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(71) Applicant: **ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.** [KR/KR]; 56, 3gongdan 1-ro, Seobuk-gu, Cheonan-si, Chungcheongnam-do 31093 (KR).

(72) Inventors: **KIM, Bitnari**; 102-2401, 101, Dongan-ro, Dongan-gu, Anyang-si, Gyeonggi-do 14074 (KR). **CHO, Sang-Hee**; 102-401, 72, Gwonseon-ro 908beon-gil, Yeongtong-gu, Suwon-si, Gyeonggi-do 16682 (KR). **KANG, Hee-Ryong**; 31, Inheon 12na-gil, Gwanak-gu, Seoul 08797 (KR). **HONG, Jin-Ri**; 38, Jibong-ro 143beon-gil, Wonmi-gu, Bucheon-si, Gyeonggi-do 14667 (KR).

(74) Agent: **CHANG, Hoon**; Central Intellectual Property & Law, Korean Re Bldg. 5F, 68, Jong-ro 5-gil, Jongno-gu, Seoul 03151 (KR).

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(54) Title: A PLURALITY OF HOST MATERIALS AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

(57) Abstract: The present disclosure relates to a plurality of host materials and organic electroluminescent device comprising the same. By comprising a specific combination of a plurality of host materials, the organic electroluminescent device of the present disclosure can show long lifespan while maintaining high luminous efficiency.

Description

Title of Invention: A PLURALITY OF HOST MATERIALS AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

Technical Field

[1] The present disclosure relates to a plurality of host materials and 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] In an organic electroluminescent device (OLED), electricity is applied to an organic light-emitting material which converts electric energy to light. Generally, OLED has a structure comprising an anode, a cathode, and an organic layer disposed between the two electrodes. The organic layer of OLED may comprise a hole injection layer, a hole transport layer, an electron blocking layer, a light-emitting layer (comprising a host and dopant materials), an electron buffering layer, a hole blocking layer, an electron transport layer, an electron injection layer, etc. A material for preparing the organic layer can be classified according to its function, as a hole injection material, a hole transport material, an electron blocking material, a light-emitting material, an electron buffering material, a hole blocking material, an electron transport material, an electron injection material, etc. Holes and electrons are injected from an anode and a cathode, respectively, to the light-emitting layer by applying electricity to OLED; excitons having high energy are formed by recombinations between the holes and the electrons, which make organic light-emitting compounds be in an excited state, and the decay of the excited state results in a relaxation of the energy into a ground state, accompanied by light-emission.

[4] The most important factor determining luminous efficiency in OLED is a light-emitting material. The light-emitting material needs to have high quantum efficiency, high electron mobility, and high hole mobility. Furthermore, the light-emitting layer formed by the light-emitting material needs to be uniform and stable. According to colors visualized by light-emission, the light-emitting material can be classified as a blue-, green-, or red-emitting material, and a yellow- or orange-emitting material can be additionally included therein. Furthermore, the light-emitting material can be

classified according to its function, as a host material and a dopant material. Recently, the development of OLED providing high efficiency and long lifespan is urgent. In particular, considering EL requirements for a middle or large-sized OLED panel, materials showing better performances than conventional ones must be urgently developed. In order to achieve the development, a host material which plays a role as a solvent in a solid state and transfers energy, should have high purity, and an appropriate molecular weight for being deposited under vacuum. In addition, a host material should have high glass transition temperature and high thermal decomposition temperature to ensure thermal stability; high electrochemical stability to have long lifespan; ease of preparation for amorphous thin film; and good adhesion to materials of adjacent layers. Furthermore, a host material should not move to an adjacent layer.

[5] The light-emitting material can be prepared by combining a host with a dopant to improve color purity, luminous efficiency, and stability. Generally, a device showing good EL performances comprises a light-emitting layer prepared by combining a host with a dopant. The host material greatly influences the efficiency and lifespan of the EL device when using a host/dopant system, and thus its selection is important.

[6] Korean Patent Application Laid-open No. 2008-0047210 discloses an organic light emitting device comprising a carbazole derivative compound as a dopant material. Also, Korean Patent Application Laid-open No. 2010-0015581 discloses an organic electroluminescent device comprising the triazine compound linked with carbazole, etc., directly as a host material. Further, Japanese Patent No. 3139321 discloses an organic emitting device comprising a biscarbazole derivative as a hole transport material. However, the above publications do not specifically disclose an organic electroluminescent device using a plurality of host materials of a combination of 7H-dibenzo[c,g]carbazole having linker triazine with a carbazole derivative.

[7] In this regard, the present inventors have tried to find an organic electroluminescent device that can provide superior efficiency and long lifespan, and have found that it could be using a plurality of host materials comprising 7H-dibenzo[c,g]carbazole having linker triazine, and a carbazole derivative compared to using the conventional sole host material for a light-emitting layer.

[8]

Disclosure of Invention

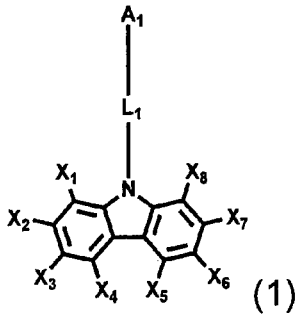
Technical Problem

[9] The objective of the present disclosure is to provide an organic electroluminescent device having long lifespan while maintaining high luminous efficiency.

Solution to Problem

[10] The present inventors found that the above objective can be achieved by an organic

electroluminescent device comprising at least one light-emitting layer disposed between an anode and a cathode, wherein the light-emitting layer comprises a host and a phosphorescent dopant, wherein the host comprises a plurality of host compounds, wherein at least a first host compound of a plurality of host compounds is represented by the carbazole derivative of the following formula 1:

[11] 

(1)

[12] wherein

[13] A_1 represents a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (5- to 30-membered)heteroaryl group, and A_1 may be linked to X_1 or X_8;

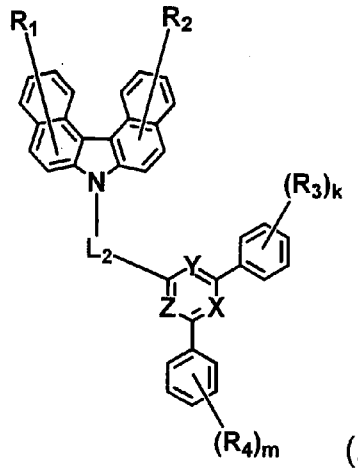
[14] L_1 represents a single bond, or a substituted or unsubstituted (C6-C30)arylene group;

[15] X_1 to X_8, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; and

[16] R_5 to R_9, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (3- to 30-membered)heteroaryl group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur;

[17] and a second host compound of a plurality of host compounds is represented by the 7H-dibenzo[c,g]carbazole having linker triazine of the following formula 2:

[18]



(2)

[19] wherein

[20] X, Y and Z, each independently, represent N or CR_{10}; provided that at least one of X, Y and Z represent N;

[21] L_2 represents a substituted or unsubstituted (C6-C30)arylene group;

[22] R_1 to R_4, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, $-NR_{11}R_{12}$, or $-SiR_{13}R_{14}R_{15}$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur;

[23] R_{10} to R_{15}, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (3- to 30-membered)heteroaryl group;

[24] k and m, each independently, represent an inter of 1 to 5; and where k or m represents an integer of 2 or more, each of R_3 or R_4 may be the same or different; and

[25] the heteroaryl and the heterocycloalkyl, each independently, contain at least one heteroatom selected from B, N, O, S, Si, and P.

[26]

Advantageous Effects of Invention

[27] According to the present disclosure, an organic electroluminescent device having

high efficiency and long lifespan is provided. In addition, the organic electroluminescent device of the present disclosure can be used for the manufacture of a display system or a lighting system.

Mode for the Invention

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

[29] The organic electroluminescent device comprising the compounds of formulae 1 and 2 will be described in detail.

[30] In formula 1, A_1 represents a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (5- to 30-membered)heteroaryl group; preferably, a substituted or unsubstituted (C6-C25)aryl group, or a substituted or unsubstituted (6- to 25-membered)heteroaryl group; and more preferably, a substituted or unsubstituted (C6-C25)aryl group, or a substituted or unsubstituted (6- to 20-membered)heteroaryl group. For example, A_1 may be selected from the group consisting of a substituted or unsubstituted phenyl, an unsubstituted biphenyl, an unsubstituted terphenyl, an unsubstituted naphthyl, a substituted fluorenyl, an unsubstituted spirofluorenyl, an unsubstituted fluoranthenyl, an unsubstituted phenanthrenyl, a substituted triazinyl, a substituted quinoxalinyl, a substituted quinazolinyl, an unsubstituted triphenylsilyl, an unsubstituted triphenylaminyl, an unsubstituted triphenylenyl, an unsubstituted dibenzothiophenyl, an unsubstituted benzonaphthothiophenyl, a substituted or unsubstituted dibenzofuranyl, a substituted carbazolyl, a substituted benzocarbazolyl, and a substituted dibenzocarbazolyl. The substituent of A_1 may not be a nitrogen-containing heteroaryl. The substituent of the substituted aryl or the substituted heteroaryl may be at least one of (C1-C30)alkyl, (C6-C30)aryl, (5- to 30-membered)heteroaryl, and mono- or di-(C1-C30)alkyl(C6-C30)aryl; preferably, at least one of (C1-C6)alkyl, (C6-C18)aryl, and di(C1-C6)alkyl(C6-C18)aryl; and for example, at least one of methyl, phenyl, biphenyl, naphthyl, naphthylphenyl, and fluorenyl substituted with dimethyl. Also, A_1 may be linked to X_1 or X_8; and the linkage is preferably a single bond.

[31] In formula 1, L_1 represents a single bond, or a substituted or unsubstituted (C6-C30)arylene group; preferably, a single bond, or a substituted or unsubstituted (C6-C18)arylene group; and more preferably, a single bond, or a substituted or unsubstituted (C6-C12)arylene group. For example, L_1 may be a single bond, a substituted or unsubstituted phenyl, or an unsubstituted naphthyl, wherein the substituent of a substituted phenyl may be a carbazolyl substituted with phenyl.

[32] In formula 1, X_1 to X_8, each independently, represent hydrogen, deuterium, a

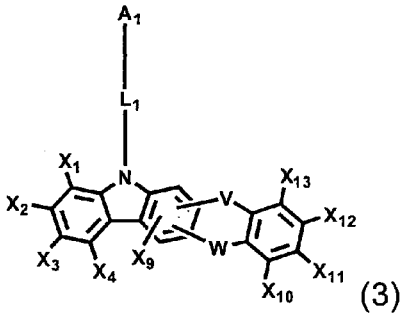
halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; preferably, each independently, hydrogen, a substituted or unsubstituted (C6-C25)aryl group, a substituted or unsubstituted (5- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C5-C25), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; and more preferably, each independently, hydrogen, a substituted or unsubstituted (C6-C18)aryl group, a substituted or unsubstituted (6- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C6-C18) aromatic ring, whose carbon atom(s) may be replaced with at least one nitrogen atom. For example, X_1 to X_8, each independently, may be hydrogen, a substituted or unsubsituted phenyl, a substituted biphenyl, a substituted naphthyl, a substituted fluorenyl, an unsubsituted triphenylaminyl, an unsubsituted dibenzothiophenyl, an unsubsituted dibenzofuranyl, a substituted carbazolyl, a substituted benzocarbazolyl, an unsubsituted dibenzocarbazolyl, a substituted pyrimidinyl, a substituted or unsubsituted 25-membered heteroaryl, an unsubsituted 29-membered heteroaryl, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form an unsubsituted benzene ring, a substituted indole ring, or a substituted benzoindole ring, wherein the substituent of the substituted phenyl, the substituted biphenyl, the substituted naphthyl, the substituted fluorenyl, the substituted carbazolyl, the substituted benzocarbazolyl, the substituted pyrimidinyl, the substituted 25-membered heteroaryl, the substituted indole ring, or the substituted benzoindole ring may be at least one of an unsubstituted (C6-C30)aryl, a tri(C6-C30)arylsilyl, a mono- or di- (C6-C30)arylamino, a mono- or di- (C1-C30)alkyl(C6-C30)aryl, and a (3- to 30-membered)heteroaryl unsubstituted or substituted with (C6-C30)aryl; preferably, at least one of an unsubstituted (C6-C18)aryl, a tri(C6-C18)arylsilyl, a di(C6-C18)arylamino, a di(C1-C10)alkyl(C6-C18)aryl, and a (6- to 25-membered)heteroaryl unsubstituted or substituted with a (C6-C18)aryl; and for example, at least one of phenyl, biphenyl, naphthyl, naphthylphenyl, diphenylamine, triphenylsilyl, fluorenyl substituted with dimethyl, dibenzofuranyl, dibenzocarbazolyl,

benzocarbazolyl substituted with phenyl, carbazolyl substituted with phenyl, naphthyl or biphenyl, and 25-membered heteroaryl.

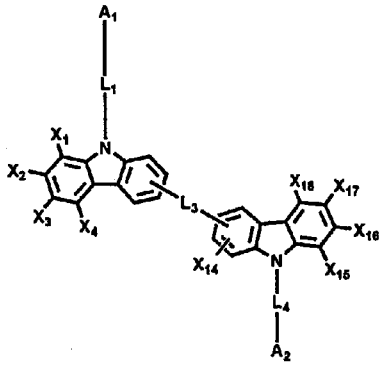
[33] In formula 1, R_5 to R_9, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (3- to 30-membered)heteroaryl group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; preferably, each independently, hydrogen, or a substituted or unsubstituted (C6-C25)aryl group; more preferably, each independently, a substituted or unsubstituted (C6-C18)aryl group; and for example, an unsubstituted phenyl, an unsubstituted biphenyl, or a fluoreneyl substituted with dimethyl.

