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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. The organic electroluminescent compound of the present disclosure can provide an organic electroluminescent device having low driving voltage, and/or excellent power and/or luminous efficiencies.

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] Among display devices, 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] The most important factor determining luminous efficiency in an organic electroluminescent device is light-emitting materials. Until now, fluorescent materials have been widely used as the light-emitting material. However, in view of electroluminescent mechanisms, since phosphorescent light-emitting materials theoretically enhance luminous efficiency by four (4) times compared to fluorescent light-emitting materials, phosphorescent light-emitting materials have been widely researched. Iridium(III) complexes have been widely known as phosphorescent light-emitting materials, including bis(2-(2'-benzothienyl)-pyridinato-N,C-3')iridium(acetylacetonate) [(acac)Ir(btp)$_2$], tris(2-phenylpyridine)iridium [Ir(ppy)$_3$] and bis(4,6-difluorophenylpyridinato-N,C2)picolinato iridium (Firpic) as red-, green- and blue-emitting materials, respectively.

[4] In conventional technology, 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 electroluminescent device using bathocuproine (BCP) and aluminum(III) bis(2-methyl-8-quinolinate)(4-phenylphenolate) (BAlq), etc., as host materials, which were known as hole blocking materials.

[5] Although these materials provide good luminous 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, and the lifespan of the device may be shortened. (2) The power efficiency of the organic electroluminescent device is given by [(π/voltage) × current efficiency], and the power efficiency is inversely proportional to the voltage. Although

the organic electroluminescent 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) Also, the operational lifespan of the organic electroluminescent device is short, and luminous efficiency is still necessary to improve. Accordingly, the materials constituting the organic layer in the device, in particular a host or a dopant constituting the light-emitting material, must be selected appropriately in order to realize the excellent characteristics of the organic EL device.

[6] Korean Patent No. 10-1511115 discloses a compound having the structure fused with two carbazoles and an organic electroluminescent device comprising the compound. However, the above reference does not specifically disclose a compound having a structure wherein nitrogen atoms comprised in the two carbazoles are linked to each other via an aryl or a heteroaryl as a linker to form a 7- to 10-membered ring, and wherein the aryls comprised in each carbazole are linked to each other via a heteroatom as a linker.

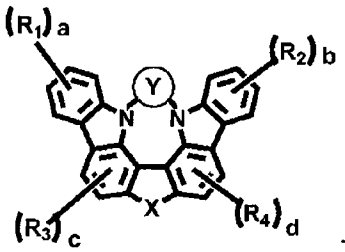
Disclosure of Invention

Technical Problem

[7] The object of the present disclosure is firstly, to provide an organic electroluminescent compound effective to produce an organic electroluminescent device having low driving voltage, and/or excellent power and/or luminous efficiencies, and secondly, to provide an organic electroluminescent device comprising the organic electroluminescent compound.

Solution to Problem

[8] As a result of intensive studies to solve the technical problem above, the present inventors found that an organic electroluminescent compound having the specific structure described herein can remarkably improve the power and/or luminous efficiencies of an organic electroluminescent device. Specifically, the present inventors found that the above objective can be achieved by an organic electroluminescent compound represented by the following formula 1:

[9] 

---------- (1)

[10] wherein

[11] ring Y represents a substituted or unsubstituted (C6-C30)aryl, or a substituted or un-

substituted (3- to 30-membered)heteroaryl;

[12] X represents O, S or NR_5;

[13] R_1 to R_4, each independently, represent hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted mono- or di- (C1-C30)alkylamino, a substituted or unsubstituted mono- or di- (C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; or are linked to adjacent R_1 to R_4 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 heteroatom selected from nitrogen, oxygen, and sulfur;

[14] R_5 represents hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted mono- or di- (C1-C30)alkylamino, a substituted or unsubstituted mono- or di- (C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino;

[15] the heteroaryl contains at least one heteroatom selected from B, N, O, S, Si, and P; and

[16] a and b, each independently, represent an integer of 1 to 4, and c and d, each independently, represent an integer of 1 or 2; where if a to d, each independently, represent an integer of 2 or more, each of R_1 to R_4 may be the same or different.

Advantageous Effects of Invention

[17] The organic electroluminescent compound of the present disclosure can produce an organic electroluminescent device having low driving voltage and/or excellent power and/or luminous efficiencies.

Mode for the Invention

[18] 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.

[19] The term "an 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 layers constituting an organic electroluminescent device, if necessary.

[20] The term "an 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. If necessary, the organic electroluminescent material may be comprised in any layers constituting an organic electroluminescent device. 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, an electron injection material, etc.

[21] The compound represented by formula 1 will be described in detail as follows.

[22] In formula 1, X represents O, S or NR_5.

[23] In formula 1, ring Y represents a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl; preferably, a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl; and more preferably, a substituted or unsubstituted (C6-C18)aryl, or a substituted or unsubstituted (5- to 18-membered)heteroaryl. According to one embodiment of the present disclosure, ring Y represents a substituted or unsubstituted benzene, a substituted or unsubstituted pyridine, a substituted or unsubstituted pyrimidine, a substituted or unsubstituted pyrazine, a substituted or unsubstituted thiophene, or a substituted or unsubstituted furan, and the benzene, the pyridine, the pyrimidine, the pyrazine, the thiophene, or the furan may be an unsubstituted ring.

[24] In formula 1, R_1 to R_4, each independently, represent hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted mono- or di- (C1-C30)alkylamino, a substituted or unsubstituted mono- or di- (C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; or are linked to adjacent R_1 to R_4 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

heteroatom selected from nitrogen, oxygen, and sulfur; preferably, hydrogen, a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl; more preferably, hydrogen, or a substituted or unsubstituted (5- to 18-membered)heteroaryl; and, for example, hydrogen, a triazinyl substituted with one or two phenyl(s), or an unsubstituted pyridyl.

[25] In formula 1, R_5 represents hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted mono- or di- (C1-C30)alkylamino, a substituted or unsubstituted mono- or di- (C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; preferably, a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl; and more preferably, a substituted or unsubstituted (C6-C18)aryl, or a substituted or unsubstituted (5- to 18-membered)heteroaryl. For example, R_5 may represent a substituted or unsubstituted phenyl, an unsubstituted naphthylphenyl, an unsubstituted biphenyl, an unsubstituted terphenyl, a triazinyl substituted with one or two phenyl(s), a quinazolinyl substituted with a phenyl, a quinoxalinyl substituted with a phenyl, a pyrimidinyl substituted with one or two phenyl(s), or a substituted pyridyl, wherein the substituent of the substituted phenyl may be a triazinyl substituted with one or two phenyl(s), a triazinyl substituted with a phenyl and/or a biphenyl, a quinoxalinyl substituted with a phenyl, or an unsubstituted pyridyl, and wherein the substituent of the substituted pyridyl may be a triazinyl substituted with one or two phenyl(s).

[26] In formula 1, the heteroaryl contains at least one heteroatom selected from B, N, O, S, Si, and P; preferably, contains at least one heteroatom selected from N, O and S; and more preferably, represents a nitrogen-containing heteroaryl comprising at least one nitrogen.

[27] In formula 1, a and b, each independently, represent an integer of 1 to 4, and c and d, each independently, represent an integer of 1 or 2; where if a to d, each independently, represent an integer of 2 or more, each of R_1 to R_4 may be the same or different. Preferably, a to d, each independently, represent an integer of 1.

[28] According to one embodiment of the present disclosure, in formula 1, ring Y represents a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl; X represents O, S or NR_5; R_1 to R_4, each independently, represent hydrogen, a substituted or unsubstituted (C6-C25)aryl, or a sub-

stituted or unsubstituted (5- to 25-membered)heteroaryl; R_5 represents a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl; and a to d, each independently, represent an integer of 1.

[29] According to one embodiment of the present disclosure, in formula 1, ring Y represents a substituted or unsubstituted (C6-C18)aryl, or a substituted or unsubstituted (5- to 18-membered)heteroaryl; X represents O, S or NR_5; R_1 to R_4, each independently, represent hydrogen, or a substituted or unsubstituted (5- to 18-membered)heteroaryl; R_5 represents a substituted or unsubstituted (C6-C18)aryl, or a substituted or unsubstituted (5- to 18-membered)heteroaryl; and a to d, each independently, represent an integer of 1.

[30] According to one embodiment of the present disclosure, in formula 1, ring Y represents a substituted or unsubstituted benzene, a substituted or unsubstituted pyridine, a substituted or unsubstituted pyrimidine, a substituted or unsubstituted pyrazine, a substituted or unsubstituted thiophene, or a substituted or unsubstituted furan; X represents O, S or NR_5; R_1 to R_4, each independently, represent hydrogen, a triazinyl substituted with a diphenyl, or an unsubstituted pyridyl; R_5 represents a substituted or unsubstituted phenyl, an unsubstituted naphthylphenyl, an unsubstituted biphenyl, an unsubstituted terphenyl, a triazinyl substituted with a diphenyl, a quinazolinyl substituted with a phenyl, a quinoxalinyl substituted with a phenyl, a pyrimidinyl substituted with a diphenyl, or a substituted pyridyl; and a to d, each independently, represent an integer of 1.

[31] Herein, the term "(C1-C30)alkyl" is meant to be a linear or branched alkyl having 1 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 1 to 20, more preferably 1 to 10, and includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, etc. The term "(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. The term "(C2-C30)alkynyl" is meant to be 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-butynyl, 2-butynyl, 3-butynyl, 1-methylpent-2-ynyl, etc. The term "(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. The term "(3- to 7- membered) heterocycloalkyl" is a cycloalkyl having 3 to 7, preferably 5 to 7, ring backbone atoms, including at least one heteroatom selected from B, N, O, S, Si, and P, preferably O, S,

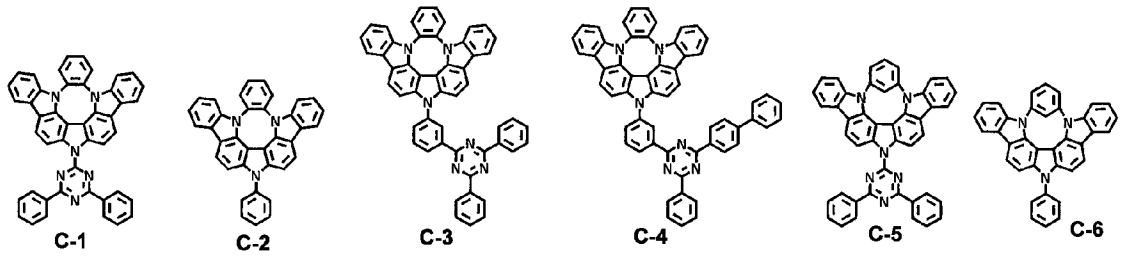
and N, and includes tetrahydrofuran, pyrrolidine, thiolan, tetrahydropyran, etc. The term "(C6-C30)aryl" is a monocyclic or fused ring radical derived from an aromatic hydrocarbon having 6 to 30 ring backbone carbon atoms, in which the number of the ring backbone carbon atoms is preferably 6 to 20, more preferably 6 to 15, may be partially saturated, and may comprise a spiro structure. The above aryl may include phenyl, biphenyl, terphenyl, naphthyl, binaphthyl, phenylnaphthyl, naphthylphenyl, fluorenyl, phenylfluorenyl, benzofluorenyl, dibenzofluorenyl, phenanthrenyl, phenylphenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, spirobifluorenyl, etc. The term "(3- to 30-membered)heteroaryl" is an aryl having 3 to 30 ring backbone atoms, including at least one, preferably 1 to 4 heteroatoms selected from the group consisting of B, N, O, S, Si, and P. The above heteroaryl 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); may comprise a spiro structure; 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, and pyridazinyl, and a fused ring-type heteroaryl such as benzofuranyl, benzothiophenyl, isobenzofuranyl, dibenzofuranyl, dibenzothiophenyl, benzimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, benzocarbazolyl, phenoxazinyl, phenothiazinyl, phenanthridinyl, benzodioxolyl, and dihydroacridinyl. Furthermore, "halogen" includes F, Cl, Br, and I.

[32] Herein, "substituted" in the expression "substituted or unsubstituted" means that a hydrogen atom in a certain functional group is replaced with another atom or another functional group, i.e. a substituent. The substituents of the substituted alkyl, the substituted aryl, the substituted heteroaryl, the substituted cycloalkyl, the substituted alkoxy, the substituted trialkylsilyl, the substituted dialkylarylsilyl, the substituted alkyldiarylsilyl, the substituted triarylsilyl, the substituted mono- or di- alkylamino, the substituted mono- or di- arylamino, the substituted alkylarylamino, and the substituted mono- or polycyclic, alicyclic or aromatic ring, or the combination thereof, in ring Y, and R_1 to R_5 of formula 1, 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 (3- to 30-membered)heteroaryl unsubstituted or substituted with a (C1-C30)alkyl and/or a

(C6-C30)aryl; a (C6-C30)aryl unsubstituted or substituted with a (3- 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; 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; preferably, are at least one selected from the group consisting of a (C6-C25)aryl unsubstituted or substituted with a (5- to 18-membered)heteroaryl, and a (5- to 25-membered)heteroaryl unsubstituted or substituted with a (C6-C25)aryl; more preferably, are at least one selected from the group consisting of an unsubstituted (C6-C18)aryl, and a (5- to 18-membered)heteroaryl unsubstituted or substituted with a (C6-C18)aryl; and for example, may be at least one selected from the group consisting of an unsubstituted phenyl, an unsubstituted naphthyl, an unsubstituted biphenyl, an unsubstituted pyridyl, a triazinyl substituted with one or two phenyl(s), a triazinyl substituted with a phenyl and/or a biphenyl, and a quinoxalinyl substituted with a phenyl.

