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[KR/KR]; #405-1409, Samik Apt., Suseo-dong, Gangnam-gu, Seoul 135-884 (KR).

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(74) Agents: **KWON, Oh-Sig** et al.; 4F, Joeeunleaderstel, 921, Dunsan-dong, Seo-gu, Daejeon 302-120 (KR).

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(71) Applicant (for all designated States except US): **DOW ADVANCED DISPLAY MATERIALS, LTD.** [KR/KR]; 735-2, Baekseok-dong, Seobuk-gu, Cheonan-si, Chungcheongnam-do 331-980 (KR).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KIM, Young Gil** [KR/KR]; #104-303, Chowon Sungwon Apt., Pyeongandong, Dongan-gu, Anyang-si, Gyeonggi-do 431-075 (KR). **CHO, Young Jun** [KR/KR]; #101-1111, Samsung Apt., 15-1, Donam-dong, Seongbuk-gu, Seoul 136-060 (KR). **KWON, Hyuck Joo** [KR/KR]; #224-2001, Samsung Raemian 2 Cha, Jangnan-dong, Dongdaemun-gu, Seoul 130-100 (KR). **KIM, Bong Ok** [KR/KR]; #101-1108, Hansol Apt., 4, Samseong-dong, Gangnam-gu, Seoul 135-090 (KR). **KIM, Sung Min** [KR/KR]; #109-902, Mokdong Paragon, 917, Mok 1-dong, Yangcheon-gu, Seoul 158-761 (KR). **YOON, Seung Soo**

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

(57) Abstract: Disclosed are a novel organic electroluminescent compound and an organic electroluminescent device including the same. When included in a hole injection layer or a hole transport layer of an organic electroluminescent device, the disclosed organic electroluminescent compound can improve luminous efficiency while lowering driving voltage of the device.



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Description

Title of Invention: NOVEL ORGANIC ELECTROLUMINESCENT COMPOUNDS AND ORGANIC ELECTROLUMINESCENT DEVICE USING THE SAME

Technical Field

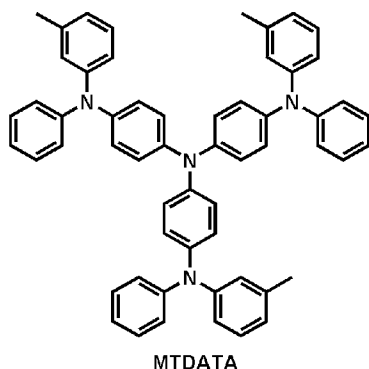
- [1] The present invention relates to a novel organic electroluminescent compound and an organic electroluminescent device including the same. The organic electroluminescent compound according to the present invention may be included in a hole transport layer or a hole injection layer of an organic electroluminescent device.

Background Art

- [2] Among display devices, electroluminescent (EL) devices are advantageous in that they provide wide view angle, superior contrast and fast response rate as self-emissive display devices. In 1987, Eastman Kodak first developed an organic EL device using low-molecular-weight aromatic diamine and aluminum complex as a substance for forming an electroluminescent layer [*Appl. Phys. Lett.* 51, 913, 1987].
- [3] In an organic EL device, when a charge is applied to an organic layer formed between an electron injection electrode (cathode) and a hole injection electrode (anode), an electron and a hole are paired and emit light as the electron-hole pair is extinguished. The organic EL device is advantageous in that it can be formed on a flexible transparent substrate such as plastic, is operable with relatively low voltage (10 V or lower) as compared to plasma display panels or inorganic EL displays, consumes less power and provides excellent color.
- [4] The organic materials used in an organic EL device may be classified into an electroluminescent material and a charge transport material. The electroluminescent material is directly related with emitted color and luminous efficiency. Some requirements include high fluorescence quantum yield in solid state, high electron and hole mobility, resistance to decomposition during vacuum deposition, ability to form uniform film and stability.
- [5] The hole injection/transport material may include copper phthalocyanine (CuPc), 4,4'-bis[N-(1-naphthyl)-N-phenylamino]biphenyl(4,4'-bis[N-(1-naphthyl)-N-phenylamino]-biphenyl (NPB), N,N'-diphenyl-N,N'-bis(3-methylphenyl)-(1,1'-biphenyl)-4,4'-diamine (TPD), 4,4',4''-tris(3-methylphenylphenylamino)triphenylamine (MTDATA), or the like. A device using these materials in the hole injection or transfer layer is problematic in efficiency and operation life. It is because, when an organic EL device is driven under high current, thermal stress occurs between an anode and the hole injection layer. The

thermal stress significantly reduces the operation life of the device. Further, since the organic material used in the hole injection layer has very high hole mobility, the hole-electron charge balance may be broken and quantum yield (cd/A) may decrease.

[6]



[7]

It is known that an amorphous compound providing good stability of thin film improves the durability of the organic EL device. Glass transition temperature (T_g) may be a measure of the amorphousness.

[8]

MTDATA has a glass transition temperature of 76 °C and cannot be said to have high amorphousness. These materials are not satisfactory in the durability of the organic EL device, as well as in the luminous efficiency, which is determined by the hole injection/transport properties.

Disclosure of Invention

Technical Problem

[9]

Accordingly, an object of the present invention is to provide an organic electroluminescent compound providing superior luminous efficiency and device operation life as compared to existing hole injection and hole transport materials. Another object of the present invention is to provide an organic electroluminescent device employing the novel organic electroluminescent compound in a hole injection layer or a hole transport layer.

Solution to Problem

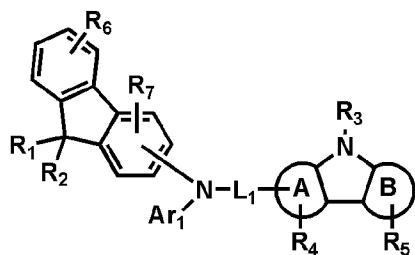
[10]

To achieve the object of the present invention, the present invention provides an organic electroluminescent compound represented by Chemical Formula 1 and an organic electroluminescent device comprising the same. When included in hole injection layer or a hole transport layer of an organic electroluminescent device, the organic electroluminescent compound according to the present invention may improve luminous efficiency while lowering driving voltage of the device.

[11]

[Chemical Formula 1]

[12]



[13] wherein

[14] ring A and ring B independently represent a monocyclic or polycyclic aromatic ring, a monocyclic or polycyclic hetero aromatic ring, a 5- or 6-membered hetero aromatic ring fused with an aromatic ring or a monocyclic or polycyclic aromatic ring fused with a 5- or 6-membered hetero aromatic ring, excluding the case where the ring A and the ring B are monocyclic aromatic rings at the same time and the substituents R₄ and R₅ are independently hydrogen, (C1-C60)alkyl, (C1-C60)alkoxy or (C6-C60)aryl;

[15] L₁ represents (C6-C60)arylene with or without substituent(s), (C3-C60)heteroarylene with or without substituent(s), (C3-C60)alkenylene with or without substituent(s) or (C3-C60)alkynylene with or without substituent(s);

[16] Ar₁ represents (C1-C60)alkyl with or without substituent(s), (C6-C60)aryl with or without substituent(s), (C3-C60)heteroaryl with or without substituent(s), heterocycloalkyl with or without substituent(s), (C3-C60)cycloalkyl with or without substituent(s), adamantyl with or without substituent(s), (C7-C60)bicycloalkyl with or without substituent(s), (C3-C60)alkenyl with or without substituent(s) or (C3-C60)alkynyl with or without substituent(s);

[17] R₁, R₂, R₃, R₄, R₅, R₆ and R₇ independently represent hydrogen, deuterium, halogen, (C1-C60)alkyl with or without substituent(s), (C6-C60)aryl with or without substituent(s), (C3-C60)heteroaryl with or without substituent(s), 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S with or without substituent(s), (C3-C60)cycloalkyl with or without substituent(s), tri(C1-C60)alkylsilyl with or without substituent(s), di(C1-C60)alkyl(C6-C60)arylsilyl with or without substituent(s), tri(C6-C60)arylsilyl with or without substituent(s), adamantyl with or without substituent(s), (C7-C60)bicycloalkyl with or without substituent(s), cyano, (C1-C60)alkyloxy with or without substituent(s), (C1-C60)alkylthio with or without substituent(s), (C6-C60)aryloxy with or without substituent(s), (C6-C60)arylthio with or without substituent(s), (C1-C60)alkoxycarbonyl with or without substituent(s), (C1-C60)alkylcarbonyl with or without substituent(s), (C6-C60)arylcarbonyl with or without substituent(s), (C6-C60)aryloxycarbonyl with or without substituent(s), (C1-C60)alkoxycarbonyloxy with or without substituent(s), (C1-C60)alkylcarbonyloxy with or without substituent(s), (C6-C60)arylcarbonyloxy with or without substituent(s), (C6-C60)aryloxycarbonyloxy with or without substituent(s);

- stituent(s), carboxyl, nitro or hydroxyl, or each of them may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form a fused ring;
- [18] the substituent substituted or unsubstituted at L_1 , Ar_1 , or R_1 through R_7 is one or more substituent(s) selected from a group consisting of hydrogen, deuterium, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, (C3-C60)cycloalkyl, cyano, (C1-C60)alkyloxy, (C1-C60)alkylthio, (C6-C60)aryloxy, (C6-C60)arylthio, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, $NR_{31}R_{32}$, $PR_{33}R_{34}$, $BR_{35}R_{36}$ and $P(=O)R_{37}R_{38}$, or it may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form a fused ring; and
- [19] R_{31} through R_{38} independently represent (C1-C60)alkyl, (C3-C60)cycloalkyl, (C6-C60)aryl or (C3-C60)heteroaryl, or each of them may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form a fused ring, and the alkyl, cycloalkyl, aryl or heteroaryl of R_{31} through R_{38} may be further substituted by one or more substituent(s) selected from a group consisting of hydrogen, deuterium, halogen, (C1-C60)alkyl, halo(C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl with or without (C6-C60)aryl substituent, cyano, carboxyl, nitro and hydroxyl.
- [20] In the present invention, "alkyl" includes a linear or branched saturated primary hydrocarbon radical consisting only of carbon and hydrogen atoms or a combination thereof, and "alkyloxy" and "alkylthio" respectively mean -O-alkyl and -S-alkyl, where the alkyl is the same as defined above.
- [21] In the present invention, "aryl" means an organic radical derived from an aromatic hydrocarbon by the removal of one hydrogen atom, and may include a 4- to 7-membered, particularly 5- or 6-membered, single ring or fused ring, including a plurality of aryls linked by chemical bond(s). Specific examples include phenyl, naphthyl, biphenyl, anthryl, indenyl, fluorenyl, phenanthryl, triphenylenyl, pyrenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, etc., but are not limited thereto.
- [22] In the present invention, "heteroaryl" means an aryl group containing 1 to 4 heteroatom(s) selected from nitrogen (N), oxygen (O), sulfur (S), phosphorus (P) and silicon (Si) as aromatic ring backbone atom(s), other remaining aromatic ring backbone atoms being carbon. It may be 5- or 6-membered monocyclic heteroaryl or polycyclic heteroaryl resulting from condensation with a benzene ring, and may be partially saturated. Further, the heteroaryl includes more than one heteroaryls linked by chemical bond(s). The heteroaryl includes a divalent aryl group wherein the heteroatom(s) in the ring may be oxidized or quaternized to form, for example, N-oxide or quaternary salt. Specific examples include monocyclic heteroaryl such as

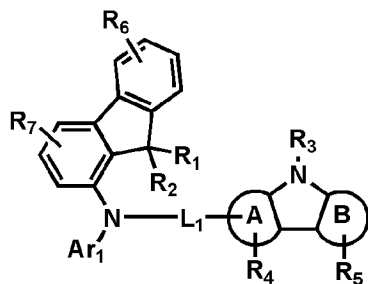
furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., polycyclic heteroaryl such as benzofuranyl, benzothiophenyl, isobenzofuranyl, benzimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolyl, quinazolinyl, quinoxalinyl, carbazolyl, phenanthridinyl, benzodioxolyl, etc., N-oxide thereof (e.g., pyridyl N-oxide, quinolyl N-oxide, etc.), quaternary salt thereof, etc., but are not limited thereto.

