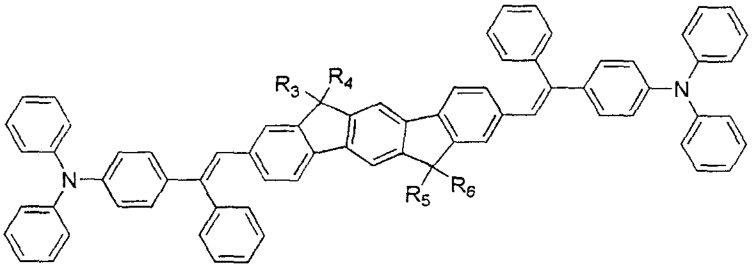

R3
R4
R5
R6
N
N


R3
R4
R5
R6
N
N

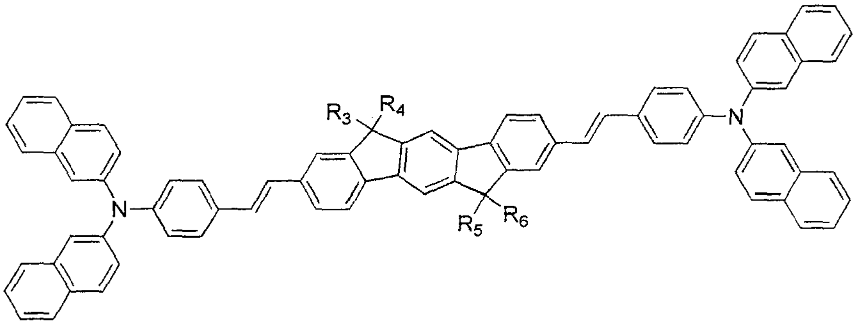

R3
R4
R5
R6
N
N



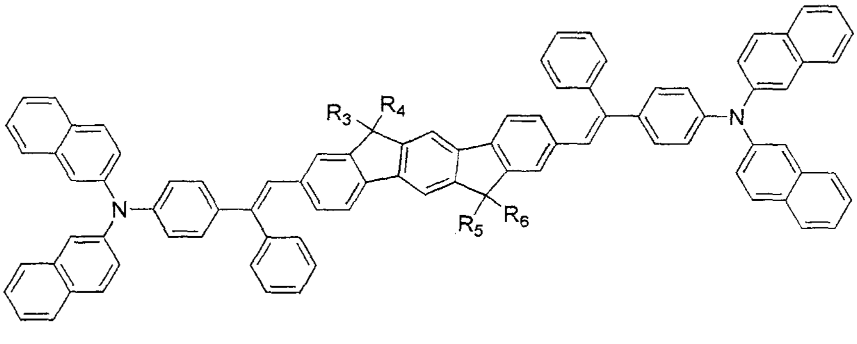
R3
R4
R5
R6
N
N



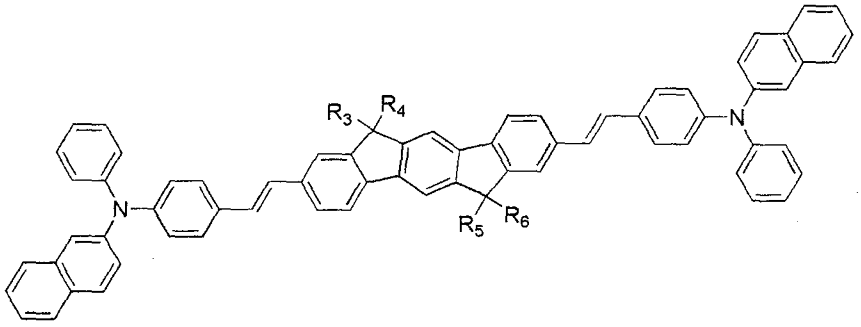
R3
R4
R5
R6
N
N

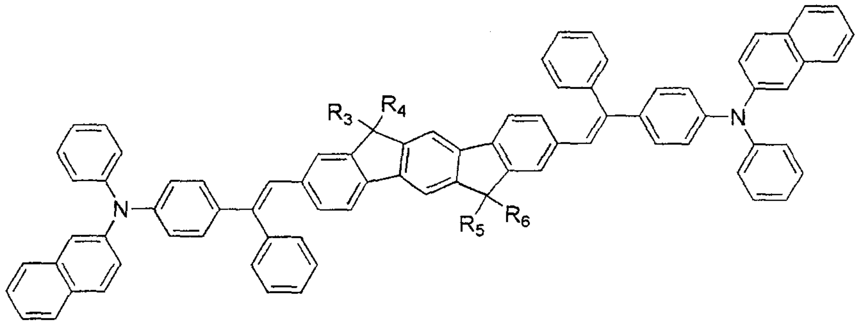


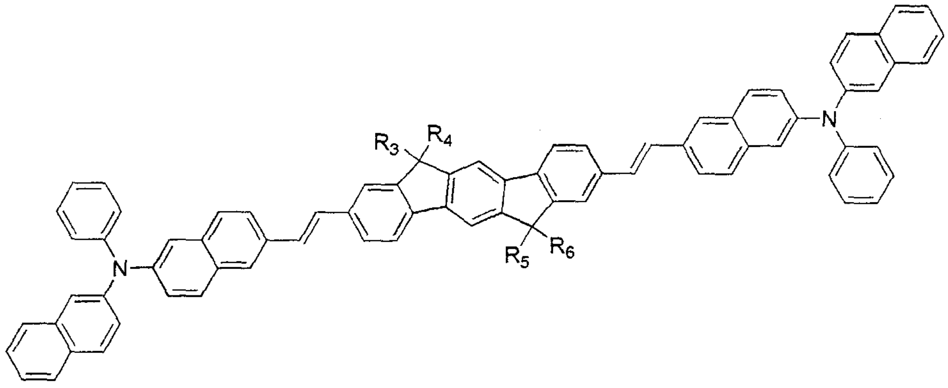
R3
R4
R5
R6
N
N

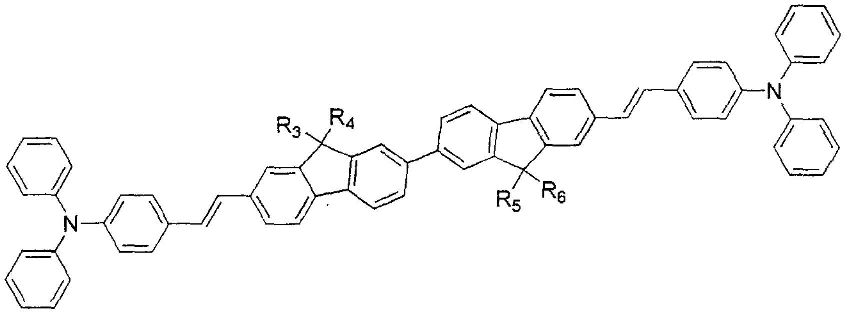


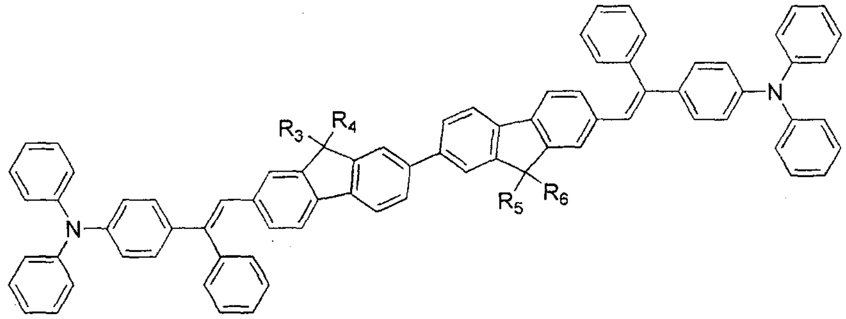
R3
R4
R5
R6
N
N


R3
R4
R5
R6
N
N


R3
R4
R5
R6
N
N


R3
R4
R5
R6
N
N


R3
R4
R5
R6
N
N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R4