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

[34]



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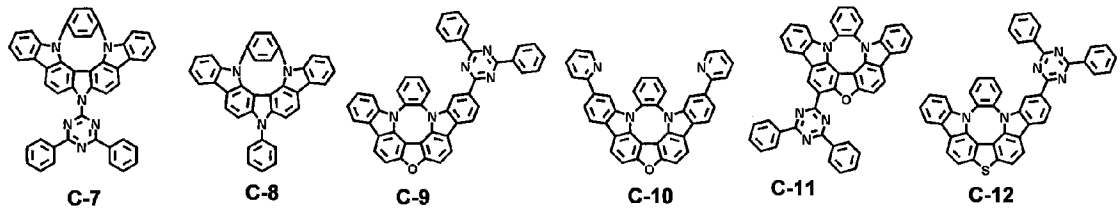

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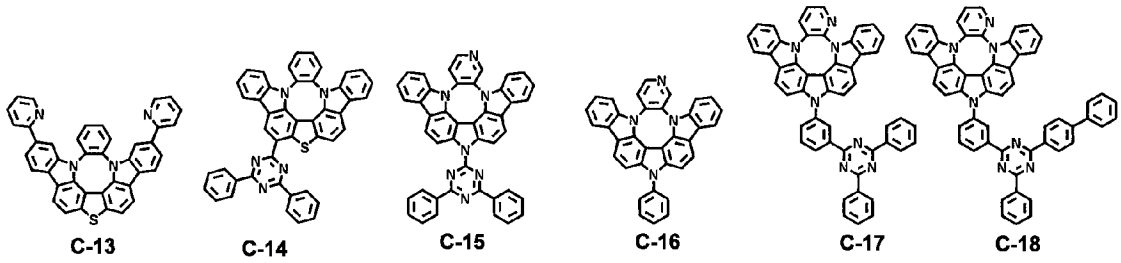

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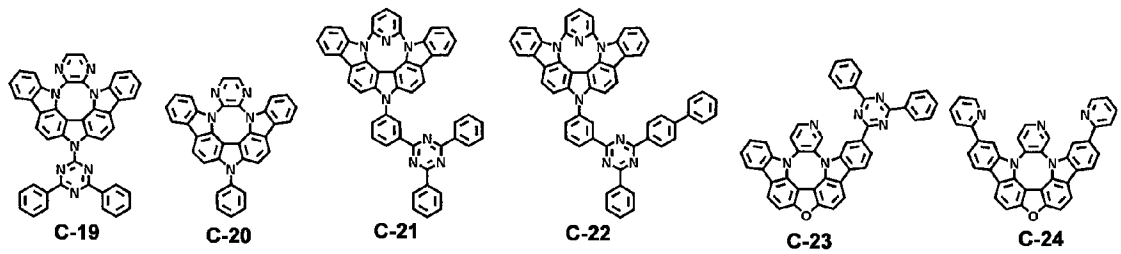

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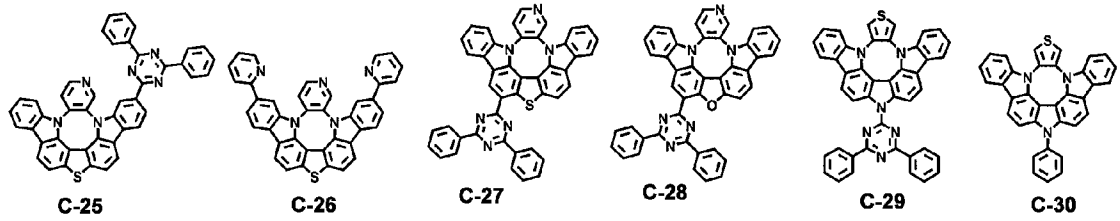

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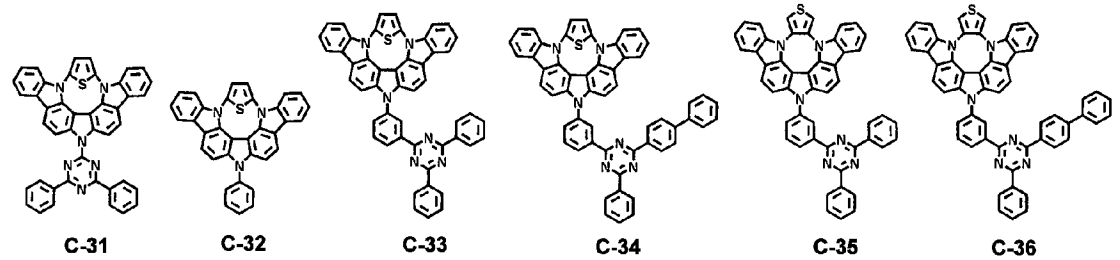

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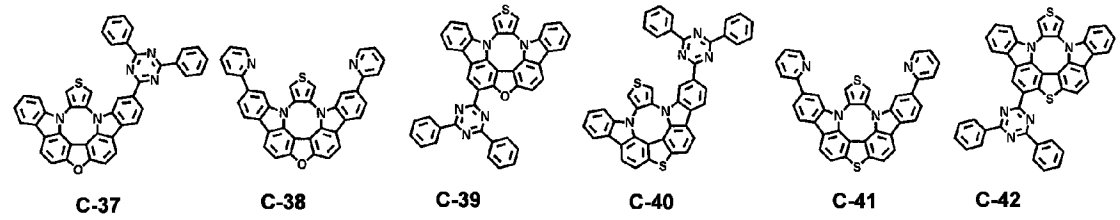
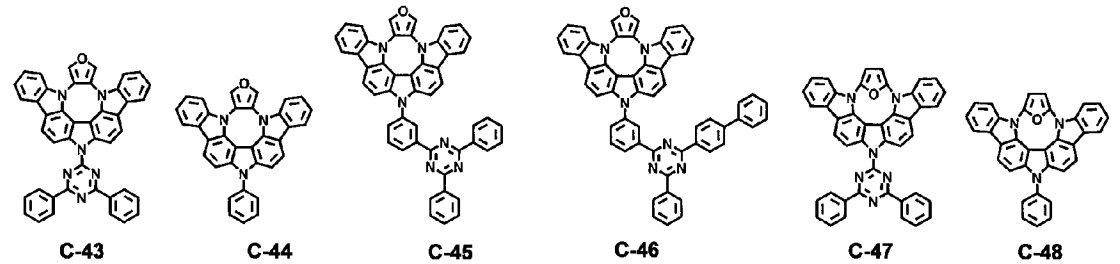


[41]



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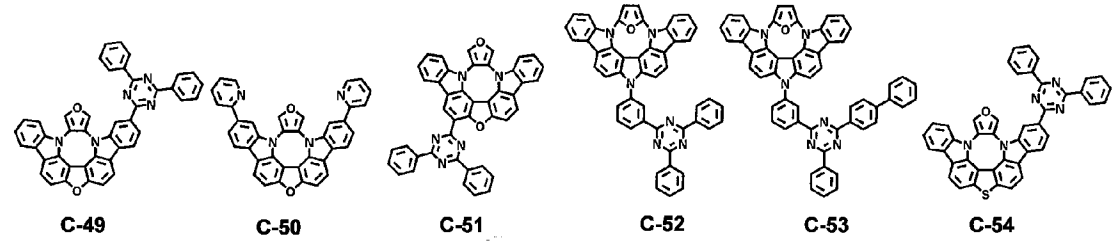

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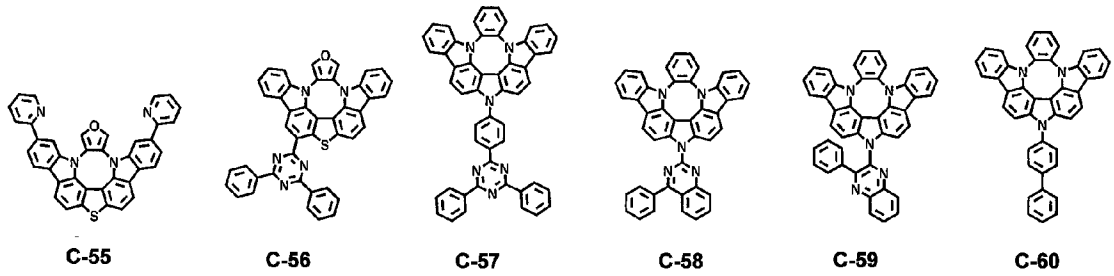

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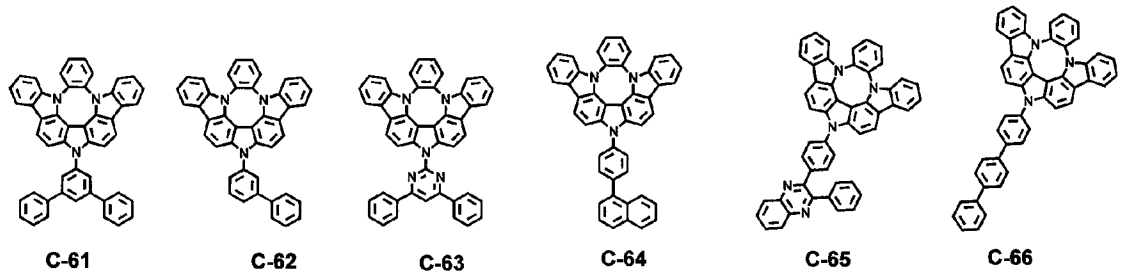

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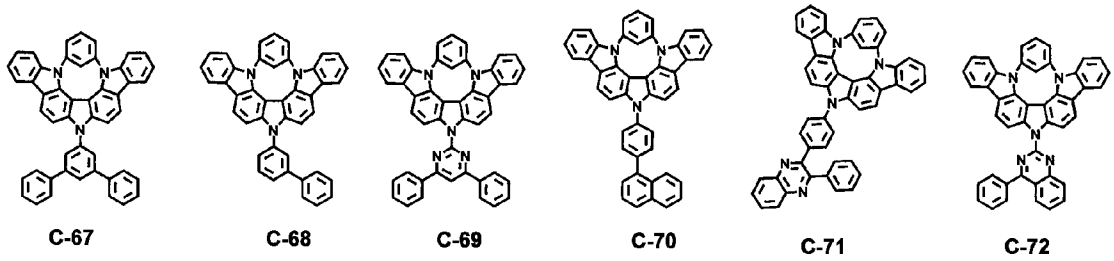

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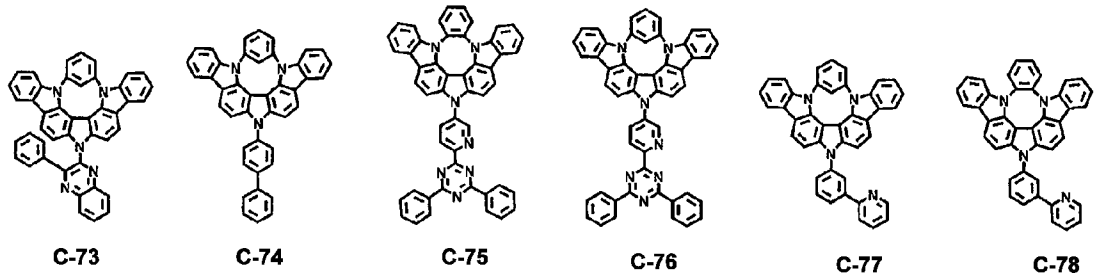
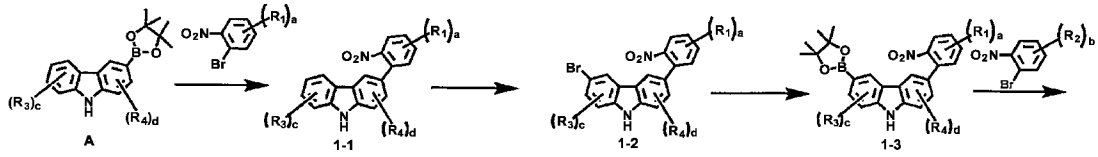


[47] The organic electroluminescent compound of the present disclosure may be produced by a synthetic method known to a person skilled in the art referring to the following reaction scheme 1, but is not limited thereto.

[48] [Reaction Scheme 1]

[49]



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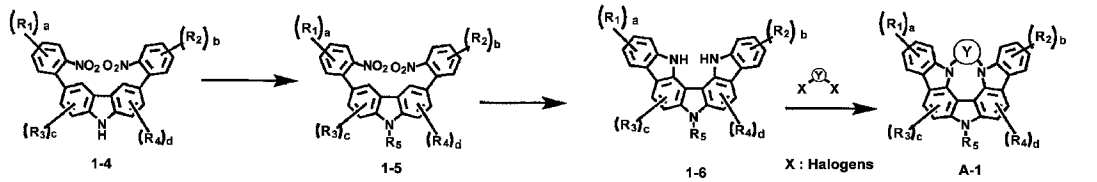


[51] wherein, ring Y, R_1 to R_4, and a to d are as defined in formula 1.

