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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 using the organic electroluminescent compound of the present disclosure, an organic electroluminescent device showing excellent current 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 (EL) device is a self-light-emitting device which has advantages in that it provides a wider viewing angle, a greater contrast ratio, and a faster response time. An organic EL device was first developed by Eastman Kodak, by using small aromatic diamine molecules and aluminum complexes as materials to form a light-emitting layer [Appl. Phys. Lett. 51, 913, 1987].
- [3] The most important factor determining luminous efficiency in the organic EL device is light-emitting materials. Until now, fluorescent materials have been widely used as light-emitting material. However, in view of electroluminescent mechanisms, since phosphorescent materials theoretically enhance luminous efficiency by four (4) times compared to fluorescent materials, phosphorescent light-emitting materials are widely being researched. Iridium(III) complexes have been widely known as phosphorescent materials, including bis(2-(2'-benzothienyl)-pyridinato-N,C3')iridium(acetylacetonate) ((acac)Ir(btp)₂), tris(2-phenylpyridine)iridium (Ir(ppy)₃) and bis(4,6-difluorophenylpyridinato-N,C2)picolate iridium (Firpic) as red-, green- and blue-emitting materials, respectively.
- [4] At present, 4,4'-N,N'-dicarbazol-biphenyl (CBP) is the most widely known host material for phosphorescent materials. Recently, Pioneer (Japan) et al., developed a high performance organic EL device using bathocuproine (BCP) and aluminum(III)bis(2-methyl-8-quinolate)(4-phenylphenolate) (BALq) etc., as host materials, which were known as hole blocking materials.
- [5] Although these materials provide good light-emitting characteristics, they have the following disadvantages: (1) Due to their low glass transition temperature and poor thermal stability, their degradation may occur during a high-temperature deposition process in a vacuum, which results in poor lifespan. (2) The power efficiency of the organic EL device is given by $[(\pi/\text{voltage}) \times \text{current efficiency}]$, and the power efficiency is inversely proportional to the voltage. Although the organic EL device comprising phosphorescent host materials provides higher current efficiency (cd/A) than one comprising fluorescent materials, a significantly high driving voltage is

necessary. Thus, there is no merit in terms of power efficiency (lm/W). (3) Furthermore, the operational lifespan of the organic EL device is short, and luminous efficiency is still required in order to be improved.

[6] To improve efficiencies and stability, the organic EL device may be manufactured with a multi-layered structure in which a hole injection layer, a hole transport layer, a light-emitting layer, an electron transport layer, an electron injection layer, etc., are comprised. In the structure, a compound for the hole transport layer is important to enhance characteristics of the device, such as efficiency for transporting holes to the light-emitting layer, luminous efficiency, and lifespan.

[7] In this regard, copper phthalocyanine (CuPc), 4,4'-bis[N-(1-naphthyl)-N-phenylamino]biphenyl (NPB), N,N'-diphenyl-N,N'-bis(3-methylphenyl)-(1,1'-biphenyl)-4,4'-diamine (TPD), 4,4',4''-tris(3-methylphenylphenylamino)triphenylamine (MTDATA), etc., were used as a hole injection and transport material for an organic EL device. However, the organic EL device using these materials is problematic in quantum efficiency and lifespan. It is due to thermal stress occurring between an anode and a hole injection layer, when the organic EL device is driven under high current. Thermal stress significantly reduces the lifespan of the device. Furthermore, since the organic material used in the hole injection layer has very high hole mobility, the hole-electron charge balance may be broken and quantum yield (cd/A) may decrease. The hole transport layer needs to be developed to enhance durability of the organic EL device.

[8] WO 2013/011891 discloses compounds for the organic EL device, in which a carbazole is fused with a benzene ring and a five-membered ring to construct a backbone, and the nitrogen atom of carbazole moiety of the backbone is bonded, directly or via a linker such as aryl or heteroaryl, to heteroaryl. However, this reference fails to specifically disclose a compound in which a carbazole is fused with a benzene ring and a five-membered ring to construct a backbone, and the nitrogen atom of carbazole moiety of the backbone is bonded, directly or via a linker such as aryl or heteroaryl, to the benzene ring which is bonded to diarylamine and another group such as aryl; and an organic EL device which uses the compound for preparing a hole transport layer.

[9]

Disclosure of Invention

Technical Problem

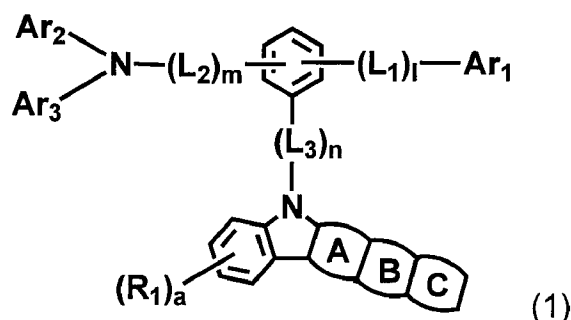
[10] The objective of the present disclosure is to provide an organic electroluminescent compound, which can provide an organic electroluminescent device having high current efficiency.

[11]

Solution to Problem

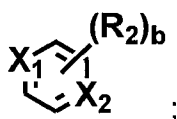
[12] The present inventors found that the above objective can be achieved by an organic electroluminescent compound represented by the following formula 1.

[13]



[14] wherein

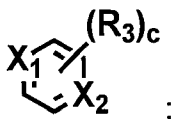
[15] ring A represents



[16] ring B represents



[17] ring C represents

[18] X₁ and X₂, each independently, represent CR₄ or N;[19] Y represents -O-, -S-, -C(R₅)(R₆)-, -Si(R₇)(R₈)-, or -N(R₉)-;

[20] L₁ to L₃, each independently, represent a single bond, a substituted or unsubstituted (C2-C30)alkylene, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (5- to 30-membered)heteroarylene;

[21] Ar₁ represents a substituted or unsubstituted(C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (5- to 30-membered)heteroaryl, or -NR₁₀R₁₁;

[22] Ar₂ and Ar₃, each independently, represent a substituted or unsubstituted(C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl;

[23] R₁ to R₄, each independently, represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (5- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl, a substituted or unsubstituted (C6-C30)aryl(C1-C30)alkyl, -NR₁₂R₁₃, -SiR₁₄R₁₅R₁₆, -SR₁₇, -OR₁₈, a cyano, a nitro, or a

- hydroxy; or may be linked to an adjacent substituent(s) to form a (3- to 30-membered), mono- or polycyclic, alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;
- [24] R_5 to R_9 , and R_{12} to R_{16} , each independently, represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (5- to 30-membered)heteroaryl, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl, or a substituted or unsubstituted (C3-C30)cycloalkyl; or may be linked to an adjacent substituent(s) to form a (3- to 30-membered), mono- or polycyclic, alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;
- [25] R_{10} and R_{11} , each independently, represent a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl;
- [26] l , m , and n , each independently, represent an integer of 0 to 3; where l , m , or n is an integer of 2 or more, each of L_1 to L_3 may be the same or different;
- [27] a and c , each independently, represent an integer of 1 to 4; where a or c is an integer of 2 or more, each of R_1 and R_3 may be the same or different;
- [28] b represents 1 or 2; where b is 2, each of R_2 may be the same or different; and
- [29] the heterocycloalkyl and heteroaryl(ene), each independently, contain at least one hetero atom selected from B, N, O, S, P(=O), Si, and P.
- [30] The compound represented by formula 1 has the asymmetric structure in which the benzene mother nucleus is linked to three different substituents. Due to the asymmetric structure, the compound has lower crystallinity than those of a symmetric structure, and thus is advantageous to form an amorphous thin film [Chem. Rev. 2007, 107, page 960, 4.1.2]. Furthermore, the heteroaryl group makes the compound be used for a hole transport material as well as a host material; and the nitrogen-containing pentacyclic fused group provides the compound with high glass transition temperature.

[31]

Advantageous Effects of Invention

- [32] The organic electroluminescent compound, according to the present disclosure, can provide an organic electroluminescent device having high current efficiency.

[33]

Mode for the Invention

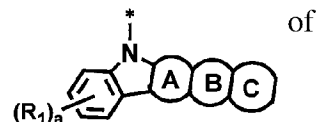
- [34] Hereinafter, the present disclosure will be described in detail. However, the following description is intended to explain the invention, and is not meant in any way to restrict the scope of the invention.

- [35] The present disclosure provides the organic electroluminescent compound of formula 1 above, an organic electroluminescent material comprising the same, and an organic electroluminescent device comprising the material.
- [36] The compound of formula 1 of the present disclosure is as follows.
- [37] Herein, “(C1-C30)alkyl” indicates a linear or branched alkyl having 1 to 30, preferably 1 to 10, and more preferably 1 to 6 carbon atoms, and includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, etc. “(C2-C30) alkenyl” indicates a linear or branched alkenyl having 2 to 30, preferably 2 to 20, and more preferably 2 to 10, carbon atoms and includes vinyl, 1-propenyl, 2-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 2-methylbut-2-enyl, etc. “(C2-C30)alkynyl” indicates a linear or branched alkynyl having 2 to 30, preferably 2 to 20, and more preferably 2 to 10, carbon atoms and includes ethynyl, 1-propynyl, 2-propynyl, 1-butyne, 2-butyne, 3-butyne, 1-methylpent-2-ynyl, etc. “(C3-C30)cycloalkyl” indicates a mono- or polycyclic hydrocarbon having 3 to 30, preferably 3 to 20, and more preferably 3 to 7, carbon atoms and includes cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, etc. “(3- to 7-membered) heterocycloalkyl” indicates a cycloalkyl having 3 to 7 ring backbone atoms including at least one hetero atom selected from B, N, O, S, P(=O), Si, and P, preferably O, S, and N, and includes tetrahydrofuran, pyrrolidine, thiolan, tetrahydropyran, etc. Furthermore, “(C6-C30)aryl(ene)” indicates a monocyclic or fused ring derived from an aromatic hydrocarbon and having 6 to 30, preferably 6 to 20, and more preferably 6 to 15 ring backbone carbon atoms, and includes phenyl, biphenyl, terphenyl, naphthyl, binaphthyl, phenylnaphthyl, naphthylphenyl, fluorenyl, phenylfluorenyl, benzofluorenyl, dibenzofluorenyl, phenanthrenyl, phenylphenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthrenyl, etc. “(5- to 30-membered) heteroaryl(ene)” indicates an aryl group having 5 to 30 ring backbone atoms including at least one, preferably 1 to 4, hetero atom selected from the group consisting of B, N, O, S, P(=O), Si, and P; may be a monocyclic ring, or a fused ring condensed with at least one benzene ring; may be partially saturated; may be one formed by linking at least one heteroaryl or aryl group to a heteroaryl group via a single bond(s); and includes a monocyclic ring-type heteroaryl such as 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 such as benzofuranyl, benzothiophenyl, isobenzofuranyl, dibenzofuranyl, dibenzothiophenyl, benzoimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazoyl, phenoxazinyl, phenanthridinyl, benzodioxolyl, etc. Fur-

thermore, “halogen” includes F, Cl, Br, and I.

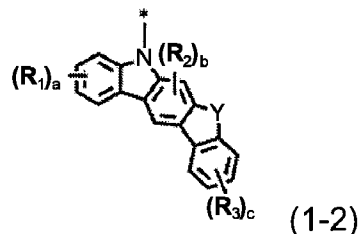
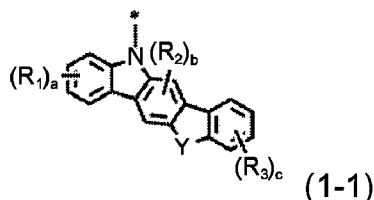
[38]

[39] According to one embodiment of the present disclosure,

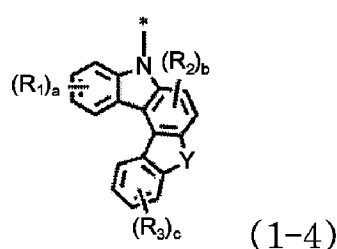
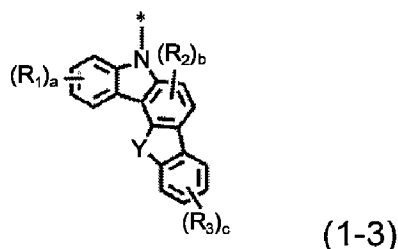


formula 1 may be selected from the following formulae [1-1] to [1-6].

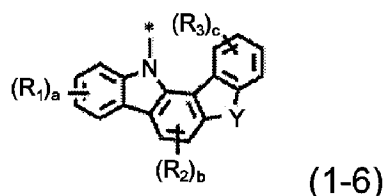
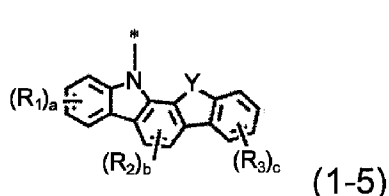
[40]



[41]



[42]



[43] wherein Y, R₁ to R₃, and a to c are as defined in formula 1.

