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(54) Title: ORGANIC ELECTROLUMINESCENT COMPOUND AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

(57) Abstract: The present disclosure relates to an organic electroluminescent compound and an organic electroluminescent device comprising the same. By comprising the organic electroluminescent compound, an organic electroluminescent device having a high luminous efficiency and/or a high power efficiency can be provided.



Description

Title of Invention: ORGANIC ELECTROLUMINESCENT COMPOUND AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

Technical Field

- [1] The present disclosure relates to an organic electroluminescent compound and an organic electroluminescent device comprising the same.

Background Art

- [2] An electroluminescent device (EL device) is a self-light-emitting display device which has advantages in that it provides a wider viewing angle, a greater contrast ratio, and a faster response time. The first organic EL device was developed by Eastman Kodak in 1987, by using small aromatic diamine molecules and aluminum complexes as materials for forming a light-emitting layer [Appl. Phys. Lett. 51, 913, 1987].
- [3] An organic electroluminescent device (OLED) changes electric energy into light by applying electricity to an organic electroluminescent material, and commonly comprises an anode, a cathode, and an organic layer formed between the two electrodes. The organic layer of the organic EL device may comprise a hole injection layer, a hole transport layer, a hole auxiliary layer, a light-emitting auxiliary layer, an electron blocking layer, a light-emitting layer (containing host and dopant materials), an electron buffer layer, a hole blocking layer, an electron transport layer, an electron injection layer, etc. The materials used in the organic layer can be classified into a hole injection material, a hole transport material, a hole auxiliary material, a light-emitting auxiliary material, an electron blocking material, a light-emitting material, an electron buffer material, a hole blocking material, an electron transport material, an electron injection material, etc., depending on their functions. In such an organic EL device, holes from the anode and electrons from the cathode are injected into a light-emitting layer by the application of electric voltage, and excitons having high energy are produced by the recombination of the holes and electrons. The organic light-emitting compound moves into an excited state by the energy and emits light from energy when the organic light-emitting compound returns to the ground state from the excited state.
- [4] The most important factor determining luminous efficiency in an organic EL device is light-emitting materials. The light-emitting materials are required to have the following features: high quantum efficiency, high movement degree of an electron and a hole, and uniformity and stability of the formed light-emitting material layer. The light-emitting material is classified into blue, green, and red light-emitting materials according to the light-emitting color, and further includes yellow or orange light-

emitting materials. Furthermore, the light-emitting material is classified into a host material and a dopant material in a functional aspect. Recently, an urgent task is the development of an organic EL device having high efficiency and long lifespan. In particular, the development of highly excellent light-emitting material over conventional materials is urgently required, considering the EL properties necessary for medium and large-sized OLED panels. For this, preferably, as a solvent in a solid state and an energy transmitter, the preferable characteristics of a host material should have high purity and a suitable molecular weight in order to be deposited under vacuum. Furthermore, a host material is required to have high glass transition temperature and pyrolysis temperature to achieve thermal stability, high electrochemical stability to achieve long lifespan, easy formability of an amorphous thin film, good adhesion with adjacent layers, and no movement between layers.

- [5] In addition, there is a need for the development of a material that has good thermal stability in a hole transport layer, a buffer layer, an electron transport layer, etc., and which can improve the performance of the organic EL device such as driving voltage, luminous efficiency, and lifespan characteristics.
- [6] KR 2016-0076881 A discloses examples, which are a condensed phenanthrene-based compound used in an electron transport auxiliary layer and as a host compound.

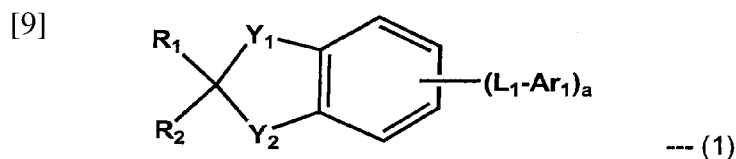
Disclosure of Invention

Technical Problem

- [7] The object of the present disclosure is firstly, to provide an organic electroluminescent compound which is able to produce an organic electroluminescent device having high luminous efficiency and/or high power efficiency, and secondly, to provide an organic electroluminescent device comprising the organic electroluminescent compound.

Solution to Problem

- [8] As a result of intensive studies to solve the technical problem above, the present inventors found that the aforementioned objective can be achieved by the organic electroluminescent compound represented by the following formula 1, and then completed the present invention.



- [10] In formula 1,
- [11] Y₁ and Y₂ each independently represent O or S;
- [12] L₁ each independently represent a single bond, a substituted or unsubstituted

- (C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene;
- [13] Ar₁ each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted fused ring of (C3-C30)aliphatic ring and (C6-C30)aromatic ring, or -N(Ar₄)(Ar₅); or may be linked to adjacent substituents to form a ring;
- [14] Ar₄ and Ar₅ each independently represent hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl;
- [15] R₁ and R₂ each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; or may be linked to adjacent substituents to form a ring; and
- [16] a represents an integer of 0 to 4, when a is 2 or more, each -L₁-Ar₁ may be the same or different.

Advantageous Effects of Invention

- [17] By comprising an organic electroluminescent compound according to the present disclosure, an organic electroluminescent device having a high luminous efficiency and/or a high power efficiency can be prepared.

Mode for the Invention

- [18] Hereinafter, the present disclosure will be described in detail. However, the following description is intended to explain the invention, and is not meant in any way to restrict the scope of the invention.
- [19] The present disclosure relates to an organic electroluminescent compound represented by formula 1 above, an organic electroluminescent material comprising the organic electroluminescent compound, and an organic electroluminescent device

comprising the organic electroluminescent material.

- [20] The term "organic electroluminescent compound" in the present disclosure means a compound that may be used in an organic electroluminescent device, and may be comprised in any material layer constituting an organic electroluminescent device, as necessary.
- [21] Herein, "organic electroluminescent material" means a material that may be used in an organic electroluminescent device, and may comprise at least one compound. The organic electroluminescent material may be comprised in any layer constituting an organic electroluminescent device, as necessary. For example, the organic electroluminescent material may be a hole injection material, a hole transport material, a hole auxiliary material, a light-emitting auxiliary material, an electron blocking material, a light-emitting material (containing host and dopant materials), an electron buffer material, a hole blocking material, an electron transport material, or an electron injection material, etc.
- [22] Herein, "(C1-C30)alkyl" is meant to be a linear or branched alkyl having 1 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 1 to 20, and more preferably 1 to 10. The above alkyl may include methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, *tert*-butyl, etc. "(C3-C30)cycloalkyl" is a mono- or polycyclic hydrocarbon having 3 to 30 ring backbone carbon atoms, in which the number of carbon atoms is preferably 3 to 20, and more preferably 3 to 7. The above cycloalkyl may include cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, etc. "(C6-C30)aryl(ene)" is a monocyclic or fused ring radical derived from an aromatic hydrocarbon having 6 to 30 ring backbone carbon atoms, in which the number of the ring backbone carbon atoms is preferably 6 to 20, more preferably 6 to 15, may be partially saturated, and may comprise a spiro structure. Examples of the aryl specifically include phenyl, biphenyl, terphenyl, quaterphenyl, naphthyl, binaphthyl, phenylnaphthyl, naphthylphenyl, fluorenyl, phenylfluorenyl, dimethylfluorenyl, diphenylfluorenyl, benzofluorenyl, diphenylbenzofluorenyl, dibenzofluorenyl, phenanthrenyl, benzophenanthrenyl, phenylphenanthrenyl, anthracenyl, benzanthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, benzochrysenyl, naphthacenyl, fluoranthenyl, benzofluoranthenyl, tolyl, xylyl, mesityl, cumenyl, spiro[fluorene-fluorene]yl, spiro[fluorene-benzofluorene]yl, azulenyl, etc. More specifically, the aryl may be o-tolyl, m-tolyl, p-tolyl, 2,3-xylyl, 3,4-xylyl, 2,5-xylyl, mesityl, o-cumenyl, m-cumenyl, p-cumenyl, p-*t*-butylphenyl, p-(2-phenylpropyl)phenyl, 4'-methylbiphenyl, 4"-*t*-butyl-*p*-terphenyl-4-yl, o-biphenyl, m-biphenyl, p-biphenyl, o-terphenyl, m-terphenyl-4-yl, m-terphenyl-3-yl, m-terphenyl-2-yl, p-terphenyl-4-yl, p-terphenyl-3-yl, p-terphenyl-2-yl, m-quaterphenyl, 1-naphthyl, 2-naphthyl, 1-fluorenyl, 2-fluorenyl, 3-fluorenyl, 4-fluorenyl, 9-fluorenyl,

9,9-dimethyl-1-fluorenyl, 9,9-dimethyl-2-fluorenyl, 9,9-dimethyl-3-fluorenyl, 9,9-dimethyl-4-fluorenyl, 9,9-diphenyl-1-fluorenyl, 9,9-diphenyl-2-fluorenyl, 9,9-diphenyl-3-fluorenyl, 9,9-diphenyl-4-fluorenyl, 1-anthryl, 2-anthryl, 9-anthryl, 1-phenanthryl, 2-phenanthryl, 3-phenanthryl, 4-phenanthryl, 9-phenanthryl, 1-chrysenyl, 2-chrysenyl, 3-chrysenyl, 4-chrysenyl, 5-chrysenyl, 6-chrysenyl, benzo[c]phenanthryl, benzo[g]chrysenyl, 1-triphenylenyl, 2-triphenylenyl, 3-triphenylenyl, 4-triphenylenyl, 3-fluoranthenyl, 4-fluoranthenyl, 8-fluoranthenyl, 9-fluoranthenyl, benzo[fluoranthenyl], etc. "(3- to 30-membered)heteroaryl(ene)" is an aryl having 3 to 30 ring backbone atoms, in which the number of ring backbone atoms is preferably 5 to 25, including at least one, preferably 1 to 4 heteroatoms selected from the group consisting of B, N, O, S, Si, P, and Ge. The above heteroaryl may be a monocyclic ring, or a fused ring condensed with at least one benzene ring; and may be partially saturated. Also, the above heteroaryl may be one formed by linking at least one heteroaryl or aryl group to a heteroaryl group via a single bond(s). Examples of the heteroaryl specifically may include a monocyclic ring-type heteroaryl including furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., and a fused ring-type heteroaryl including benzofuranyl, benzothiophenyl, isobenzofuranyl, dibenzofuranyl, dibenzothiophenyl, benzoimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, imidazopyridinyl, isoindolyl, indolyl, benzoindolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolyl, quinazolyl, quinoxalyl, carbazolyl, azacarbazolyl, benzocarbazolyl, dibenzocarbazolyl, phenoxazinyl, phenanthridinyl, benzodioxolyl, indolizidinyl, acrylidinyl, silafluorenyl, germafluorenyl, etc. More specifically, the heteroaryl may be 1-pyrrolyl, 2-pyrrolyl, 3-pyrrolyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl, 2-pyrimidinyl, 4-pyrimidinyl, 5-pyrimidinyl, 6-pyrimidinyl, 1,2,3-triazin-4-yl, 1,2,4-triazin-3-yl, 1,3,5-triazin-2-yl, 1-imidazolyl, 2-imidazolyl, 1-pyrazolyl, 1-indolizidinyl, 2-indolizidinyl, 3-indolizidinyl, 5-indolizidinyl, 6-indolizidinyl, 7-indolizidinyl, 8-indolizidinyl, 2-imidazopyridinyl, 3-imidazopyridinyl, 5-imidazopyridinyl, 6-imidazopyridinyl, 7-imidazopyridinyl, 8-imidazopyridinyl, 1-indolyl, 2-indolyl, 3-indolyl, 4-indolyl, 5-indolyl, 6-indolyl, 7-indolyl, 1-isoindolyl, 2-isoindolyl, 3-isoindolyl, 4-isoindolyl, 5-isoindolyl, 6-isoindolyl, 7-isoindolyl, 2-furyl, 3-furyl, 2-benzofuranyl, 3-benzofuranyl, 4-benzofuranyl, 5-benzofuranyl, 6-benzofuranyl, 7-benzofuranyl, 1-isobenzofuranyl, 3-isobenzofuranyl, 4-isobenzofuranyl, 5-isobenzofuranyl, 6-isobenzofuranyl, 7-isobenzofuranyl, 2-quinolyl, 3-quinolyl, 4-quinolyl, 5-quinolyl, 6-quinolyl, 7-quinolyl, 8-quinolyl, 1-isoquinolyl, 3-isoquinolyl, 4-isoquinolyl, 5-isoquinolyl, 6-isoquinolyl, 7-isoquinolyl, 8-isoquinolyl, 2-quinoxalyl, 5-quinoxalyl,

6-quinoxaliny, 1-carbazolyl, 2-carbazolyl, 3-carbazolyl, 4-carbazolyl, 9-carbazolyl, azacarbazole-1-yl, azacarbazole-2-yl, azacarbazole-3-yl, azacarbazole-4-yl, azacarbazole-5-yl, azacarbazole-6-yl, azacarbazole-7-yl, azacarbazole-8-yl, azacarbazole-9-yl, 1-phenanthridinyl, 2-phenanthridinyl, 3-phenanthridinyl, 4-phenanthridinyl, 6-phenanthridinyl, 7-phenanthridinyl, 8-phenanthridinyl, 9-phenanthridinyl, 10-phenanthridinyl, 1-acrylidinyl, 2-acrylidinyl, 3-acrylidinyl, 4-acrylidinyl, 9-acrylidinyl, 2-oxazolyl, 4-oxazolyl, 5-oxazolyl, 2-oxadiazolyl, 5-oxadiazolyl, 3-furazanyl, 2-thienyl, 3-thienyl, 2-methylpyrrole-1-yl, 2-methylpyrrole-3-yl, 2-methylpyrrole-4-yl, 2-methylpyrrole-5-yl, 3-methylpyrrole-1-yl, 3-methylpyrrole-2-yl, 3-methylpyrrole-4-yl, 3-methylpyrrole-5-yl, 2-t-butylpyrrole-4-yl, 3-(2-phenylpropyl)pyrrole-1-yl, 2-methyl-1-indolyl, 4-methyl-1-indolyl, 2-methyl-3-indolyl, 4-methyl-3-indolyl, 2-t-butyl-1-indolyl, 4-t-butyl-1-indolyl, 2-t-butyl-3-indolyl, 4-t-butyl-3-indolyl, 1-dibenzofuranyl, 2-dibenzofuranyl, 3-dibenzofuranyl, 4-dibenzofuranyl, 1-dibenzothiophenyl, 2-dibenzothiophenyl, 3-dibenzothiophenyl, 4-dibenzothiophenyl, 1-silafluorenyl, 2-silafluorenyl, 3-silafluorenyl, 4-silafluorenyl, 1-germafluorenyl, 2-germafluorenyl, 3-germafluorenyl, 4-germafluorenyl, etc. Herein, "Halogen" includes F, Cl, Br, and I.

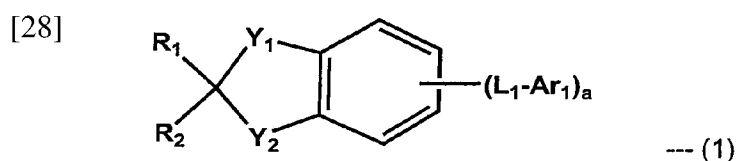
- [23] In addition, "ortho (o)," "meta (m)," and "para (p)" are meant to signify the substitution position of all substituents. Ortho position is a compound with substituents, which are adjacent to each other, e.g., at the 1 and 2 positions on benzene. Meta position is the next substitution position of the immediately adjacent substitution position, e.g., a compound with substituents at the 1 and 3 positions on benzene. Para position is the next substitution position of the meta position, e.g., a compound with substituents at the 1 and 4 positions on benzene.
- [24] Herein, "a ring formed in linking to an adjacent substituent" means a substituted or unsubstituted (3- to 30-membered) mono- or polycyclic, alicyclic, aromatic ring, or a combination thereof, formed by linking or fusing two or more adjacent substituents, preferably may be a substituted or unsubstituted (3- to 26-membered) mono- or polycyclic, alicyclic, aromatic ring, or a combination thereof. Further, the formed ring may be included at least one heteroatom selected from the group consisting of B, N, O, S, Si and P, preferably, N, O and S. According to one embodiment of the present disclosure, the number of atoms in the ring skeleton is 5 to 20; according to another embodiment of the present disclosure, the number of atoms in the ring skeleton is 5 to 15. In one embodiment, the fused ring may be, for example, a substituted or unsubstituted dibenzothiophene ring, a substituted or unsubstituted dibenzofuran ring, a substituted or unsubstituted naphthalene ring, a substituted or unsubstituted phenanthrene ring, a substituted or unsubstituted fluorene ring, a substituted or unsubstituted ben-

zothiophene ring, a substituted or unsubstituted benzofuran ring, a substituted or unsubstituted indole ring, a substituted or unsubstituted indene ring, a substituted or unsubstituted benzene ring or a substituted or unsubstituted carbazole ring, etc.

- [25] In addition, "substituted" in the expression "substituted or unsubstituted" means that a hydrogen atom in a certain functional group is replaced with another atom or functional group, i.e., a substituent. The substituents of the substituted (C1-C30)alkyl, the substituted (C2-C30)alkenyl, the substituted (C6-C30)aryl(ene), the substituted (3- to 30-membered)heteroaryl(ene), the substituted (C3-C30)cycloalkyl, the substituted (C1-C30)alkoxy, the substituted tri(C1-C30)alkylsilyl, the substituted di(C1-C30)alkyl(C6-C30)arylsilyl, the substituted (C1-C30)alkyldi(C6-C30)arylsilyl, the substituted tri(C6-C30)arylsilyl, the substituted fused ring of (C3-C30)aliphatic ring and (C6-C30)aromatic ring, and the substituted (C1-C30)alkyl(C6-C30)aryl amino in L_1 , Ar_1 , Ar_4 , Ar_5 , R_1 , and R_2 are each independently at least one selected from the group consisting of deuterium, halogen, cyano, carboxyl, nitro, hydroxyl, (C1-C30)alkyl, halo(C1-C30)alkyl, (C2-C30)alkenyl, (C2-C30)alkynyl, (C1-C30)alkoxy, (C1-C30)alkylthio, (C3-C30)cycloalkyl, (C3-C30)cycloalkenyl, (3- to 7-membered)heterocycloalkyl, (C6-C30)aryloxy, (C6-C30)arylthio, (C6-C30)aryl-substituted or unsubstituted (5- to 30-membered)heteroaryl, (5- to 30-membered)heteroaryl-substituted or unsubstituted (C6-C30)aryl, tri(C1-C30)alkylsilyl, tri(C6-C30)arylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl, (C1-C30)alkyldi(C6-C30)arylsilyl, amino, mono- or di(C1-C30)alkylamino, (C1-C30)alkyl-substituted or unsubstituted mono- or di(C6-C30)aryl amino, (C1-C30)alkyl(C6-C30)aryl amino, (C1-C30)alkylcarbonyl, (C1-C30)alkoxycarbonyl, (C6-C30)arylcarbonyl, di(C6-C30)arylboronyl, di(C1-C30)alkylboronyl, (C1-C30)alkyl(C6-C30)arylboronyl, (C6-C30)ar(C1-C30)alkyl, and (C1-C30)alkyl(C6-C30)aryl. For example, the substituents may be a substituted or unsubstituted phenyl, a substituted or unsubstituted m-biphenyl, or a substituted or unsubstituted triazinyl, etc.

- [26] Hereinafter, the organic electroluminescent compound according to one embodiment will be described.