[52] The present disclosure also discloses an organic electroluminescent material

comprising the organic electroluminescent compound of formula 1, and an organic electroluminescent device comprising the material.

[53] The organic electroluminescent material may consist of the organic electroluminescent compound of the present disclosure as a sole compound, or may further comprise conventional materials generally used in organic electroluminescent materials.

[54] The organic electroluminescent device of the present disclosure may comprise a first electrode, a second electrode, and at least one organic layer between the first and second electrodes. The organic layer may comprise at least one organic electroluminescent compound of formula 1.

[55] 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, a hole auxiliary layer, a light-emitting auxiliary layer, an electron transport layer, an electron injection layer, an interlayer, a hole blocking layer, an electron blocking layer, and an electron buffer layer.

[56] The light-emitting auxiliary layer may be placed between the anode and the light-emitting layer, or between the cathode and the light-emitting layer. When the light-emitting auxiliary layer is placed between the anode and the light-emitting layer, it can be used for promoting the hole injection and/or the hole transport, or for preventing the overflow of electrons. When the light-emitting auxiliary layer is placed between the cathode and the light-emitting layer, it can be used for promoting the electron injection and/or the electron transport, or for preventing the overflow of holes. 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 the 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 in 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 light-emitting auxiliary layer, the hole auxiliary layer or the electron blocking layer may have an effect of improving the efficiency and/or the lifespan of the organic electroluminescent device.

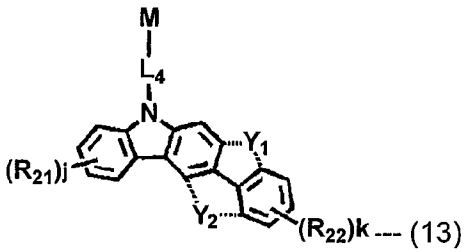
[57] The organic electroluminescent compound represented by formula 1 may be comprised in the light-emitting layer. When used in the light-emitting layer, the organic electroluminescent compound of formula 1 may be comprised as a host

material. Preferably, the light-emitting layer may further comprise at least one dopant. If necessary, another compound besides the organic electroluminescent compound of formula 1 may be further comprised 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.

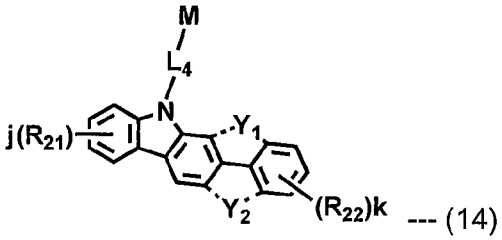
[58] The second host material can use any of the known phosphorescent hosts. Preferably, the second host material may comprise the compound selected from the group consisting of the compounds represented by the following formulas 11 to 16:

[59] $H\text{-}(Cz\text{-}L_4)_h\text{-}M$ --- (11)

[60] $H\text{-}(Cz)_i\text{-}L_4\text{-}M$ --- (12)

[61] 

--- (13)

[62] 

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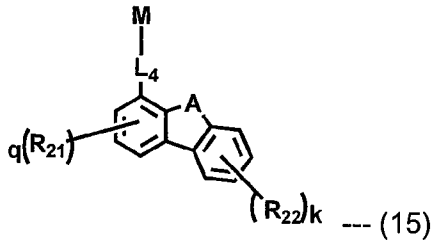
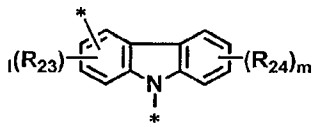
[63] 

--- (15)

[64] wherein

[65] Cz represents the following structure:

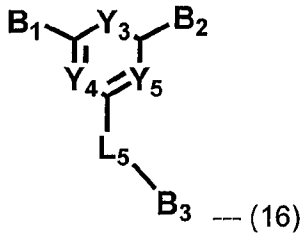
[66] 

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

[68] 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 $-SiR_{25}R_{26}R_{27}$; 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 sub-

stituted 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-, -NR_{31}- or -$CR_{32}R_{33}$-, 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 m, each independently, represent an integer of 0 to 4; q represents an integer of 0 to 3; where if h, i, j, k, l, m or q 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;

[69]



--- (16)

[70] wherein

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

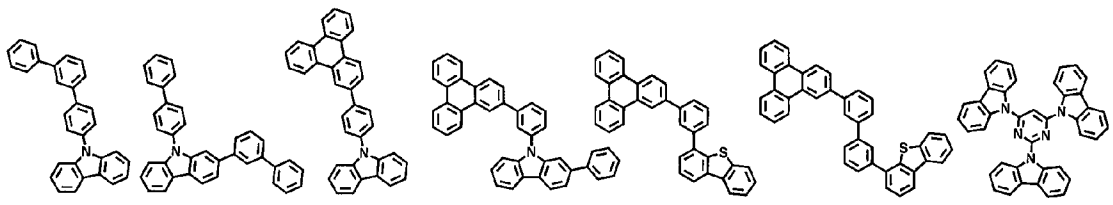
[72] B_1 and B_2, each independently, represent hydrogen, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (5- to 30-membered)heteroaryl;

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

[74] L_5 represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted (5- to 30-membered)heteroarylene.

[75] Specifically, the preferred examples of the second host material are as follows:

[76]



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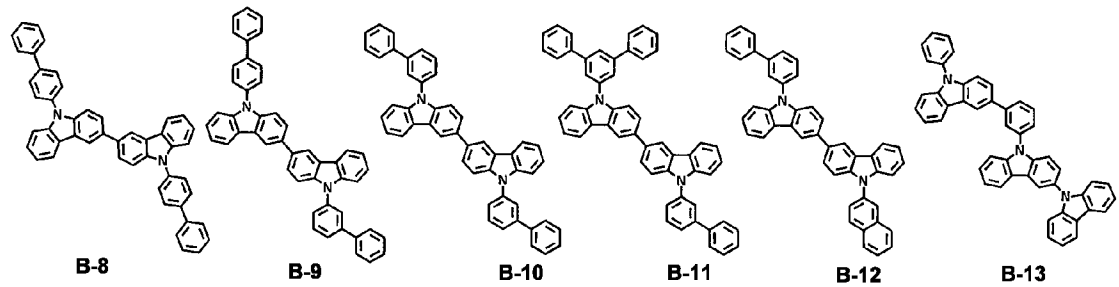

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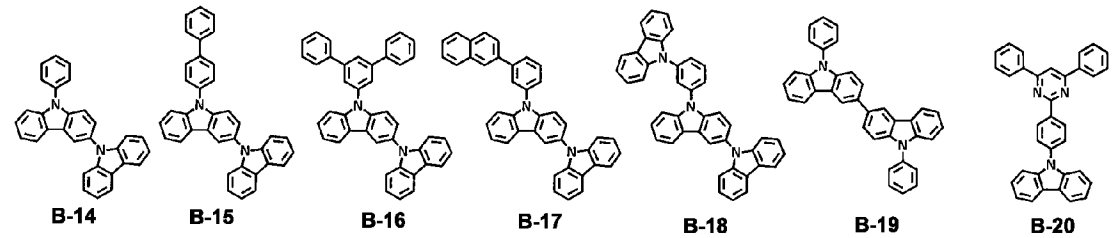

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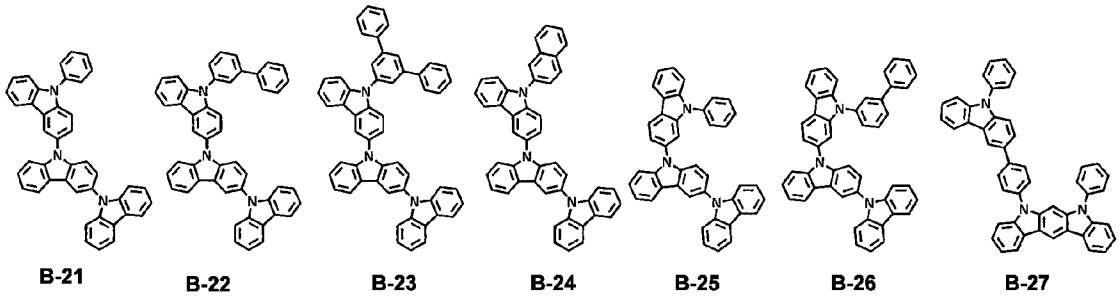

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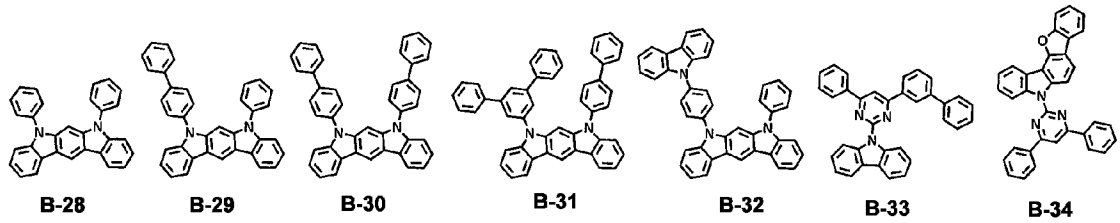

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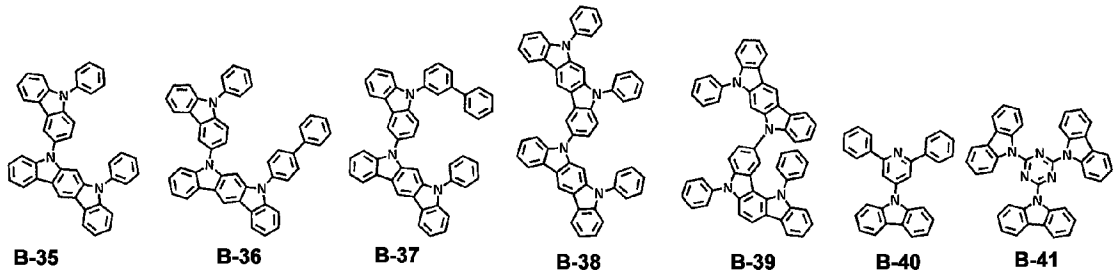

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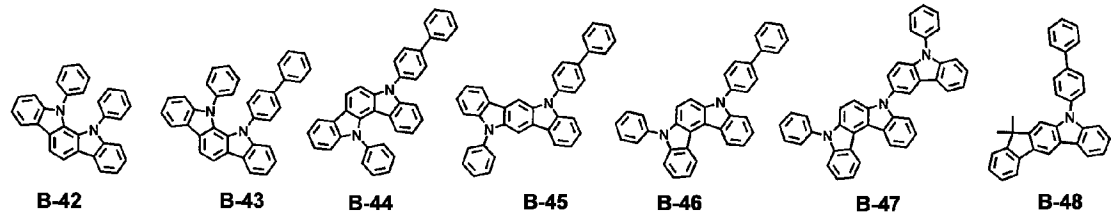

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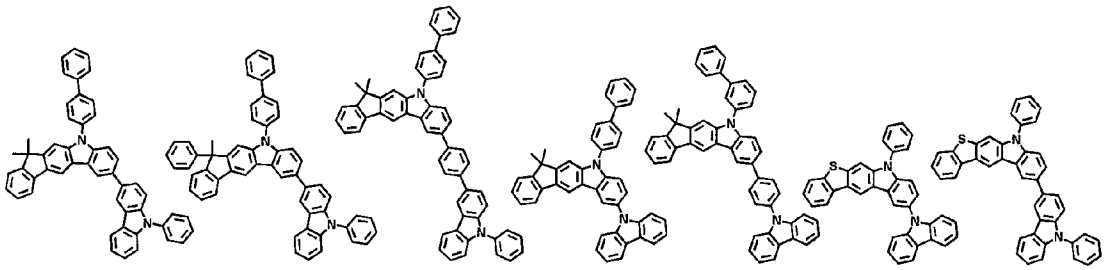

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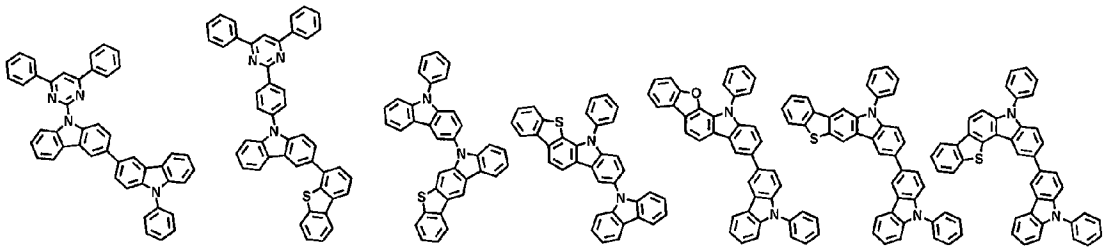