[44] Herein, “substituted” in the expression, “substituted or unsubstituted,” means that a hydrogen atom in a certain functional group is replaced with another atom or group, i.e. a substituent. The substituents of the substituted alkyl(ene), the substituted aryl(ene), the substituted heteroaryl(ene), the substituted cycloalkyl, the substituted heterocycloalkyl, and the substituted arylalkyl in L₁ to L₃, Ar₁ to Ar₃, and R₁ to R₁₆, each independently, are at least one selected from the group consisting of deuterium, a halogen, a (C1-C30)alkyl unsubstituted or substituted with a halogen, a (C1-C30)alkoxy, a (C6-C30)aryl, a (3- to 30-membered)heteroaryl unsubstituted or substituted with a (C6-C30)aryl, a (C3-C30)cycloalkyl, a (3- to 7-membered) heterocycloalkyl, a tri(C1-C30)alkylsilyl, a tri(C6-C30)arylsilyl, a di(C1-C30)alkyl(C6-C30)arylsilyl, a (C1-C30)alkyldi(C6-C30)arylsilyl, a (C2-C30)alkenyl, a (C2-C30)alkynyl, a cyano, a carbazolyl, a di(C1-C30)alkylamino, a di(C6-C30)aryl amino unsubstituted or substituted with a (C1-C30)alkyl, a (C1-C30)alkyl(C6-C30)aryl amino, a di(C6-C30)arylboronyl, a di(C1-C30)alkylboronyl, a (C1-C30)alkyl(C6-C30)arylboronyl, a

(C6-C30)aryl(C1-C30)alkyl, a (C1-C30)alkyl(C6-C30)aryl, a carboxy, a nitro, and a hydroxy; and preferably, each independently, are at least one selected from the group consisting of a (C6-C30)aryl and a di(C6-C30)arylamino.

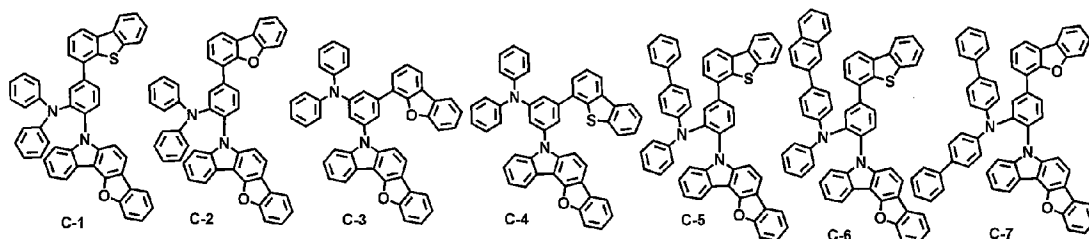
- [45] In formula 1, preferably, X_1 and X_2 , each independently, represent CR_4 .
- [46] Y represents -O-, -S-, -C(R_5)(R_6)-, -Si(R_7)(R_8)-, or -N(R_9)-.
- [47] Preferably, L_1 to L_3 , each independently, represent a single bond, or an unsubstituted (C6-C20)arylene; and more preferably, a single bond, or an unsubstituted (C6-C15)arylene. Specifically, L_1 to L_3 , each independently, may represent a single bond, phenylene, biphenylene, or naphthylene.
- [48] Preferably, Ar_1 represents a substituted or unsubstituted (C6-C20)aryl, a substituted or unsubstituted (5- to 20-membered)heteroaryl, or -NR₁₀R₁₁. The heteroaryl may contain at least one hetero atom selected from N, O, and S. Preferably, R_{10} and R_{11} , each independently, represent a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted (5- to 20-membered)heteroaryl; and more preferably, represent a substituted or unsubstituted (C6-C18)aryl. Specifically, Ar_1 may represent a substituted or unsubstituted fluoranthenyl, a substituted or unsubstituted triphenylenyl, a substituted or unsubstituted acenaphthenyl, a substituted or unsubstituted pyridyl, a substituted or unsubstituted pyrimidinyl, a substituted or unsubstituted pyrazinyl, a substituted or unsubstituted pyridazinyl, a substituted or unsubstituted triazinyl, a substituted or unsubstituted quinolyl, a substituted or unsubstituted isoquinolyl, a substituted or unsubstituted quinazolinyl, a substituted or unsubstituted quinoxaliny, a substituted or unsubstituted benzoimidazolyl, a substituted or unsubstituted benzothioophenyl, a substituted or unsubstituted benzofuranyl, a substituted or unsubstituted dibenzothiophenyl, a substituted or unsubstituted dibenzofuranyl, or a substituted or unsubstituted carbazolyl; or may represent -NR₁₀R₁₁ in which R_{10} and R_{11} , each independently, represent a substituted or unsubstituted phenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted phenylnaphthyl, or a substituted or unsubstituted naphthylphenyl.
- [49] Preferably, Ar_2 and Ar_3 , each independently, represent a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted (5- to 20-membered)heteroaryl; and more preferably, represent a substituted or unsubstituted (C6-C20)aryl. Specifically, Ar_2 and Ar_3 , each independently, may represent a substituted or unsubstituted phenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted phenylnaphthyl, or a substituted or unsubstituted naphthylphenyl.
- [50] Preferably, R_1 to R_3 , each independently, represent hydrogen, or are linked to an adjacent substituent(s) to form a (3- to 20-membered) monocyclic aromatic ring; and more preferably, represent hydrogen, or are linked to an adjacent substituent(s) to form

- a (3- to 15-membered) monocyclic aromatic ring. Preferably, R₄ represents hydrogen.
- [51] Preferably, R₅ to R₉, and R₁₂ to R₁₆, each independently, represent an unsubstituted (C1-C10)alkyl, or an unsubstituted (C6-C20)aryl; and more preferably, an unsubstituted (C1-C6)alkyl, or an unsubstituted (C6-C15)aryl.
- [52] l, m, and n, each independently, represent an integer of 0 to 3; and where l, m, or n represents an integer of 2 or more, each of L₁ to L₃ may be the same or different. Preferably, l, m, and n, each independently, represent 0 or 1.
- [53] a and c, each independently, represent an integer of 1 to 4; and where a or c is an integer of 2 or more, each of R₁ and R₃ may be the same or different.
- [54] b represent 1 or 2; and where b is 2, each of R₂ may be the same or different.
- [55] According to one embodiment of the present disclosure, in formula 1, X₁ and X₂, each independently, represent CR₄; Y represents -O-, -S-, -C(R₅)(R₆)-, -Si(R₇)(R₈)-, or -N(R₉)-; L₁ to L₃, each independently, represent a single bond, or an unsubstituted (C6-C20)arylene; Ar₁ represents a substituted or unsubstituted (C6-C20)aryl, a substituted or unsubstituted (5- to 20-membered)heteroaryl, or -NR₁₀R₁₁; Ar₂ and Ar₃, each independently, represent a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted (5- to 20-membered)heteroaryl; R₁ to R₃, each independently, represent hydrogen, or are linked to an adjacent substituent(s) to form a (3- to 20-membered) monocyclic aromatic ring; R₄ represents hydrogen; R₅ to R₉, and R₁₂ to R₁₆, each independently, represent an unsubstituted (C1-C10)alkyl, or an unsubstituted (C6-C20)aryl; R₁₀ and R₁₁, each independently, represent a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted (5- to 20-membered)heteroaryl; and l, m, and n, each independently, represent 0 or 1.
- [56] According to another embodiment of the present disclosure, in formula 1, X₁ and X₂, each independently, represent CR₄; Y represents -O-, -S-, -C(R₅)(R₆)-, -Si(R₇)(R₈)-, or -N(R₉)-; L₁ to L₃, each independently, represent a single bond, or an unsubstituted (C6-C15)arylene; Ar₁ represents a substituted or unsubstituted (C6-C20)aryl, a substituted or unsubstituted (5- to 20-membered)heteroaryl, or -NR₁₀R₁₁; Ar₂ and Ar₃, each independently, represent a substituted or unsubstituted (C6-C20)aryl; R₁ to R₃, each independently, represent hydrogen, or are linked to an adjacent substituent(s) to form a (3- to 15-membered) monocyclic aromatic ring; R₄ represents hydrogen; R₅ to R₉, and R₁₂ to R₁₆, each independently, represent an unsubstituted (C1-C6)alkyl, or an unsubstituted (C6-C15)aryl; R₁₀ and R₁₁, each independently, represent a substituted or unsubstituted (C6-C18)aryl; and l, m, and n, each independently, represent 0 or 1.
- [57] According to another embodiment of the present disclosure, the heteroaryl in the definitions of the groups of formula 1 is pyrrolyl, imidazolyl, triazinyl, tetrazinyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, dibenzofuranyl, dibenzothiophenyl, benzoimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl,

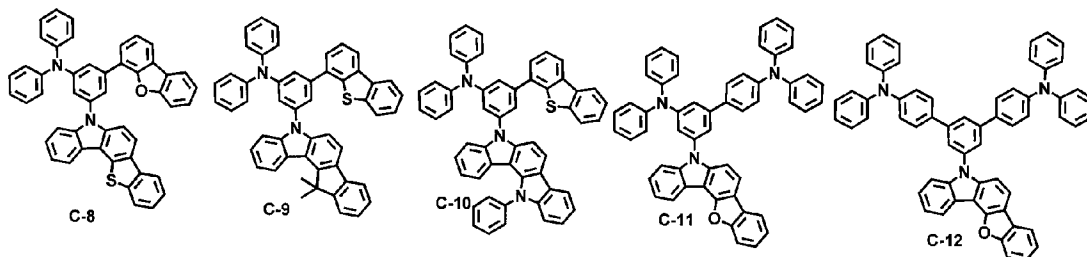
indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, quinazolinyl, quinoxaliny, carbazolyl, phenoxazinyl, or phenanthridinyl.

[58] More specifically, the organic electroluminescent compound of formula 1 of the present disclosure includes the following, but is not limited thereto:

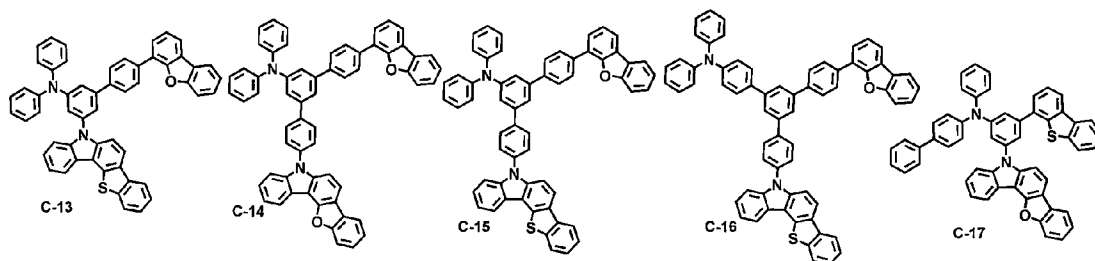
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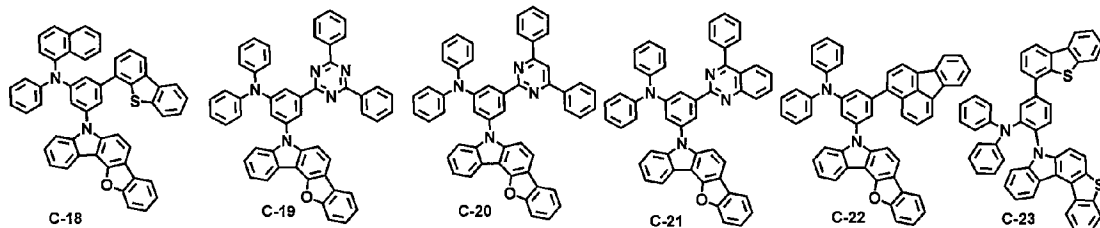
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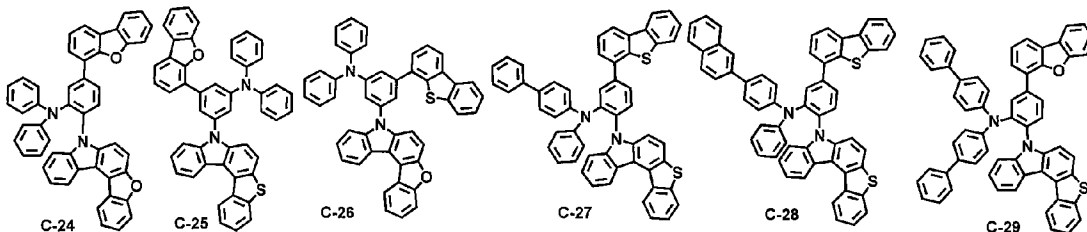
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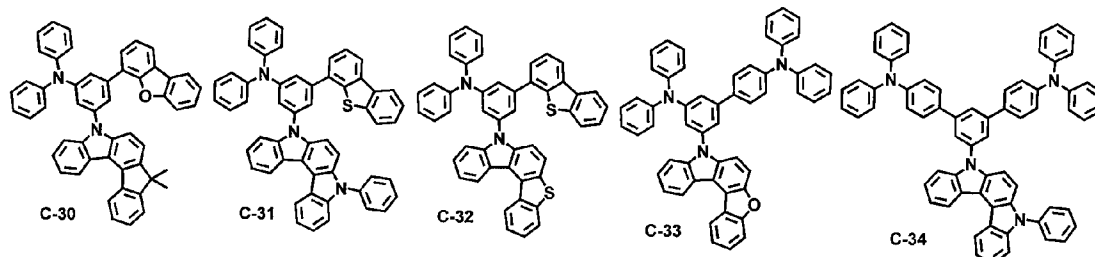
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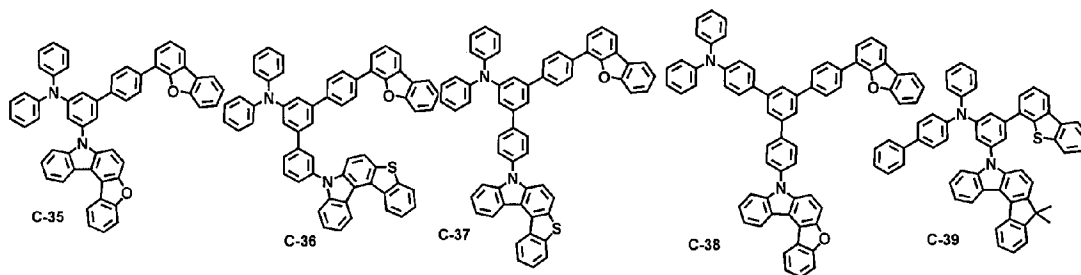
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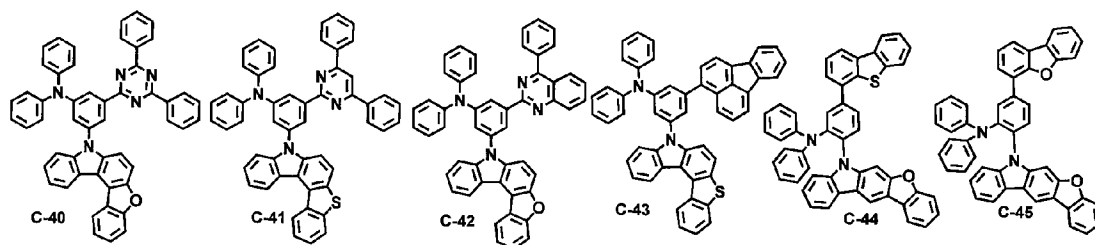
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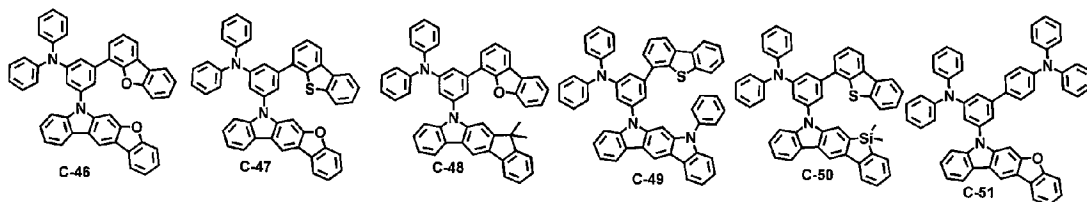
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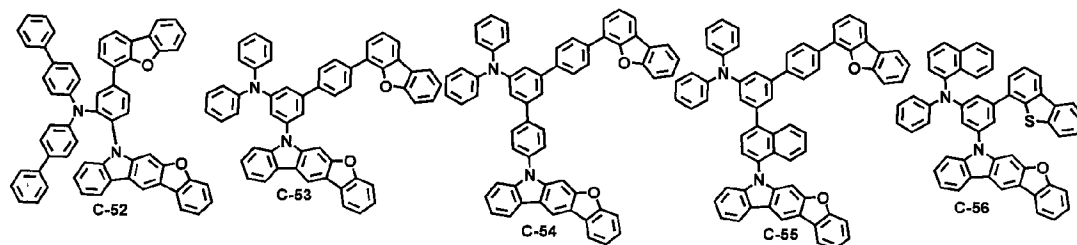
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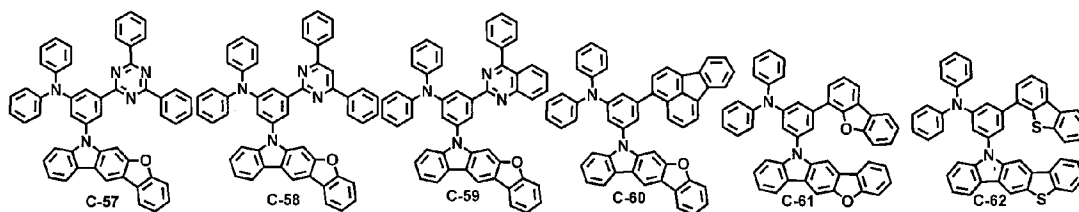
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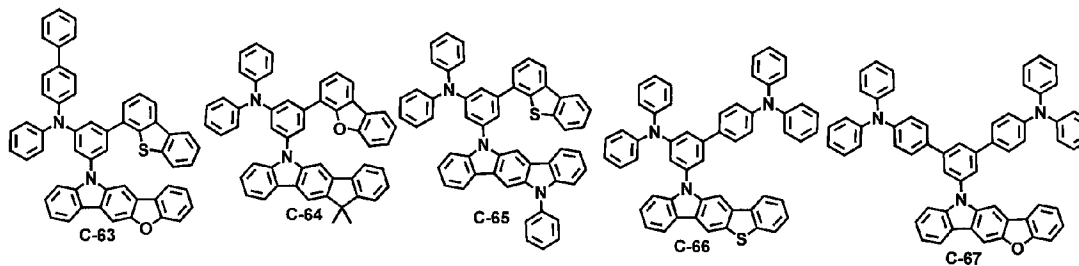
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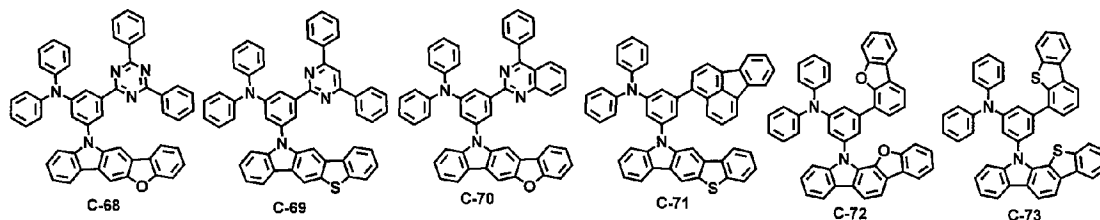
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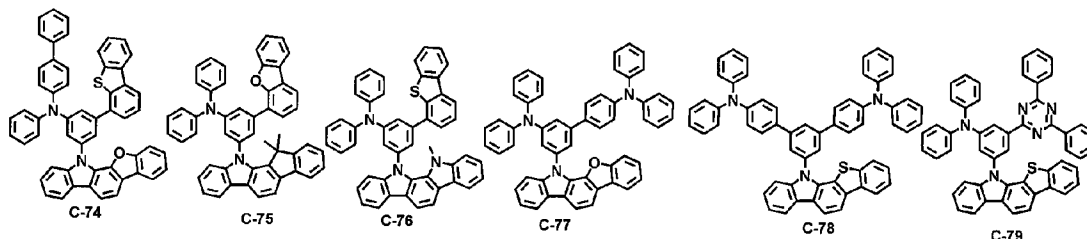
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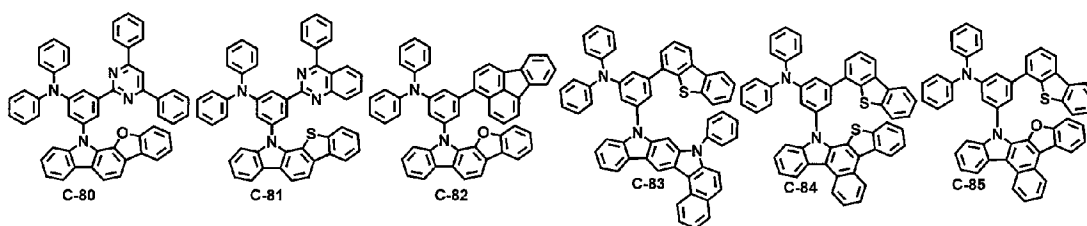
[71]



[72]



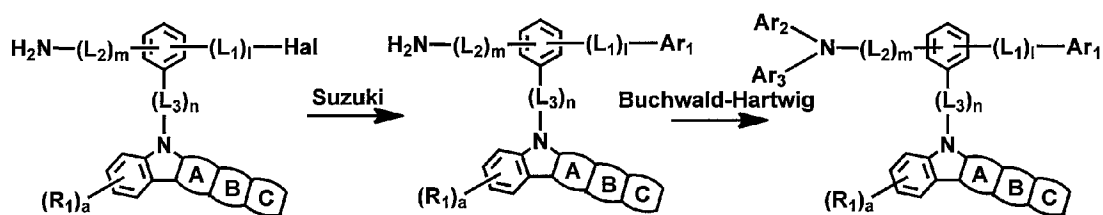
[73]



[74] The organic electroluminescent compound of the present disclosure can be prepared by a synthetic method known to one skilled in the art. For example, it can be prepared according to the following reaction scheme 1 or 2.

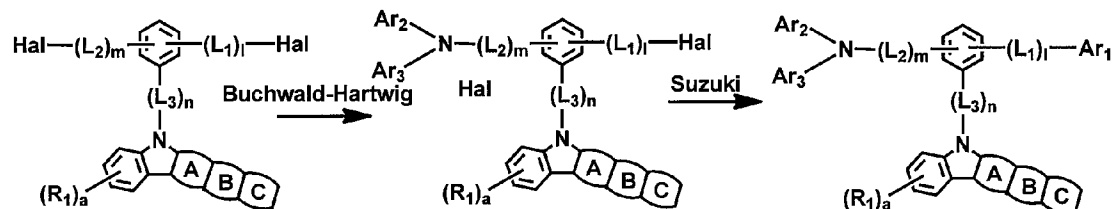
[75] [Reaction Scheme 1]

[76]



[77] [Reaction Scheme 2]

[78]



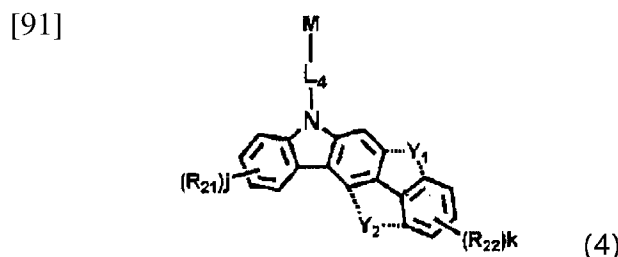
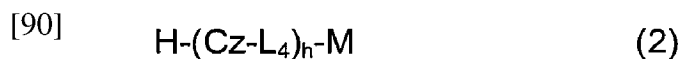
[79] In the above reaction scheme 1 and 2, ring A to ring C, L₁ to L₃, R₁, Ar₁ to Ar₃, a, l, m, and n are as defined in formula 1 above, and Hal represents a halogen.

[80] According to the Suzuki reaction in reaction scheme 1 and 2, aryl boronic acid and aryl halide are reacted with each other under a basic condition (e.g. by potassium carbonate or potassium phosphate) to form a carbon-carbon bond. The reaction is carried out in a mixed solvent of toluene and ethanol; and is usually performed under

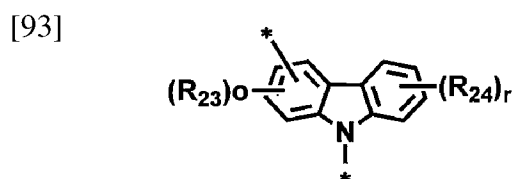
reflux by using palladium complex such as tetrakis(triphenylphosphine) palladium and a combination of palladium acetate and S-Phos (e.g. 2-dicyclopophosphino-2',6'-dimethoxyphenyl) as a catalyst.