[34] The compound of formula 1 may be represented by any one of the following formulae 3 to 5:

[35]

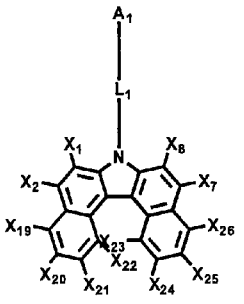


(3)



(4)

[36]



(5)

[37] In formula 3, V and W represent a single bond or NR_{16}; provided that both V and W are not a single bond or NR_{16}; wherein R_{16} represents hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or un-

substituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (3- to 30-membered)heteroaryl group; preferably, a substituted or unsubstituted (C6-C25)aryl group; more preferably, a substituted or unsubstituted (C6-C18)aryl group; and for example, an unsubstituted phenyl, an unsubstituted biphenyl, an unsubstituted naphthylphenyl, an unsubstituted naphthyl, or a fluorenyl substituted with dimethyl.

[38] In formula 4, A_2 represents a substituted or unsubstituted (C6-C30)aryl group; preferably, an unsubstituted (C6-C25)aryl group; more preferably, an unsubstituted (C6-C18)aryl group; and for example, an unsubstituted phenyl, an unsubstituted biphenyl, or an unsubstituted naphthyl. Also, A_2 may be linked to X_{14} or X_{15}; and the linkage is preferably a single bond.

[39] In formula 4, L_3 and L_4, each independently, represent a single bond, or a substituted or unsubstituted (C6-C30)arylene group; preferably, each independently, a single bond, or an unsubstituted (C6-C25)arylene group; more preferably, each independently, a single bond, or an unsubstituted (C6-C18)arylene group; and for example, each independently, a single bond, an unsubstituted phenylene, an unsubstituted biphenylene, or an unsubstituted naphthylene.

[40] In formulae 3 to 5, X_9 to X_{26}, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; preferably, each independently, hydrogen, a substituted or unsubstituted (C6-C25)aryl group, a substituted or unsubstituted (5- to 25-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C5-C25), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; more preferably, each independently, hydrogen, an unsubstituted (C6-C18)aryl group, an unsubstituted (6- to 18-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form an unsubstituted mono- or polycyclic (C5-C18) aromatic ring; and for example, each independently, hydrogen, an unsubstituted phenyl, an unsubstituted naphthyl, an unsubstituted dibenzothiophenyl, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form an unsubstituted benzene ring.

[41] In formulae 3 to 5, A_1, L_1, X_1 to X_4, X_7, X_8, and R_5 to R_9 are as defined in formula 1.

[42] In formula 2, X, Y and Z, each independently, represent N or CR_{10}; provided that at least one of X, Y and Z represent N;

[43] In formula 2, L_2 represents a substituted or unsubstituted (C6-C30)arylene group; preferably, a substituted or unsubstituted (C6-C18)arylene group; more preferably, an unsubstituted (C6-C12)arylene group; and for example, phenylene, naphthylene, or biphenylene.

[44] In formula 2, R_1 to R_4, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, $-NR_{11}R_{12}$, or $-SiR_{13}R_{14}R_{15}$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; preferably, each independently, hydrogen, a substituted or unsubstituted (C6-C25)aryl group, or a substituted or unsubstituted (3- to 25-membered)heteroaryl group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C25), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; more preferably, each independently, hydrogen, a substituted or unsubstituted (C6-C18)aryl group, or a substituted or unsubstituted (5- to 18-membered)heteroaryl group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C5-C18), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; and for example, hydrogen, an unsubstituted phenyl, an unsubstituted naphthyl, a fluorenyl substituted with dimethyl, a carbazolyl substituted with phenyl, an unsubstituted dibenzofuranyl, or an unsubstituted dibenzothiophenyl; or may be linked to an adjacent substituent(s) to form an unsubstituted benzene ring, an indene ring substituted with dimethyl, an indole ring substituted with phenyl, an unsubstituted benzothiophene ring, or an unsubstituted benzofuran ring.

[45] In formula 2, R_{10} to R_{15}, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted

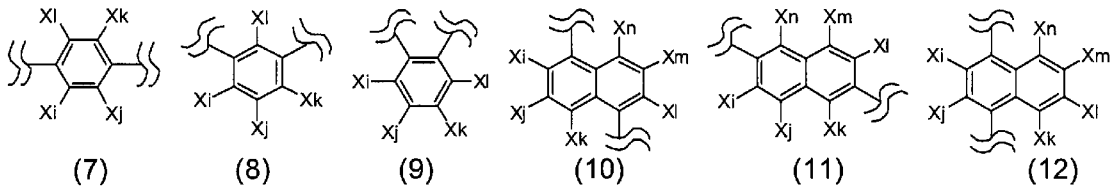
or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (3- to 30-membered)heteroaryl group; preferably, each independently, hydrogen, or a substituted or unsubstituted (C6-C25)aryl group; more preferably, each independently, hydrogen, or a substituted or unsubstituted (C6-C18)aryl group; and for example, hydrogen, a substituted or unsubstituted phenyl, an unsubstituted biphenyl, an unsubstituted naphthyl, or a fluorenyl substituted with dimethyl.

[46] In formula 2, k and m, each independently, represent an inter of 0 to 5; and preferably, each independently, an inter of 0 to 2, and where k or m represents an integer of 2 or more, each of R_3 or R_4 may be the same or different.

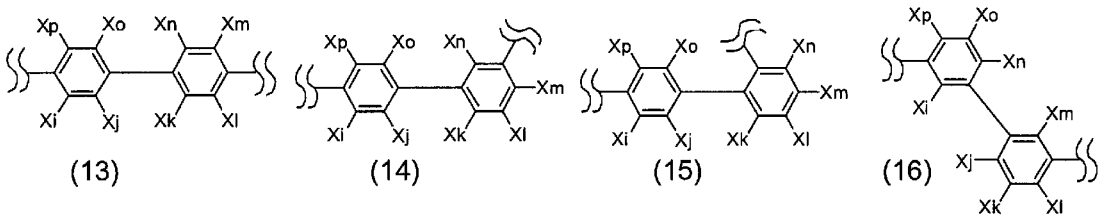
[47] In formulae 1 and 2, the heteroaryl and the heterocycloalkyl, each independently, contain at least one heteroatom selected from B, N, O, S, Si, and P; and preferably, contain at least one heteroatom selected from N, O, S and Si.

[48] In formula 2, L_2 may be represented by any one of the following formulae 7 to 19:

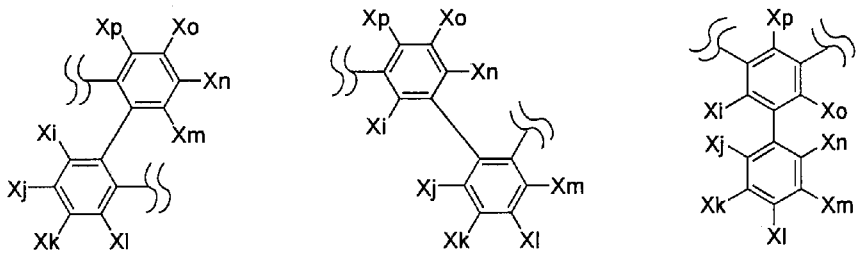
[49]



[50]



[51]



[52] wherein

[53] Xi to Xp, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C2-C30)alkenyl group, a substituted or unsubstituted (C2-C30)alkynyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C6-C60)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, a substituted or unsubstituted tri(C1-C30)alkylsilyl group, a substituted or un-

substituted tri(C6-C30)arylsilyl group, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl group, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl group, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; preferably, each independently, hydrogen, a halogen, a cyano group, a substituted or unsubstituted (C1-C10)alkyl group, a substituted or unsubstituted (C3-C20)cycloalkyl group, a substituted or unsubstituted (C6-C12)aryl group, a substituted or unsubstituted (C1-C6)alkyldi(C6-C12)arylsilyl group, or a substituted or unsubstituted tri(C6-C20)arylsilyl group; more preferably, hydrogen.

[54] Herein, "(C1-C30)alkyl" is meant to be a linear or branched alkyl having 1 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 1 to 20, more preferably 1 to 10, and includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, etc.; "(C2-C30)alkenyl" is meant to be a linear or branched alkenyl having 2 to 30 carbon atoms constituting the chain, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes vinyl, 1-propenyl, 2-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 2-methylbut-2-enyl, etc.; "(C2-C30)alkynyl" is 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.; "(C3-C30)cycloalkyl" is a mono- or polycyclic hydrocarbon having 3 to 30 ring backbone carbon atoms, in which the number of carbon atoms is preferably 3 to 20, more preferably 3 to 7, and includes cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, etc.; "3- to 7- membered heterocycloalkyl" is a cycloalkyl having 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.; "(C6-C30)aryl(ene)" is a monocyclic or fused ring derived from an aromatic hydrocarbon having 6 to 30 ring backbone carbon atoms, in which the number of carbon atoms is preferably 6 to 20, more preferably 6 to 15, and includes phenyl, biphenyl, terphenyl, naphthyl, binaphthyl, phenylnaphthyl, naphthylphenyl, fluorenyl, phenylfluorenyl, benzofluorenyl, dibenzofluorenyl, phenanthrenyl, phenylphenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, etc.; "3- to 30-membered heteroaryl" 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; 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 including furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., and a fused ring-type heteroaryl including benzofuranyl, benzothiophenyl, isobenzofuranyl, dibenzofuranyl, dibenzothiophenyl, benzimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, benzoindolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, phenoxazinyl, phenanthridinyl, benzodioxolyl, etc.; "nitrogen-containing (5- to 30-membered) heteroaryl" indicates an aryl group having 5 to 30 ring backbone atoms, preferably 5 to 20 ring backbone atoms, more preferably 5 to 15 ring backbone atoms, containing at least one, preferably 1 to 4, nitrogen as the heteroatom, 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 pyrrolyl, imidazolyl, pyrazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc. and a fused ring-type heteroaryl such as benzoimidazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, benzocarbazolyl, dibenzocarbazolyl, phenanthridinyl, etc. Furthermore, "halogen" includes F, Cl, Br, and I.

[55] Herein, "substituted" in the expression "substituted or unsubstituted" means that a hydrogen atom in a certain functional group is replaced with another atom or group, i.e. a substituent. The substituents of the substituted alkyl group, the substituted cycloalkyl group, the substituted cycloalkenyl group, the substituted heterocycloalkyl group, the substituted aryl(ene) group, the substituted heteroaryl group, and the substituted mono- or polycyclic, alicyclic or aromatic ring in A_1, A_2, L_1 to L_4, X_1 to X_{26}, and R_1 to R_{16} of formulae 1 to 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 (C6-C30)aryl; a (C6-C30)aryl unsubstituted or substituted with a cyano, a (3- to 30-membered)heteroaryl or a tri(C6-C30)arylsilyl; 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 mono- or di-(C1-C30)alkyl(C6-C30)aryl; preferably, each independently, at least one selected from the group consisting of a (C1-C15)alkyl; a (5- to 30-membered)heteroaryl unsubstituted or substituted with a (C6-C25)aryl; an unsubstituted (C6-C25)aryl; a tri(C6-C18)arylsilyl; a di(C6-C18)arylamino; and a di(C1-C15)alkyl(C6-C18)aryl; more preferably, each independently, at least one selected from the group consisting of a (C1-C6)alkyl; a (6- to 25-membered)heteroaryl unsubstituted or substituted with a (C6-C12)aryl; an unsubstituted (C6-C18)aryl; a tri(C6-C12)arylsilyl; a di(C6-C12)arylamino; and a di(C1-C6)alkyl(C6-C18)aryl; and for example, at least one selected from the group consisting of methyl, phenyl, biphenyl, naphthyl, naphthylphenyl, fluorenyl substituted with dimethyl, dibenzofuranyl, triphenylsilyl, diphenylamino, dibenzothiophenyl, dibenzocarbazolyl, benzocarbazolyl substituted with phenyl, carbazolyl substituted with phenyl, biphenyl or naphthyl, and 25-membered heteroaryl.

[56] According to one embodiment of the present invention, in formula 1, A_1 represents a substituted or unsubstituted (C6-C25)aryl group, or a substituted or unsubstituted (6- to 25-membered)heteroaryl group; L_1 represents a single bond, or a substituted or unsubstituted (C6-C18)arylene group; X_1 to X_8, each independently, represent hydrogen, a substituted or unsubstituted (C6-C25)aryl group, a substituted or unsubstituted (5- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C5-C25), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; and R_5 to R_9, each independently, represent hydrogen, or a substituted or unsubstituted (C6-C25)aryl group.

[57] According to another embodiment of the present invention, in formula 1, A_1 represents a substituted or unsubstituted (C6-C25)aryl group, or a substituted or unsubstituted (6- to 20-membered)heteroaryl group; L_1 represents a single bond, or a substituted or unsubstituted (C6-C12)arylene group; X_1 to X_8, each independently, represent hydrogen, a substituted or unsubstituted (C6-C18)aryl group, a substituted or unsubstituted (6- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C6-C18) aromatic ring, whose carbon atom(s) may be replaced with at least one nitrogen atom; and R_5 to R_9, each independently, represent a substituted or unsubstituted (C6-C18)aryl group.

