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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 according to the present disclosure can provide an organic electroluminescent device which has low driving voltage, good luminous efficiency including good current efficiency and good power efficiency, high color purity, and improved lifespan.



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Description

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

Technical Field

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

Background Art

- [2] An electroluminescent (EL) device is a self-light-emitting device which has advantages in that it provides a wider viewing angle, a greater contrast ratio, and a faster response time. An organic EL device was first developed by Eastman Kodak, by using small aromatic diamine molecules and aluminum complexes as materials to form a light-emitting layer [Appl. Phys. Lett. 51, 913, 1987].
- [3] The most important factor determining luminous efficiency in the organic EL device is light-emitting materials. Until now, fluorescent materials have been widely used as light-emitting material. However, in view of electroluminescent mechanisms, since phosphorescent materials theoretically enhance luminous efficiency by four (4) times compared to fluorescent materials, phosphorescent light-emitting materials have been widely researched. Iridium(III) complexes have been widely known as phosphorescent 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)picolate iridium (Firpic) as red-, green-, and blue-emitting materials, respectively.
- [4] At present, 4,4'-N,N'-dicarbazol-biphenyl (CBP) is the most widely known host material for phosphorescent materials. Recently, Pioneer (Japan) et al., developed a high performance organic EL device using bathocuproine (BCP) and aluminum(III) bis(2-methyl-8-quinolate)(4-phenylphenolate) (BALq), etc., as host materials, which were known as hole blocking materials.
- [5] Although these materials provide good 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. (2) The power efficiency of the organic EL device is given by $[(\pi/\text{voltage}) \times \text{current efficiency}]$, and the power efficiency is inversely proportional to the voltage. Although the organic EL device comprising phosphorescent host materials provides higher current efficiency (cd/A) than one comprising fluorescent materials, a

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

- [6] Meanwhile, copper phthalocyanine (CuPc), 4,4'-bis[N-(1-naphthyl)-N-phenylamino]biphenyl (NPB), N,N'-diphenyl-N,N'-bis(3-methylphenyl)-(1,1'-biphenyl)-4,4'-diamine (TPD), 4,4',4''-tris(3-methylphenylphenylamino)triphenylamine (MTDATA), etc., were used as a hole injection and transport material of the organic EL device. However, the organic EL device using these materials is problematic in quantum efficiency and operational lifespan. It is because, when the organic EL device is driven under high current, thermal stress occurs between an anode and a hole injection layer. Thermal stress significantly reduces the operational lifespan of the device. Furthermore, since the organic material used in the hole injection layer has very high hole mobility, the hole-electron charge balance may be broken and quantum yield (cd/A) may decrease.
- [7] Japanese Patent Application Laying-Open No. 2013-93432 discloses a carbazole- or biscarbazole-based compound having a triphenylsilyl group. However, it fails to teach a compound having a biscarbazole backbone in which a nitrogen atom of a carbazole is bonded to a nitrogen-containing heteroaryl group or an aryl group and a nitrogen atom of the other carbazole is bonded to a silyl-substituted heteroaryl group or a silyl-substituted aryl group.

Disclosure of Invention

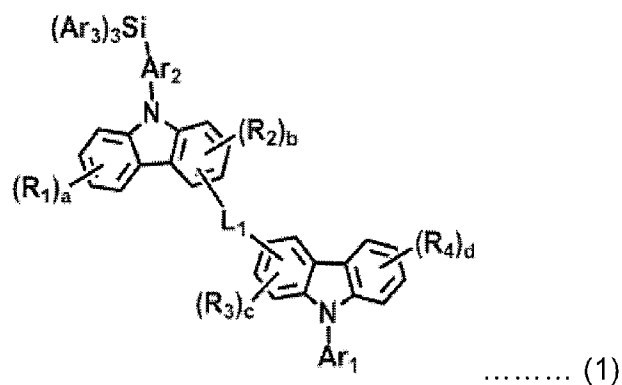
Technical Problem

- [8] The objective of the present disclosure is to provide an organic electroluminescent compound, which can provide an organic electroluminescent device having long lifespan, low driving voltage, good luminous efficiency such as current efficiency and power efficiency, and high color purity, and an organic electroluminescent device comprising the same.

Solution to Problem

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

[10]



[11] wherein

[12] Ar_1 represents a substituted or unsubstituted nitrogen-containing 5- to 30-membered heteroaryl, or a substituted or unsubstituted (C6-C30)aryl;[13] Ar_2 and Ar_3 , each independently, represent a substituted or unsubstituted 5- to 30-membered heteroaryl, or a substituted or unsubstituted (C6-C30)aryl;[14] L_1 represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted 3- to 30-membered heteroarylene;[15] R_1 to R_4 , each independently, represent hydrogen, deuterium, a halogen, a cyano, a carboxy, a nitro, a hydroxy, 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, a substituted or unsubstituted 3- to 30-membered heteroaryl, a substituted or unsubstituted mono(C6-C30)arylamino, a substituted or unsubstituted mono(C1-C30)alkylamino, $-NR_5R_6$, or $-SiR_7R_8R_9$, or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted, (C3-C30), mono- or polycyclic, alicyclic or aromatic ring;[16] R_5 to R_9 , each independently, represent a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted 3- to 30-membered heteroaryl;

[17] the carbon atom(s) of the alicyclic or aromatic ring may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

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

[19] a and d, each independently, represent an integer of 1 to 4; where a or d is an integer of 2 or more, each of R_1 or R_4 may be the same or different; and[20] b and c, each independently, represent an integer of 1 to 3; where b or c is an integer of 2 or more, each of R_2 or R_3 may be the same or different.

Advantageous Effects of Invention

[21] The organic electroluminescent compound according to the present disclosure can

provide an organic electroluminescent device which has low driving voltage, good luminous efficiency including good current efficiency and good power efficiency, high color purity, and improved lifespan.

Mode for the Invention

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

[23] Herein, “(C1-C30)alkyl” indicates a linear or branched alkyl having 1 to 30, preferably 1 to 10, and more preferably 1 to 6 carbon atoms, and includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, etc. “(C3-C30)cycloalkyl” indicates a mono- or polycyclic hydrocarbon having 3 to 30, preferably 3 to 20, and more preferably 3 to 7 ring backbone carbon atoms and includes cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, etc. “3- to 7-membered heterocycloalkyl” indicates a cycloalkyl having 3 to 7 ring backbone atoms including at least one hetero atom selected from B, N, O, S, Si, and P, preferably O, S, and N, and includes tetrahydrofuran, pyrrolidine, thiolan, tetrahydropyran, etc. Furthermore, “(C6-C30)aryl(ene)” indicates a monocyclic or fused ring radical having 6 to 30, preferably 6 to 20, and more preferably 6 to 15 ring backbone carbon atoms and derived from an aromatic hydrocarbon. The aryl includes phenyl, biphenyl, terphenyl, naphthyl, binaphthyl, phenylnaphthyl, naphthylphenyl, fluorenyl, phenylfluorenyl, benzofluorenyl, dibenzofluorenyl, spirobifluorenyl, phenanthrenyl, phenylphenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, etc. “3- to 30-membered or 5- to 30-membered heteroaryl(ene)” indicates an aryl group having 3 to 30 or 5 to 30, preferably 5 to 20 ring backbone atoms including at least one, preferably 1 to 4, hetero atom selected from the group consisting of B, N, O, S, Si, and P, preferably N, O, and S; may be a monocyclic ring, or a fused ring condensed with at least one benzene ring; may be partially saturated; may be one formed by linking at least one heteroaryl or aryl group to a heteroaryl group via a single bond(s); and includes a monocyclic ring-type heteroaryl such as furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidyl, pyridazinyl, etc., and a fused ring-type heteroaryl such as benzofuranyl, benzothiophenyl, isobenzofuranyl, dibenzofuranyl, dibenzothiophenyl, benzonaphthothiophenyl, benzoimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, phenoxazinyl, phenanthridinyl, benzodioxolyl, etc. Furthermore, “halogen” includes F,

Cl, Br, and I.

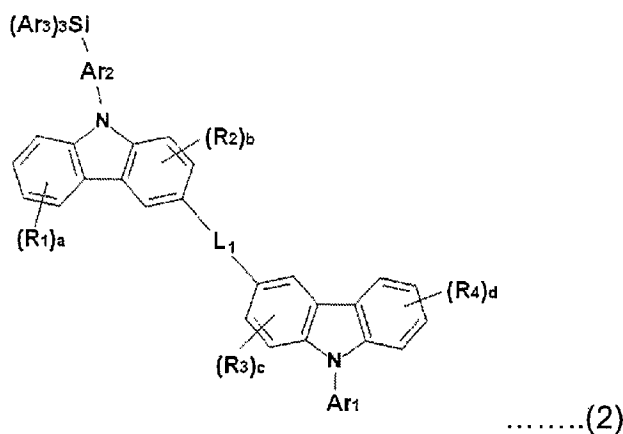
[24] Herein, “substituted” in the expression, “substituted or unsubstituted,” means that a hydrogen atom in a certain functional group is replaced with another atom or group, i.e. a substituent. In the present disclosure, the substituents for the substituted alkyl, the substituted cycloalkyl, the substituted cycloalkenyl, the substituted heterocycloalkyl, the substituted aryl(ene), the substituted heteroaryl(ene), the substituted monoarylamine, the substituted monoalkylamine, and the substituted mono- or polycyclic, alicyclic or aromatic ring, each independently, may be at least one selected from the group consisting of deuterium, a halogen, a cyano, a carboxy, a nitro, a hydroxy, a (C1-C30)alkyl, a halo(C1-C30)alkyl, a (C1-C30)alkoxy, a (C1-C30)alkylthio, a (C3-C30)cycloalkyl, 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 (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)arylcabonyl, 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.

[25] The present disclosure relates to an organic electroluminescent compound represented by formula 1, an organic electroluminescent material comprising the organic electroluminescent compound, and an organic electroluminescent device comprising the compound.

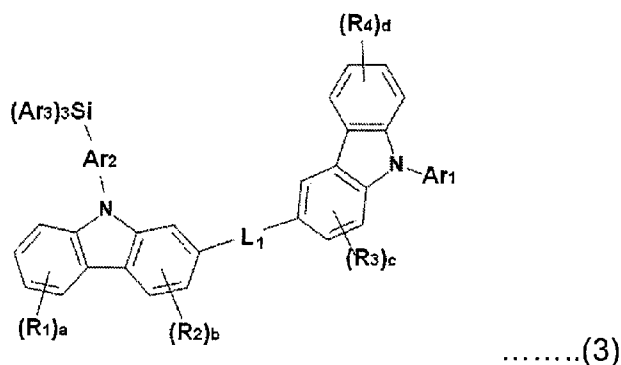
[26] The organic electroluminescent compound represented by formula 1 will be described in detail.

[27] Preferably, the compound of formula 1 may be represented by any one of the following formulae 2 to 5:

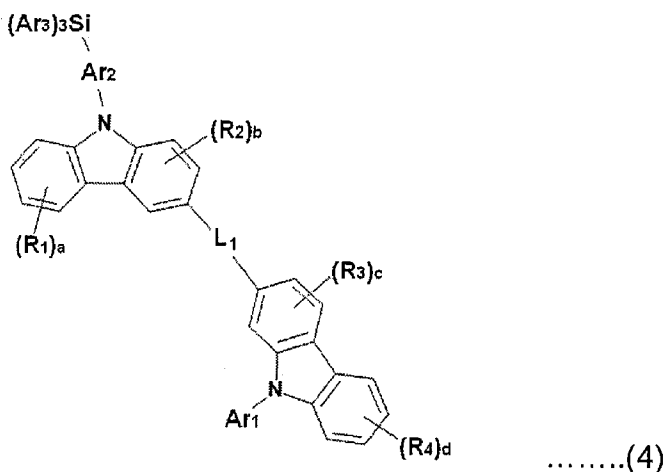
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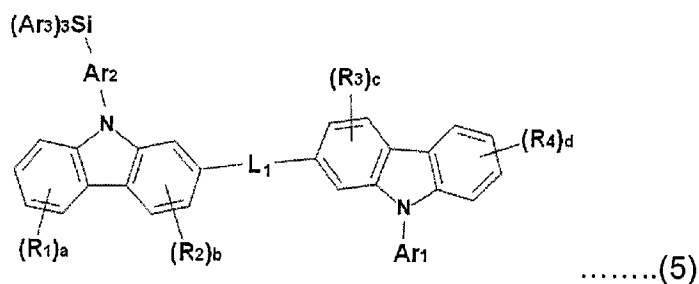
[29]



[30]

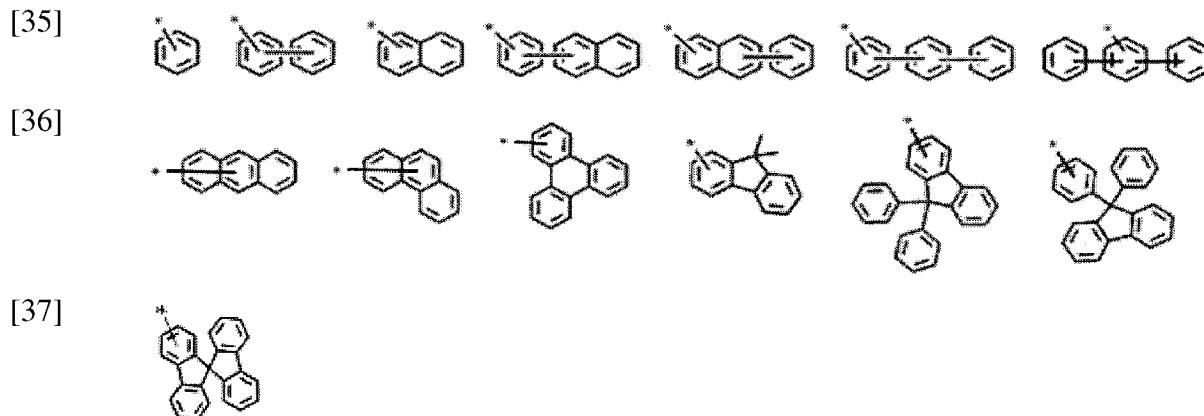


[31]

[32] wherein Ar₁ to Ar₃, L₁, and R₁ to R₄ are as defined in formula 1 above.