- [81] According to the Buchwald-Hartwig reaction in reaction scheme 1 and 2, aryl amine and aryl halide are reacted with each other under a basic condition (e.g. by sodium *t*-butoxide) to form a carbon-nitrogen bond. The reaction is carried out in an aromatic organic solvent such as toluene or xylene; and is usually performed under reflux by using palladium complex such as a combination of palladium acetate and S-Phos (e.g. 2-dicyclopophosphino-2',6'-dimethoxyphenyl) as a catalyst.
- [82] Furthermore, the present disclosure provides an organic electroluminescent material comprising the organic electroluminescent compound of formula 1, and an organic electroluminescent device comprising the material.
- [83] The material may consist of the organic electroluminescent compound of formula 1. Otherwise, the material may further comprise a conventional compound(s) which has been comprised for an organic electroluminescent device, in addition to the compound of formula 1.
- [84] The organic electroluminescent device may comprise a first electrode, a second electrode, and at least one organic layer disposed between the first and second electrodes. The organic layer may comprise at least one compound of formula 1.
- [85] One of the first and second electrodes may be an anode, and the other may be a cathode. The organic layer may comprise a light-emitting layer, and may further comprise at least one layer selected from a hole injection layer, a hole transport layer, an electron transport layer, an electron injection layer, an interlayer, a hole blocking layer, and an electron blocking layer.
- [86] The compound of the present disclosure may be comprised in at least one of the light-emitting layer and the hole transport layer. When used in the hole transport layer, the compound of the present disclosure may be comprised as a hole transport material. When used in the light-emitting layer, the compound of the present disclosure may be comprised as a host material.
- [87] The organic electroluminescent device comprising the compound of the present disclosure may further comprise at least one host compound other than the compound of the present disclosure. Furthermore, the organic electroluminescent device may further comprise at least one dopant.
- [88] Where the compound of the present disclosure is comprised as a host material (a first host material) in a light-emitting layer, another compound may be comprised as a second host material. The weight ratio between the first host material and the second host material is in the range of 1:99 to 99:1.
- [89] The second host material may be from any of the known phosphorescent host

materials. Specifically, the material selected from the group consisting of the compounds of formulae 2 to 4 below is preferable as the second host material in view of luminous efficiency.



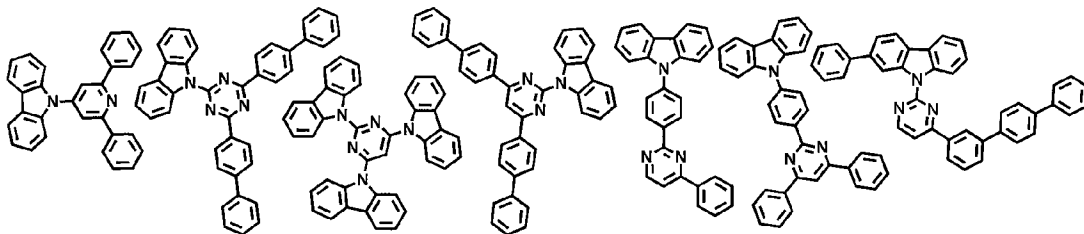
[92] Wherein, Cz represents the following structure:



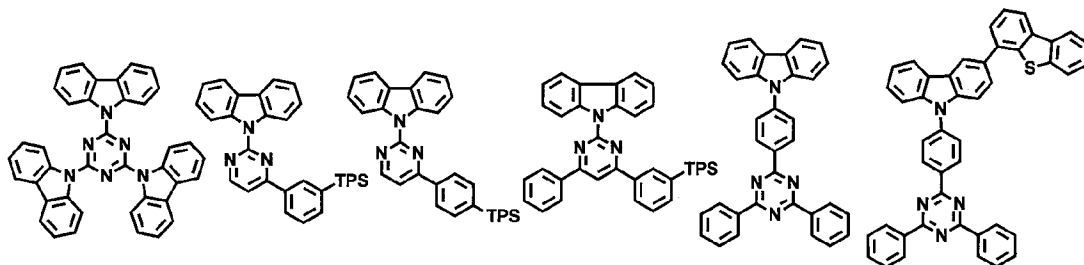
[94] R_{21} to R_{24} , each independently, represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, or $R_{25}R_{26}R_{27}Si-$; R_{25} to R_{27} , each independently, represent a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C6-C30)aryl; L_4 represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (5- to 30-membered)heteroarylene; M represents a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl; Y_1 and Y_2 , each independently, represent -O-, -S-, -N(R_{31})-, or -C(R_{32})(R_{33})-, provided that Y_1 and Y_2 do not simultaneously exist; R_{31} to R_{33} , each independently, represent a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl, R_{32} and R_{33} may be the same or different; h and i , each independently, represent an integer of 1 to 3; j , k , o , and r , each independently, represent an integer of 0 to 4; and where h , i , j , k , o , or r is an integer of 2 or more, each of $(Cz-L_4)$, each of (Cz) , each of R_{21} , each of R_{22} , each of R_{23} , or each of R_{24} may be the same or different.

[95] Specifically, the second host material includes the following:

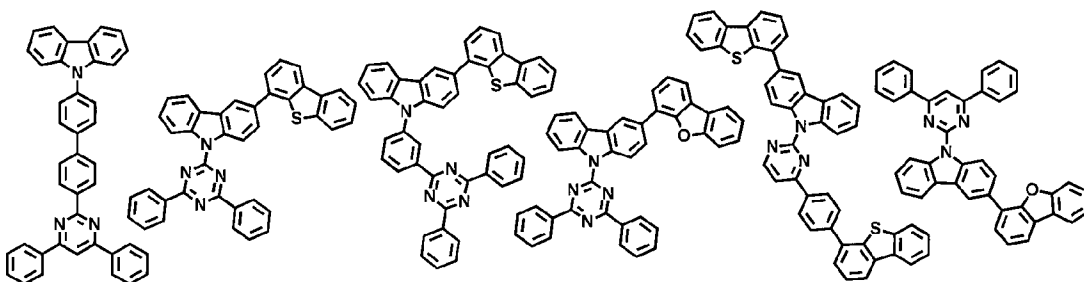
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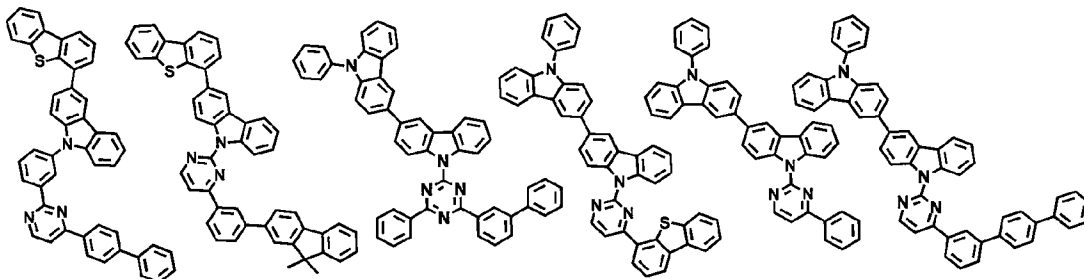
[97]



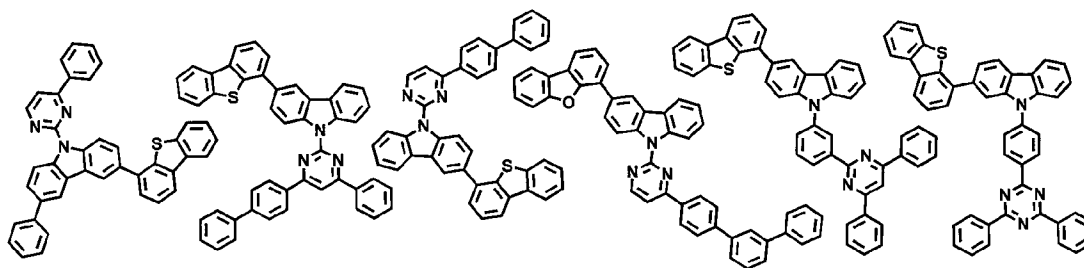
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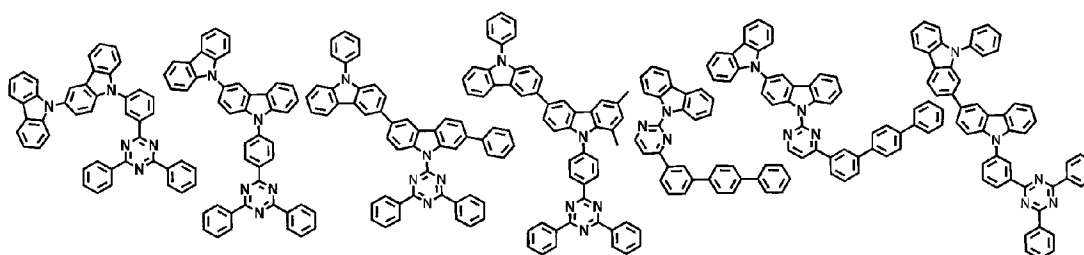
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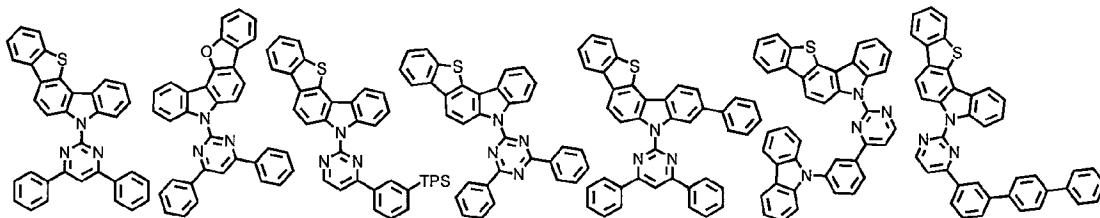
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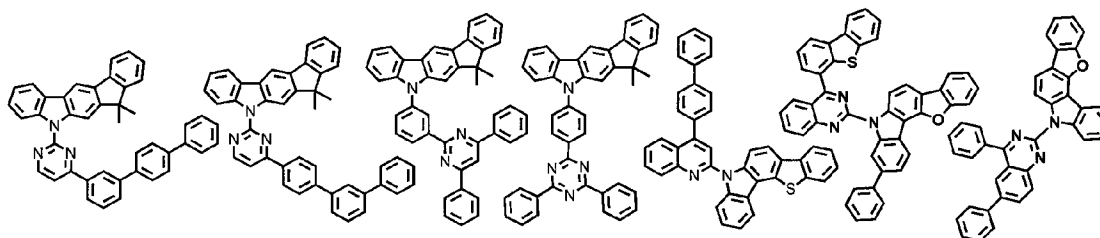
[101]



[107]



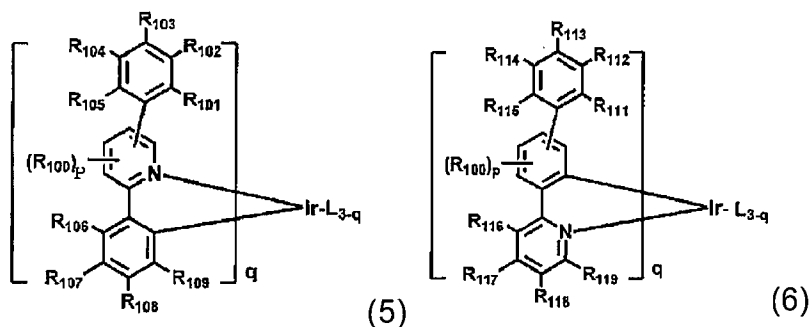
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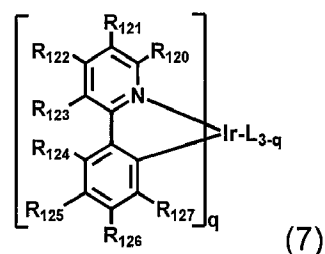
[109] The dopant for the organic electroluminescent device of the present disclosure is preferably at least one phosphorescent dopant. The phosphorescent dopant for the organic electroluminescent device of the present disclosure is not limited, but may be preferably selected from metallated complex compounds of iridium (Ir), osmium (Os), copper (Cu) and platinum (Pt), more preferably selected from ortho-metallated complex compounds of iridium (Ir), osmium (Os), copper (Cu) and platinum (Pt), and even more preferably ortho-metallated iridium complex compounds.

[110] The phosphorescent dopant may be preferably selected from the group consisting of compounds represented by the following formulae 5 to 7.