[23] In the present invention, the substituents including "(C1-C60)alkyl" may have 1 to 60 carbon atoms, specifically 1 to 20 carbon atoms, more specifically 1 to 10 carbon atoms. The substituents including "(C6-C60)aryl" may have 6 to 60 carbon atoms, specifically 6 to 20 carbon atoms, more specifically 6 to 12 carbon atoms. The substituents including "(C3-C60)heteroaryl" may have 3 to 60 carbon atoms, specifically 4 to 20 carbon atoms, more specifically 4 to 12 carbon atoms. The substituents including "(C3-C60)cycloalkyl" may have 3 to 60 carbon atoms, specifically 3 to 20 carbon atoms, more specifically 3 to 7 carbon atoms. The substituents including "(C2-C60)alkenyl or alkynyl" may have 2 to 60 carbon atoms, specifically 2 to 20 carbon atoms, more specifically 2 to 10 carbon atoms.

[24] The organic electroluminescent compound of the present invention includes the compounds represented by Chemical Formulas 2 to 5:

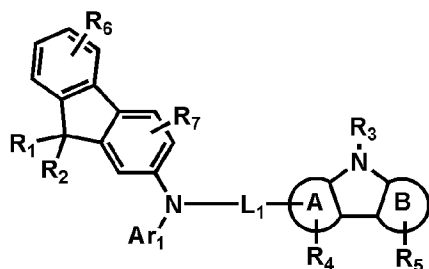
[25] [Chemical Formula 2]

[26]



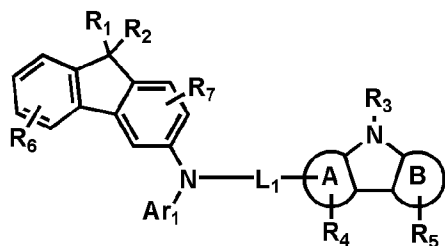
[27] [Chemical Formula 3]

[28]

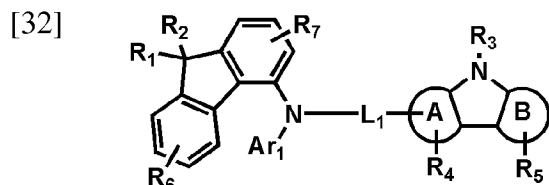


[29] [Chemical Formula 4]

[30]



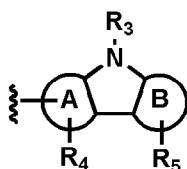
[31] [Chemical Formula 5]



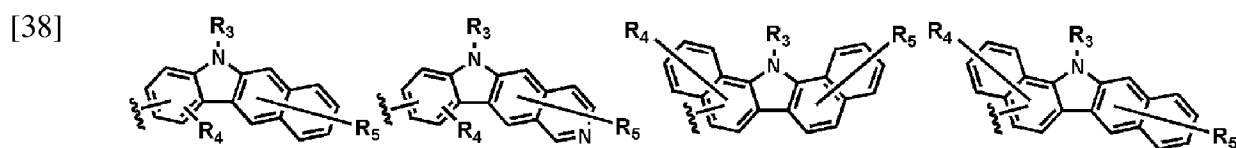
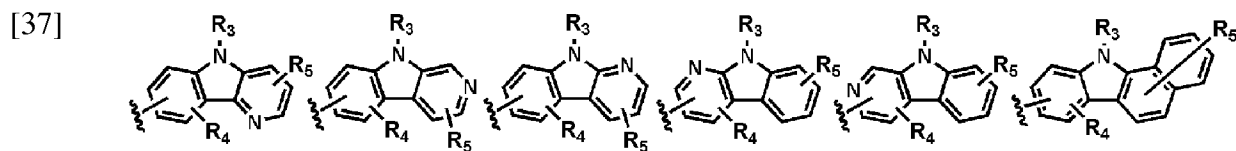
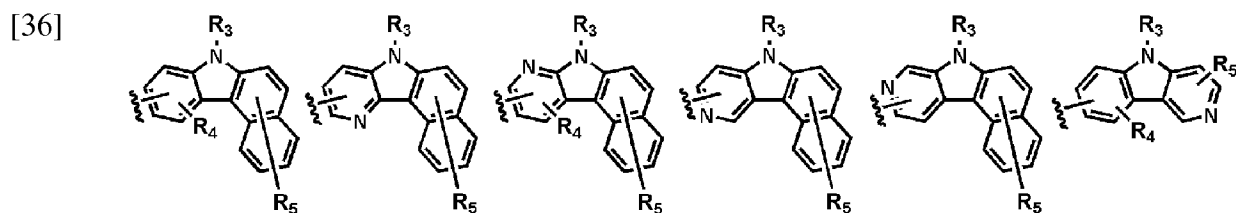
[33] wherein ring A, ring B, L_1 , Ar_1 and R_1 through R_7 are the same as defined in Chemical Formula 1.

[34] The ring A and the ring B may be independently benzene, naphthalene, anthracene, pyridine, quinoline, isoquinoline or quinoxaline, but are not limited thereto. When the ring A and the ring B are benzenes at the same time, R_4 and R_5 substituted at the ring A and the ring B are not independently hydrogen, (C1-C60)alkyl, (C1-C60)alkoxy or (C6-C60)aryl.

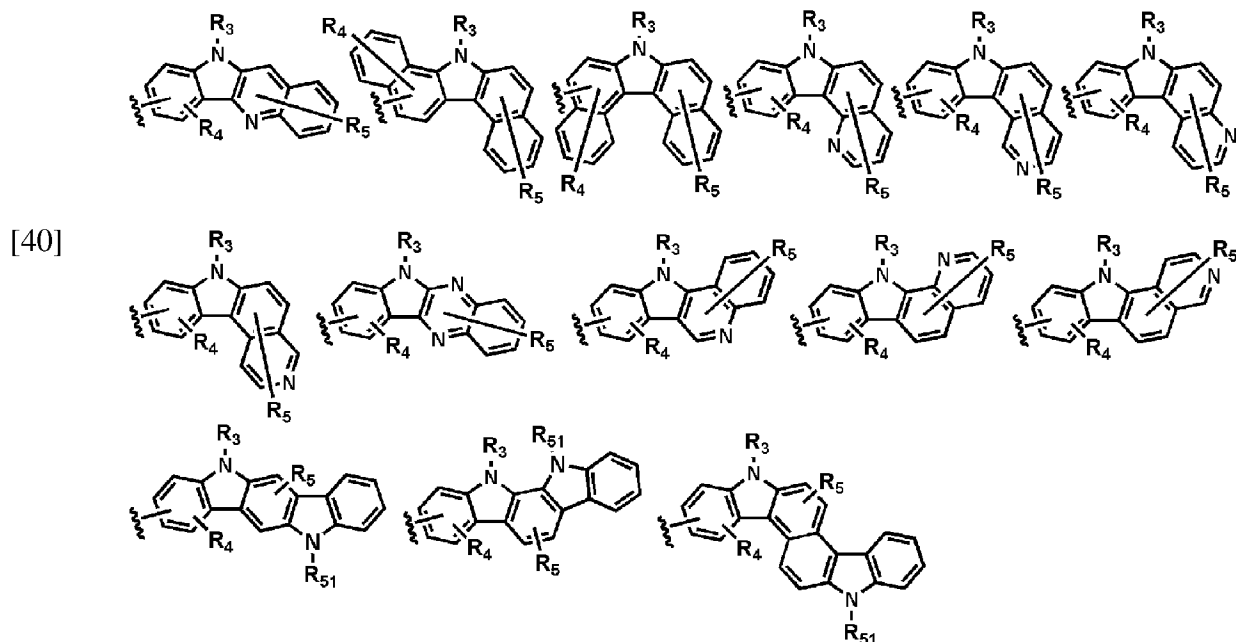
[35] More specifically,



is selected from the following structures:

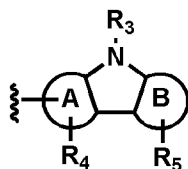


[39]

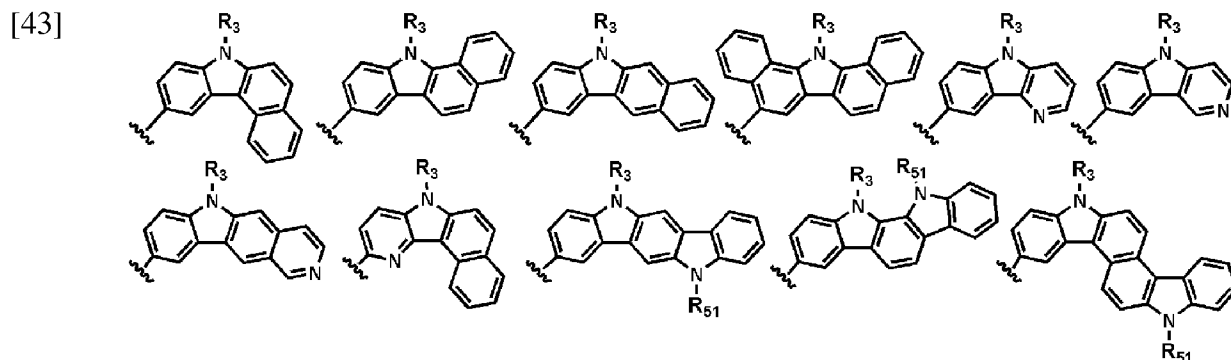


[41] wherein R₃, R₄ and R₅ are the same as defined in Chemical Formula 1.

[42] More preferably,



is selected from the following structures:

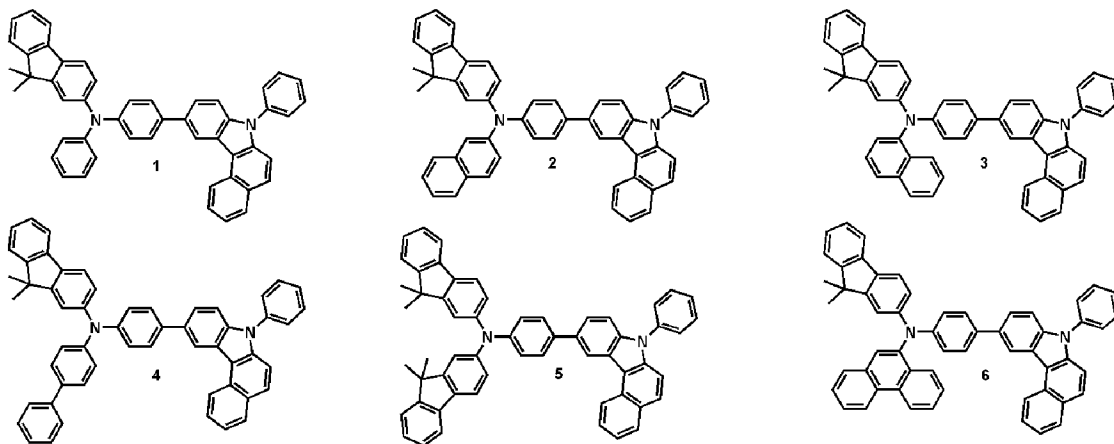


[44] R₃ and R₅₁ may be independently methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, n-hexyl, n-heptyl, n-octyl, 2-ethylhexyl, n-nonyl, decyl, dodecyl, hexadecyl, benzyl, phenyl, naphthyl, biphenyl, fluorenyl, spirobifluorenyl, phenanthryl, anthryl, fluoranthenyl, triphenylenyl, pyrenyl, chrysenyl, naphthacenyl, perylenyl, pyridyl, quinolyl, isoquinolyl or triazinyl, and the phenyl, naphthyl, biphenyl, fluorenyl, spirobifluorenyl, phenanthryl, anthryl, fluoranthenyl, triphenylenyl, pyrenyl, chrysenyl, naphthacenyl, perylenyl, pyridyl, quinolyl, isoquinolyl or triazinyl may be further substituted with deuterium, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, n-hexyl, n-heptyl, n-octyl, 2-ethylhexyl, n-

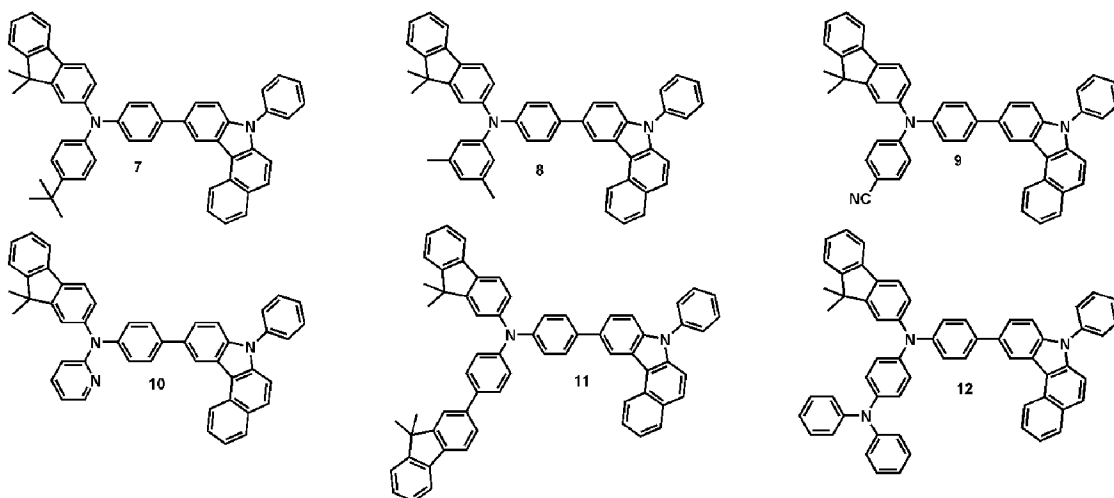
nonyl, decyl, phenyl, naphthyl or pyridyl.

