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(54) Title: ORGANIC ELECTROLUMINESCENT DEVICE

(57) Abstract: The present disclosure relates to an organic electroluminescent device. The organic electroluminescent device of the present disclosure can provide an excellent lifespan characteristic by comprising a specific combination of a host compound and a hole transport material.



WO 2018/097618 A1

Description

Title of Invention: ORGANIC ELECTROLUMINESCENT DEVICE

Technical Field

- [1] The present disclosure relates to an organic electroluminescent device.

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 EL device (OLED) changes electric energy into light by applying electricity to an organic light-emitting material, and commonly comprises an anode, a cathode, and a medium layer formed between the two electrodes. The medium layer of the organic EL device may comprise a hole injection layer, a hole transport layer, an electron blocking layer, a light-emitting layer, an electron buffer layer, a hole blocking layer, an electron transport layer, an electron injection layer, etc. The materials used in the medium layer are classified into a hole injection material, a hole transport 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 functions. In the organic EL device, holes from an anode and electrons from a cathode are injected into a light-emitting layer by the application of electric voltage, and an exciton having high energy is 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 selection of a compound comprised in the hole transport layer is known as a method for improving the characteristics of a device such as hole transport efficiency to the light-emitting layer, luminous efficiency, lifespan, etc. 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 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. A light-emitting material can be used as a combination of a host and a dopant to improve color purity,

luminous efficiency, and stability. Generally, an EL device having excellent characteristics has a structure comprising a light-emitting layer formed by doping a dopant to a host. Since host materials greatly influence the efficiency and lifespan of the EL device when using a dopant/host material system as a light-emitting material, their selection is important.

- [5] Japanese Patent No. 3670707 and Korean Appln. Laying-Open No. 2013-0099098 disclose a spirobifluorene substituted with a diarylamine as an organic electroluminescent compound such as a hole transport material, and Korean Patent No. 1477614 discloses a compound wherein a benzene ring is fused to one of the two carbazoles of a biscarbazole structure, and a nitrogen-containing heteroaryl is bonded to one of the two nitrogen atoms, as a light-emitting layer material. In addition, Korean Appln. Laying-Open No. 2014-0104895 discloses a spirobifluorene fused with a benzothiophene, etc., substituted with a diarylamine as a hole transport material. However, these references do not specifically disclose applying to an organic electroluminescent device a combination of a spirobifluorene fused with a benzothiophene, etc., substituted with a diarylamine, and a compound wherein a benzene ring is fused to one of the two carbazoles of a biscarbazole structure and a nitrogen-containing heteroaryl is bonded to one of the two nitrogen atoms.

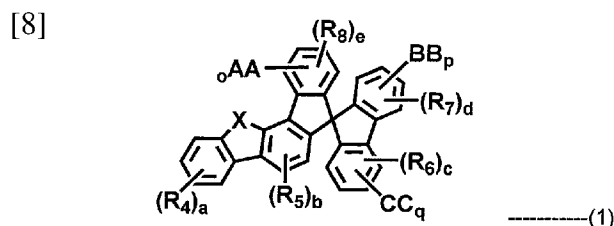
Disclosure of Invention

Technical Problem

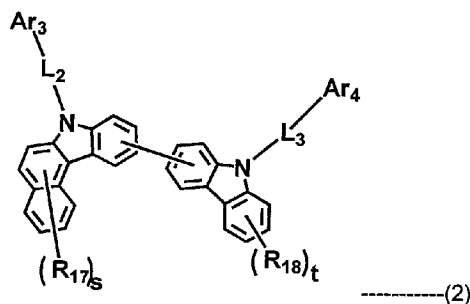
- [6] The objective of the present disclosure is to provide an organic electroluminescent device having an excellent lifespan characteristic by comprising a specific combination of compounds in a hole transport zone and a light-emitting layer.

Solution to Problem

- [7] The present inventors found that the problem can be solved by an organic electroluminescent device comprising: a first electrode; a second electrode opposing the first electrode; and a medium layer between the first electrode and the second electrode, wherein the medium layer comprises a hole transport zone of one or more layers, and one or more light-emitting layers, at least one layer of the hole transport zone comprises a compound represented by the following formula 1, and at least one layer of the light-emitting layers comprises a compound represented by the following formula 2:

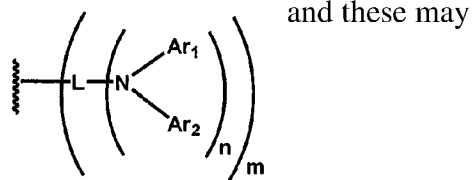


[9]



[10] wherein

[11] AA, BB, and CC each independently represent



be the same or different;

[12] L represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene;

[13] L₂ and L₃ each independently represent a single bond, or a substituted or unsubstituted (C6-C30)arylene;[14] Ar₁ to Ar₄ each independently represent a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl; and Ar₁ and Ar₂ may be linked to each other to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;[15] X represents -O-, -S-, -C(R₁)(R₂)-, or -N(R₃)-;[16] R₁ to R₃ each independently represent hydrogen, deuterium, a halogen, a cyano, a carboxyl, a nitro, a hydroxyl, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C3-C30)cycloalkenyl, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl; and R₁ and R₂ may be linked to each other to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;[17] R₄ to R₈, R₁₇, and R₁₈ each independently represent hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C2-C30)alkynyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, a sub-

stituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, 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 mono- or di-(C1-C30)alkylamino, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino; or are linked to an adjacent substituent(s) to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

- [18] a, c, d, e, and t each independently represent an integer of 1 to 4;
- [19] b, m, and n each independently represent 1 or 2;
- [20] o, p, and q each independently represent 0 or 1;
- [21] s represents an integer of 1 to 6;
- [22] c+q, d+p, and e+o are each independently 4;
- [23] where a, b, c, d, e, m, n, s, or t is an integer of 2 or more, each of R₄, each of R₅, each of R₆, each of R₇, each of R₈, each of [L-(NAr₁Ar₂)_n], each of (NAr₁Ar₂), each of R₁₇, or each of R₁₈ may be the same or different; and
- [24] the heteroaryl(ene) contains at least one hetero atom selected from B, N, O, S, Si, and P.

Advantageous Effects of Invention

- [25] According to the present disclosure, an organic electroluminescent device having an excellent lifespan characteristic can be provided, and it is possible to produce a display device or a lighting device using the same.

Mode for the Invention

- [26] Hereinafter, the present disclosure will be described in detail. However, the following description is intended to explain the disclosure, and is not meant in any way to restrict the scope of the disclosure.
- [27] 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 layer constituting an organic electroluminescent device, as necessary.
- [28] The term “organic electroluminescent material” in the present disclosure 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, an electron buffer material, a hole

blocking material, an electron transport material, or an electron injection material.

[29] Hereinafter, the organic electroluminescent device of the present disclosure will be described in detail.

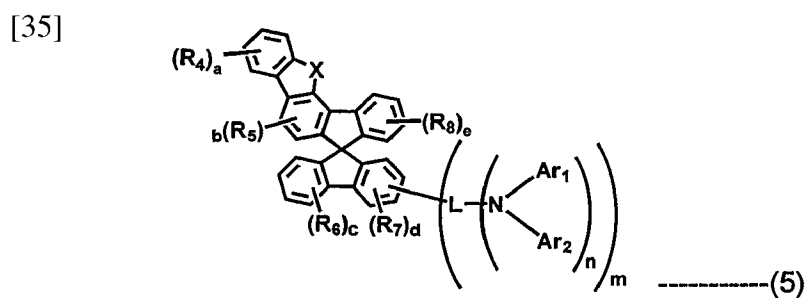
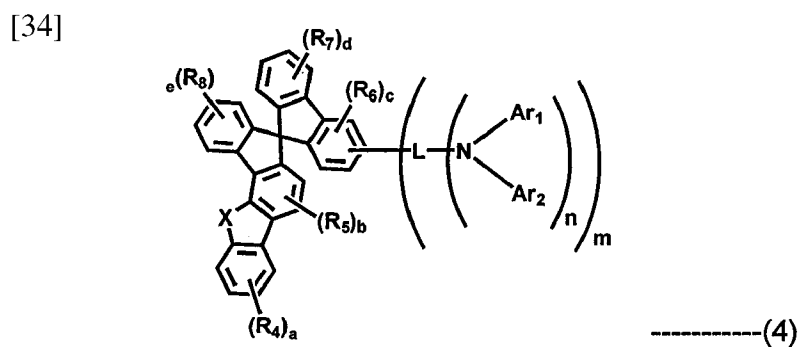
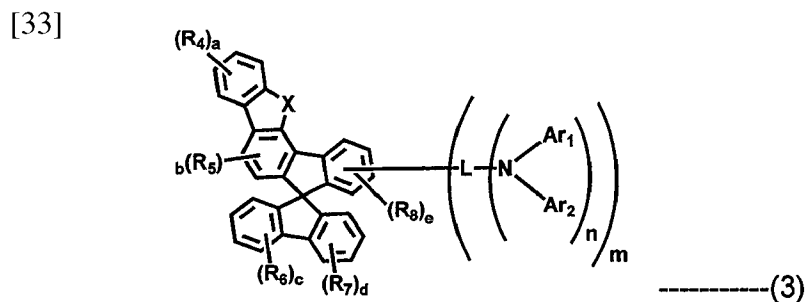
[30] Herein, “(C1-C30)alkyl” is meant to be a linear or branched alkyl having 1 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 1 to 10, more preferably 1 to 6, and includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, etc. “(C2-C30)alkenyl” is meant to be a linear or branched alkenyl having 2 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes vinyl, 1-propenyl, 2-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 2-methylbut-2-enyl, etc. “(C2-C30)alkynyl” is a linear or branched alkynyl having 2 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes ethynyl, 1-propynyl, 2-propynyl, 1-butyne, 2-butyne, 3-butyne, 1-methylpent-2-ynyl, 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, more preferably 3 to 7, and includes cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, etc. “(3- to 7-membered)heterocycloalkyl” is a cycloalkyl having at least one hetero atom selected from the group consisting of B, N, O, S, Si, and P, preferably O, S, and N, and 3 to 7 ring backbone atoms, and includes tetrahydrofuran, pyrrolidine, thiolan, tetrahydropyran, etc. “(C6-C30)aryl(ene)” is a monocyclic or fused ring-type radical derived from an aromatic hydrocarbon having 6 to 30 ring backbone carbon atoms, in which the number of ring backbone carbon atoms is preferably 6 to 20, more preferably 6 to 15, may be partially saturated, and includes phenyl, biphenyl, terphenyl, naphthyl, binaphthyl, phenylnaphthyl, naphthylphenyl, fluorenyl, phenylfluorenyl, benzofluorenyl, dibenzofluorenyl, phenanthrenyl, phenylphenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, etc. “(3- to 30-membered)heteroaryl(ene)” is an aryl group having at least one, preferably 1 to 4 hetero atoms selected from the group consisting of B, N, O, S, Si, and P, and 3 to 30 ring backbone atoms, in which the number of ring backbone atoms is preferably 3 to 20, more preferably 5 to 15; is 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 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, benzonaph-

thothiophenyl, benzimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, phenoxazinyl, phenanthridinyl, benzo[dioxolyl], etc. “Nitrogen-containing (5- to 30-membered)heteroaryl(ene)” is an aryl group having at least one hetero atom of N, preferably 1 to 4 hetero atoms, and 5 to 30 ring backbone atoms, in which the number of ring backbone atoms is preferably 5 to 20, more preferably 5 to 15; is 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 including pyrrolyl, imidazolyl, pyrazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., and a fused ring-type heteroaryl including benzimidazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, phenanthridinyl, etc. “Halogen” includes F, Cl, Br, and I.

- [31] Herein, “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 (C2-C30)alkynyl, the substituted (C3-C30)cycloalkyl, the substituted (C3-C30)cycloalkenyl, the substituted (3- to 7-membered)heterocycloalkyl, the substituted (C6-C30)aryl(ene), the substituted (3- to 30-membered)heteroaryl(ene), the substituted tri(C1-C30)alkylsilyl, the substituted tri(C6-C30)arylsilyl, the substituted di(C1-C30)alkyl(C6-C30)arylsilyl, the substituted (C1-C30)alkyldi(C6-C30)arylsilyl, the substituted mono- or di- (C1-C30)alkylamino, the substituted mono- or di- (C6-C30)arylamino, and the substituted mono- or polycyclic, (C3-C30) alicyclic, aromatic ring, or a combination thereof in L, L₂, L₃, Ar₁ to Ar₄, R₁ to R₈, R₁₇, and R₁₈ each independently are selected from the group consisting of deuterium, a halogen, a cyano, a carboxyl, a nitro, a hydroxyl, a (C1-C30)alkyl, a halo(C1-C30)alkyl, a (C2-C30)alkenyl, a (C2-C30)alkynyl, a (C1-C30)alkoxy, a (C1-C30)alkylthio, a (C3-C30)cycloalkyl, a (C3-C30)cycloalkenyl, a (3- to 7-membered)heterocycloalkyl, a (C6-C30)aryloxy, a (C6-C30)arylthio, a (5- to 30-membered)heteroaryl unsubstituted or substituted with a (C6-C30)aryl, a (C6-C30)aryl unsubstituted or substituted with a (5- to 30-membered)heteroaryl, 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, an amino, a mono- or di- (C1-C30)alkylamino, a mono- or di- (C6-C30)arylamino unsubstituted or substituted with a (C1-C30)alkyl, a (C1-C30)alkyl(C6-C30)arylamino, a (C1-C30)alkylcarbonyl, a (C1-C30)alkoxycarbonyl, a (C6-C30)arylcarbonyl, a di(C6-C30)arylboronyl, a di(C1-C30)alkylboronyl, a (C1-C30)alkyl(C6-C30)arylboronyl, a

(C6-C30)aryl(C1-C30)alkyl, and a (C1-C30)alkyl(C6-C30)aryl.

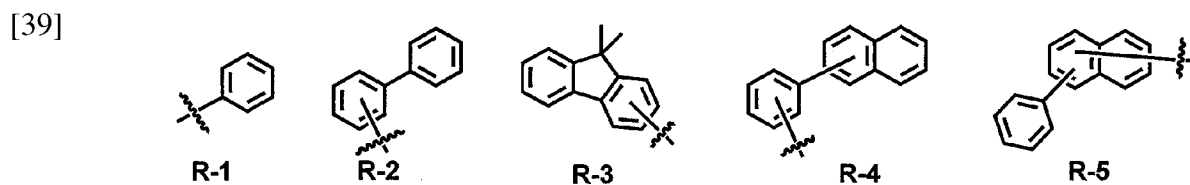
[32] According to one embodiment of the organic electroluminescent device of the present disclosure, formula 1 may be represented by any one of the following formulas 3 to 5:



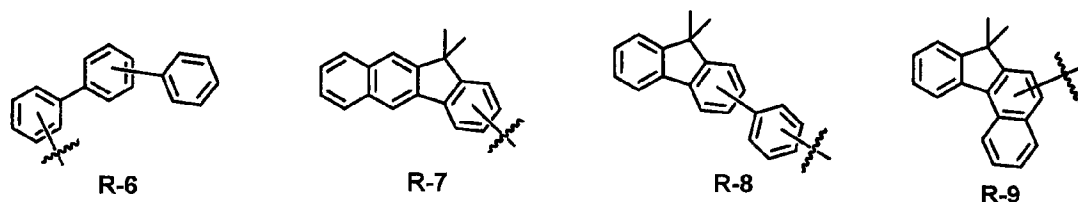
[36] wherein

[37] L, Ar₁, Ar₂, X, R₄ to R₈, a to e, m, and n are as defined in formula 1.