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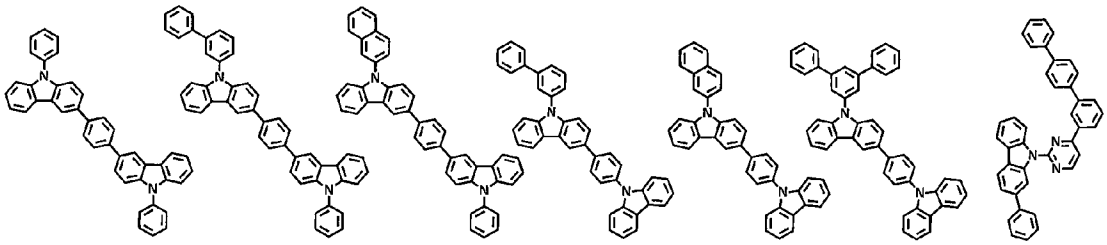

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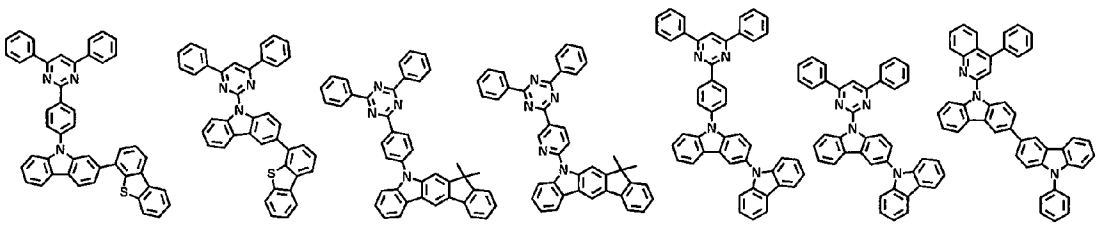

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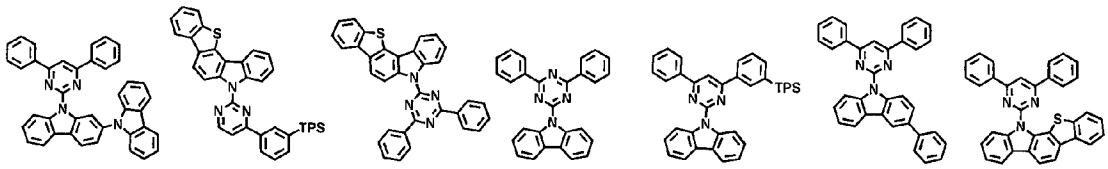

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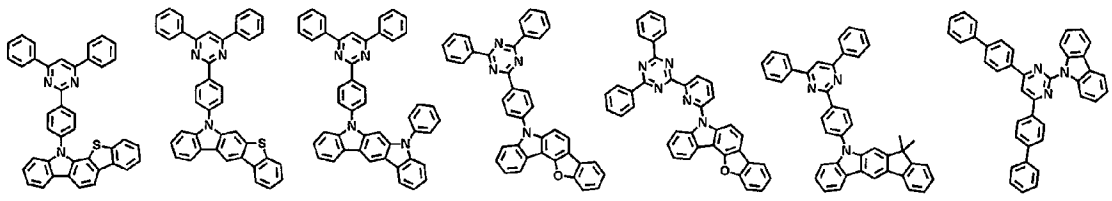

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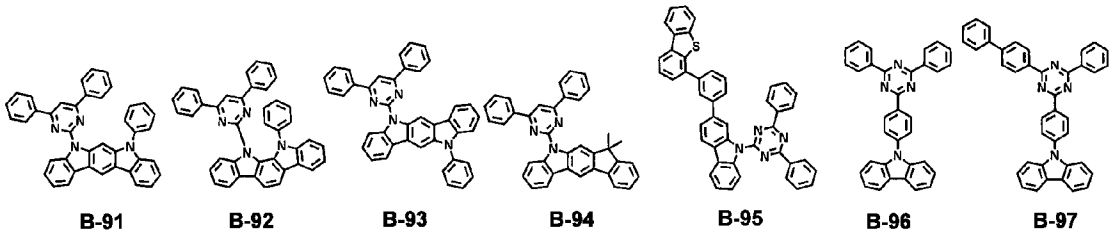

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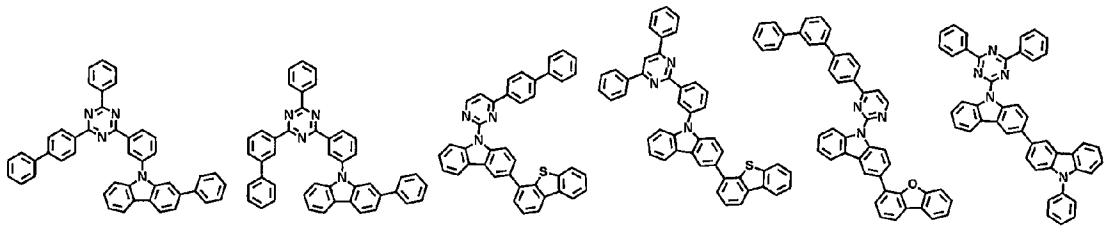

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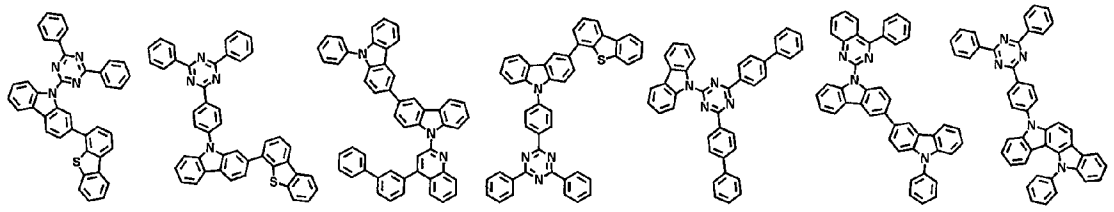

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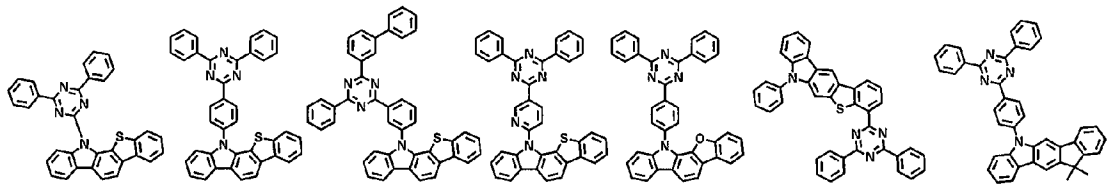

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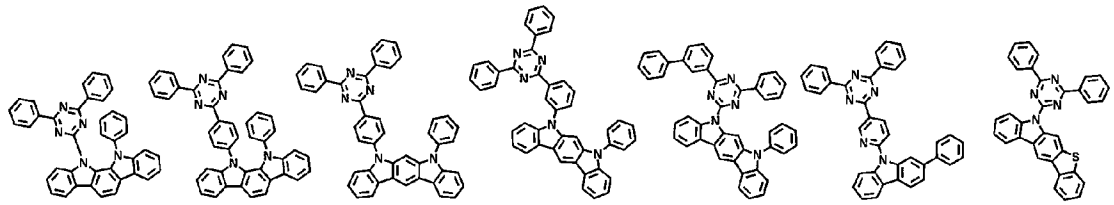

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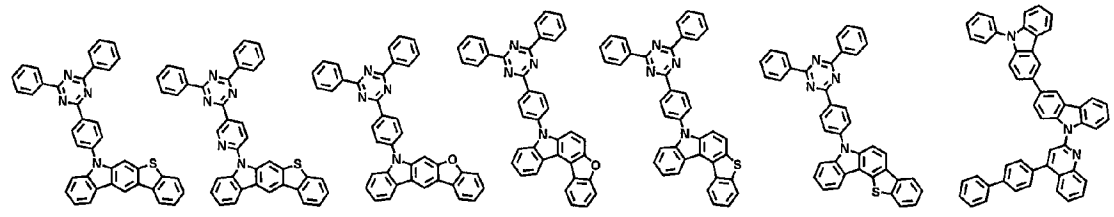

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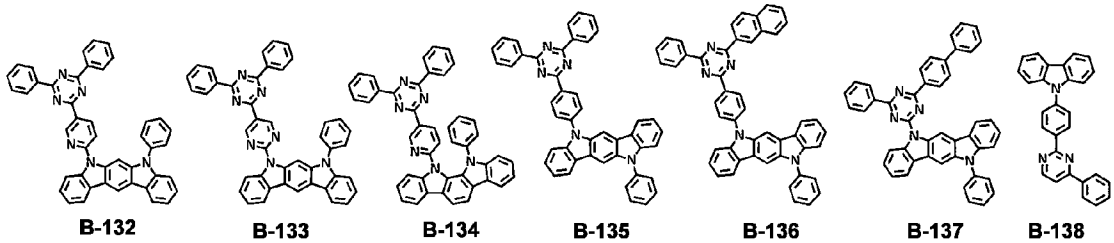

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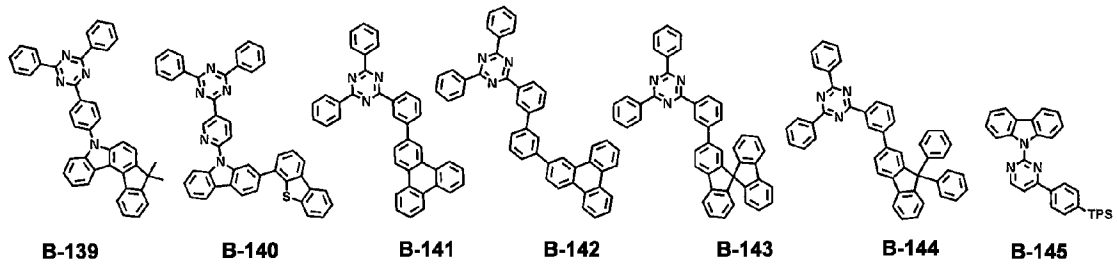

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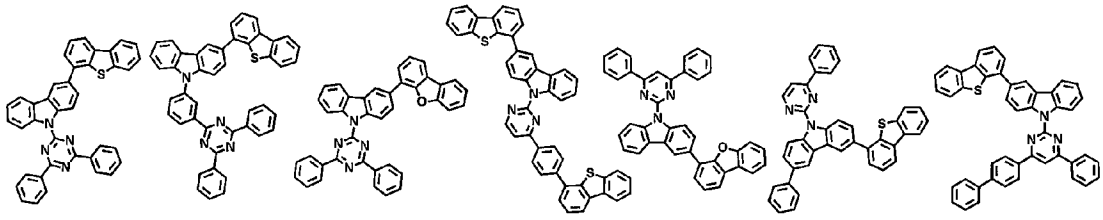

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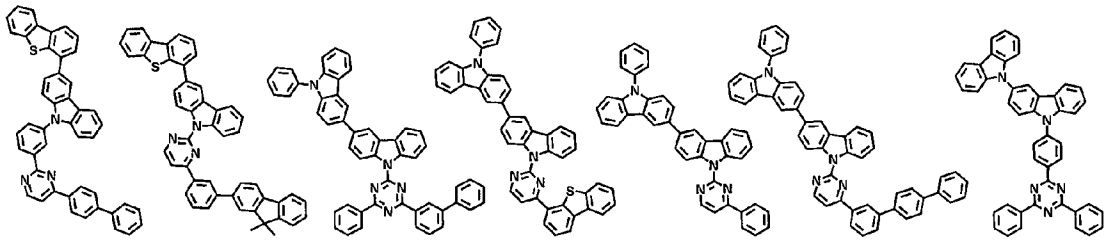

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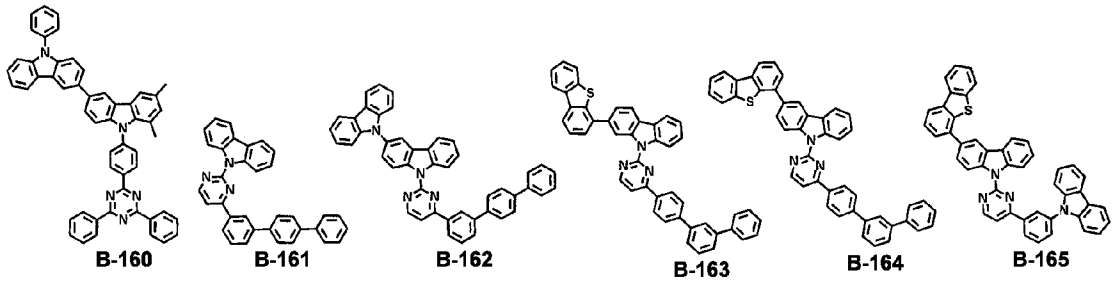