[33] Specifically, the compound of formula 1 may be represented by formula 2 above.

[34] Ar₁ may represent preferably, a substituted or unsubstituted (C₆-C₃₀)aryl; and more preferably, a (C₆-C₁₈)aryl unsubstituted or substituted with a (C₁-C₁₀)alkyl or a (C₆-C₁₈)aryl. Specifically, Ar₁ may represent a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted terphenyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted phenanthrenyl, a substituted or unsubstituted tetracenyl, a substituted or unsubstituted triphenylenyl, a substituted or unsubstituted chrysenyl, a substituted or unsubstituted pyrenyl, a substituted or unsubstituted phenylnaphthyl, a substituted or unsubstituted naphthylphenyl, a substituted or unsubstituted fluorenyl, or a substituted or unsubstituted spirobifluorenyl. More specifically, Ar₁ may be selected from the following formulae:

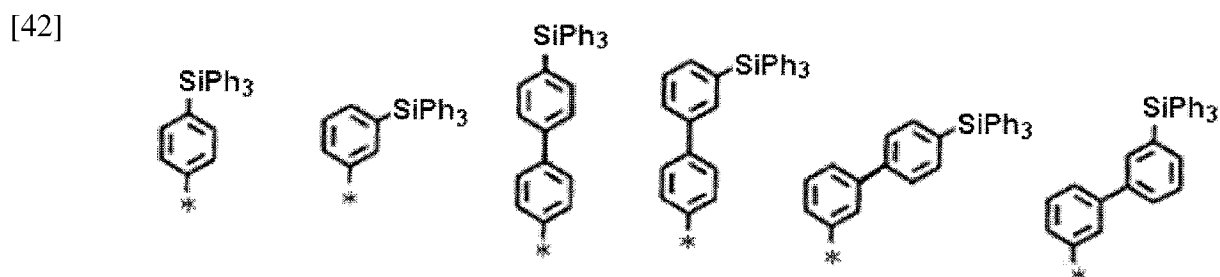


[38] (In the formulae above, * represents a bonding site.)

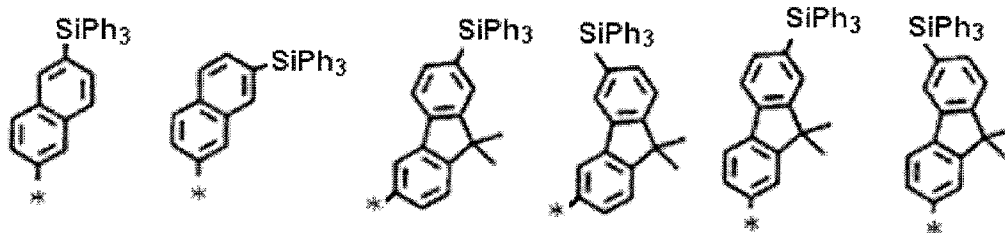
[39] Ar₂ may represent preferably, a substituted or unsubstituted 5- to 20-membered heteroaryl or a substituted or unsubstituted (C6-C20)aryl; more preferably, a substituted or unsubstituted (C6-C20)aryl; and even more preferably, a (C6-C18)aryl unsubstituted or substituted with a (C1-C10)alkyl, a (C6-C18)aryl, or a 5- to 12-membered heteroaryl. Specifically, Ar₂ may represent a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted terphenyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted phenanthrenyl, a substituted or unsubstituted tetracenyl, a substituted or unsubstituted triphenylenyl, a substituted or unsubstituted chrysenyl, a substituted or unsubstituted pyrenyl, a substituted or unsubstituted phenylnaphthyl, a substituted or unsubstituted naphthylphenyl, or a substituted or unsubstituted fluorenyl. Specifically, a substituent for the substituted group of Ar₂ may be a (C1-C6)alkyl, phenyl, biphenyl, naphthyl, terphenyl, anthracenyl, phenanthrenyl, tetracenyl, triphenylenyl, chrysenyl, pyrenyl, phenylnaphthyl, naphthylphenyl, pyridyl, or pyrimidyl.

[40] Ar₃ may represent preferably, a substituted or unsubstituted 5- to 20-membered heteroaryl or a substituted or unsubstituted (C6-C20)aryl; more preferably, a substituted or unsubstituted (C6-C20)aryl; and even more preferably, a (C6-C18)aryl unsubstituted or substituted with a (C1-C6)alkyl. Ar₃ may represent specifically, a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, or a substituted or unsubstituted naphthyl; and more specifically phenyl.

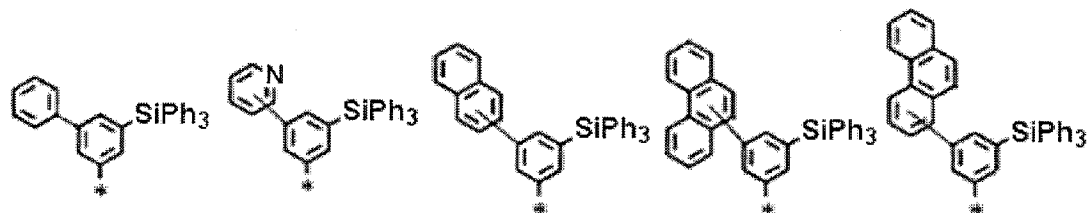
[41] Specifically, *-Ar₂-Si(Ar₃)₃ of formula 1 may be selected from the following formulae:



[43]



[44]

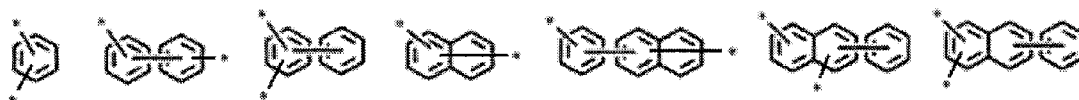


[45] (In the formulae above, * represents a bonding site, and Ph represents phenyl.)

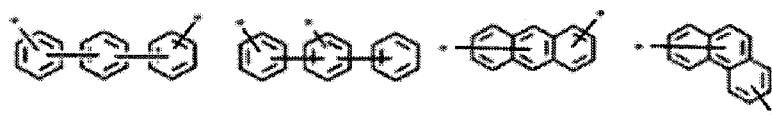
[46] L_1 may represent preferably, a single bond, a substituted or unsubstituted (C6-C20)arylene, or a substituted or unsubstituted 5- to 20-membered heteroarylene; more preferably, a single bond, or a substituted or unsubstituted (C6-C20)arylene; and even more preferably, a (C6-C18)arylene unsubstituted or substituted with a (C1-C10)alkyl or a (C6-C18)aryl. Specifically, L_1 may represent a substituted or unsubstituted phenylene, a substituted or unsubstituted biphenylene, a substituted or unsubstituted naphthylene, a substituted or unsubstituted terphenylene, a substituted or unsubstituted anthracenylene, a substituted or unsubstituted phenanthrenylene, a substituted or unsubstituted tetracenylene, a substituted or unsubstituted triphenylenylene, a substituted or unsubstituted chrysenylene, a substituted or unsubstituted pyrenylene, a substituted or unsubstituted phenylnaphthylene, a substituted or unsubstituted naphthylphenylene, or a substituted or unsubstituted fluorenylene.

[47] Specifically, L_1 is selected from the following formulae:

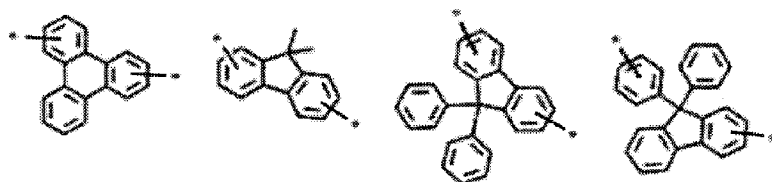
[48]



[49]



[50]



[51] (In the formulae above, * represents a bonding site.)

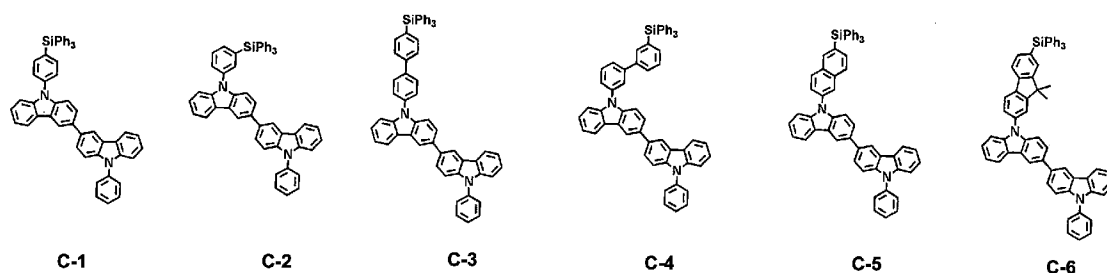
[52] R_1 to R_4 , each independently, may represent preferably, hydrogen, a substituted or

unsubstituted (C1-C20)alkyl, a substituted or unsubstituted (C5-C20)cycloalkyl, a substituted or unsubstituted 3- to 7-membered heterocycloalkyl, a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted 5- to 20-membered heteroaryl, or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted (C3-C20), mono- or polycyclic, alicyclic or aromatic ring. Specifically, R_2 and R_3 may represent hydrogen; and R_1 and R_4 , each independently, may represent hydrogen, a substituted or unsubstituted (C1-C20)alkyl, a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted 5- to 20-membered heteroaryl.

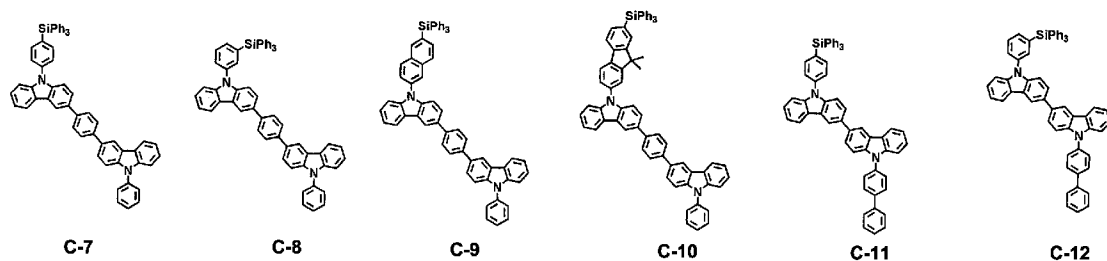
[53] According to one embodiment of the present disclosure, Ar_1 may represent a substituted or unsubstituted (C6-C30)aryl; Ar_2 and Ar_3 , each independently, may represent a substituted or unsubstituted 5- to 20-membered heteroaryl, or a substituted or unsubstituted (C6-C20)aryl; L_1 may represent a single bond, a substituted or unsubstituted (C6-C20)arylene, or a substituted or unsubstituted 5- to 20-membered heteroarylene; R_1 to R_4 , each independently, may represent hydrogen, a substituted or unsubstituted (C1-C20)alkyl, a substituted or unsubstituted (C5-C20)cycloalkyl, a substituted or unsubstituted 3- to 7-membered heterocycloalkyl, a substituted or unsubstituted (C6-C20)aryl, or a substituted or unsubstituted 5- to 20-membered heteroaryl, or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted (C3-C20), mono- or polycyclic, alicyclic or aromatic ring.

[54] More specifically, the organic electroluminescent compound of the present disclosure includes the following, but is not limited thereto.