- [45] More specifically, the organic electroluminescent compound according to the present invention may be exemplified by the following compounds, but they do not limit the present invention.

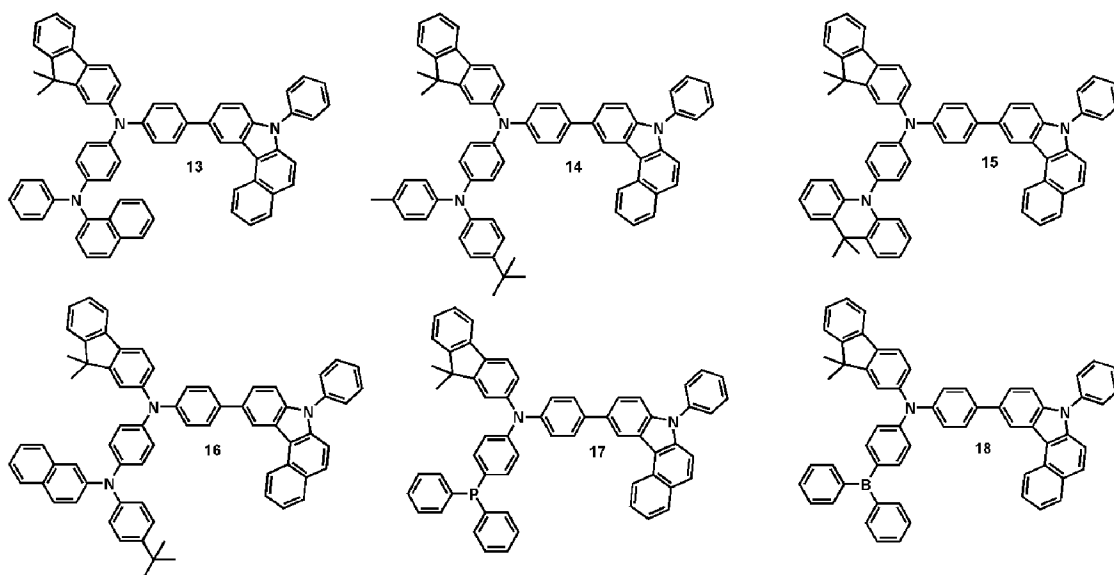
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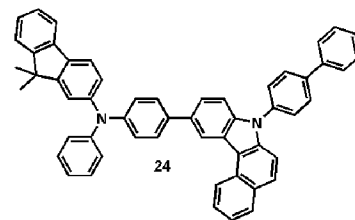
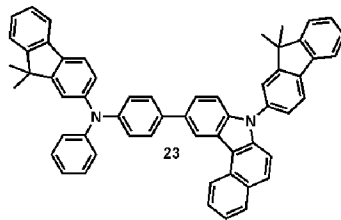
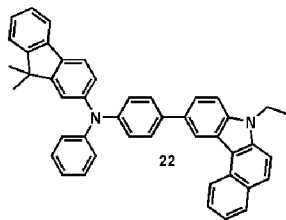
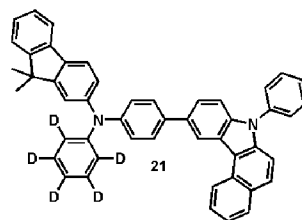
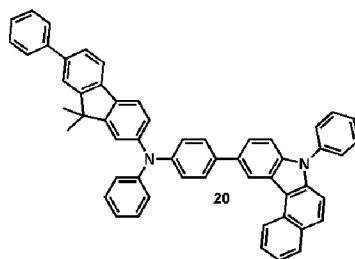
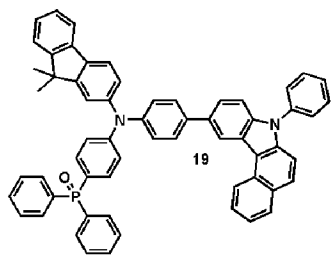
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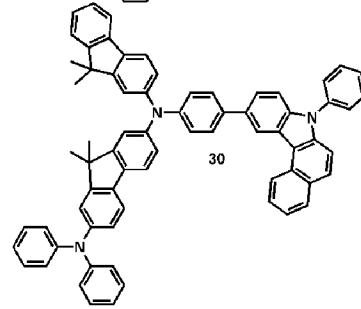
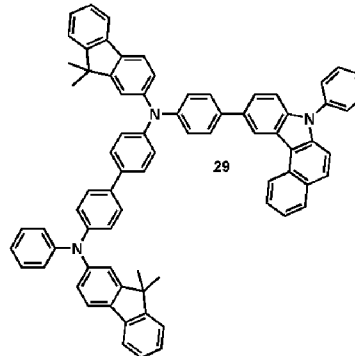
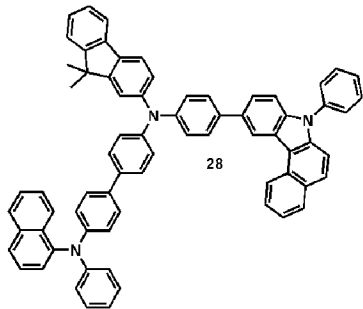
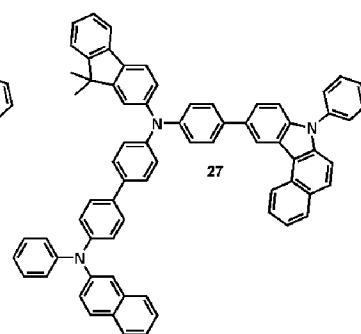
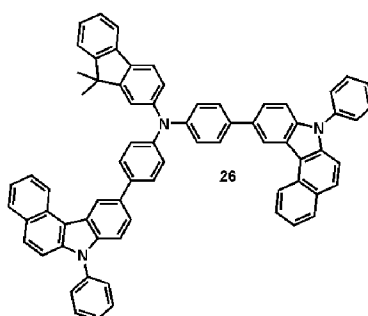
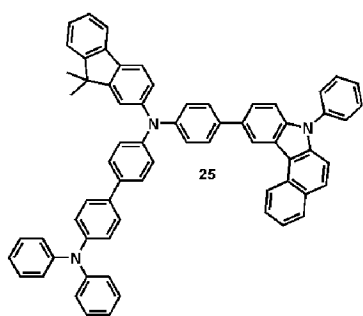
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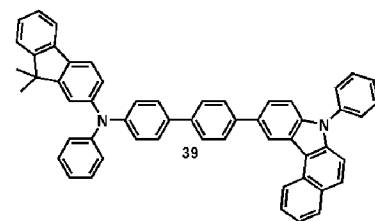
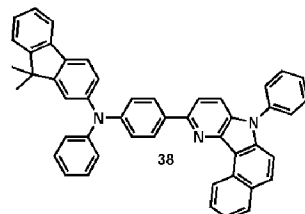
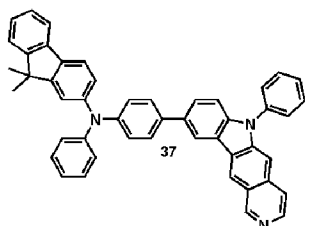
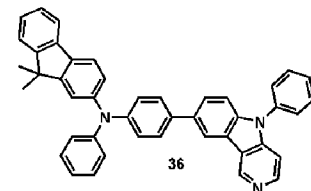
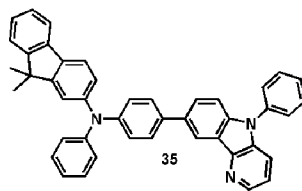
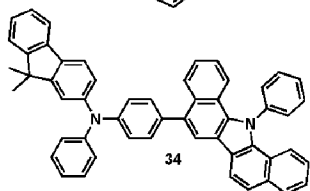
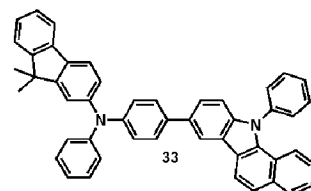
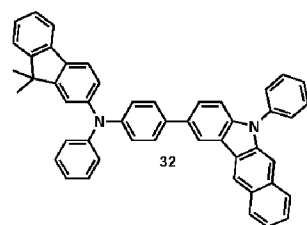
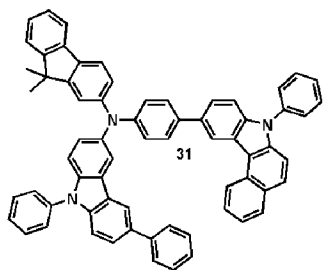
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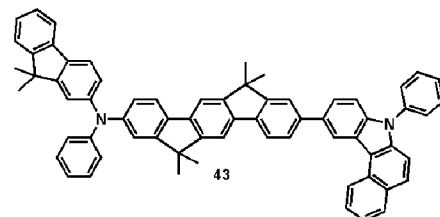
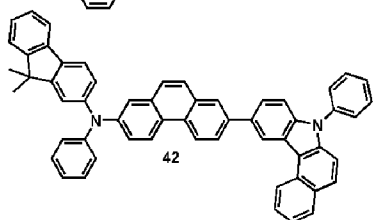
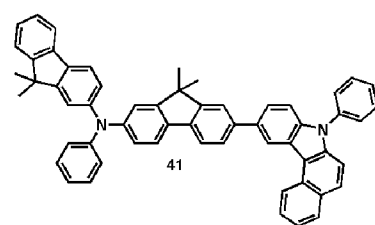
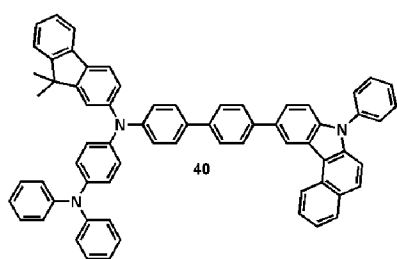
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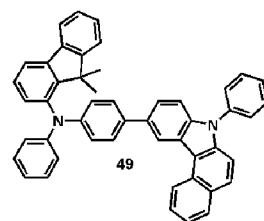
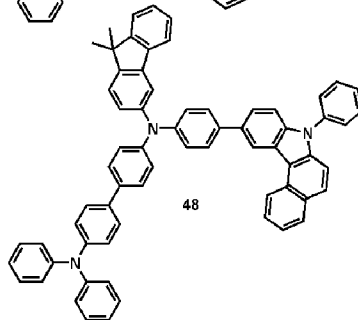