R5
R6
N
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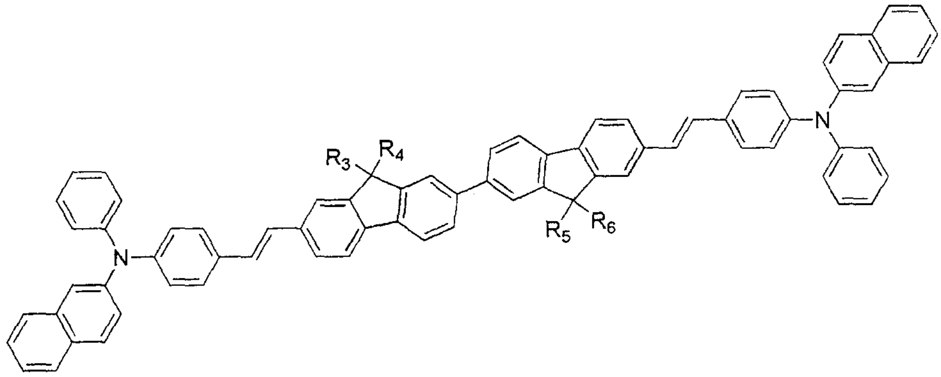
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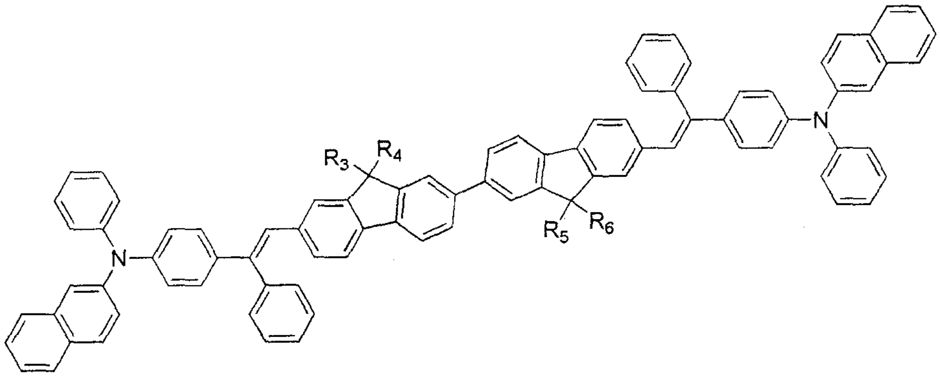
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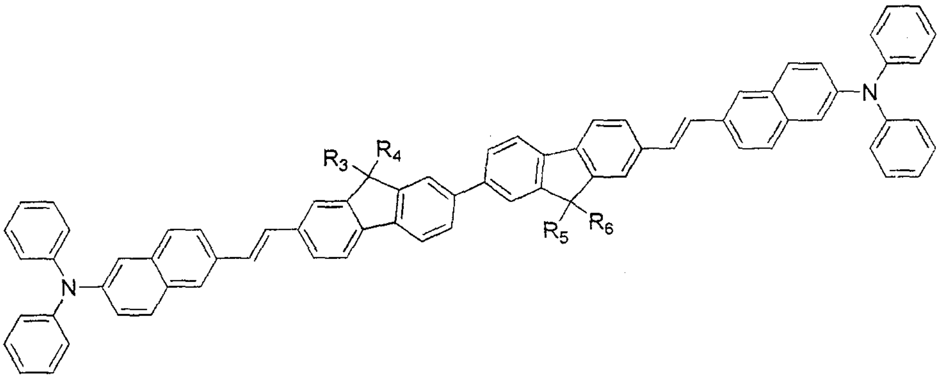
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R5
R6
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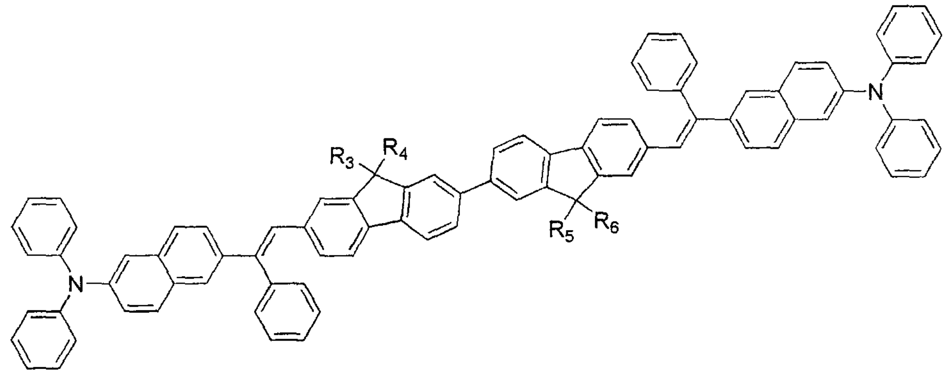
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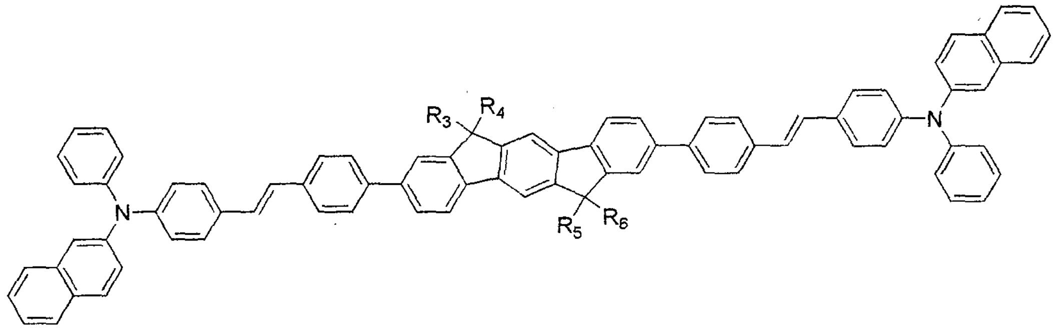