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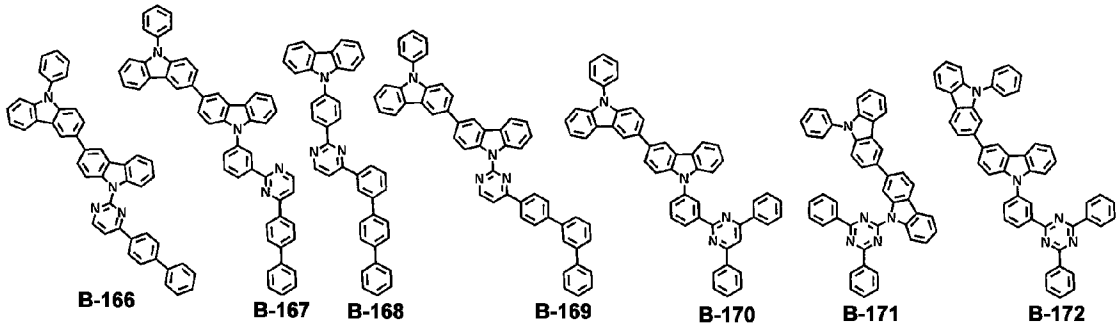

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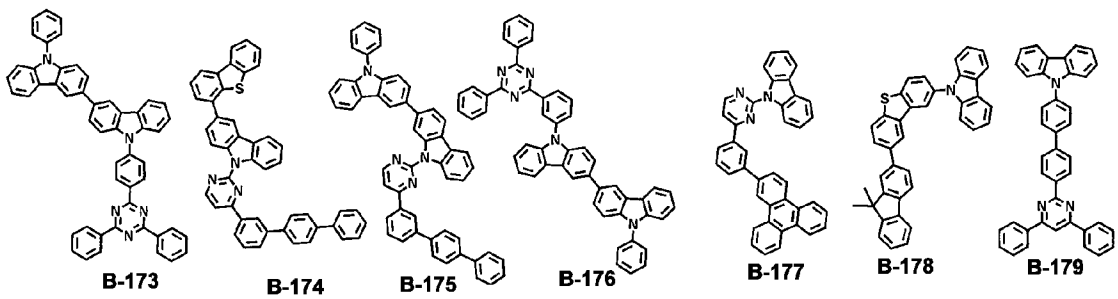

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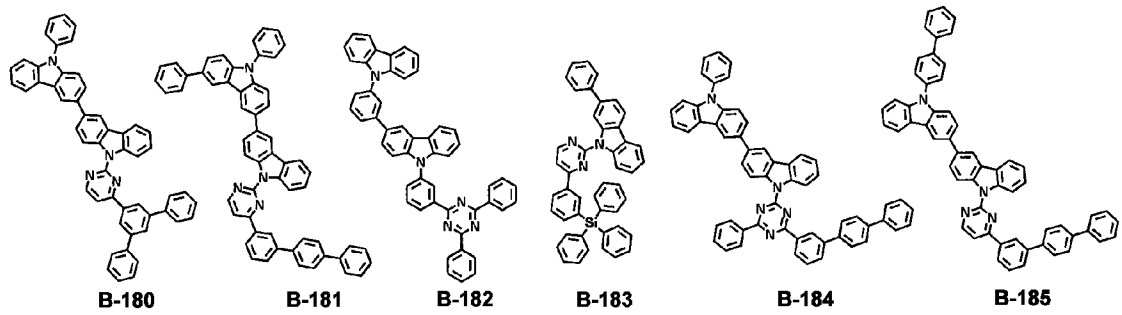

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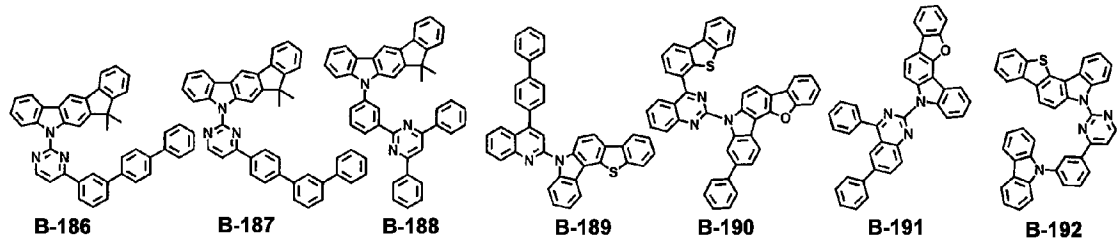

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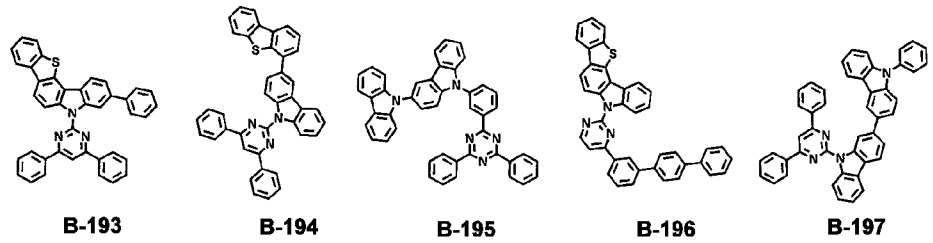
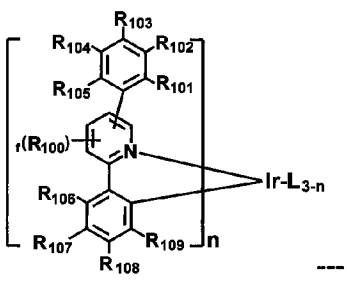


[105] [Wherein, TPS represents a triphenylsilyl group.]

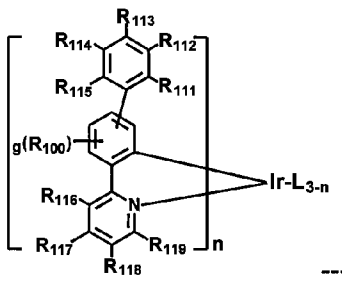
[106] The dopant comprised in the organic electroluminescent device of the present disclosure is preferably at least one phosphorescent dopant. The phosphorescent dopant material applied to the organic electroluminescent device of the present disclosure is not particulary limited, but may be preferably selected from the 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.

[107] The dopant comprised in the organic electroluminescent device of the present disclosure may comprise the compound selected from the group consisting of the compounds represented by the following formulas 101 to 103:

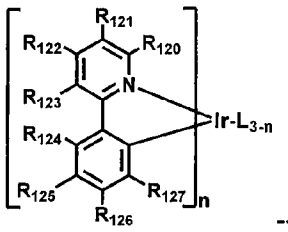
[108]



--- (101)

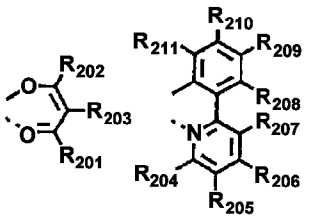


--- (102)

[109] 

--- (103)

[110] wherein, L is selected from the following structures:

[111] 

[112] R_{100} represents hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C3-C30)cycloalkyl;

[113] 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 substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C30)aryl, a cyano, or a substituted or unsubstituted (C1-C30)alkoxy; R_{106} to R_{109} may be linked to adjacent R_{106} to R_{109}, respectively, 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 R_{120} to R_{123} may be linked to adjacent R_{120} to R_{123}, respectively, to form a substituted or unsubstituted fused ring, e.g., a quinoline unsubstituted or substituted with an alkyl or an aryl;

[114] 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; and R_{124} to R_{127} may be linked to adjacent R_{124} to R_{127}, respectively, 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;

[115] R_{201} to R_{211}, each independently, represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl unsubstituted or substituted with a halogen, a substituted or unsubstituted (C3-C30)cycloalkyl, or a substituted or unsubstituted (C6-C30)aryl; and R_{208} to R_{211} may be linked to adjacent R_{208} to R_{211}, respectively, 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;

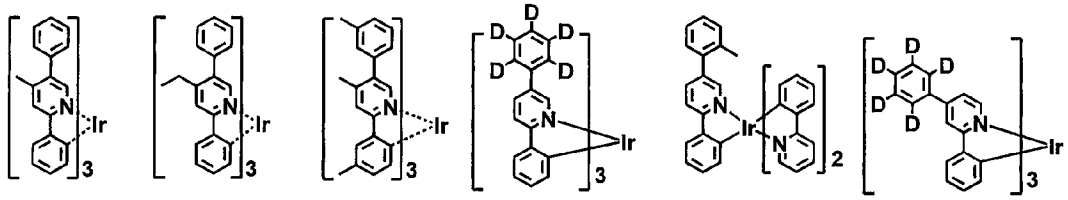
[116] f and g, each independently, represent an integer of 1 to 3; where if f or g is an

integer of 2 or more, each R_{100} may be the same or different; and

[117] n represents an integer of 1 to 3.

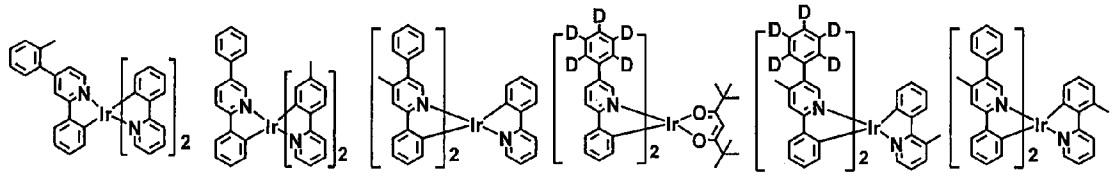
[118] The specific examples of the compound used as a dopant are as follows:

[119]



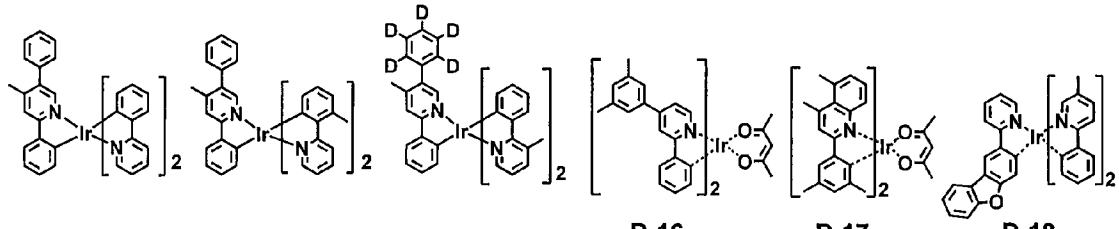
D-1 D-2 D-3 D-4 D-5 D-6

[120]



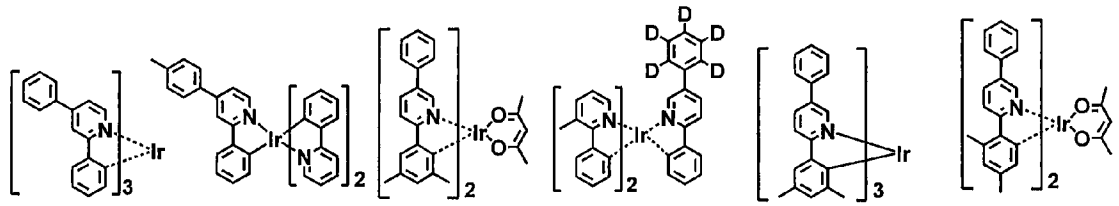
D-7 D-8 D-9 D-10 D-11 D-12

[121]



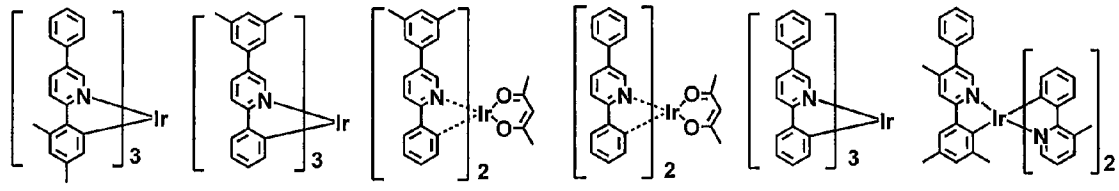
D-13 D-14 D-15 D-16 D-17 D-18

[122]



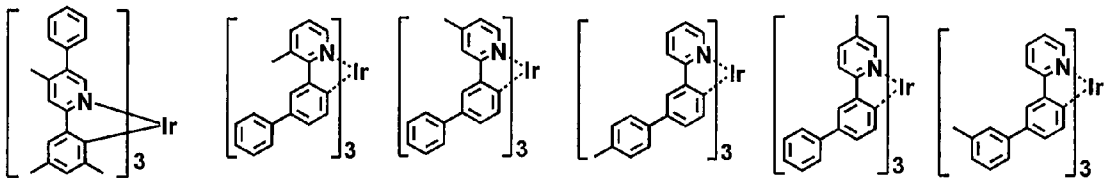
D-19 D-20 D-21 D-22 D-23 D-24

[123]



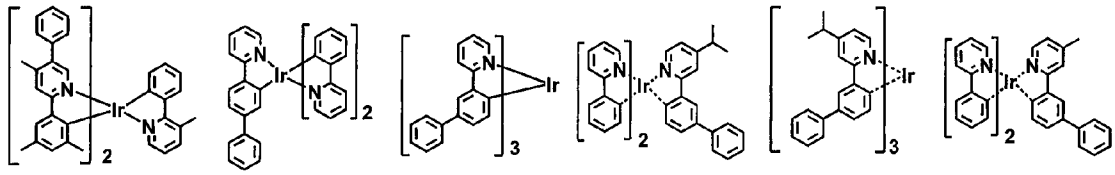
D-25 D-26 D-27 D-28 D-29 D-30

[124]