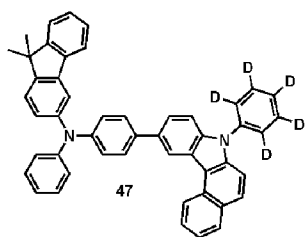
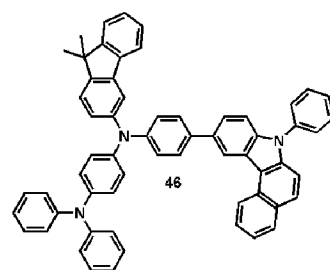
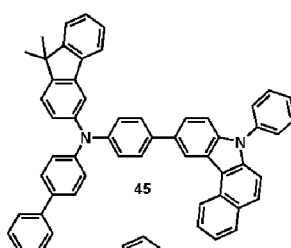
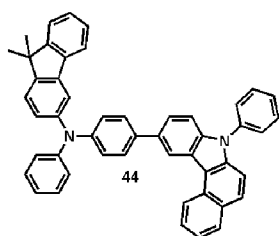
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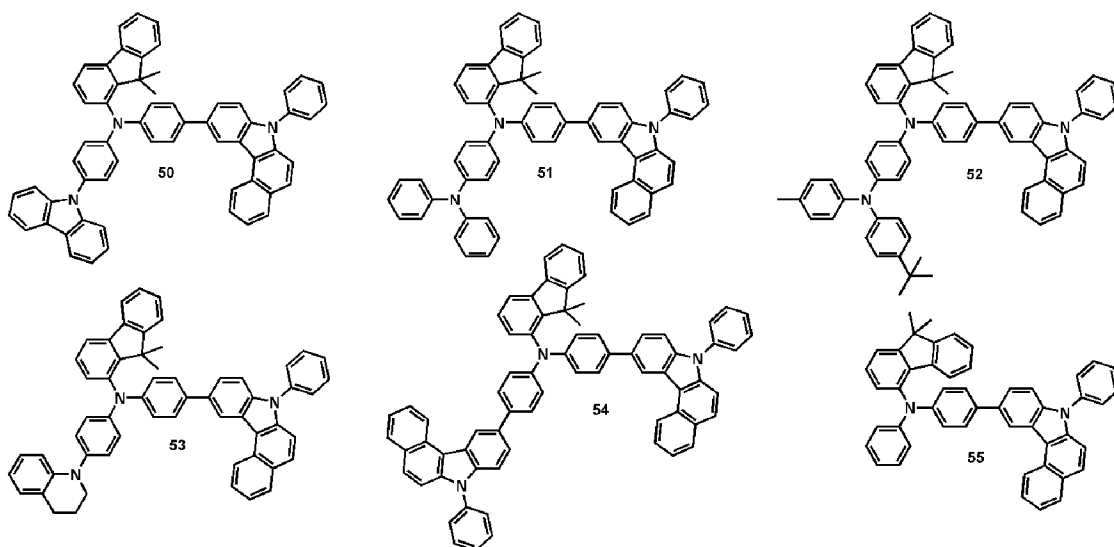
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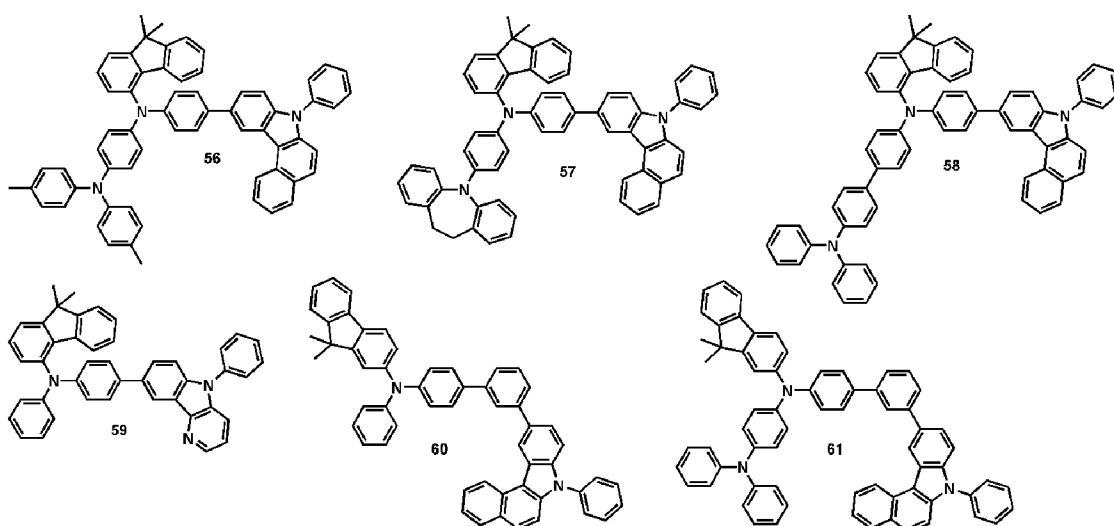
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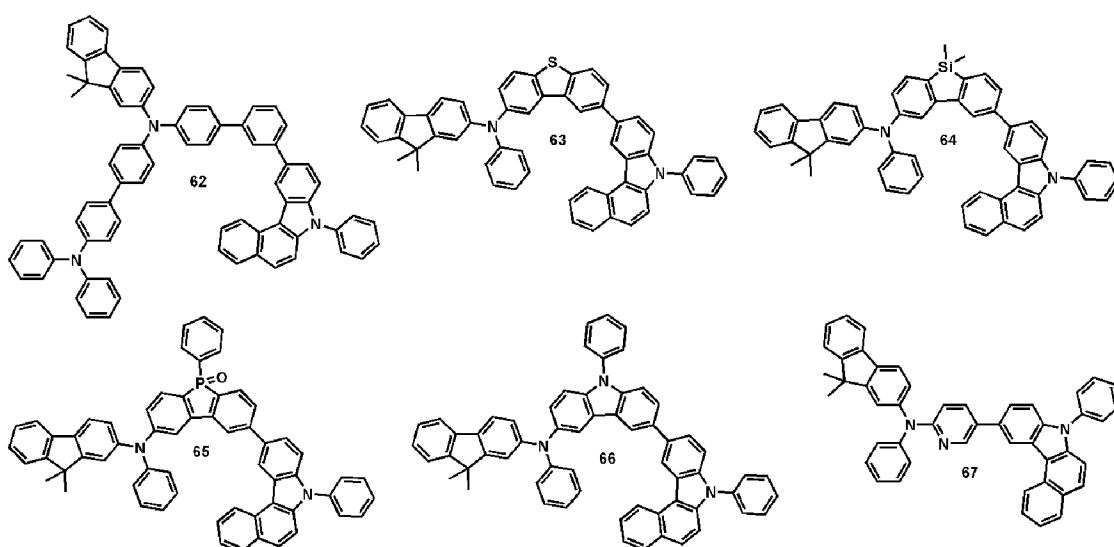
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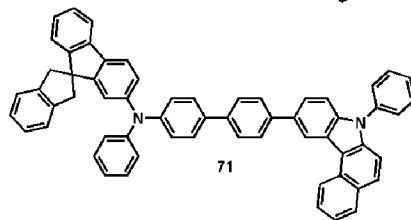
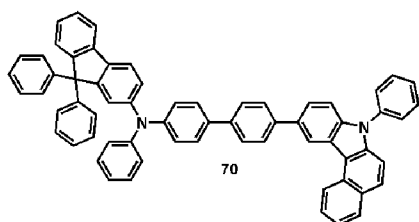
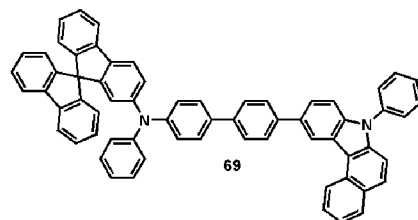
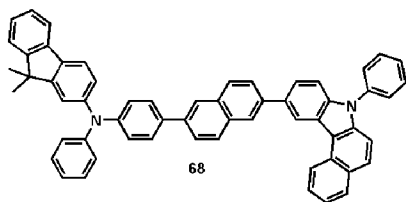
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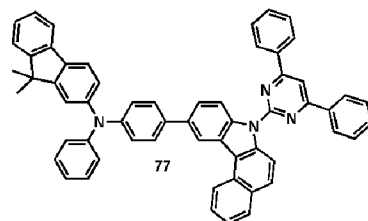
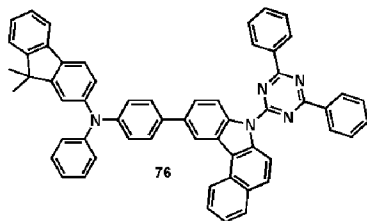
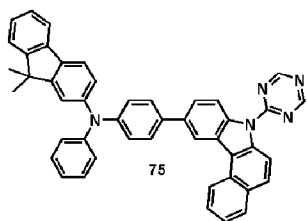
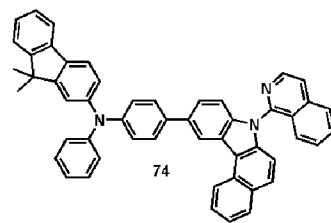
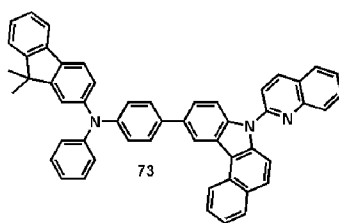
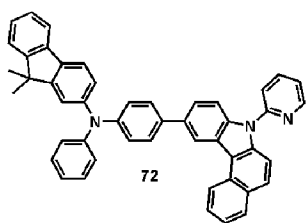
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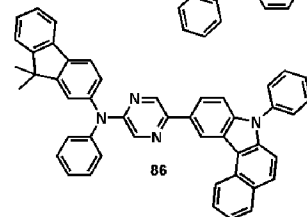
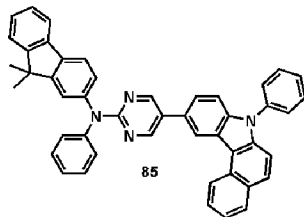
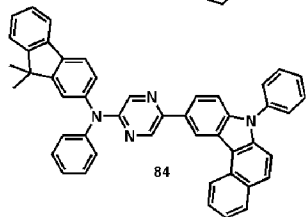
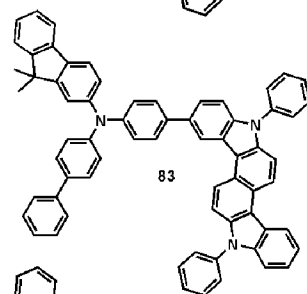
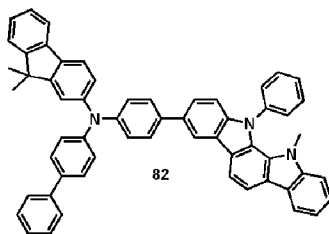
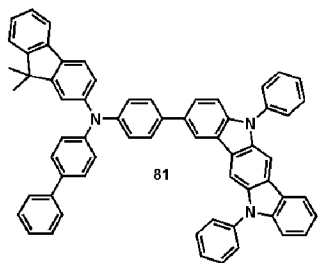
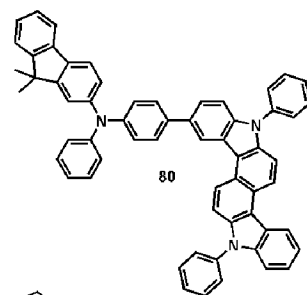
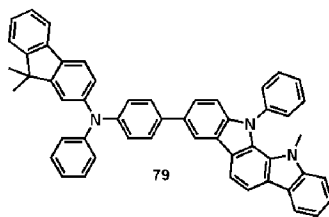
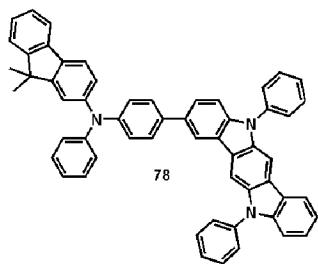
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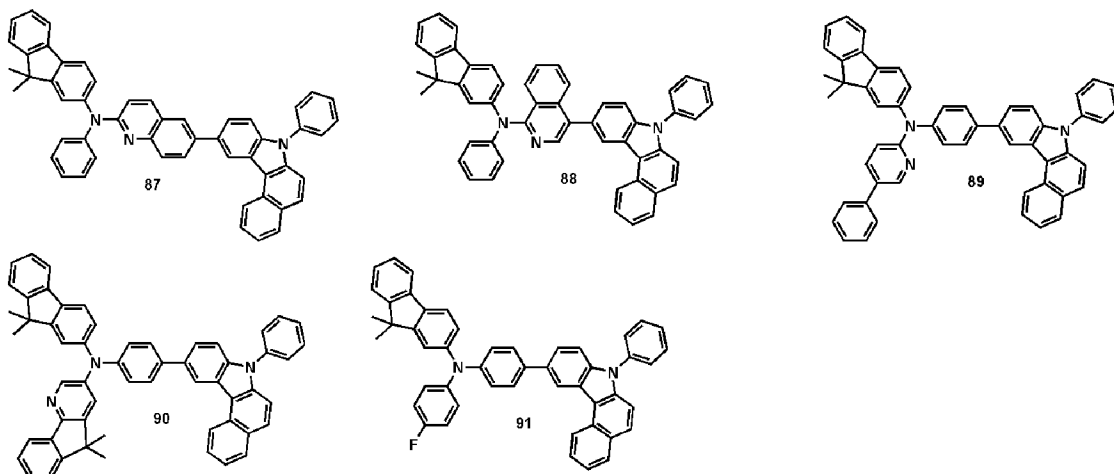
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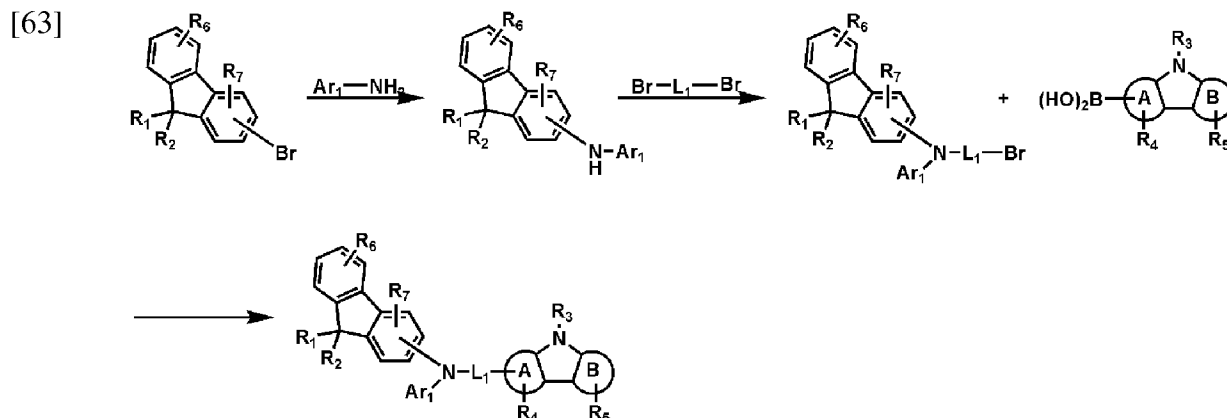