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R5
R6
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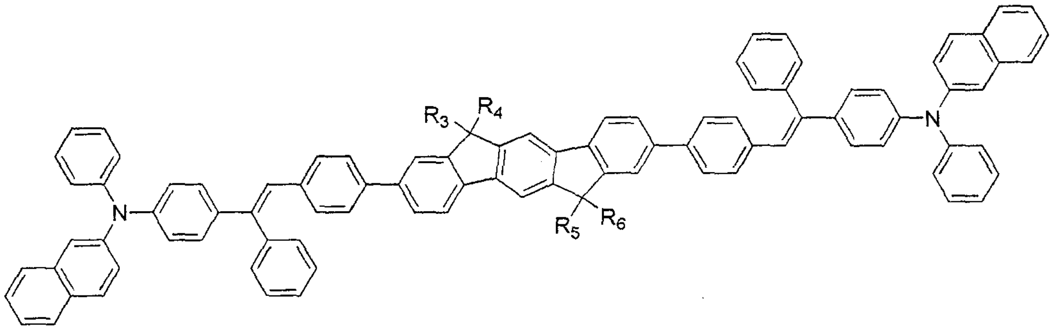
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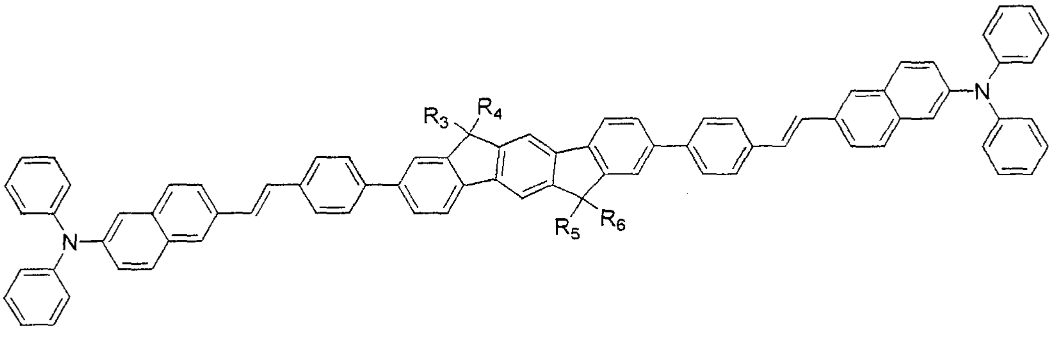
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R6
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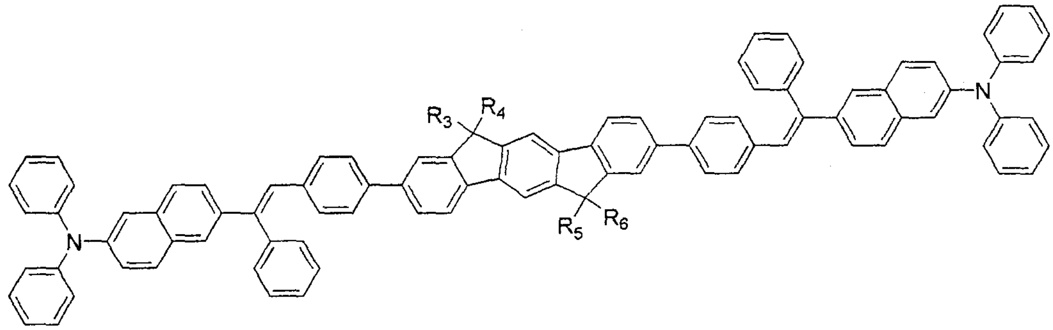
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R6
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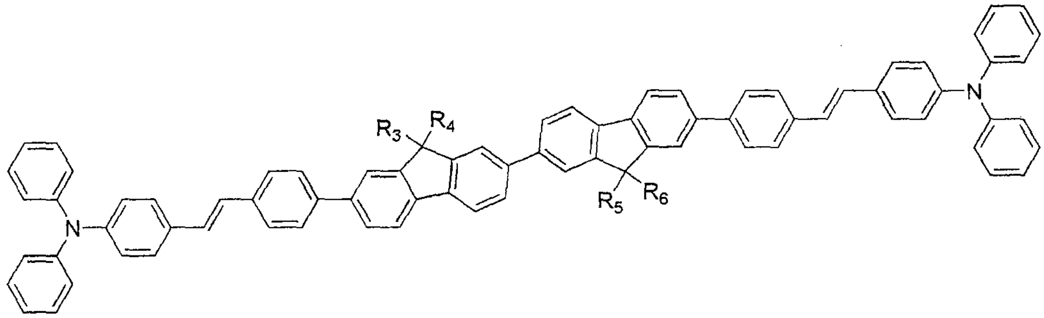
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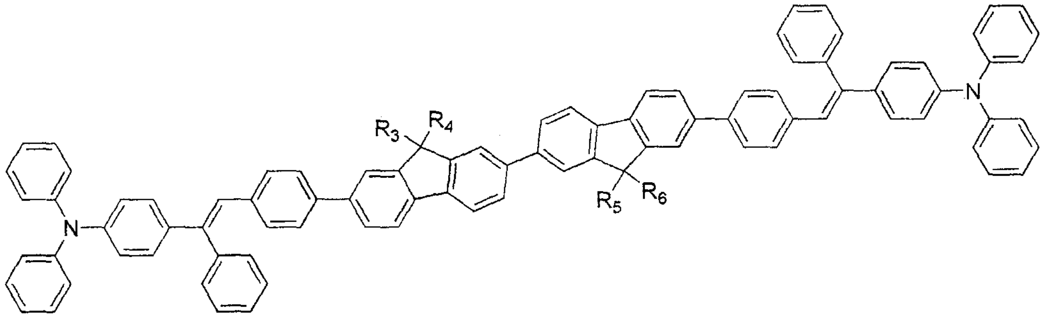