[38] In formulas 3 to 5, Ar₁ and Ar₂ may be each independently represented by any one of the following formulas R-1 to R-9:

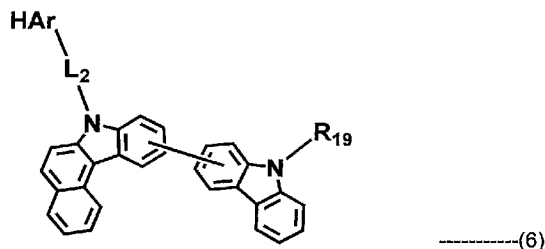


[40]

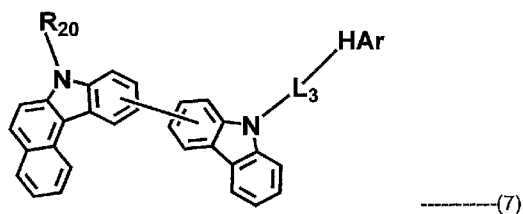


[41] According to one embodiment of the organic electroluminescent device of the present disclosure, formula 2 may be represented by formula 6 or 7:

[42]



[43]



[44] wherein

[45] HAr represents a substituted or unsubstituted nitrogen-containing (5- to 30-membered)heteroaryl; and

[46] L₂ and L₃ each independently represent a single bond, or a substituted or unsubstituted (C6-C30)arylene; and

[47] R₁₉ and R₂₀ each independently represent a substituted or unsubstituted (C6-C30)aryl.

[48] In formula 1 above, L represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene, preferably represents a single bond, or a substituted or unsubstituted (C6-C12)arylene, and more preferably represents a single bond, or an unsubstituted (C6-C12)arylene. Specifically, L may represent a single bond, a phenylene, a naphthylene, or a biphenylene.

[49] In formula 1 above, Ar₁ and Ar₂ each independently represent a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl; or may be linked to each other to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur, preferably each independently represent a substituted or unsubstituted (C6-C20)aryl, and more preferably each independently represent a (C6-C20)aryl unsubstituted or substituted with a (C1-C6)alkyl or a (C6-C12)aryl.

Specifically, Ar₁ and Ar₂ may each independently represent a phenyl, a naphthyl, a biphenyl, a phenylnaphthyl, a naphthylphenyl, a terphenyl, a anthracenyl, a phenanthrenyl, a di(C1-C6)alkylfluorenyl, a di(C6-C12)arylfluorenyl, a di(C1-C6)alkylbenzofluorenyl, or a di(C6-C12)arylbenzofluorenyl.

- [50] In formula 1 above, R₁ to R₃ each independently represent hydrogen, deuterium, a halogen, a cyano, a carboxyl, a nitro, a hydroxyl, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C3-C30)cycloalkenyl, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl; and R₁ and R₂ may be linked to each other to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur, preferably each independently represent a substituted or unsubstituted (C1-C6)alkyl, or a substituted or unsubstituted (C6-C12)aryl, and more preferably each independently represent an unsubstituted (C1-C6)alkyl, or an unsubstituted (C6-C12)aryl. Specifically, R₁ to R₃ may each independently represent a methyl or a phenyl.

- [51] In formula 1 above, R₄ to R₈ each independently represent hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C2-C30)alkynyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, 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 mono- or di-(C1-C30)alkylamino, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino; or are linked to an adjacent substituent(s) to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur, and preferably each independently represent hydrogen.

- [52] In formula 2 above, L₂ and L₃ each independently represent a single bond, or a substituted or unsubstituted (C6-C30)arylene, preferably each independently represent a single bond, or a substituted or unsubstituted (C6-C12)arylene, and more preferably each independently represent a single bond, or an unsubstituted (C6-C12)arylene. Specifically, L₂ and L₃ may each independently represent a single bond, a phenylene, a naphthylene, or a biphenylene.

- [53] In formula 2 above, Ar₃ and Ar₄ each independently represent a substituted or unsub-

stituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl, preferably each independently represent a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted nitrogen-containing (5- to 30-membered)heteroaryl, and more preferably each independently represent a (C6-C20)aryl unsubstituted or substituted with a (C1-C6)alkyl or a (C6-C12)aryl; or a nitrogen-containing (5- to 15-membered)heteroaryl substituted with a (5- to 20-membered)heteroaryl unsubstituted or substituted with a (C6-C20)aryl, a (C1-C6)alkyl(C6-C20)aryl, or a (C6-C12)aryl. Specifically, Ar₃ and Ar₄ may each independently represent a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted naphthylphenyl, a substituted or unsubstituted phenylnaphthyl, a substituted or unsubstituted terphenyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted phenanthrenyl, a substituted or unsubstituted fluorenyl, a substituted or unsubstituted quinazolinyl, or a substituted or unsubstituted quinoxalinyl.

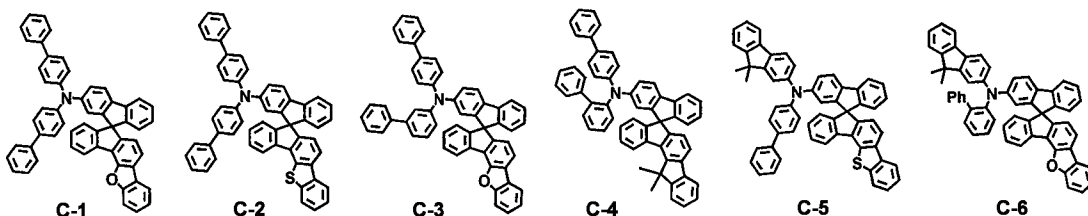
[54] In formula 2 above, R₁₇ and R₁₈ each independently represent hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C2-C30)alkynyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, 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 mono- or di-(C1-C30)alkylamino, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino; or are linked to an adjacent substituent(s) to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur, preferably each independently represent hydrogen, or a substituted or unsubstituted (C6-C12)aryl, and more preferably each independently represent hydrogen, or an unsubstituted (C6-C12)aryl. Specifically, R₁₇ and R₁₈ may each independently represent hydrogen or phenyl.

[55] In formulas 6 and 7 above, HAr may specifically represent a quinazolinyl substituted with phenyl, a quinazolinyl substituted with di(C1-C6)alkylphenyl, a quinazolinyl substituted with naphthylphenyl, a quinazolinyl substituted with phenylnaphthyl, a quinazolinyl substituted with terphenyl, a quinazolinyl substituted with anthracenyl, a quinazolinyl substituted with phenanthrenyl, a quinazolinyl substituted with biphenyl, a quinazolinyl substituted with di(C1-C6)alkylfluorenyl, a quinazolinyl substituted with phenylcarbazolyl, a quinoxalinyl substituted with phenyl, a quinoxalinyl substituted with naphthylphenyl, a quinoxalinyl substituted with phenylnaphthyl, a quinoxalinyl substituted with terphenyl, a quinoxalinyl substituted with anthracenyl, a

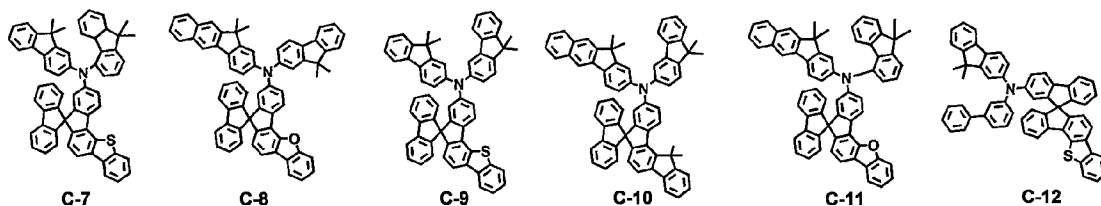
quinoxaliny1 substituted with phenanthrenyl, a quinoxaliny1 substituted with biphenyl, a quinoxaliny1 substituted with di(C1-C6)alkylfluoreny1, or a quinoxaliny1 substituted with phenylcarbazoly1. In addition, R₁₉ and R₂₀ may specifically each independently represent a phenyl, a naphthyl, a biphenyl, a naphthylphenyl, a phenylnaphthyl, a terphenyl, an anthraceny1, a phenanthrenyl, or a di(C1-C6)alkylfluoreny1.

[56] The compound represented by formula 1 includes the following compounds, but is not limited thereto:

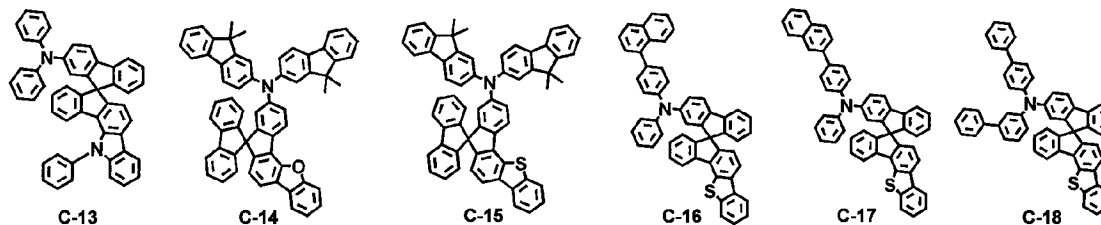
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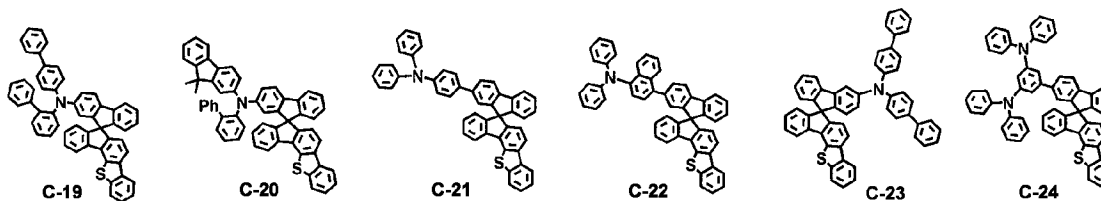
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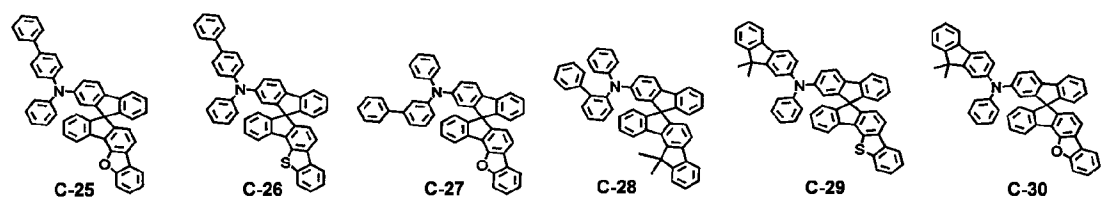
[59]



[60]

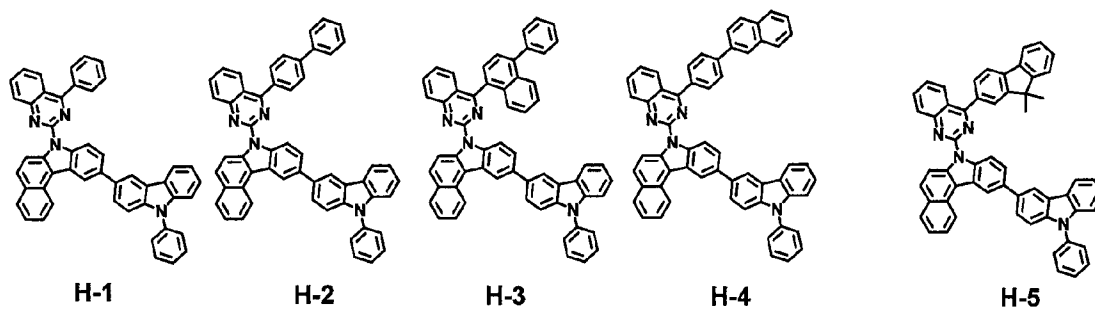


[61]

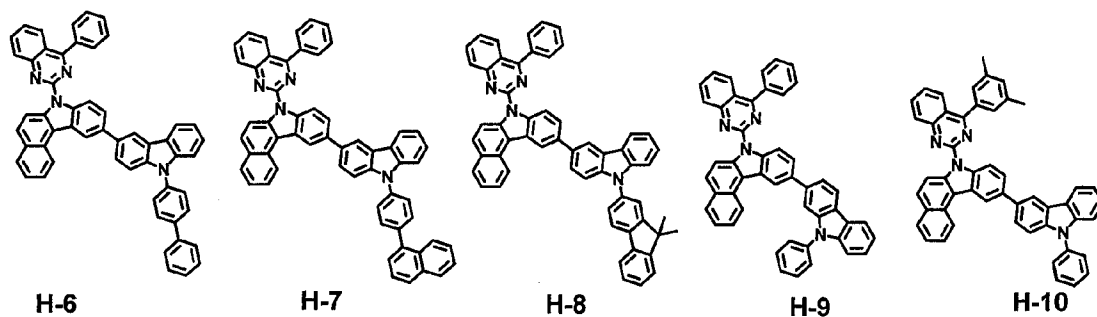


[62] The compound represented by formula 2 includes the following compounds, but is not limited thereto:

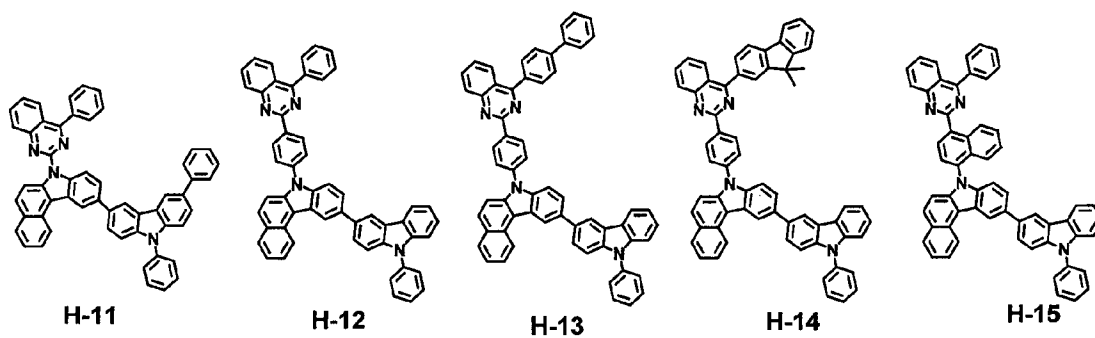
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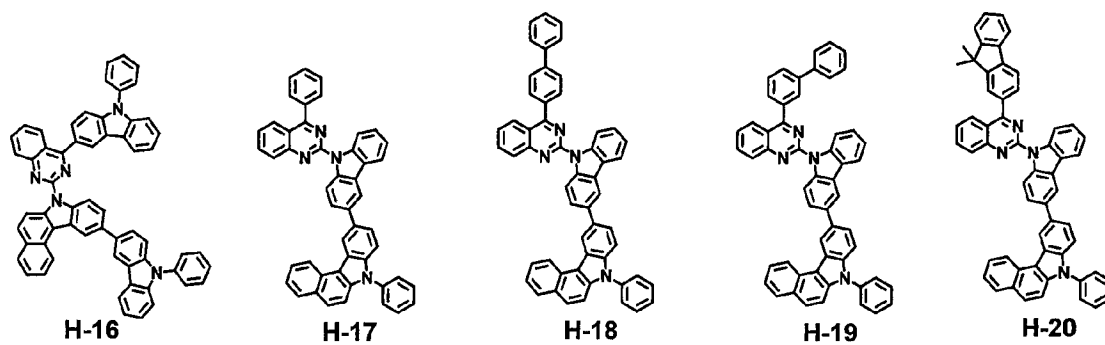
[64]