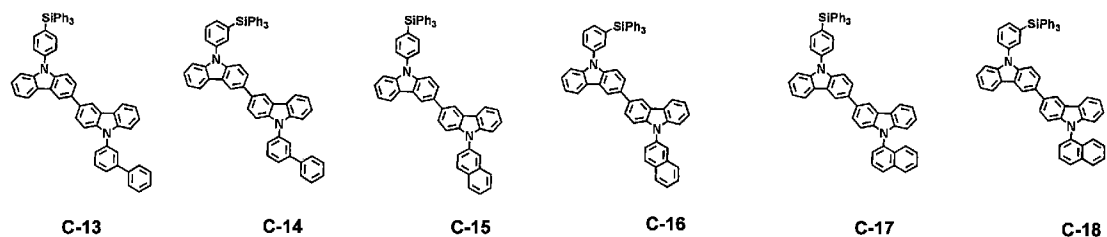
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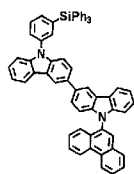
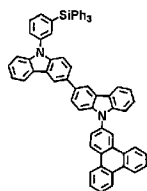
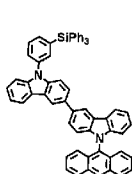
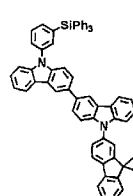
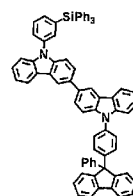
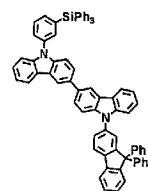
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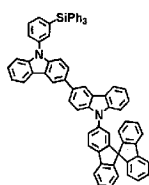
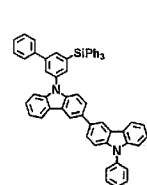
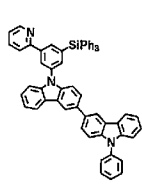
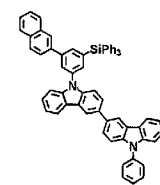
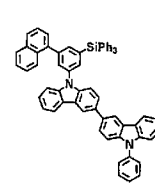
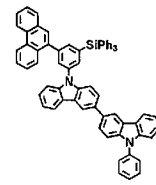
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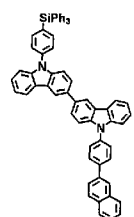
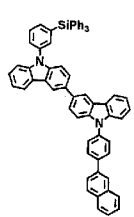
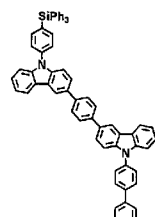
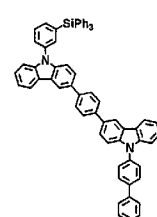
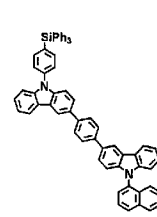
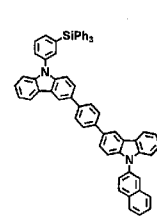
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**C-19****C-20****C-21****C-22****C-23****C-24**

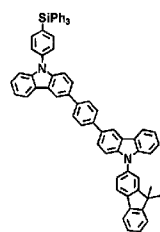
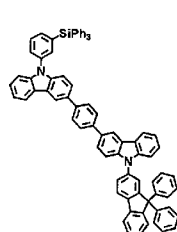
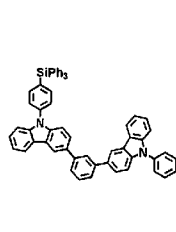
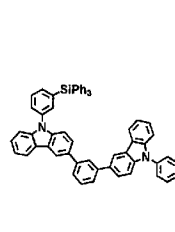
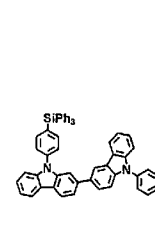
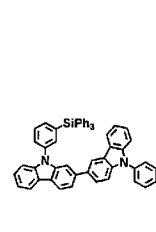
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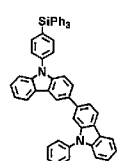
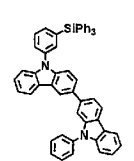
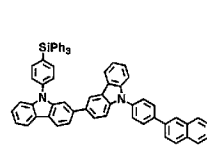
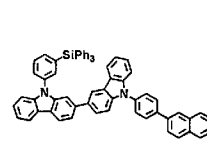
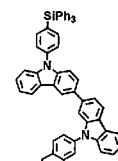
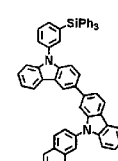
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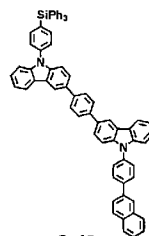
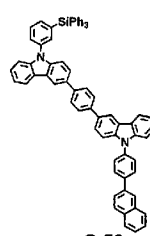
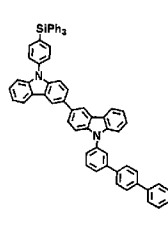
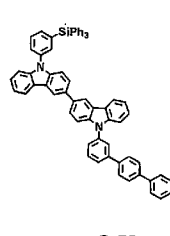
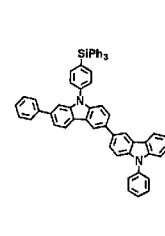
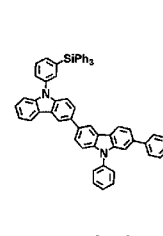
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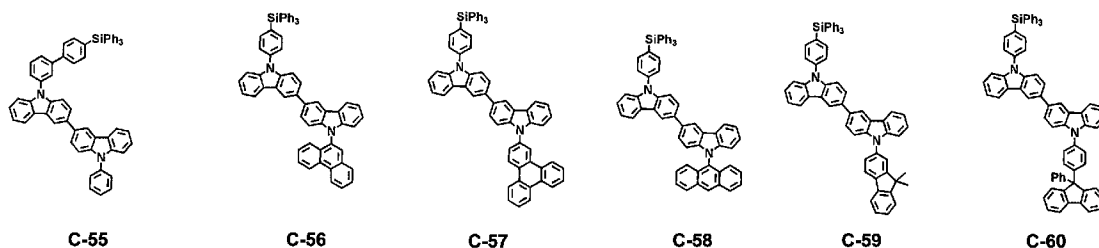
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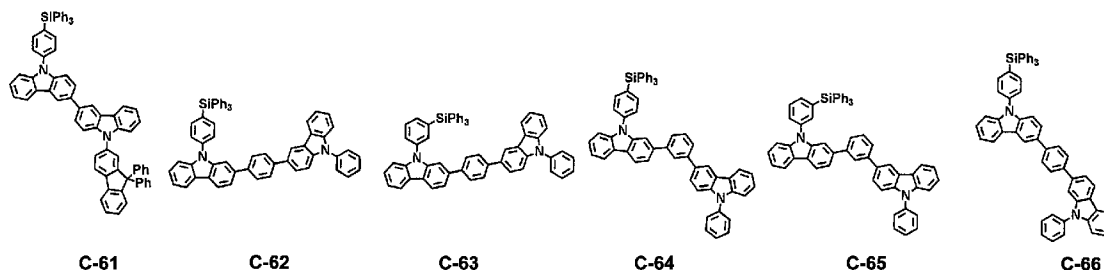
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**C-49****C-50****C-51****C-52****C-53****C-54**

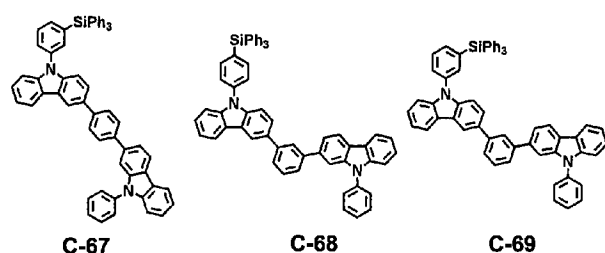
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[65]



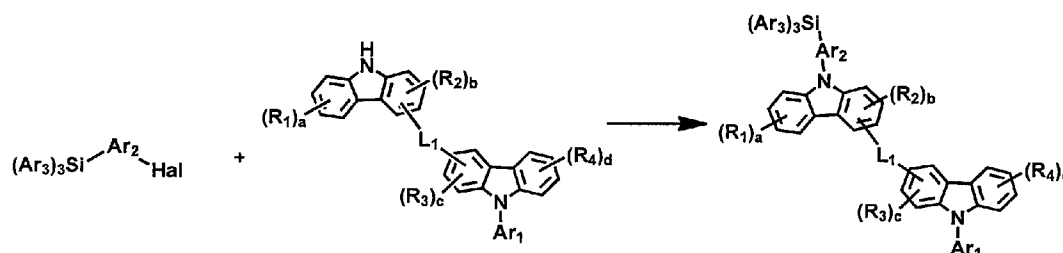
[66]



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

[68] [Reaction Scheme 1]

[69]



[70] In reaction scheme 1, Ar_1 to Ar_3 , L_1 , R_1 to R_4 , and a to d are as defined in formula 1, and Hal represents a halogen.

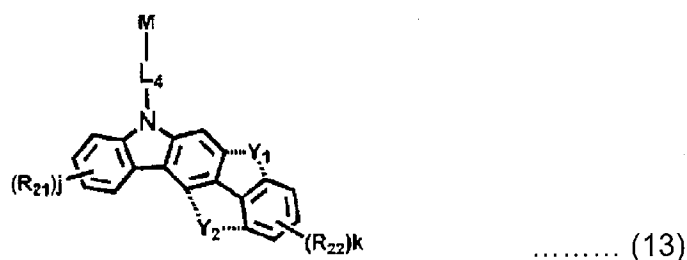
[71] The present disclosure provides an organic electroluminescent material comprising the organic electroluminescent compound of formula 1, and an organic electroluminescent device comprising the material.

[72] The organic electroluminescent material may consist of the organic electroluminescent compound of the present disclosure. Otherwise, the material may further comprise a conventional compound(s) which has been comprised in an organic electroluminescent material, in addition to the compound of the present disclosure.

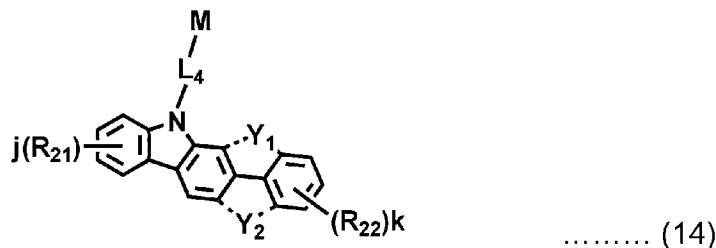
[73] The organic electroluminescent material may be preferably a hole transport material

or a host material, and more preferably a hole transport material. When used as a host material, the organic electroluminescent material may further comprise a second host material as described below, in addition to the compound of formula 1.

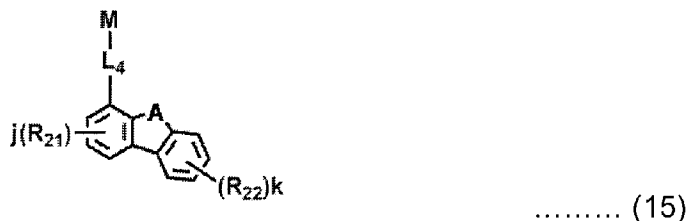
- [74] The organic electroluminescent device of the present disclosure may comprise a first electrode; a second electrode; and at least one organic layer disposed between the first and second electrodes. The organic layer may comprise at least one compound of formula 1.
- [75] One of the first and second electrodes may be an anode, and the other may be a cathode. The organic layer may comprise a light-emitting layer, and may further comprise at least one layer selected from a hole injection layer, a hole transport layer, an electron transport layer, an electron injection layer, an interlayer, a hole blocking layer, an electron blocking layer, and an electron buffering layer.
- [76] The organic electroluminescent compound of the present disclosure may be comprised in at least one of a light-emitting layer and a hole transport layer. When used in the light-emitting layer, the compound of formula 1 may be comprised therein as a host material, and preferably a phosphorescent host material. Preferably, at least one dopant may be further comprised in the light-emitting layer. If necessary, a compound other than the compound of formula 1 may be comprised as a second host material in the light-emitting layer. When used in the hole transport layer, the organic electroluminescent compound of the present disclosure may be comprised therein as a hole transport material; and in this case, the light-emitting layer may comprise the compound of formula 1 or a host material which has been known in the art and does not have formula 1, as a host material.
- [77] When the compound of formula 1 is used in the light-emitting layer, the second host material may be from any of the known phosphorescent host materials. Further, when the compound of formula 1 is used in the hole transport layer, the host material which has been known in the art and does not have formula 1 may be from any of the known phosphorescent host materials. As the second host material and the known host material, the material selected from the group consisting of the compounds of formulae 11 to 15 below is preferable in view of luminous efficiency.



[79]

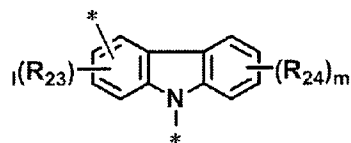


[80]



[81] wherein Cz represents the following structure:

[82]



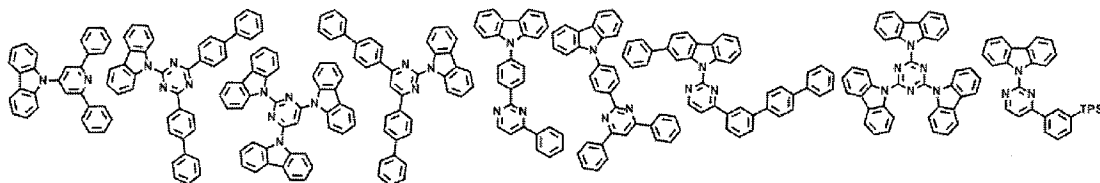
[83]

A represents -O- or -S-; 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 $R_{25}R_{26}R_{27}Si$ -; R_{25} to R_{27} , each independently, represent a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C6-C30)aryl; L_4 represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted 5- to 30-membered heteroarylene; M represents a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted 5- to 30-membered heteroaryl; Y_1 and Y_2 , each independently, represent -O-, -S-, -N(R_{31})-, or -C(R_{32})(R_{33})-; 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; where h, i, j, k, l, or m is an integer of 2 or more, each of (Cz- L_4), (Cz), R_{21} , R_{22} , R_{23} , or R_{24} may be the same or different.

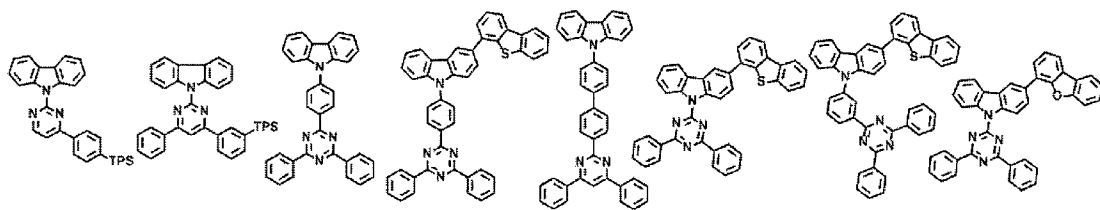
[84]

Specifically, the compounds represented by formula 11 to 15 include preferably the following, but are not limited thereto.