- [27] The organic electroluminescent compound according to one embodiment is represented by the following formula 1.



- [29] In formula 1,

- [30] Y_1 and Y_2 each independently represent O or S;

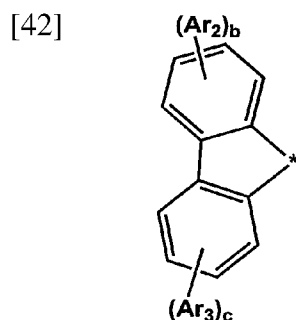
- [31] L_1 each independently represent a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene;
- [32] Ar_1 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted fused ring of (C3-C30)aliphatic ring and (C6-C30)aromatic ring, or $-N(Ar_4)(Ar_5)$; or may be linked to adjacent substituents to form a ring;
- [33] Ar_4 and Ar_5 each independently represent hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl;
- [34] R_1 and R_2 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)aryl amino; or may be linked to adjacent substituents to form a ring;
- [35] a represents an integer of 0 to 4, when a is 2 or more, each $-L_1-Ar_1$ may be the same or different.
- [36] In one embodiment, Y_1 and Y_2 may both be O, or both be S.
- [37] In one embodiment, L_1 each independently may be a single bond, a substituted or unsubstituted (C6-C25)arylene, or a substituted or unsubstituted (5- to 25-membered)heteroarylene, preferably a single bond, a substituted or unsubstituted (C6-C18)arylene, or a substituted or unsubstituted (5- to 18-membered)heteroarylene, for example, may be a single bond, phenylene, naphthylene, or pyridylene.
- [38] In one embodiment, Ar_1 each independently may be hydrogen, a substituted or unsubstituted (C6-C25)aryl, a substituted or unsubstituted (5- to 25-membered)heteroaryl, $-N(Ar_4)(Ar_5)$; or may be linked to an adjacent substituent to form a substituted or unsubstituted (3- to 30-membered) mono- or polycyclic, alicyclic, aromatic ring, or a combination thereof. Preferably, Ar_1 each independently may be

hydrogen, a substituted or unsubstituted (C6-C18)aryl, a substituted or unsubstituted (5- to 18-membered)heteroaryl, -N(Ar₄)(Ar₅); or may be linked to an adjacent substituent to form a substituted or unsubstituted (5- to 25-membered) mono- or polycyclic, aromatic ring, or a combination thereof, for example, may be hydrogen, a substituted or unsubstituted phenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted carbazolyl, a substituted or unsubstituted dibenzofuranyl, a substituted or unsubstituted triazinyl, a substituted or unsubstituted pyridinyl, a substituted or unsubstituted pyrimidinyl, -N(Ar₄)(Ar₅); or may be linked to adjacent Ar₁s to form a substituted or unsubstituted fused ring.

[39] In one embodiment, Ar₄ and Ar₅ each independently may be hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, a substituted or unsubstituted (C2-C10)alkenyl, a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl, preferably a substituted or unsubstituted (C6-C18)aryl or a substituted or unsubstituted (5- to 18-membered)heteroaryl, for example, may be a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted fluorenyl, a substituted or unsubstituted phenanthrenyl, a substituted or unsubstituted dibenzofuranyl, or a substituted or unsubstituted carbazolyl.

[40] In one embodiment, R₁ and R₂ each independently may be hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C10)alkyl, a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl; or may be linked to adjacent R₁s, or adjacent R₂s, or adjacent R₁ and R₂ to form a ring. Preferably R₁ and R₂ each independently represent a substituted or unsubstituted (C6-C18)aryl or a substituted or unsubstituted (5- to 18-membered)heteroaryl; or may be linked to adjacent R₁s, or adjacent R₂s, or adjacent R₁ and R₂ to form a ring, for example, may be a substituted or unsubstituted phenyl, a substituted or unsubstituted fluorenyl, or a substituted or unsubstituted carbazolyl.

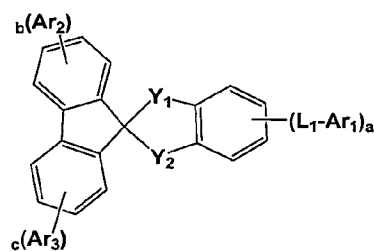
[41] In one embodiment, when adjacent R₁s, or adjacent R₂s, or adjacent R₁ and R₂ are linked to each other to form a ring, the following structure may be formed, so that a spiro structure may be formed together with the core of formula 1.



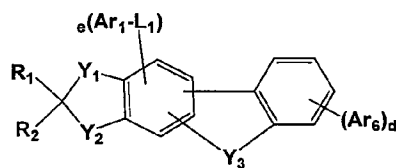
[43] In the above structure, * is a linking point with a core of formula 1.

[44] The organic electroluminescent compound of formula 1 according to one embodiment may be represented by any one of the following formulae 2 to 4.

[45]

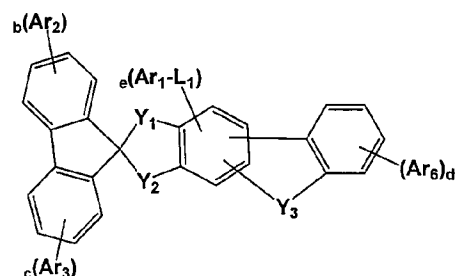


--- (2)



--- (3)

[46]



--- (4)

[47] In formulae 2 to 4,

[48] Y_1 , Y_2 , R_1 , R_2 , L_1 , Ar_1 , and a are as defined in formula 1;

[49] Ar_2 , Ar_3 , and Ar_6 are as defined as Ar_1 ;

[50] Y_3 represents O, S, $-N(L_2-Ar_7)$, or $-C(Ar_8)(Ar_9)$;

[51] L_2 represents as defined as L_1 ;

[52] Ar_7 represents as defined as Ar_4 ;

[53] Ar_8 and Ar_9 each independently represent a substituted or unsubstituted (C1-C30)alkyl or a substituted or unsubstituted (C6-C30)aryl;

[54] b to d each independently represent an integer of 1 to 4, e represents an integer of 1 or 2; and

[55] when b to e are 2 or more, each of Ar_2 , Ar_3 , Ar_6 , and $-L_1-Ar_1$ may be the same or different.

[56] In one embodiment, Ar_2 and Ar_3 each independently may be hydrogen, a substituted or unsubstituted (C6-C25)aryl, a substituted or unsubstituted (5- to 25-membered)heteroaryl, $-N(Ar_4)(Ar_5)$; or may be linked to an adjacent substituent to form a substituted or unsubstituted (3- to 30-membered) mono- or polycyclic, alicyclic, aromatic ring, or a combination thereof, preferably may be hydrogen, a substituted or unsubstituted (C6-C18)aryl, a substituted or unsubstituted (5- to 18-membered)heteroaryl, $-N(Ar_4)(Ar_5)$; or may be linked to an adjacent substituent to form a substituted or unsubstituted (5- to 25-membered) mono- or polycyclic, aromatic ring, or a combination thereof, for example, may be hydrogen, a substituted or unsubstituted pyridinyl, a substituted or unsubstituted carbazolyl, a substituted or unsubstituted triazinyl, $-N(Ar_4)(Ar_5)$, e.g., a substituted or unsubstituted diarylamine; or may

be fused to adjacent substituents to form a substituted or unsubstituted fluorene ring or a substituted or unsubstituted carbazole ring.

[57] In one embodiment, Ar₆ each independently may be hydrogen, a substituted or unsubstituted (C6-C25)aryl; or may be linked to adjacent substituents to form a substituted or unsubstituted (3- to 30-membered) mono- or polycyclic, alicyclic, aromatic ring, or a combination thereof, preferably may be hydrogen, an unsubstituted (C6-C18)aryl; or may be linked to adjacent substituents to form a substituted or unsubstituted (5- to 25-membered) mono- or polycyclic, aromatic ring, or a combination thereof, for example, hydrogen, a substituted or unsubstituted phenyl; or may be fused to adjacent substituents to form a substituted or unsubstituted fluorene ring.

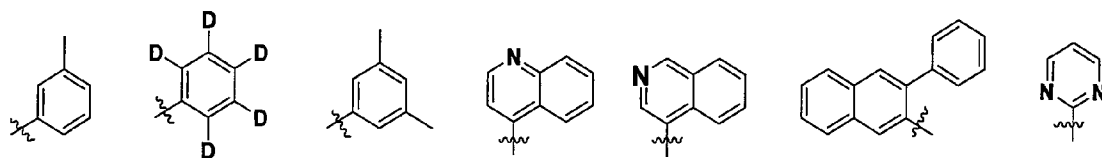
[58] In one embodiment, L₂ may a single bond, a substituted or unsubstituted (C6-C25)arylene, or a substituted or unsubstituted (5- to 25-membered)heteroarylene, preferably a single bond, a substituted or unsubstituted (C6-C18)arylene, or a substituted or unsubstituted (5- to 18-membered)heteroarylene. For example, L₂ may be a single bond, phenylene, or pyridylene.

[59] In one embodiment, Ar₇ may be a substituted or unsubstituted (C6-C25)aryl or a substituted or unsubstituted (5- to 25-membered)heteroaryl, preferably, a substituted or unsubstituted (C6-C18)aryl or a substituted or unsubstituted (5- to 18-membered)heteroaryl, for example, may be a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted triazinyl, a substituted or unsubstituted pyridinyl, or a substituted or unsubstituted pyrimidinyl.

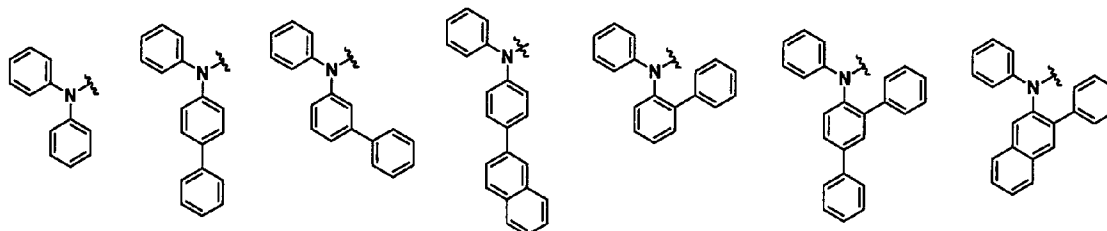
[60] Ar₁, Ar₄, Ar₅, R₁, and R₂ according to one embodiment each independently may be selected from any one of the substituents listed in the following Group 1.

[61] [Group 1]

[62]

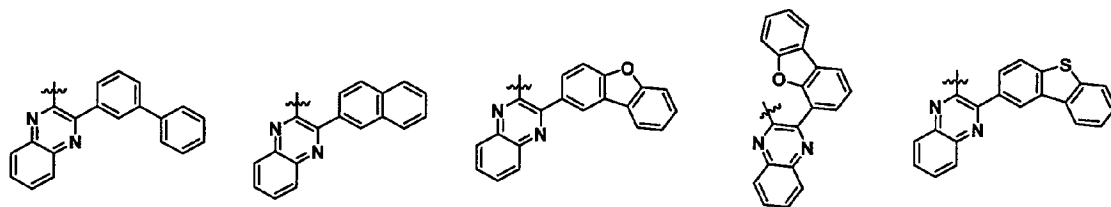


[63]

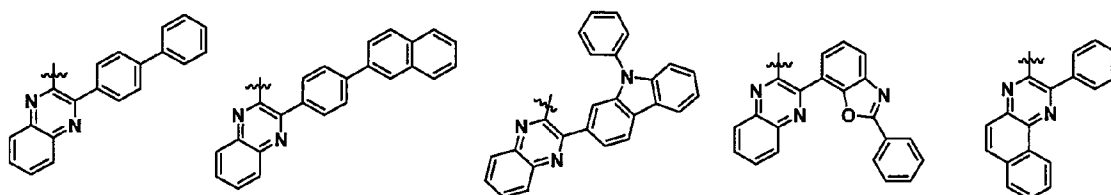


Chemical structures of 2-, 3-, and 4-pyridyl groups, each with a wavy line indicating a point of attachment.

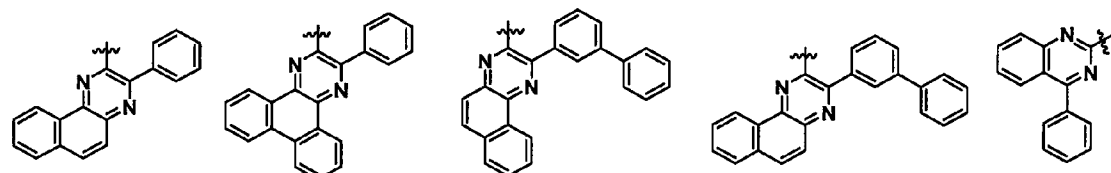
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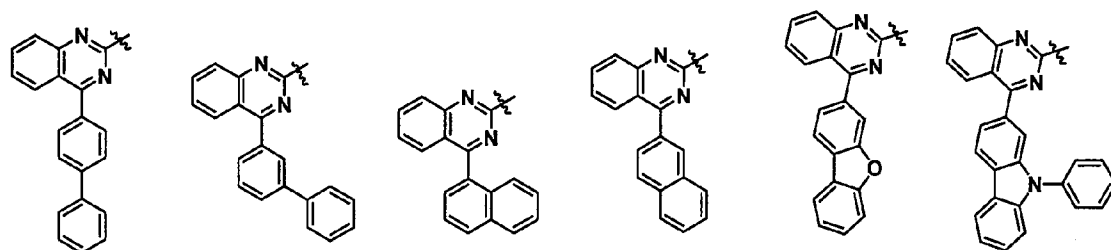
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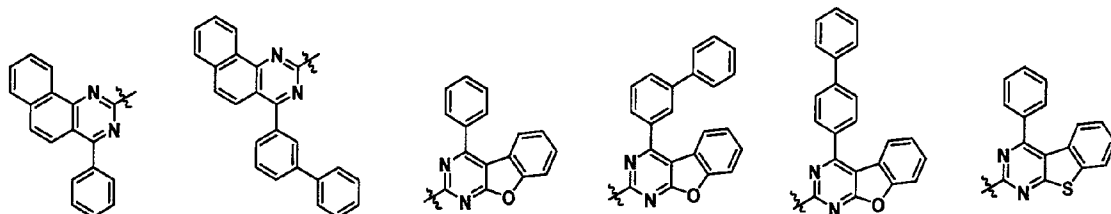
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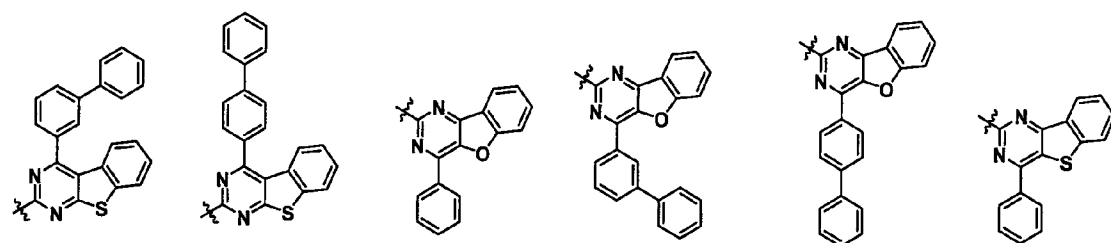
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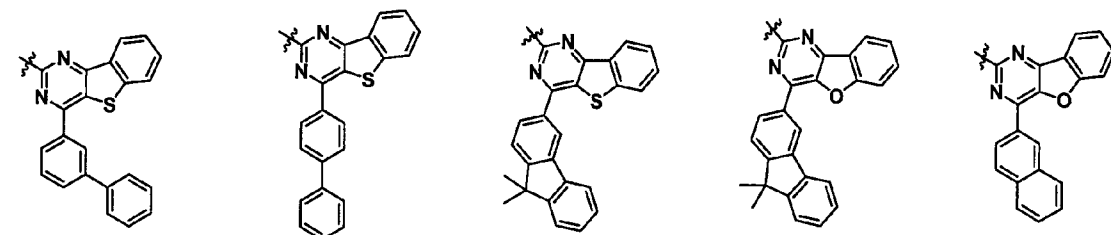
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[78]



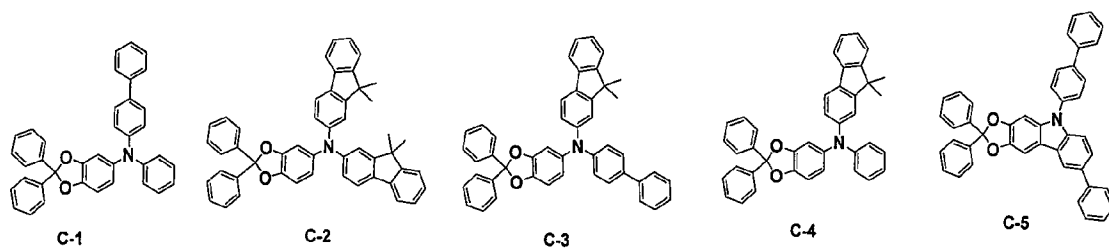
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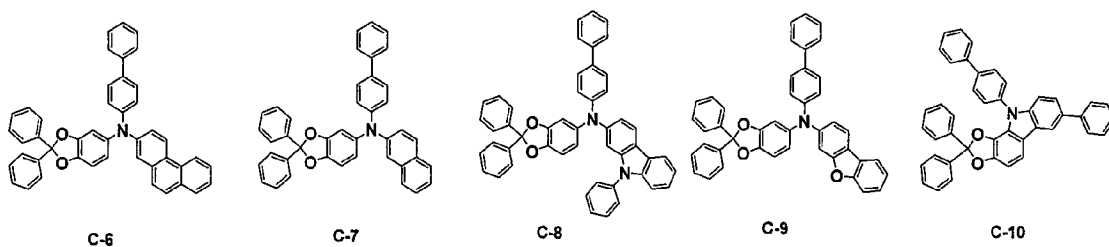
[80]

According to one embodiment, the organic electroluminescent compound represented by formula 1 may be more specifically illustrated by the following compounds, but is not limited thereto.