[111]

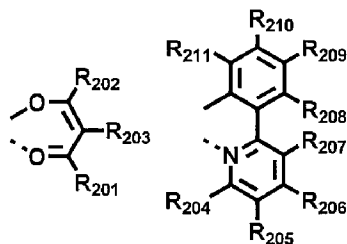


[112]



[113] wherein L is selected from the following:

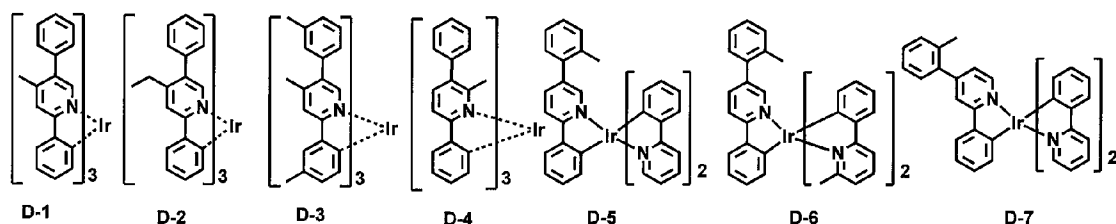
[114]



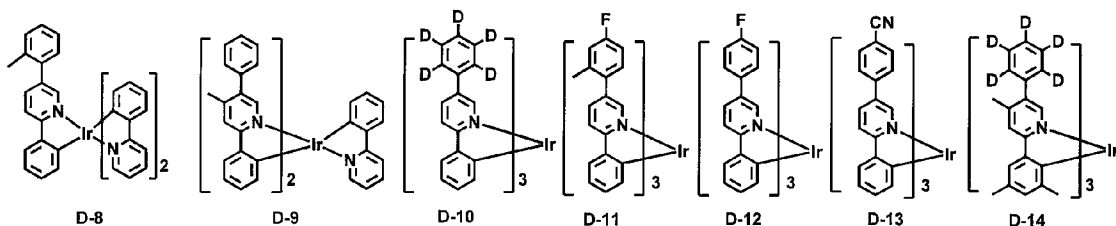
[115] R_{100} represents hydrogen, or a substituted or unsubstituted (C1-C30)alkyl; R_{101} to R_{109} and R_{111} to R_{123} , each independently, represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl unsubstituted or substituted with a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkoxy, or a substituted or unsubstituted (C3-C30)cycloalkyl; or R_{120} to R_{123} may be linked to an adjacent substituent(s) to form a (3- to 30-membered), mono- or polycyclic, alicyclic or aromatic ring, e.g. quinoline, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur; R_{124} to R_{127} , each independently, represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C6-C30)aryl; where R_{124} to R_{127} are aryl, they may be linked to an adjacent substituent(s) to form a (3- to 30-membered), mono- or polycyclic, alicyclic or aromatic ring, e.g. fluorene, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur; R_{201} to R_{211} , each independently, represent hydrogen, deuterium, a halogen, or a (C1-C30)alkyl unsubstituted or substituted with a halogen; o and p, each independently, represent an integer of 1 to 3; where o or p is an integer of 2 or more, each of R_{100} may be the same or different; and q represents an integer of 1 to 3.

[116] Specifically, the phosphorescent dopant material includes the following:

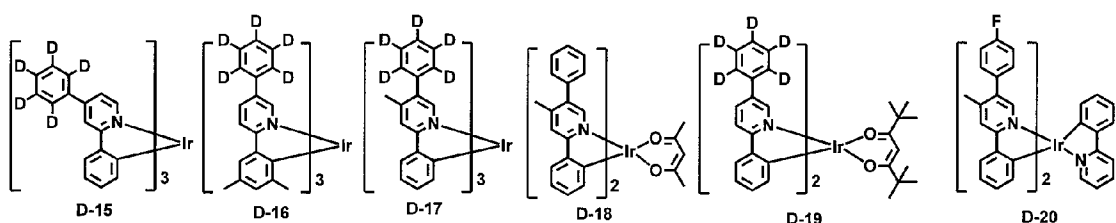
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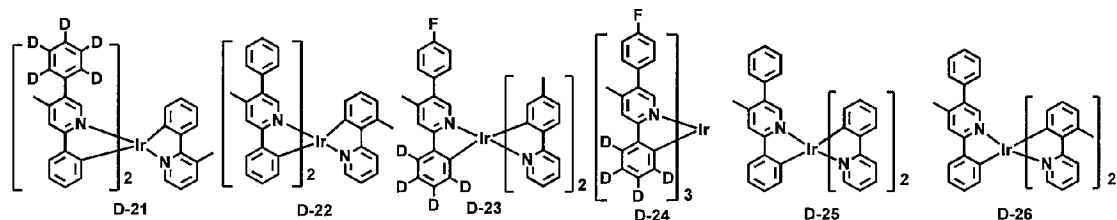
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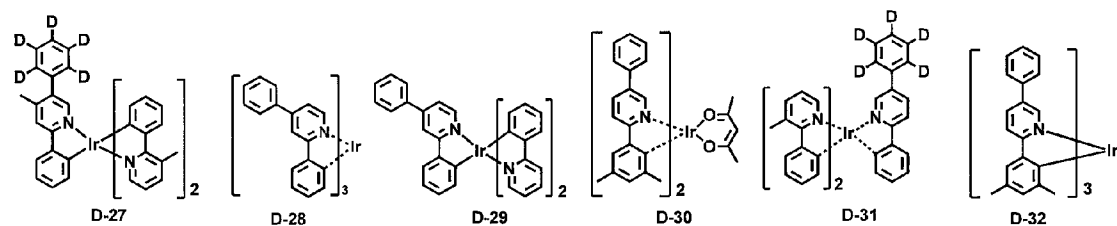
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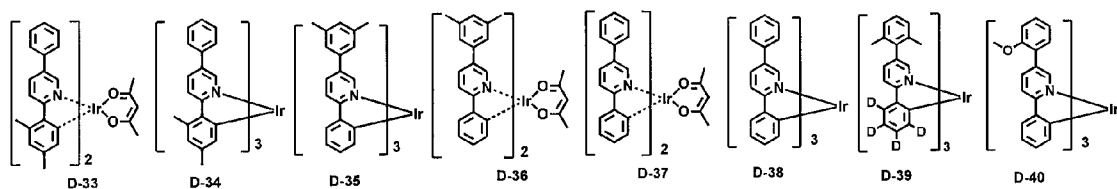
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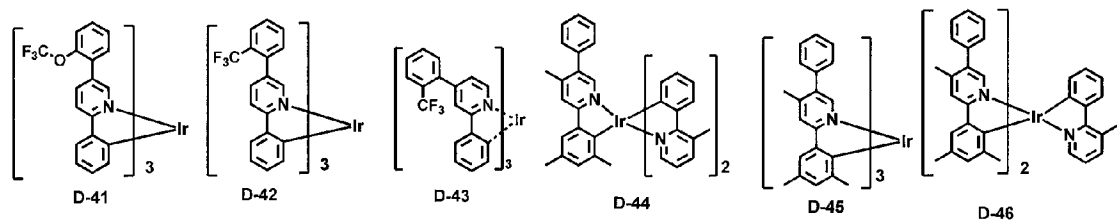
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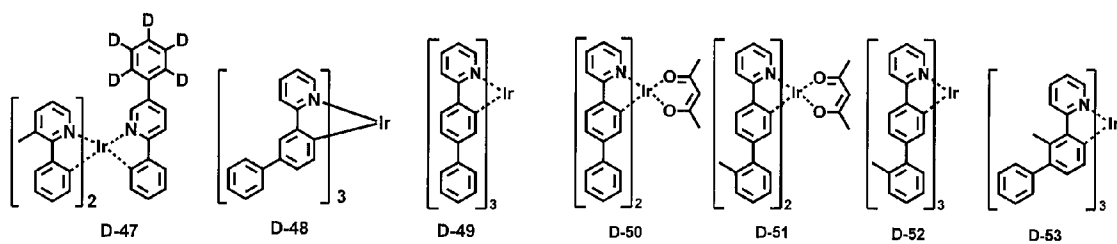
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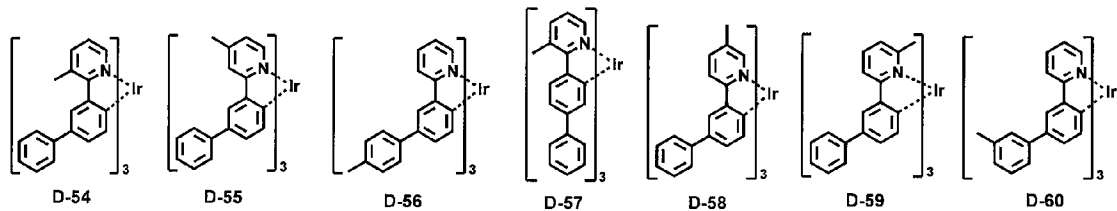
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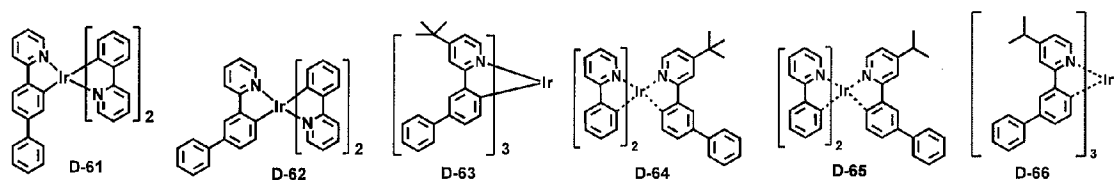
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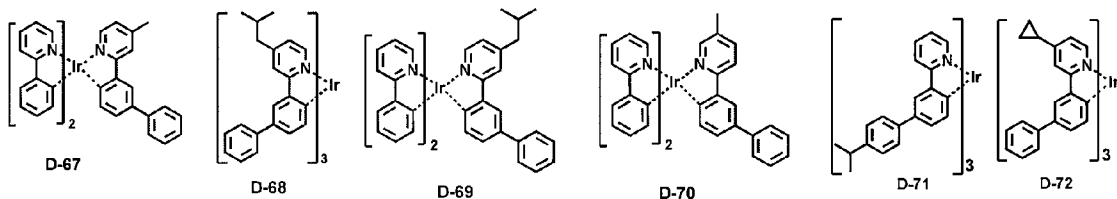
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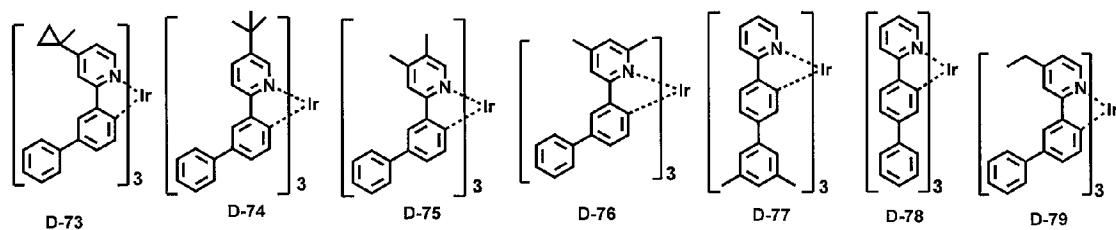
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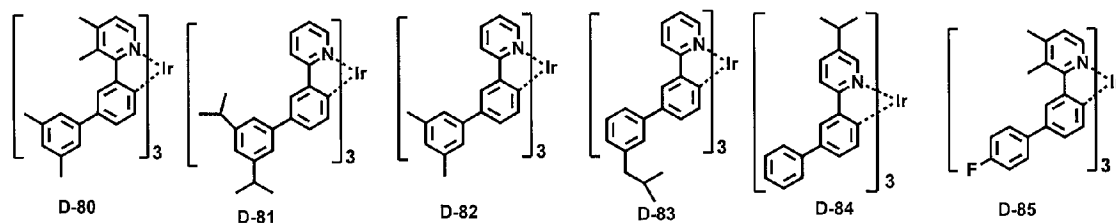
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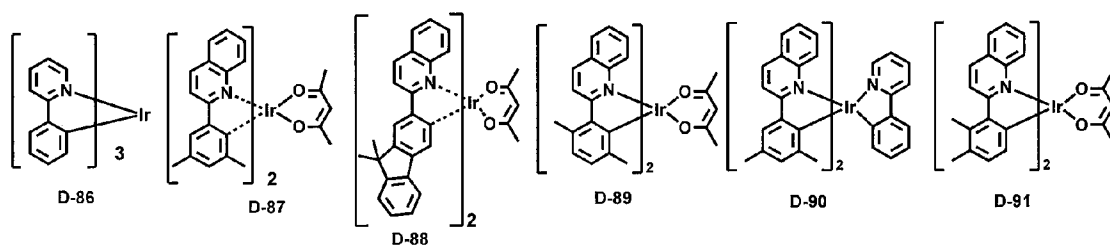
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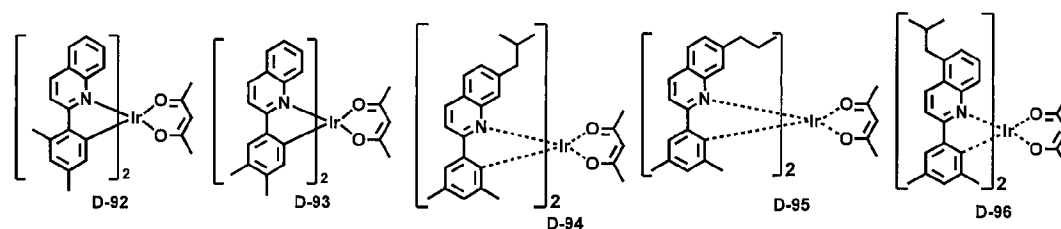
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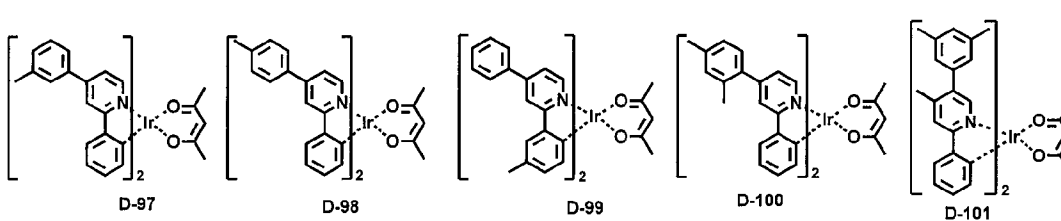
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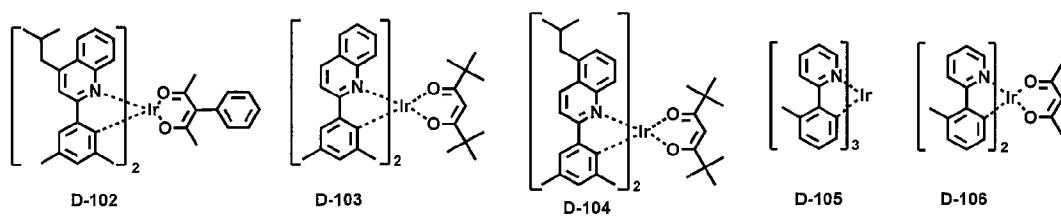
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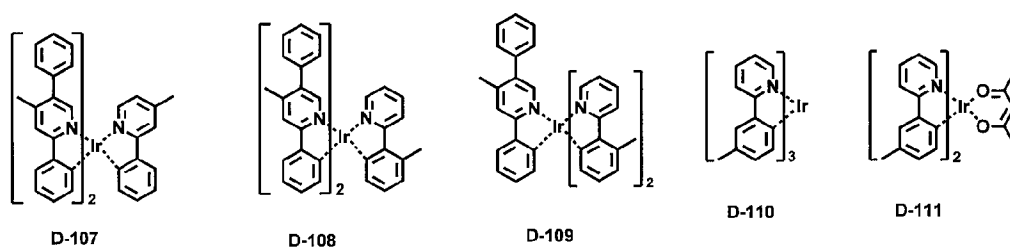
[132]