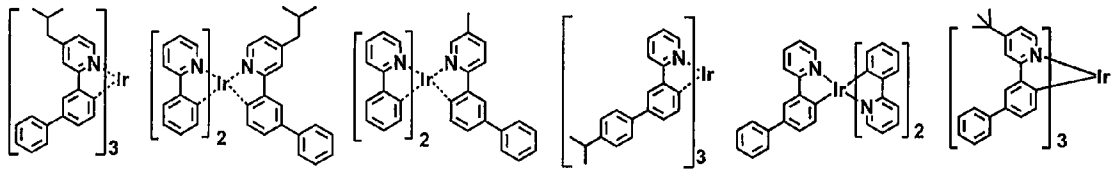
D-31 D-32 D-33 D-34 D-35 D-36

[125]



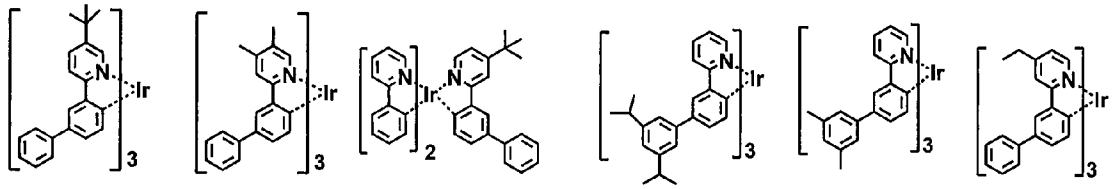
D-37 D-38 D-39 D-40 D-41 D-42

[126]



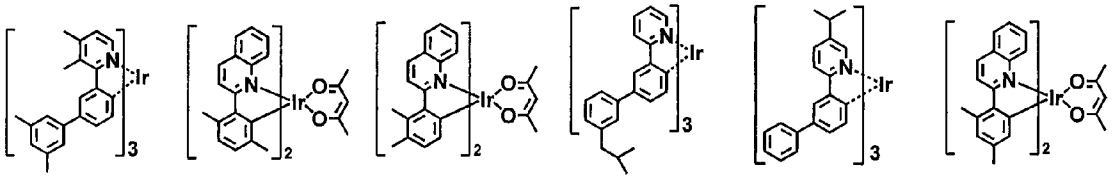
D-43 D-44 D-45 D-46 D-47 D-48

[127]



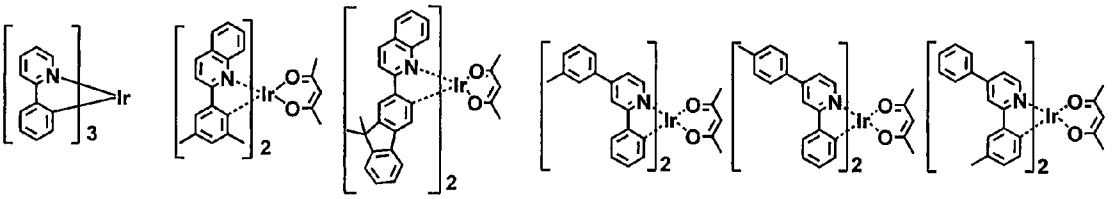
D-49 D-50 D-51 D-52 D-53 D-54

[128]



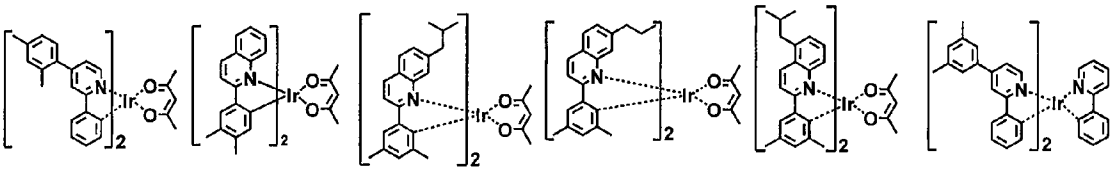
D-55 D-56 D-57 D-58 D-59 D-60

[129]



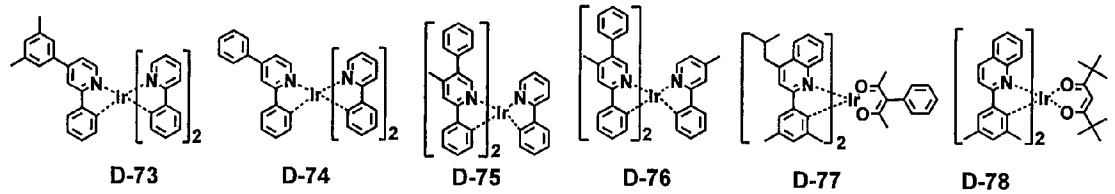
D-61 D-62 D-63 D-64 D-65 D-66

[130]



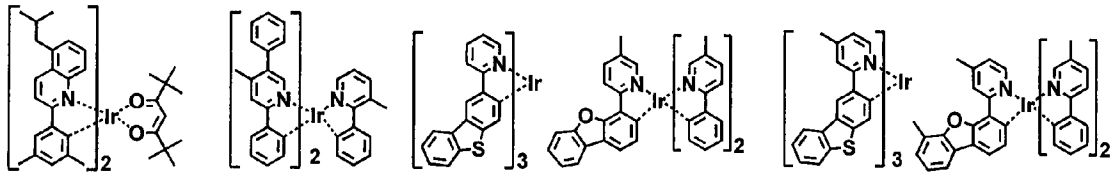
D-67 D-68 D-69 D-70 D-71 D-72

[131]



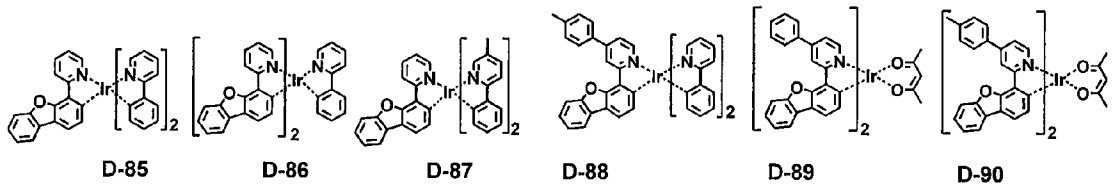
D-73 D-74 D-75 D-76 D-77 D-78

[132]



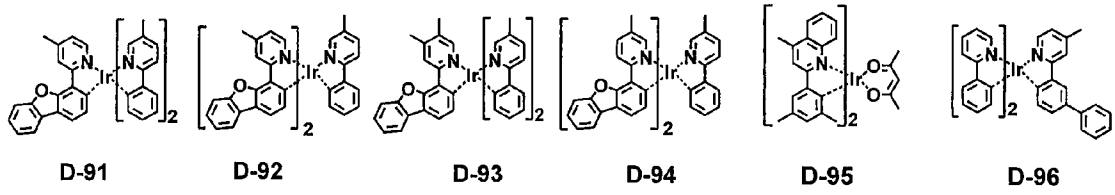
D-79 D-80 D-81 D-82 D-83 D-84

[133]



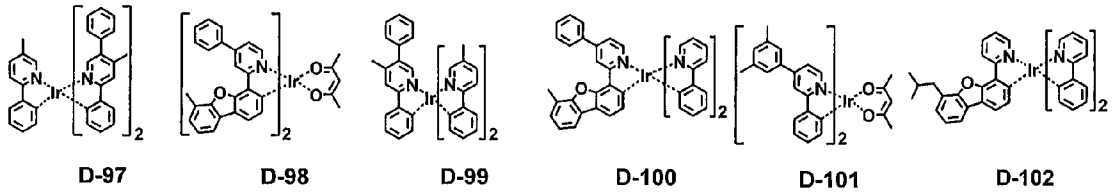
D-85 D-86 D-87 D-88 D-89 D-90

[134]



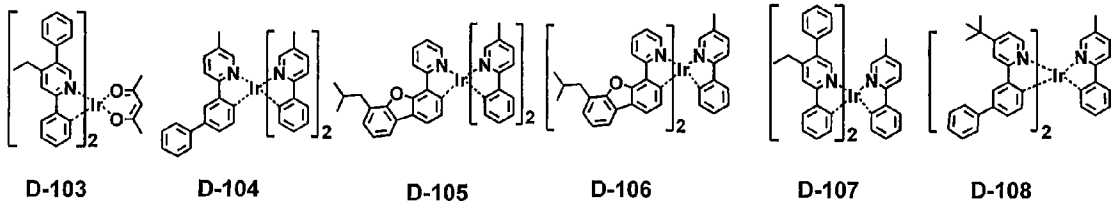
D-91 D-92 D-93 D-94 D-95 D-96

[135]



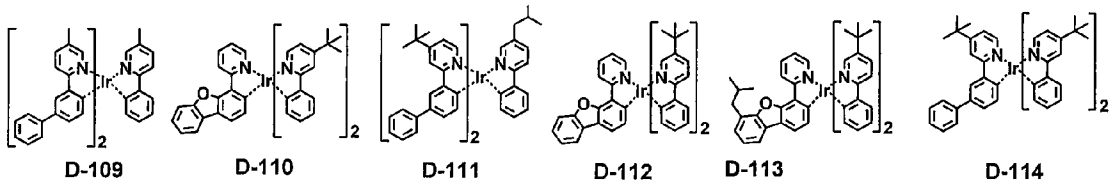
D-97 D-98 D-99 D-100 D-101 D-102

[136]



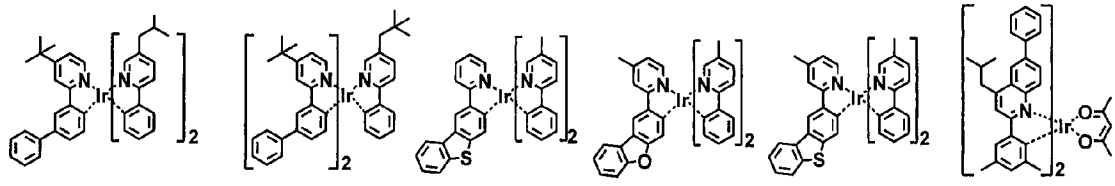
D-103 D-104 D-105 D-106 D-107 D-108

[137]



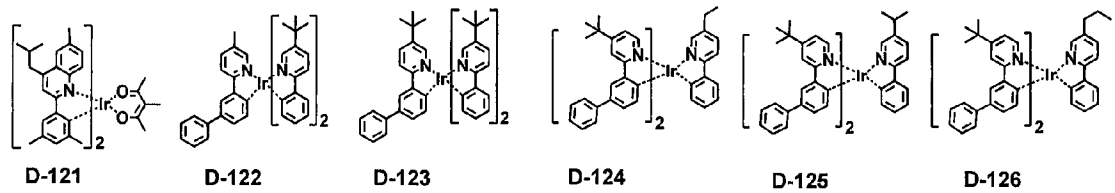
D-109 D-110 D-111 D-112 D-113 D-114

[138]



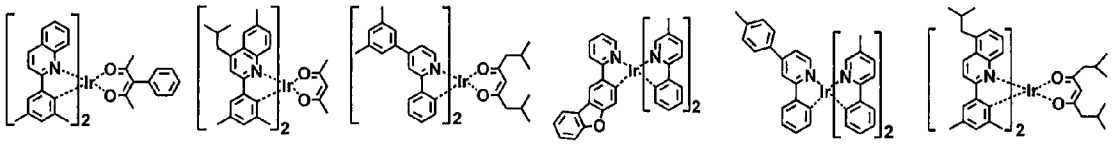
D-115 D-116 D-117 D-118 D-119 D-120

[139]



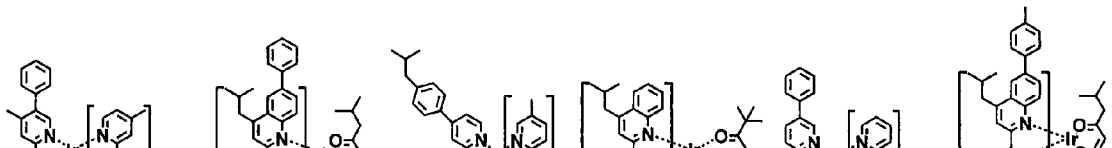
D-121 D-122 D-123 D-124 D-125 D-126

[140]



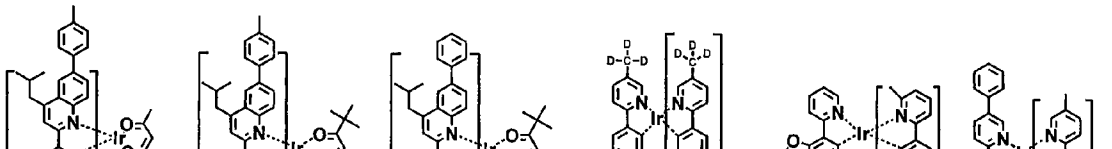
D-127 D-128 D-129 D-130 D-131 D-132

[141]



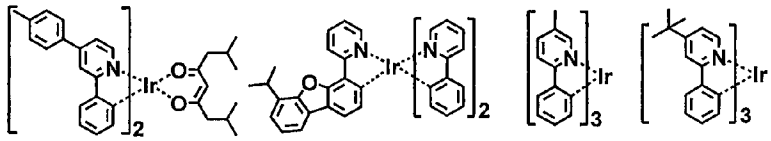
D-133 D-134 D-135 D-136 D-137 D-138

[142]



D-139 D-140 D-141 D-142 D-143 D-144

[143]



D-145 D-146 D-147 D-148.