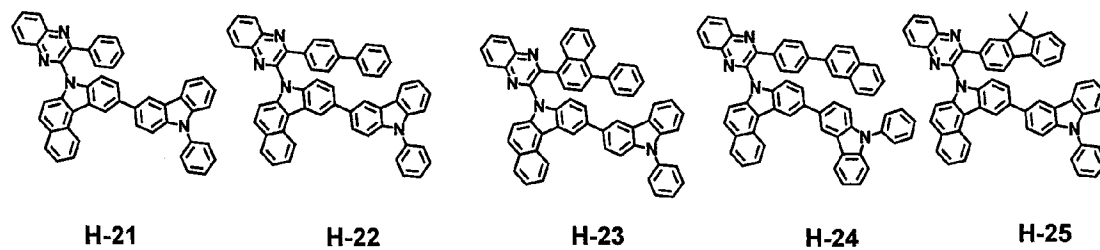
[65]



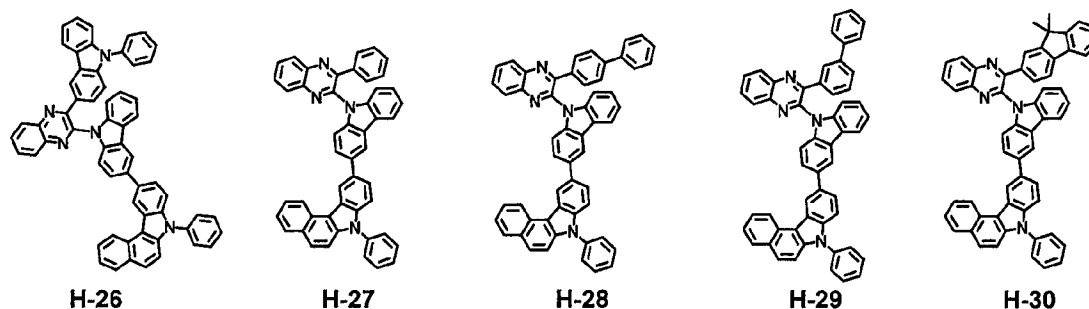
[66]



[67]



[68]



[69] The compounds of formulas 1 and 2 of the present disclosure can be prepared by a synthetic method known to a person skilled in the art. For example, the compound of formula 1 can be prepared by referring to Korean Appln. Laying-Open No. 2014-0104895 (2014.08.29), etc., and the compound of formula 2 can be prepared by referring to Korean Patent Nos. 1477614 (2014.12.31), 1712808 (2017.03.08), etc.

[70] The organic electroluminescent device according to one embodiment of the present disclosure may comprise a first electrode; a second electrode opposing the first electrode; and a medium layer between the first electrode and the second electrode, wherein the medium layer comprises a hole transport zone of one or more layers, and one or more light-emitting layers, at least one layer of the hole transport zone comprises a compound represented by formula 1, and at least one layer of the light-emitting layers comprises a compound represented by formula 2.

[71] According to one embodiment of the present disclosure, compounds of formulas 1 and 2 may be comprised in the same layer or may be each comprised in different layers of the organic electroluminescent device. The compound of formula 1 may be comprised in the hole transport zone and the compound of formula 2 may be comprised in the light-emitting layer, and more specifically, the compound of formula 1 may be comprised in the hole transport layer and the compound of formula 2 may be comprised in the light-emitting layer as a host compound, for example, but not limited thereto.

[72] In addition to the light-emitting layer and the hole transport zone, the medium layer may further comprise at least one layer selected from an electron transport layer, an electron buffer layer, an electron injection layer, an interlayer, and a hole blocking layer.

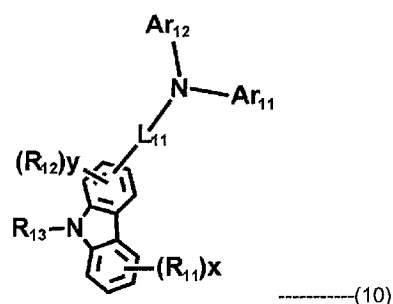
[73] The hole transport zone of the present disclosure may consist of at least one layer selected from the group consisting of a hole transport layer, a hole injection layer, an electron blocking layer, and a hole auxiliary layer, and each layer may consist of one or more layers.

[74] According to one embodiment of the present disclosure, the hole transport zone comprises a hole transport layer. Herein, the hole transport layer may comprise the

compound represented by formula 1.

- [75] According to another embodiment of the present disclosure, the hole transport zone comprises a hole transport layer, and may further comprise at least one layer of a hole injection layer, an electron blocking layer, and a hole auxiliary layer. Herein, at least one layer of the hole transport layer, the hole injection layer, the electron blocking layer, and the hole auxiliary layer may comprise the compound represented by formula 1.
- [76] 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 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 electron transport, or for preventing the overflow of holes. Also, 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 hole injection rate), thereby enabling the charge balance to be controlled. Further, 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. When an organic electroluminescent device includes two or more hole transport layers, the hole transport layer, which is further included, may be used as a hole auxiliary layer or an electron blocking layer. The hole auxiliary layer and the electron blocking layer may have an effect of improving the efficiency and/or the lifespan of the organic electroluminescent device.
- [77] According to another embodiment of the present disclosure, the hole transport zone may comprise a hole transport layer, a hole auxiliary layer, and an electron blocking layer, and the hole transport layer may consist of multi-layers of two or more layers. A hole transport material comprising the compound represented by formula 1 of the present disclosure may be comprised in at least one layer of the multi-layers. In the hole transport layer comprising the compound of formula 1, the other hole transport layer, the hole auxiliary layer, and the electron blocking layer, any compound used for the conventional hole transport material may be comprised. For example, a compound of the following formula 10 may be comprised.

[78]



[79] wherein

[80] L_{11} represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (5- to 30-membered)heteroarylene;[81] Ar_{11} and Ar_{12} each independently represent a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl, or Ar_{11} and L_{11} may form a nitrogen-containing (5- to 30-membered)heteroaryl with the bonded nitrogen;[82] R_{11} to R_{13} each independently represent hydrogen, deuterium, a halogen, a cyano, a carboxyl, a nitro, a hydroxyl, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C2-C30)alkynyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C3-C30)cycloalkenyl, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (5- to 30-membered)heteroaryl, $-NR_{41}R_{42}$, $-SiR_{43}R_{44}R_{45}$, $-SR_{46}$, $-OR_{47}$, $-COR_{48}$, or $-B(OR_{49})(OR_{50})$, or are linked to an adjacent substituent(s) to form a mono- or polycyclic, (3- to 30-membered) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;[83] R_{41} to R_{50} each independently represent hydrogen, deuterium, a halogen, a cyano, a carboxyl, a nitro, a hydroxyl, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C2-C30)alkynyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C3-C30)cycloalkenyl, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl, or are linked to an adjacent substituent(s) to form a mono- or polycyclic, (3- to 30-membered) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;[84] x represents an integer of 1 to 4, where x is an integer of 2 or more, each of R_{11} may

be the same or different;

[85] y represents an integer of 1 to 3, where y is an integer of 2 or more, each of R_{12} may be the same or different;

[86] the heteroaryl(ene) contains at least one hetero atom selected from B, N, O, S, Si, and P; and

[87] the heterocycloalkyl contains at least one hetero atom selected from O, S, and N.

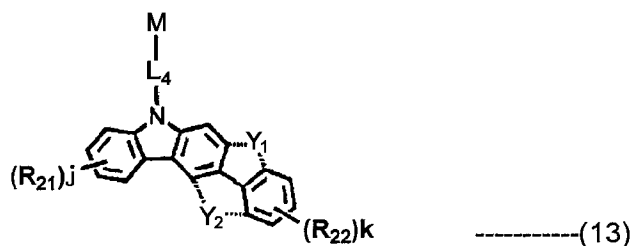
[88] The compound of formula 2 of the present disclosure may be comprised in the light-emitting layer. Where used in the light-emitting layer, the organic electroluminescent compound of formula 2 of the present disclosure can be comprised as a host material. Preferably, the light-emitting layer can further comprise one or more dopants. If necessary, the compound of formula 2 of the present disclosure can be used as a co-host material. That is, the light-emitting layer can additionally comprise a compound other than the organic electroluminescent compound of formula 2 of the present disclosure (first host material) as a second host material. Herein, the weight ratio of the first host material to the second host material is in the range of 1:99 to 99:1.

[89] The second host material can be any of the known phosphorescent hosts. The host selected from the group consisting of the compounds of formulas 11 to 16 below is preferable in terms of luminous efficiency.

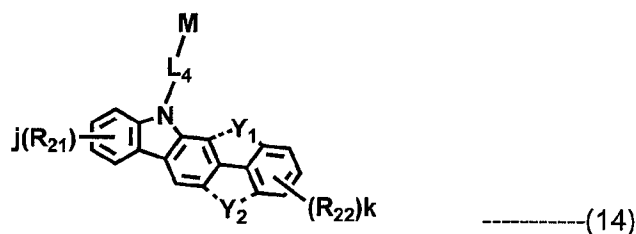
[90] $H-(Cz-L_4)_h-M$ -----(11)

[91] $H-(Cz)_i-L_4-M$ -----(12)

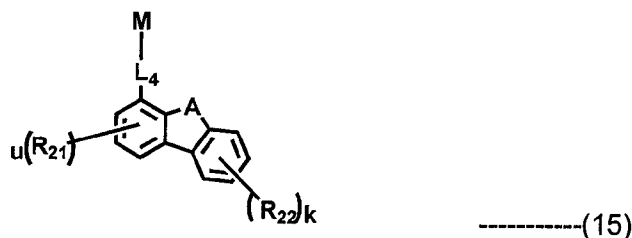
[92]



[93]



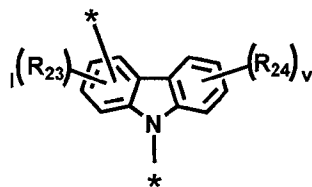
[94]



[95] wherein

[96] Cz represents the following structure:

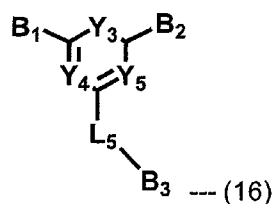
[97]



[98] A represents -O- or -S-; and

[99] 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 (5- to 30-membered)heteroaryl, or $-\text{Si}R_{25}R_{26}R_{27}$; in which 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-, $-\text{N}(R_{31})-$ or $-\text{C}(R_{32})(R_{33})-$, with the proviso that Y_1 and Y_2 are not present simultaneously; 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 , l , and v , each independently, represent an integer of 0 to 4; u represents an integer of 0 to 3; if h , i , j , k , l , u , or v represents an integer of 2 or more, each (Cz- L_4), each (Cz), each R_{21} , each R_{22} , each R_{23} , or each R_{24} may be the same or different;

[100]



[101] wherein

[102] Y_3 to Y_5 , each independently, represent CR_{34} or N;

[103] R_{34} represents hydrogen, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl;

[104] B_1 and B_2 , each independently, represent hydrogen, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl;

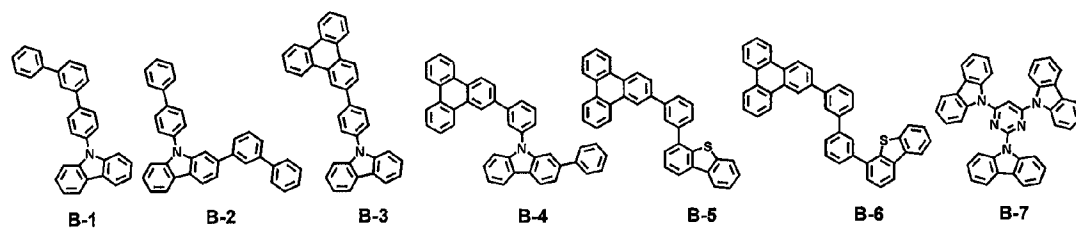
[105] B_3 represents a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl; and

[106] L_5 represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a sub-

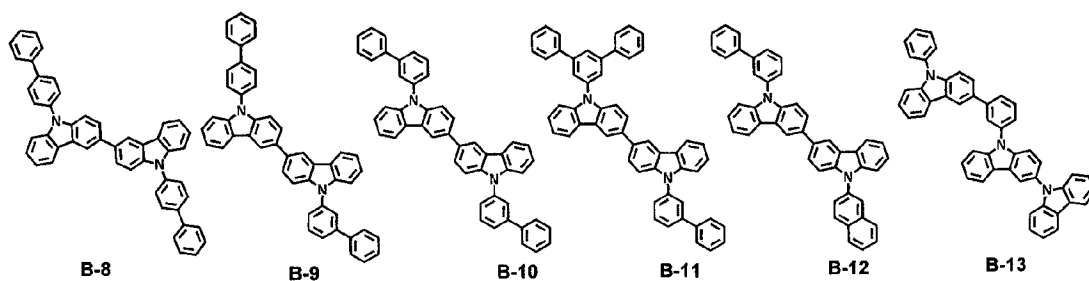
stituted or unsubstituted (5- to 30-membered)heteroarylene.

[107] Specifically, the preferable examples of the second host material are as follows, but are not limited thereto.