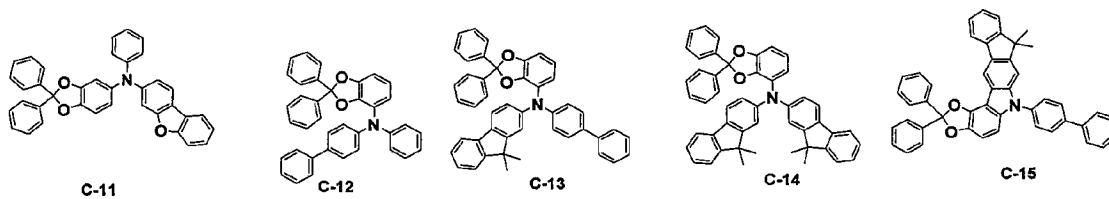
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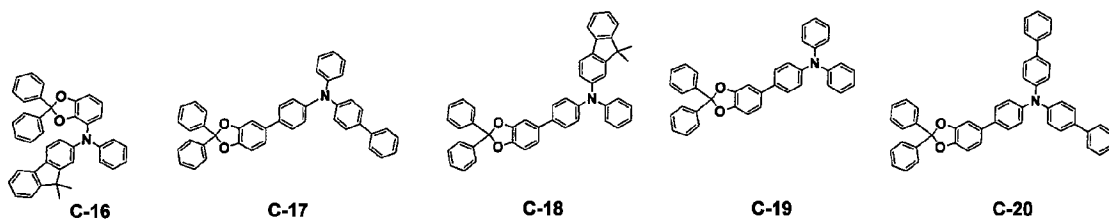
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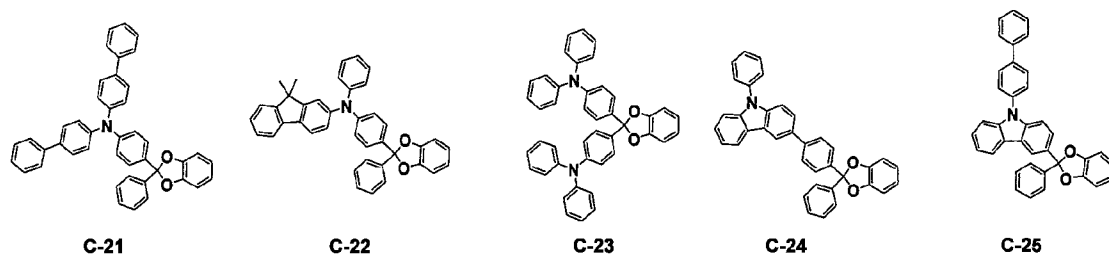
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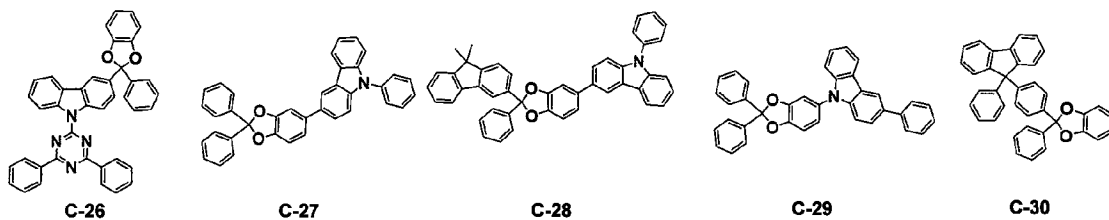
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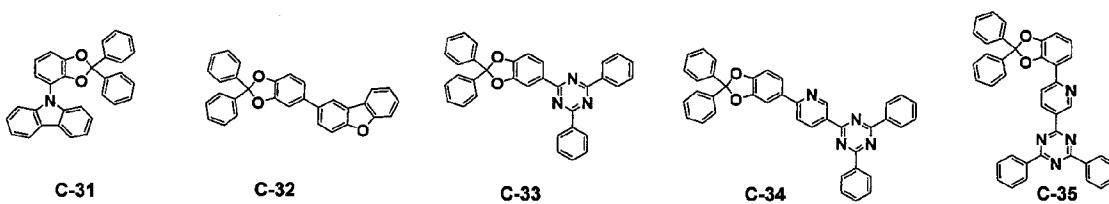
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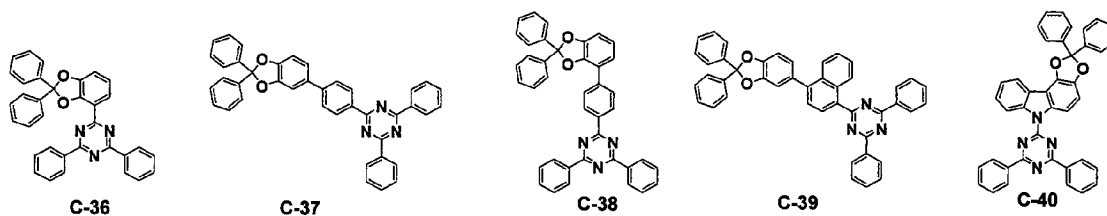
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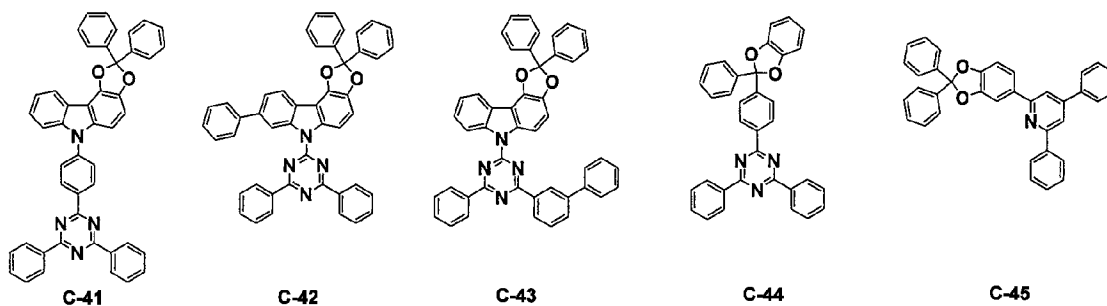
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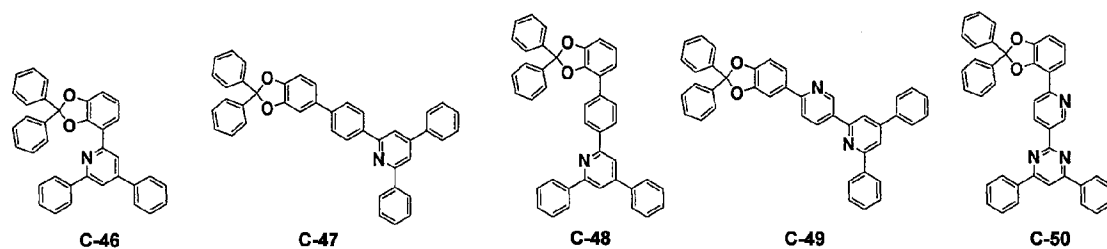
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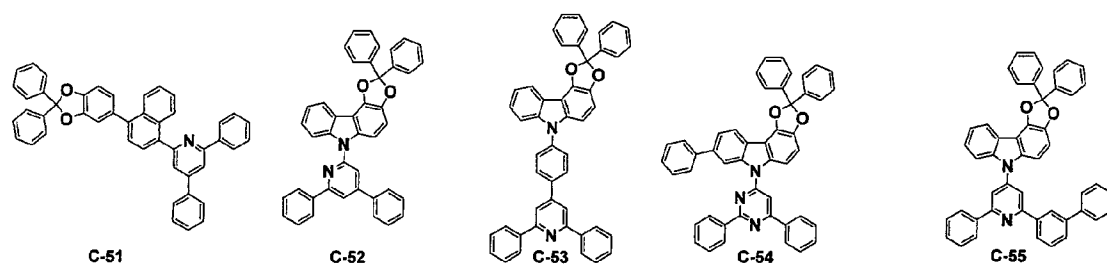
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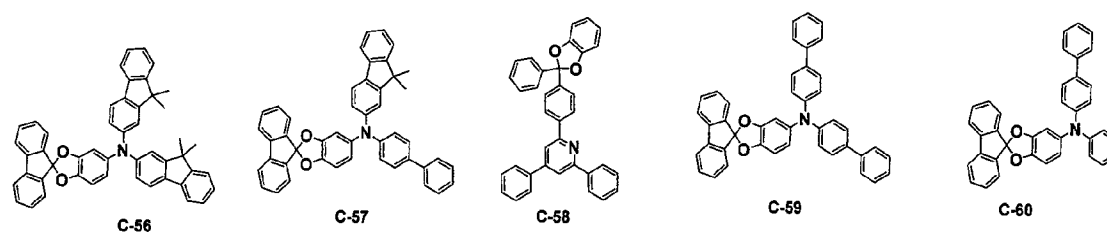
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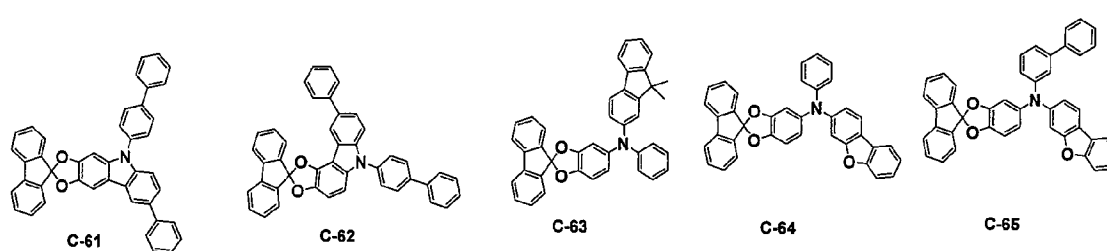
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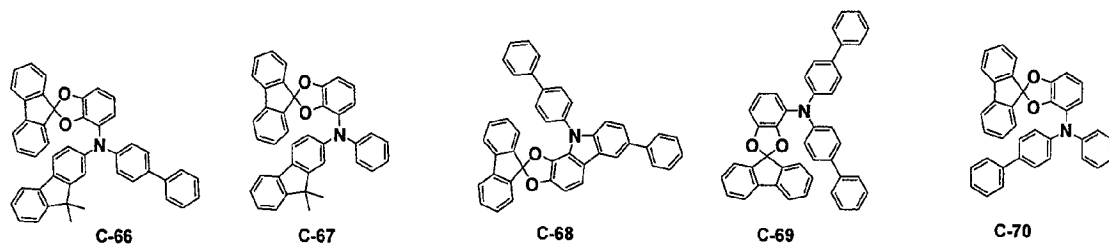
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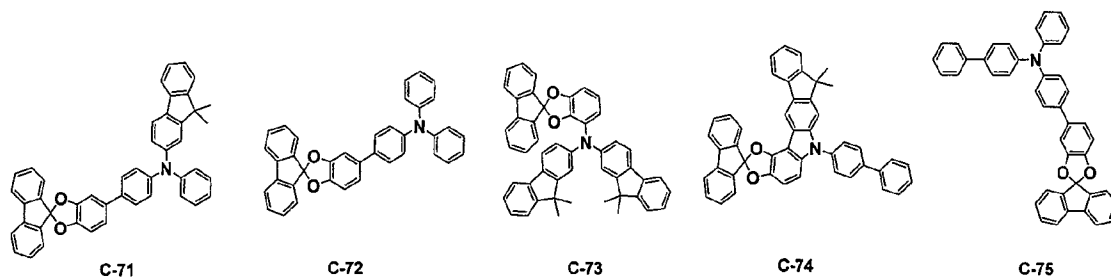
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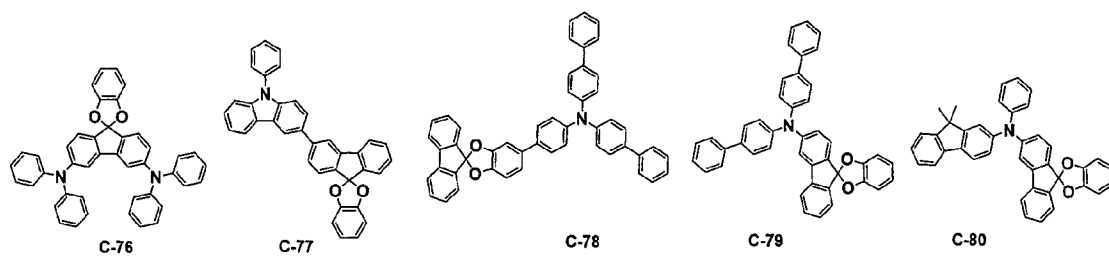
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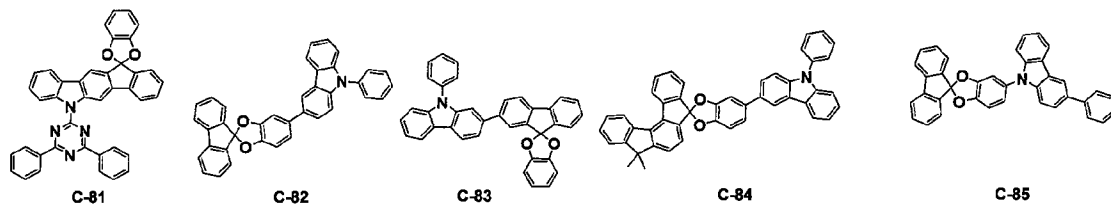
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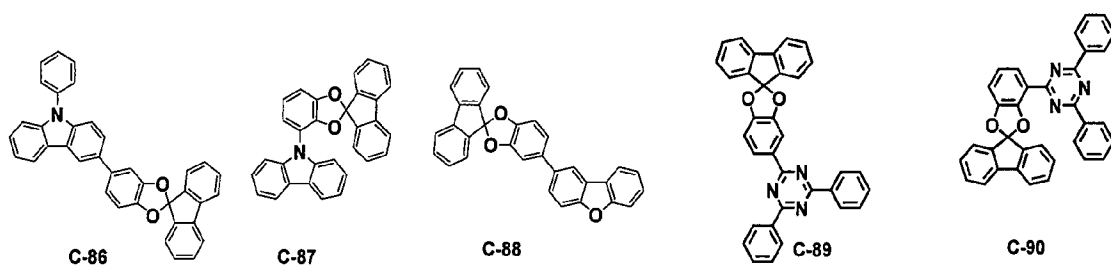
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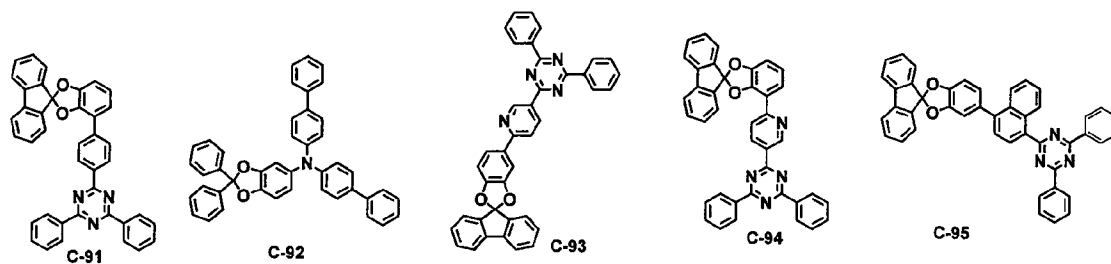
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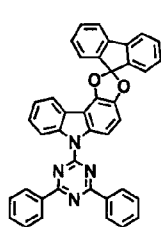
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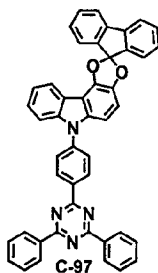
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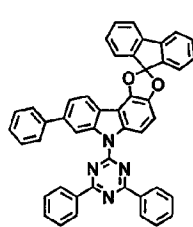
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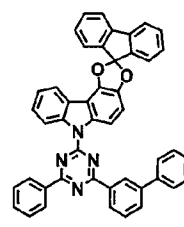
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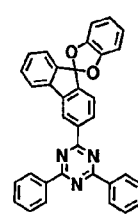
C-97



C-98

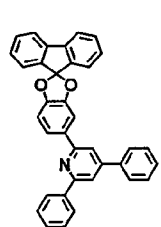


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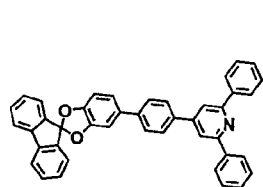


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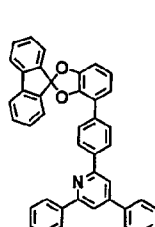
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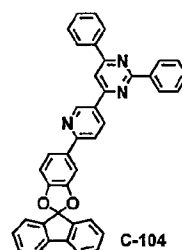
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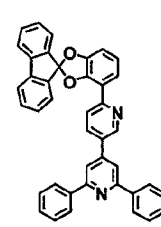
C-102



C-103

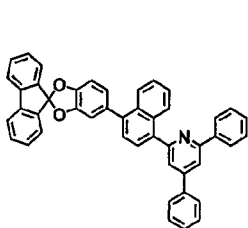


C-104

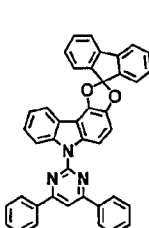


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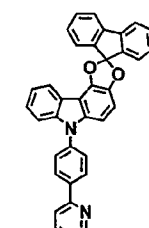
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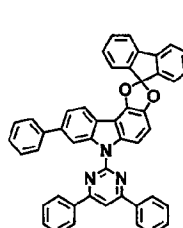
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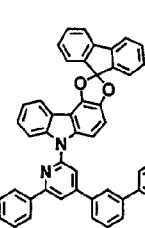
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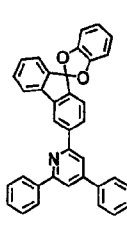
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C-109

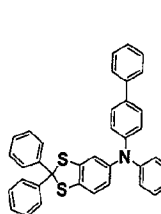


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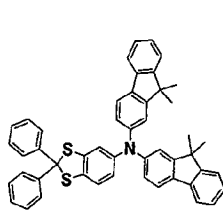


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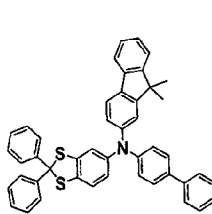
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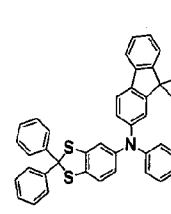
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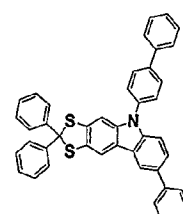
C-113



C-114

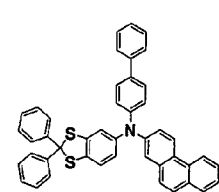


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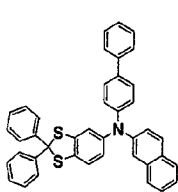


C-116

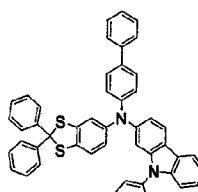
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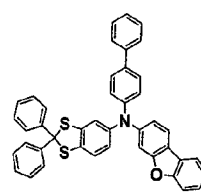
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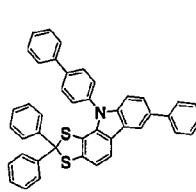
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C-119

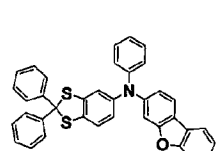


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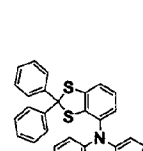


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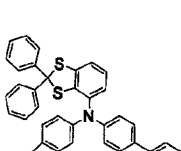
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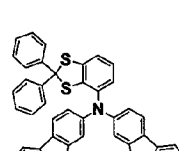
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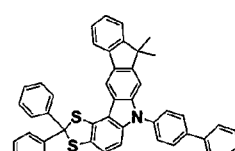
C-123



C-124

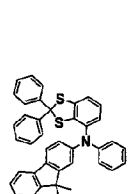


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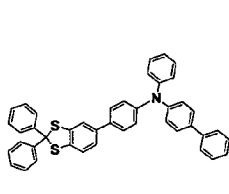


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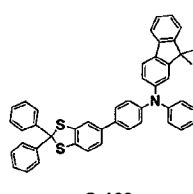
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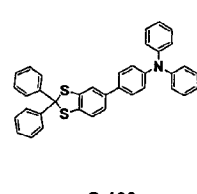
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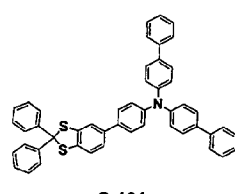
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C-129

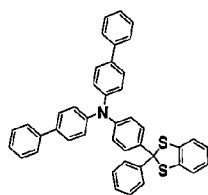


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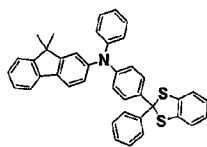


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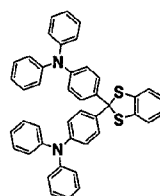
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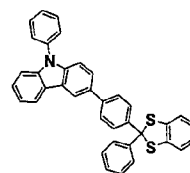
C-132