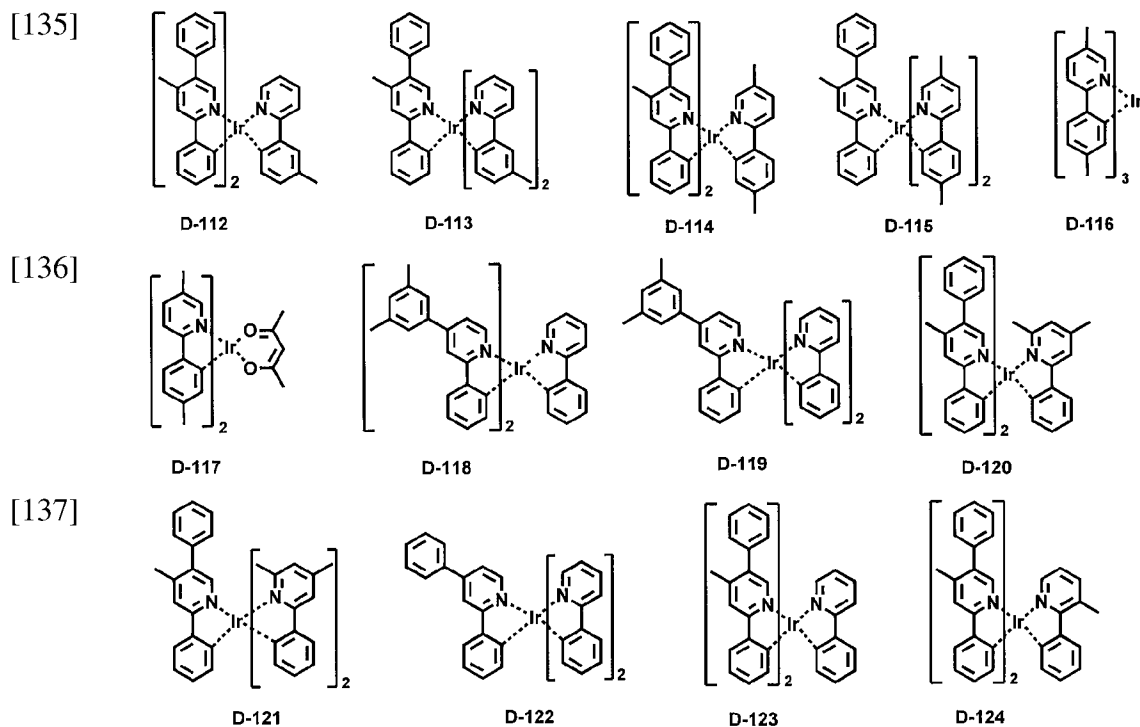


[133]



[134]





[138] Furthermore, the present disclosure provides a composition for preparing an organic electroluminescent device. The composition may comprise the compound of the present disclosure as a material for a hole transport layer.

[139] The organic electroluminescent device of the present disclosure may comprise a first electrode, a second electrode, and at least one organic layer disposed between the first and second electrodes. The organic layer may comprise a light-emitting layer, which may comprise the composition for the organic electroluminescent device of the present disclosure.

[140] The organic electroluminescent device of the present disclosure may further comprise, in addition to the compound of formula 1, at least one compound selected from the group consisting of arylamine-based compounds and styrylamine-based compounds.

[141] In the organic electroluminescent device of the present disclosure, the organic layer may further comprise, in addition to the compound of formula 1, 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 the metal. The organic layer may further comprise a light-emitting layer and a charge generating layer.

[142] In addition, the organic electroluminescent device of the present disclosure may emit white light by further comprising at least one light-emitting layer, which comprises a blue electroluminescent compound, a red electroluminescent compound or a green

electroluminescent compound known in the field, besides the compound of the present disclosure. If necessary, it may further comprise an orange light-emitting layer or a yellow light-emitting layer.

[143] In the organic electroluminescent device of the present disclosure, preferably, at least one layer (hereinafter, "a surface layer") may be placed on an inner surface(s) of one or both electrode(s), selected from a chalcogenide layer, a metal halide layer and a metal oxide layer. Specifically, a chalcogenide (includes oxides) layer of silicon or aluminum is preferably placed on an anode surface of an electroluminescent medium layer, and a metal halide layer or a metal oxide layer is preferably placed on a cathode surface of an electroluminescent medium layer. Such a surface layer provides operation stability for the organic electroluminescent device. Preferably, the chalcogenide includes SiO_x ($1 \leq x \leq 2$), AlO_x ($1 \leq x \leq 1.5$), SiON , SiAlON , etc.; the metal halide 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.

[144] 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 electroluminescent device having two or more light-emitting layers and emitting white light.

[145] 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 and ion plating methods, or wet film-forming methods such as spin coating, dip coating, and flow coating methods can be used.

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

[147] Hereinafter, the compound of the present disclosure, the preparation method of the compound, and the luminescent properties of the device will be explained in detail

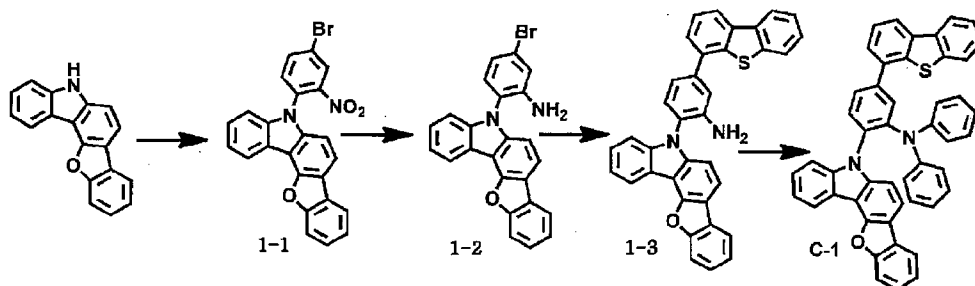
with reference to the following examples.

[148]

[149]

[150]

Example 1: Preparation of compound C-1



[151]

Preparation of compound 1-1

[152]

After introducing 5H-benzofuro[3,2-c]carbazole (30 g, 117 mmol), 4-bromo-1-fluoro-2-nitrobenzene (26 g, 117 mmol), cesium carbonate (46 g, 140 mmol), and dimethylsulfoxide 300 mL into a reaction vessel, the mixture was stirred overnight at room temperature. The mixture was diluted with ethyl acetate, washed several times with water, and dried with anhydrous magnesium sulfate. The mixture was distilled under reduced pressure, and purified by column chromatography to obtain compound 1-1 (45 g, 85 %).

[153]

Preparation of compound 1-2

[154]

After introducing compound 1-1 (30 g, 66 mmol), tin(II) chloride hydrate (44.4 g, 200 mmol), and ethyl acetate 700 mL into a reaction vessel, the mixture was under reflux for 2 hours. After cooling to room temperature, the mixture was diluted with ethyl acetate, washed several times with water, and dried with anhydrous magnesium sulfate. The mixture was distilled under reduced pressure, and purified by column chromatography to obtain compound 1-2 (25 g, 83 %).

[155]

Preparation of compound 1-3

[156]

After introducing compound 1-2 (23 g, 54 mmol), 4-dibenzothiophene boronic acid (15 g, 65 mmol), palladium(0) tetrakis(triphenylphosphine) (2.5 g, 2.2 mmol), potassium carbonate (15 g, 108 mmol), toluene 150 mL, ethanol 50 mL, and distilled water 50 mL into a reaction vessel, the mixture was under reflux for 2 hours. After completing the reaction, the mixture was washed with distilled water, extracted with ethylacetate, and dried with magnesium sulfate. After removing the solvent by a rotary evaporator, the mixture was purified by column chromatography to obtain compound 1-3 (29.5 g (quantitative yield)).

[157]

Preparation of compound C-1

[158]

After introducing compound 1-3 (15.5 g, 29.2 mmol), iodobenzene (10 mL, 88 mmol, d=1.823), palladium(II) acetate (1 g, 4.4 mmol), tri-t-butyl phosphine (4 mL, 50 %, 8.8 mmol), sodium tert-butoxide (8.5 g, 88 mmol), and o-xylene 150 mL into a

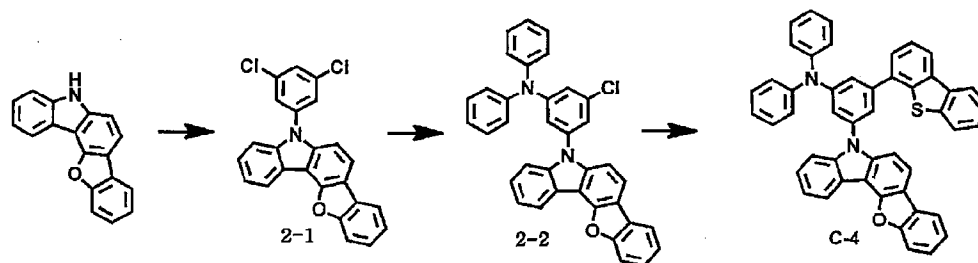
reaction vessel, the mixture was under reflux for 48 hours. The reaction mixture was cooled to room temperature, and filtered. The obtained solids were washed with methylene chloride (MC). The filtrate was distilled under reduced pressure, and purified by column chromatography to obtain compound C-1 (6.4 g, 32%).

[159] Physical Properties: Melting point 284°C, UV 352 nm (in toluene), PL 407 nm (in toluene), molecular weight 683.54 [M+1]

[160]

[161] **Example 2: Preparation of compound C-4**

[162]



[163] **Preparation of compound 2-1**

[164] After introducing 5H-benzofuro[3,2-c]carbazole (30 g, 117 mmol), 1-bromo-3,5-dichlorobenzene (40 g, 176 mmol), copper(I) iodide (11 g, 59 mmol), ethylene diamine (15 mL, 234 mmol), potassium phosphate (50 g, 234 mmol), and toluene 600 mL into a reaction vessel, the mixture was under reflux overnight. The mixture was diluted with ethyl acetate, washed several times with water, and dried with anhydrous magnesium sulfate. The mixture was distilled under reduced pressure, and purified by column chromatography to obtain compound 2-1 (28 g, 60 %).

[165] **Preparation of compound 2-2**

[166] After introducing compound 2-1 (14.3 g, 35.5 mmol), diphenylamine (6 g, 35.5 mmol), palladium(II) acetate (0.16 g, 0.71 mmol), S-Phos (2-dicyclopophosphino-2',6'-dimethoxyphenyl) (0.58 g, 1.42 mmol), sodium t-butoxide (4 g, 43 mmol), and o-xylene 350 mL into a reaction vessel, the mixture was stirred overnight. The mixture was cooled to room temperature, diluted with ethyl acetate, washed several times with water, and dried with anhydrous magnesium sulfate. The mixture was distilled under reduced pressure, and purified by column chromatography to obtain compound 2-2 (12.5 g, 66 %).