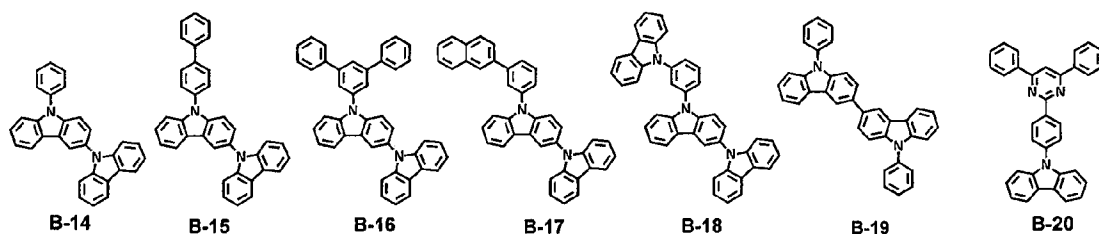
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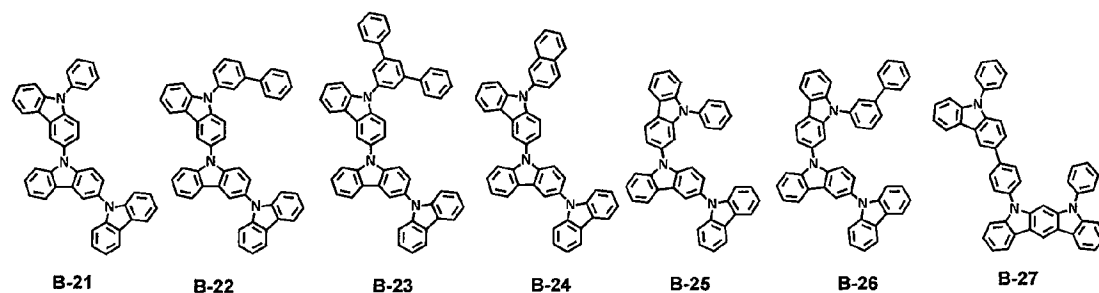
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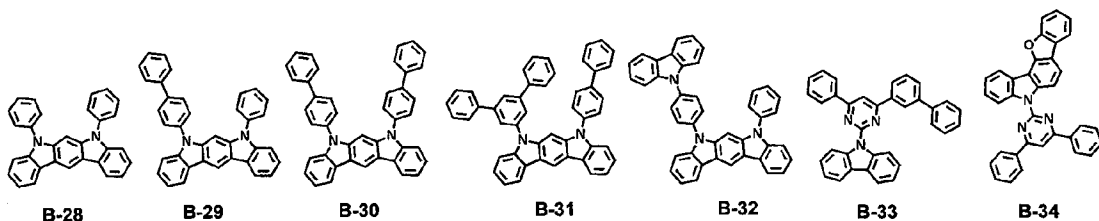
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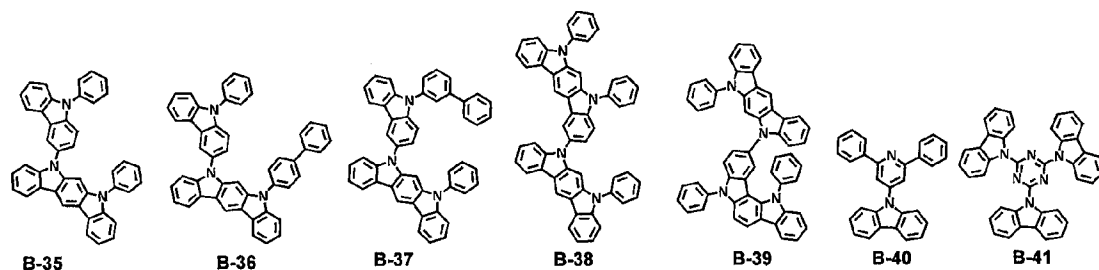
[111]



[112]



[113]



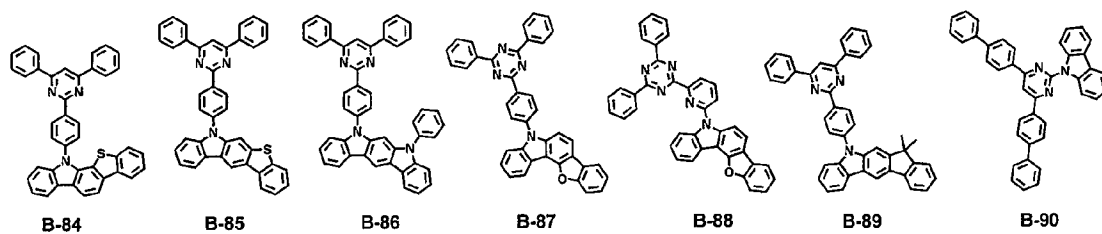
B-42 **B-43** **B-44** **B-45** **B-46** **B-47** **B-48**

B-49 **B-50** **B-51** **B-52** **B-53** **B-54** **B-55**

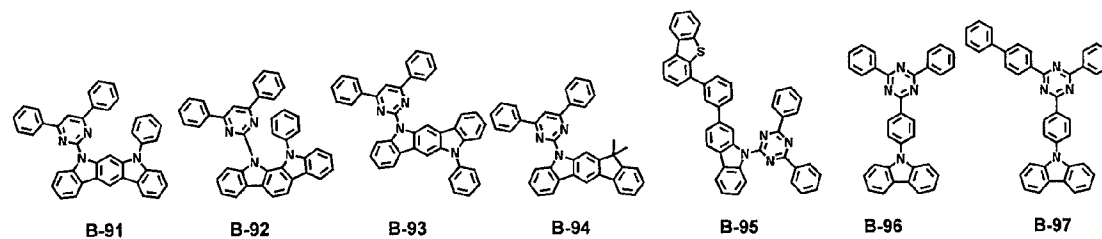
B-56 **B-57** **B-58** **B-59** **B-60** **B-61** **B-62**

Chemical structures of compounds B-63 through B-69 are shown. B-63 to B-68 are linear or branched structures with indole and phenyl groups. B-69 is a branched structure with a triazole ring.

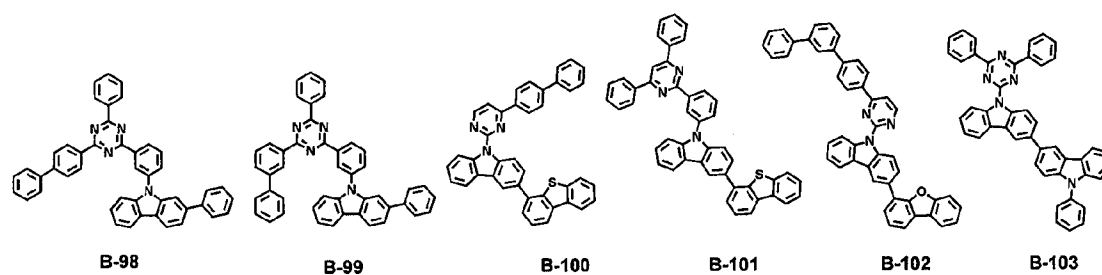
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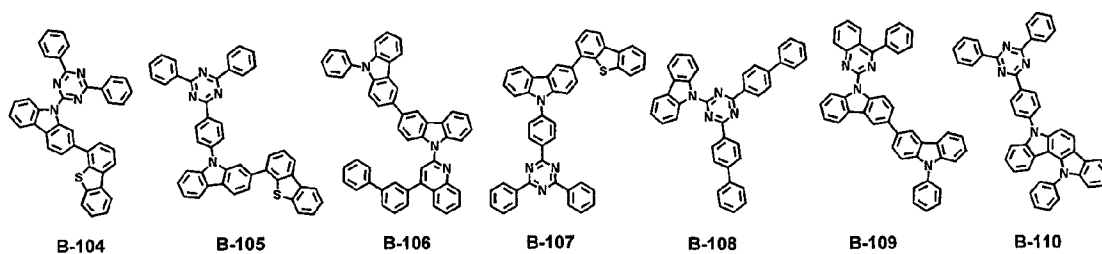
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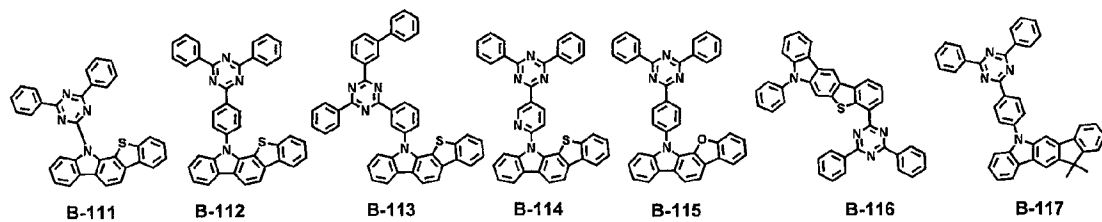
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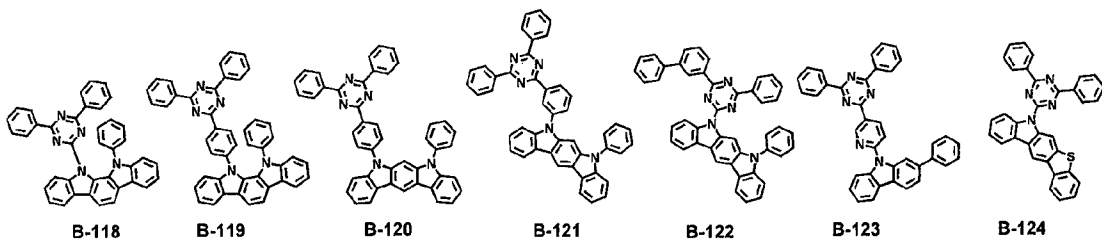
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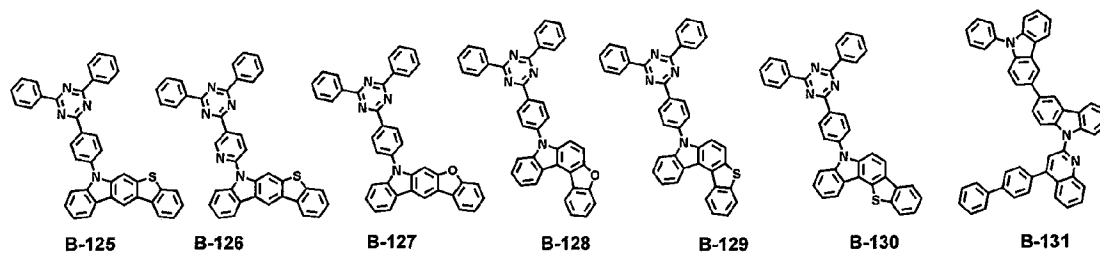
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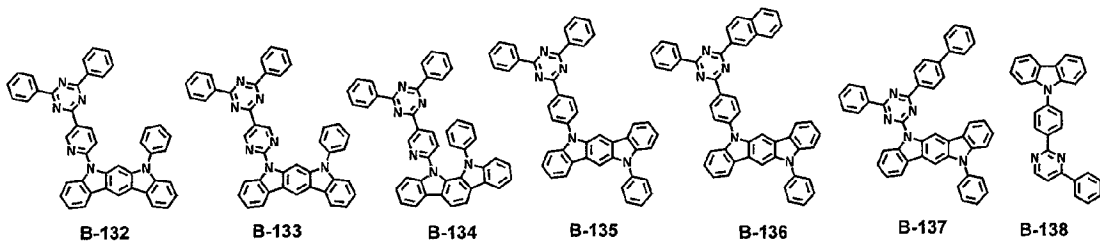
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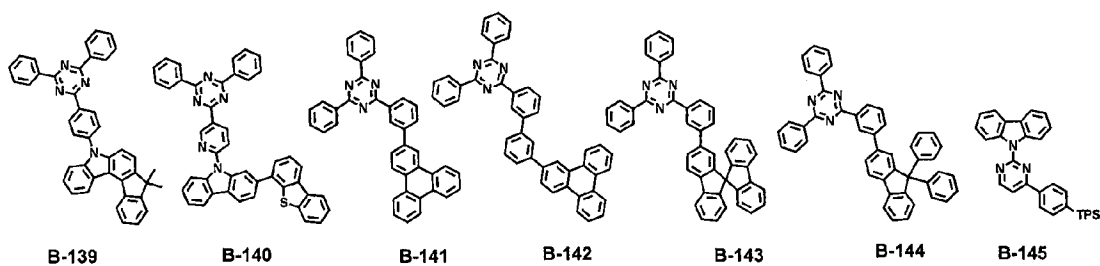
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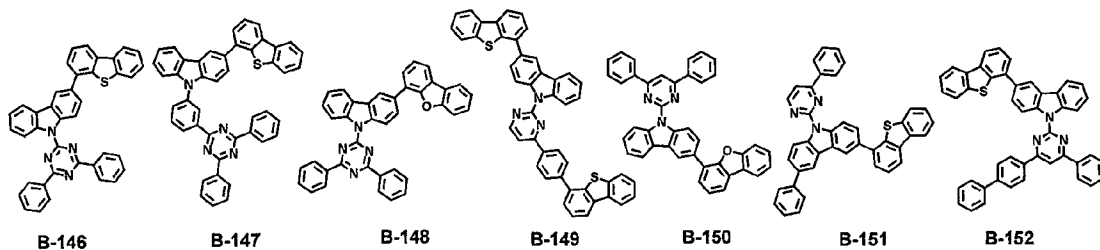
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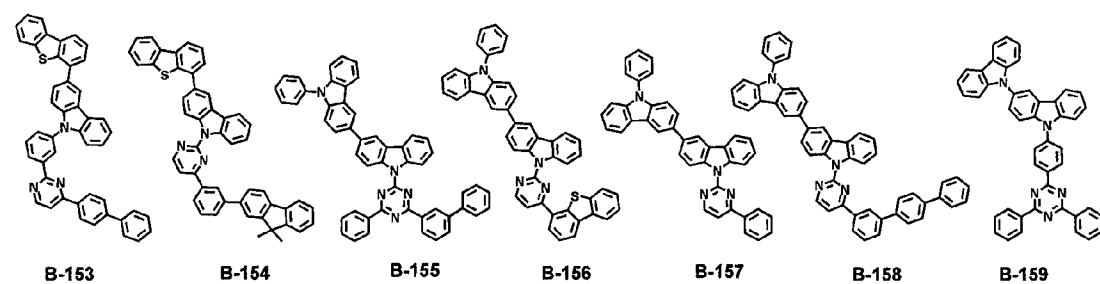
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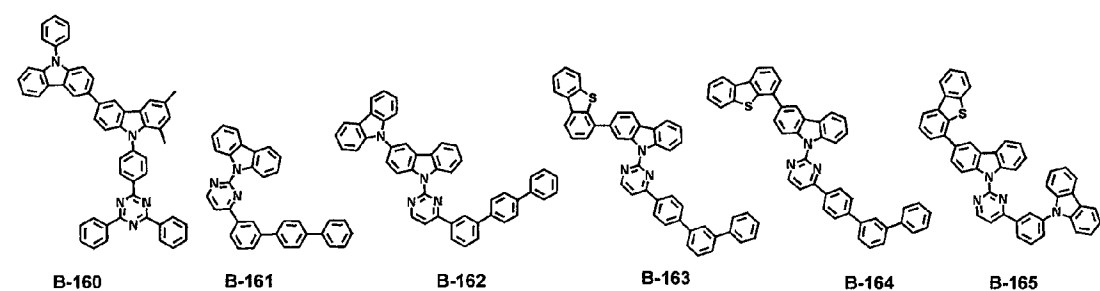
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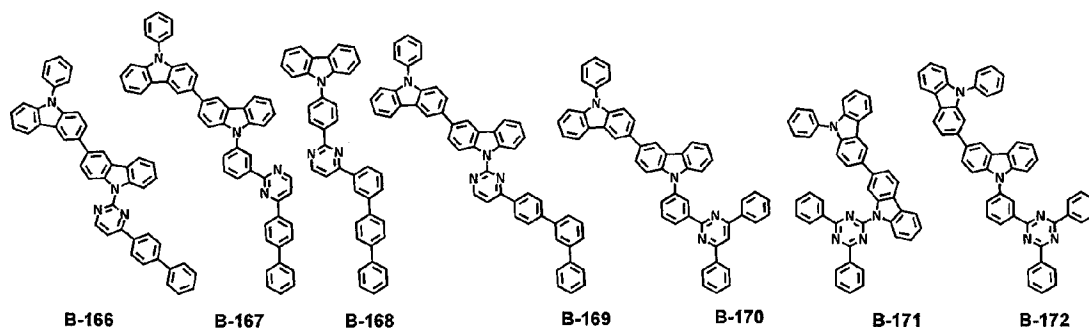
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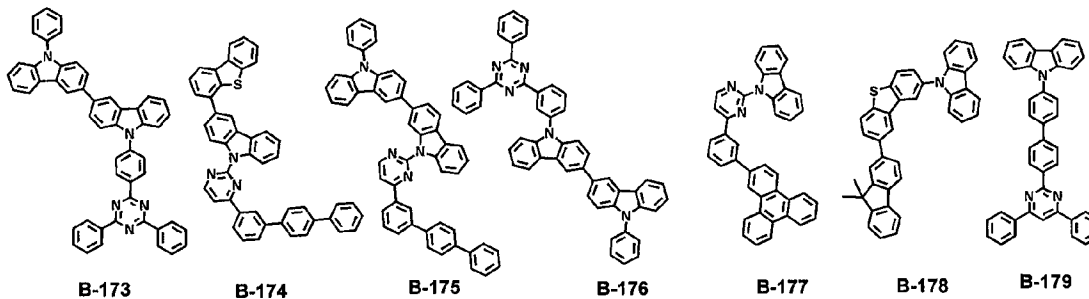
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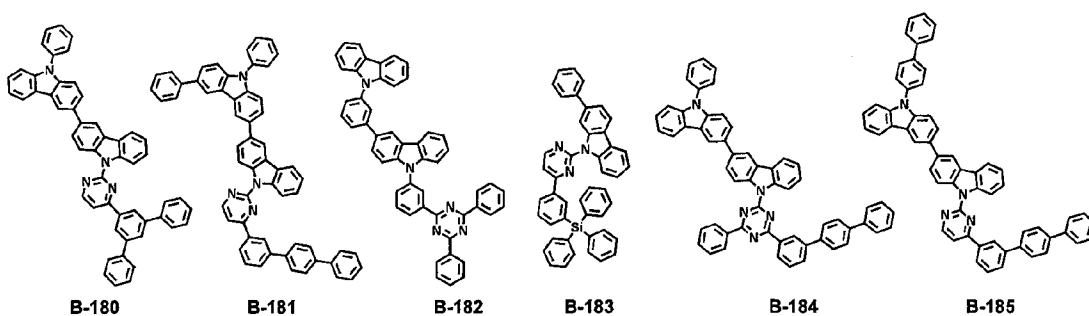
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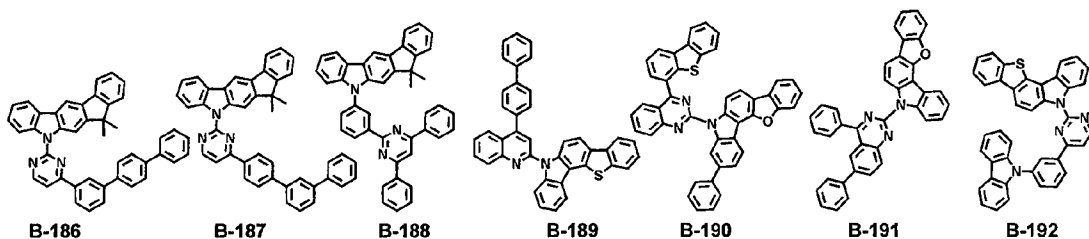
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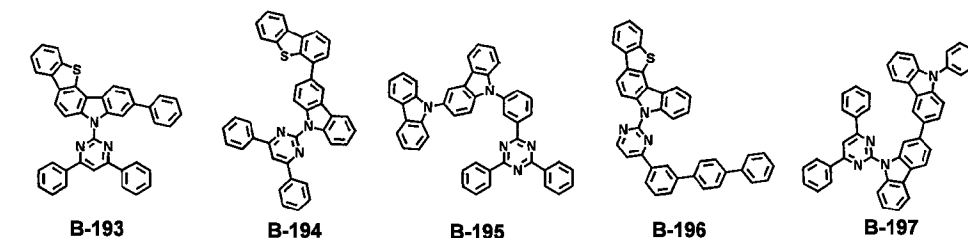
[134]