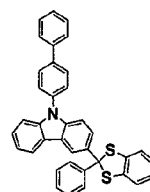
C-133



C-134

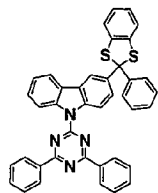


C-135

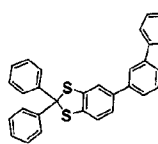


C-136

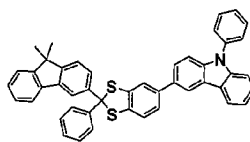
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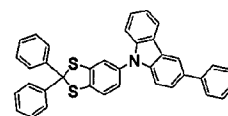
C-137



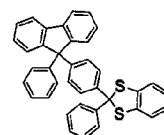
C-138



C-139

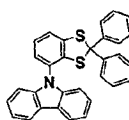


C-140

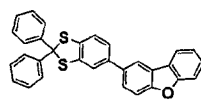


C-141

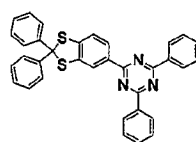
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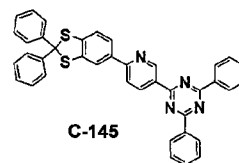
C-142



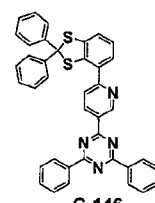
C-143



C-144

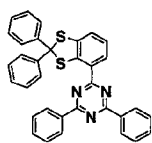


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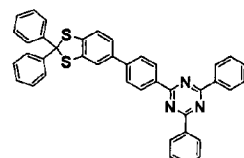


C-146

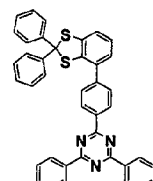
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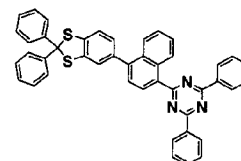
C-147



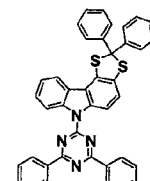
C-148



C-149

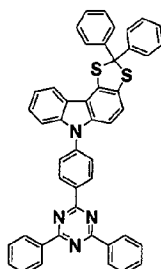


C-150

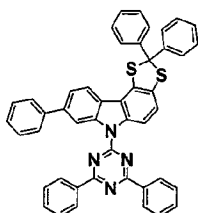


C-151

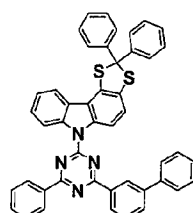
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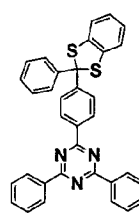
C-152



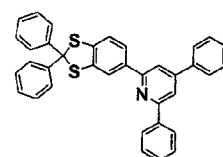
C-153



C-154

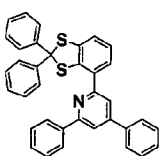


C-155

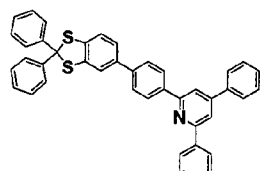


C-156

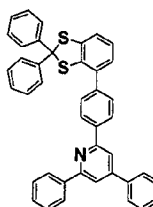
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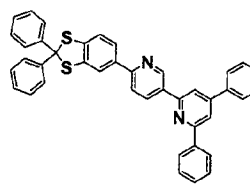
C-157



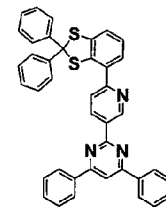
C-158



C-159

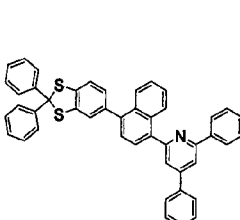


C-160

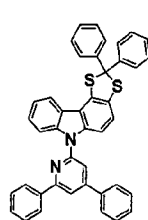


C-161

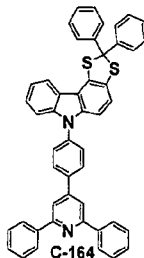
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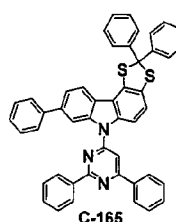
C-162



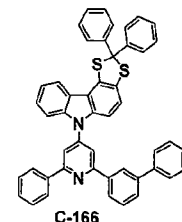
C-163



C-164

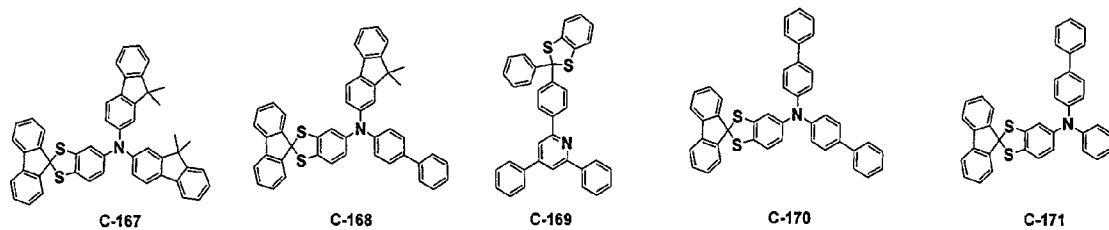


C-165

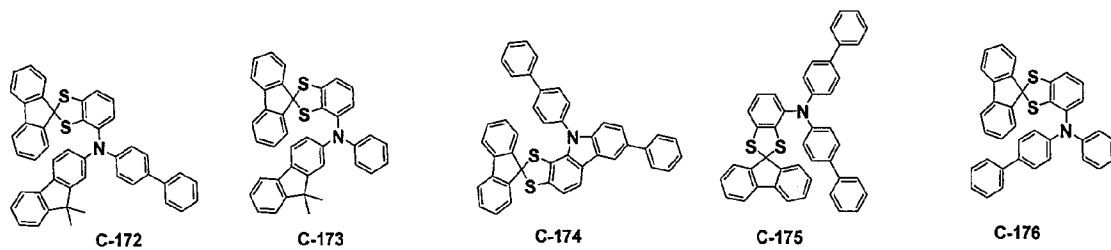


C-166

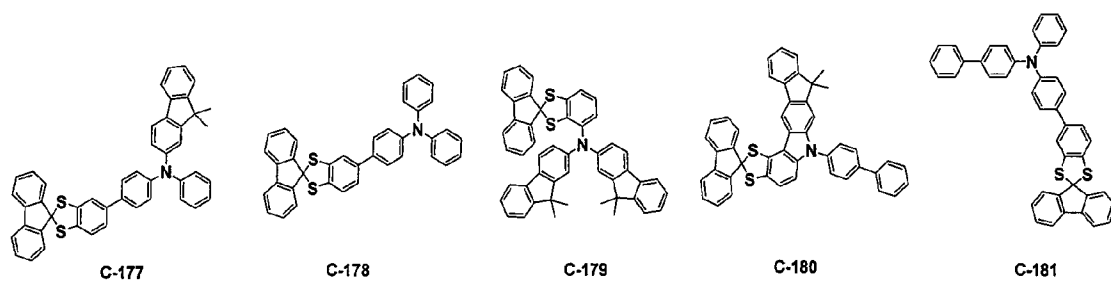
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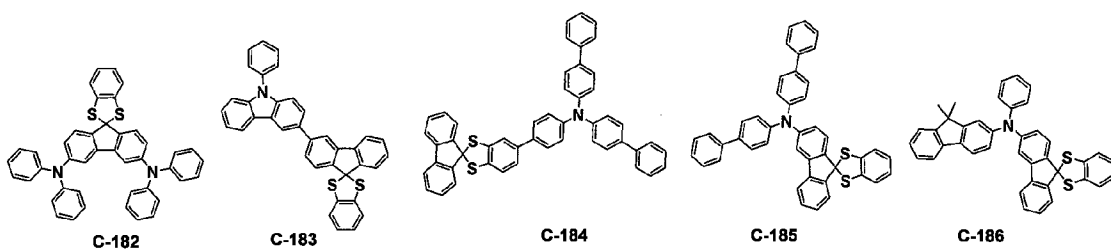
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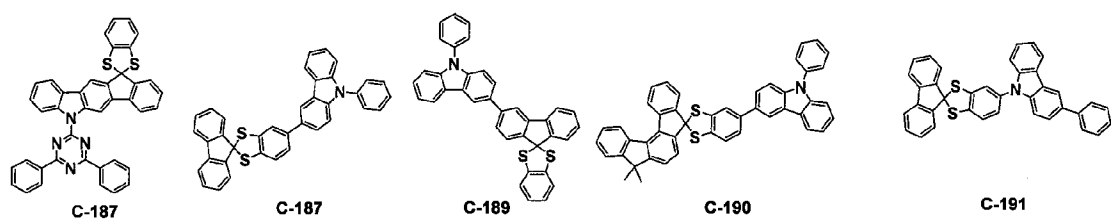
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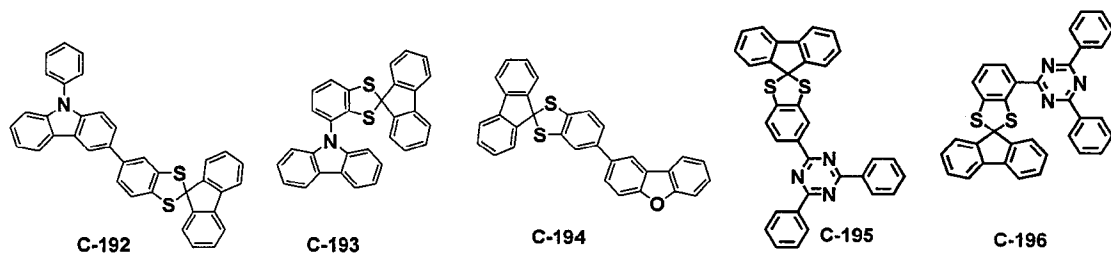
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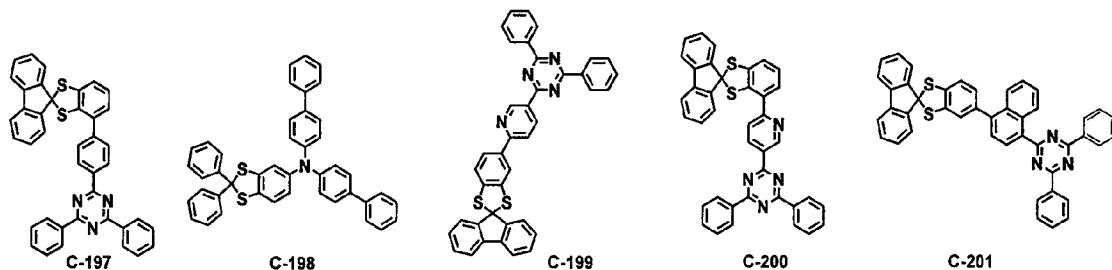
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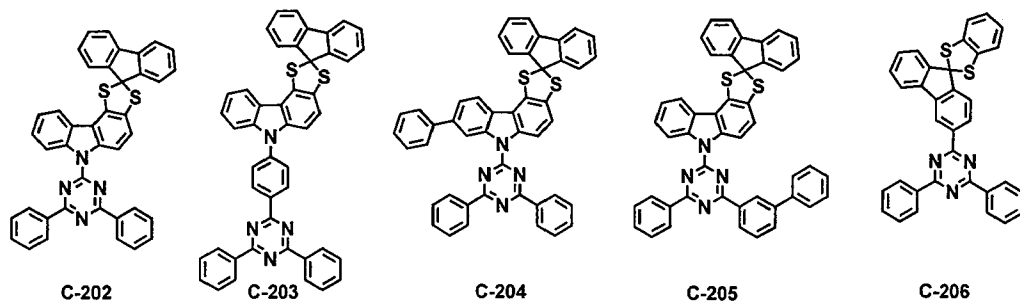
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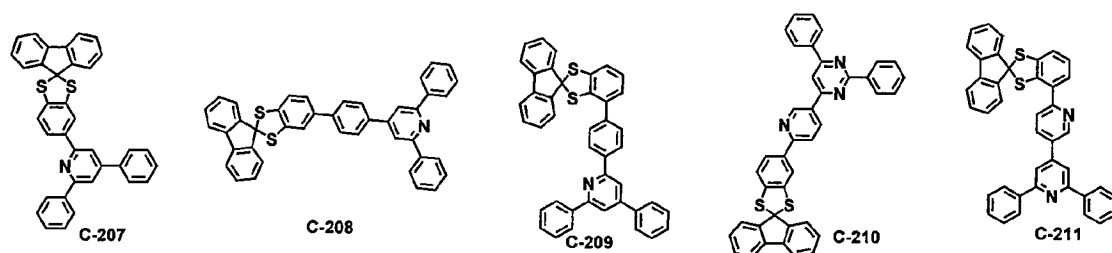
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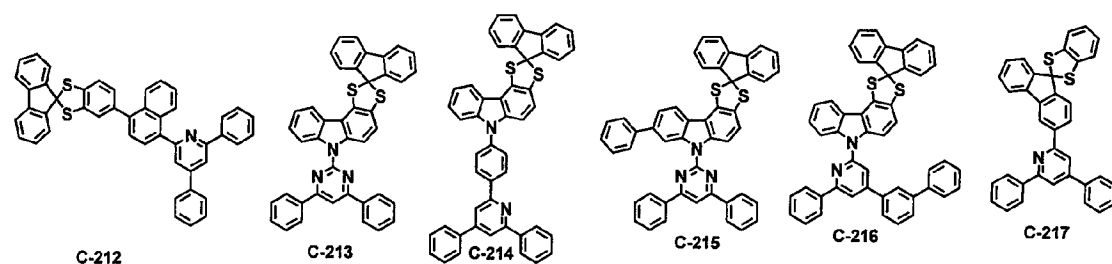
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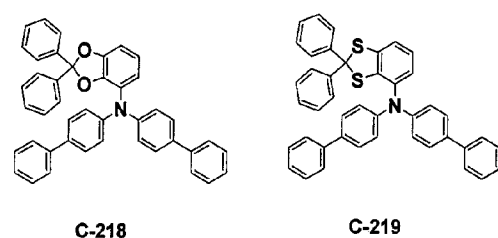
[122]



[123]



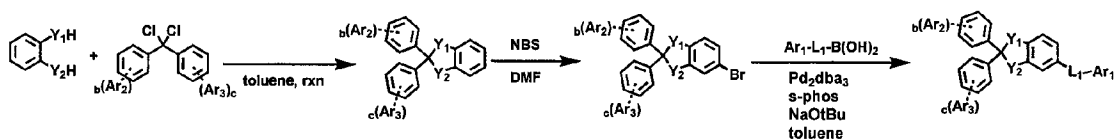
[124]



[125] The compound represented by formula 1 according to the present disclosure may be prepared as represented by the following reaction schemes 1 and 2, but is not limited thereto; further produced by a synthetic method known to a person skilled in the art.

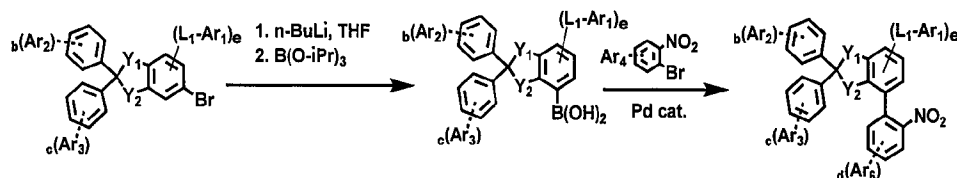
[126] [Reaction Scheme 1]

[127]

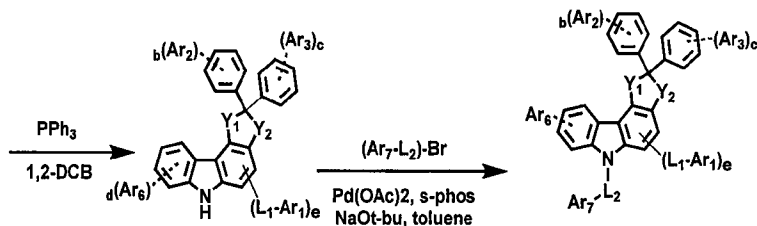


[128] [Reaction Scheme 2]

[129]



[130]



[131] In reaction schemes 1 and 2, the definition of the substituents is as defined in formulae 1 to 4.

[132] As described above, exemplary synthesis examples of the compounds represented by formula 1 according to one embodiment are described, but they are based on Buchwald-Hartwig cross coupling reaction, Suzuki cross-coupling reaction, Bromination reaction, organolithium reaction and Phosphine-mediated reductive cyclization reaction etc. It will be understood by one skilled in the art that the above reaction proceeds even if other substituents defined in the formulae 1 to 4 other than the substituents described in the specific synthesis examples are bonded.

[133] The present disclosure may provide an organic electroluminescent material comprising an organic electroluminescent compound of formula 1, and an organic electroluminescent device comprising the organic electroluminescent material.

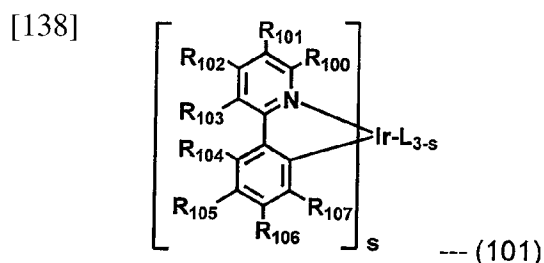
[134] The organic electroluminescent material may be comprised solely of the organic electroluminescent compound of the present disclosure, or may further comprise conventional materials included in the organic electroluminescent material. When two or more species of materials are included in one layer, the at least two compounds may be a mixture-evaporation or a co-evaporation to form a layer. The organic electroluminescent material according to one embodiment may comprise at least one compound represented by formula 1. For example, the compound of formula 1 may be included as a hole transport layer (HTL) material of an organic electroluminescent device.

[135] The organic electroluminescent material of the present disclosure may further comprise host compound other than the organic electroluminescent compound of formula 1. Preferably, the organic electroluminescent material may further comprise at least one dopant.

[136] The dopant comprised in the organic electroluminescent material of the present disclosure may be at least one phosphorescent or fluorescent dopant, preferably a phosphorescent dopant. The phosphorescent dopant material applied to the organic electroluminescent device of the present disclosure is not particularly limited, but may be

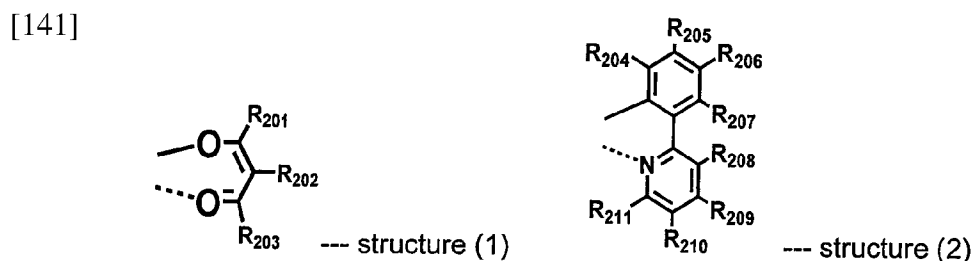
preferably a metallated complex compound(s) of a metal atom(s) selected from iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), more preferably an ortho-metallated complex compound(s) of a metal atom(s) selected from iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), and even more preferably ortho-metallated iridium complex compound(s).