[144] According to a further embodiment of the present disclosure, a composition for producing an organic electroluminescent device may be provided. The composition may comprise the compound of the present disclosure as a host material or a hole transport material.

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

[146] The organic electroluminescent device of the present disclosure may comprise the organic electroluminescent compound of formula 1, and further comprise at least one compound selected from the group consisting of arylamine-based compounds and styrylarylamine-based compounds, simultaneously.

[147] 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 one or more additional light-emitting layers and a charge generating layer.

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

[149] In the organic electroluminescent device of the present disclosure, preferably, at least one layer selected from a chalcogenide layer, a metal halide layer, and a metal oxide layer (hereinafter, "a surface layer") may be placed on an inner surface(s) of one or both electrode(s). 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.

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

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

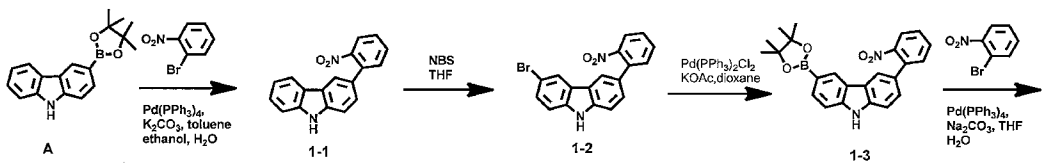
[152] When using a wet film-forming method, a thin film can be formed by dissolving or

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.

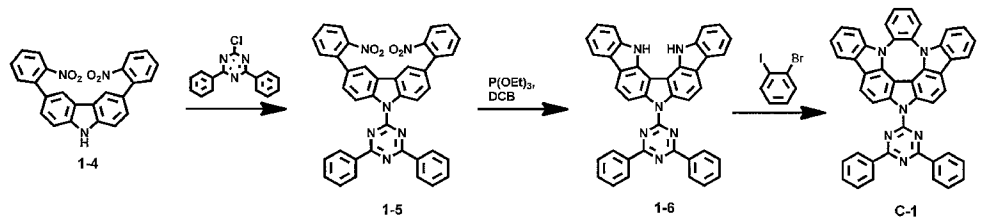
[153] Hereinafter, the preparation method of the organic electroluminescent compounds of the present disclosure, and the properties of the device comprising the compounds will be explained in detail with reference to the representative compounds of the present disclosure. However, the present disclosure is not limited by the following examples.

[154] **Example 1: Preparation of compound C-1**

[155]



[156]



[157] 1) Preparation of compound **1-1**

[158] After introducing 39 g of compound A (132 mmol), 24 g of 1-bromo-2-nitrobenzene (120 mmol), 7 g of tetrakis(triphenylphosphine)palladium (6.0 mmol), 41 g of calcium carbonate (300 mmol), 600 mL of toluene and 140 mL of ethanol into a reaction vessel, 140 mL of distilled water was added, and the mixture was stirred for 5 hours at 120°C. After completion of the reaction, toluene and ethanol were removed with a rotary evaporator, and an organic layer was extracted with methylene chloride and distilled water. The organic layer was dried with magnesium sulfate. After removing the solvent with a rotary evaporator, the resulting product was purified by column chromatography to obtain 34.4 g of compound **1-1** (yield: 91%).

[159] 2) Preparation of compound **1-2**

[160] After introducing 34.4 g of compound **1-1** (119 mmol) and 500 mL of tetrahydrofuran into a reaction vessel, the mixture was stirred at room temperature. After completely dissolving 23.3 g of N-bromosuccinimide (NBS) (131 mmol) in 300 mL of tetrahydrofuran, the solution was added dropwise to the reaction vessel. The mixture was stirred for 6 hours at room temperature. After completion of the reaction, an organic layer was extracted with methylene chloride and distilled water, and the organic layer was dried with magnesium sulfate. After removing the solvent with a rotary evaporator, the resulting product was purified by column chromatography to obtain 41 g of compound **1-2** (yield: 94%).

[161] 3) Preparation of compound **1-3**

[162] After introducing 40 g of compound **1-2** (109 mmol), 36 g of bis(pinacolato)diboron (142 mmol), 3.8 g of dichloro(triphenylphosphine)palladium (5.5 mmol), 27 g of potassium acetate (273 mmol), and 700 mL of 1,4-dioxane into a reaction vessel, and the mixture was stirred for 6 hours at 160°C. After completion of the reaction, the reaction product was cooled to room temperature, and then the solid was removed by a celite filter. After removing the solvent with a rotary evaporator, the resulting product was purified by column chromatography to obtain 36 g of compound **1-3** (yield: 80%).

[163] 4) Preparation of compound **1-4**

[164] After introducing 45 g of compound **1-3** (109 mmol), 26.4 g of 1-bromo-2-nitrobenzene (130.8 mmol), 5.5 g of tetrakis(triphenylphosphine)palladium (6.3 mmol), 18.3 g of sodium carbonate (218 mmol), and 1000 mL of tetrahydrofuran into a reaction vessel, 436 mL of distilled water was added, and the mixture was stirred for 4 hours at 100°C. After completion of the reaction, tetrahydrofuran was removed with a rotary evaporator, and an organic layer was extracted with methylene chloride and distilled water. The organic layer was dried with magnesium sulfate. After removing the solvent with a rotary evaporator, the resulting product was purified by column chromatography to obtain 34 g of compound **1-4** (yield: 76%).

[165] 5) Preparation of compound **1-5**

[166] After introducing 10 g of compound **1-4** (24.4 mmol), 7.84 g of chlorobiphenyl triazine (29.3 mmol), 10.1 g of potassium carbonate (73.2 mmol), 2.98 g of 4-dimethylaminopyridine (24.4 mmol), and 244 mL of dimethylformamide into a reaction vessel, the mixture was stirred for 5 hours at 100°C. After completion of the reaction, the mixture was cooled to room temperature, and then 200 mL of methanol and 400 mL of distilled water were introduced into the reaction solution to terminate the reaction. A solid compound was obtained through a filter. After drying the obtained solid compound, the resulting product was purified by column chromatography to obtain 11 g of compound **1-5** (yield: 69%).

[167] 6) Preparation of compound **1-6**

[168] After introducing 9.5 g of compound **1-5** (14.8 mmol), 70 mL of triethylphosphite, and 100 mL of 1,2-dichlorobenzene into a reaction vessel, the mixture was stirred for 5 hours at 200°C. After completion of the reaction, the solvent was removed by distillation under reduced pressure. The reaction product was washed with distilled water, and an organic layer was extracted with ethyl acetate. After drying the organic layer with magnesium sulfate, the solvent was removed with a rotary evaporator. The resulting product was recrystallized with ethyl acetate and methanol to obtain 5.2 g of compound **1-6** (yield: 61%).

[169] 7) Preparation of compound **C-1**

[170] After introducing 14 g of compound **1-6** (24.3 mmol), 7 g of 1-bromo-2-iodobenzene (29.2 mmol), 1.54 g of copper (24.3 mmol), 13.4 g of potassium carbonate (97.2 mmol), and 300 mL of 1,2-dichlorobenzene into a reaction vessel, the mixture was stirred for 8 hours at 200°C. After completion of the reaction, the solvent was removed by distillation under reduced pressure, and then purified by column chromatography. Thereafter, the resulting product was recrystallized with toluene to obtain 4.3 g of compound **C-1** (yield: 27%).

[171]

	MW	UV	PL	M.P.
C-1	650.75	336nm	486nm	324℃

[172] Hereinafter, the luminescent properties of the organic light-emitting diode (OLED) device comprising the compound of the present disclosure will be explained in detail. However, the present disclosure is not limited by the following examples.

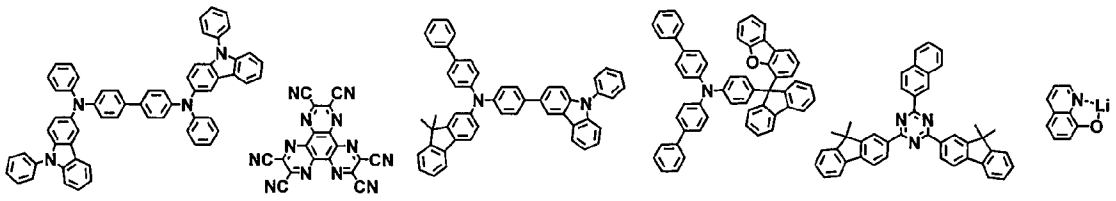
[173] **Device Example 1-1: Producing an OLED device comprising the compound of**

[174] **the present disclosure as a host**

[175] An OLED device was produced by using the organic electroluminescent compound according to the present disclosure. A transparent electrode indium tin oxide (ITO) thin film (10 Ω/sq) on a glass substrate for an OLED device (GEOMATEC CO., LTD., Japan) was subjected to an ultrasonic washing with acetone, ethanol, and distilled water, sequentially, and then was stored in isopropanol. The ITO substrate was then mounted on a substrate holder of a vacuum vapor deposition apparatus. Compound **HI-1** was introduced into a cell of the vacuum vapor deposition apparatus, and then the pressure in the chamber of the 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 80 nm on the ITO substrate. Next, compound **HI-2** was introduced into another cell of the vacuum vapor deposition 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 then introduced into another cell of the vacuum vapor deposition 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 **HT-2** was then introduced into another cell of the vacuum vapor deposition apparatus, and was evaporated by applying an electric current to the cell, thereby forming a second hole transport layer having a thickness of 30 nm on the first hole transport layer. After forming the hole injection layer and the hole transport layer, a light-emitting layer was formed thereon as follows: Compound **C-1** was introduced into one cell of the vacuum vapor depositing apparatus as a host, and compound **D-74** was introduced into another cell as a

dopant. The two materials were evaporated at a different rate, and the dopant was deposited in a doping amount of 10 wt% 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, and respectively evaporated at a rate of 4:6 to form an electron transport layer having a thickness of 35 nm on the light-emitting layer. After depositing compound **EI-1** as an electron injection layer having a thickness of 2 nm on the electron transport layer, an Al cathode having a thickness of 80 nm was deposited on the electron injection layer by another vacuum vapor deposition apparatus. Thus, an OLED device was produced. Each of the materials used for producing the OLED device was purified by vacuum sublimation at 10^{-6} torr.

[176]



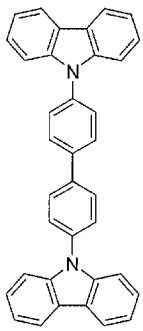
HI-1 HI-2 HT-1 HT-2 ET-1 EI-1

[177] **Comparative Example 1-1: Producing an OLED device using a conventional**

[178] **luminescent material as a host**

[179] An OLED device was produced in the same manner as in Device Example 1-1, except for using the following compound **CBP** as a host.

[180]



CBP

[181] The driving voltage, the luminous efficiency, the power efficiency, and the CIE color coordinate based on 10 mA/cm^2 of the OLED devices produced as set forth above are provided in Table 1 below.

[182] **[Table 1]**

	Host	Voltage [V]	Luminous Efficiency [cd/A]	Power Efficiency [lm/W]	Color Coordinate (x, y)
Device Example 1-1	C-1	4.4	72	52	0.430, 0.557
Comparative Example 1-1	CBP	8.6	51	18	0.413, 0.570

[183] **Device Example 2-1: Producing an OLED device comprising the compound of**

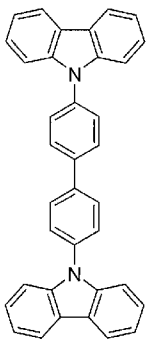
[184] the present disclosure as a host

[185] An OLED device was produced in the same manner as in Device Example 1-1, except for using compound **D-1** as a dopant.

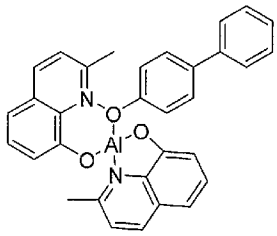
[186] **Comparative Example 2-1: Producing an OLED device using a conventional**

[187] **luminescent material as a host**

[188] An OLED device was produced in the same manner as in Device Example 1-1, except for the following: A light-emitting layer having a thickness of 40 nm was deposited on the second hole transport layer by using compound **CBP** as a host and compound **D-1** as a dopant; compound **Balq** was deposited as a hole blocking layer having a thickness of 10 nm; and thereafter, compound **ET-1** and compound **EI-1** were introduced into another two cells, and evaporated at a rate of 4:6 to form an electron transport layer having a thickness of 25 nm on the light-emitting layer.

[189] 

CBP



Balq

[190] The driving voltage, the luminous efficiency, the power efficiency, and the CIE color coordinate based on a luminance of 1,000 nits of the OLED devices produced as set forth above are provided in Table 2 below.