[60]



[61] The organic electroluminescent compound according to the present invention may be prepared by Scheme 1:

[62] [Scheme 1]



[64] wherein Ar_1 , L_1 and R_1 through R_7 are the same as defined in Chemical Formula 1.

[65] The present invention also provides an organic electroluminescent device comprising: a first electrode; a second electrode; and one or more organic layer(s) interposed between the first electrode and the second electrode, wherein the organic layer comprises one or more organic electroluminescent compound(s) represented by Chemical Formula 1. The organic electroluminescent compound is used in a hole injection layer or a hole transport layer.

[66] The organic layer may comprise one or more layer(s) comprising the organic electroluminescent compound represented by Chemical Formula 1 and one or more layer(s) comprising a fluorescent host and a fluorescent dopant or a phosphorescent host and a phosphorescent dopant. The fluorescent host, the fluorescent dopant, the phosphorescent host and the phosphorescent dopant used in the organic electroluminescent device of the present invention are not particularly limited.

[67] Further, in the organic electroluminescent device of the present invention, the organic layer may further comprise one or more metal(s) or complex(es) selected from a group

consisting of organic metals of Group 1, Group 2, 4th period and 5th period transition metals, lanthanide metals and d-transition elements, and the organic layer may comprise an electroluminescent layer and a charge generating layer at the same time.

[68] Further, the organic layer may comprise one or more organic electroluminescent layer(s) emitting blue, red and green light at the same time, in addition to the aforesaid organic electroluminescent compound, to provide a white light-emitting electroluminescent device. The compounds emitting blue, red or green light are exemplified in Korean Patent Application Nos. 10-2008-0123276, 10-2008-0107606 and 10-2008-0118428, but are not limited thereto.

[69] Further, in the organic electroluminescent device of the present invention, a mixed region of an electron transport compound and a reductive dopant or a mixed region of a hole transport compound and an oxidative dopant may be placed on the inner surface of one or both electrode(s) among the pair of electrodes. In this case, injection and transport of electrons from the mixed region to the electroluminescent medium become easier because the electron transport compound is reduced to an anion. Also, injection and transport of holes from the mixed region to the electroluminescent medium become easier because the hole transport compound is oxidized to a cation. Preferred examples of the oxidative dopant include various Lewis acids and acceptor compounds. Preferred examples of the reductive dopant include alkali metals, alkali metal compounds, alkaline earth metals, rare earth metals and mixtures thereof.

Advantageous Effects of Invention

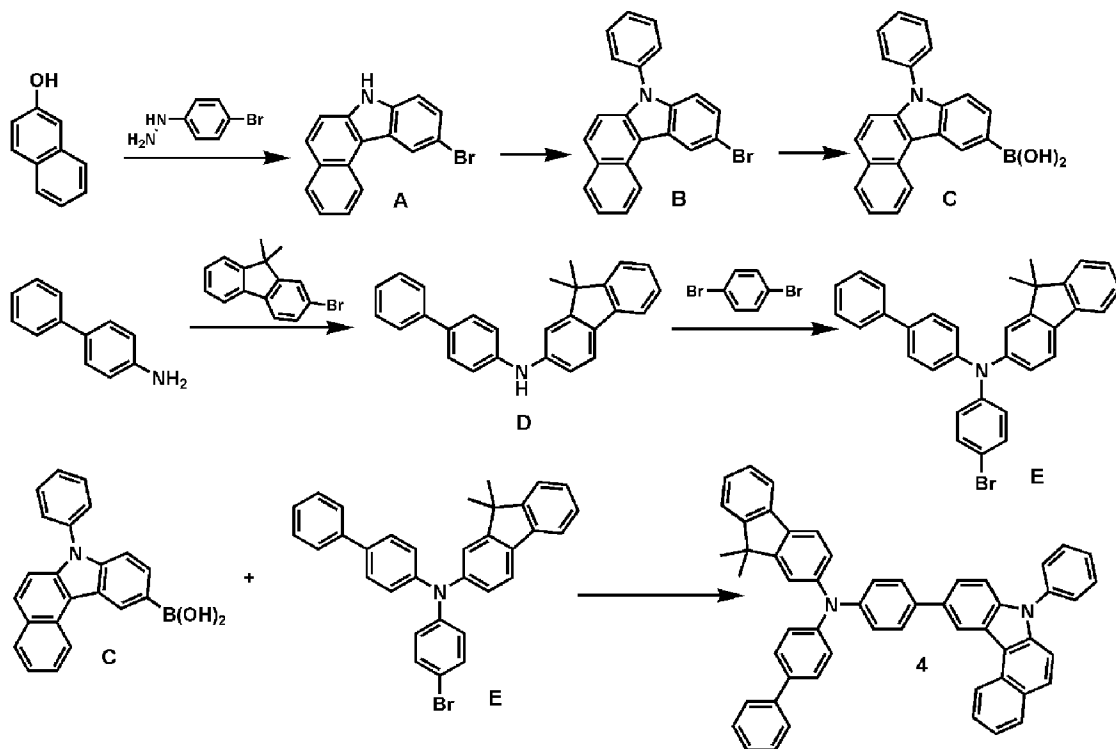
[70] When included in a hole injection layer or a hole transport layer of an organic electroluminescent device, the organic electroluminescent compound according to the present invention may improve luminous efficiency while lowering driving voltage of the device. Especially, the organic compounds including carbazole derivatives have large triplet gap. Since they can more effectively block excitons in a phosphorescent device than existing materials, they may improve luminous efficiency and operation life of the device.

Mode for the Invention

[71] Hereinafter, the organic electroluminescent compound, the preparation method thereof and the electroluminescent property of the device according to the present invention will be described for some compounds. However, the following embodiments are only exemplary and do not limit the scope of the present invention.

[72] [Preparation Example 1] Preparation of Compound 4

[73]



[74] Preparation of Compound A

[75] 2-Naphthol (20.0 g, 138.8 mmol), NaHSO_3 (28.8 g, 277.4 mmol), distilled water (160 mL) and 4-bromophenylhydrazine (31.2 mL, 166.4 mmol) were heated at 120 °C. 12 hours later, distilled water was added and the resultant solid was filtered under reduced pressure. Thus obtained solid was added to an aqueous HCl solution and heated to 100 °C. One hour later, following extraction with dichloromethane, the product was washed with distilled water and an aqueous NaOH solution. Column separation yielded Compound A (9.2 g, 31.0 mmol, 22.4 %).

[76] Preparation of Compound B

[77] Compound A (9.2 g, 31.0 mmol), Cu (2.0 g, 31.0 mmol), 18-crown-6 (0.4 g, 1.6 mmol), K_2CO_3 (12.8 g, 93.2 mmol) and 1,2-dichlorobenzene (100 mL) were mixed and stirred at 180 °C for 12 hours under reflux. After cooling to room temperature and distillation under reduced pressure, the product was extracted with dichloromethane and washed with distilled water. Drying with MgSO_4 followed by distillation under reduced pressure and column separation yielded Compound B (7.6 g, 20.4 mmol, 65.7 %).

[78] Preparation of Compound C

[79] Compound B (7.6 g, 20.4 mmol) was cooled to -78 °C in the presence of nitrogen, after adding tetrahydrofuran (250 mL). After slowly adding n-butyllithium (2.5 M in hexane, 12.2 mL, 30.6 mmol), the mixture was stirred for 1 hour while maintaining the temperature. After adding $\text{B}(\text{i-pro})_3$ (8.8 mL, 40.8 mmol) at -78 °C, the mixture was further stirred for 1 hour. Upon completion of the reaction, 1 M HCl was added at 0 °C.

After washing with distilled water followed by extraction with ethyl acetate, the organic layer was dried with MgSO_4 and the solvent was removed using a rotary evaporator. Purification by column chromatography yielded Compound **C** (5.9 g, 17.5 mmol, 86%).

[80] Preparation of Compound **D**

[81] 4-Biphenylamine (35.0 g, 120.0 mmol), 9,9'-dimethyl-2-bromofluorene (24.0 g, 140.0 mmol), $\text{Pd}(\text{OAc})_2$ (862 mg, 3.84 mmol), $\text{P}(\text{t-Bu})_3$ (8.5 mL, 0.01 mmol) and Cs_2CO_3 (83.0 g, 250.0 mmol) were dissolved in toluene (600 mL) in the presence of nitrogen and stirred at 120 °C under reflux. 12 hours later, upon completion of the reaction, after washing with distilled water followed by extraction with ethyl acetate, the organic layer was dried with MgSO_4 and the solvent was removed using a rotary evaporator. Purification by column chromatography yielded Compound **D** (40.0 g, 110.7 mmol, 86%).

[82] Preparation of Compound **E**

[83] Compound **D** (20.0 g, 55.3 mmol), 1,4-dibromobenzene (26.0 g, 110.0 mmol), $\text{Pd}_2(\text{dba})_3$ (1.0 g, 1.1 mmol), tri-*o*-tolylphosphine (1.0 g, 3.3 mmol) and NaOt-Bu (10.6 g, 110.0 mmol) were dissolved in toluene (600 mL) in the presence of nitrogen and stirred at 120 °C under reflux. 12 hours later, upon completion of the reaction, after washing with distilled water followed by extraction with ethyl acetate, the organic layer was dried with MgSO_4 and the solvent was removed using a rotary evaporator. Purification by column chromatography yielded Compound **E** (17.0 g, 32.9 mmol, 60%).