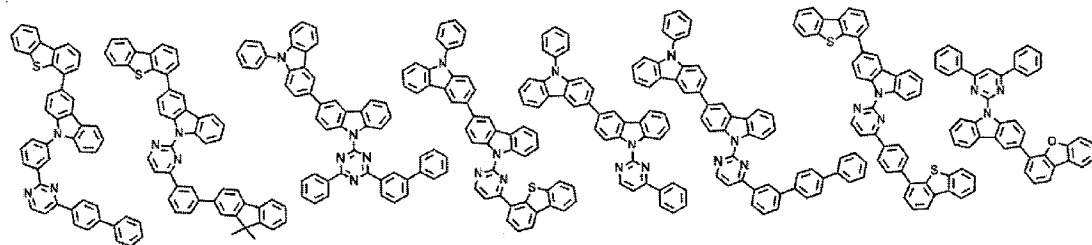
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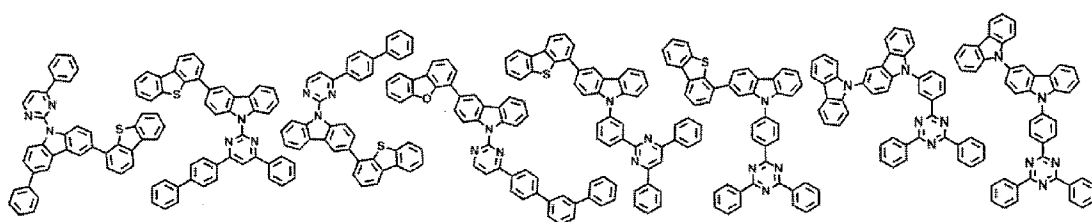
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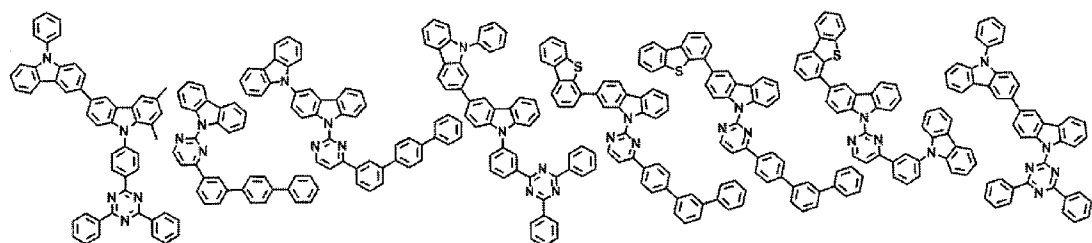
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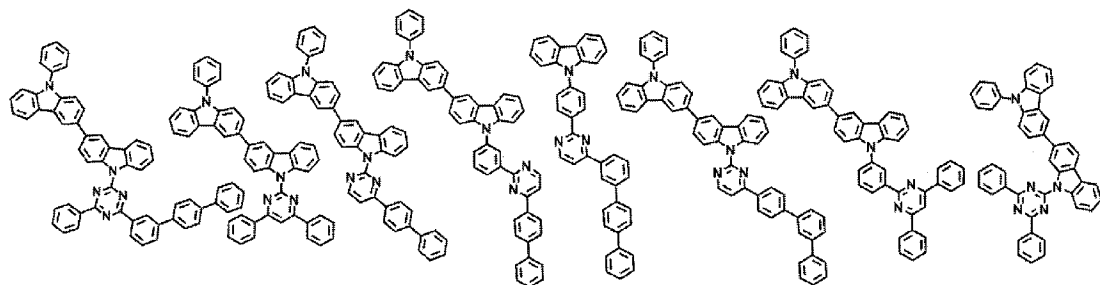
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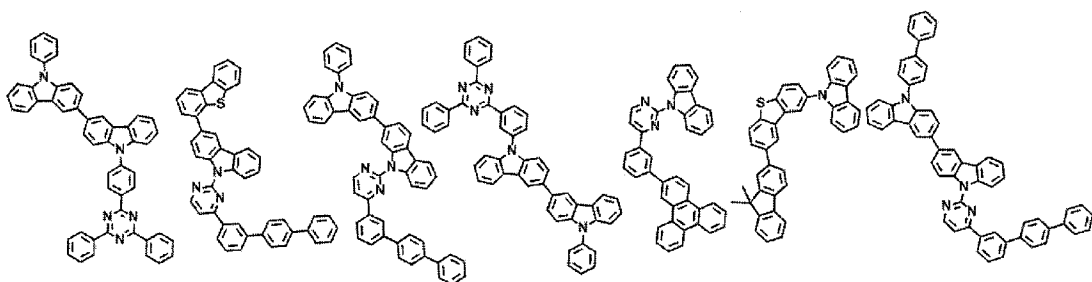
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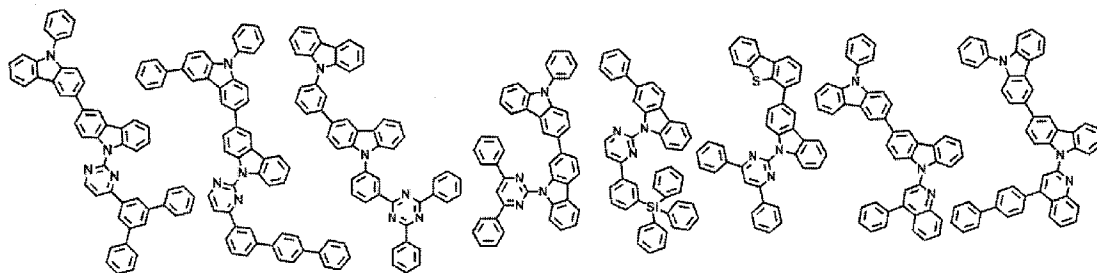
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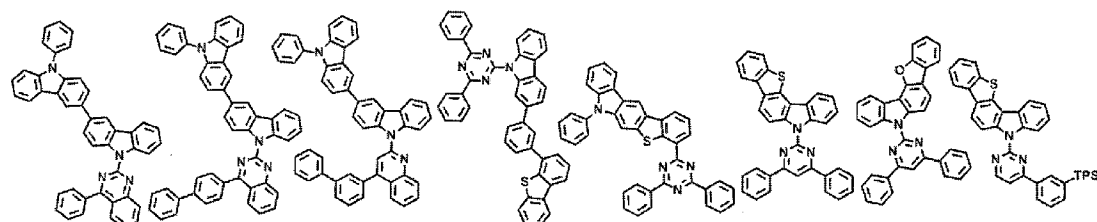
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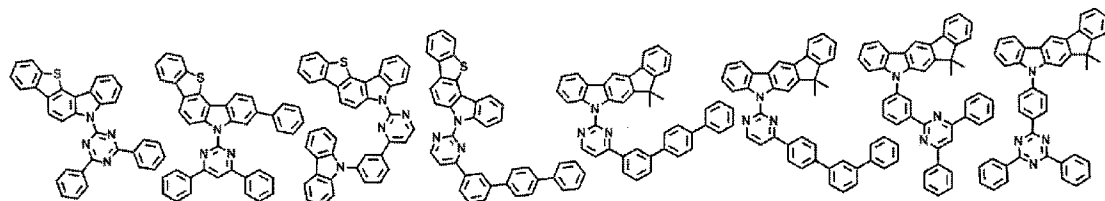
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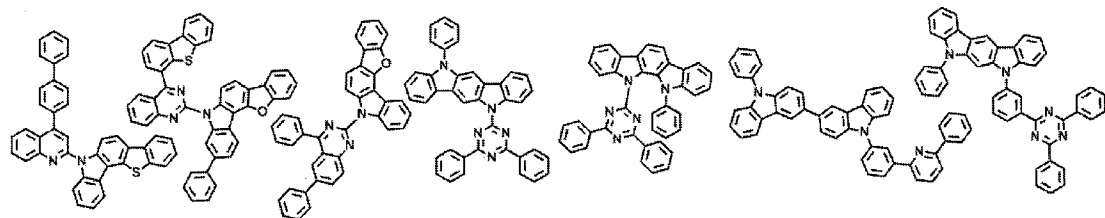
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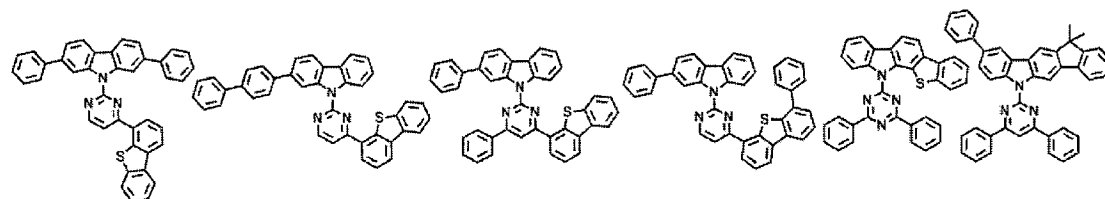
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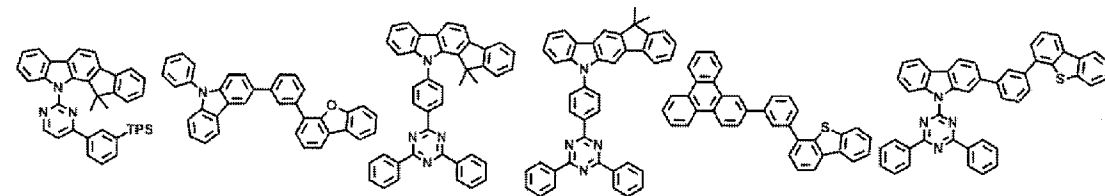
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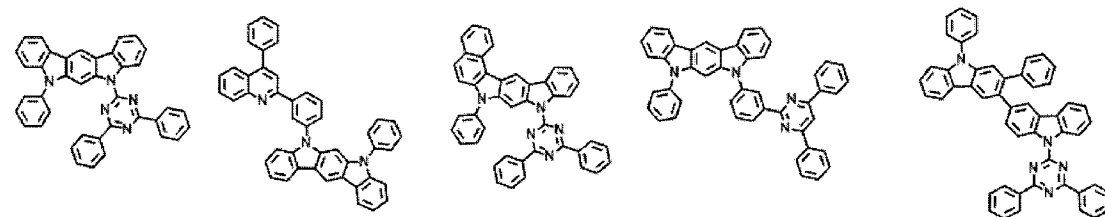
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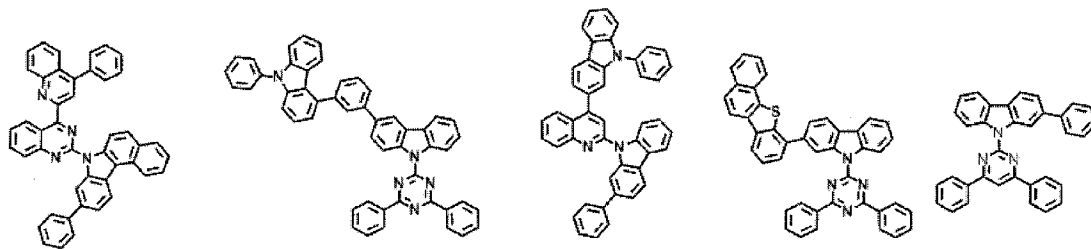
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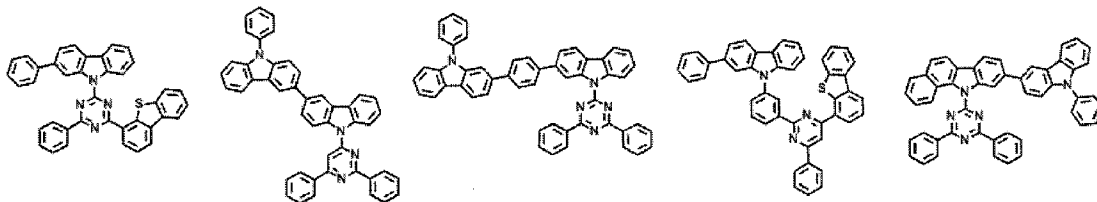
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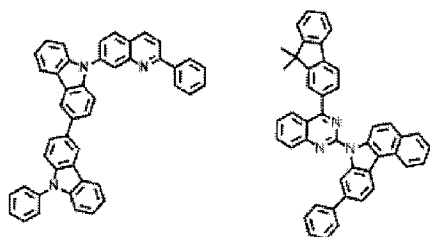
[99]



[100]



[101]

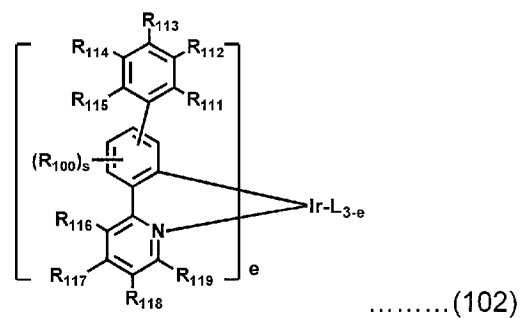
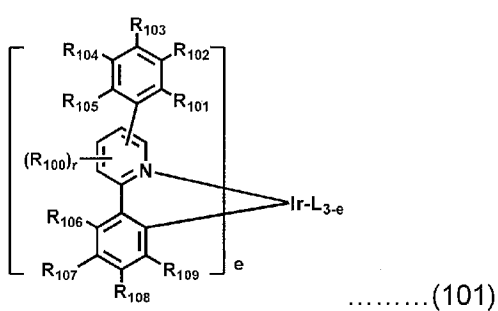


[102] (wherein TPS represents a triphenylsilyl group.)