[137] The dopant comprised may use the compound represented by the following formula 101, but is not limited thereto:



[139] In formula 101,

[140] wherein, L is selected from the following structure 1 or 2:



[142] R_{100} to R_{103} each independently represent hydrogen, deuterium, halogen, halogen-substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, cyano, a substituted or unsubstituted (3- to 30-membered)heteroaryl, or a substituted or unsubstituted (C1-C30)alkoxy; or R_{100} to R_{103} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, e.g., a substituted or unsubstituted quinoline, a substituted or unsubstituted benzofuopyridine, a substituted or unsubstituted benzothienopyridine, a substituted or unsubstituted indenopyridine, a substituted or unsubstituted benzofuroquinoline, a substituted or unsubstituted benzothienoquinoline, or a substituted or unsubstituted indenoquinoline;

[143] R_{104} to R_{107} each independently represent hydrogen, deuterium, halogen, halogen-substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, cyano, or a substituted or unsubstituted (C1-C30)alkoxy; or R_{104} to R_{107} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, e.g., a substituted or unsubstituted naphthyl, a substituted or unsubstituted fluorene, a substituted or unsubstituted dibenzothiophene,

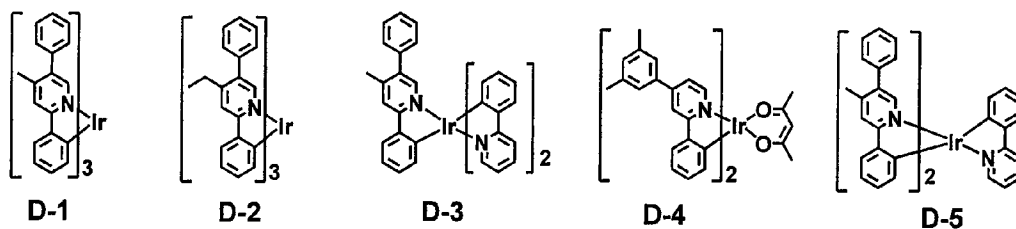
a substituted or unsubstituted dibenzofuran, a substituted or unsubstituted indenopyridine, a substituted or unsubstituted benzofuopyridine, or a substituted or unsubstituted benzothienopyridine;

[144] R_{201} to R_{211} each independently represent hydrogen, deuterium, halogen, halogen-substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C3-C30)cycloalkyl, or a substituted or unsubstituted (C6-C30)aryl; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring; and

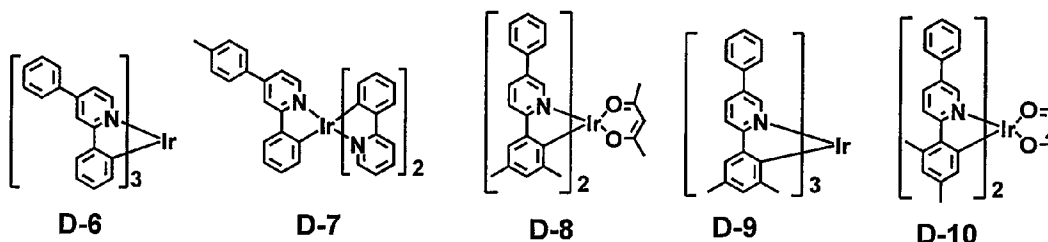
[145] s represents an integer of 1 to 3.

[146] The specific examples of the dopant compound include the following, but are not limited thereto:

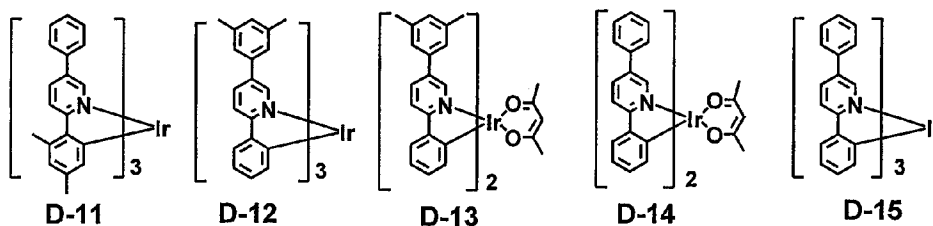
[147]



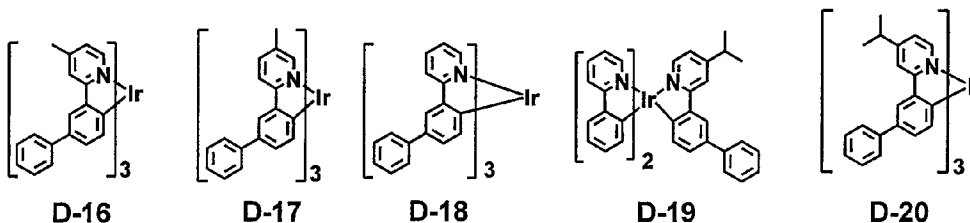
[148]



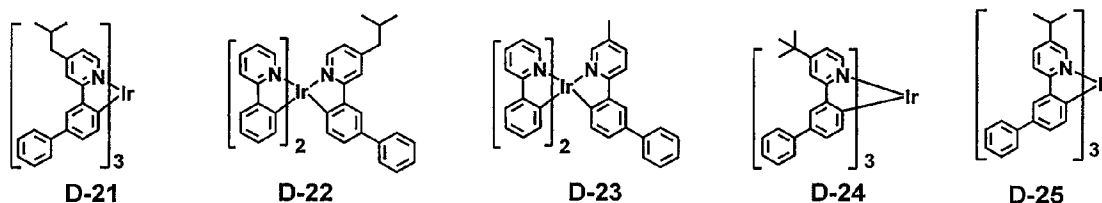
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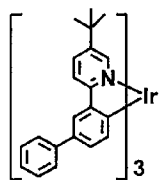
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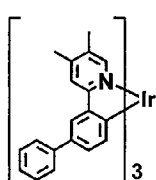
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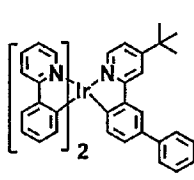
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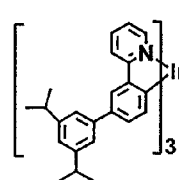
D-26



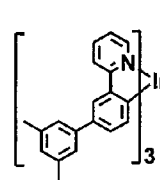
D-27



D-28

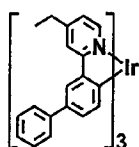


D-29

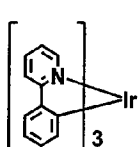


D-30

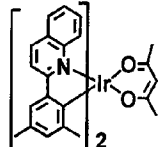
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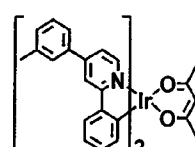
D-31



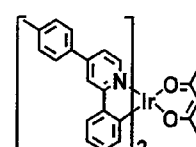
D-32



D-33

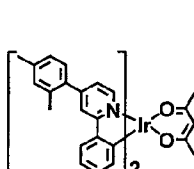


D-34

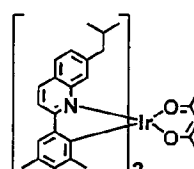


D-35

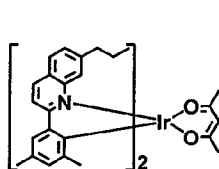
[154]



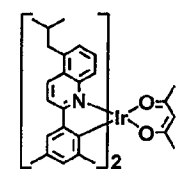
D-36



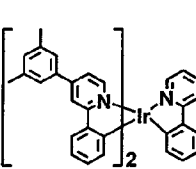
D-37



D-38

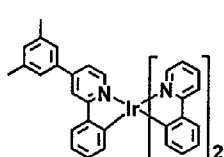


D-39

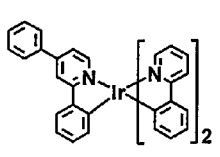


D-40

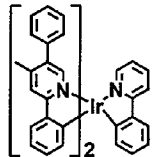
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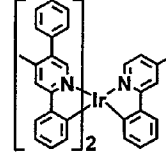
D-41



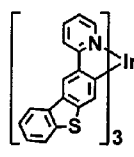
D-42



D-43

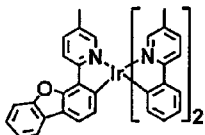


D-44

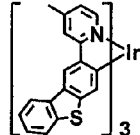


D-45

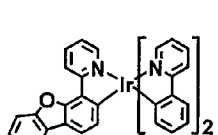
[156]



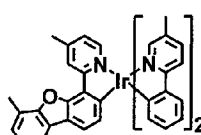
D-46



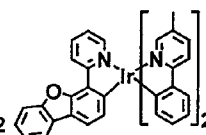
D-47



D-48

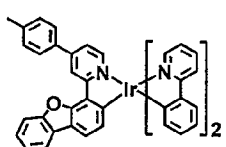


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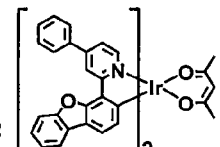


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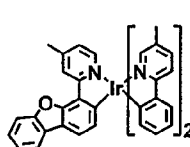
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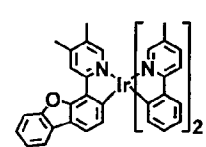
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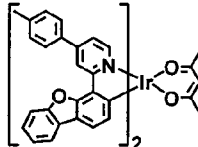
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D-53

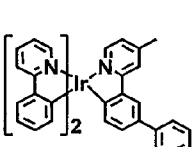


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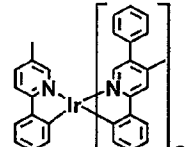


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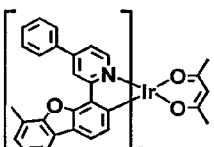
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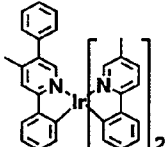
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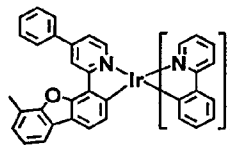
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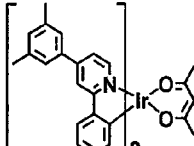


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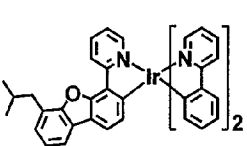


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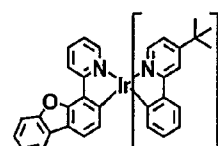
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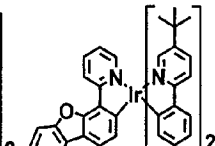
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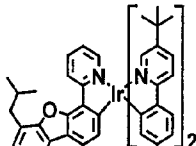
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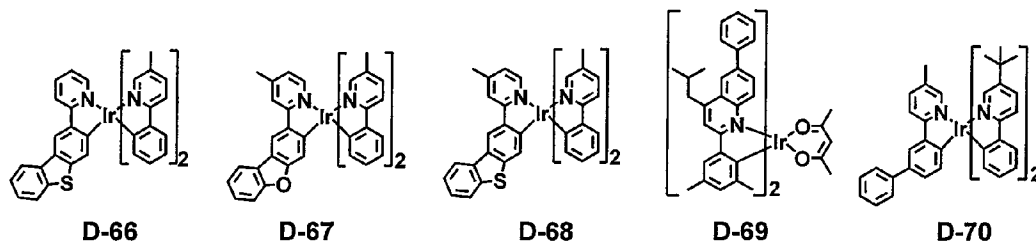


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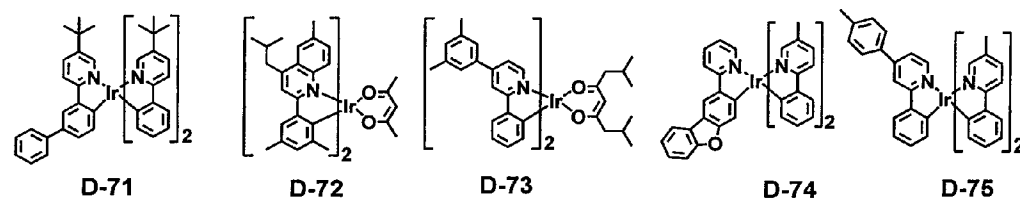


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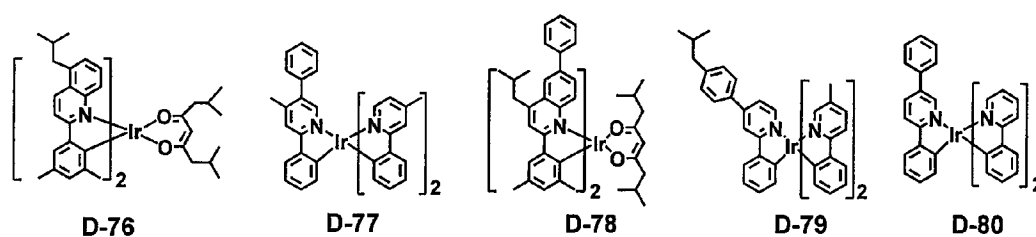
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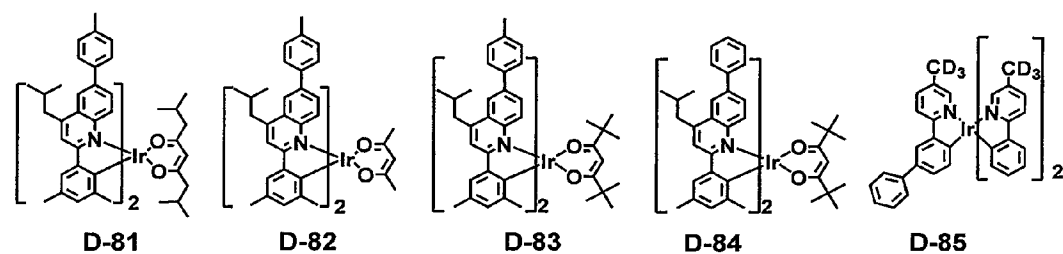
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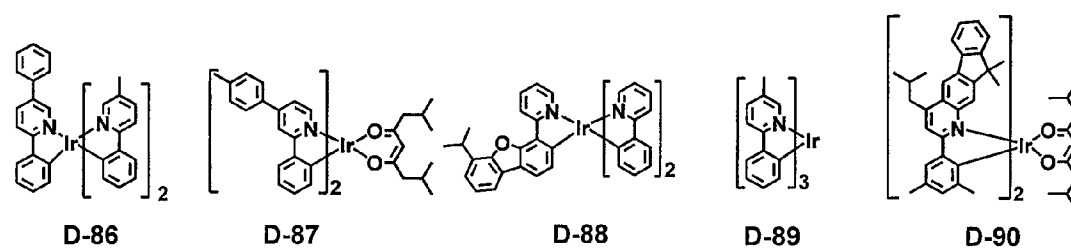
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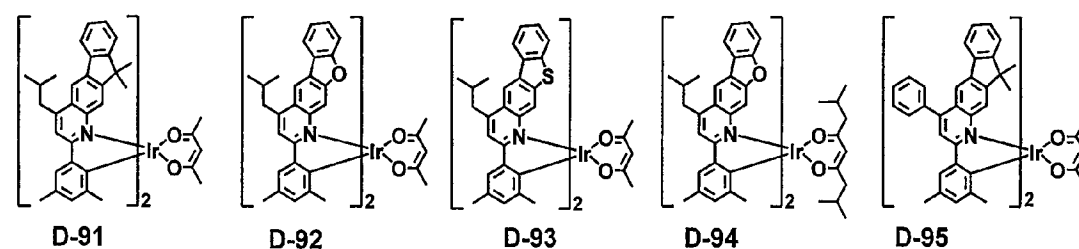
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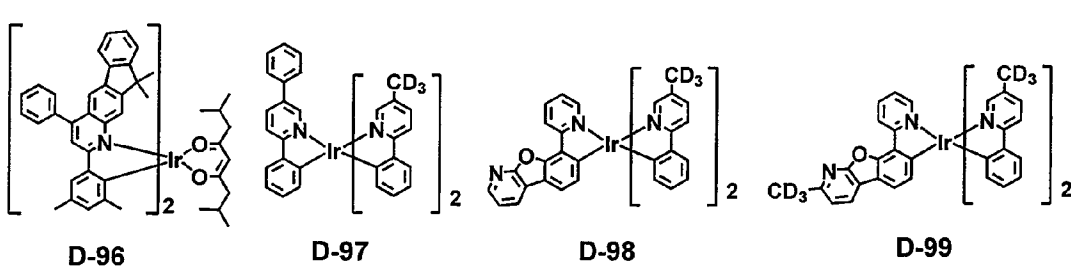
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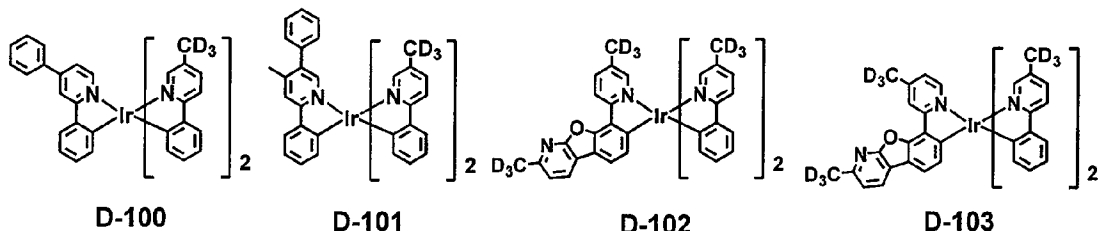
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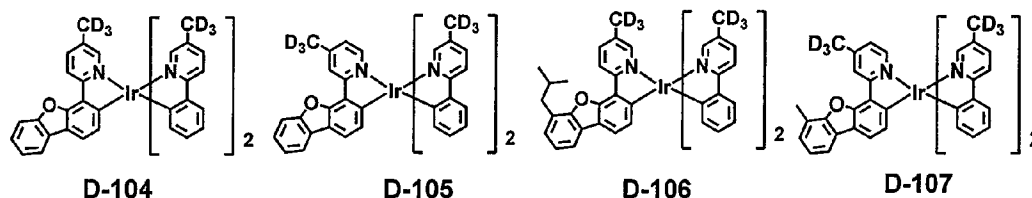
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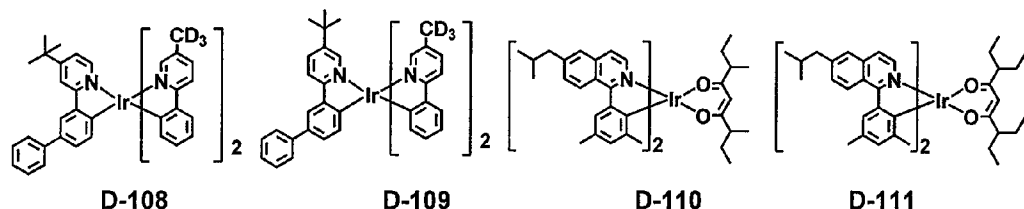
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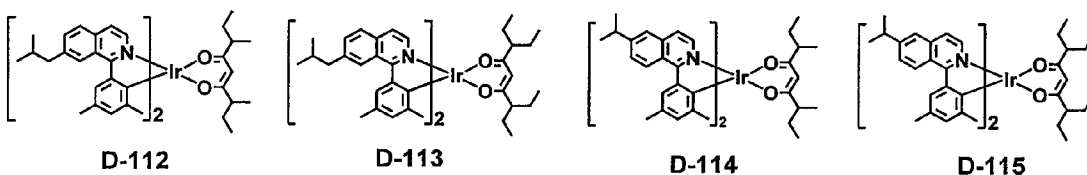
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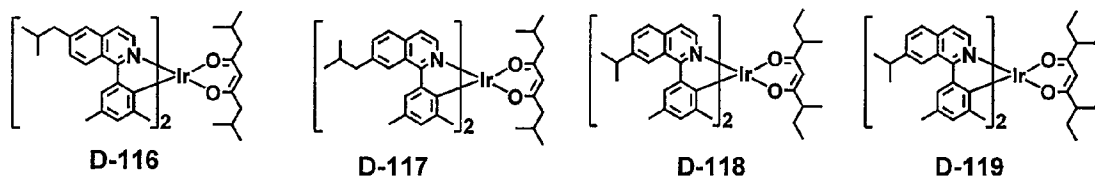
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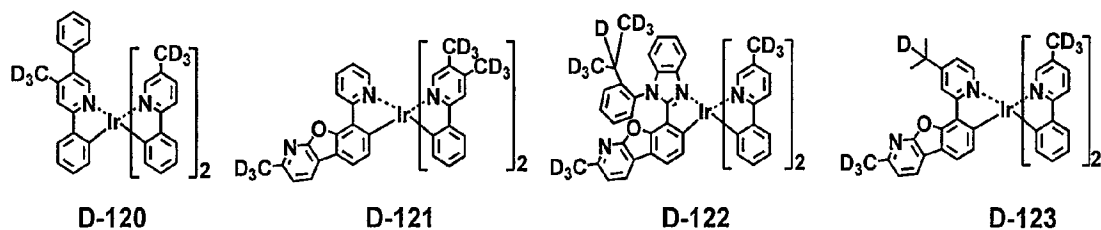
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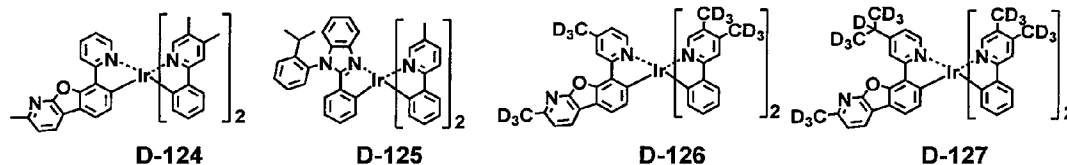
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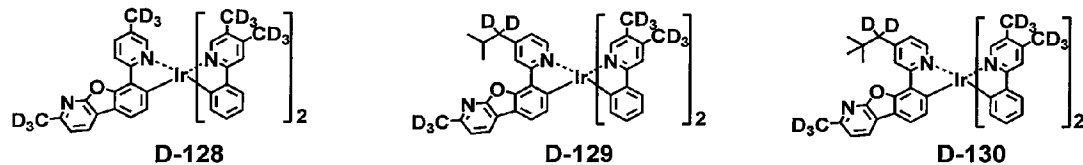
[172]



[173]



[174]



[175] Hereinafter, the organic electroluminescent device to which the aforementioned

organic electroluminescent compound or the organic electroluminescent material is applied will be described.