[84] Preparation of Compound **4**

[85] Compound **E** (10.0 g, 19.4 mmol), Compound **C** (7.8 g, 23.2 mmol), $\text{Pd}(\text{PPh}_3)_4$ (2.2 g, 1.9 mmol), K_2CO_3 (2 M, 96 mL, 190 mmol), ethanol (96 mL) and toluene (180 mL) were stirred at 120 °C under reflux. 12 hours later, upon completion of the reaction, after washing with distilled water followed by extraction with ethyl acetate, the organic layer was dried with MgSO_4 and the solvent was removed using a rotary evaporator. Purification by column chromatography yielded Compound **4** (10.3 g, 14.1 mmol, 73%).

[86]

[87] Organic electroluminescent compounds, Compounds **1** to **91**, were prepared in the same manner as Preparation Example 1. ^1H NMR and MS/FAB data of thus prepared organic electroluminescent compounds are given in Table 1.

[88] [Table 1]

[89]

Compound	¹ H NMR(CDCl ₃ , 200 MHz)	MS/FAB	
		found	calculated
1	δ = 1.72(6H, s), 6.58~6.63(3H, m), 6.69~6.81(4H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5~7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	652.82	652.29
2	δ = 1.72(6H, s), 6.58(1H, m), 6.69~6.75(3H, m), 7.28(1H, m), 7.36~7.38(2H, m), 7.45(1H, m), 7.49(1H, m), 7.5~7.58(13H, m), 7.74~7.77(3H, m), 7.84~7.88(3H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	702.88	702.30
3	δ = 1.72(6H, s), 6.58(1H, m), 6.69~6.75(3H, m), 6.98(1H, m), 7.28(1H, m), 7.38(2H, m), 7.45(1H, m), 7.5(2H, m), 7.53(1H, m), 7.54~7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8~8.07(3H, m), 8.16~8.18(2H, m), 8.54(1H, m)	702.88	702.30
4	δ = 1.72(6H, s), 6.58(1H, m), 6.69~6.75(5H, m), 7.28(1H, m), 7.38(1H, m), 7.41(1H, m), 7.45(1H, m), 7.5(2H, m), 7.51(2H, m), 7.52~7.58(14H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	728.92	728.32
5	δ = 1.72(12H, s), 6.58(2H, m), 6.69~6.75(4H, m), 7.28(2H, m), 7.38(2H, m), 7.45(1H, m), 7.5~7.58(14H, m), 7.77(1H, m), 7.87(2H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	768.98	768.35
7	δ = 1.35(9H, s), 1.72(6H, s), 6.55~6.58(3H, m), 6.69~6.75(3H, m), 7.01(2H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5~7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	708.93	708.35
8	δ = 1.72(6H, s), 2.34(6H, s), 6.36(2H, m), 6.58(1H, m), 6.69~6.75(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5~7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	680.88	680.32
9	δ = 1.72(6H, s), 6.58(1H, m), 6.69~6.81(5H, m), 7.28(1H, m), 7.38~7.39(3H, m), 7.45(1H, m), 7.5~7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	677.83	677.28
10	δ = 1.72(6H, s), 6.58~6.62(2H, m), 6.69~6.75(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5~7.58(13H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.07(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	653.81	653.28
12	δ = 1.72(6H, s), 6.38(4H, m), 6.58~6.63(5H, m), 6.69~6.81(5H, m), 7.2(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5~7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	820.03	819.36
14	δ = 1.35(9H, s), 1.72(6H, s), 2.34(3H, s), 6.38(4H, m), 6.51~6.58(5H, m), 6.69~6.75(3H, m), 6.98~7.01(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5~7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	890.16	889.44
15	δ = 1.72(12H, s), 6.38(4H, m), 6.55~6.58(3H, m), 6.69~6.75(5H, m), 7.02~7.05(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5~7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	860.09	859.39
16	δ = 1.35(9H, s), 1.72(6H, s), 6.38(4H, m), 6.55~6.58(3H, m), 6.69~6.75(3H, m), 7.01(2H, m), 7.28(1H, m), 7.36~7.38(2H, m), 7.45(1H, m), 7.49(1H, m), 7.5~7.58(13H, m), 7.74~7.77(3H, m), 7.84~7.88(3H, m), 8(1H, m), 8.16~8.18(2H, m), 8.54(1H, m)	926.20	925.44

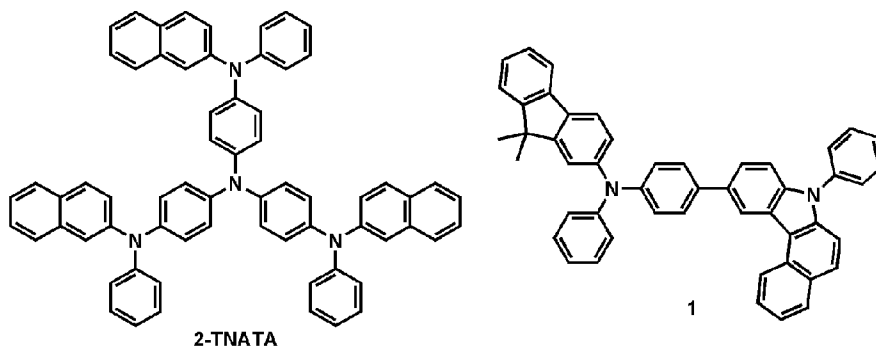
17	$\delta = 1.72(6H, s), 6.58(1H, m), 6.69\sim 6.75(3H, m), 6.96(2H, m), 7.11(2H, m), 7.28(1H, m), 7.36\sim 7.38(5H, m), 7.45(1H, m), 7.5\sim 7.58(12H, m), 7.77\sim 7.78(7H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	837.00	836.33
18	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.69\sim 6.75(3H, m), 7.28(1H, m), 7.38(1H, m), 7.45(7H, m), 7.5\sim 7.58(14H, m), 7.75\sim 7.77(5H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	816.83	816.37
21	$\delta = 1.72(6H, s), 6.58(1H, m), 6.69\sim 6.75(3H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5\sim 7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	657.85	657.32
24	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.69\sim 6.81(4H, m), 7.2(2H, m), 7.28(1H, m), 7.38\sim 7.41(2H, m), 7.51\sim 7.55(7H, m), 7.62\sim 7.68(7H, m), 7.77\sim 7.79(3H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	728.92	728.32
25	$\delta = 1.72(6H, s), 6.58\sim 6.63(5H, m), 6.69\sim 6.81(9H, m), 7.2(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5\sim 7.58(16H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	896.13	895.39
26	$\delta = 1.72(6H, s), 6.58(1H, m), 6.69\sim 6.75(5H, m), 7.28(1H, m), 7.38(1H, m), 7.45(2H, m), 7.5\sim 7.58(22H, m), 7.77(2H, m), 7.87(1H, m), 8(2H, m), 8.16\sim 8.18(4H, m), 8.54(2H, m)$	944.17	943.39
29	$\delta = 1.72(12H, s), 6.58\sim 6.63(4H, m), 6.69\sim 6.81(9H, m), 7.2(2H, m), 7.28(2H, m), 7.38(2H, m), 7.45(1H, m), 7.5\sim 7.58(18H, m), 7.77(1H, m), 7.87(2H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	1012.29	1011.46
30	$\delta = 1.72(12H, s), 6.58\sim 6.63(7H, m), 6.69\sim 6.81(7H, m), 7.2(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5\sim 7.58(14H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	936.19	935.42
31	$\delta = 1.72(6H, s), 5.93(1H, m), 6.58(1H, m), 6.69\sim 6.75(3H, m), 7.28(1H, m), 7.38(1H, m), 7.41(1H, m), 7.45(2H, m), 7.5(4H, m), 7.51(2H, m), 7.52(2H, m), 7.54\sim 7.62(15H, m), 7.77(2H, m), 7.87(2H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	894.11	893.38
32	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.69\sim 6.81(4H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.4\sim 7.54(13H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(3H, m)$	652.82	652.29
39	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.69\sim 6.81(4H, m), 7.2\sim 7.28(7H, m), 7.38(1H, m), 7.45(1H, m), 7.5\sim 7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	728.92	728.32
40	$\delta = 1.72(6H, s), 6.38(4H, m), 6.58\sim 6.63(5H, m), 6.69\sim 6.81(5H, m), 7.2\sim 7.28(9H, m), 7.38(1H, m), 7.45(1H, m), 7.5\sim 7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	896.13	895.39
41	$\delta = 1.72(12H, s), 6.58\sim 6.63(4H, m), 6.75\sim 6.81(3H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.45\sim 7.58(13H, m), 7.77(2H, m), 7.87\sim 7.93(2H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	768.98	768.35
43	$\delta = 1.72(18H, s), 6.58\sim 6.64(4H, m), 6.75\sim 6.81(3H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.45\sim 7.58(12H, m), 7.69(1H, s), 7.77(3H, s), 7.77(0H, m), 7.84\sim 7.93(3H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	885.14	884.41
44	$\delta = 1.72(6H, s), 6.48(1H, m), 6.63(2H, m), 6.69(2H, m), 6.81(1H, m), 7.04(1H, m), 7.2(2H, m), 7.28\sim 7.3(2H, m), 7.38(1H, m), 7.45\sim 7.55(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	652.82	652.29

46	$\delta = 1.72(6H, s), 6.38(4H, m), 6.48(1H, m), 6.63(4H, m), 6.69(2H, m), 6.81(2H, m), 7.04(1H, m), 7.2(4H, m), 7.28\sim 7.3(2H, m), 7.38(1H, m), 7.45\sim 7.55(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	820.03	819.36
49	$\delta = 1.72(6H, s), 6.48(1H, m), 6.63(2H, m), 6.69(2H, m), 6.81(1H, m), 7.13(1H, m), 7.2\sim 7.28(4H, m), 7.38(1H, m), 7.45\sim 7.55(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	642.85	652.29
50	$\delta = 1.72(6H, s), 6.48(1H, m), 6.63(2H, m), 6.69(2H, m), 7.13(1H, m), 7.23\sim 7.38(8H, m), 7.45\sim 7.55(14H, m), 7.77(1H, m), 7.87(1H, m), 7.94\sim 8(2H, m), 8.12\sim 8.18(3H, m), 8.54\sim 8.55(2H, m)$	818.01	817.35
51	$\delta = 1.72(6H, s), 6.38(4H, m), 6.48(1H, m), 6.63(4H, m), 6.69(2H, m), 6.81(2H, m), 7.13(1H, m), 7.2\sim 7.28(6H, m), 7.38(1H, m), 7.45\sim 7.55(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	820.03	819.36
58	$\delta = 1.72(6H, s), 6.58\sim 6.63(5H, m), 6.69(6H, m), 6.81(2H, m), 6.91(1H, m), 7.03(1H, m), 7.2(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45\sim 7.55(16H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	896.13	895.39
60	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.69\sim 6.81(4H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.48(2H, m), 7.5(2H, m), 7.54(2H, m), 7.55\sim 7.62(10H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	728.92	728.32
62	$\delta = 1.72(6H, s), 6.58\sim 6.63(5H, m), 6.69\sim 6.81(9H, m), 7.2(4H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.48(2H, m), 7.5(2H, m), 7.54(6H, m), 7.55\sim 7.62(10H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	972.22	971.42
63	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.75\sim 6.86(3H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.4(1H, m), 7.45\sim 7.58(11H, m), 7.73\sim 7.77(2H, m), 7.86\sim 7.87(2H, m), 8(3H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	758.97	758.28
64	$\delta = 0.66(6H, s), 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.69\sim 6.81(3H, m), 6.99(1H, m), 7.2(2H, m), 7.27\sim 7.28(2H, m), 7.38(1H, m), 7.45\sim 7.58(12H, m), 7.77\sim 7.87(4H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	785.06	784.33
65	$\delta = 1.72(6H, s), 6.58\sim 6.63(4H, m), 6.75\sim 6.81(2H, m), 6.89(1H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.45\sim 7.58(15H, m), 7.75\sim 7.77(4H, m), 7.87\sim 7.89(3H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	850.98	850.31
66	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.75\sim 6.81(4H, m), 7.2(2H, m), 7.28(1H, m), 7.38(2H, m), 7.45\sim 7.58(16H, m), 7.77(2H, m), 7.87(1H, m), 8(2H, m), 8.16\sim 8.18(3H, m), 8.54(1H, m)$	818.01	817.35
67	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.75\sim 6.81(3H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5\sim 7.62(11H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.33(1H, m), 8.54(1H, m)$	653.81	653.28
68	$\delta = 1.72(6H, s), 6.58\sim 6.63(3H, m), 6.69\sim 6.81(4H, m), 7.2(2H, m), 7.28(1H, m), 7.38(1H, m), 7.45(1H, m), 7.5\sim 7.58(14H, m), 7.73\sim 7.77(3H, m), 7.87\sim 7.92(3H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	778.98	778.33
70	$\delta = 6.58\sim 6.63(3H, m), 6.69\sim 6.81(4H, m), 7.11(4H, m), 7.2\sim 7.38(14H, m), 7.45(1H, m), 7.5\sim 7.58(12H, m), 7.77(1H, m), 7.87(1H, m), 8(1H, m), 8.16\sim 8.18(2H, m), 8.54(1H, m)$	853.06	852.35