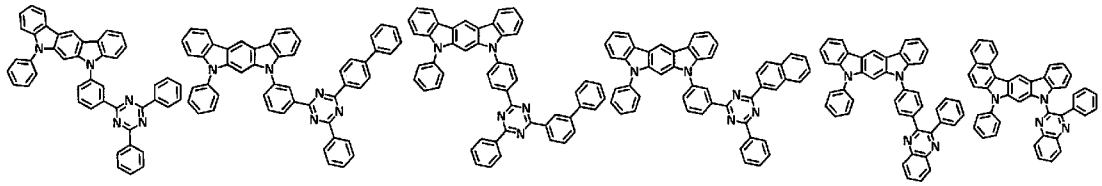
[58] According to one embodiment of the present invention, in formula 2, L_2 represents a

substituted or unsubstituted (C6-C18)arylene group; R_1 to R_4, each independently, represent hydrogen, a substituted or unsubstituted (C6-C25)aryl group, or a substituted or unsubstituted (3- to 25-membered)heteroaryl group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C25), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; and k and m, each independently, represent an inter of 0 to 2.

[59] According to another embodiment of the present invention, in formula 2, L_2 represents an unsubstituted (C6-C12)arylene group; R_1 to R_4, each independently, represent hydrogen, a substituted or unsubstituted (C6-C18)aryl group, or a substituted or unsubstituted (5- to 18-membered)heteroaryl group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C5-C18), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur; and k and m, each independently, represent an inter of 0 to 2.

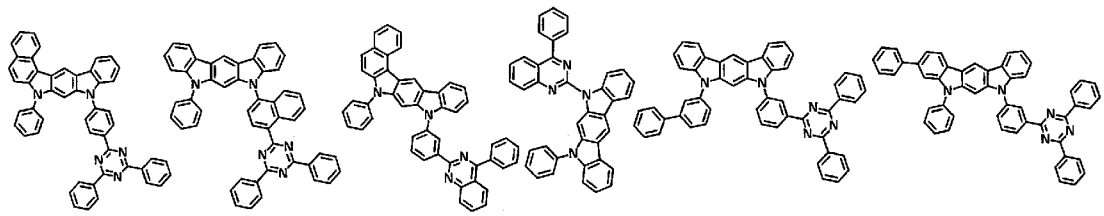
[60] The first host compound of formula 1 may be selected from the group consisting of the following compounds, but is not limited thereto:

[61]



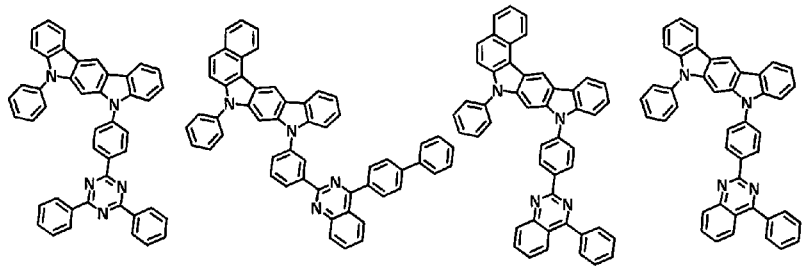
H-1 H-2 H-3 H-4 H-5 H-6

[62]



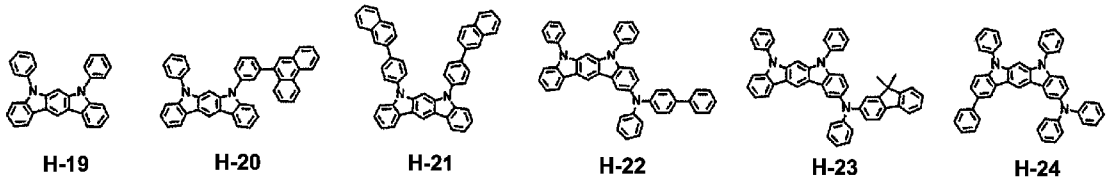
H-7 H-8 H-9 H-10 H-11 H-12

[63]



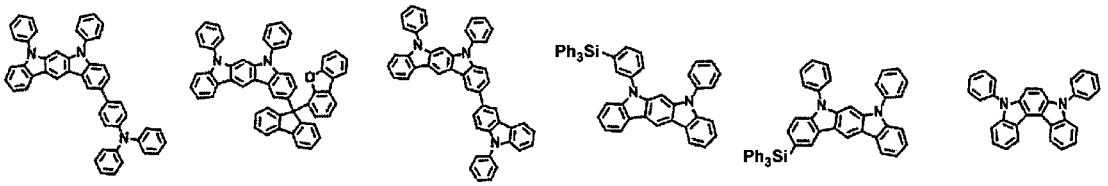
H-13 H-14 H-15 H-16

[64]



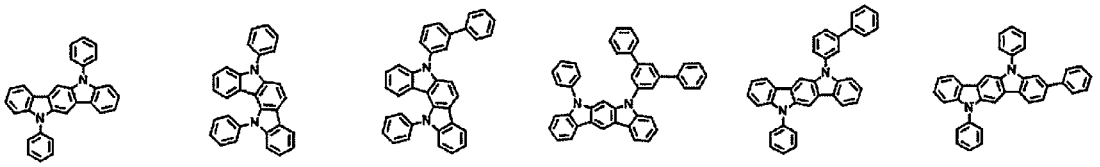
H-19 H-20 H-21 H-22 H-23 H-24

[65]



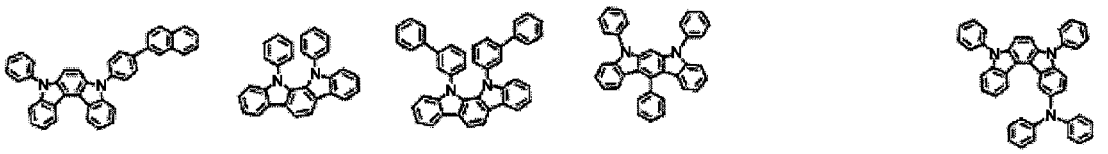
H-25 H-26 H-27 H-28 H-29 H-30

[66]



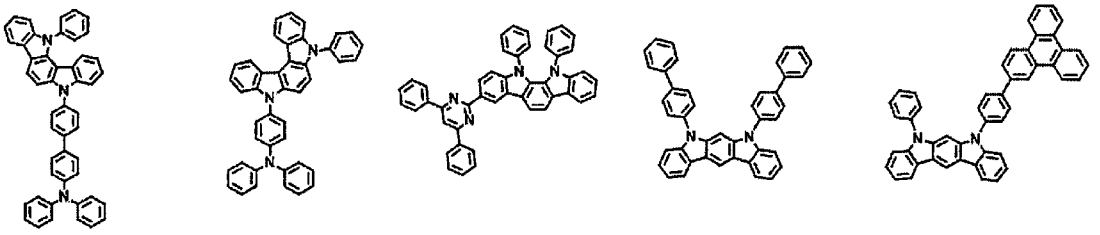
H-31 H-32 H-33 H-34 H-35 H-36

[67]



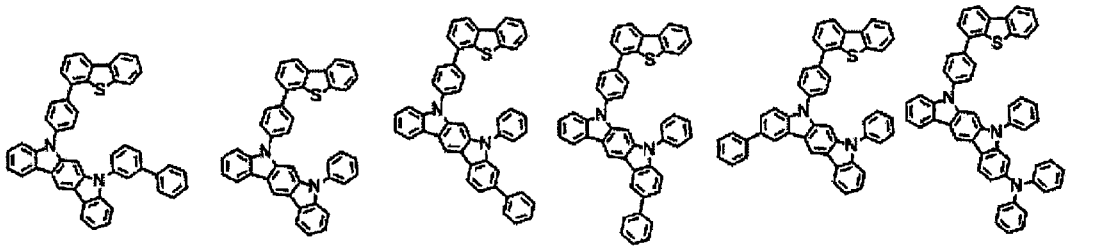
H-37 H-38 H-39 H-40 H-42

[68]



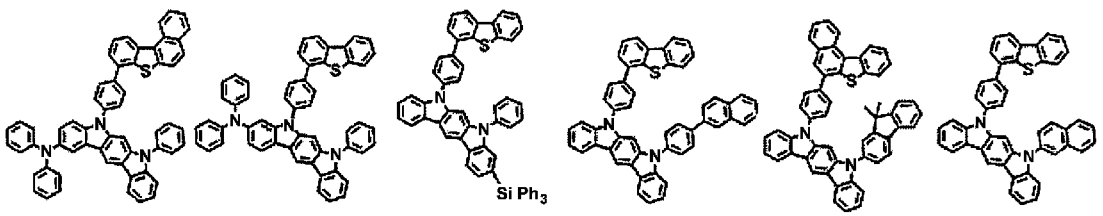
H-43 H-44 H-45 H-46 H-47

[69]



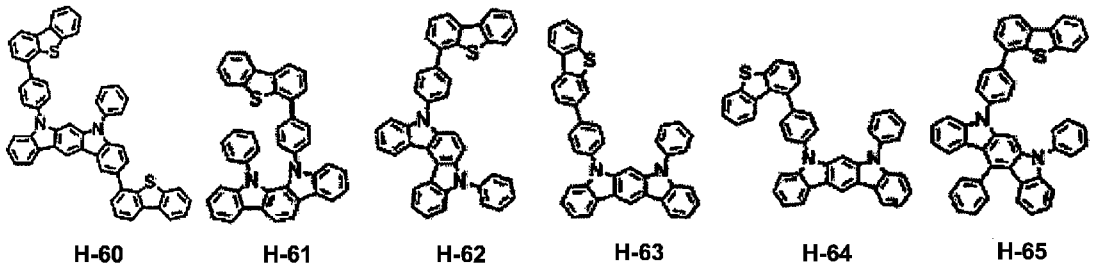
H-48 H-49 H-50 H-51 H-52 H-53

[70]

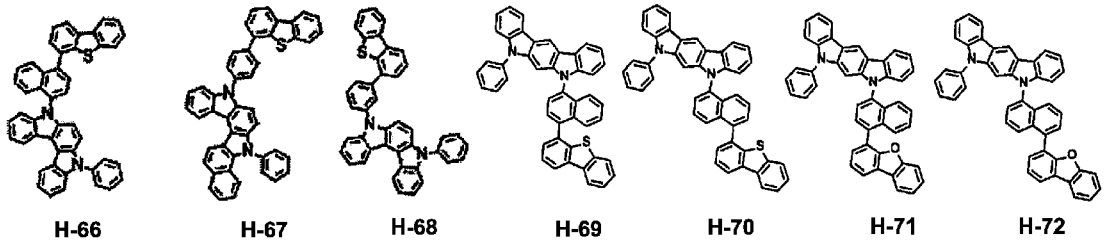


H-54 H-55 H-56 H-57 H-58 H-59

[71]



[72]



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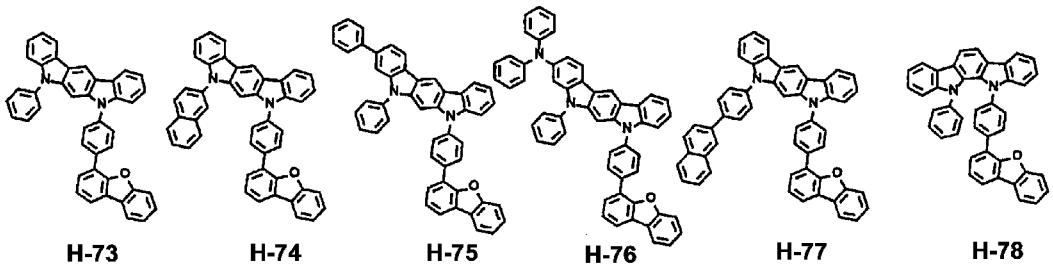
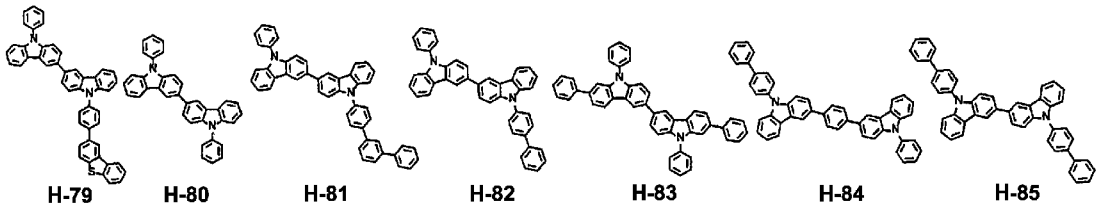
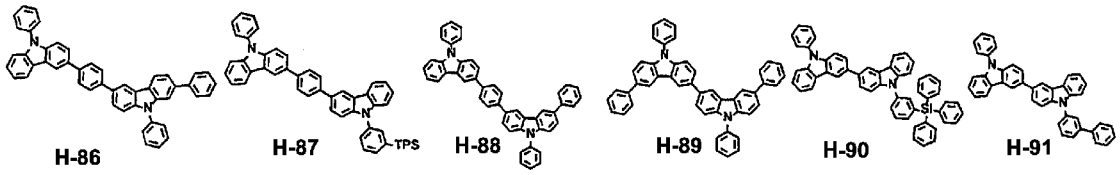