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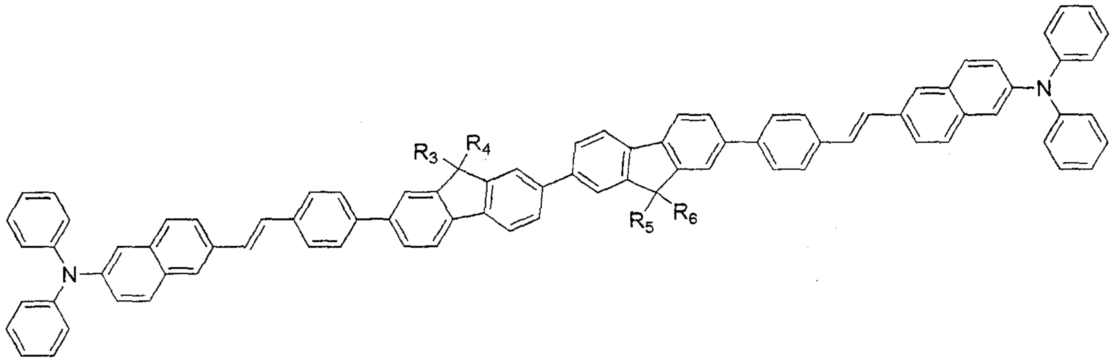
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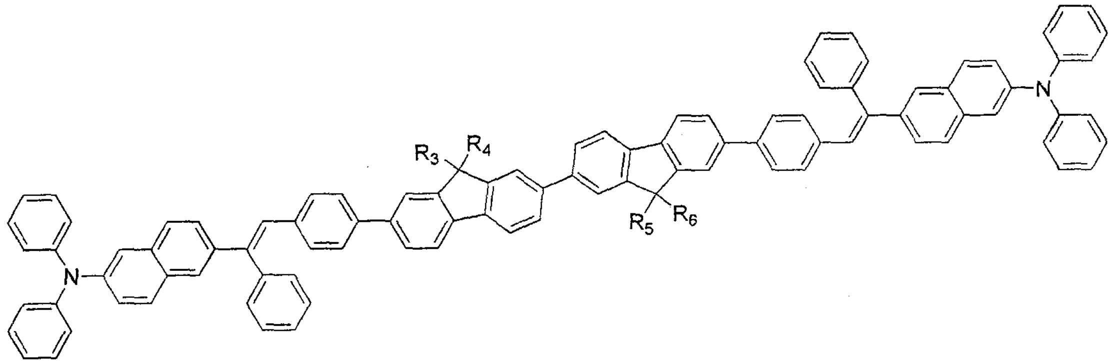
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R6
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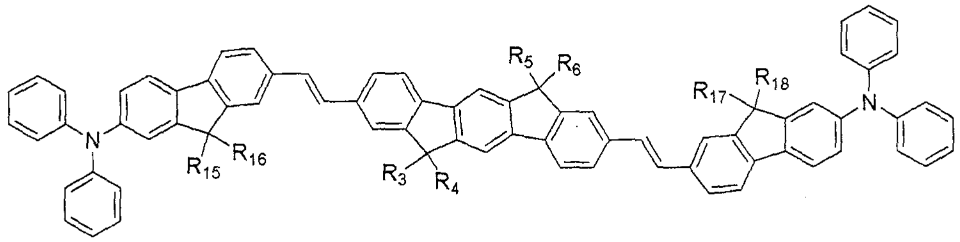
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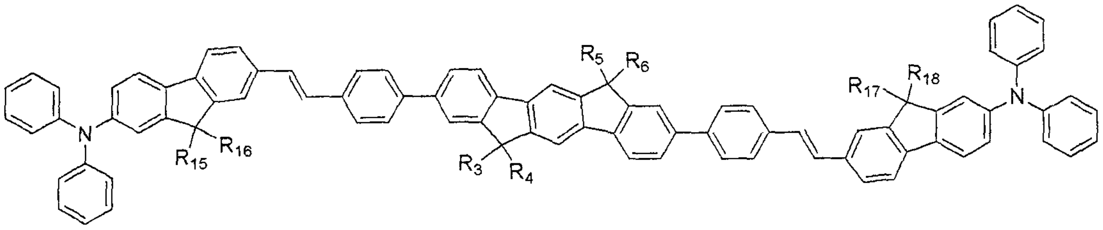
R15
R16
R5
R6
R3
R4
R17
R18
N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R6
R3