[176] The organic electroluminescent device according to one embodiment may comprise a first electrode; a second electrode; and at least one organic layer between the first and second electrodes.

[177] The compound represented by formula 1 of the present disclosure may be included in one or more layers constituting the organic electroluminescent device. According to one embodiment, the organic layer includes a light-emitting layer, a hole transport layer and/or a hole auxiliary layer containing an organic electroluminescent compound according to the present disclosure. In one embodiment, when the compound of formula 1 is included in the light-emitting layer, it may be included as a host material. Wherein, the host material may be a host material for a green or red light-emitting organic electroluminescent device. In addition, when the compound of formula 1 is included in the a hole transport layer and/or a hole auxiliary layer, it may be included as a hole transport material and/or a hole auxiliary material. For example, the light-emitting layer, the hole transport layer and/or the hole auxiliary layer may include solely of the organic electroluminescent compound of the present disclosure or at least two species of the organic electroluminescent compound of the present disclosure, and may further comprise conventional materials included in the organic electroluminescent material.

[178] In addition, the organic layer may comprise a light-emitting layer, a hole transport layer, and a hole auxiliary layer, and may further comprise at least one layer selected from a hole injection layer, a light-emitting auxiliary layer, an electron transport layer, an electron injection layer, an interlayer, a hole blocking layer, an electron blocking layer, and an electron buffer layer. Each layer may further consist of several layers. Also, the organic layer may further comprise at least one compound selected from the group consisting of an arylamine-based compound and a styrylamine-based compound, and further comprise at least one metal selected from the group consisting of metals of Group 1, metals of Group 2, transition metals of the 4th period, transition metals of the 5th period, lanthanides, and organic metals of the d-transition elements of the Periodic Table, or at least one complex compound comprising such a metal.

[179] An organic electroluminescent material according to one embodiment may be used as light-emitting materials for a white organic light-emitting device. The white organic light-emitting device has suggested various structures such as a parallel side-by-side arrangement method, a stacking arrangement method, or CCM (color conversion material) method, etc., according to the arrangement of R (Red), G (Green), B (blue), or YG (yellowish green) light-emitting units. In addition, the organic electroluminescent material according to one embodiment may also be applied to the organic

electroluminescent device comprising a QD (quantum dot).

- [180] One of the first electrode and the second electrode may be an anode and the other may be a cathode. Wherein, the first electrode and the second electrode may each be formed as a transmissive conductive material, a transfective conductive material, or a reflective conductive material. The organic electroluminescent device may be a top emission type, a bottom emission type, or a both-sides emission type according to the kinds of the material forming the first electrode and the second electrode.
- [181] A hole injection layer, a hole transport layer, an electron blocking layer, or a combination thereof can be used between the anode and the light-emitting layer. The hole injection layer may be multi-layers in order to lower the hole injection barrier (or hole injection voltage) from the anode to the hole transport layer or the electron blocking layer, wherein each of the multi-layers may use two compounds simultaneously. The hole injection layer may be doped as a p-dopant. Also, the electron blocking layer may be placed between the hole transport layer (or hole injection layer) and the light-emitting layer, and can confine the excitons within the light-emitting layer by blocking the overflow of electrons from the light-emitting layer to prevent a light-emitting leakage. The hole transport layer or the electron blocking layer may be multi-layers, and wherein each layer may use a plurality of compounds.
- [182] An electron buffer layer, a hole blocking layer, an electron transport layer, an electron injection layer, or a combination thereof can be used between the light-emitting layer and the cathode. The electron buffer layer may be multi-layers in order to control the injection of the electron and improve the interfacial properties between the light-emitting layer and the electron injection layer, wherein each of the multi-layers may use two compounds simultaneously. The hole blocking layer or the electron transport layer may also be multi-layers, wherein each layer may use a plurality of compounds. Also, the electron injection layer may be doped as an n-dopant.
- [183] The light-emitting auxiliary layer may be placed between the anode and the light-emitting layer, or between the cathode and the light-emitting layer. When the light-emitting auxiliary layer is placed between the anode and the light-emitting layer, it can be used for promoting the hole injection and/or the hole transport, or for preventing the overflow of electrons. When the light-emitting auxiliary layer is placed between the cathode and the light-emitting layer, it can be used for promoting the electron injection and/or the electron transport, or for preventing the overflow of holes. In addition, the hole auxiliary layer may be placed between the hole transport layer (or hole injection layer) and the light-emitting layer, and may be effective to promote or block the hole transport rate (or the hole injection rate), thereby enabling the charge balance to be controlled. When an organic electroluminescent device includes two or more hole transport layers, the hole transport layer, which is further included, may be used as the

hole auxiliary layer or the electron blocking layer. The light-emitting auxiliary layer, the hole auxiliary layer, or the electron blocking layer may have an effect of improving the efficiency and/or the lifespan of the organic electroluminescent device.

[184] In the organic electroluminescent device of the present disclosure, preferably, at least one layer (hereinafter, "a surface layer") selected from a chalcogenide layer, a halogenated metal layer, and a metal oxide layer may be placed on an inner surface(s) of one or both electrode(s). Specifically, a chalcogenide (including oxides) layer of silicon and aluminum is preferably placed on an anode surface of an electroluminescent medium layer, and a halogenated metal layer or a metal oxide layer is preferably placed on a cathode surface of an electroluminescent medium layer. The operation stability for the organic electroluminescent device may be obtained by the surface layer. Preferably, the chalcogenide includes SiO_x ($1 \leq x \leq 2$), AlO_x ($1 \leq x \leq 1.5$), SiON , SiAlON , etc.; the halogenated metal includes LiF , MgF_2 , CaF_2 , a rare earth metal fluoride, etc.; and the metal oxide includes Cs_2O , Li_2O , MgO , SrO , BaO , CaO , etc.

[185] Further, in the organic electroluminescent device of the present disclosure, 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 at least one surface of a pair of electrodes. In this case, the electron transport compound is reduced to an anion, and thus it becomes easier to inject and transport electrons from the mixed region to an electroluminescent medium. Furthermore, the hole transport compound is oxidized to a cation, and thus it becomes easier to inject and transport holes from the mixed region to the electroluminescent medium. Preferably, the oxidative dopant includes various Lewis acids and acceptor compounds, and the reductive dopant includes alkali metals, alkali metal compounds, alkaline earth metals, rare-earth metals, and mixtures thereof. A reductive dopant layer may be employed as a charge generating layer to prepare an organic electroluminescent device having two or more light-emitting layers and emitting white light.

[186] In order to form each layer of the organic electroluminescent device of the present disclosure, dry film-forming methods such as vacuum evaporation, sputtering, plasma, ion plating methods, etc., or wet film-forming methods such as ink jet printing, nozzle printing, slot coating, spin coating, dip coating, flow coating methods, etc., can be used.

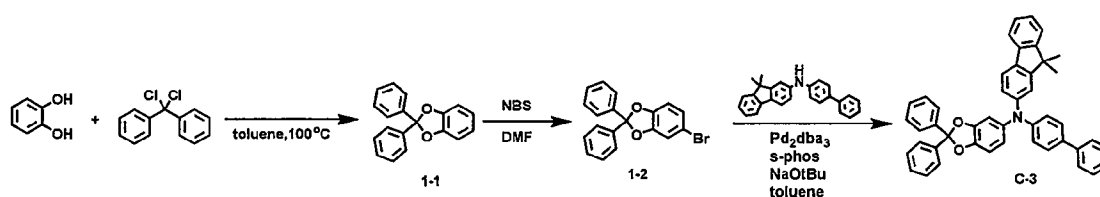
[187] When using a wet film-forming method, a thin film may be formed by dissolving or diffusing materials forming each layer into any suitable solvent such as ethanol, chloroform, tetrahydrofuran, dioxane, etc. The solvent may be any solvent where the materials forming each layer can be dissolved or diffused, and where there are no problems in film-formation capability.

[188] Further, the present disclosure can provide display devices using the compound represented by formula 1. That is, by using the compound of the present disclosure, it can be used for the manufacture of display devices or lighting devices. Specifically, the organic electroluminescent device of the present disclosure can be used for the manufacture of display devices such as smartphones, tablets, notebooks, PCs, TVs, or display devices for vehicles, or lighting devices such as outdoor or indoor lighting.

[189] Hereinafter, the preparation method of compounds according to the present disclosure will be explained with reference to the synthesis method of a representative compound or the intermediate compound of the present disclosure in order to understand the present disclosure in detail.

[190] **[Example 1] Synthesis of Compound C-3**

[191]



[192] Synthesis of Compound 1-1

[193] Catechol (20 g, 181.7 mmol), α, α -dichlorodiphenylmethane (43 g, 181.7 mmol), and 454 mL of toluene were added into the 1L round bottom flask (RBF), and stirred at 100°C for 27 hours. Thereafter the reaction mixture was cooled to room temperature and concentrated by distillation. The resulting mixture was purified by column chromatography to obtain the compound **1-1** (41 g, 82%).

[194] Synthesis of Compound 1-2

[195] Compound **1-1** (20 g, 73.0 mmol) and 730 mL of dimethylformamide (DMF) were added into 1L RBF, and stirred at room temperature for 10 minutes, and then N-bromosuccinimide (NBS) (13.6 g, 76 mmol) was added into the mixture followed by reacting at room temperature for 24 hours. After completion of the reaction, the solid obtained by distilled the reaction mixture was purified by column chromatography to obtain the compound **1-2** (24.4 g, 95%).

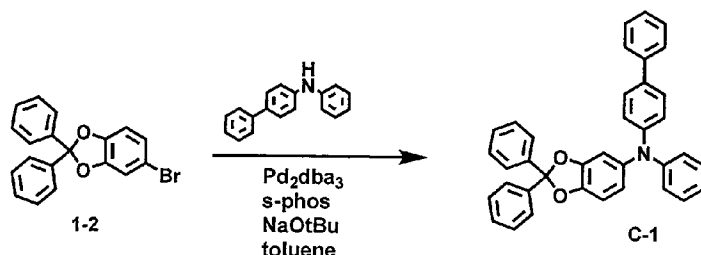
[196] Synthesis of Compound C-3

[197] N-([1,1'-biphenyl]-4-yl)-9,9-dimethyl-9H-fluoren-2-amine (6.8 g, 19.4 mmol), tris(dibenzylideneacetone)dipalladium(0) ($\text{Pd}_2(\text{dba})_3$) (710 mg, 0.776 mmol), 2-dicyclohexylphosphino-2',6'-dimethoxybiphenyl (s-phos) (637 mg, 1.55 mmol), sodium *tert*-butoxide (NaOtBu) (2.8 g, 29 mmol), and 144 mL of toluene were added into 500 mL RBF, and heated to 100°C. Compound **1-2** was dissolved in 50 mL of toluene followed by adding it dropwise to the reaction mixture, and then reacted for 3 hours. After completion of the reaction, the reaction mixture was cooled to room temperature and the organic layer was extracted with dichloromethane. The remaining

liquid of the organic layer was removed with MgSO_4 and dried, and then the reaction mixture was purified by column chromatography to obtain the compound **C-3** (1 g, 8%).

[198] **[Example 2] Synthesis of Compound C-1**

[199]



[200] N-phenyl-[1,1'-biphenyl]-4-amine (10 g, 19.4 mmol), Pd_2dba_3 (1.5 g, 1.64 mmol), s-phos (1.3 g, 3.3 mmol), NaOtBu (5.9 g, 61 mmol), and 310 mL of toluene were added into 500 mL RBF and heated to 100°C . Compound **1-2** was dissolved in 100 mL of toluene followed by adding it dropwise to the reaction mixture, and then reacted for 3 hours. After completion of the reaction, the reaction mixture was cooled to room temperature and the organic layer was extracted with dichloromethane. The remaining liquid of the organic layer was removed with MgSO_4 and dried, and then the reaction mixture was purified by column chromatography to obtain the compound **C-1** (7.5 g, 35%).

[201] Hereinafter, the preparation method and the properties of an organic electroluminescent device comprising an organic electroluminescent compound of the present disclosure will be explained in order to understand the present disclosure in detail.

[202] **[Device Examples 1 and 2] Producing OLEDs using the organic**

[203] **electroluminescent compound according to the present disclosure**

[204] OLEDs were produced by using the organic electroluminescent compound according to the present disclosure. First, a transparent electrode indium tin oxide (ITO) thin film ($10 \Omega/\text{sq}$) on a glass substrate for an OLED (GEOMATEC CO., LTD., Japan) was subjected to an ultrasonic washing with acetone and isopropanol, sequentially, and then was stored in isopropanol. Next, the ITO substrate was mounted on a substrate holder of a vacuum vapor deposition apparatus. Compound **HI-1** was introduced into a cell of the vacuum vapor deposition apparatus, and the pressure in the chamber of the apparatus was then controlled to 10^{-6} torr. Thereafter, an electric current was applied to the cell to evaporate the introduced material, thereby forming a first hole injection layer having a thickness of 80 nm on the ITO substrate. Compound **HI-2** was then introduced into another cell of the vacuum vapor deposition apparatus, and an electric current was applied to the cell to evaporate the introduced material, thereby forming a second hole injection layer having a thickness of 5 nm on the first hole injection layer. Next, compound **HT-1** was introduced into another cell of the vacuum vapor de-

position apparatus. Thereafter, an electric current was applied to the cell to evaporate the introduced material, thereby forming a first hole transport layer having a thickness of 10 nm on the second hole injection layer. The compound listed in the following Table 1 as a second hole transport material was then introduced into another cell of the vacuum vapor deposition apparatus, and an electric current was applied to the cell to evaporate the introduced material, thereby forming a second hole transport layer (a hole auxiliary layer) having a thickness of 30 nm on the first hole transport layer. After forming the hole injection layers and the hole transport layers, a light-emitting layer was then deposited thereon as follows: the compound **H-1** as a host was introduced into one cell of the vacuum vapor deposition apparatus and the compound **D-1** was introduced into another cell as a dopant. The dopant was doped in a doping amount of 10 wt% with respect to the rate of the deposition of the light-emitting layer, to form a light-emitting layer having a thickness of 40 nm on the hole transport layer. Next, compounds **ET-1** and **EI-1** were introduced into another cell, were evaporated at a rate of 1:1, and were deposited to form an electron transport layer having a thickness of 35 nm on the light-emitting layer. After depositing compound **EI-1** as an electron injection layer having a thickness of 2 nm on the electron transport layer, an Al cathode having a thickness of 800 nm was deposited on the electron injection layer by another vacuum vapor deposition apparatus. Thus, OLEDs were produced.

[205] **[Device Comparative Example 1] Producing an OLED not according to the**
[206] **present disclosure**

[207] An OLED was produced in the same manner as in Device Example 1, except that compound **HT-1** was used in a second host transport material (a hole auxiliary material).

[208] The results of the driving voltage, the current efficiency, the power efficiency, the external quantum efficiency, and the color coordinates at a luminance of 1,000 nits, of the organic electroluminescent device of Device Examples 1 and 2 and Device Comparative Example 1 produced as described above, are shown in the following Table 1.

[209]

【Table 1】

	Second Hole Transport Layer Material	Driving Voltage (V)	Current Efficiency (Cd/A)	Power Efficiency (Lm/W)	External Quantum Efficiency (%)	Color Coordinates CIE (x, y)	
Device Example 1	C-3	2.6	73.4	89.9	15.5	0.335	0.632
Device Example 2	C-1	2.8	81.7	92.2	21.5	0.333	0.633
Device Comparative Example 1	HT-1	2.6	61.5	74.6	12.4	0.340	0.628

[210]

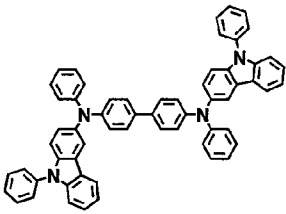
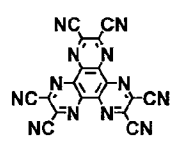
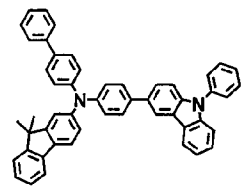
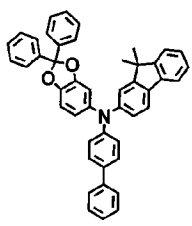
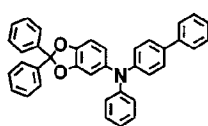
Referring to Table 1 above, when the organic electroluminescent compound according to the present disclosure uses a material of the second hole transport layer of the organic electroluminescent device, it can be confirmed that the organic electroluminescent device according to one embodiment is superior with regard to the current efficiency, the power efficiency, and the external quantum efficiency, compared to the Device Comparative Example 1 using a conventional hole transport material. Thereby, the organic electroluminescent device according to one embodiment can be expected to have a high luminous efficiency.

[211]

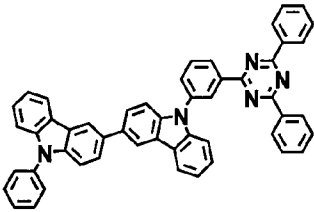
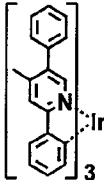
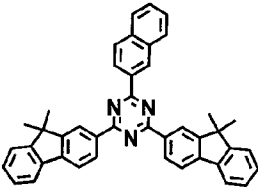
The compounds used in Device Examples 1 and 2 and Device Comparative Example 1 are shown specifically in Table 2 below.