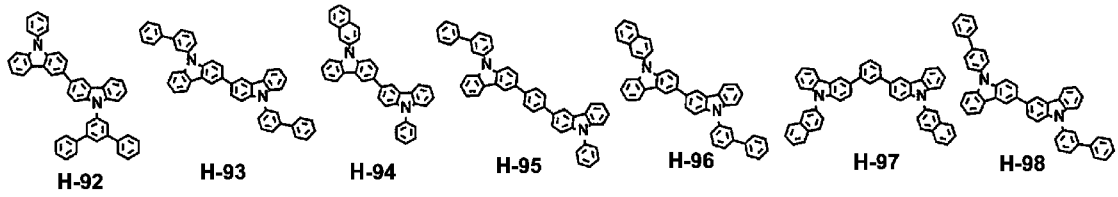
[74]



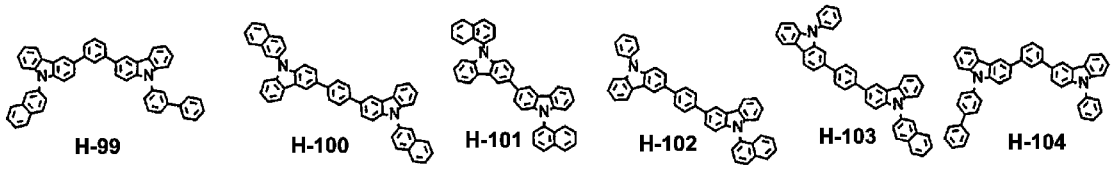
[75]



[76]



[77]



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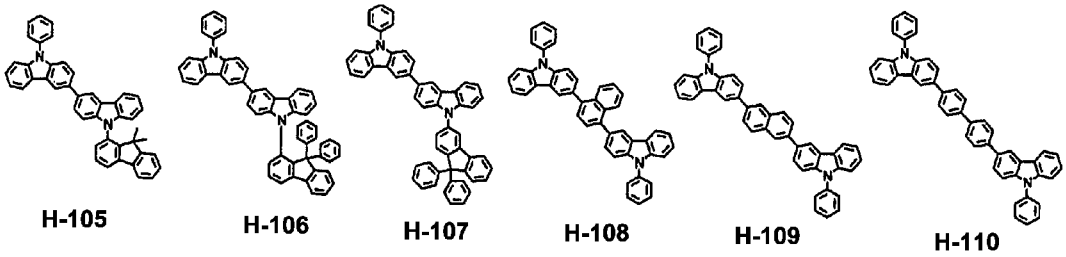

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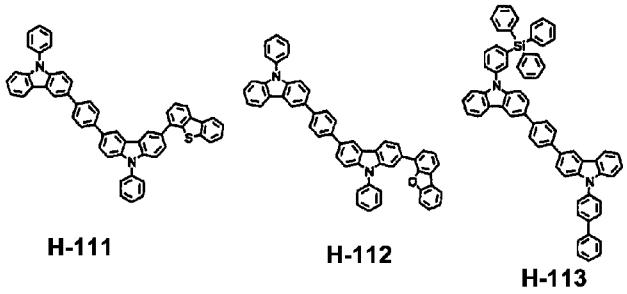
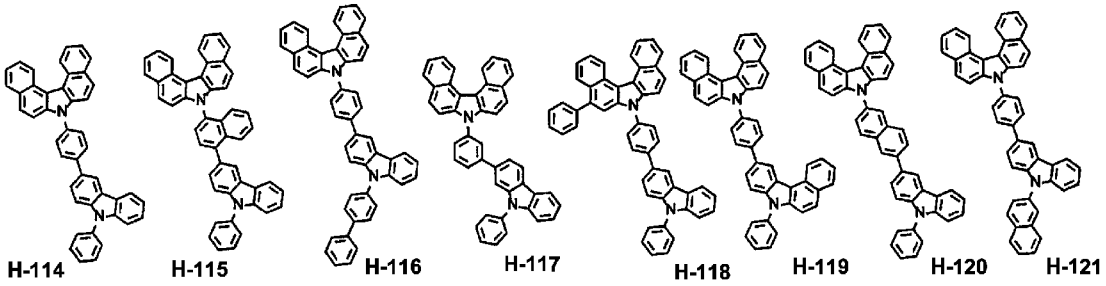
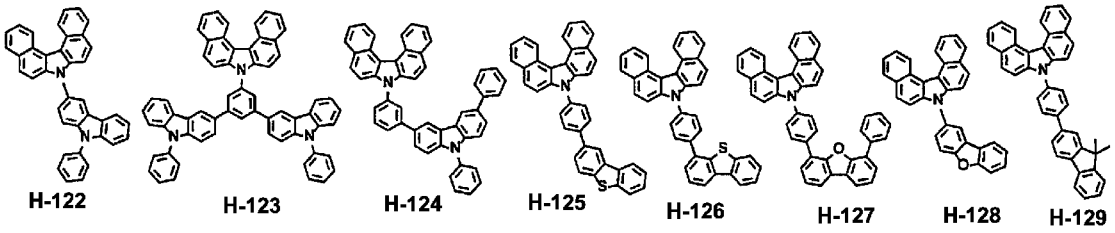


[80]



[81]



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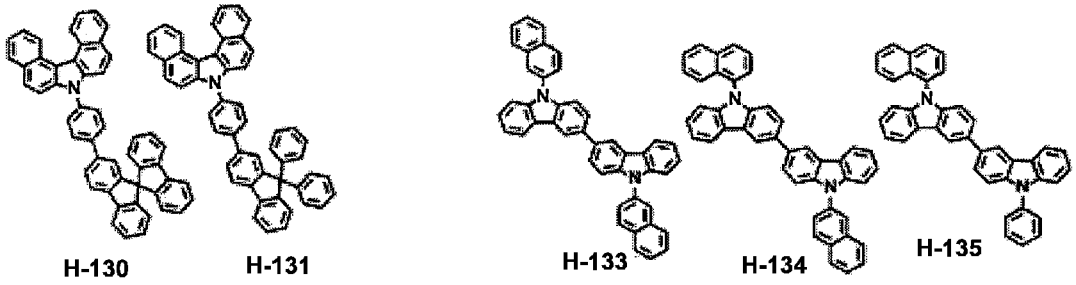
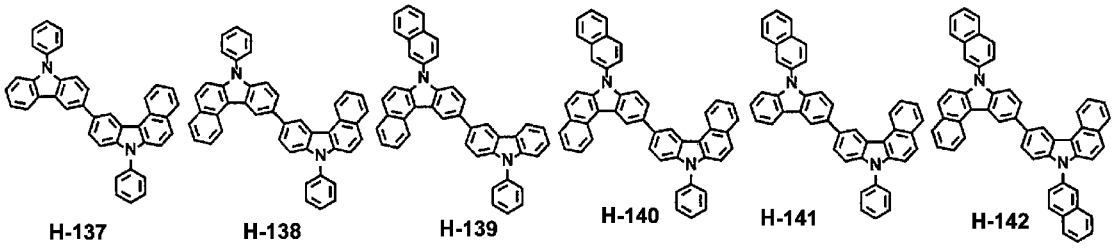
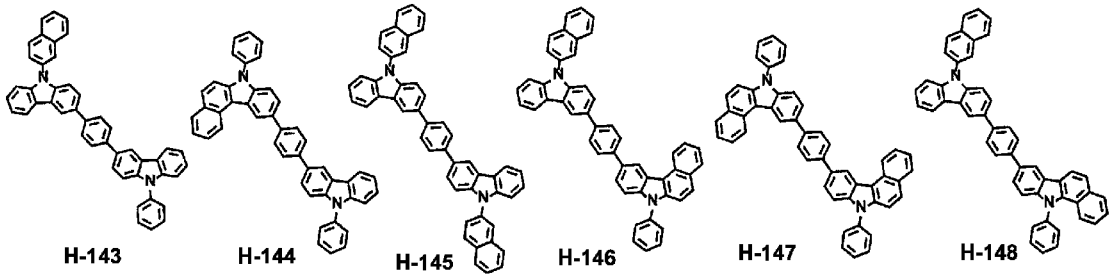


[83]

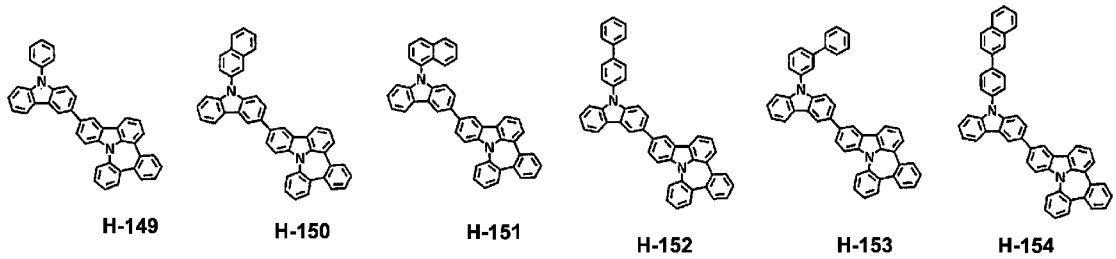


[84]



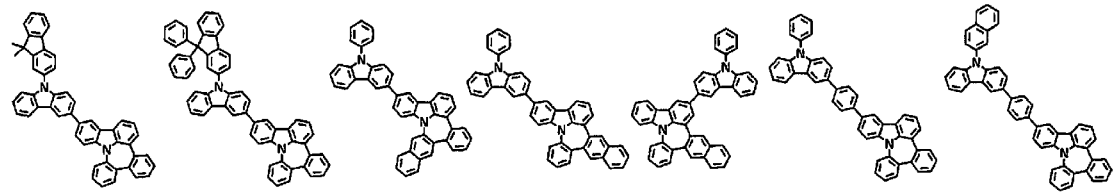
H-143 H-144 H-145 H-146 H-147 H-148

[85]



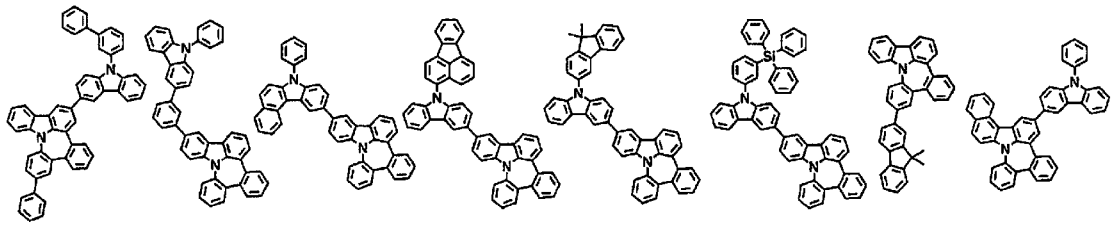
H-149 H-150 H-151 H-152 H-153 H-154

[86]



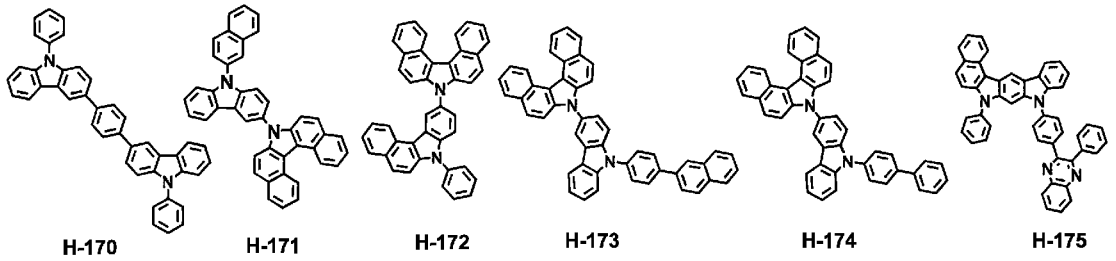
H-155 H-156 H-157 H-158 H-159 H-160 H-161

[87]



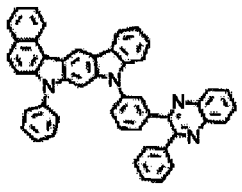
H-162 H-163 H-164 H-165 H-166 H-167 H-168 H-169

[88]



H-170 H-171 H-172 H-173 H-174 H-175

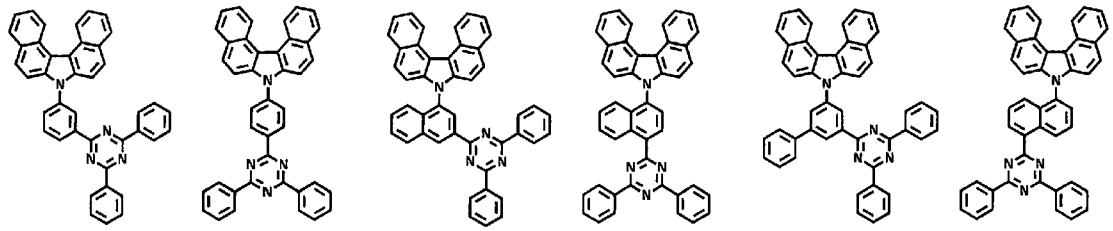
[89]