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R17
R18
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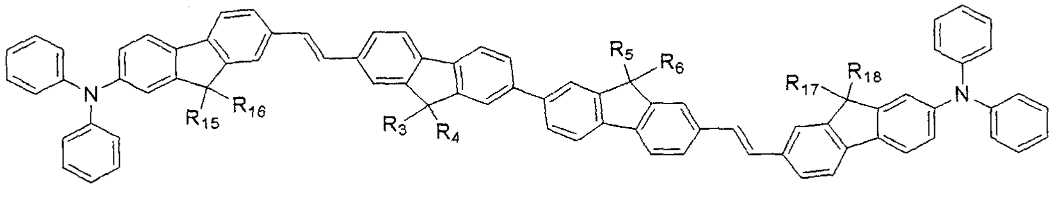
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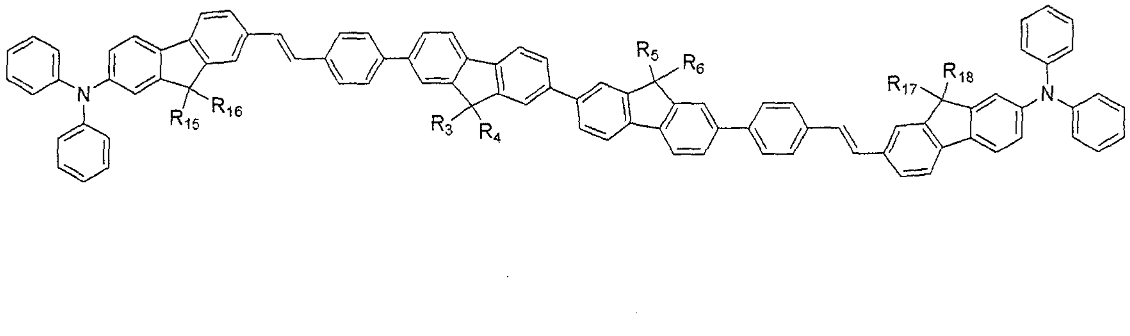
R15
R16
R3
R4
R5
R6
R17
R18
N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R15
R16
R3
R4
R5
R6
R17
R18
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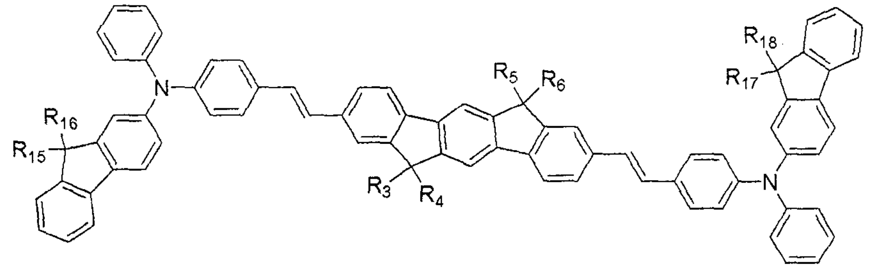
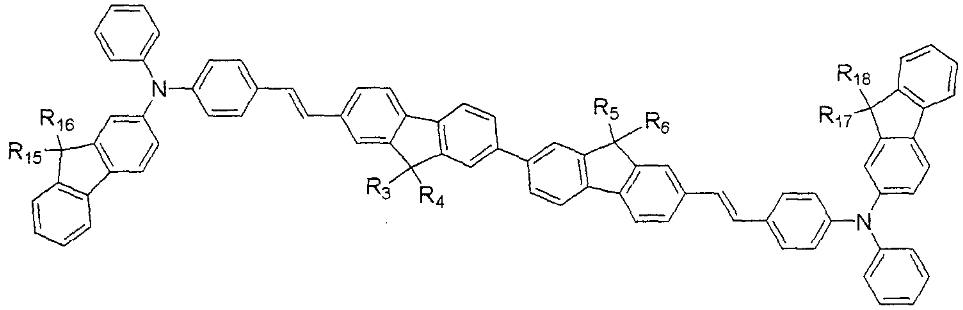
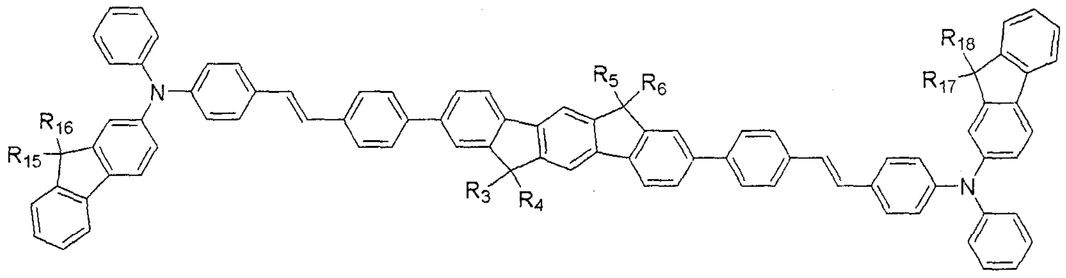
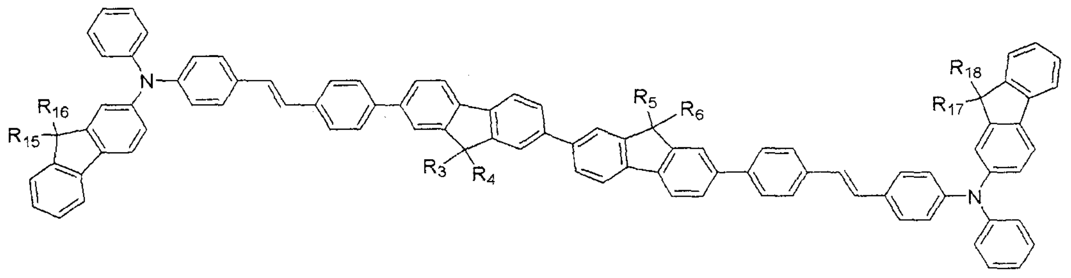