[135]



[136]



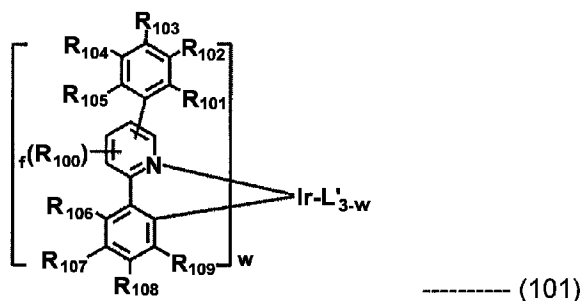
[137] [wherein TPS represents a triphenylsilyl group]

[138] The dopant comprised in the organic electroluminescent device according to the present disclosure is preferably at least one phosphorescent dopant. The phosphorescent dopant materials applied to the organic electroluminescent device according to the present disclosure are not particularly limited, but are preferably

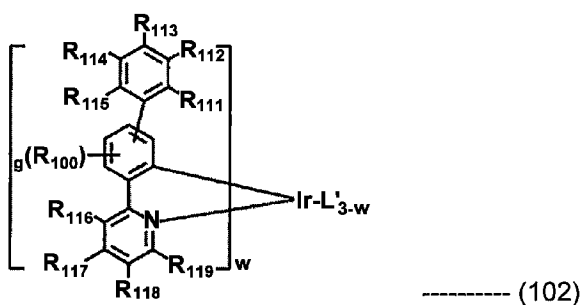
selected from metallated complex compounds of iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), are more preferably selected from ortho-metallated complex compounds of iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), and are even more preferably an ortho-metallated iridium complex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

[139] The dopant comprised in the organic electroluminescent device of the present disclosure may be selected from the group consisting of the compounds represented by formulas 101 to 104 below, but is not limited thereto.

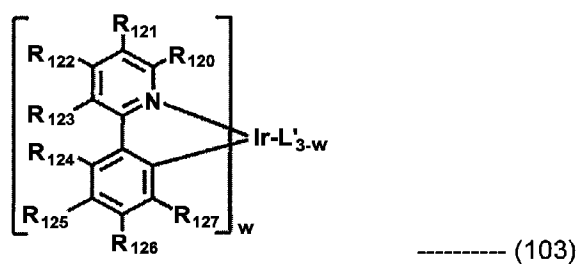
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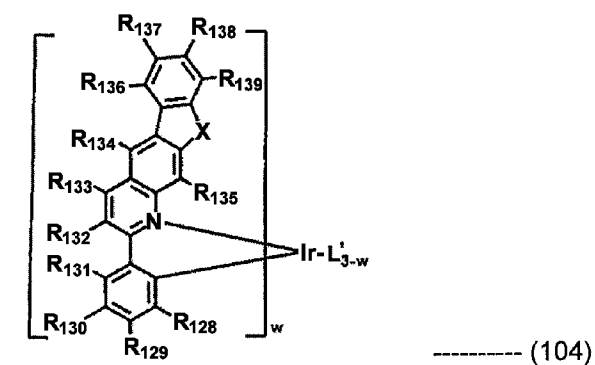
[141]



[142]

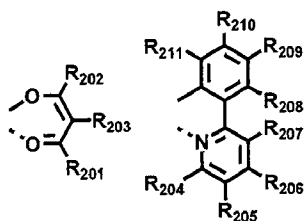


[143]



[144] wherein L' is selected from the following structures:

[145]



[146] R_{100} , R_{134} , and R_{135} , each independently, represent hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C3-C30)cycloalkyl;

[147] 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 deuterium or a halogen, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, a cyano, or a substituted or unsubstituted (C1-C30)alkoxy; adjacent substituents of R_{106} to R_{109} may be linked to each other to form a substituted or unsubstituted fused ring, e.g., a fluorene unsubstituted or substituted with an alkyl, a dibenzothiophene unsubstituted or substituted with an alkyl, or a dibenzofuran unsubstituted or substituted with an alkyl; and adjacent substituents of R_{120} to R_{123} may be linked to each other to form a substituted or unsubstituted fused ring, e.g., a quinoline unsubstituted or substituted with at least one of an alkyl, an aryl, an aralkyl, and an alkylaryl;

[148] R_{124} to R_{133} and R_{136} to R_{139} , each independently, represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C6-C30)aryl; and adjacent substituents of R_{124} to R_{127} may be linked to each other to form a substituted or unsubstituted fused ring, e.g., a fluorene unsubstituted or substituted with an alkyl, a dibenzothiophene unsubstituted or substituted with an alkyl, or a dibenzofuran unsubstituted or substituted with an alkyl;

[149] X represents $CR_{51}R_{52}$, O, or S;

[150] R_{51} and R_{52} , each independently, represent a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl;

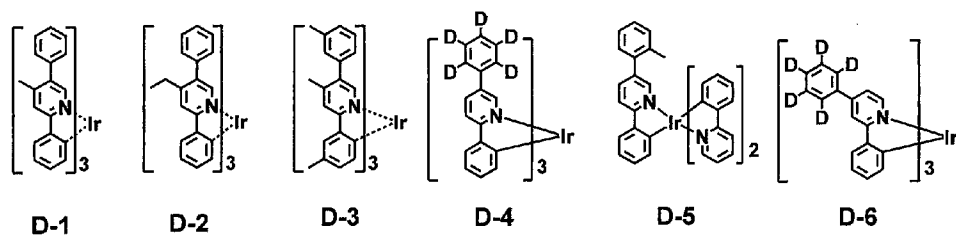
[151] R_{201} to R_{211} , each independently, represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl unsubstituted or substituted with deuterium or a halogen, a substituted or unsubstituted (C3-C30)cycloalkyl, or a (C6-C30)aryl unsubstituted or substituted with an alkyl or deuterium; and adjacent substituents of R_{208} to R_{211} may be linked to each other to form a substituted or unsubstituted fused ring, e.g., a fluorene unsubstituted or substituted with an alkyl, a dibenzothiophene unsubstituted or substituted with an alkyl, or a dibenzofuran unsubstituted or substituted with an alkyl;

[152] f and g, each independently, represent an integer of 1 to 3; where f or g is an integer of 2 or more, each R_{100} may be the same or different; and

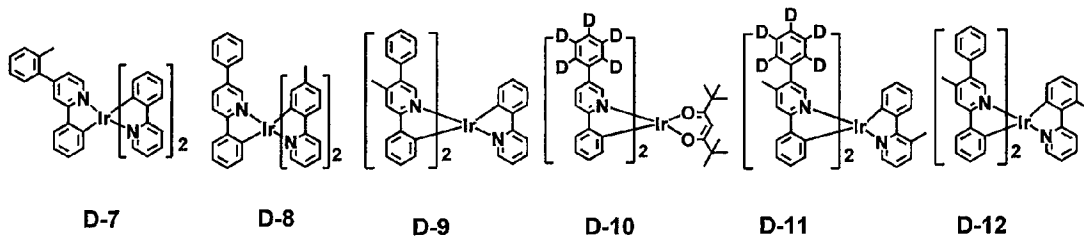
[153] w represents an integer of 1 to 3.

[154] The specific examples of the dopant compound are as follows, but are not limited thereto.

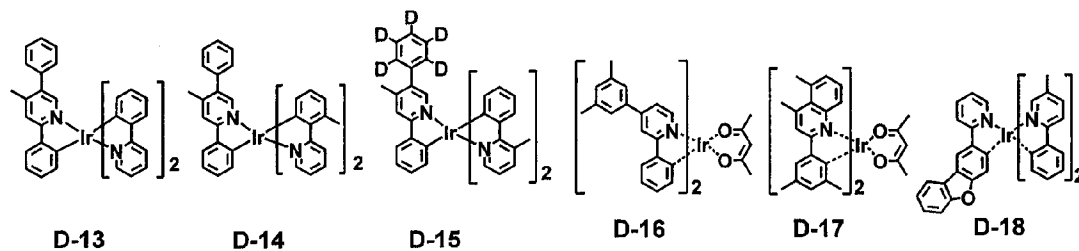
[155]



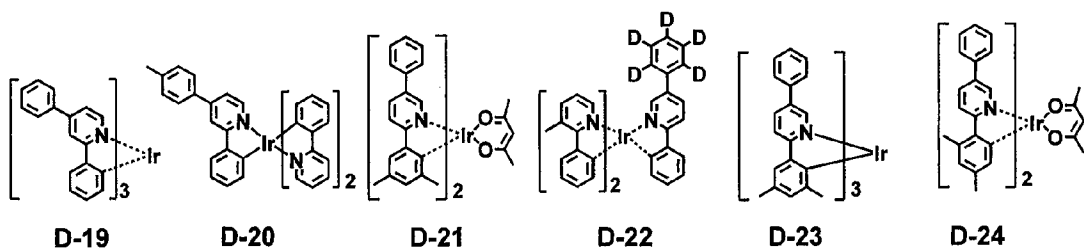
[156]



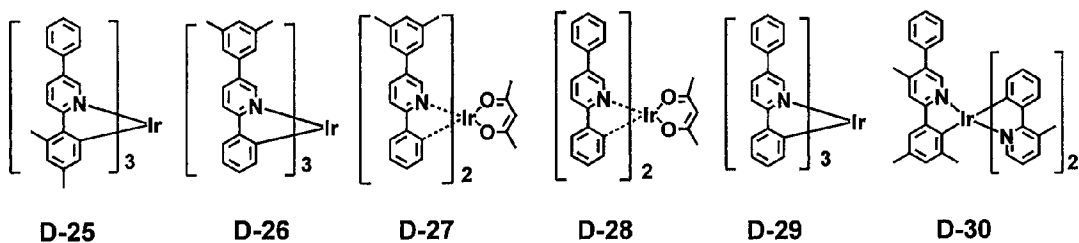
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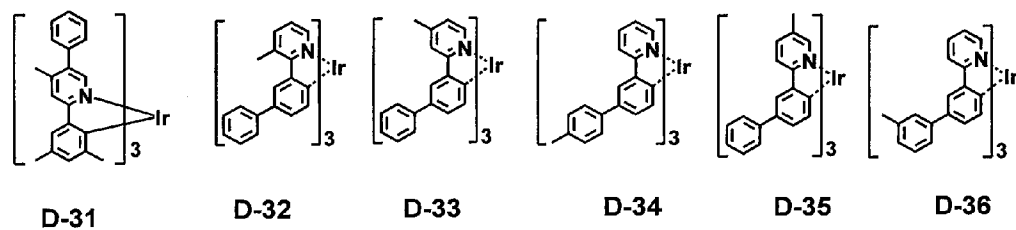
[158]