H-176

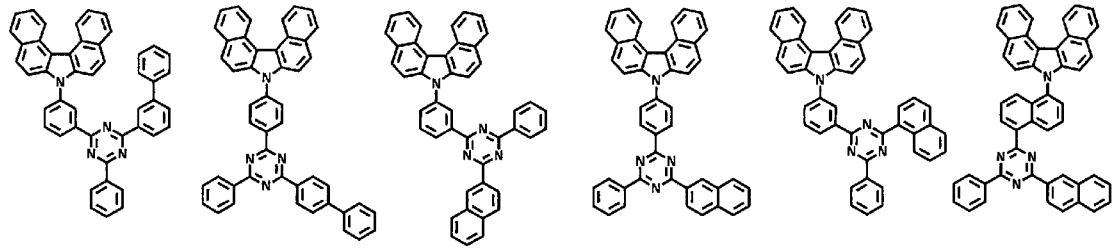
[90] The second host compound of formula 2 may be selected from the group consisting of the following compounds, but is not limited thereto:

[91]



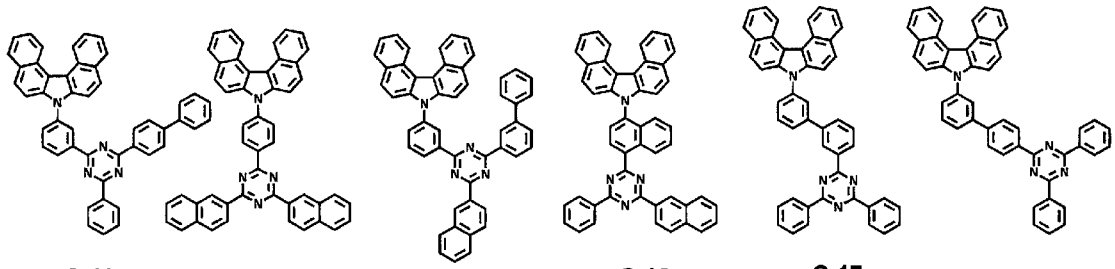
C-1 C-2 C-3 C-4 C-5 C-6

[92]



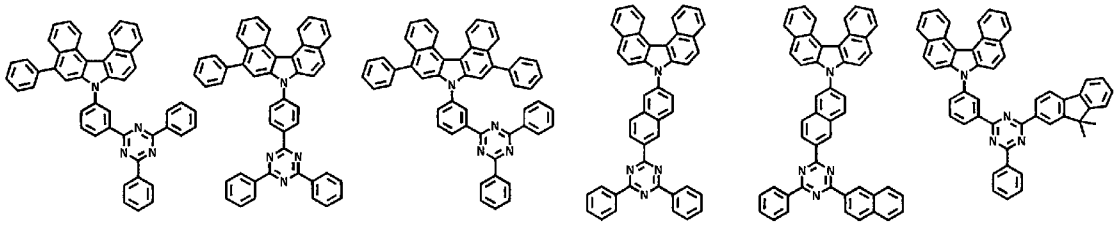
C-7 C-8 C-9 C-10 C-11 C-12

[93]



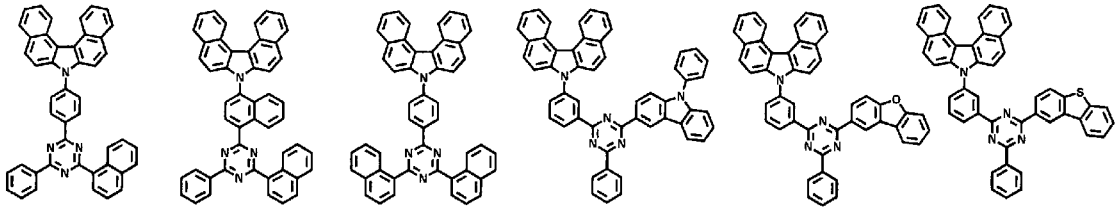
C-13 C-14 C-15 C-16 C-17 C-18

[94]



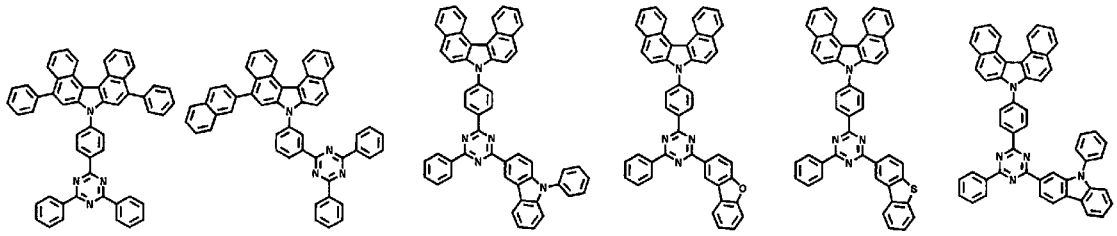
C-19 C-20 C-21 C-22 C-23 C-24

[95]



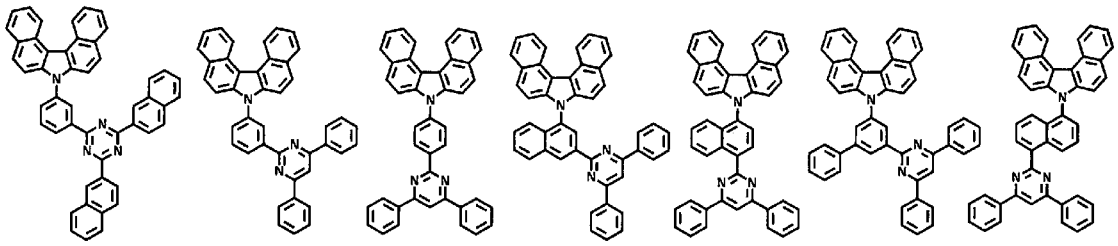
C-25 C-26 C-27 C-28 C-29 C-30

[96]



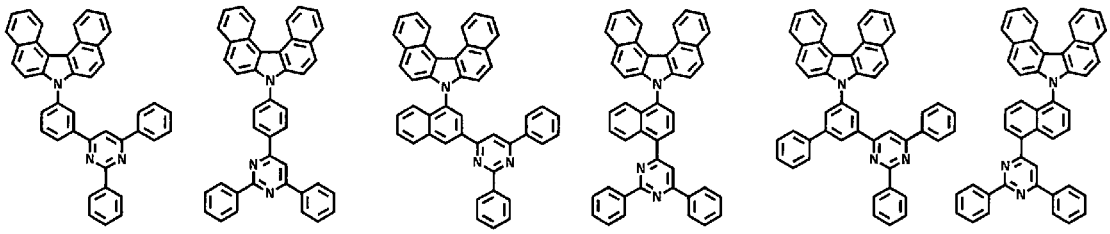
C-31 C-32 C-33 C-34 C-35 C-36

[97]



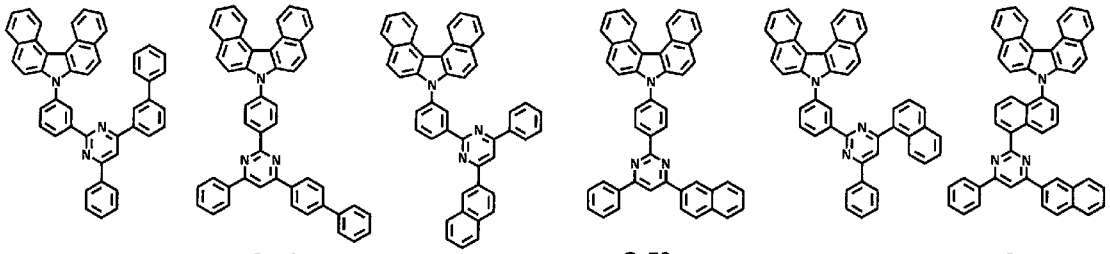
C-37 C-38 C-39 C-40 C-41 C-42 C-43

[98]



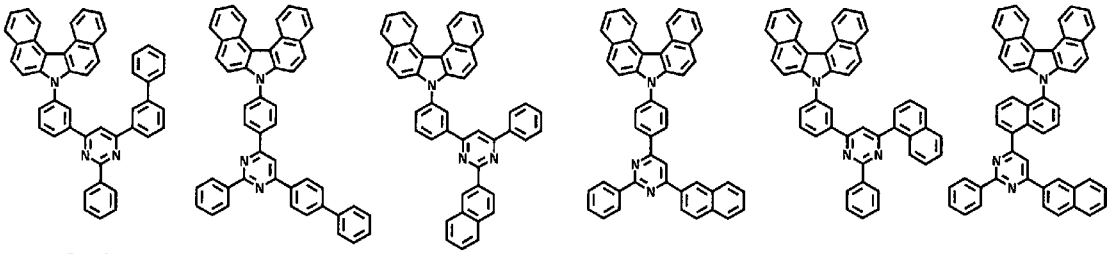
C-44 C-45 C-46 C-47 C-48 C-49

[99]



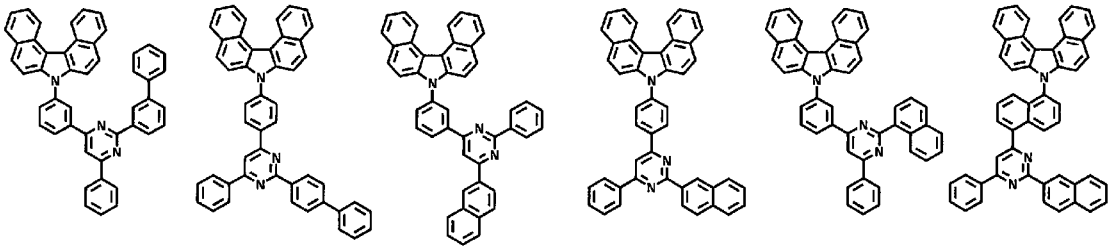
C-50 C-51 C-52 C-53 C-54 C-55

[100]



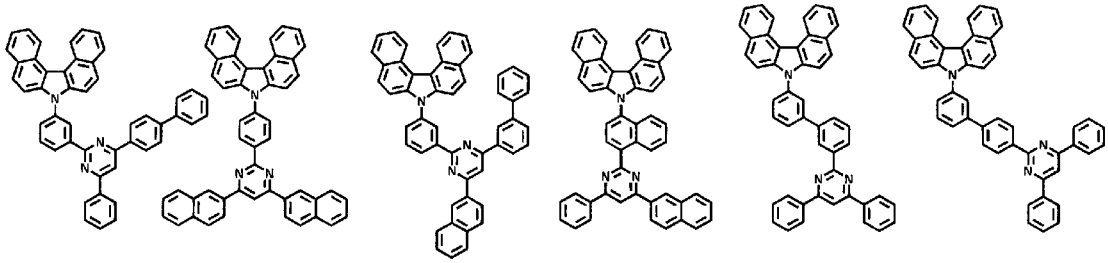
C-56 C-57 C-58 C-59 C-60 C-61

[101]



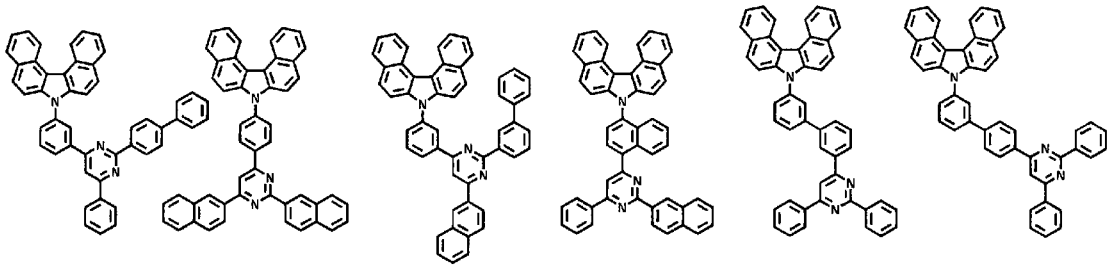
C-62 C-63 C-64 C-65 C-66 C-67

[102]



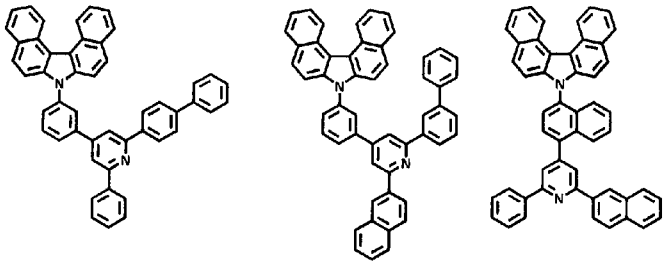
C-68 C-69 C-70 C-71 C-72 C-73

[103]



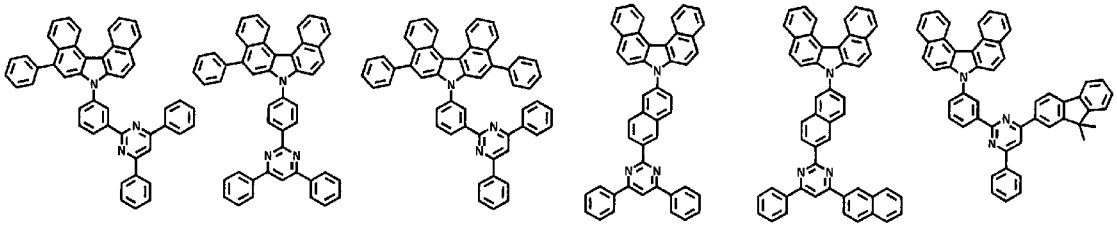
C-74 C-75 C-76 C-77 C-78 C-79

[104]