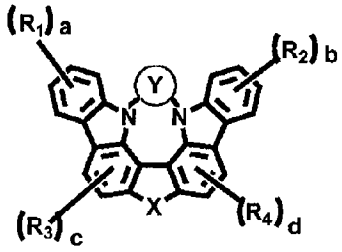
[191] **[Table 2]**

	Host	Voltage [V]	Luminous Efficiency [cd/A]	Power Efficiency [lm/W]	Color Coordinate (x,y)
Device Example 2-1	C-1	3.2	52.3	51.3	0.320, 0.659
Comparative Example 2-1	CBP	5.5	43.2	24.7	0.304, 0.669

[192] From the Device Examples and the Comparative Examples above, it can be seen that the OLED device comprising the organic electroluminescent compound of the present disclosure has low driving voltage, and excellent power and luminous efficiencies, compared to the OLED device using a conventional organic electroluminescent compound.

Claims

[Claim 1] An organic electroluminescent compound represented by the following formula 1:



---------- (1)

wherein

ring Y represents a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (3- to 30-membered)heteroaryl;

X represents O, S or NR_5;

R_1 to R_4, each independently, represent hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted mono- or di-(C1-C30)alkylamino, a substituted or unsubstituted mono- or di-(C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino; or are linked to adjacent R_1 to R_4 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 heteroatom selected from nitrogen, oxygen, and sulfur;

R_5 represents hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, a substituted or unsubstituted (3- to 30-membered)heteroaryl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsub-

stituted tri(C6-C30)arylsilyl, a substituted or unsubstituted mono- or di-(C1-C30)alkylamino, a substituted or unsubstituted mono- or di-(C6-C30)arylamino, or a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino;

the heteroaryl contains at least one heteroatom selected from B, N, O, S, Si, and P; and

a and b, each independently, represent an integer of 1 to 4, and c and d, each independently, represent an integer of 1 or 2; where if a to d, each independently, represent an integer of 2 or more, each of R_1 to R_4 may be the same or different.

[Claim 2] The organic electroluminescent compound according to claim 1, wherein the substituents of the substituted alkyl, the substituted aryl, the substituted heteroaryl, the substituted cycloalkyl, the substituted alkoxy, the substituted trialkylsilyl, the substituted dialkylarylsilyl, the substituted alkyldiarylsilyl, the substituted triarylsilyl, the substituted mono- or di- alkylamino, the substituted mono- or di- arylamino, the substituted alkylarylamino, and the substituted mono- or polycyclic, alicyclic or aromatic ring, or the combination thereof, in ring Y, and R_1 to R_5, 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 (3- to 30-membered)heteroaryl unsubstituted or substituted with a (C1-C30)alkyl or a (C6-C30)aryl; a (C6-C30)aryl unsubstituted or substituted with a (3- 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; 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 compound according to claim 1, wherein ring Y represents a substituted or unsubstituted benzene, a substituted or unsubstituted pyridine, a substituted or unsubstituted

pyrimidine, a substituted or unsubstituted pyrazine, a substituted or unsubstituted thiophene, or a substituted or unsubstituted furan.

[Claim 4] The organic electroluminescent compound according to claim 1, wherein

ring Y represents a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl;

R_1 to R_4, each independently, represent hydrogen, a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl;

R_5 represents a substituted or unsubstituted (C6-C25)aryl, or a substituted or unsubstituted (5- to 25-membered)heteroaryl; and

a to d, each independently, represent an integer of 1.

[Claim 5] The organic electroluminescent compound according to claim 1, wherein

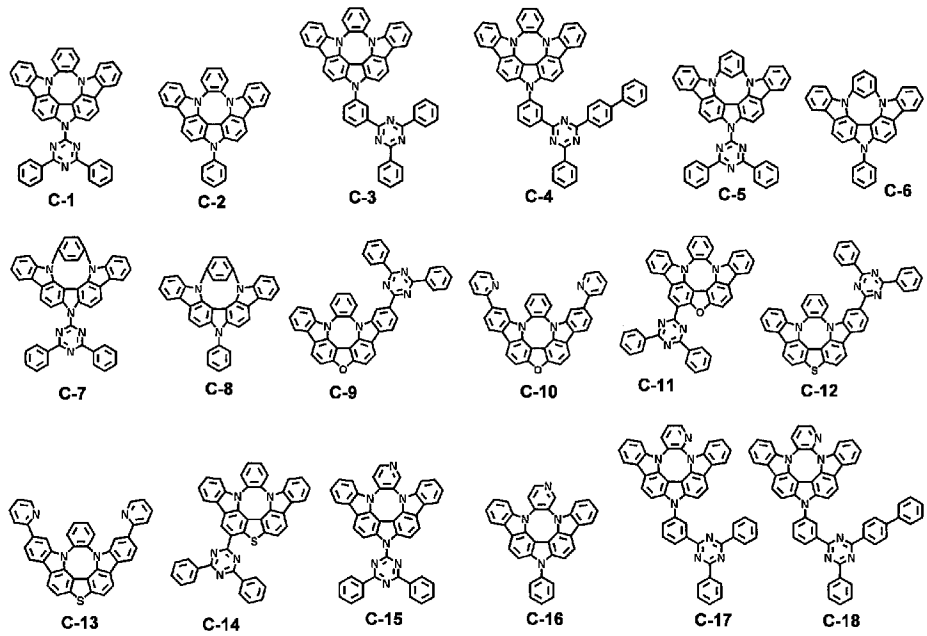
ring Y represents a substituted or unsubstituted (C6-C18)aryl, or a substituted or unsubstituted (5- to 18-membered)heteroaryl;

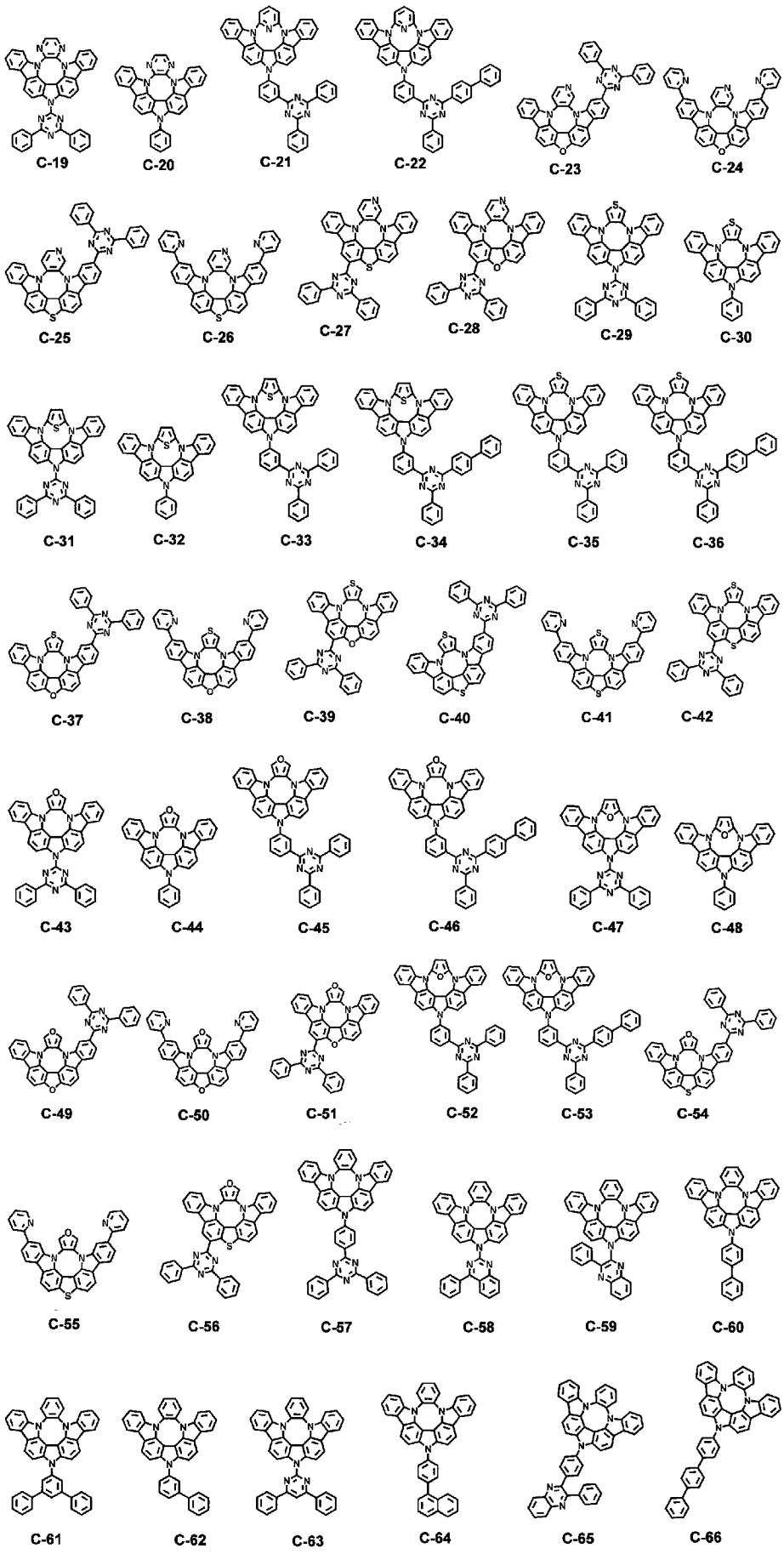
R_1 to R_4, each independently, represent hydrogen, or a substituted or unsubstituted (5- to 18-membered)heteroaryl;

R_5 represents a substituted or unsubstituted (C6-C18)aryl, or a substituted or unsubstituted (5- to 18-membered)heteroaryl; and

a to d, each independently, represent an integer of 1.

[Claim 6] The organic electroluminescent compound according to claim 1, wherein the compound represented by formula 1 is selected from the group consisting of:

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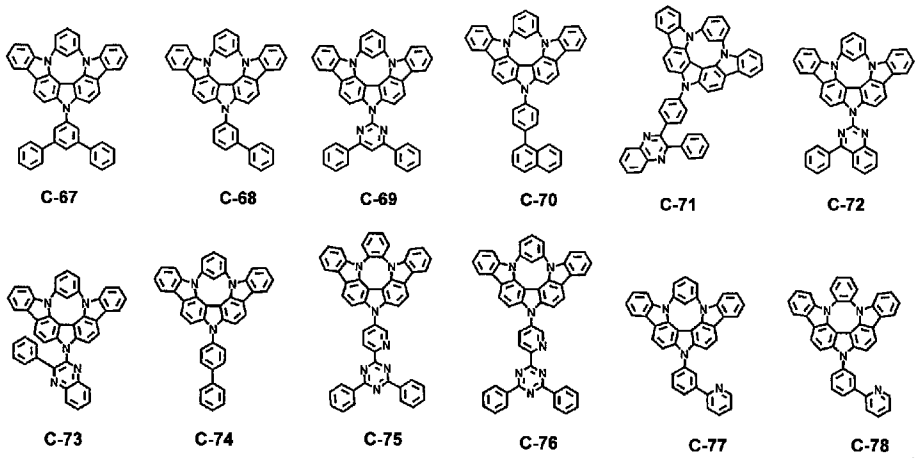

[Claim 7] A host material comprising the organic electroluminescent compound according to claim 1.

[Claim 8] An organic electroluminescent device comprising the organic electroluminescent compound according to claim 1.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2016/014458

A. CLASSIFICATION OF SUBJECT MATTER

C07D 487/22 (2006.01) ***C07D 491/22 (2006.01)*** ***C07D 495/22 (2006.01)*** ***C07D 498/22 (2006.01)*** ***C07D 513/22 (2006.01)***
C07D 515/22 (2006.01) ***H01L 51/50 (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)

STN: Caplus, Registry: Substructure search of formula 1; and Keywords OLED, lumin?

Espacenet: Applicant/Inventor search and CPC: H01L2251/5384, H01L51/5056

Internal databases provided by IP Australia: Applicant/Inventor

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	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 March 2017	27 March 2017
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Marica Nikac AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61 2 62832087

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/KR2016/014458**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2014/098455 A1 (DOOSAN CORPORATION) 26 June 2014 Abstract; formula I, paragraph [11], page 2; paragraph [49], page 12; compounds in paragraphs [49]-[53], pages 12-16	1-8
A	KR 10-2012-0098561 A (DOOSAN CORPORATION) 05 September 2012 see compounds in paragraphs [0050]-[0068], pages 13-69	1-8
A	KR 10-2015-0121337 A (DUK SAN NEOLUX CO. LTD.) 29 October 2015 Title; Abstract; claim 1, page 3; see compounds 1-1, 1-2, 1-3, and 1-4 of claim 3, page 4; see also pages 5-9	1-8

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/KR2016/014458**

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 2014/098455 A1	26 June 2014	WO 2014098455 A1	26 Jun 2014
		KR 20140079594 A	27 Jun 2014
		KR 101601355 B1	09 Mar 2016
KR 10-2012-0098561 A	05 September 2012	None	
KR 10-2015-0121337 A	29 October 2015	None	

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.