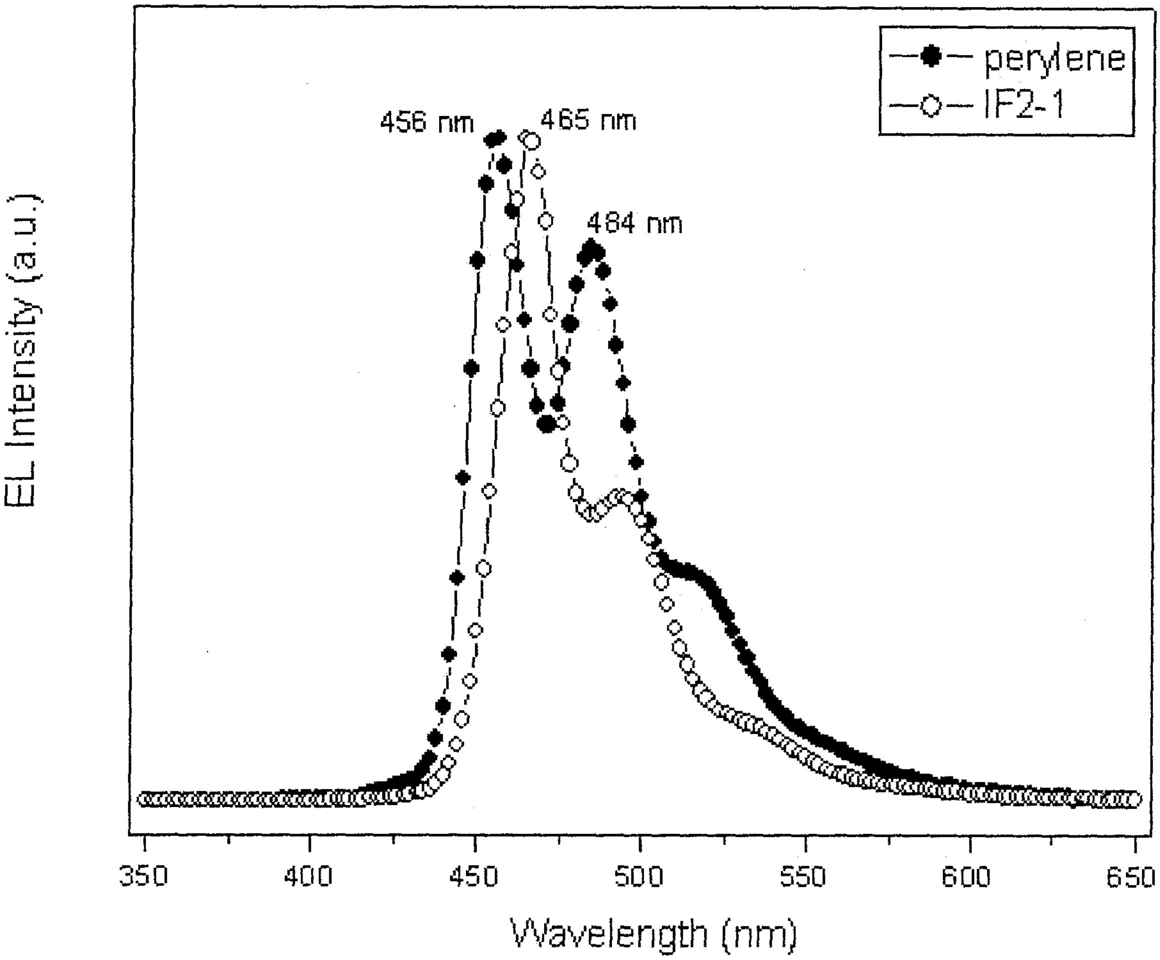


wherein, R_3 through R_6 represent methyl group or ethyl group, and R_{15} to R_{18} represent methyl group, ethyl group or phenyl group.

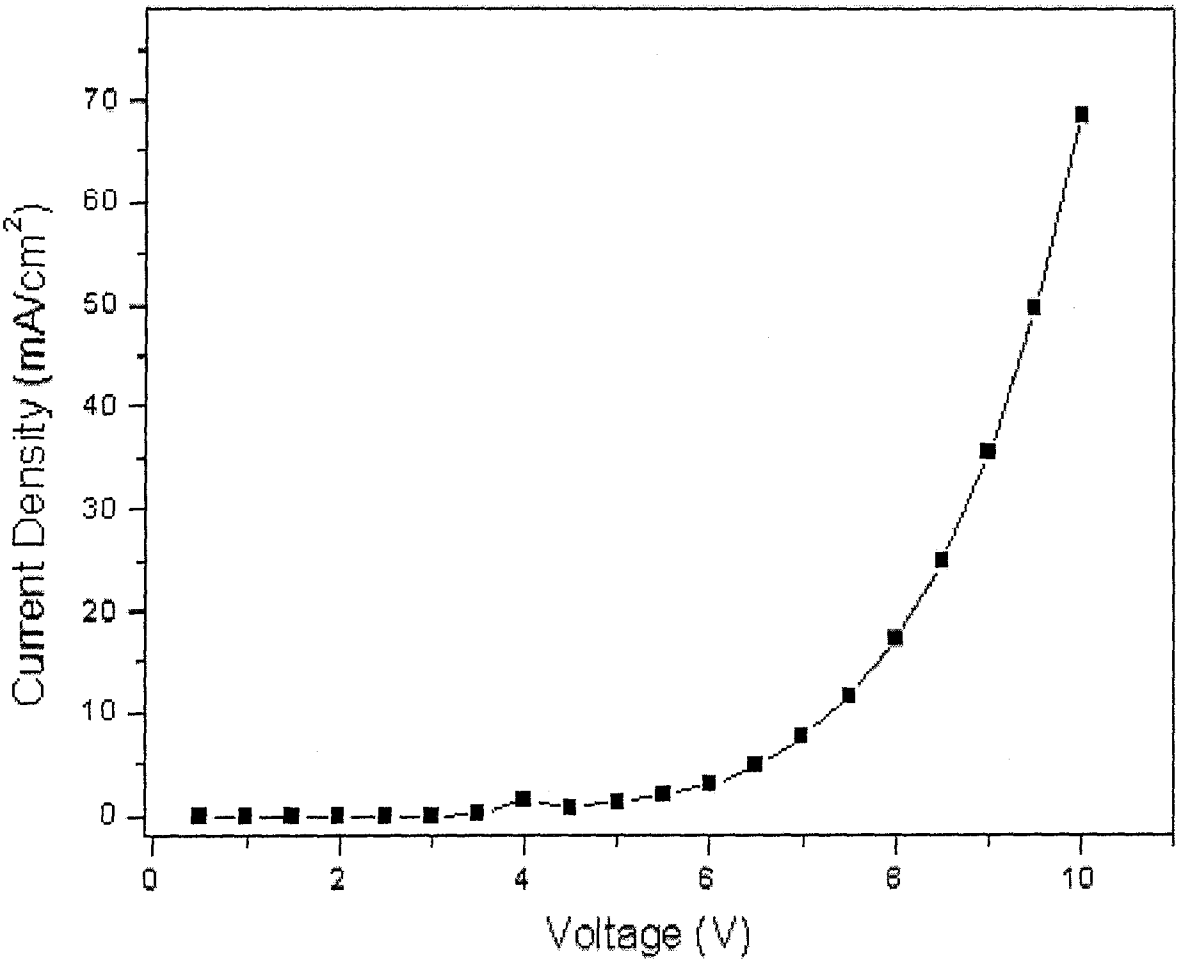
5. An organic electroluminescent device comprising an anode; a cathode; and an organic electroluminescent compound according to any one of claims 1 to 4 between the anode and the cathode.