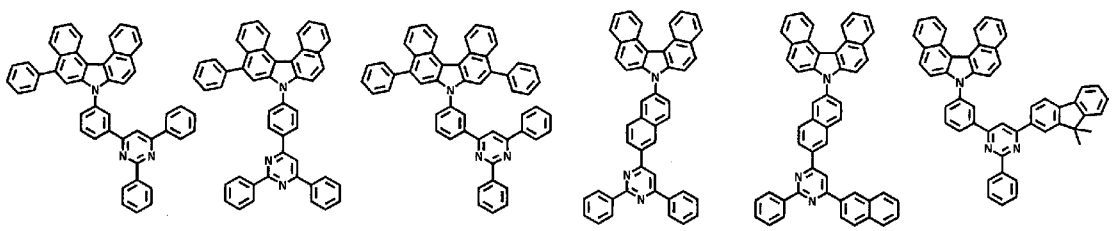
C-80 C-81 C-82

[105]



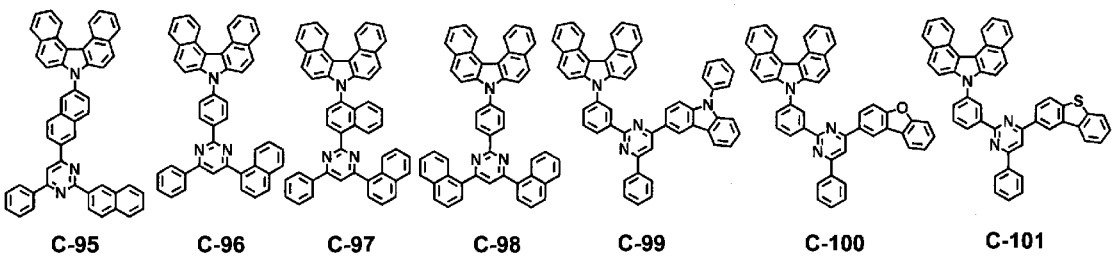
C-83 C-84 C-85 C-86 C-87 C-88

[106]



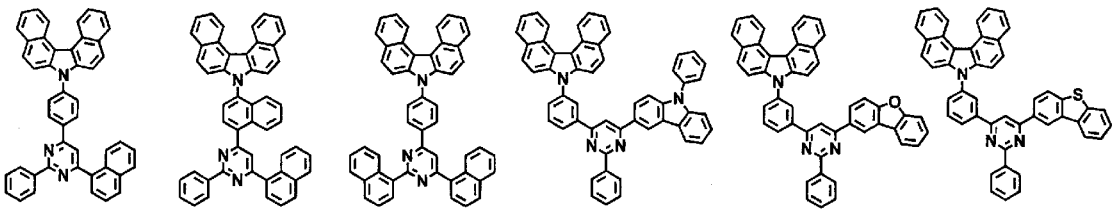
C-89 C-90 C-91 C-92 C-93 C-94

[107]



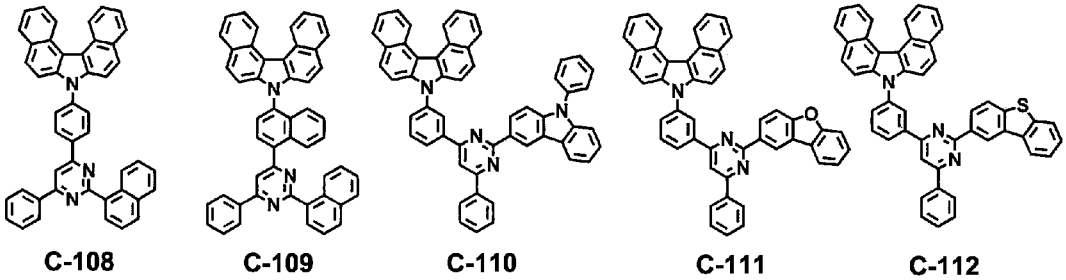
C-95 C-96 C-97 C-98 C-99 C-100 C-101

[108]



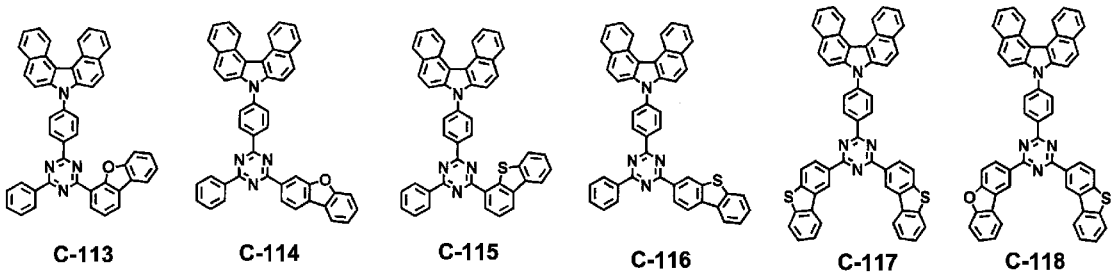
C-102 C-103 C-104 C-105 C-106 C-107

[109]



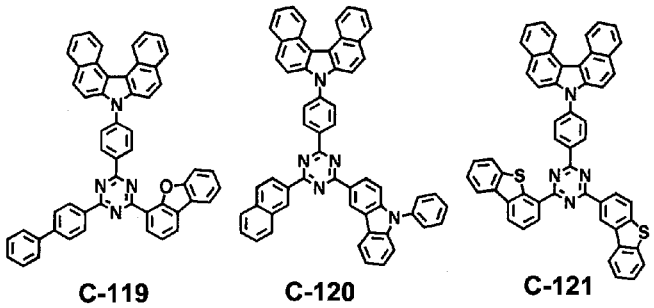
C-108 C-109 C-110 C-111 C-112

[110]



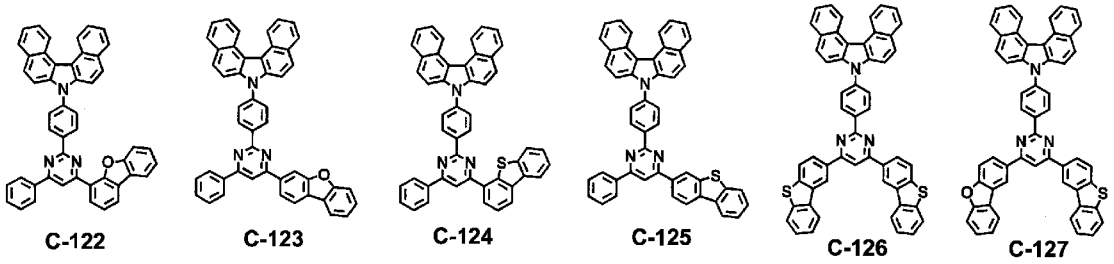
C-113 C-114 C-115 C-116 C-117 C-118

[111]



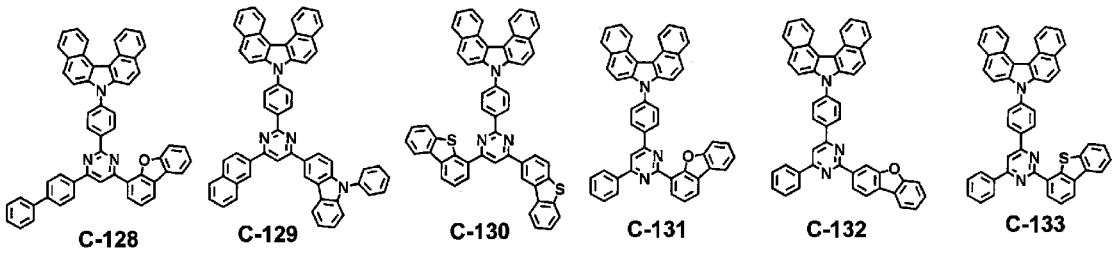
C-119 C-120 C-121

[112]



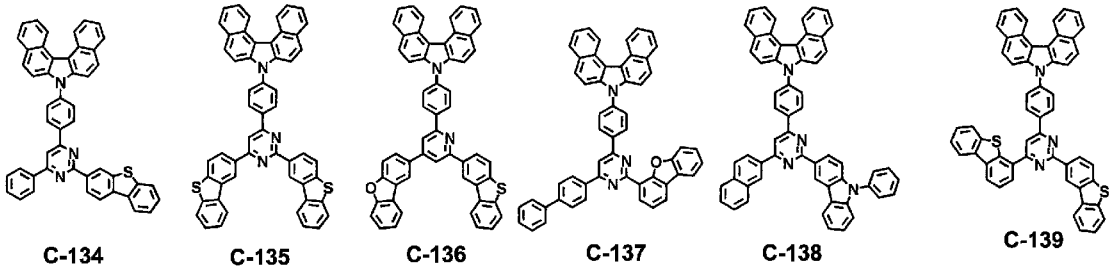
C-122 C-123 C-124 C-125 C-126 C-127

[113]



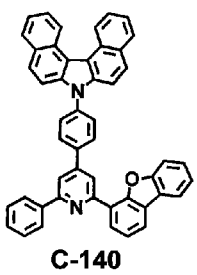
C-128 C-129 C-130 C-131 C-132 C-133

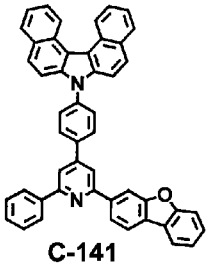
[114]

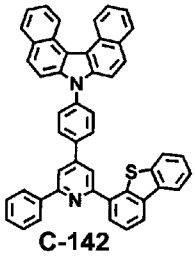


C-134 C-135 C-136 C-137 C-138 C-139

[115]


C-140


C-141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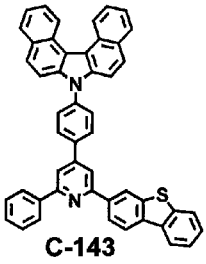
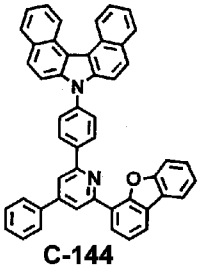

C-143

[116]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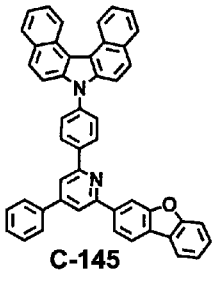
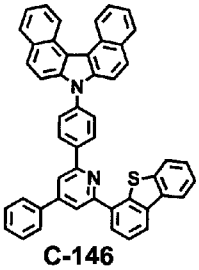

C-145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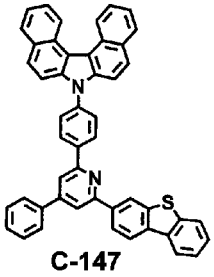
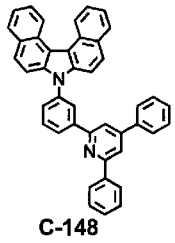

C-147

[117]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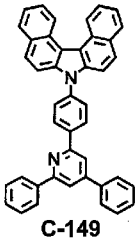
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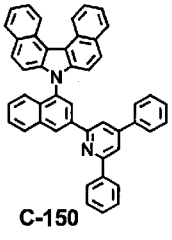
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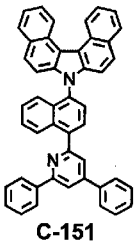
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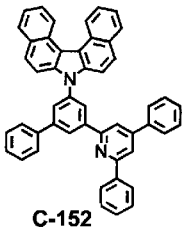
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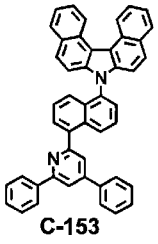
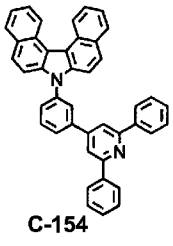

C-153

[118]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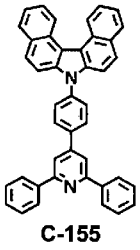
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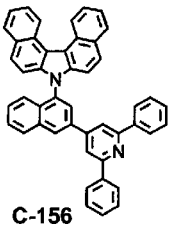
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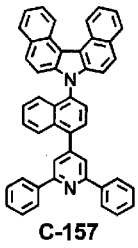
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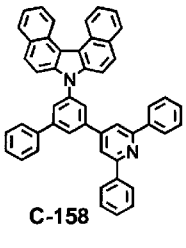
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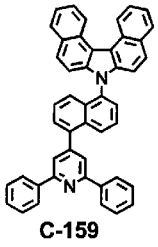
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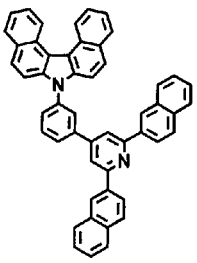
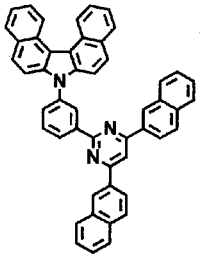
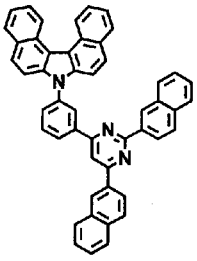

C-160


C-161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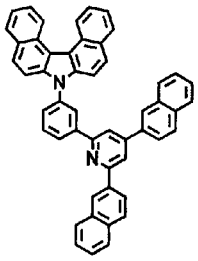
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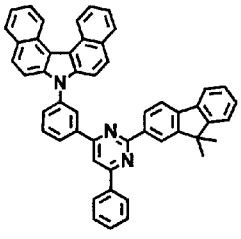

C-164

[120] The organic electroluminescent device of the present disclosure comprises an anode; a cathode; and at least one organic layer disposed between the anode and cathode, wherein the organic layer comprises one or more light-emitting layers; the light-emitting layer comprises a host and a phosphorescent dopant; the host comprises a plurality of host compounds; and at least a first host compound of a plurality of host compounds is represented by formula 1, and a second host compound is represented by formula 2.