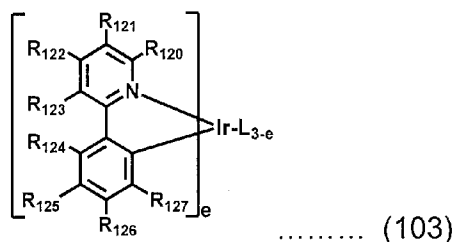
[103] The dopant is preferably at least one phosphorescent dopant. The phosphorescent dopant material for the organic electroluminescent device of the present disclosure is not limited, but may be preferably selected from metallated complex compounds of iridium (Ir), osmium (Os), copper (Cu) or platinum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

[104] The compounds represented by the following formulae 101 to 103 may be used as the dopant to be comprised in the organic electroluminescent device of the present disclosure.

[105]



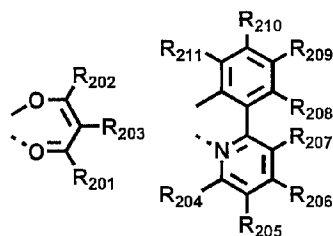
[106]



[107]

wherein L is selected from the following structures:

[108]



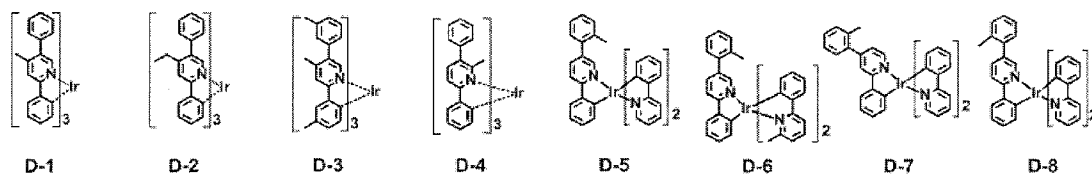
[109]

R_{100} represents hydrogen, a substituted or unsubstituted (C1-C30)alkyl, or a substituted or unsubstituted (C3-C30)cycloalkyl; R_{101} to R_{109} and R_{111} to R_{123} , each independently, represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl unsubstituted or substituted with a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkoxy, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted (C3-C30)cycloalkyl; R_{106} to R_{109} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, fluorene unsubstituted or substituted with alkyl, dibenzothiophene unsubstituted or substituted with alkyl, or dibenzofuran unsubstituted or substituted with alkyl; R_{120} to R_{123} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, quinoline unsubstituted or substituted with alkyl or aryl; 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; R_{124} to R_{127} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, fluorene unsubstituted or substituted with alkyl, dibenzothiophene unsubstituted or substituted with alkyl, or dibenzofuran unsubstituted or substituted with alkyl; 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; R_{208} to R_{211} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, fluorene unsubstituted or substituted with alkyl, dibenzothiophene unsubstituted or substituted with alkyl, or dibenzofuran unsubstituted or substituted with alkyl; r and s , each independently, represent an integer of 1 to 3; and where r or s is an integer of 2 or more, each of R_{100} may be the same or different; and e represents an integer of 1 to 3.

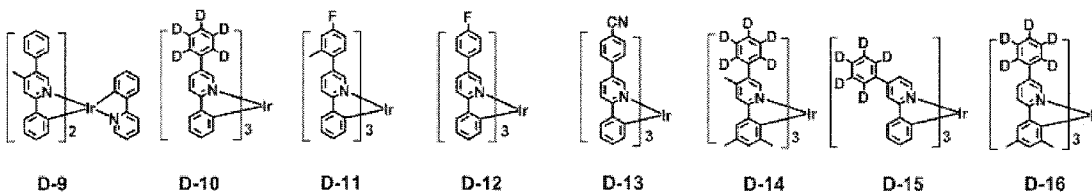
[110]

Specifically, the dopant material includes the following, but is not limited thereto.

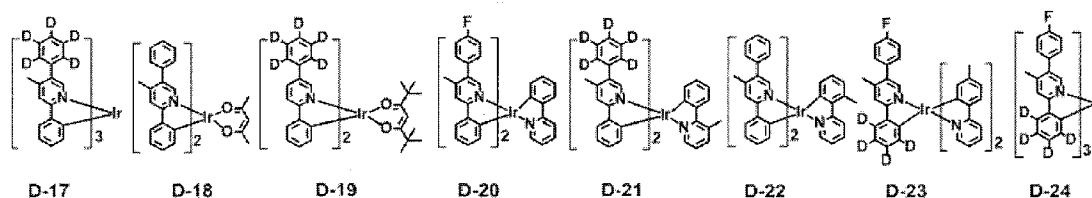
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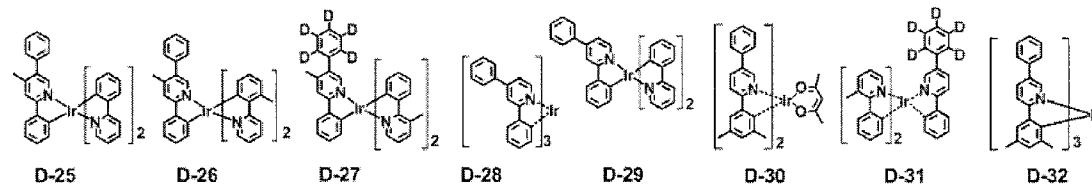
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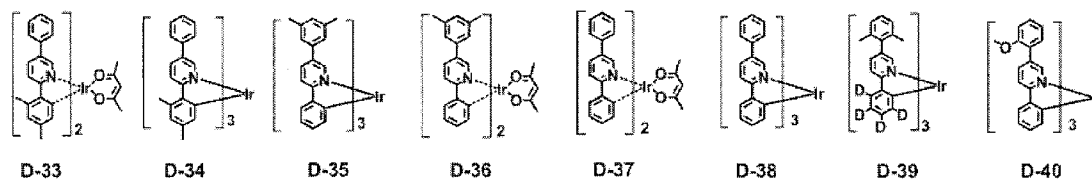
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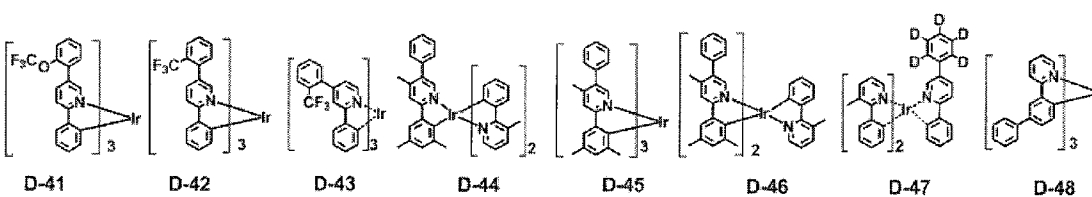
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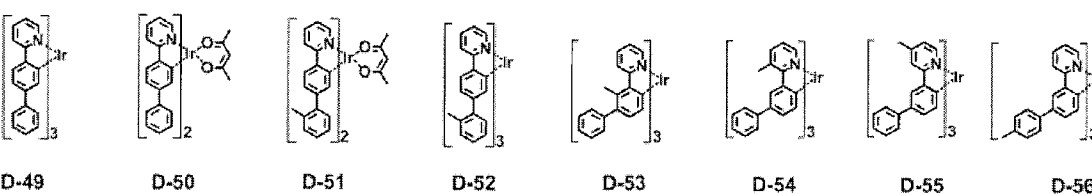
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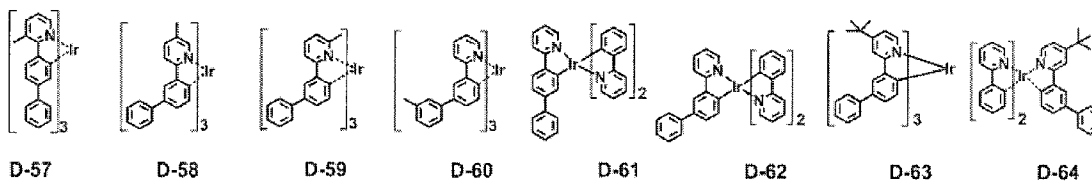
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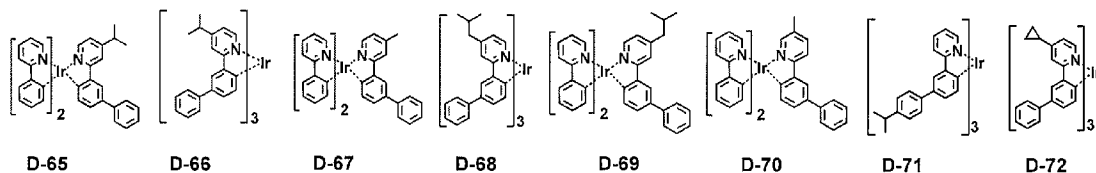
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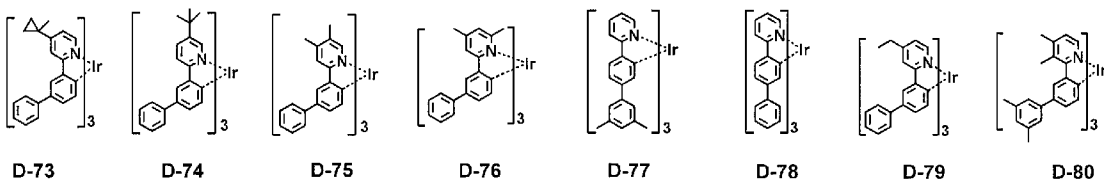
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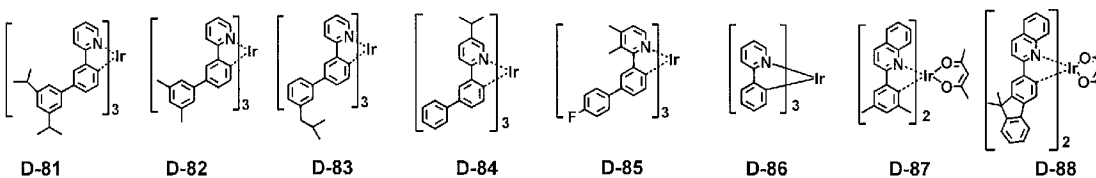
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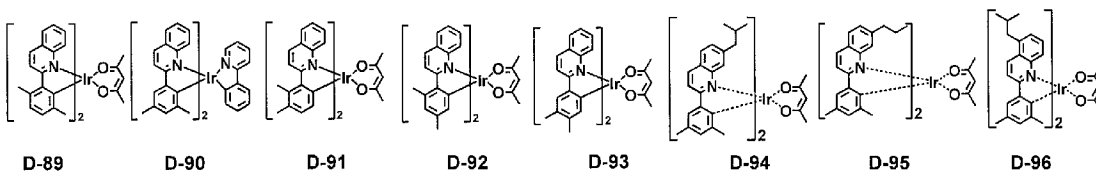
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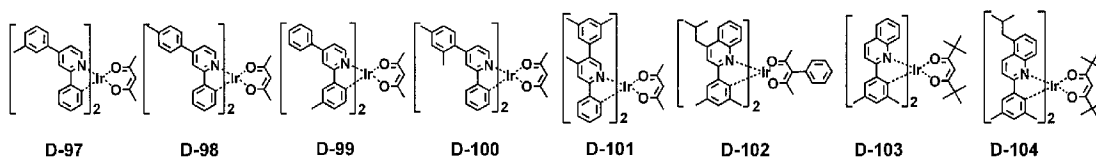
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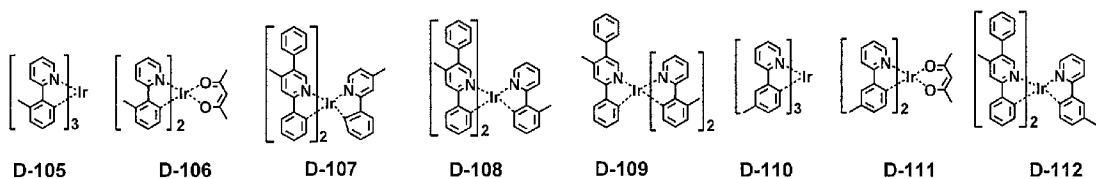
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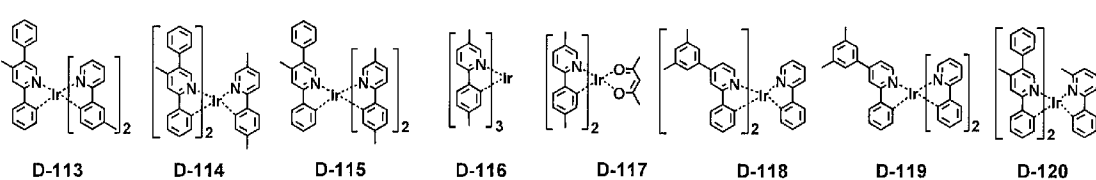
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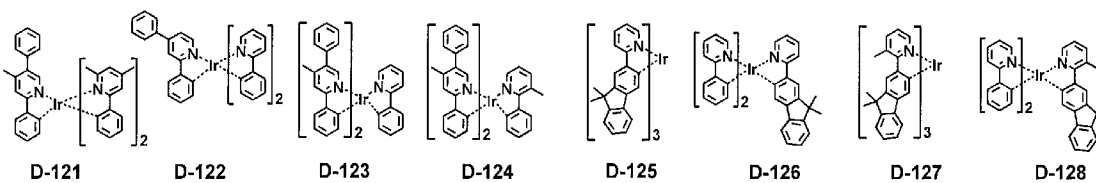
[124]