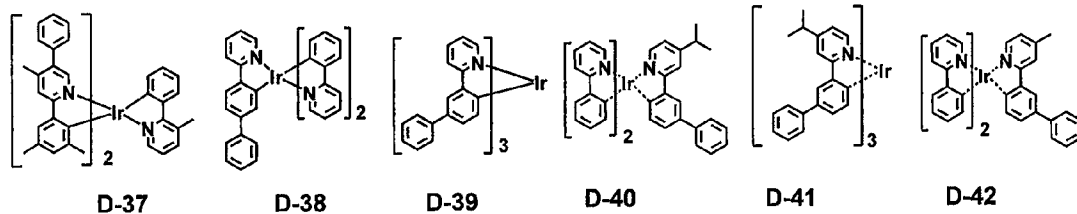
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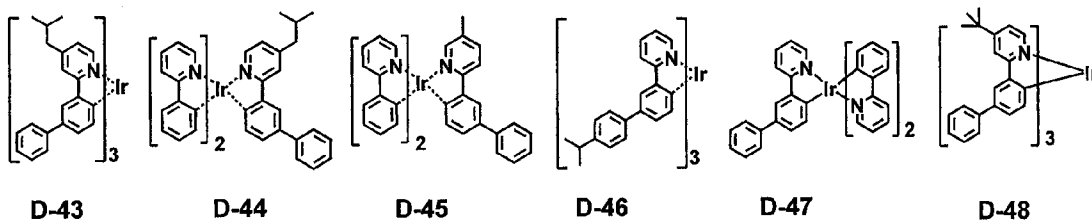
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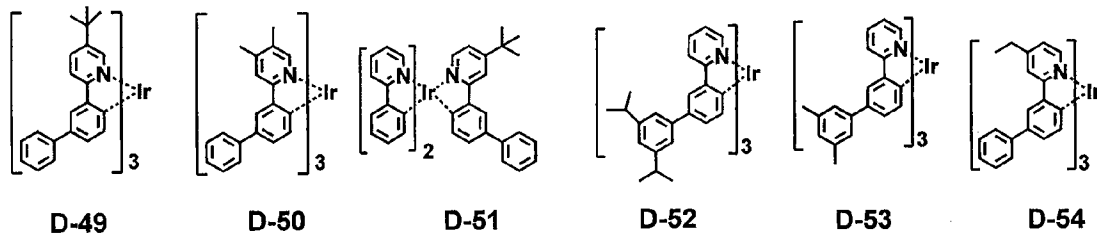
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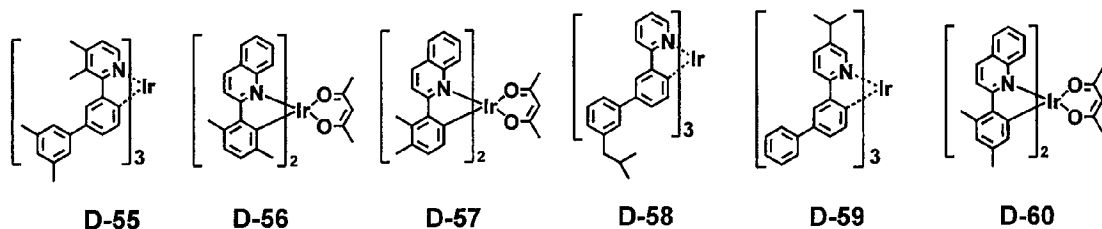
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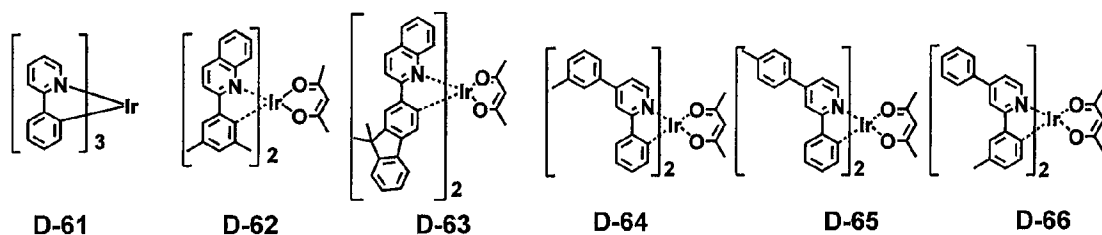
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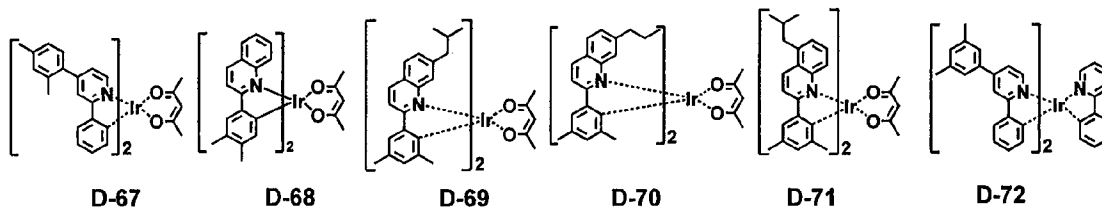
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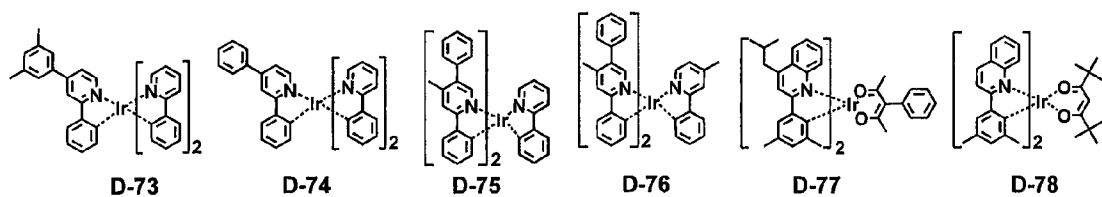
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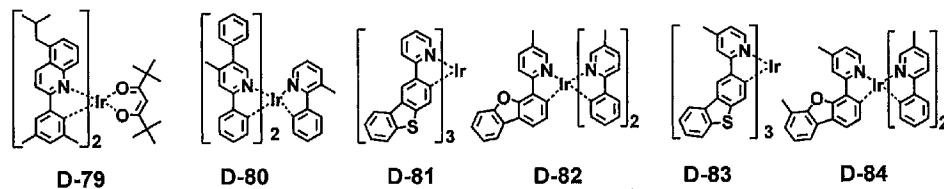
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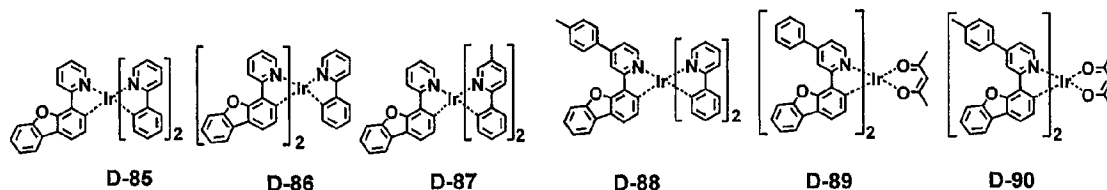
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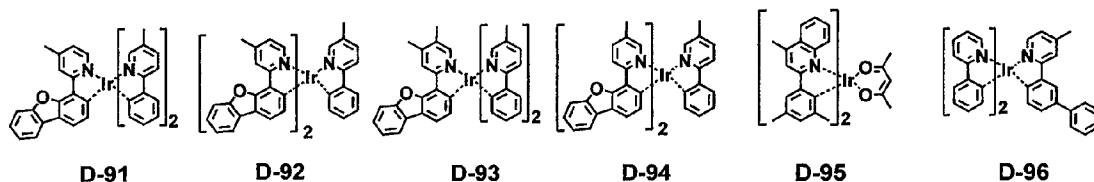
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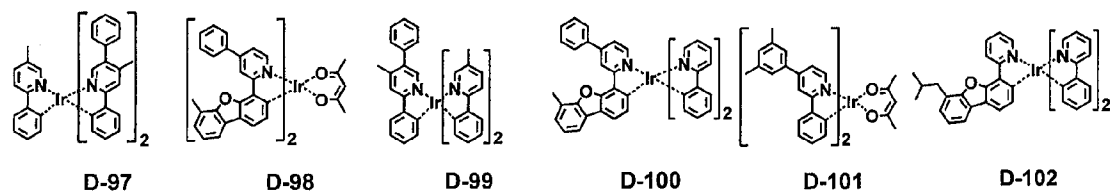
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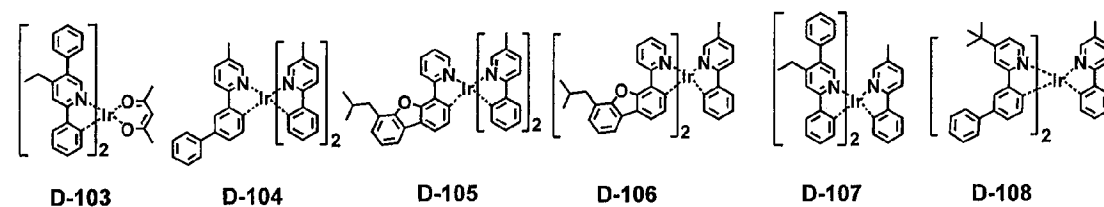
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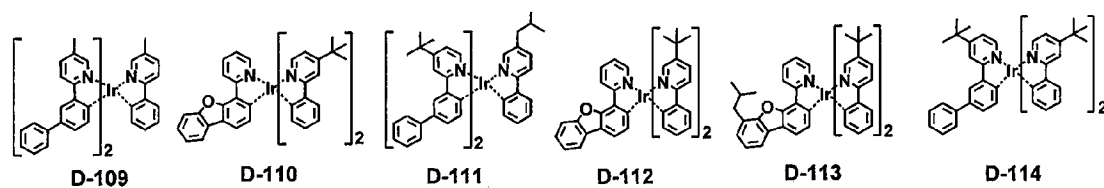
[171]



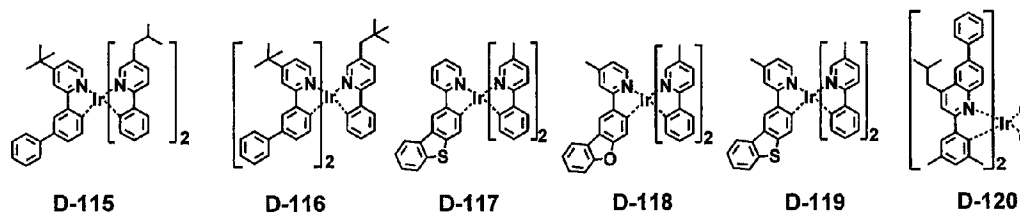
[172]



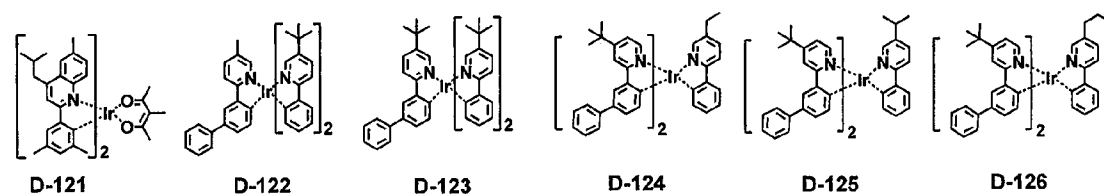
[173]



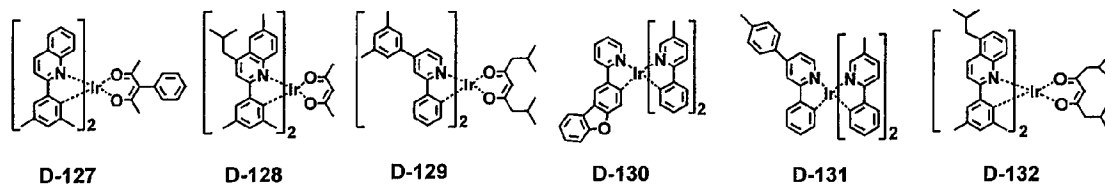
[174]



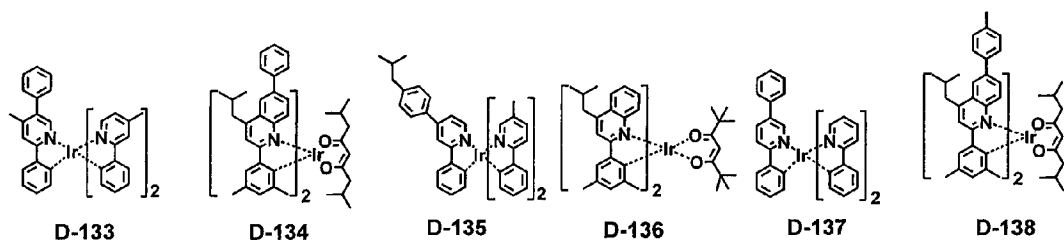
[175]



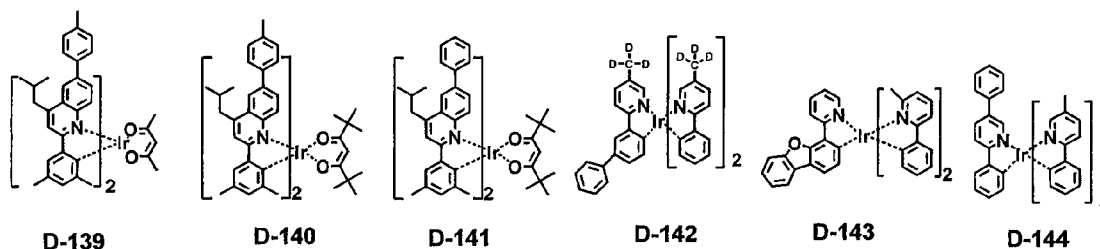
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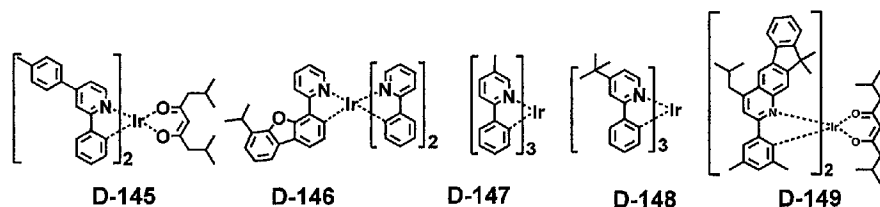
[177]



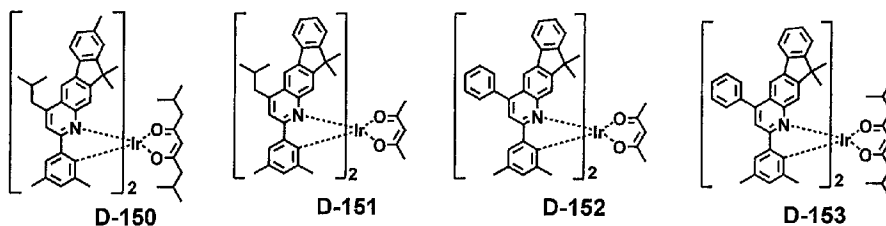
[178]



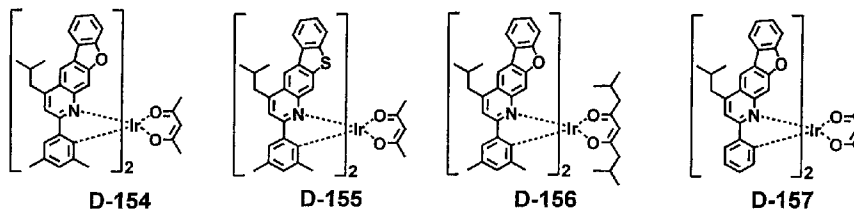
[179]



[180]



[181]



[182] The organic electroluminescent device of the present disclosure may further comprise at least one compound selected from the group consisting of arylamine-based compounds and styrylarylamine-based compounds in the medium layer.

[183] In addition, in the organic electroluminescent device of the present disclosure, the medium layer may 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 d-transition

elements of the Periodic Table, or at least one complex compound comprising said metal.