[121] The light-emitting layer indicates a layer from which light is emitted, and may be a single layer or a multiple layer deposited by two or more layers. It is preferable that a doping amount of the dopant compound is less than 20 wt% based on the total amount of the host compound and the dopant compound.

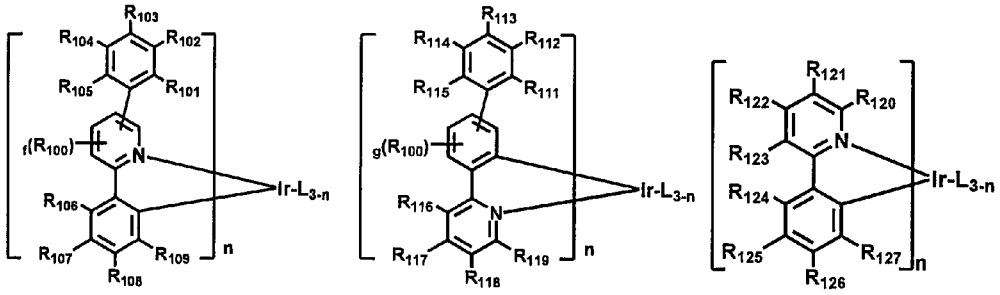
[122] The organic layer may comprise a light-emitting layer, and may further comprise at least one layer selected from a hole injection layer, a hole transport layer, an electron transport layer, an electron injection layer, an electron buffering layer, an interlayer, a hole blocking layer, and an electron blocking layer.

[123] In the organic electroluminescent device of the present disclosure, the weight ratio in the light-emitting layer between the first host material and the second host material may be in the range of 1:99 to 99:1.

[124] The dopant to be comprised in the organic electroluminescent device of the present disclosure 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) 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.

[125] Preferably, the phosphorescent dopant may be selected from the group consisting of compounds represented by the following formulae 101 to 103.

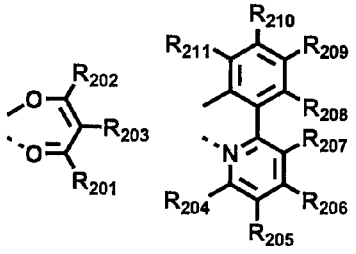
[126]



(101) (102) (103)

[127] wherein L is selected from the following structures:

[128]



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

[130] R_{101} to R_{109}, and R_{111} to R_{123}, each independently, represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group unsubstituted or substituted with a halogen, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a cyano group, or a substituted or unsubstituted (C1-C30)alkoxy group; R_{106} to R_{109} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, 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 group; R_{120} to R_{123} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, a quinoline unsubstituted or substituted with an alkyl or aryl;

[131] R_{124} to R_{127}, each independently, represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, or a substituted or unsubstituted (C6-C30)aryl group; and R_{124} to R_{127} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, a fluorene unsubstituted or substituted with an alkyl group, a dibenzothiophene unsubstituted or substituted with an alkyl group, or a dibenzofuran unsubstituted or substituted with an alkyl group;

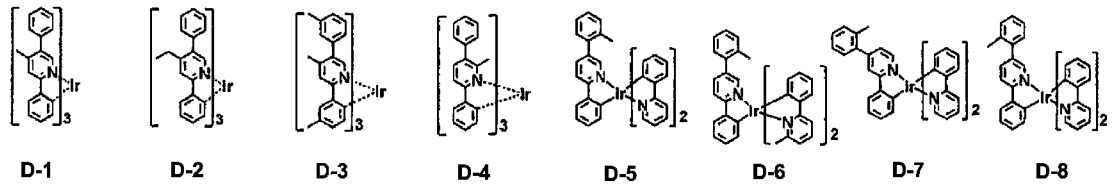
[132] R_{201} to R_{211}, each independently, represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group unsubstituted or substituted with a halogen, a substituted or unsubstituted (C3-C30)cycloalkyl group, or a substituted or unsubstituted (C6-C30)aryl group; and R_{208} to R_{211} may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, a fluorene unsubstituted or substituted with an alkyl, a dibenzothiophene unsubstituted or substituted with an alkyl group, or a dibenzofuran unsubstituted or substituted with an alkyl group;

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

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

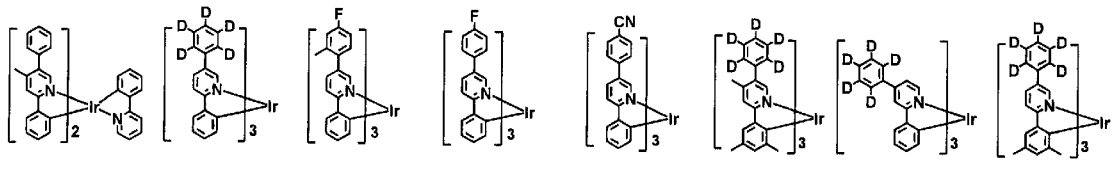
[135] Specifically, the phosphorescent dopant material includes the following:

[136]



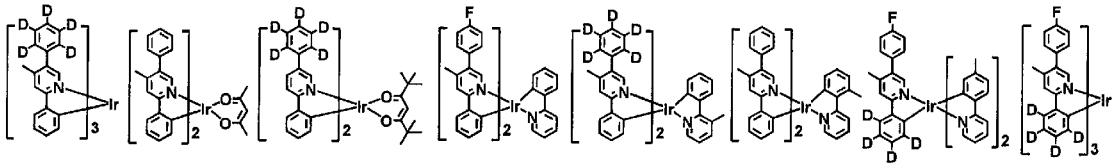
D-1 D-2 D-3 D-4 D-5 D-6 D-7 D-8

[137]



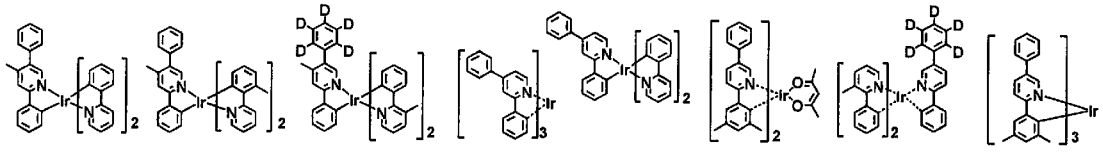
D-9 D-10 D-11 D-12 D-13 D-14 D-15 D-16

[138]



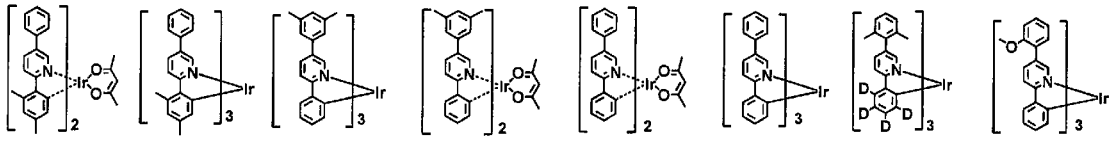
D-17 D-18 D-19 D-20 D-21 D-22 D-23 D-24

[139]



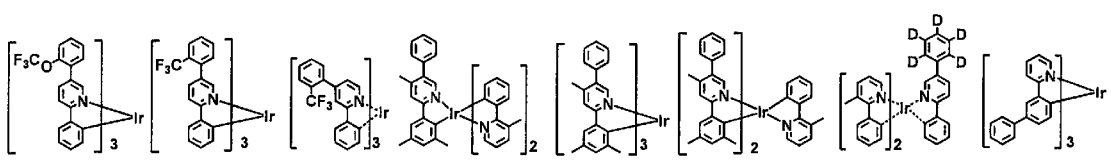
D-25 D-26 D-27 D-28 D-29 D-30 D-31 D-32

[140]



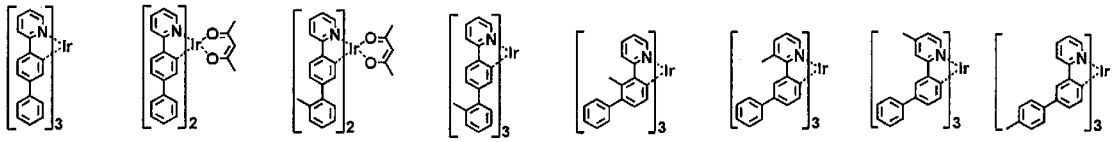
D-33 D-34 D-35 D-36 D-37 D-38 D-39 D-40

[141]



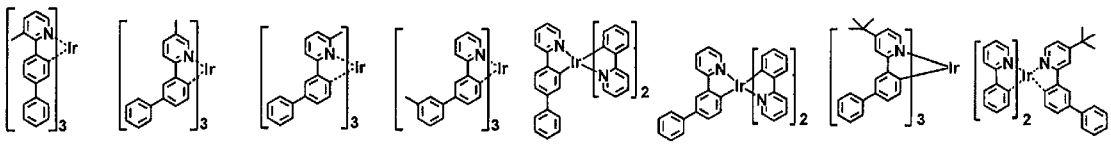
D-41 D-42 D-43 D-44 D-45 D-46 D-47 D-48

[142]



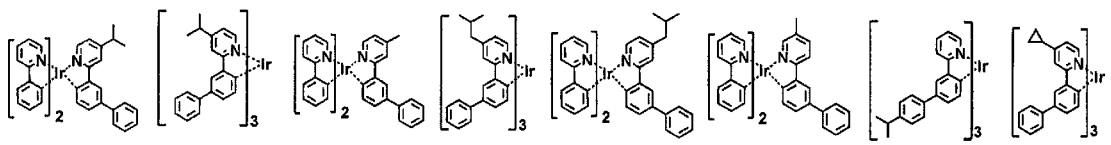
D-49 D-50 D-51 D-52 D-53 D-54 D-55 D-56

[143]



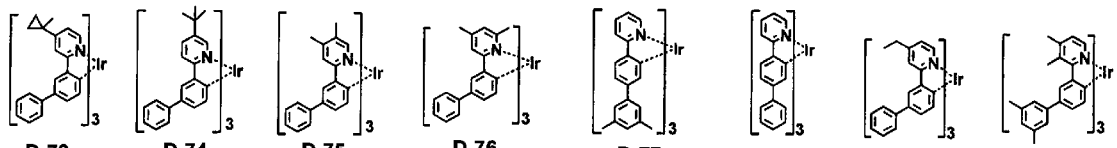
D-57 D-58 D-59 D-60 D-61 D-62 D-63 D-64

[144]



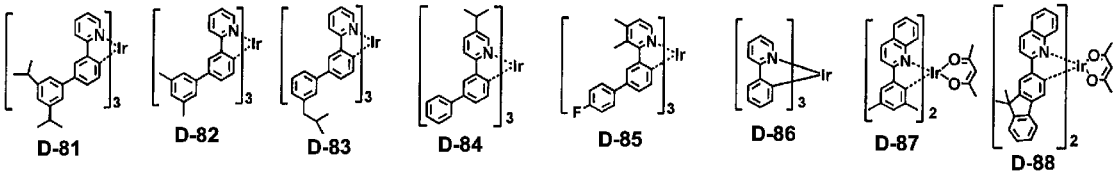
D-65 D-66 D-67 D-68 D-69 D-70 D-71 D-72

[145]



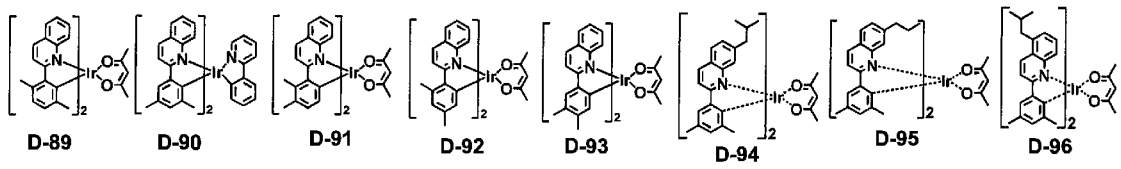
D-73 D-74 D-75 D-76 D-77 D-78 D-79 D-80

[146]



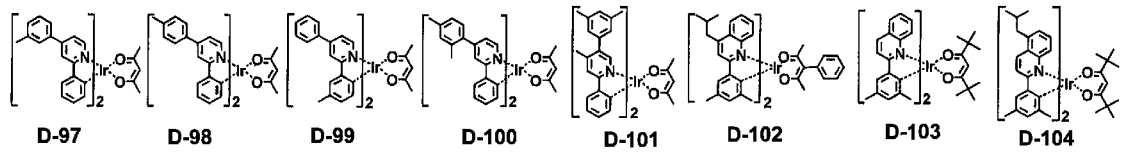
D-81 D-82 D-83 D-84 D-85 D-86 D-87 D-88

[147]



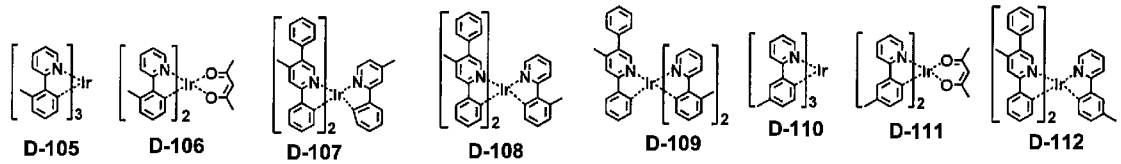
D-89 D-90 D-91 D-92 D-93 D-94 D-95 D-96

[148]