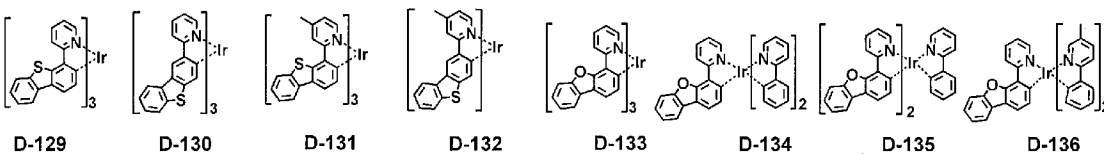
[125]



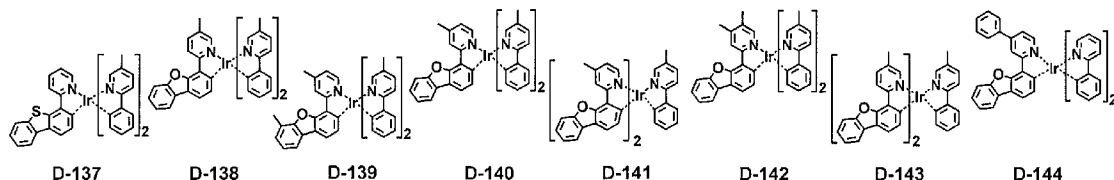
[126]



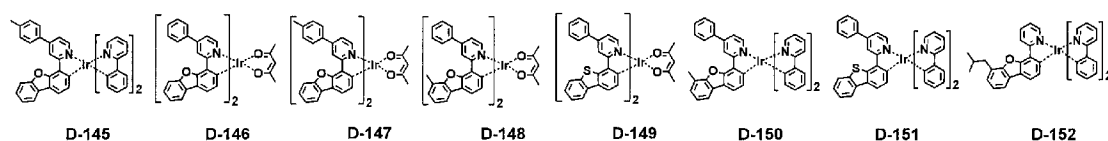
[127]



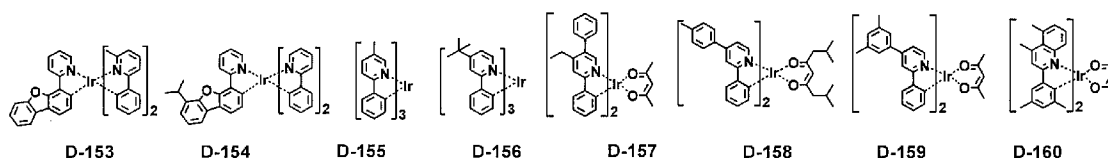
[128]



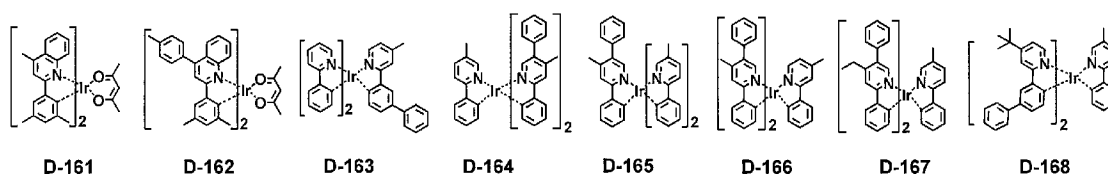
[129]



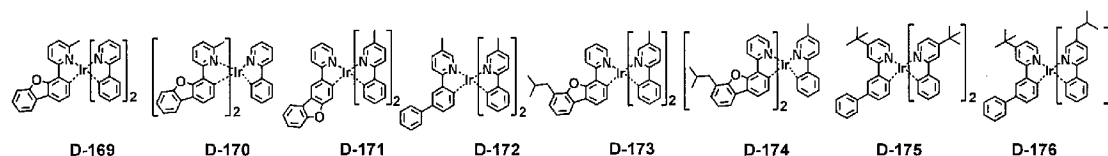
[130]



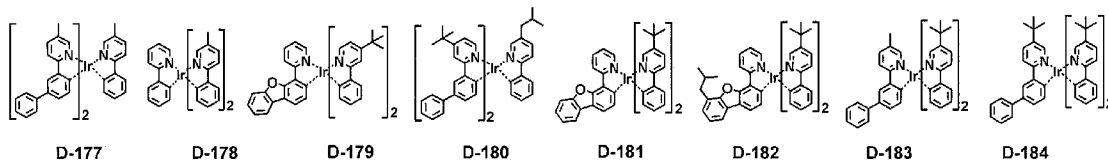
[131]



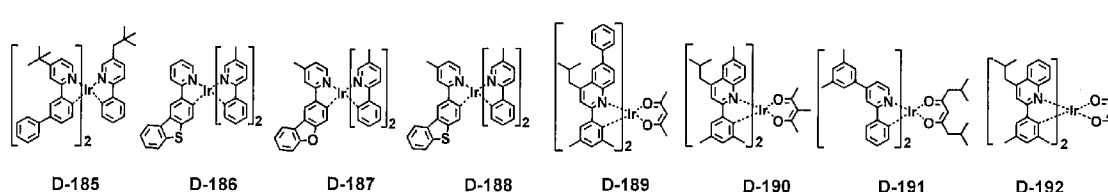
[132]



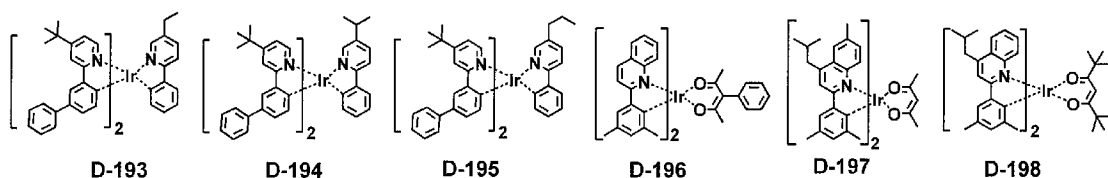
[133]



[134]



[135]



[136]

According to an additional aspect of the present disclosure, a mixture or composition for preparing an organic electroluminescent device is provided. The mixture or composition comprises the compound of the present disclosure. The mixture or composition may be used for preparing a light-emitting layer or hole transport layer of the organic electroluminescent device. The mixture or composition may be used for preparing a phosphorescent light-emitting layer of the organic electroluminescent device. When comprised in the mixture or composition for preparing a light-emitting

layer of the organic electroluminescent device, the compound of the present disclosure may be comprised as a host material. When the compound of the present disclosure is comprised as a host material, the mixture or composition may further comprise a second host material. The weight ratio between the first host material and the second host material is in the range of 1:99 to 99:1. Preferably, the compounds represented by formulae 11 to 15 above may be used as the second host material. When comprised in the mixture or composition for preparing a hole transport layer of the organic electroluminescent device, the compound of the present disclosure may be comprised as a hole transport material.

[137] The organic electroluminescent device of the present disclosure may comprise a first electrode, a second electrode, and at least one organic layer disposed between the first and second electrodes, wherein the organic layer comprises a light-emitting layer and a hole transport layer, and at least one of the light-emitting layer and the hole transport layer may comprise the mixture or composition of the present disclosure for preparing an organic electroluminescent device.

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

[139] In the organic electroluminescent device of the present disclosure, the organic layer may further comprise, in addition to the compound of formula 1, at least one metal selected from the group consisting of metals of Group 1, metals of Group 2, transition metals of the 4th period, transition metals of the 5th period, lanthanides and organic metals of the d-transition elements of the Periodic Table, or at least one complex compound comprising the metal. The organic layer may further comprise a light-emitting layer and a charge generating layer.

[140] In addition, the organic electroluminescent device of the present disclosure may emit white light by further comprising at least one light-emitting layer, which comprises a blue electroluminescent compound, a red electroluminescent compound or a green electroluminescent compound known in the art, besides the compound of the present disclosure. If necessary, the organic electroluminescent device of the present disclosure may further comprise a yellow- or orange-light-emitting layer.

[141] In the organic electroluminescent device of the present disclosure, preferably, at least one layer (hereinafter, "a surface layer") may be placed on an inner surface(s) of one or both electrode(s), selected from a chalcogenide layer, a metal halide layer and a metal oxide layer. Specifically, a chalcogenide (includes oxides) layer of silicon or aluminum is preferably placed on an anode surface of an electroluminescent medium layer, and a metal halide layer or a metal oxide layer is preferably placed on a cathode surface of an

electroluminescent medium layer. Such a surface layer provides operation stability for the organic electroluminescent device. Preferably, the chalcogenide includes SiO_x ($1 \leq x \leq 2$), AlO_x ($1 \leq x \leq 1.5$), SiON , SiAlON , etc.; the metal halide includes LiF , MgF_2 , CaF_2 , a rare earth metal fluoride, etc.; and the metal oxide includes Cs_2O , Li_2O , MgO , SrO , BaO , CaO , etc.

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

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

[144] 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.

[145] The organic electroluminescent device of the present disclosure can be used for the manufacture of a display system or a lighting system.

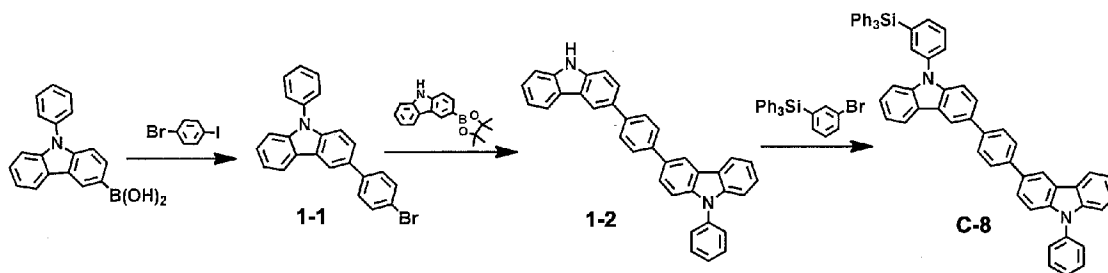
[146] Hereinafter, the organic electroluminescent compound of the present disclosure, the preparation method of the compound, and the luminescent properties of the device will be explained in detail with reference to the following examples.

[147]

[148] **Example 1: Preparation of compound C-8**

[149]

[150]

[151] Preparation of compound 1-1

[152] After introducing (9-phenyl-9H-carbazol-3-yl)boronic acid (30g, 104.49 mmol), 1-bromo-4-iodobenzene (30g, 104.49 mmol), tetrakis(triphenylphosphine)palladium (3.6 g, 3.13 mmol), sodium carbonate (28 g, 261.23 mmol), toluene (520mL), and ethanol (130mL) into a reaction vessel, distilled water (130mL) was added thereto. The mixture was stirred at 120°C for 4 hours. After completion of the reaction, the mixture was washed with distilled water, and extracted with ethyl acetate. The obtained organic layer was dried with magnesium sulfate, and the solvent was removed therefrom by a rotary evaporator. The resultant was subjected to column chromatography to obtain compound **1-1** (27g, yield: 65%).

[153] Preparation of compound 1-2

[154] After introducing compound **1-1** (13g, 32.65 mmol), 3-(4,4,5,5-tetramethyl-1,3,2-dioxaboran-2-yl)-9H-carbazole (10 g, 39.18 mmol), tetrakis(triphenylphosphine)palladium (1.1 g, 0.98 mmol), potassium carbonate (11 g, 81.63 mmol), toluene (160mL), and ethanol (40mL) into a reaction vessel, distilled water (40mL) was added thereto. The mixture was stirred at 120°C for 4 hours. After completion of the reaction, the mixture was washed with distilled water, and extracted with ethyl acetate. The obtained organic layer was dried with magnesium sulfate, and the solvent was removed therefrom by a rotary evaporator. The resultant was subjected to column chromatography to obtain compound **1-2** (11g, yield: 70%).

[155] Preparation of compound C-8

[156] After introducing compound **1-2** (9.3g, 19.26 mmol), (3-bromophenyl)triphenylsilane (12 g, 28.89 mmol), copper(I) iodide (1.8g, 9.63 mmol), ethylene diamine (1.3mL, 19.26 mmol), potassium phosphate (10g, 48.15 mmol), and toluene (100mL) into a reaction vessel, the mixture was stirred at 120°C for 4 hours. After completion of the reaction, the mixture was washed with distilled water, and extracted with ethyl acetate. The obtained organic layer was dried with magnesium sulfate, and the solvent was removed therefrom by a rotary evaporator. The resultant was subjected to column chromatography to obtain compound **C-8** (10g, yield: 64%).