[167] **Preparation of compound C-4**

[168] After introducing compound 2-2 (12 g, 22.4 mmol), 4-dibenzothiophene boronic acid (7.2 g, 27 mmol), palladium(II) acetate (0.25 g, 0.9 mmol), S-Phos (2-dicyclopophosphino-2',6'-dimethoxyphenyl) (0.55 g, 1.3 mmol), potassium carbonate (12 g, 56 mmol), toluene 75 mL, 1,4-dioxane 25 mL, and distilled water 25 mL into a reaction vessel, the mixture was under reflux overnight. After completing the reaction,

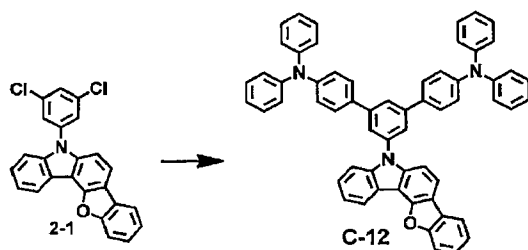
the mixture was washed with distilled water, extracted with ethyl acetate, and dried with magnesium sulfate. After removing the solvent by a rotary evaporator, the mixture was purified by column chromatography to obtain compound C-4 (10 g, 67%).

[169] Physical properties: Melting point 238°C, UV 342 nm (in toluene), PL 400 nm (in toluene), molecular weight 683.54 [M+1]

[170]

[171] **Example 3: Preparation of compound C-12**

[172]



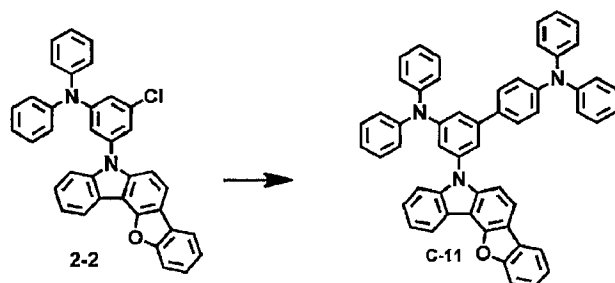
[173] After introducing compound 2-1 (7.5 g, 18.5 mmol), 4-(diphenylamino)phenyl boronic acid (12.3 g, 42.5 mmol), palladium(II) acetate (0.35 g, 1.5 mmol), S-Phos (2-dicyclophosphino-2',6'-dimethoxyphenyl) (0.9 g, 2.2 mmol), potassium phosphate (12 g, 55.5 mmol), toluene 100 mL, 1,4-dioxane 25 mL, and distilled water 25 mL into a reaction vessel, the mixture was under reflux overnight. After completing the reaction, the mixture was washed with distilled water, extracted with ethyl acetate, and dried with magnesium sulfate. After removing the solvent by a rotary evaporator, the mixture was purified by column chromatography to obtain compound C-12 (9.4 g, 62%).

[174] Physical properties: Melting point 178°C, UV 354 nm (in toluene), PL 396 nm (in toluene), molecular weight 821.59 [M+1]

[175]

[176] **Example 4: Preparation of compound C-11**

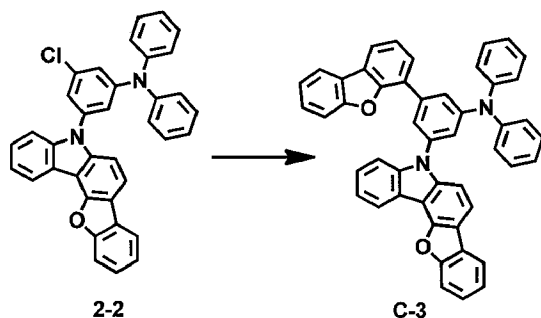
[177]



[178] After introducing compound 2-2 (12 g, 22.4 mmol), 4-(diphenylamino)phenyl boronic acid (7.8 g, 26.9 mmol), palladium(II) acetate (0.20 g, 0.90 mmol), S-Phos (2-dicyclophosphino-2',6'-dimethoxyphenyl) (0.55 g, 1.34 mmol), potassium phosphate (12 g, 55.5 mmol), toluene 120 mL, 1,4-dioxane 30 mL, and distilled water 30 mL into a reaction vessel, the mixture was under reflux overnight. After completing

[179] Physical properties: Melting point 160°C, UV 312 nm (in toluene), PL 396 nm (in toluene), molecular weight 821.59 [M+1]

[181] **Example 5: Preparation of compound C-3**



[184] Physical properties: Melting point 243°C, UV 362 nm (in toluene), PL 415 nm (in toluene), molecular weight 667.76 [M+1]

[186] **[Device Example 1] OLED using the compound of the present disclosure**

[187] OLED was produced using the compound of the present disclosure as follows. A transparent electrode indium tin oxide (ITO) thin film (15 Ω /sq) on a glass substrate for an organic light-emitting diode (OLED) (Samsung Corning) was subjected to an ultrasonic washing with trichloroethylene, acetone, ethanol, and distilled water, sequentially, and was then stored in isopropanol. The ITO substrate was then mounted on a substrate holder of a vacuum vapor depositing apparatus. N¹,N^{1'} - ([1,1'-biphenyl]-4,4'-diyl)bis(N¹-(naphthalen-1-yl)-N⁴,N⁴-diphenylbenzene-1,4-diamine) was introduced into a cell of said vacuum vapor depositing apparatus, and then the pressure in the chamber of said apparatus was controlled to 10⁻⁶ torr. Thereafter, an electric current was applied to the cell to evaporate the above introduced material,

thereby forming a hole injection layer having a thickness of 60 nm on the ITO substrate. Compound **C-1** was then introduced into another cell of said vacuum vapor depositing apparatus, and evaporated by applying electric current to the cell, thereby forming a hole transport layer having a thickness of 20 nm on the hole injection layer. Thereafter,

9-(4-([1,1':3',1''-terphenyl]-4-yl)pyrimidin-2-yl)-9'-phenyl-9H,9'H-3,3'-bicarbazole was introduced into one cell of the vacuum vapor depositing apparatus as a host material, and compound **D-1** was introduced into another cell as a dopant. The two materials were evaporated at different rates, so that the dopant was deposited in a doping amount of 15 wt% based on the total amount of the host and dopant to form a light-emitting layer having a thickness of 30 nm on the hole transport layer.

2-(4-(9,10-di(naphthalen-2-yl)anthracen-2-yl)phenyl)-1-phenyl-1H-benzo[d]imidazole was then introduced into one cell, and lithium quinolate was introduced into another cell. The two materials were evaporated at the same rate, so that they were respectively deposited in a doping amount of 50 wt% to form an electron transport layer having a thickness of 30 nm on the light-emitting layer. After depositing lithium quinolate as an electron injection layer having a thickness of 2 nm on the electron transport layer, an Al cathode having a thickness of 150 nm was then deposited by another vacuum vapor deposition apparatus on the electron injection layer. Thus, an OLED was produced. All the materials used for producing the OLED were those purified by vacuum sublimation at 10^{-6} torr. The produced OLED showed green emission having a luminance of 1,300 cd/m² and a current density of 2.8 mA/cm².

[188]

[189] **[Device Example 2] OLED using the compound of the present disclosure**

[190] OLED was produced in the same manner as in Device Example 1, except for using compound **C-4** to form a hole transport layer having a thickness of 20 nm. The produced OLED showed green emission having a luminance of 5,100 cd/m² and a current density of 11.0 mA/cm².

[191]

[192] **[Device Example 3] OLED using the compound of the present disclosure**

[193] OLED was produced in the same manner as in Device Example 1, except for using compound **C-12** to form a hole transport layer having a thickness of 20 nm. The produced OLED showed green emission having a luminance of 1,500 cd/m² and a current density of 3.2 mA/cm².

[194]

[195] **[Device Example 4] OLED using the compound of the present disclosure**

[196] OLED was produced in the same manner as in Device Example 1, except for using compound **C-11** to form a hole transport layer having a thickness of 20 nm. The

produced OLED showed green emission having a luminance of 7,600 cd/m² and a current density of 15.5 mA/cm².

[197]

[198] **[Device Example 5] OLED using the compound of the present disclosure**

[199] OLED was produced in the same manner as in Device Example 1, except for using compound **C-3** to form a hole transport layer having a thickness of 20 nm. The produced OLED showed green emission having a luminance of 4,700 cd/m² and a current density of 9.8 mA/cm².

[200]

[201] **[Comparative Device Example 1] OLED using a conventional compound**

[202] OLED was produced in the same manner as in Device Example 1, except for using N,N'-di(4-biphenyl)-N,N'-di(4-biphenyl)-4,4'-diaminobiphenyl to form a hole transport layer having a thickness of 20 nm. The produced OLED showed green emission having a luminance of 10,730 cd/m² and a current density of 27.0 mA/cm².

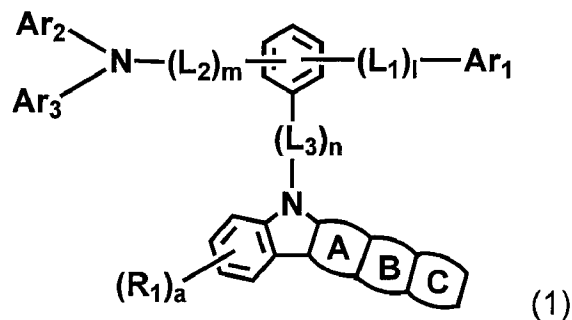
[203]

[204] From the above device examples, it is confirmed that the organic electroluminescent compound of the present disclosure has better luminous characteristics than the conventional compound. The organic electroluminescent device using the compound of the present disclosure shows excellent luminous characteristics, particularly current efficiency.

Claims

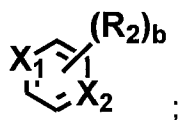
[Claim 1]

An organic electroluminescent compound represented by the following formula 1:

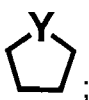


wherein

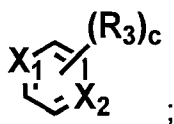
ring A represents



ring B represents



ring C represents



X₁ and X₂, each independently, represent CR₄ or N;

Y represents -O-, -S-, -C(R₅)(R₆)-, -Si(R₇)(R₈)-, or -N(R₉)-;

L₁ to L₃, each independently, represent a single bond, a substituted or unsubstituted (C2-C30)alkylene, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (5- to 30-membered)heteroarylene;

Ar₁ represents a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (5- to 30-membered)heteroaryl, or -NR₁₀R₁₁;

Ar₂ and Ar₃, each independently, represent a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl;

R₁ to R₄, each independently, represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (5- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (3- to

7-membered)heterocycloalkyl, a substituted or unsubstituted (C6-C30)aryl(C1-C30)alkyl, $-NR_{12}R_{13}$, $-SiR_{14}R_{15}R_{16}$, $-SR_{17}$, $-OR_{18}$, a cyano, a nitro, or a hydroxy; or may be linked to an adjacent substituent(s) to form a (3- to 30-membered), mono- or polycyclic, alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur; R_5 to R_9 , and R_{12} to R_{16} , each independently, represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (5- to 30-membered)heteroaryl, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl, or a substituted or unsubstituted (C3-C30)cycloalkyl; or may be linked to an adjacent substituent(s) to form a (3- to 30-membered), mono- or polycyclic, alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

R_{10} and R_{11} , each independently, represent a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl;

l , m , and n , each independently, represent an integer of 0 to 3; where l , m , or n is an integer of 2 or more, each of L_1 to L_3 may be the same or different;

a and c , each independently, represent an integer of 1 to 4; where a or c is an integer of 2 or more, each of R_1 and R_3 may be the same or different;

b represents 1 or 2; where b is 2, each of R_2 may be the same or different; and

the heterocycloalkyl and heteroaryl(ene), each independently, contain at least one hetero atom selected from B, N, O, S, P(=O), Si, and P.

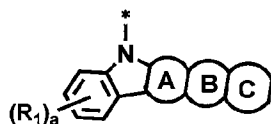
[Claim 2]

The organic electroluminescent compound according to claim 1, wherein the substituents of the substituted alkyl(ene), the substituted aryl(ene), the substituted heteroaryl(ene), the substituted cycloalkyl, the substituted heterocycloalkyl and the substituted arylalkyl in L_1 to L_3 , Ar_1 to Ar_3 , and R_1 to R_{16} , each independently, are at least one selected from the group consisting of deuterium, a halogen, a (C1-C30)alkyl unsubstituted or substituted with a halogen, a (C1-C30)alkoxy, a (C6-C30)aryl, a (3- to 30-membered)heteroaryl unsubstituted or substituted with a (C6-C30)aryl, a (C3-C30)cycloalkyl, a (3- to 7-membered) heterocycloalkyl, a tri(C1-C30)alkylsilyl, a

tri(C6-C30)arylsilyl, a di(C1-C30)alkyl(C6-C30)arylsilyl, a (C1-C30)alkyldi(C6-C30)arylsilyl, a (C2-C30)alkenyl, a (C2-C30)alkynyl, a cyano, a carbazoyl, a di(C1-C30)alkylamino, a di(C6-C30)arylamino unsubstituted or substituted with a (C1-C30)alkyl, a (C1-C30)alkyl(C6-C30)arylamino, a di(C6-C30)arylboronyl, a di(C1-C30)alkylboronyl, a (C1-C30)alkyl(C6-C30)arylboronyl, a (C6-C30)aryl(C1-C30)alkyl, a (C1-C30)alkyl(C6-C30)aryl, a carboxy, a nitro, and a hydroxy.