【DRAWINGS】

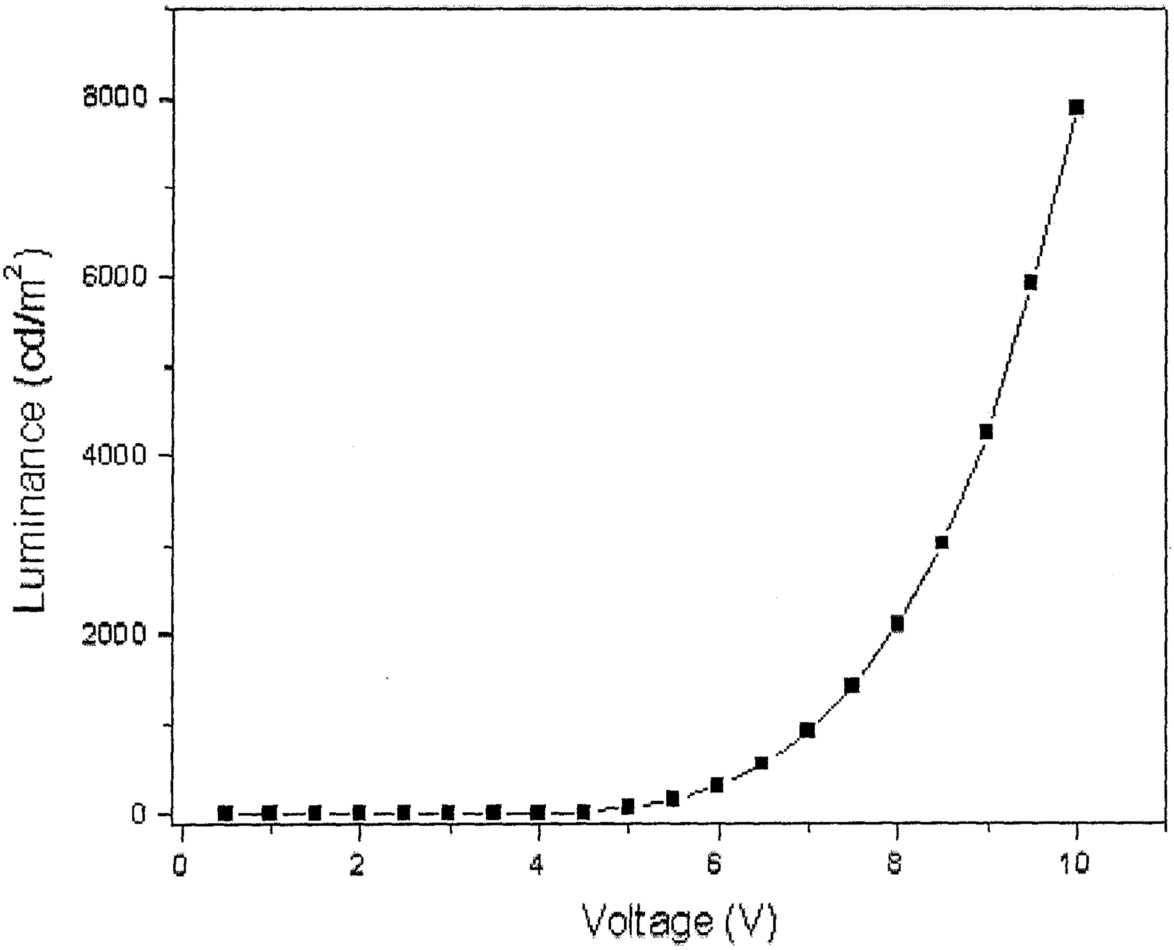
【Figure 1】



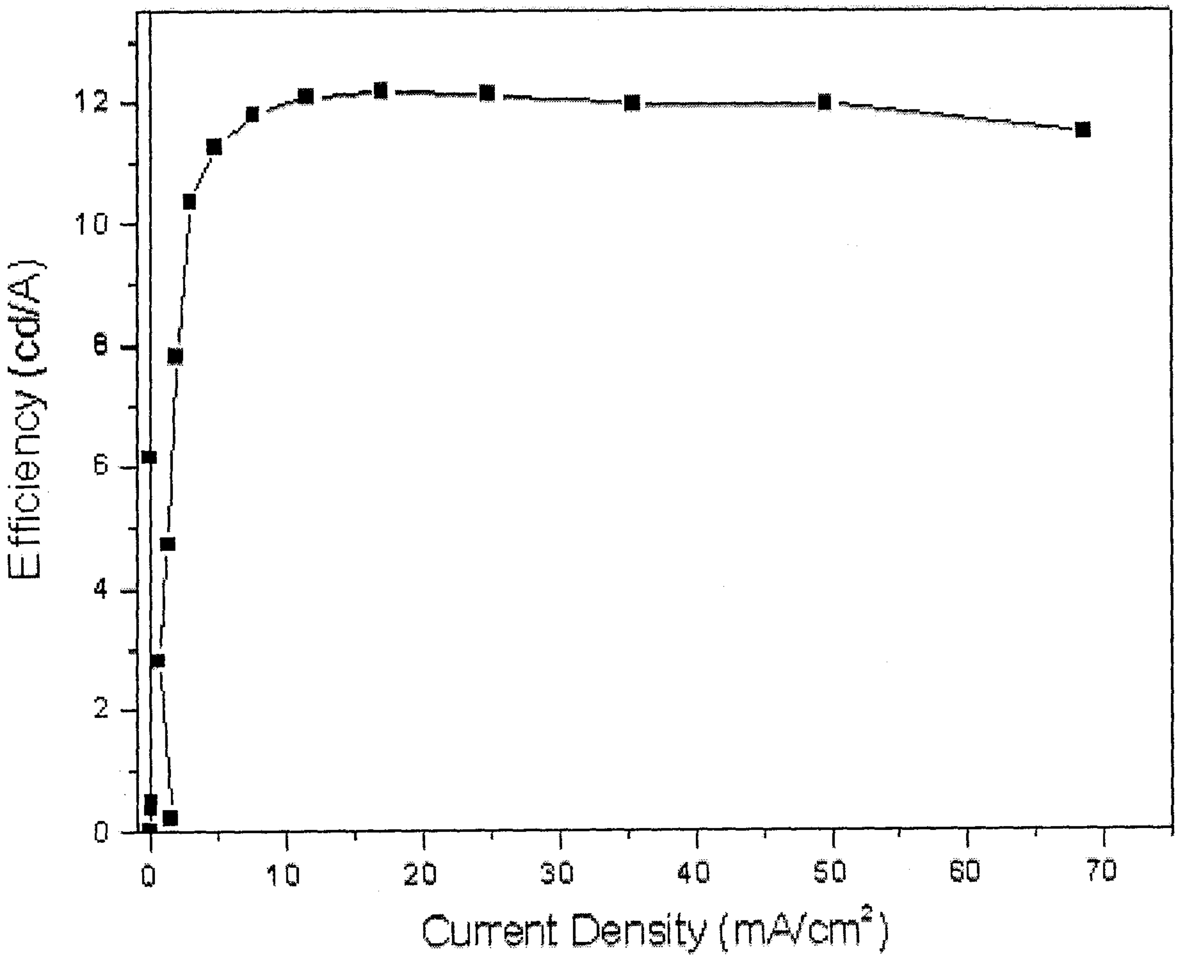
【Figure 2】



【Figure 3】



【Figure 4】


Efficiency (cd/A)
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
Current Density (mA/cm²)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/004922

A. CLASSIFICATION OF SUBJECT MATTER

C09K 11/06(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC C09K, C07C, H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean patents and applications for inventions

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)
eKIPASS, USPAT, PAJ, CA(STN)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-83481 A (CANON INC) 18 March 2004 See abstract, claims, formula (I)	1-5
A	JP 2002-326965 A (SONY CORP) 15 November 2002 See abstract, claims, general formula (1)	1-5
A	US 2004/63981 A1 (STOSSEL et al.) 01 April 2004 See the whole document	1-5
A	EP 1220339 A2 (SEL SEMICONDUCTOR ENERGY LABORATORY CO., LTD) 03 July 2002 See the whole document	1-5
A	JP 2000-12228 A (SONY CORP) 14 January 2000 See the whole document	1-5

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search
09 FEBRUARY 2007 (09.02.2007)

Date of mailing of the international search report
09 FEBRUARY 2007 (09.02.2007)

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Facsimile No. 82-42-472-7140

Authorized officer
SOHN, Chang Ho
Telephone No. 82-42-481-8398

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2006/004922

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP16083481	18.03.2004	AU2003253442AA	19.03.2004