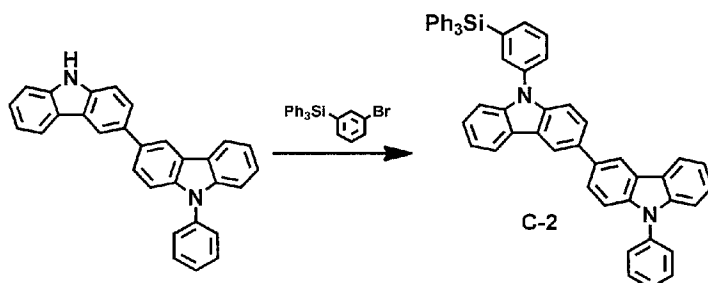
[157]

Molecular Weight (MW)	UV	PL	Melting Point (M.P.)
819.07	358nm	395nm	249°C

[158]

[159]

[160]

Example 2: Preparation of compound C-2

[161]

Preparation of compound C-2

[162]

After introducing 9-phenyl-9H,9'H-3,3'-bicarbazole (8g, 19.58 mmol), (3-bromophenyl)triphenylsilane (9.8 g, 23.50 mmol), tris(dibenzylideneacetone)dipalladium(0) (0.9g, 1.00 mmol), tri-*t*-butyl phosphine (0.9 mL, 1.96 mmol), sodium *tert*-butoxide (2.8g, 29.37 mmol), and toluene (100mL) into a reaction vessel, the mixture was stirred at 120°C for 4 hours. After completion of the reaction, the mixture was washed with distilled water, and extracted with ethyl acetate. The obtained organic layer was dried with magnesium sulfate, and the solvent was removed therefrom by a rotary evaporator. The resultant was subjected to column chromatography to obtain compound C-2 (2.7g, yield: 19%).

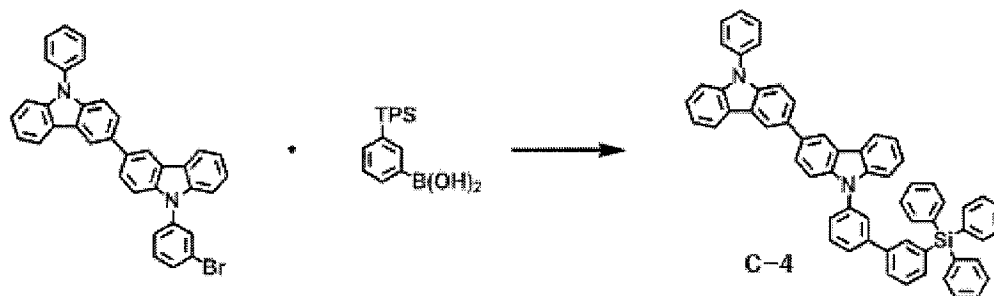
[163]

MW	UV	PL	M.P.
742.98	360nm	407nm	217°C

[164]

Example 3: Preparation of compound C-4

[165]



[166]

Preparation of compound C-4

[167]

After dissolving 9-(3-bromophenyl)-9'-phenyl-3,3'-bis-9H-carbazole (12g, 31.8mmol), B-[3-(triphenylsilyl)phenyl]-boronic acid (12g, 31.8mmol), tetrakis(triphenylphosphine) palladium(0) (Pd(PPh₃)₄) (1.0g, 0.88mmol), 2M K₂CO₃ (6.1g, 44.3mmol), toluene (100 mL) and ethanol (25 mL) in a flask, the mixture was

under reflux for 4 hours. After completion of the reaction, the mixture was extracted with ethyl acetate. The obtained organic layer was dried with magnesium sulfate to remove the remaining moisture, and subjected to column chromatography to obtain compound **C-4** (9.5g, yield: 69 %).

[168]

MW	UV	PL	M.P.
819.07	344 nm	405 nm	206°C

[169]

[Device Example 1] OLED using the compound for the organic

[170]

electroluminescent material of the present disclosure

[171]

OLED was produced using the luminescent material of the present disclosure as follows. A transparent electrode indium tin oxide (ITO) thin film (10 Ω /sq) on a glass substrate for an organic electroluminescent device (OLED) (Geomatec) was subjected to an ultrasonic washing with acetone and isopropanol, sequentially, and was then stored in isopropanol. The ITO substrate was then mounted on a substrate holder of a vacuum vapor depositing apparatus.

N4,N4'-biphenyl-N4,N4'-bis(9-phenyl-9H-carbazol-3-yl)-[1,1'-biphenyl]-4,4'-diamine was introduced into a cell of the vacuum vapor depositing 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 60 nm on the ITO substrate. 1,4,5,8,9,11-hexaazatriphenylene-hexacarbonitrile (HAT-CN) was then introduced into another cell of said vacuum vapor depositing apparatus, and evaporated by applying electric current to the cell, thereby forming a second hole injection layer having a thickness of 5 nm on the first hole injection layer. **T-1** shown in Table 1 below was introduced into one cell of the vacuum vapor depositing apparatus, and evaporated by applying electric current to the cell, thereby forming a first hole transport layer having a thickness of 10 nm on the second hole injection layer. **C-2** was introduced into another cell of the vacuum vapor depositing apparatus, and evaporated by applying electric current to the cell, thereby forming a second hole transport layer having a thickness of 30 nm on the first hole transport layer. Thereafter, as a host material, compound **H-1** and compound **H-2** shown in Table 1 below were introduced into two cells of the vacuum vapor depositing apparatus, respectively. Compound **D-25** was introduced into another cell as a dopant. The two host compounds were evaporated at the same rate of 1:1, while the dopant was evaporated at a different rate from the host compounds, so that the dopant was deposited in a doping amount of 5 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.

2-(4-(9,10-di(naphthalen-2-yl)anthracen-2-yl)phenyl)-1-phenyl-1H-benzo[d]imidazole

was then introduced into one cell, and lithium quinolate was introduced into another cell. The two materials were evaporated at the same rate, so that they were respectively deposited in a doping amount of 50 wt% to form an electron transport layer having a thickness of 35 nm on the light-emitting layer. After depositing lithium quinolate as an electron injection layer having a thickness of 2 nm on the electron transport layer, an Al cathode having a thickness of 80 nm was then deposited by another vacuum vapor deposition apparatus on the electron injection layer. Thus, an OLED was produced. All the materials were those purified by vacuum sublimation at 10^{-6} torr. The produced OLED showed green emission having a luminance of 1,500 cd/m² and a current density of 2.3 mA/cm². Time taken to be reduced to 85% of the luminance at 15,000 nit at a constant current was 220 hours.

[172]

[173] **[Device Example 2] OLED using the luminescent material of the present disclosure**

[174] An OLED was produced in the same manner as in Device Example 1, except that compound **C-4** was deposited to form a second hole transport layer having a thickness of 30 nm. The produced OLED showed green emission having a luminance of 2,000 cd/m² and a current density of 3.1 mA/cm². Time taken to be reduced to 85% of the luminance at 15,000 nit at a constant current was 200 hours.

[175]

[176] **[Comparative Example 1] OLED using a conventional luminescent material**

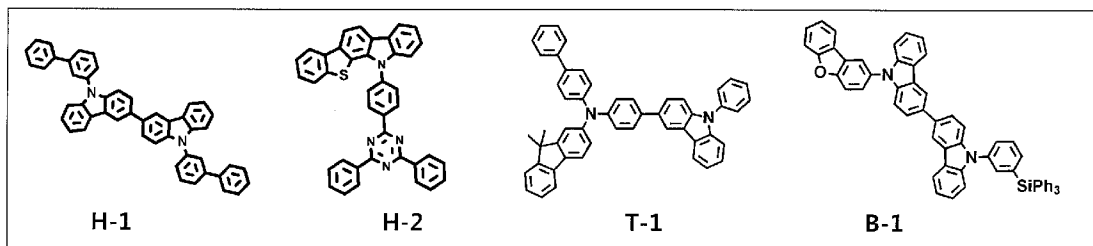
[177] An OLED was produced in the same manner as in Device Example 1, except that compound **T-1** shown in Table 1 below was deposited to form a second hole transport layer having a thickness of 30 nm. The produced OLED showed green emission having a luminance of 5,000 cd/m² and a current density of 14.8 mA/cm². Time taken to be reduced to 85% of the luminance at 15,000 nit at a constant current was 150 hours.

[178]

[179] **[Comparative Example 2] OLED using a conventional luminescent material**

[180] An OLED was produced in the same manner as in Device Example 1, except that compound **B-1** shown in Table 1 below was deposited to form a second hole transport layer having a thickness of 30 nm. The produced OLED showed green emission having a luminance of 6,000 cd/m² and a current density of 12.8 mA/cm². Time taken to be reduced to 85% of the luminance at 15,000 nit at a constant current was 1 hour.

[181]

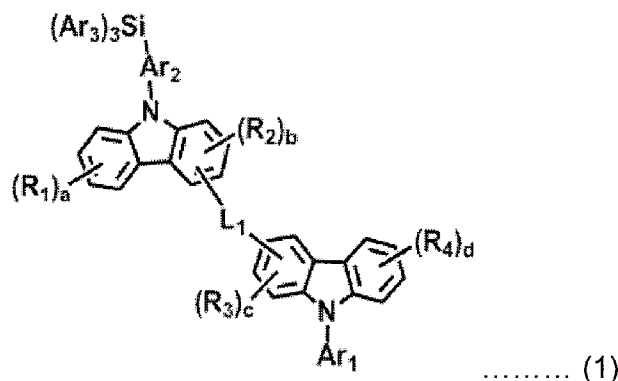


[182] The working examples above confirm that the compounds for an organic electronic material of the present disclosure have better luminous characteristics than conventional materials. The device employing the compound for an organic electronic material of the present disclosure shows excellence in luminous characteristics and lifespan.

Claims

[Claim 1]

An organic electroluminescent compound represented by the following formula 1:



wherein

Ar₁ represent a substituted or unsubstituted nitrogen-containing 5- to 30-membered heteroaryl, or a substituted or unsubstituted (C6-C30)aryl;

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

L₁ represents a single bond, a substituted or unsubstituted (C6-C30)arylene, or a substituted or unsubstituted 3- to 30-membered heteroarylene;

R₁ to R₄, each independently, represent hydrogen, deuterium, a halogen, a cyano, a carboxy, a nitro, a hydroxy, 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, a substituted or unsubstituted 3- to 30-membered heteroaryl, a substituted or unsubstituted mono(C6-C30)arylamino, a substituted or unsubstituted mono(C1-C30)alkylamino, -NR₅R₆, or -SiR₇R₈R₉, or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted, (C3-C30), mono- or polycyclic, alicyclic or aromatic ring;

R₅ to R₉, each independently, represent a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C6-C30)aryl, or a substituted or unsubstituted 3- to 30-membered heteroaryl;

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

sulfur;

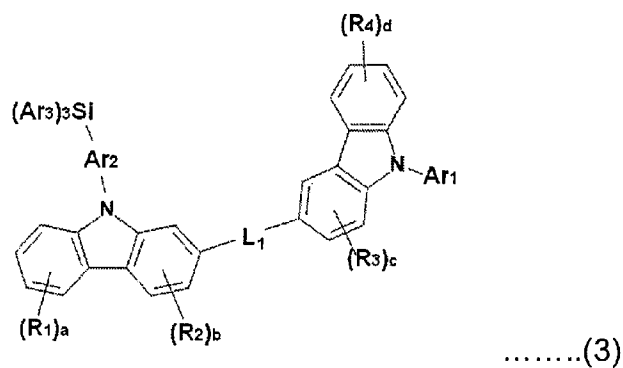
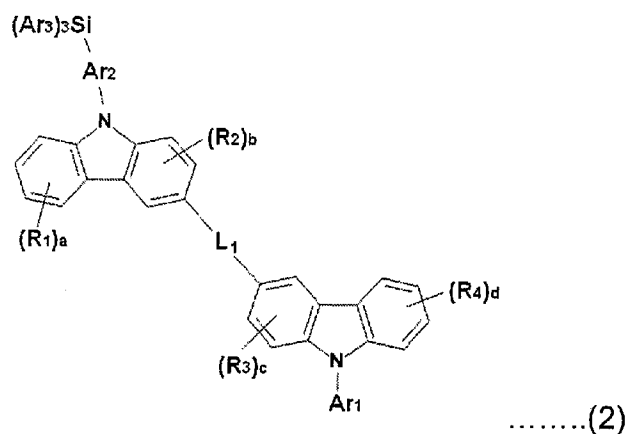
the heteroaryl(ene) and heterocycloalkyl contain at least one hetero atom selected from B, N, O, S, Si, and P;

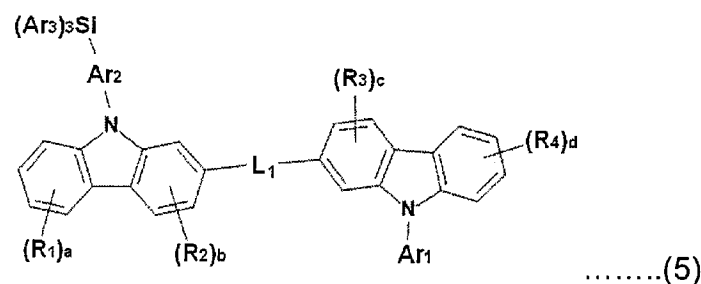
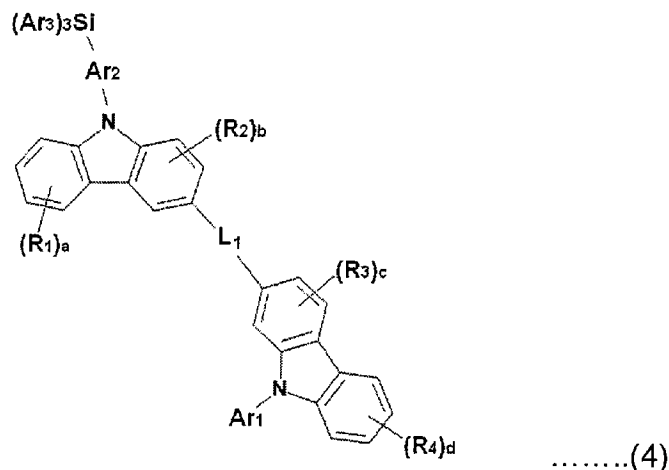
a and d, each independently, represent an integer of 1 to 4; where a or d is an integer of 2 or more, each of R₁ or R₄ may be the same or different; and

b and c, each independently, represent an integer of 1 to 3; where b or c is an integer of 2 or more, each of R₂ or R₃ may be the same or different.