[212]

【Table 2】

Hole Injection Layer / Hole Transport Layer	 HI-1			 HI-2			 HT-1		
	 C-3			 C-1					

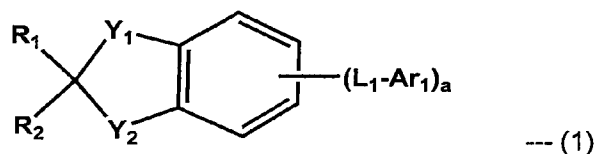
[213]

Light-Emitting Layer	 H-1  D-1
Electron Transport Layer / Electron Injection Layer	 ET-1  EI-1

Claims

[Claim 1]

An organic electroluminescent compound represented by the following formula 1:



wherein,

Y_1 and Y_2 each independently represent O or S;

L_1 each independently represent a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene;

Ar_1 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted fused ring of (C3-C30)aliphatic ring and (C6-C30)aromatic ring, or $-N(Ar_4)(Ar_5)$; or may be linked to adjacent substituents to form a ring;

Ar_4 and Ar_5 each independently represent hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl;

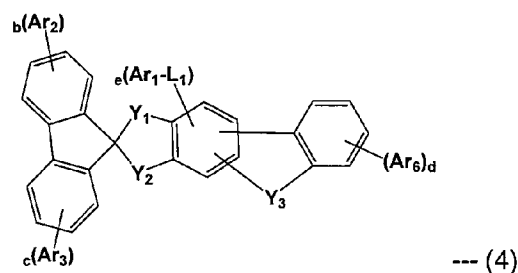
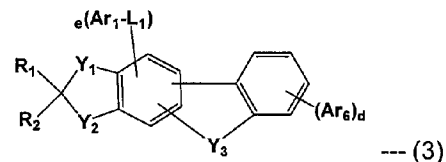
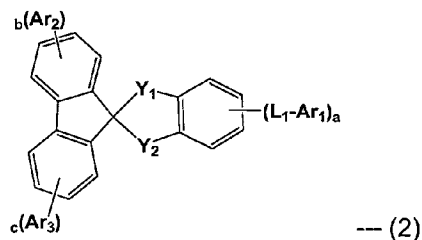
R_1 and R_2 each independently represent hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; or may be linked to adjacent sub-

stituents to form a ring; and

a represents an integer of 0 to 4, when a is 2 or more, each $-L_1-Ar_1$ may be the same or different.

[Claim 2]

The organic electroluminescent compound according to claim 1, wherein the formula 1 is represented by any one of the following formulae 2 to 4:



wherein,

Y_1 , Y_2 , R_1 , R_2 , L_1 , Ar_1 , and a are as defined in claim 1;

Ar_2 , Ar_3 , and Ar_6 are as defined as Ar_1 ;

Y_3 represents O, S, $-N(L_2-Ar_7)$, or $-C(Ar_8)(Ar_9)$;

L_2 is as defined as L_1 ;

Ar_7 is as defined as Ar_4 ;

Ar_8 and Ar_9 each independently represent a substituted or unsubstituted (C1-C30)alkyl or a substituted or unsubstituted (C6-C30)aryl;

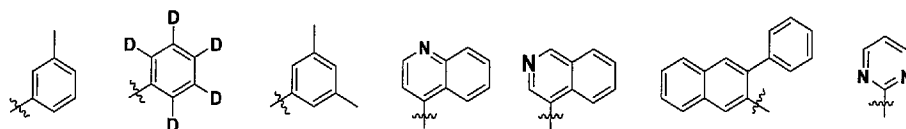
b to d each independently represent an integer of 1 to 4, e represents an integer of 1 or 2; and

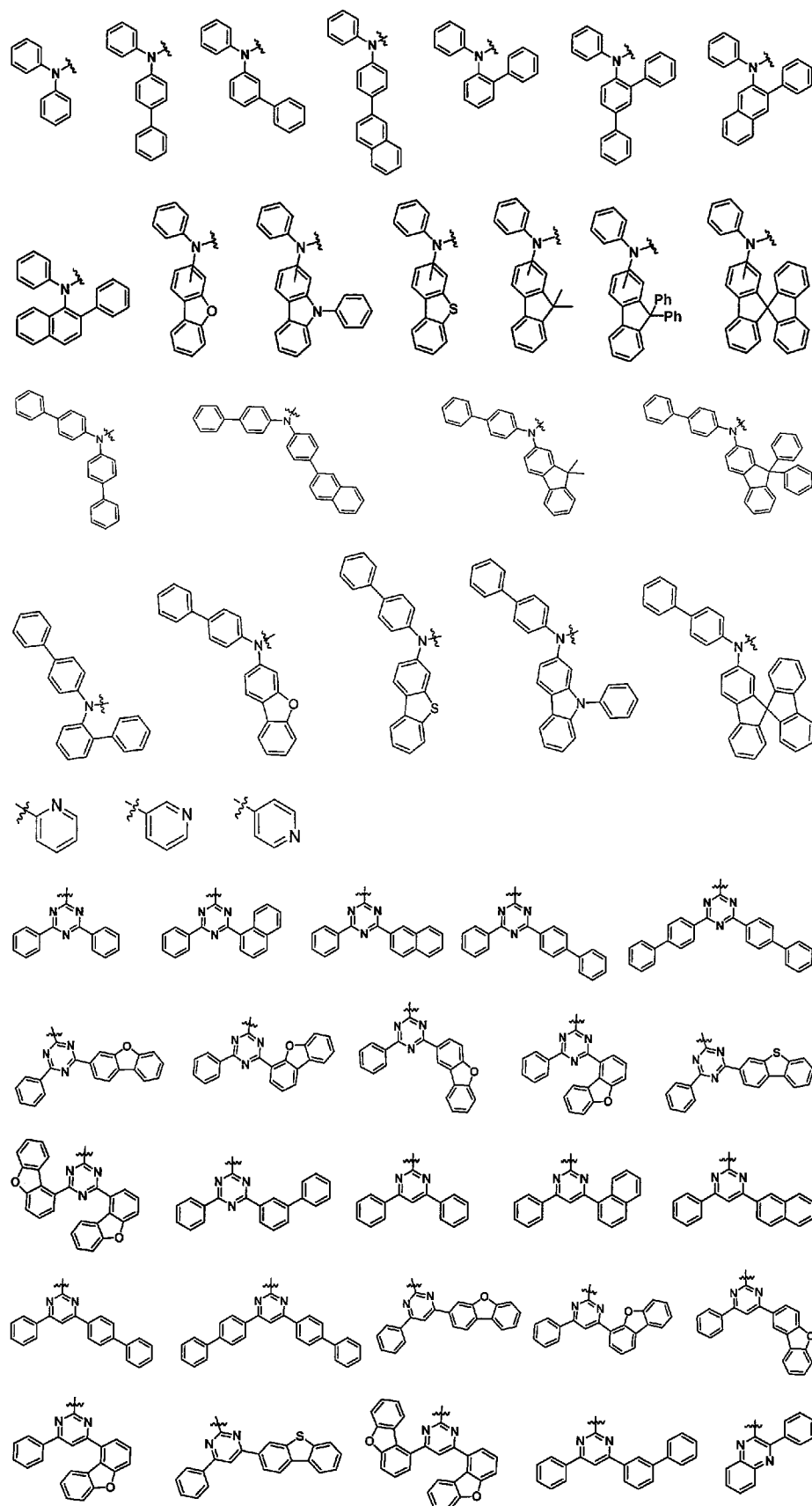
when b to e are 2 or more, each of Ar_2 , Ar_3 , Ar_6 , and $-L_1-Ar_1$ may be the same or different.

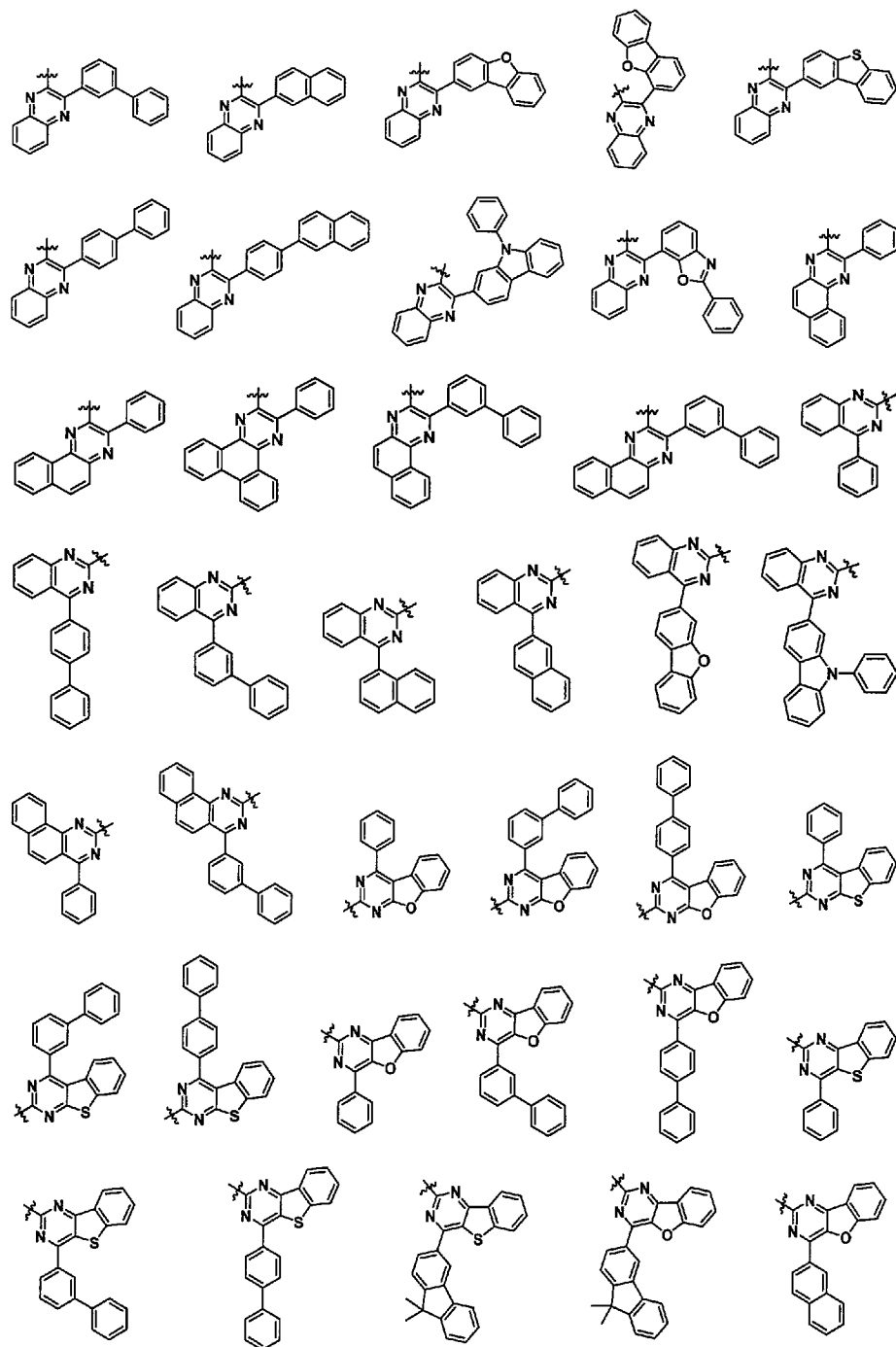
[Claim 3]

The organic electroluminescent compound according to claim 1, Ar_1 , Ar_4 , Ar_5 , R_1 , and R_2 each independently are selected from any one of the substituents listed in the following Group 1:

[Group 1]







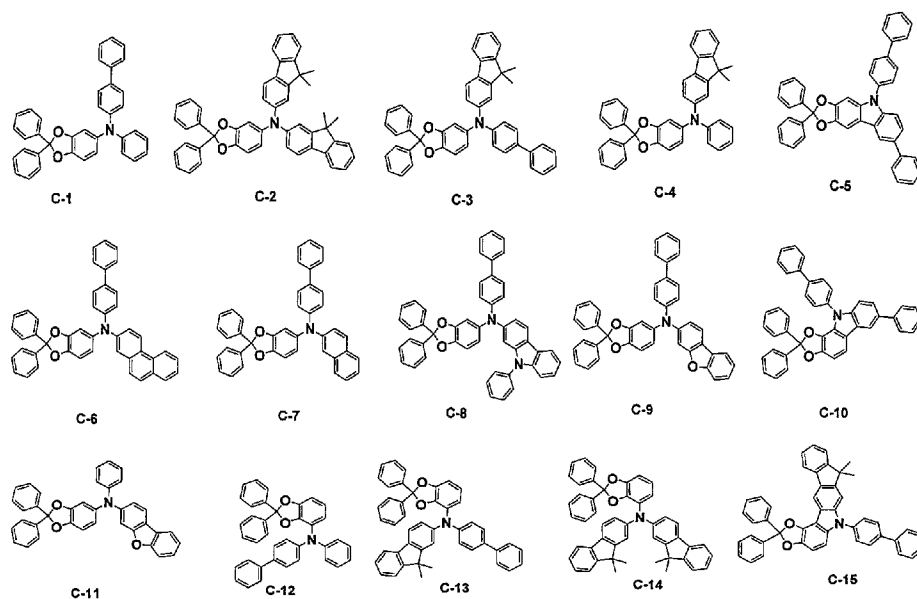
[Claim 4]

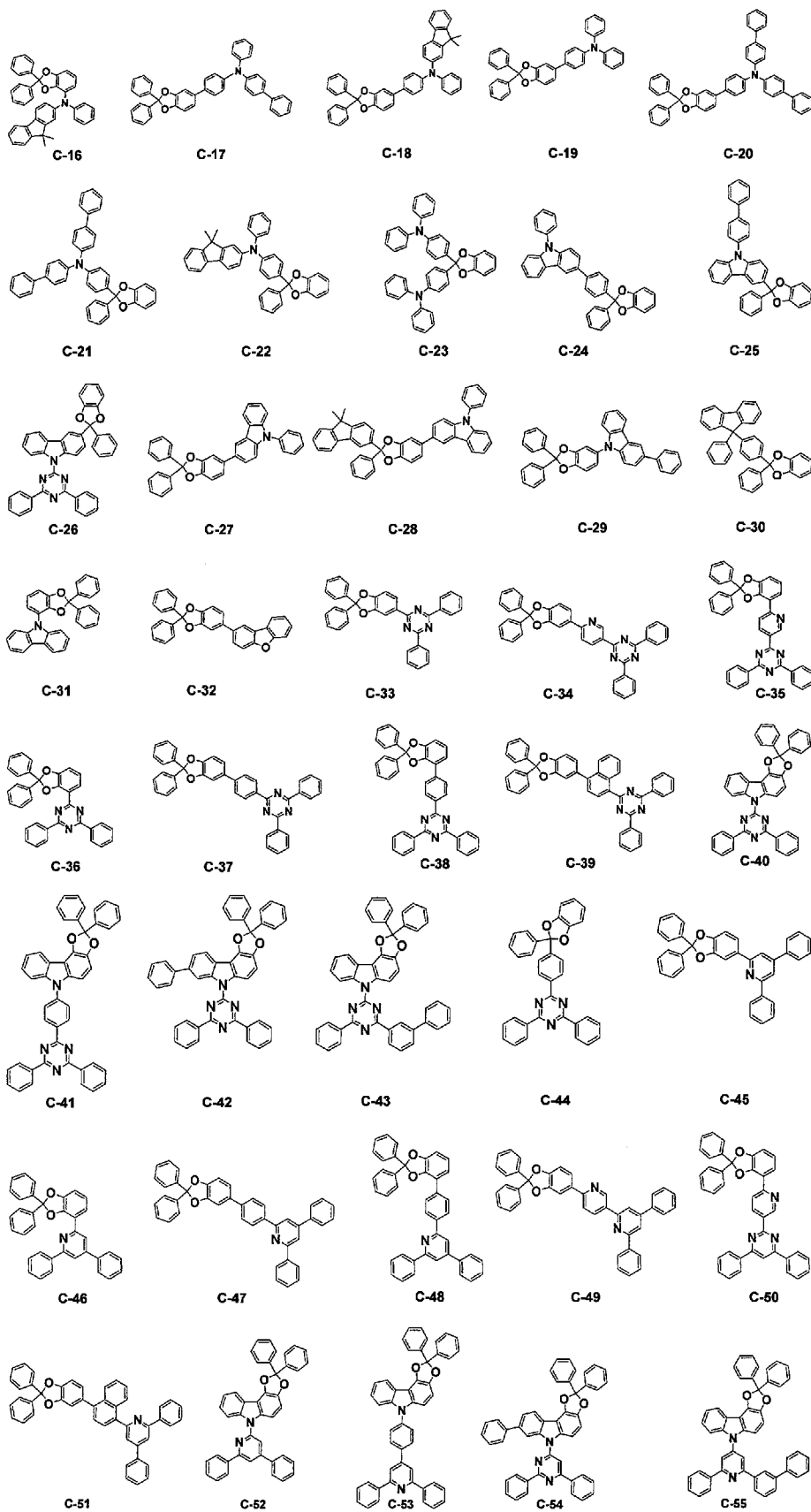
The organic electroluminescent compound according to claim 1, wherein the substituents of the substituted (C1-C30)alkyl, the substituted (C2-C30)alkenyl, the substituted (C6-C30)aryl(ene), the substituted (3- to 30-membered)heteroaryl(ene), the substituted (C3-C30)cycloalkyl, the substituted (C1-C30)alkoxy, the substituted tri(C1-C30)alkylsilyl, the substituted di(C1-C30)alkyl(C6-C30)arylsilyl, the substituted (C1-C30)alkyldi(C6-C30)arylsilyl, the substituted tri(C6-C30)arylsilyl,