		CN1255365C	10.05.2006
		CN1571763A	26.01.2005
		EP1532089A1	25.05.2005
		EP1532089A4	26.07.2006
		KR2005038634A	27.04.2005
		US20040253389A1	16.12.2004
		WO2004020372A1	11.03.2004
JP14326965	15.11.2002	NONE	
US2004063981A1	01.04.2004	CN1221555C	05.10.2005
		CN1483036A	17.03.2004
		DE50104149C0	18.11.2004
		EP01345948A1	24.09.2003
		EP01345948B1	13.10.2004
		EP1345948A1	24.09.2003
		JP16525878	26.08.2004
		KR1020040023579	18.03.2004
		US6911551BB	28.06.2005
		WO2002051850A1	04.07.2002
EP1220339A2	03.07.2002	CN1268008C	02.08.2006
		CN1362747	07.08.2002
		CN1870285A	29.11.2006
		JP2002324680A2	08.11.2002
		KR2002055418A	08.07.2002
		SG93298A1	17.12.2002
		TW545080B	01.08.2003
		US2002121860AA	05.09.2002
JP12012228	14.01.2000	CN1242682	26.01.2000
		KR1020000006491	25.01.2000
		US06440585	27.08.2002
		US20010038924A1	08.11.2001

专利名称(译)	有机电致发光化合物和使用其的显示装置		
公开(公告)号	EP1960493A1	公开(公告)日	2008-08-27
申请号	EP2006823676	申请日	2006-11-22
申请(专利权)人(译)	GRACEL显示增量.		
当前申请(专利权)人(译)	GRACEL显示增量.		
[标]发明人	KWON HYUCK JOO CHO YOUNG JUN YOON SEUNG SOO KIM BONG OK KIM SUNG MIN		
发明人	KWON, HYUCK-JOO CHO, YOUNG-JUN YOON, SEUNG-SOO KIM, BONG-OK KIM, SUNG-MIN		
IPC分类号	C09K11/06 H05B33/14		
CPC分类号	H05B33/14 C09K11/06 C09K2211/1007 C09K2211/1011 C09K2211/1014 H01L51/0055 H01L51/006 H01L51/5012 H01L2251/308		
代理机构(译)	ALBRECHT，THOMAS		
优先权	1020060115344 2006-11-21 KR 1020050112046 2005-11-22 KR		
其他公开文献	EP1960493A4 EP1960493B1		
外部链接	Espacenet		

摘要(译)

本发明涉及具有茚并芴或二芴骨架的新型有机电致发光化合物，以及使用该化合物作为电致发光材料的显示器。根据本发明的有机电致发光化合物表现出良好的电致发光效率和优异的寿命特性，因此可以有利地制备具有非常好的工作寿命的OLED器件。