- [184] In the organic electroluminescent device of the present disclosure, at least one layer (hereinafter, "a surface layer") selected from a chalcogenide layer, a metal halide layer and a metal oxide layer may be preferably placed on an inner surface(s) of one or both electrodes. Specifically, a chalcogenide (including 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 may provide 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.; said metal halide includes LiF, MgF_2 , CaF_2 , a rare earth metal fluoride, etc.; and said metal oxide includes Cs_2O , Li_2O , MgO, SrO, BaO, CaO, etc.
- [185] The first electrode may be an anode. Between the anode and the light-emitting layer, a hole transport zone may be comprised, and the hole transport zone may comprise a hole transport layer. In addition to the hole transport layer, at least one layer of a hole auxiliary layer, a hole injection layer, or an electron blocking layer may be used. Multi-layers can be used for the hole injection layer 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. Two compounds can be simultaneously used in each layer. The hole auxiliary layer and the electron blocking layer may also be formed of multi-layers.
- [186] The second electrode may be a cathode. Between the light-emitting layer and the cathode, a layer selected from an electron buffer layer, a hole blocking layer, an electron transport layer, or an electron injection layer, or a combination thereof can be used. Multi-layers can be used for the electron buffer layer in order to control the injection of the electrons and enhance the interfacial characteristics between the light-emitting layer and the electron injection layer. Two compounds may be simultaneously used in each layer. The hole blocking layer or the electron transport layer may also be formed of multi-layers, and each layer can comprise two or more compounds.
- [187] Preferably, 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 the light-emitting 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 light-emitting 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. The reductive dopant layer may be employed as a charge-generating layer to prepare an organic EL device having two or more light-emitting layers and emitting white light.

- [188] In order to form each layer constituting the organic EL device of the present disclosure, dry film-forming methods such as vacuum deposition, 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.
- [189] When using a wet film-forming method, a thin film is formed by dissolving or dispersing the material constituting each layer in suitable solvents, such as ethanol, chloroform, tetrahydrofuran, dioxane, etc. The solvents are not specifically limited as long as the material constituting each layer is soluble or dispersible in the solvents, which do not cause any problems in forming a film.
- [190] By using the organic electroluminescent device of the present disclosure, a display device, for example, for smartphones, tablets, notebooks, PCs, TVs, or vehicles, or a lighting device, for example, an indoor or outdoor lighting device, can be produced.
- [191] Hereinafter, the preparation method and luminous properties of the device comprising the host compound and the hole transport material of the present disclosure will be explained in detail.
- [192] **Device Example 1: Production of an OLED device comprising the**
- [193] **combination of the hole transport material and the host compound of the**
- [194] **present disclosure**
- [195] An OLED device comprising the combination of the hole transport material and the host compound of the present disclosure was produced. A transparent electrode indium tin oxide (ITO) thin film (10 Ω /sq) on a glass substrate for an organic light-emitting diode (OLED) device (Geomatec, Japan) was subjected to an ultrasonic washing with acetone, ethanol, and distilled water, sequentially, and was then stored in isopropyl alcohol. Next, the ITO substrate was mounted on a substrate holder of a vacuum vapor depositing apparatus. Compound HI-1 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 first hole injection layer having a thickness of 90 nm on the ITO substrate. Compound HI-2 was then introduced into another cell of said vacuum vapor depositing apparatus, and was evaporated by applying an electric current to the cell, thereby forming a second hole injection layer having a thickness of 5 nm on the first hole injection layer. Compound

HT-1 was introduced into another cell of said vacuum vapor depositing apparatus, and was evaporated by applying an electric current to the cell, thereby forming a first hole transport layer having a thickness of 10 nm on the second hole injection layer.

Compound C-1 was introduced into another cell of said vacuum vapor depositing apparatus, and was evaporated by applying an electric current to the cell, thereby forming a second hole transport layer having a thickness of 60 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 as follows. Compound H-17 was introduced into one cell of the vacuum vapor depositing apparatus as a host of the light-emitting layer, and compound D-71 was introduced into another cell. The two materials were evaporated at different rates and were deposited in a doping amount of 2 wt% (the amount of dopant) based on the total amount of the host and dopant to form a light-emitting layer having a thickness of 40 nm on the second hole transport layer.

Compound ET-1 and compound EI-1 were then introduced into another two cells, evaporated at the rate of 1:1, and deposited to form an electron transport layer having a thickness of 35 nm on the light-emitting layer. Next, 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 80 nm was deposited by another vacuum vapor deposition apparatus on the electron injection layer. Thus, an OLED device was produced.

[196] As a result, the least time taken to be reduced from 100% to 97% of the luminance at 5,000 nits was 167 hours.

[197] **Device Example 2: Production of an OLED device comprising the**
[198] **combination of the hole transport material and the host compound of the**
[199] **present disclosure**

[200] An OLED device was produced in the same manner as in Device Example 1, except for using compound C-2 as the second hole transport material.

[201] As a result, the least time taken to be reduced from 100% to 97% of the luminance at 5,000 nits was 238 hours.

[202] **Comparative Example 1: Production of an OLED device not comprising the**
[203] **combination of the hole transport material and the host compound of the**
[204] **present disclosure**

[205] An OLED device was produced in the same manner as in Device Example 1, except for using compound A-4 as the second hole transport material, and compound B-2 as the host material.

[206] As a result, the least time taken to be reduced from 100% to 97% of the luminance at 5,000 nits was 1.8 hours.

[207] **Comparative Example 2: Production of an OLED device not comprising the**

[208] **combination of the hole transport material and the host compound of the**
 [209] **present disclosure**

[210] An OLED device was produced in the same manner as in Device Example 1, except for using compound A-4 as the second hole transport material, and compound B-3 as the host material.

[211] As a result, the least time taken to be reduced from 100% to 97% of the luminance at 5,000 nits was 21.4 hours.

[212] **Comparative Example 3: Production of an OLED device not comprising the**
 [213] **combination of the hole transport material and the host compound of the**
 [214] **present disclosure**

[215] An OLED device was produced in the same manner as in Device Example 1, except for using compound A-3 as the second hole transport material.

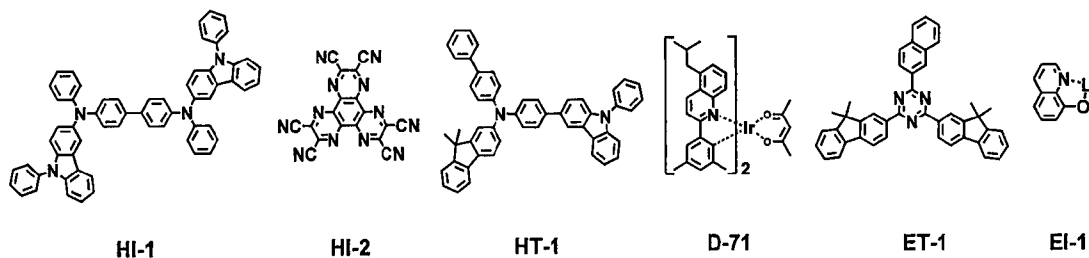
[216] As a result, the least time taken to be reduced from 100% to 97% of the luminance at 5,000 nits was 16.5 hours.

[217] **Comparative Example 4: Production of an OLED device not comprising the**
 [218] **combination of the hole transport material and the host compound of the**
 [219] **present disclosure**

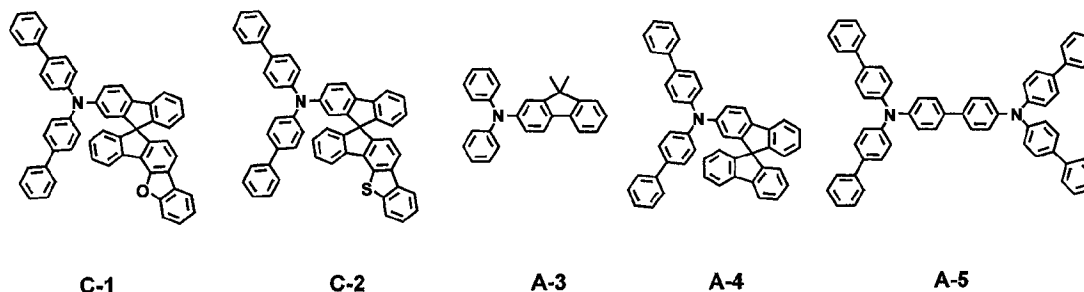
[220] An OLED device was produced in the same manner as in Device Example 1, except for using compound A-5 as the second hole transport material.

[221] As a result, the least time taken to be reduced from 100% to 97% of the luminance at 5,000 nits was 137 hours.

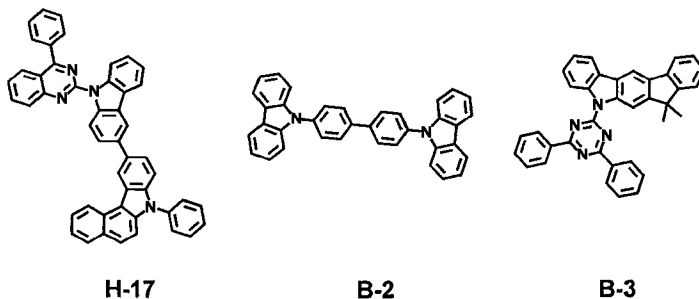
[222]



[223]



[224]



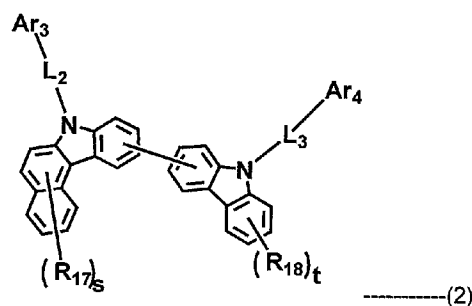
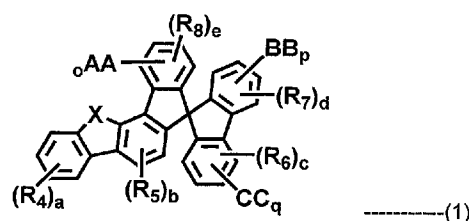
[225] It was verified that the present disclosure can produce an organic electroluminescent device using a specific combination of a hole transport zone material and a light-emitting layer compound, thereby providing a much superior driving lifespan to the conventional organic electroluminescent device.

[226] Thus, the HOMO (highest occupied molecular orbital) energy level of the compound of a fused spirofluorene structure used in the hole transport zone is formed at 4.7 to 4.8 eV, and the HOMO energy level of compound H-17 used in the light-emitting layer, wherein a benzene ring is fused to one of the two carbazoles of a biscarbazole structure and a nitrogen-containing heteroaryl is bonded to one of the two nitrogen atoms, is formed at 4.9 to 5.1 eV. It is understood that a hole injection ability can be improved due to a comparatively low energy barrier, which leads to a decrease of deterioration at the interface of the hole transport layer and the light-emitting layer, and finally exhibits an effect of an improved lifespan of the device.

Claims

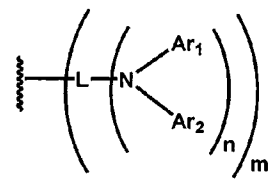
[Claim 1]

An organic electroluminescent device comprising: a first electrode; a second electrode opposing the first electrode; and a medium layer between the first electrode and the second electrode, wherein the medium layer comprises a hole transport zone of one or more layers, and one or more light-emitting layers, at least one layer of the hole transport zone comprises a compound represented by the following formula 1, and at least one layer of the light-emitting layers comprises a compound represented by the following formula 2:



wherein

AA, BB, and CC each independently represent



and these may be the same or different;

L represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (3- to 30-membered)heteroarylene;

L₂ and L₃ each independently represent a single bond, or a substituted or unsubstituted (C6-C30)arylene;

Ar₁ to Ar₄ each independently represent a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl; and Ar₁ and Ar₂ may be linked to each other to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30)

alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

X represents -O-, -S-, -C(R₁)(R₂)-, or -N(R₃)-;

R₁ to R₃ each independently represent hydrogen, deuterium, a halogen, a cyano, a carboxyl, a nitro, a hydroxyl, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C3-C30)cycloalkenyl, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl; and R₁ and R₂ may be linked to each other to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

R₄ to R₈, R₁₇, and R₁₈ each independently represent hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C2-C30)alkynyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, 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 mono- or di- (C1-C30)alkylamino, or a substituted or unsubstituted mono- or di- (C6-C30)arylamino; or are linked to an adjacent substituent(s) to form a substituted or unsubstituted, mono- or polycyclic, (C3-C30) alicyclic or aromatic ring, or the combination thereof, whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

a, c, d, e, and t each independently represent an integer of 1 to 4;

b, m, and n each independently represent 1 or 2;

o, p, and q each independently represent 0 or 1;

s represents an integer of 1 to 6;

c+q, d+p, and e+o are each independently 4;

where a, b, c, d, e, m, n, s, or t is an integer of 2 or more, each of R₄,

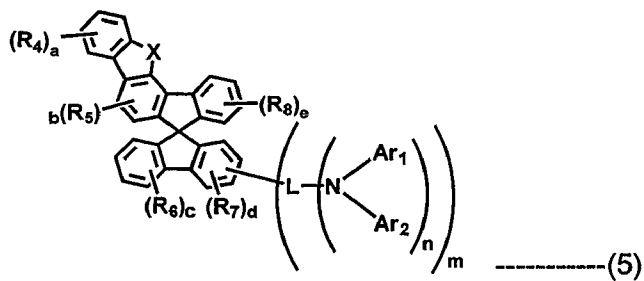
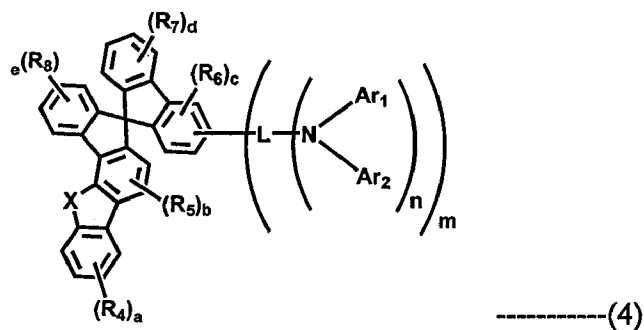
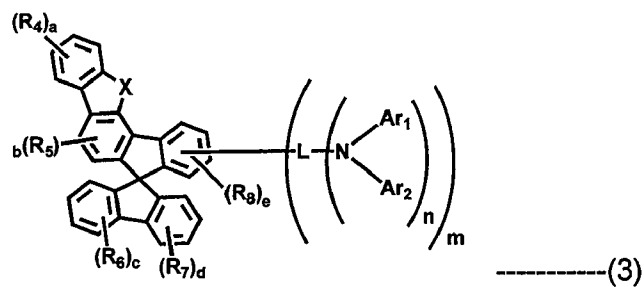
each of R₅, each of R₆, each of R₇, each of R₈, each of [L-(NAr₁Ar₂)_n], each of (NAr₁Ar₂), each of R₁₇, or each of R₁₈ may be the same or different; and
the heteroaryl(ene) contains at least one hetero atom selected from B, N, O, S, Si, and P.