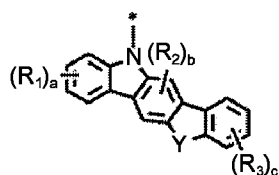
[Claim 3]

The organic electroluminescent compound according to claim 1, wherein

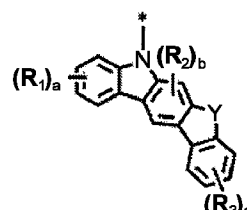


of formula 1 is selected from the

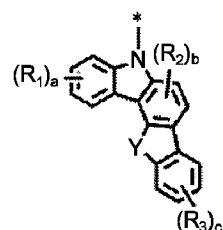
following formulae [1-1] to [1-6].



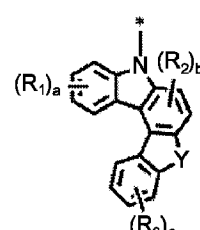
(1-1)



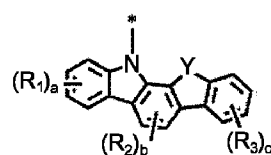
(1-2)



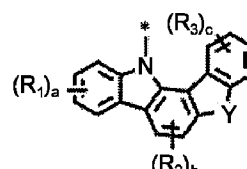
(1-3)



(1-4)



(1-5)



(1-6)

wherein Y, R₁ to R₃, and a to c are as defined in claim 1.

[Claim 4]

The organic electroluminescent compound according to claim 1, wherein X₁ and X₂, each independently, represent CR₄; Y represents -O-, -S-, -C(R₅)(R₆)-, -Si(R₇)(R₈)-, or -N(R₉)-; L₁ to L₃, each independently, represent a single bond, or an unsubstituted (C6-C20)arylene; Ar₁ represents a substituted or unsubstituted (C6-C20)aryl, a substituted or unsubstituted (5- to 20-membered)heteroaryl, or -NR₁₀R₁₁; Ar₂ and Ar₃, each independently, represent a substituted or unsubstituted (C6-C20)aryl, or a substituted

or unsubstituted (5- to 20-membered)heteroaryl; R₁ to R₃, each independently, represent hydrogen, or are linked to an adjacent substituent(s) to form a (3- to 20-membered) monocyclic aromatic ring; R₄ represents hydrogen; R₅ to R₉, and R₁₂ to R₁₆, each independently, represent an unsubstituted (C1-C10)alkyl, or an unsubstituted (C6-C20)aryl; R₁₀ and R₁₁, each independently, represent a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted (5- to 20-membered)heteroaryl; and l, m, and n, each independently, represent 0 or 1.

[Claim 5]

The organic electroluminescent compound according to claim 1, wherein

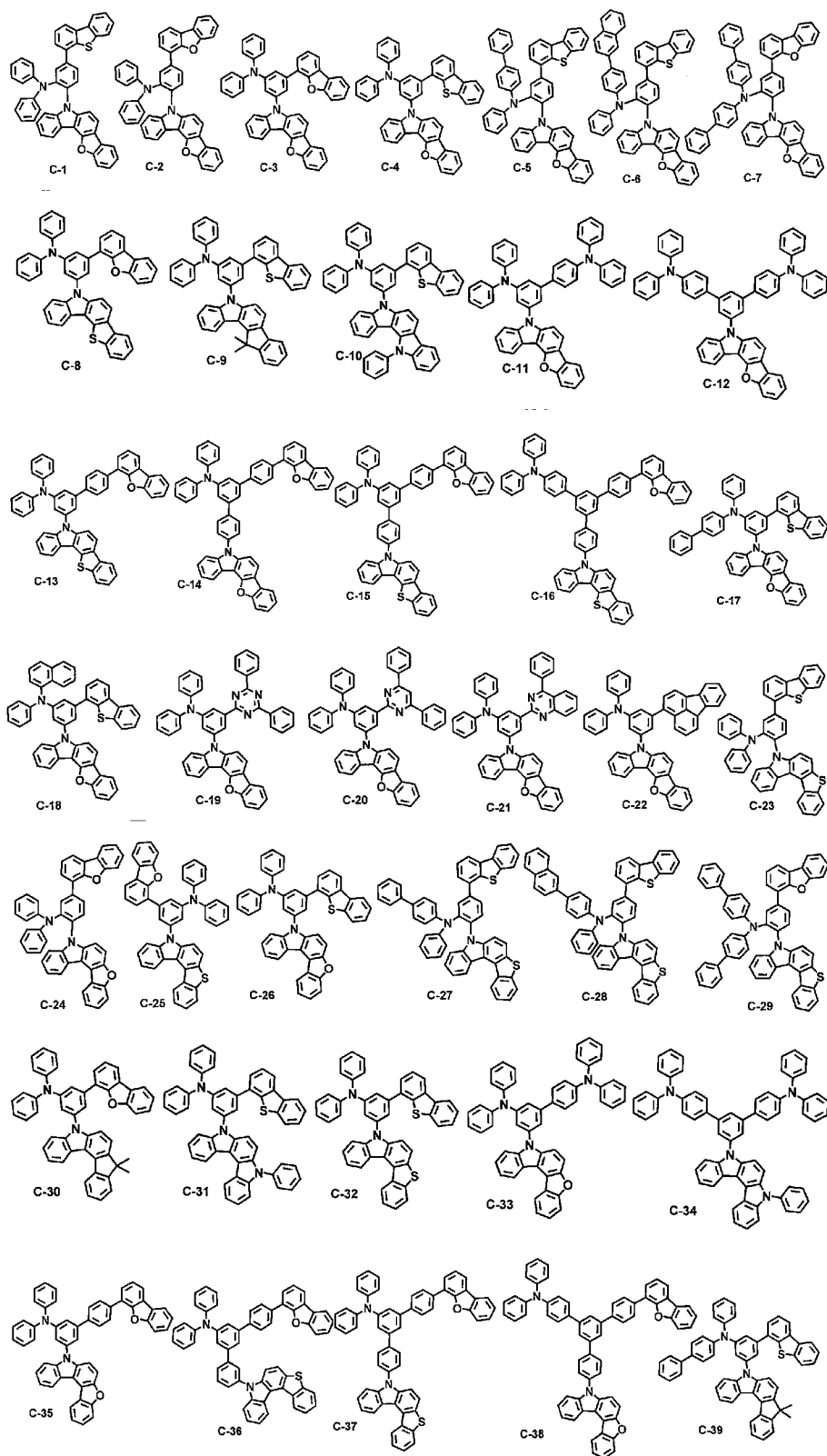
X₁ and X₂, each independently, represent CR₄; Y represents -O-, -S-, -C(R₅)(R₆)-, -Si(R₇)(R₈)-, or -N(R₉)-; L₁ to L₃, each independently, represent a single bond, or an unsubstituted (C6-C15)arylene; Ar₁ represents a substituted or unsubstituted (C6-C20)aryl, a substituted or unsubstituted (5- to 20-membered)heteroaryl, or -NR₁₀R₁₁; Ar₂ and Ar₃, each independently, represent a substituted or unsubstituted (C6-C20)aryl; R₁ to R₃, each independently, represent hydrogen, or are linked to an adjacent substituent(s) to form a (3- to 15-membered) monocyclic aromatic ring; R₄ represents hydrogen; R₅ to R₉, and R₁₂ to R₁₆, each independently, represent an unsubstituted (C1-C6)alkyl, or an unsubstituted (C6-C15)aryl; R₁₀ and R₁₁, each independently, represent a substituted or unsubstituted (C6-C18)aryl; and l, m, and n, each independently, represent 0 or 1.

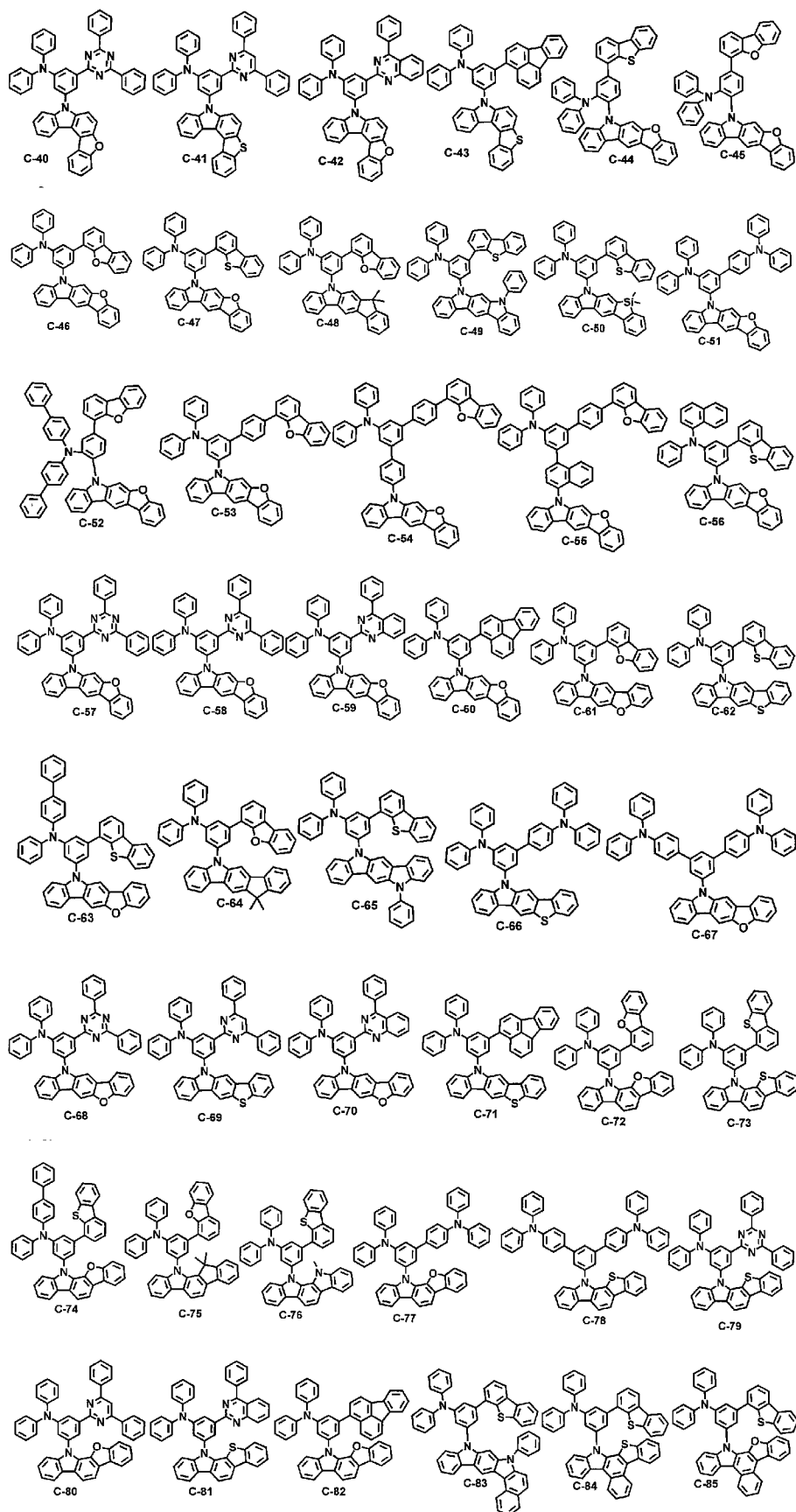
[Claim 6]

The organic electroluminescent compound according to claim 1, wherein the heteroaryl in the definitions of the groups of formula 1 is pyrrolyl, imidazolyl, triazinyl, tetrazinyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, dibenzofuranyl, dibenzothiophenyl, benzoimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, quinazolinyl, quinoxalinyl, carbazolyl, phenoxazinyl, or phenanthridinyl.

[Claim 7]

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





[Claim 8]

An organic electroluminescent device comprising the organic electrolu-

minescent compound according to claim 1.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2014/004963

A. CLASSIFICATION OF SUBJECT MATTER

C07D 491/048 (2006.01) C07D 495/04 (2006.01) C07D 487/04 (2006.01) C07D 409/10 (2006.01) C09K 11/06 (2006.01)
H01L 51/54 (2006.01) H01L 27/32 (2006.01)

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)

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

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

Chemical Abstracts, CAPLUS: Structure search based on claim 1, limited to a generalisation of exemplified compounds as defined in claim 7.

Esp@cenet: search based on Applicant and Inventor names.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



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	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
30 July 2014

Date of mailing of the international search report
30 July 2014

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Telephone No. 0262832424

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/KR2014/004963
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 2011-0110508 A (SFC LTD) 07 October 2011 & Chemical Abstracts Accession No. 2014:1093882 page 22, compound 102; Chemical Abstracts abstract.	1-3, 6, 8
E	WO 2014/098518 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD) 07 October 2011 paragraph [0014]; claims 4, 6	1-6, 8

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/KR2014/004963
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.		
Patent Document/s Cited in Search Report		Patent Family Member/s
Publication Number	Publication Date	Publication Number
KR 2011-0110508 A	07 October 2011	None
WO 2014/098518 A1	07 October 2011	None
End of Annex		
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)		