72	$\delta = 1.72(6\text{H, s}), 6.58\sim 6.63(3\text{H, m}), 6.69\sim 6.81(4\text{H, m}), 7.2(2\text{H, m}), 7.28(1\text{H, m}), 7.38\sim 7.4(2\text{H, m}), 7.54\sim 7.55(3\text{H, m}), 7.62\sim 7.67(5\text{H, m}), 7.77(1\text{H, m}), 7.87\sim 7.9(2\text{H, m}), 8\sim 8.01(2\text{H, m}), 8.16\sim 8.18(2\text{H, m}), 8.41(1\text{H, m}), 8.54(1\text{H, m})$	653.81	653.28
76	$\delta = 1.72(6\text{H, s}), 6.58\sim 6.63(3\text{H, m}), 6.69\sim 6.81(4\text{H, m}), 7.2(2\text{H, m}), 7.28(1\text{H, m}), 7.38\sim 7.41(3\text{H, m}), 7.51\sim 7.55(7\text{H, m}), 7.62\sim 7.67(5\text{H, m}), 7.77(1\text{H, m}), 7.87(1\text{H, m}), 8(1\text{H, m}), 8.16\sim 8.18(2\text{H, m}), 8.28(4\text{H, m}), 8.54(1\text{H, m})$	807.98	807.34
77	$\delta = 1.72(6\text{H, s}), 6.58\sim 6.63(3\text{H, m}), 6.69\sim 6.81(4\text{H, m}), 7.2(2\text{H, m}), 7.28(1\text{H, m}), 7.38\sim 7.41(3\text{H, m}), 7.51\sim 7.55(7\text{H, m}), 7.62\sim 7.67(5\text{H, m}), 7.77\sim 7.79(5\text{H, m}), 7.87(1\text{H, m}), 8(1\text{H, m}), 8.16\sim 8.18(2\text{H, m}), 8.54(1\text{H, m}), 8.63(1\text{H, s})$	806.99	806.34
78	$\delta = 1.72(6\text{H, s}), 6.58\sim 6.63(3\text{H, m}), 6.69\sim 6.81(4\text{H, m}), 7.2(2\text{H, m}), 7.28\sim 7.29(2\text{H, m}), 7.38(1\text{H, m}), 7.4(1\text{H, s}), 7.45\sim 7.54(9\text{H, m}), 7.55(2\text{H, s}), 7.55\sim 7.63(6\text{H, m}), 7.77(1\text{H, m}), 7.87(1\text{H, m}), 8(1\text{H, m}), 8.12(1\text{H, m}), 8.18(1\text{H, m})$	767.96	767.33
87	$\delta = 1.72(6\text{H, s}), 6.58\sim 6.63(3\text{H, m}), 6.75\sim 6.81(2\text{H, m}), 7.2(2\text{H, m}), 7.28(1\text{H, m}), 7.38(1\text{H, m}), 7.45(1\text{H, m}), 7.5\sim 7.58(11\text{H, m}), 7.77\sim 7.81(3\text{H, m}), 7.87(1\text{H, m}), 8(1\text{H, m}), 8.12\sim 8.22(4\text{H, m}), 8.54(1\text{H, m})$	703.87	703.30
89	$\delta = 1.72(6\text{H, s}), 6.58(1\text{H, m}), 6.69\sim 6.76(4\text{H, m}), 7.28(1\text{H, m}), 7.38(1\text{H, m}), 7.41(1\text{H, m}), 7.45(1\text{H, m}), 7.5(2\text{H, m}), 7.51(2\text{H, m}), 7.52(2\text{H, m}), 7.54\sim 7.62(11\text{H, m}), 7.77(1\text{H, m}), 7.87(1\text{H, m}), 8(1\text{H, m}), 8.16\sim 8.18(2\text{H, m}), 8.33(1\text{H, m}), 8.54(1\text{H, m})$	729.91	729.31
90	$\delta = 1.72(12\text{H, s}), 6.58(1\text{H, m}), 6.69\sim 6.75(3\text{H, m}), 6.92(1\text{H, m}), 7.28(1\text{H, m}), 7.36\sim 7.39(4\text{H, m}), 7.45(1\text{H, m}), 7.5(2\text{H, m}), 7.54\sim 7.6(11\text{H, m}), 7.77(1\text{H, m}), 7.87(1\text{H, m}), 8(1\text{H, m}), 8.11\sim 8.18(3\text{H, m}), 8.54(1\text{H, m})$	769.97	769.35
91	$\delta = 1.72(6\text{H, s}), 6.58\sim 6.61(3\text{H, m}), 6.69\sim 6.75(3\text{H, m}), 6.99(2\text{H, m}), 7.28(1\text{H, m}), 7.38(1\text{H, m}), 7.45(1\text{H, m}), 7.5\sim 7.58(12\text{H, m}), 7.77(1\text{H, m}), 7.87(1\text{H, m}), 8(1\text{H, m}), 8.16\sim 8.18(2\text{H, m}), 8.54(1\text{H, m})$	670.81	670.28

- [93] [Example 1] Manufacture of OLED device using the organic electroluminescent compound according to the present invention
- [94] An OLED device was manufactured using the organic electroluminescent compound of the present invention.
- [95] First, a transparent electrode ITO film ($15\Omega/\square$) prepared from a glass substrate for an OLED (Samsung Corning) was subjected to ultrasonic washing sequentially using trichloroethylene, acetone, ethanol and distilled water, and stored in isopropanol for later use.
- [96] Then, the ITO substrate was mounted on a substrate holder of a vacuum deposition apparatus. After adding 4,4',4"-tris(N,N-(2-naphthyl)-phenylamino)triphenylamine (2-TNATA) in a cell of the vacuum deposition apparatus, the pressure inside the chamber was reduced to 10^{-6} torr. Then, 2-TNATA was evaporated by applying electrical current to the cell to form a hole injection layer having a thickness of 60 nm on the ITO substrate.
- [97] Subsequently, after adding Compound 1 in another cell of the vacuum deposition apparatus, Compound 1 was evaporated by applying electrical current to the cell to form a hole transport layer having a thickness of 20 nm on the hole injection layer.

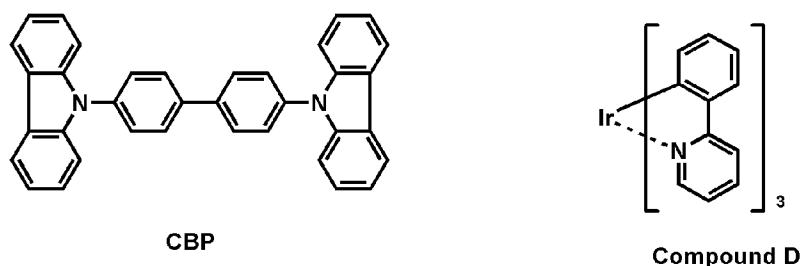
[98]



[99]

An electroluminescent layer was formed on the hole transport layer as follows. 4,4'-N,N'-dicarbazole-biphenyl (CBP) was added in a cell of a vacuum deposition apparatus as a host material, and Compound **D** was added in another cell. The two cells were heated such that an electroluminescent layer having a thickness of 30 nm was formed on the hole transport layer at 2 to 5 wt% based on Compound **D**.

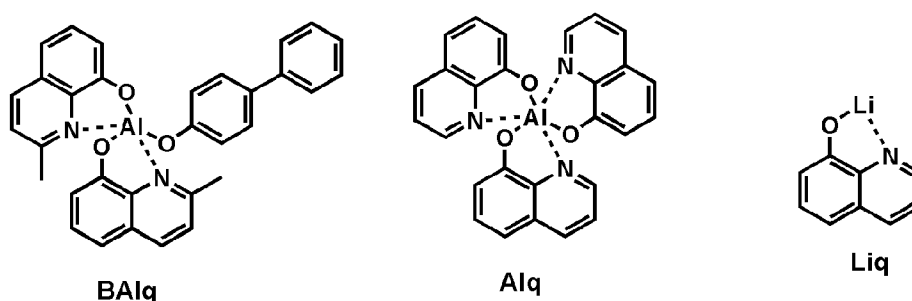
[100]



[101]

Thereafter, bis(2-methyl-8-quinolino)(*p*-phenylphenolato)aluminum(III) (BALq) was deposited with a thickness of 5 nm on the electroluminescent layer as a hole blocking layer. Then, tris(8-hydroxyquinoline)-aluminum(III) (Alq) was deposited with a thickness of 20 nm as an electron transport layer, and lithium quinolate (Liq) was deposited with a thickness of 1 to 2 nm as an electron injection layer. Then, an Al cathode having a thickness of 150 nm was formed using another vacuum deposition apparatus to manufacture an OLED.

[102]



[103]

Each OLED electroluminescent used in the OLED device had been purified by vacuum sublimation at 10^{-6} torr.

[104]

[105]

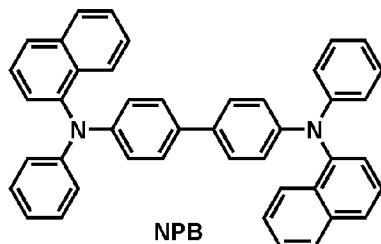
[Comparative Example 1] Electroluminescent property of OLED device using existing electroluminescent material

[106]

A hole injection layer was formed using 2-TNATA in the same manner as Example

1. Then, after adding N,N'-bis(α -naphthyl)-N,N'-diphenyl-4,4'-diamine (NPB) in another cell of the vacuum deposition apparatus, NPB was evaporated by applying electrical current to the cell to form a hole transport layer having a thickness of 20 nm on the hole injection layer.

[107]



[108] The remaining procedure was the same as Example 1.

[109] Luminous efficiency of the OLED devices manufactured in Example 1 and Comparative Example 1 was measured at 1,000 cd/m². The result is given in Table 2.

[110] [Table 2]

[111]

No.	Hole transport layer material	Driving voltage (V) @ 1,000 cd/m ²	Luminous efficiency (cd/A) @ 1,000 cd/m ²
1	Compound 1	5.6	38.5
2	Compound 4	5.6	39.4
3	Compound 21	5.6	39.6
4	Compound 31	5.8	38.4
5	Compound 55	5.7	38.2
6	Compound 76	5.7	39.3
Comp. Ex. 1	NPB	7	20.1

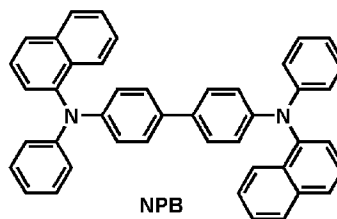
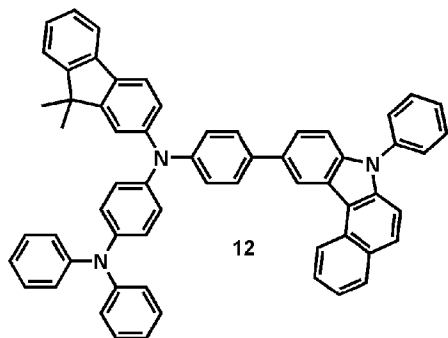
[112] It can be seen that the compounds of the present invention show superior performance as compared to the existing material.