[Claim 2]

The organic electroluminescent compound according to claim 1, wherein the compound of formula 1 is represented by any one of the following formulae 2 to 5.





wherein Ar₁ to Ar₃, L₁, and R₁ to R₄ are as defined in claim 1.

[Claim 3]

The organic electroluminescent compound according to claim 1, wherein Ar₁ represents a substituted or unsubstituted (C₆-C₃₀)aryl; Ar₂ and Ar₃, each independently, represent a substituted or unsubstituted 5- to 20-membered heteroaryl, or a substituted or unsubstituted (C₆-C₂₀)aryl; L₁ represents a single bond, a substituted or unsubstituted (C₆-C₂₀)arylene, or a substituted or unsubstituted 5- to 20-membered heteroarylene; R₁ to R₄, each independently, represent hydrogen, a substituted or unsubstituted (C₁-C₂₀)alkyl, a substituted or unsubstituted (C₅-C₂₀)cycloalkyl, a substituted or unsubstituted 3- to 7-membered heterocycloalkyl, a substituted or unsubstituted (C₆-C₂₀)aryl, or a substituted or unsubstituted 5- to 20-membered heteroaryl, or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted, (C₃-C₂₀), mono- or polycyclic, alicyclic or aromatic ring.

[Claim 4]

The organic electroluminescent compound according to claim 1, wherein Ar₁ represents a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted terphenyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted phenanthrenyl, a substituted or unsubstituted tetracenyl, a substituted or unsubstituted

triphenylenyl, a substituted or unsubstituted chrysenyl, a substituted or unsubstituted pyrenyl, a substituted or unsubstituted phenylnaphthyl, a substituted or unsubstituted naphthylphenyl, a substituted or unsubstituted fluorenyl, or a substituted or unsubstituted spirobifluorenyl.

[Claim 5]

The organic electroluminescent compound according to claim 1, wherein Ar_2 represents a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted terphenyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted phenanthrenyl, a substituted or unsubstituted tetracenyl, a substituted or unsubstituted triphenylenyl, a substituted or unsubstituted chrysenyl, a substituted or unsubstituted pyrenyl, a substituted or unsubstituted phenylnaphthyl, a substituted or unsubstituted naphthylphenyl, or a substituted or unsubstituted fluorenyl.

[Claim 6]

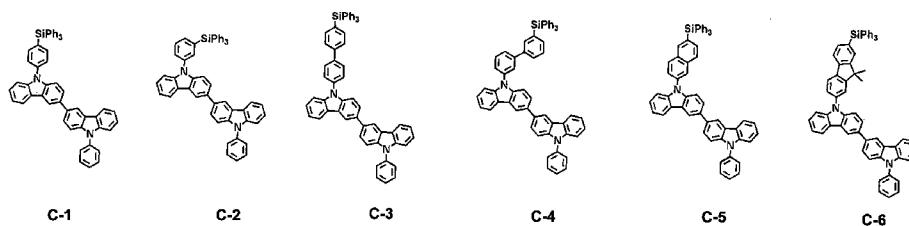
The organic electroluminescent compound according to claim 1, wherein Ar_3 represents a substituted or unsubstituted phenyl, a substituted or unsubstituted biphenyl, or a substituted or unsubstituted naphthyl.

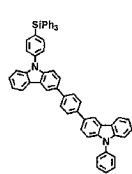
[Claim 7]

The organic electroluminescent compound according to claim 1, wherein L_1 represents a substituted or unsubstituted phenylene, a substituted or unsubstituted biphenylene, a substituted or unsubstituted naphthylene, a substituted or unsubstituted terphenylene, a substituted or unsubstituted anthracenylene, a substituted or unsubstituted phenanthrenylene, a substituted or unsubstituted tetracenylene, a substituted or unsubstituted triphenylenylene, a substituted or unsubstituted chrysenylene, a substituted or unsubstituted pyrenylene, a substituted or unsubstituted phenylnaphthylene, a substituted or unsubstituted naphthylphenylene, or a substituted or unsubstituted fluorenylene.

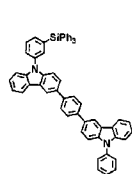
[Claim 8]

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

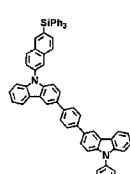




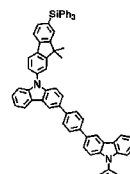
C-7



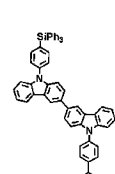
C-8



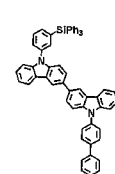
C-9



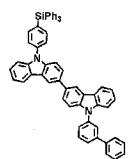
C-10



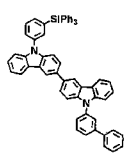
C-11



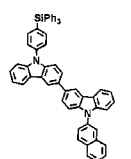
C-12



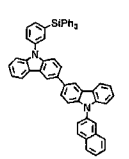
C-13



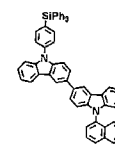
C-14



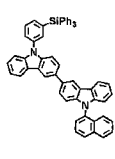
C-15



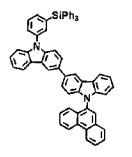
C-16



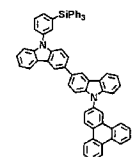
C-17



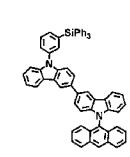
C-18



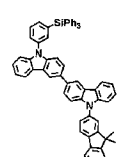
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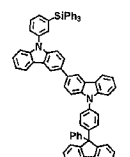
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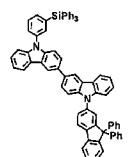
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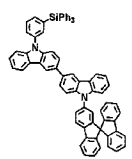
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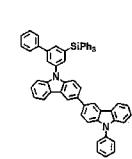
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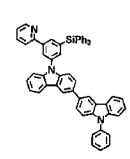
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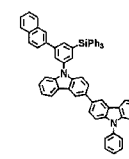
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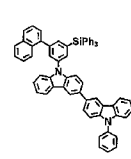
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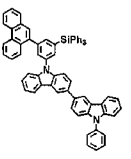
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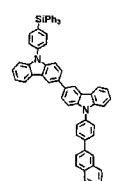
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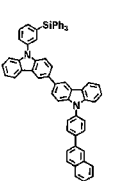
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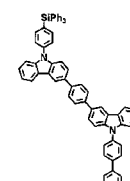
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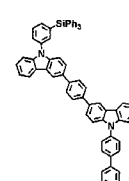
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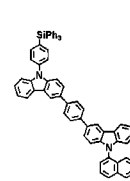
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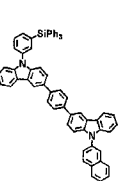
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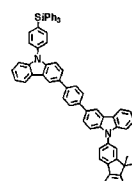
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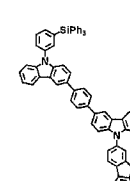
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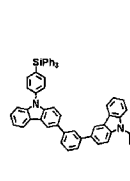
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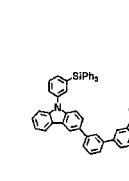
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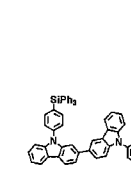
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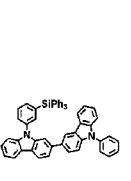
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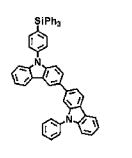
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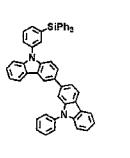
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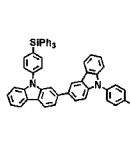
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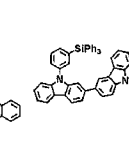
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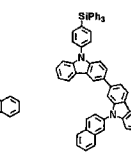
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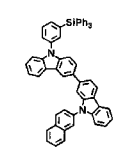
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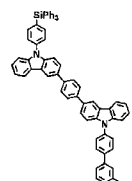
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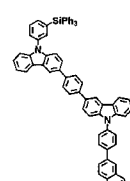
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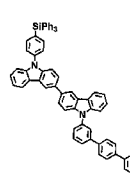
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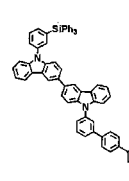
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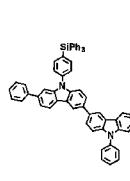
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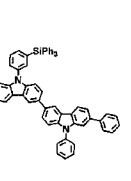
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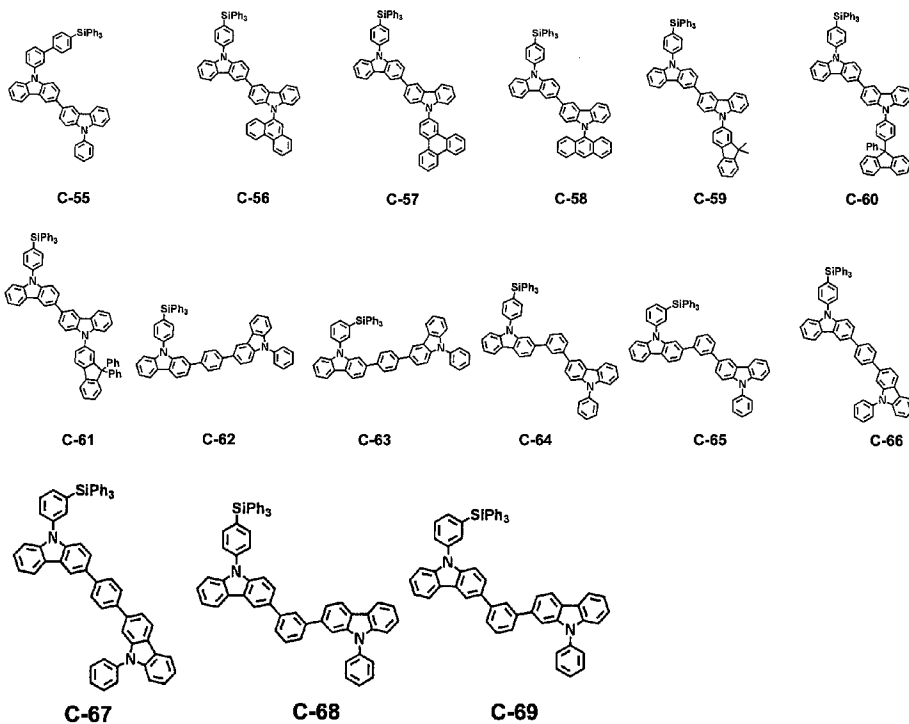
C-52



C-53



C-54



[Claim 9]

An organic electroluminescent device comprising the organic electroluminescent compound according to claim 1.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2015/013355

A. CLASSIFICATION OF SUBJECT MATTER

C07F 7/08 (2006.01) C09K 11/06 (2006.01) H01L 51/50 (2006.01) H05B 33/14 (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: Chemical Abstracts Registry and CAPLUS; Substructure search of general formula (1) in claim 1.

Applicant search: AusPat, Espacenet - Rohm and Haas, C07F, electroluminescent

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 29 January 2016		Date of mailing of the international search report 29 January 2016	
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 Scott Makin AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61 2 6283 7971	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/KR2015/013355
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/081206 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 30 May 2014 Abstract; Claims; Examples; Formula (1); Cpd. H-10, p. 9	1-9
X	KR 10-2011-0011578 A (SFC CO., LTD.) 08 February 2011 Abstract; Claims; Examples; Cpd SPH57, p. 8	1-6, 9
X	JP 2009-120582 A (TOKYO INK MANUFACTURING CO., LTD.) 04 June 2009 Abstract; Claims; Examples; Cpd 28, p. 16	1-7, 9
A	LIU, H. et al, "Solution-Processable Hosts Constructed by Carbazole/PO Substituted Tetraphenylsilanes for Efficient Blue Electrophosphorescent Devices", Advanced Functional Materials, 2014, vol. 24, pp. 5881-5888 Abstract; Cpd CSPO, CS2PO, DCSPPO, DCS2PO, Scheme 1, p. 5882; Table 1, p. 5884; Table 2, p. 5885	1-9
A	GUO, R. et al, "Novel tetraarylsilan-centred compounds as single host for white organic light-emitting diodes with high efficiency and low roll-off", Journal of Physics D: Applied Physics, 2013, vol. 46, 265101 (pp. 1-6). Abstract; Cpd DCzSiPy, DDCzSi, Figure 1, p. 2; Figure 3, Tables 2 and 3, p. 4	1-9
P,X	WO 2015/099507 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 02 July 2015 Abstract; Claims; Cpd H1-137, H1-139, H1-145, H1-169, H1-171 (p. 20), H1-177, H1-185, H1-201, H1-203 (p. 21), H1-233, H1-273, H1-275, H1-284 (p. 22), H1-295, H1-298 (p. 23)	1-9
P,X	WO 2015/160224 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 22 October 2015 Abstract; Claims; Cpd H1-13, H1-15 (p. 10), H1-18 (p. 11), H1-97, H1-126 to H1-128 (p. 12), H1-129 to H1-131, H1-135 (p. 13)	1-9
Form PCT/ISA/210 (fifth sheet) (July 2009)		

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/KR2015/013355	
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
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		KR 101478990 B1	06 Jan 2015
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		KR 101502316 B1	13 Mar 2015
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)			