[Claim 2]

The organic electroluminescent device according to claim 1, wherein the substituents of the substituted (C1-C30)alkyl, the substituted (C2-C30)alkenyl, the substituted (C2-C30)alkynyl, the substituted (C3-C30)cycloalkyl, the substituted (C3-C30)cycloalkenyl, the substituted (3- to 7-membered)heterocycloalkyl, the substituted (C6-C30)aryl(ene), the substituted (3- to 30-membered)heteroaryl(ene), the substituted tri(C1-C30)alkylsilyl, the substituted tri(C6-C30)arylsilyl, the substituted di(C1-C30)alkyl(C6-C30)arylsilyl, the substituted (C1-C30)alkyldi(C6-C30)arylsilyl, the substituted mono- or di- (C1-C30)alkylamino, the substituted mono- or di- (C6-C30)arylamino, and the substituted mono- or polycyclic, (C3-C30) alicyclic, aromatic ring, or a combination thereof in L, L₂, L₃, Ar₁ to Ar₄, R₁ to R₈, R₁₇, and R₁₈ each independently are at least one selected from the group consisting of deuterium, a halogen, a cyano, a carboxyl, a nitro, a hydroxyl, a (C1-C30)alkyl, a halo(C1-C30)alkyl, a (C2-C30)alkenyl, a (C2-C30)alkynyl, a (C1-C30)alkoxy, a (C1-C30)alkylthio, a (C3-C30)cycloalkyl, a (C3-C30)cycloalkenyl, a (3- to 7-membered)heterocycloalkyl, a (C6-C30)aryloxy, a (C6-C30)arylthio, a (5- to 30-membered)heteroaryl unsubstituted or substituted with a (C6-C30)aryl, a (C6-C30)aryl unsubstituted or substituted with a (5- to 30-membered)heteroaryl, 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, an amino, a mono- or di- (C1-C30)alkylamino, a mono- or di- (C6-C30)arylamino unsubstituted or substituted with a (C1-C30)alkyl, a (C1-C30)alkyl(C6-C30)arylamino, a (C1-C30)alkylcarbonyl, a (C1-C30)alkoxycarbonyl, a (C6-C30)arylcarbonyl, a di(C6-C30)arylboronyl, a di(C1-C30)alkylboronyl, a (C1-C30)alkyl(C6-C30)arylboronyl, a (C6-C30)aryl(C1-C30)alkyl, and a (C1-C30)alkyl(C6-C30)aryl.

[Claim 3]

The organic electroluminescent device according to claim 1, wherein formula 1 is represented by any one of the following formulas 3 to 5:

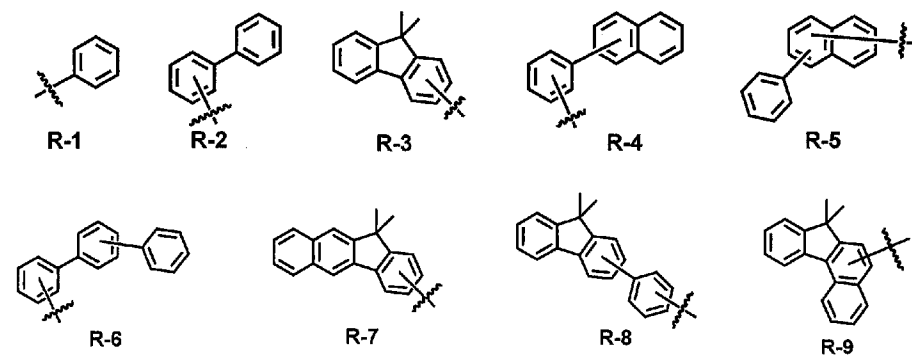


wherein

L, Ar₁, Ar₂, X, R₄ to R₈, a to e, m, and n are as defined in claim 1.

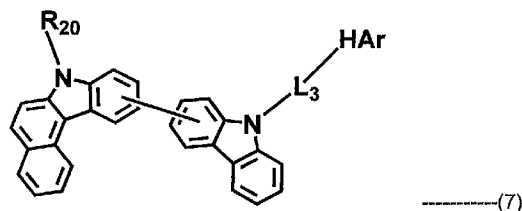
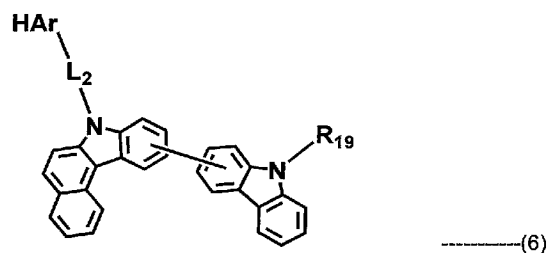
[Claim 4]

The organic electroluminescent device according to claim 3, wherein Ar₁ and Ar₂ are each independently represented by any one of the following formulas R-1 to R-9:



[Claim 5]

The organic electroluminescent device according to claim 1, wherein formula 2 is represented by formula 6 or 7:



wherein

HAr represents a substituted or unsubstituted nitrogen-containing (5- to 30-membered)heteroaryl; and

L₂ and L₃ each independently represent a single bond, or a substituted or unsubstituted (C6-C30)arylene; and

R₁₉ and R₂₀ each independently represent a substituted or unsubstituted (C6-C30)aryl.

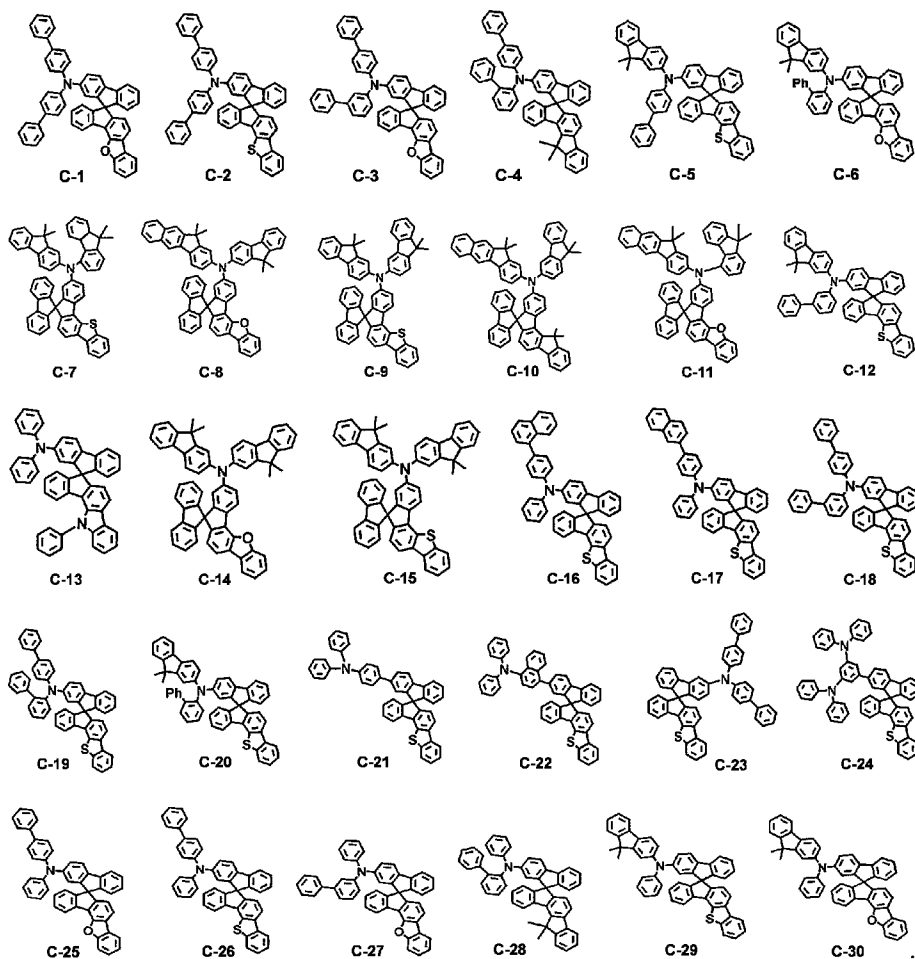
[Claim 6]

The organic electroluminescent device according to claim 5, wherein in formulas 6 and 7, HAr represents a quinazolinyl substituted with phenyl, a quinazolinyl substituted with di(C1-C6)alkylphenyl, a quinazolinyl substituted with naphthylphenyl, a quinazolinyl substituted with phenylnaphthyl, a quinazolinyl substituted with terphenyl, a quinazolinyl substituted with anthracenyl, a quinazolinyl substituted with phenanthrenyl, a quinazolinyl substituted with biphenyl, a quinazolinyl substituted with di(C1-C6)alkylfluorenyl, a quinazolinyl substituted with phenylcarbazolyl, a quinoxalinylyl substituted with phenyl, a quinoxalinylyl substituted with naphthylphenyl, a quinoxalinylyl substituted with phenylnaphthyl, a quinoxalinylyl substituted with terphenyl, a quinoxalinylyl substituted with anthracenyl, a quinoxalinylyl substituted with phenanthrenyl, a quinoxalinylyl substituted with biphenyl, a quinoxalinylyl substituted with di(C1-C6)alkylfluorenyl, or a quinoxalinylyl substituted with phenylcarbazolyl, and R₁₉ and R₂₀ each independently represent a phenyl, a naphthyl, a biphenyl, a naphthylphenyl, a phenylnaphthyl, a terphenyl, an anthracenyl, a phenanthrenyl, or a di(C1-C6)alkylfluorenyl.

[Claim 7]

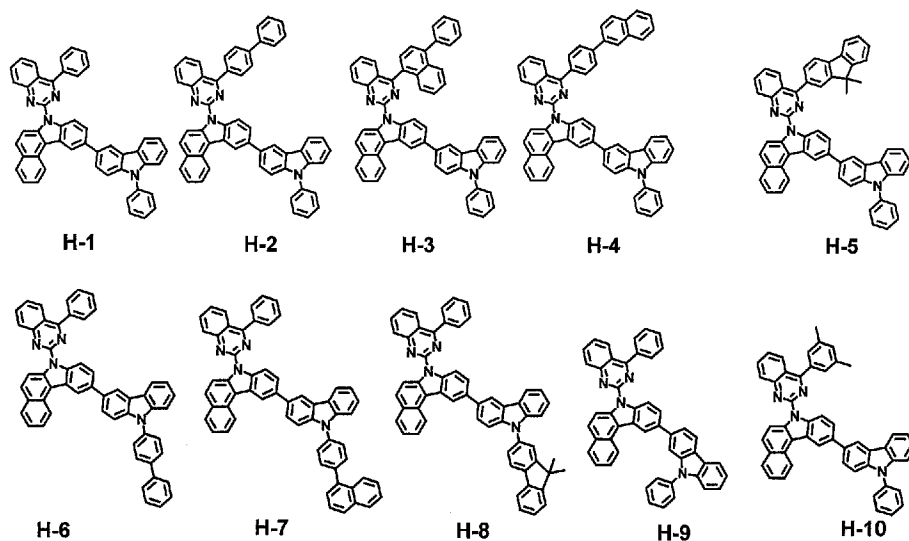
The organic electroluminescent device according to claim 1, wherein the compound represented by formula 1 is selected from the group

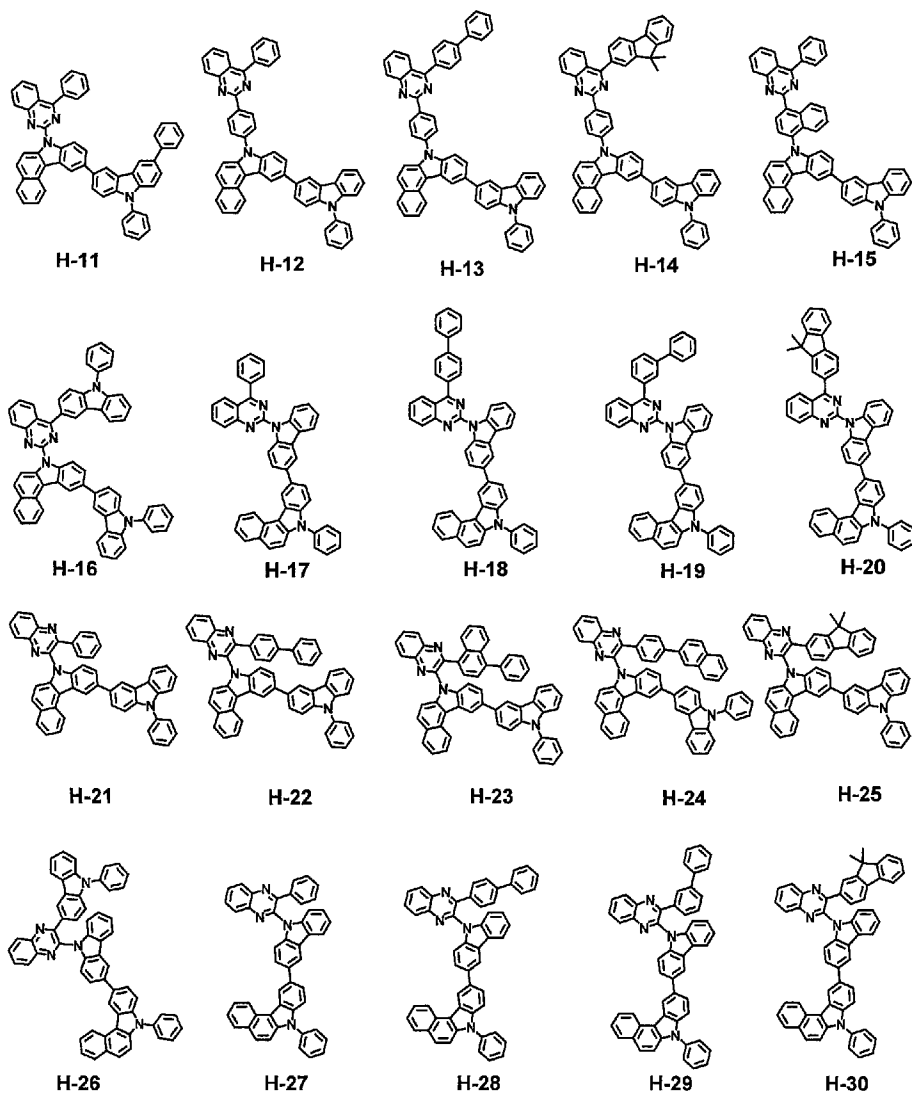
consisting of:



[Claim 8]

The organic electroluminescent device according to claim 1, wherein the compound represented by formula 2 is selected from the group consisting of:





[Claim 9]

The organic electroluminescent device according to claim 1, wherein the hole transport zone comprises a hole transport layer, and a hole auxiliary layer or an electron blocking layer.

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/KR2017/013420

A. CLASSIFICATION OF SUBJECT MATTER

H01L 51/50 (2006.01) H01L 51/00 (2006.01) C09K 11/06 (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)

 REGISTRY, CAPLUS - substructure search based on formula (1) and formula (2), keywords such as hole transport
 CAPLUS - applicant and inventor name search in combination with keywords such as hole transport
 Applicant and inventor names searched in internal databases provided by IP Australia.

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

* "A"	Special categories of cited documents: 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 23 January 2018	Date of mailing of the international search report 23 January 2018
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au	Authorised officer Cassandra Sweetman AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262223633

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/KR2017/013420
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2016/013867 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 28 January 2016 paragraphs 3, 111-184, 187, 225; compounds H4-41-H4-55, H4-57-H4-74, H4-77, H2-129-H2-135, H2-155	1-9
A	WO 2014/171779 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 23 October 2014 paragraphs 88-101, 154-156, compound C-98, device example 1	1-9
A	WO 2015/142036 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 24 September 2015 compounds C41-C43, C53, C92, C102, C106-C107, table 1, abstract	1-9

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

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/KR2017/013420	
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	Publication Date
WO 2016/013867 A1	28 January 2016	WO 2016013867 A1	28 Jan 2016
		CN 106537634 A	22 Mar 2017
		EP 3172779 A1	31 May 2017
		JP 2017529685 A	05 Oct 2017
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		EP 3119767 A1	25 Jan 2017
		JP 2017510071 A	06 Apr 2017
		KR 20150108330 A	25 Sep 2015
		TW 201600519 A	01 Jan 2016
		US 2017117485 A1	27 Apr 2017
End of Annex			