[113]

[114] [Example 2] Preparation of OLED device using the organic electroluminescent compound according to the present invention

[115] An ITO substrate was mounted on a substrate holder of a vacuum deposition apparatus in the same manner as Example 1. After adding Compound **12** in a cell of the vacuum deposition apparatus, the pressure inside the chamber was reduced to 10⁻⁶ torr. Then, Compound **12** was evaporated by applying electrical current to the cell to form a hole injection layer having a thickness of 60 nm on the ITO substrate.[116] Subsequently, after adding N,N'-bis(α -naphthyl)-N,N'-diphenyl-4,4'-diamine (NPB) in another cell of the vacuum deposition apparatus, NPB was evaporated by applying electrical current to the cell to form a hole transport layer having a thickness of 20 nm on the hole injection layer.

[117]



[118] The remaining procedure was the same as Example 1.

[119] Luminous efficiency of the OLED devices manufactured in Example 2 and Comparative Example 1 was measured at 1,000 cd/m². The result is given in Table 3.

[120] [Table 3]

No.	Hole injection layer material	Driving voltage (V) @ 1,000 cd/m ²	Luminous efficiency (cd/A) @ 1,000 cd/m ²
1	Compound 12	5.5	35.8
2	Compound 16	5.7	37.6
3	Compound 25	5.4	36.9
4	Compound 29	5.3	38.4
5	Compound 62	5.8	38.1
Comp. Ex. 1	2-TNATA	7	19.6

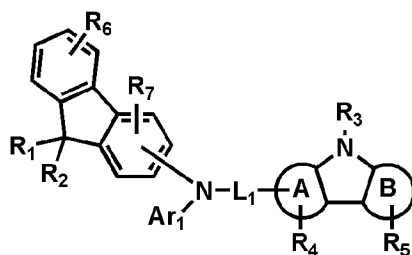
[122] It can be seen that the compounds of the present invention show superior performance as compared to the existing material.

Claims

[Claim 1]

An organic electroluminescent compound represented by Chemical Formula 1:

[Chemical Formula 1]



wherein

ring A and ring B independently represent a monocyclic or polycyclic aromatic ring, a monocyclic or polycyclic hetero aromatic ring, a 5- or 6-membered hetero aromatic ring fused with an aromatic ring or a monocyclic or polycyclic aromatic ring fused with a 5- or 6-membered hetero aromatic ring, excluding the case where the ring A and the ring B are monocyclic aromatic rings at the same time and the substituents R₄ and R₅ are independently hydrogen, (C1-C60)alkyl, (C1-C60)alkoxy or (C6-C60)aryl;

L₁ represents (C6-C60)arylene with or without substituent(s), (C3-C60)heteroarylene with or without substituent(s), (C3-C60)alkenylene with or without substituent(s) or (C3-C60)alkynylene with or without substituent(s);

Ar₁ represents (C1-C60)alkyl with or without substituent(s), (C6-C60)aryl with or without substituent(s), (C3-C60)heteroaryl with or without substituent(s), heterocycloalkyl with or without substituent(s), (C3-C60)cycloalkyl with or without substituent(s), adamantyl with or without substituent(s), (C7-C60)bicycloalkyl with or without substituent(s), (C3-C60)alkenyl with or without substituent(s) or (C3-C60)alkynyl with or without substituent(s);

R₁, R₂, R₃, R₄, R₅, R₆ and R₇ independently represent hydrogen, deuterium, halogen, (C1-C60)alkyl with or without substituent(s), (C6-C60)aryl with or without substituent(s), (C3-C60)heteroaryl with or without substituent(s), 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S with or without substituent(s), (C3-C60)cycloalkyl with or without substituent(s), tri(C1-C60)alkylsilyl with or without substituent(s),

di(C1-C60)alkyl(C6-C60)arylsilyl with or without substituent(s), tri(C6-C60)arylsilyl with or without substituent(s), adamantyl with or without substituent(s), (C7-C60)bicycloalkyl with or without substituent(s), cyano, (C1-C60)alkyloxy with or without substituent(s), (C1-C60)alkylthio with or without substituent(s), (C6-C60)aryloxy with or without substituent(s), (C6-C60)arylthio with or without substituent(s), (C1-C60)alkoxycarbonyl with or without substituent(s), (C1-C60)alkylcarbonyl with or without substituent(s), (C6-C60)arylcarbonyl with or without substituent(s), (C6-C60)aryloxycarbonyl with or without substituent(s), (C1-C60)alkoxycarbonyloxy with or without substituent(s), (C1-C60)alkylcarbonyloxy with or without substituent(s), (C6-C60)arylcarbonyloxy with or without substituent(s), (C6-C60)aryloxycarbonyloxy with or without substituent(s), carboxyl, nitro or hydroxyl, or each of them may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form a fused ring;

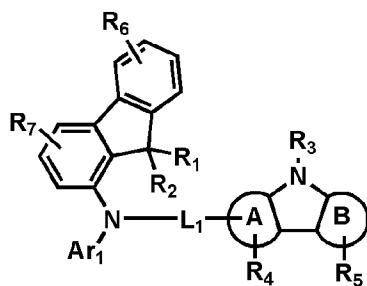
the substituent substituted or unsubstituted at L_1 , Ar_1 , or R_1 through R_7 is one or more substituent(s) selected from a group consisting of hydrogen, deuterium, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, (C3-C60)cycloalkyl, cyano, (C1-C60)alkyloxy, (C1-C60)alkylthio, (C6-C60)aryloxy, (C6-C60)arylthio, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, $NR_{31}R_{32}$, $PR_{33}R_{34}$, $BR_{35}R_{36}$ and $P(=O)R_{37}R_{38}$, or it may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form a fused ring; and

R_{31} through R_{38} independently represent (C1-C60)alkyl, (C3-C60)cycloalkyl, (C6-C60)aryl or (C3-C60)heteroaryl, or each of them may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form a fused ring, and the alkyl, cycloalkyl, aryl or heteroaryl of R_{31} through R_{38} may be further substituted by one or more substituent(s) selected from a group consisting of hydrogen, deuterium, halogen, (C1-C60)alkyl, halo(C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl with or without (C6-C60)aryl substituent, cyano, carboxyl, nitro and hydroxyl.

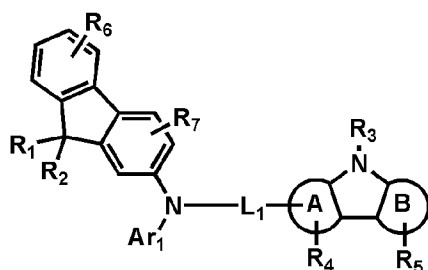
[Claim 2]

The organic electroluminescent compound according to claim 1, which is represented by one of Chemical Formulas 2 to 5:

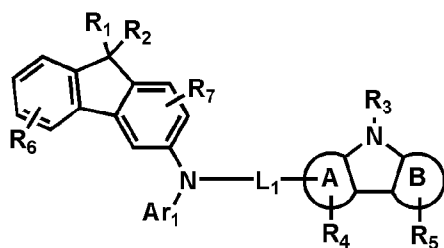
[Chemical Formula 2]



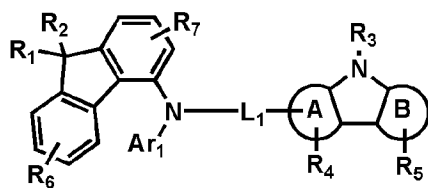
[Chemical Formula 3]



[Chemical Formula 4]



[Chemical Formula 5]

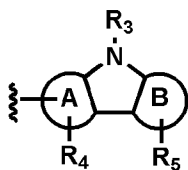


wherein

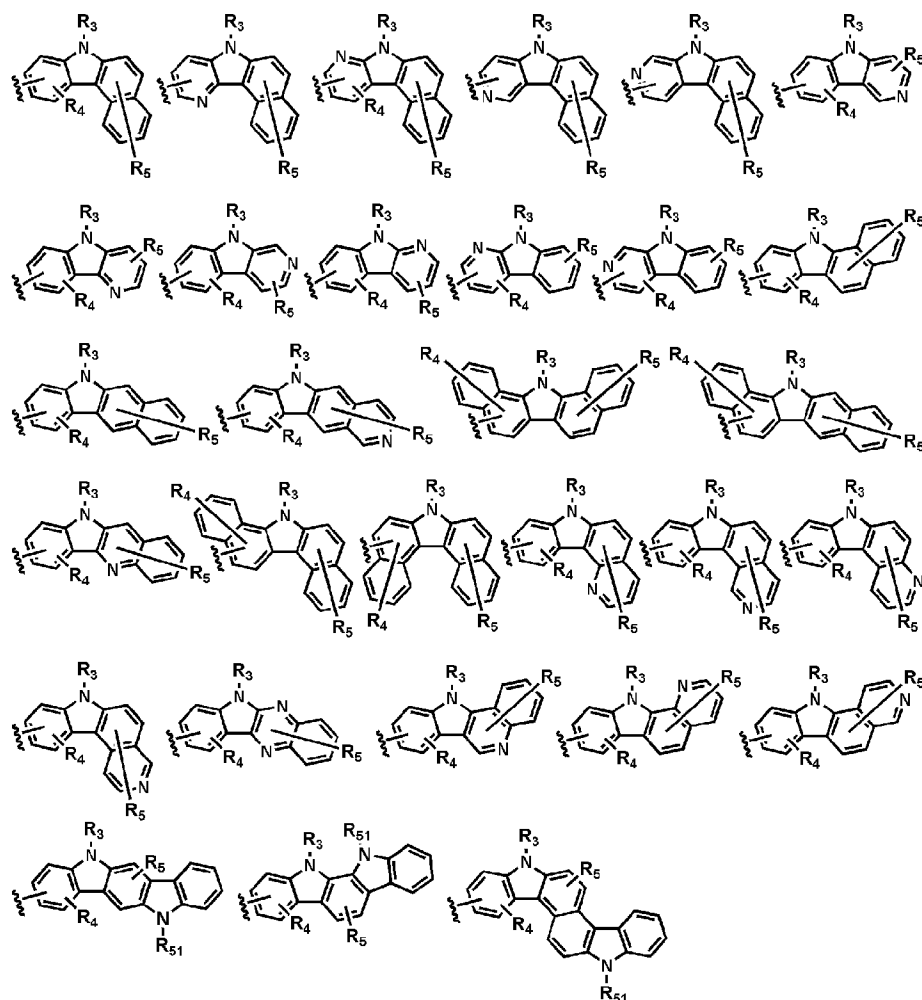
ring A, ring B, L₁, Ar₁, and R₁ through R₇ are the same as defined in claim 1.

[Claim 3]

The organic electroluminescent compound according to claim 2, wherein



is selected from the following structures:



wherein

R₃, R₄ and R₅ are the same as defined in claim 1.

- [Claim 4] An organic electroluminescent device comprising the organic electroluminescent compound according to any one of claims 1 to 3.
- [Claim 5] The organic electroluminescent device according to claim 4, wherein the organic electroluminescent compound is used as a material for hole injection or hole transport.
- [Claim 6] The organic electroluminescent device according to claim 4, which comprises a first electrode; a second electrode; and one or more organic layer(s) interposed between the first electrode and the second electrode, wherein the organic layer comprises one or more layer(s) comprising the organic electroluminescent compound represented by Chemical Formula 1 and one or more layer(s) comprising a fluorescent host and a fluorescent dopant or a phosphorescent host and a phosphorescent dopant.
- [Claim 7] The organic electroluminescent device according to claim 6, wherein

the organic layer further comprises one or more metal(s) or complex(es) selected from a group consisting of organic metals of Group 1, Group 2, 4th period and 5th period transition metals, lanthanide metals and d-transition elements.

[Claim 8] The organic electroluminescent device according to claim 6, wherein the organic layer comprises an electroluminescent layer and a charge generating layer.

[Claim 9] The organic electroluminescent device according to claim 6, which is a white light-emitting organic electroluminescent device wherein the organic layer comprises one or more organic electroluminescent layer(s) emitting blue, red and green light at the same time.