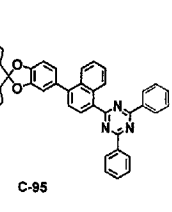
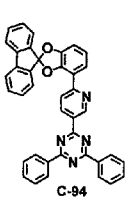
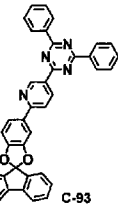
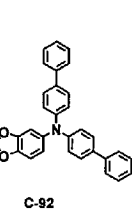
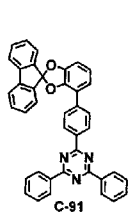
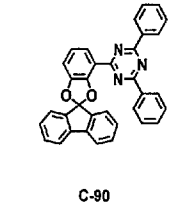
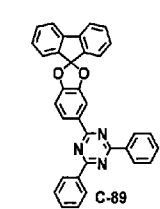
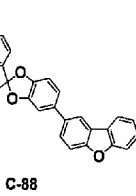
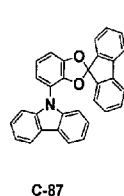
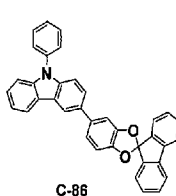
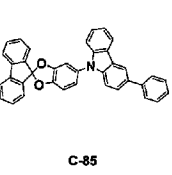
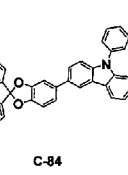
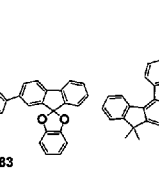
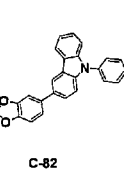
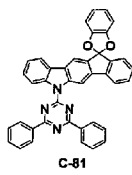
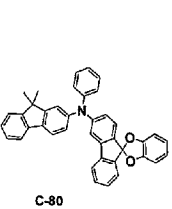
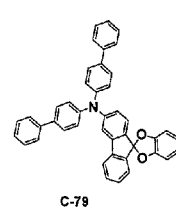
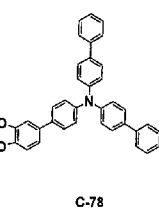
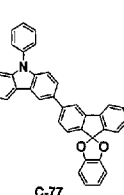
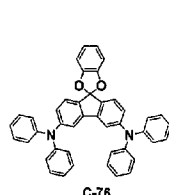
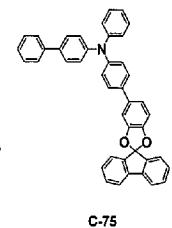
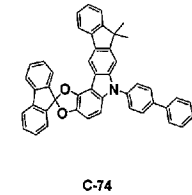
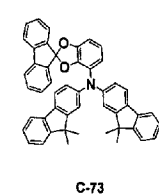
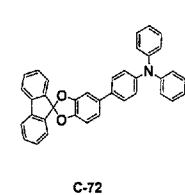
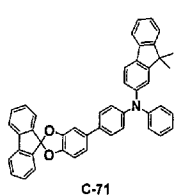
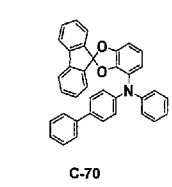
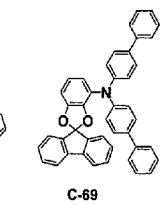
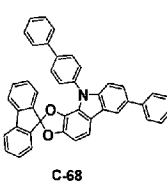
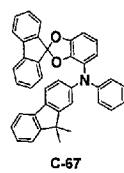
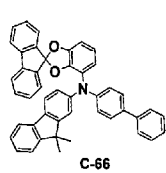
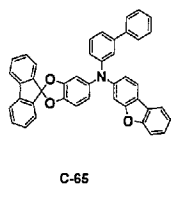
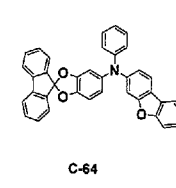
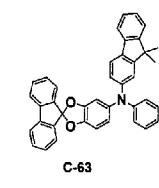
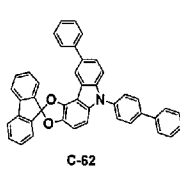
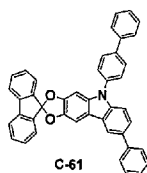
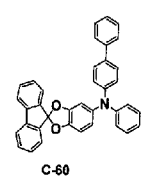
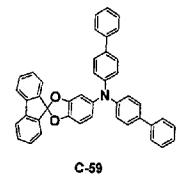
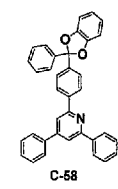
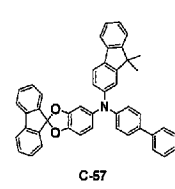
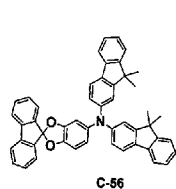
the substituted fused ring of (C3-C30)aliphatic ring and (C6-C30)aromatic ring, and the substituted (C1-C30)alkyl(C6-C30)arylamino in L_1 , Ar_1 , Ar_4 , Ar_5 , R_1 , and R_2 , each independently represent at least one selected from the group consisting of deuterium, halogen, cyano, carboxyl, nitro, hydroxyl, (C1-C30)alkyl, halo(C1-C30)alkyl, (C2-C30)alkenyl, (C2-C30)alkynyl, (C1-C30)alkoxy, (C1-C30)alkylthio, (C3-C30)cycloalkyl, (C3-C30)cycloalkenyl, (3- to 7-membered)heterocycloalkyl, (C6-C30)aryloxy, (C6-C30)arylthio, (C6-C30)aryl-substituted or unsubstituted (5- to 30-membered)heteroaryl, (5- to 30-membered)heteroaryl-substituted or unsubstituted (C6-C30)aryl, tri(C1-C30)alkylsilyl, tri(C6-C30)arylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl, (C1-C30)alkyldi(C6-C30)arylsilyl, amino, mono- or di- (C1-C30)alkylamino, (C1-C30)alkyl-substituted or unsubstituted mono- or di-(C6-C30)arylamino, (C1-C30)alkyl(C6-C30)arylamino, (C1-C30)alkylcarbonyl, (C1-C30)alkoxycarbonyl, (C6-C30)arylcarbonyl, di(C6-C30)arylboronyl, di(C1-C30)alkylboronyl, (C1-C30)alkyl(C6-C30)arylboronyl, (C6-C30)ar(C1-C30)alkyl, and (C1-C30)alkyl(C6-C30).

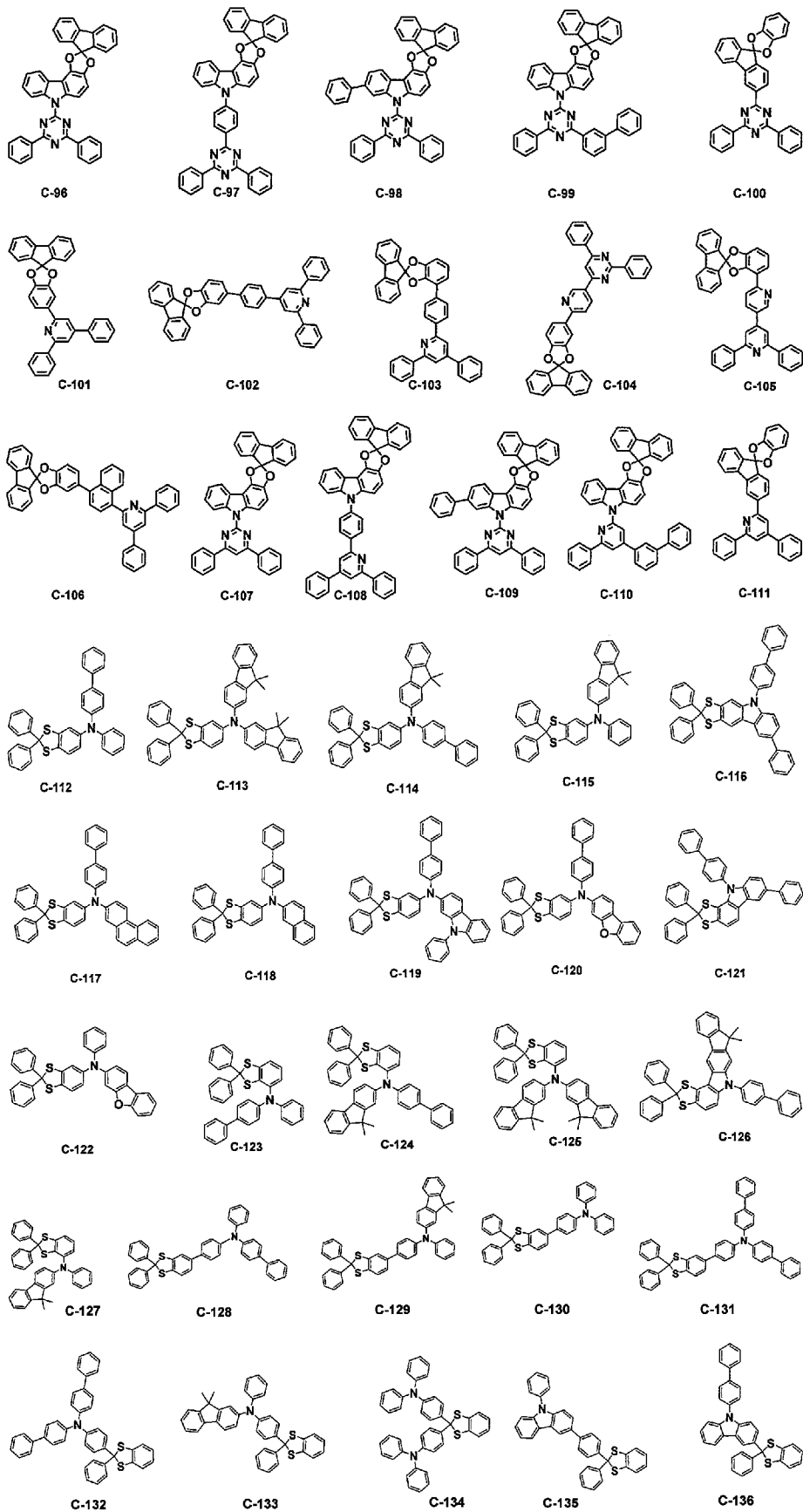
[Claim 5]

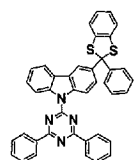
The organic electroluminescent compound according to claim 1, wherein the compound represented by formula 1 is selected from the group consisting of:



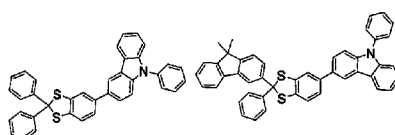




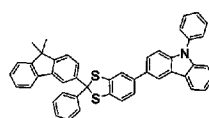




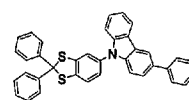
C-137



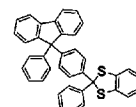
C-138



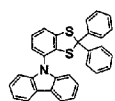
C-139



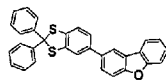
C-140



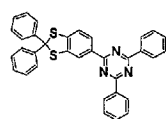
C-141



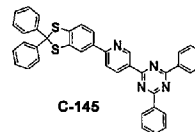
C-142



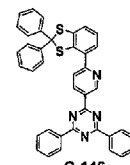
C-143



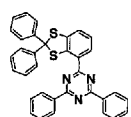
C-144



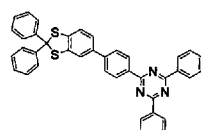
C-145



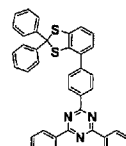
C-146



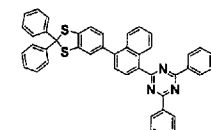
C-147



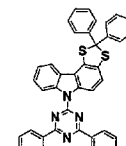
C-148



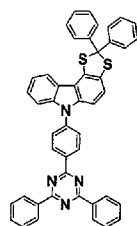
C-149



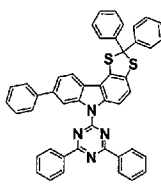
C-150



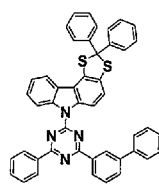
C-151



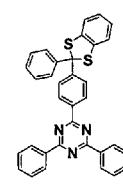
C-152



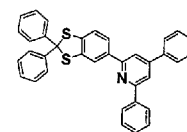
C-153



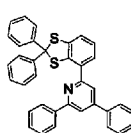
C-154



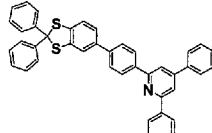
C-155



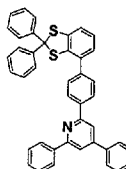
C-156



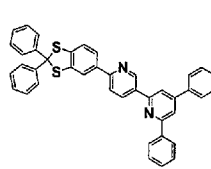
C-157



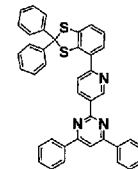
C-158



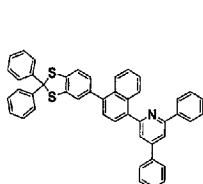
C-159



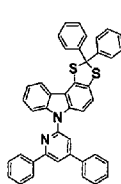
C-160



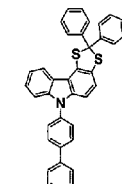
C-161



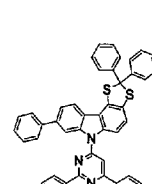
C-162



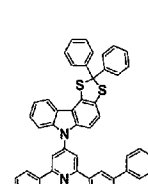
C-163



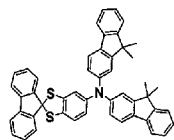
C-164



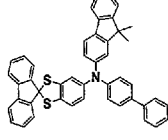
C-165



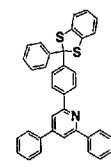
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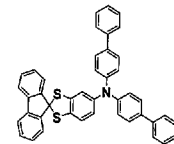
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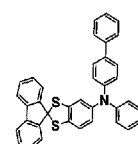
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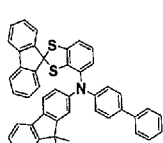
C-169



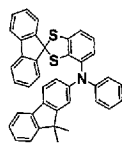
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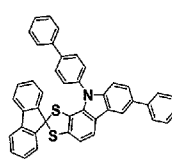
C-171



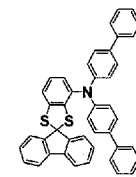
C-172



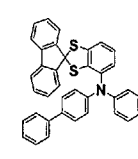
C-173



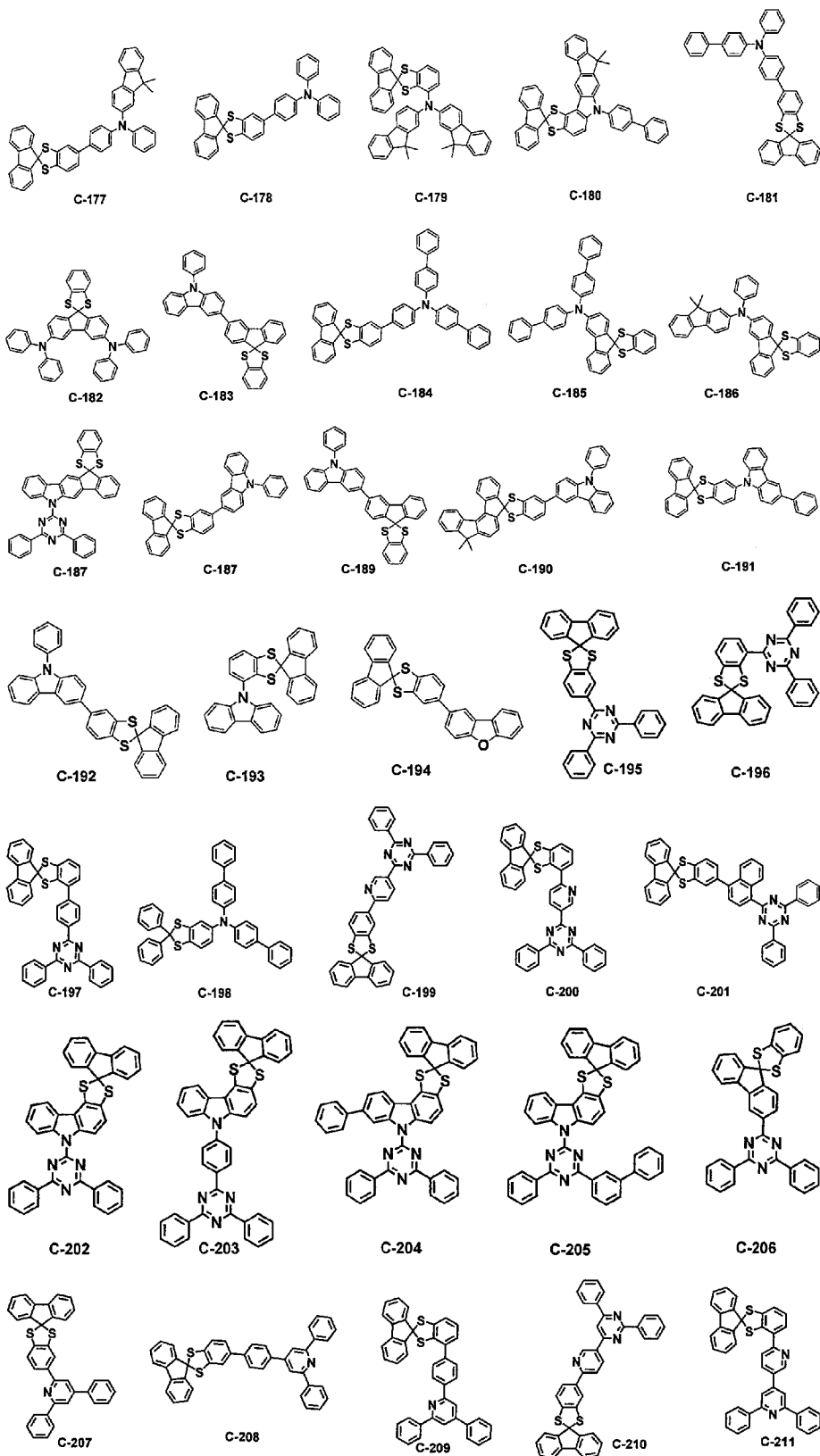
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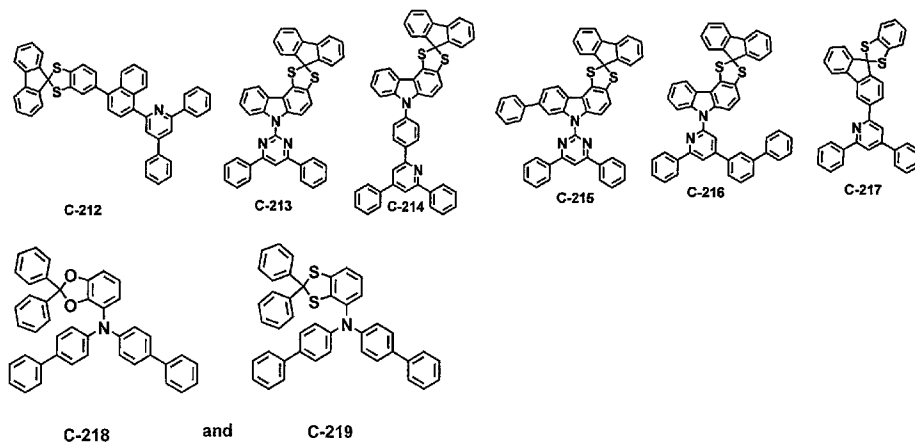


C-175



C-176





- [Claim 6] An organic electroluminescent material comprising the organic electroluminescent compound according to claim 1.
- [Claim 7] An organic electroluminescent device comprising the organic electroluminescent compound according to claim 1.
- [Claim 8] The organic electroluminescent device according to claim 7, wherein the organic electroluminescent compound is contained in at least one layer of a light-emitting layer, a hole transport layer, and a hole auxiliary layer.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2020/002389**A. CLASSIFICATION OF SUBJECT MATTER****C09K 11/06(2006.01)i, H01L 51/00(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)

C09K 11/06; C07D 231/54; C07D 235/02; C07D 239/70; C07D 249/16; C07D 263/52; C07D 403/04; C07D 409/04; C07F 7/10; H01L 51/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal), STN(Registry, Caplus) & keywords: organic electroluminescent device, hole transport layer, light emitting layer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2019-0001967 A (DUK SAN NEOLUX CO., LTD.) 08 January 2019 claims 1, 6-9	1-8
A	KR 10-2019-0010811 A (DUK SAN NEOLUX CO., LTD.) 31 January 2019 the whole document	1-8
A	KR 10-2017-0074652 A (DOOSAN CORPORATION) 30 June 2017 the whole document	1-8
A	CN 102146077 A (SHANGHAI UNIVERSITY) 10 August 2011 the whole document	1-8
A	KR 10-2011-0016031 A (SAMSUNG MOBILE DISPLAY CO., LTD.) 17 February 2011 the whole document	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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

05 June 2020 (05.06.2020)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2020/002389

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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KR 10-2019-0010811 A	31/01/2019	None	
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		US 8338000 B2	25/12/2012