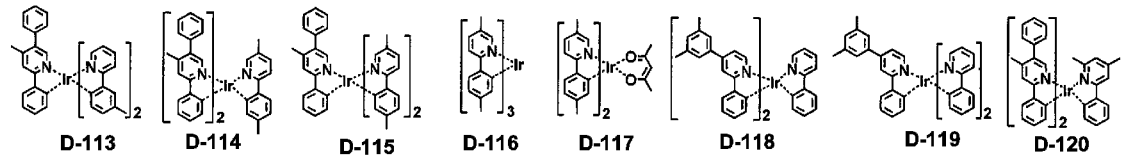
D-97 D-98 D-99 D-100 D-101 D-102 D-103 D-104

[149]



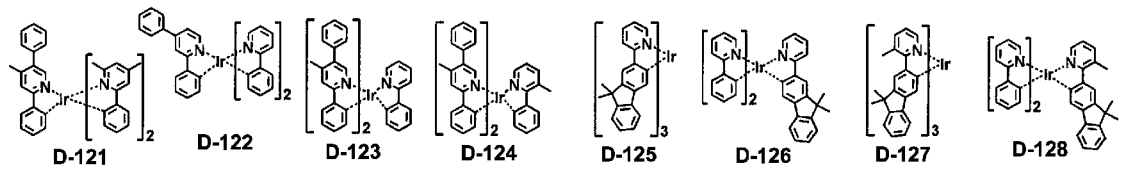
D-105 D-106 D-107 D-108 D-109 D-110 D-111 D-112

[150]



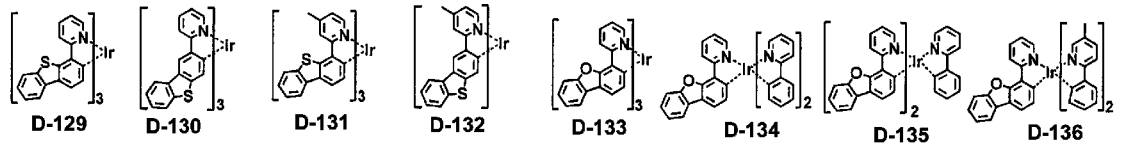
D-113 D-114 D-115 D-116 D-117 D-118 D-119 D-120

[151]



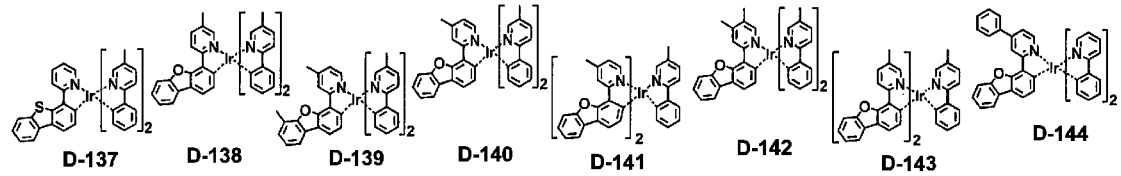
D-121 D-122 D-123 D-124 D-125 D-126 D-127 D-128

[152]



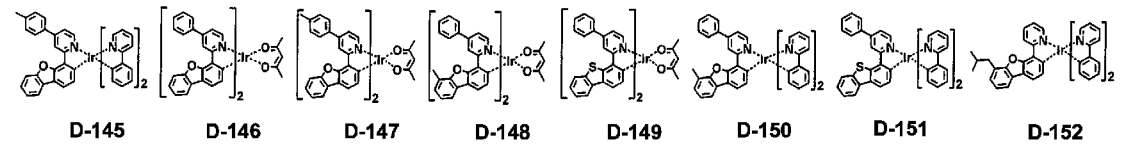
D-129 D-130 D-131 D-132 D-133 D-134 D-135 D-136

[153]



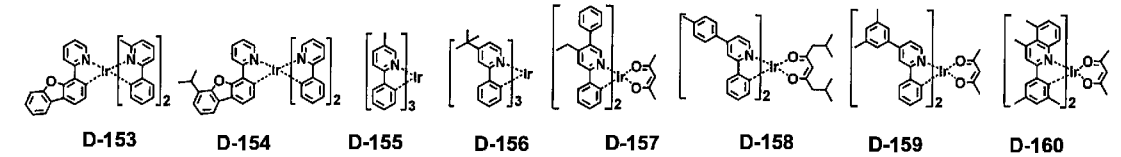
D-137 D-138 D-139 D-140 D-141 D-142 D-143 D-144

[154]



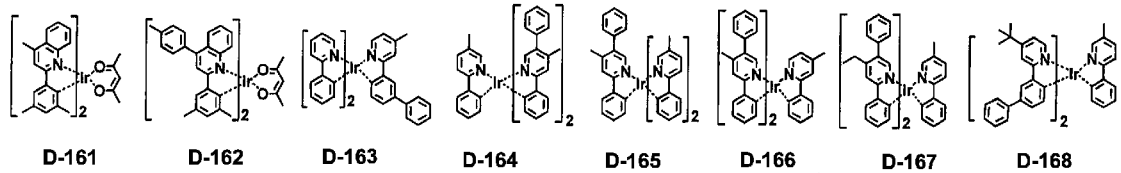
D-145 D-146 D-147 D-148 D-149 D-150 D-151 D-152

[155]



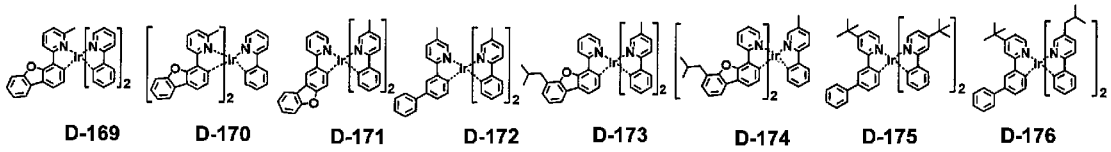
D-153 D-154 D-155 D-156 D-157 D-158 D-159 D-160

[156]



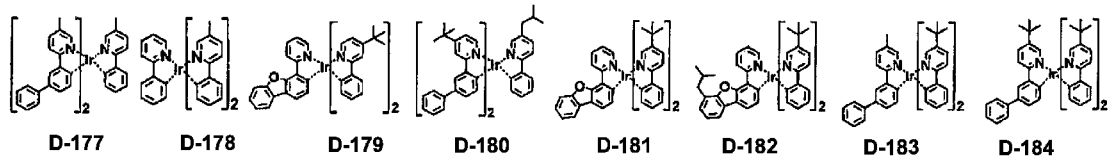
D-161 D-162 D-163 D-164 D-165 D-166 D-167 D-168

[157]



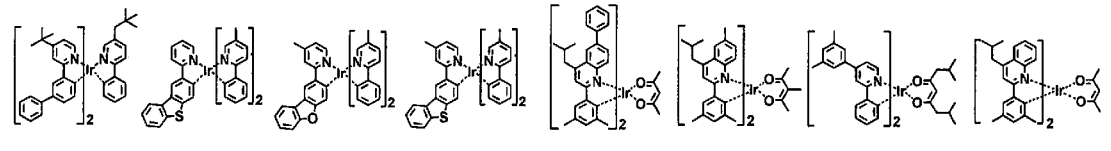
D-169 D-170 D-171 D-172 D-173 D-174 D-175 D-176

[158]



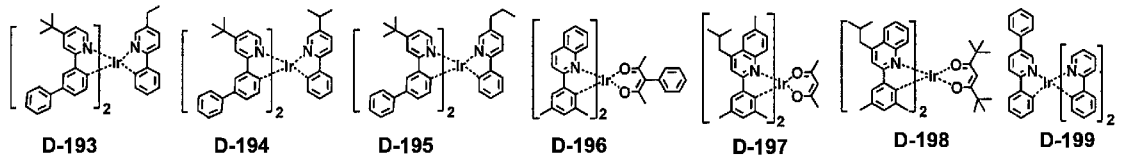
D-177 D-178 D-179 D-180 D-181 D-182 D-183 D-184

[159]



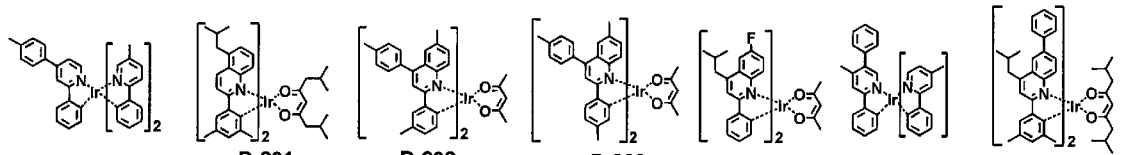
D-185 D-186 D-187 D-188 D-189 D-190 D-191 D-192

[160]



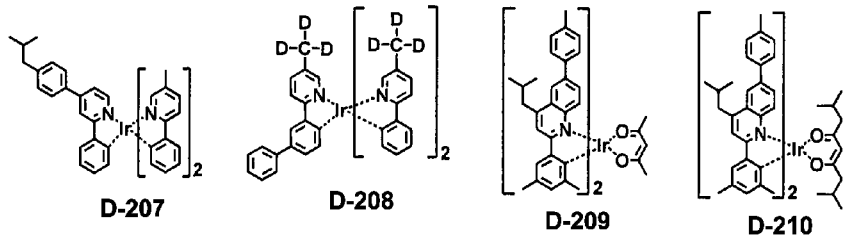
D-193 D-194 D-195 D-196 D-197 D-198 D-199

[161]



D-200 D-201 D-202 D-203 D-204 D-205 D-206

[162]



D-207 D-208 D-209 D-210

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

[164] Also, in the organic electroluminescent device of the present disclosure, the organic layer may further comprise at least one metal selected from the group consisting of metals of Group 1, metals of Group 2, transition metals of the 4th period, transition metals of the 5th period, lanthanides and organic metals of the d-transition elements of the Periodic Table, or at least one complex compound comprising the metal.

[165] Preferably, in the organic electroluminescent device of the present disclosure, 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.

[166] A hole injection layer, a hole transport layer, an electron blocking layer, or a combination thereof may be disposed between the anode and the light-emitting layer. The hole injection layer may be composed of two or more layers in order to lower an energy barrier for injecting holes from the anode to a hole transport layer or an electron blocking layer (or a voltage for injecting a hole). Each of the layers may comprise two or more compounds. The hole transport layer or electron blocking layer may be composed of two or more layers.

[167] An electron buffering layer, a hole blocking layer, an electron transport layer, an electron injection layer, or a combination thereof may be disposed between the light-emitting layer and the cathode. The electron buffering layer may be composed of two or more layers in order to control the electron injection and improve characteristics of interface between the light-emitting layer and the electron injection layer. Each of the layers may comprise two or more compounds. The hole blocking layer or electron transport layer may be composed of two or more layers, and each of the layers may comprise two or more compounds.

[168] 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.

[169] 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 inkjet printing, nozzle

printing, slot coating, spin coating, dip coating, flow coating methods, etc., can be used. In the organic electroluminescent device of the present disclosure, the first host compound and the second host compound may be film-formed by co-evaporaton or mixture-evaporaton.

[170] 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.

[171] A co-evaporation indicates a process for two or more materials to be deposited as a mixture, by introducing each of the two or more materials into respective crucible cells, and applying electric current to the cells for each of the materials to be evaporated. Herein, a mixture-evaporation indicates a process for two or more materials to be deposited as a mixture, by mixing the two or more materials in one crucible cell before the deposition, and applying electric current to the cell for the mixture to be evaporated.

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

[173] Hereinafter, the luminescent properties of the device comprising the host compound of the present disclosure will be explained in detail with reference to the following examples.

[174] **[Device Examples 1-1 to 1-27] Production of an OLED device by a co-**

[175] **evaporation of a first host compound and a second host compound of the present disclosure as a host**

[176] An OLED device was produced comprising a plurality of host compounds 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, ethanol, and distilled water sequentially, and was then stored in isopropanol. The ITO substrate was then mounted on a substrate holder of a vacuum vapor depositing apparatus. $N^4,N^{4'}$-diphenyl-$N^4,N^{4'}$-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, and evaporated by applying electric current to the cell, thereby forming a first hole injection layer having a thickness of 80 nm on the ITO substrate. Thereafter, dipyrazino[2,3-f:2',3'-h]quinoxaline-2,3,6,7,10,11-hexacarbonitrile was then introduced into another cell of the 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. N-([1,1'-biphenyl]-4-yl)-9,9-dimethyl-N-(4-(9-phenyl-9H-carbazol-3-yl)phenyl)-9H-fluorene-2-amine 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. N-(4-(9,9-diphenyl-9H,9'H-[2,9'-bifluorene]-9'-yl)phenyl)-(9,9-dimethyl-N-phenyl-9H-fluorene-2-amine was then 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 60 nm on the first hole transport layer. After forming the hole injection layers and the hole transport layers, a light-emitting layer was then deposited as follows. As a host material, a first host compound and a second host compound shown in Table 1 below were introduced into two cells of the vacuum vapor depositing apparatus, respectively. A compound **D-96** 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 3 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 hole transport layer. Next, 2,4-bis(9,9-dimethyl-9H-fluorene-2-yl)-6-(naphthalene-2-yl)-1,3,5-triazine and lithium quinolate were evaporated at the rate of 1:1 on another two cells of the vacuum vapor depositing apparatus to form an electron transport layer having a thickness of 30 nm on the light-emitting layer. After depositing lithium quinolate having a thickness of 2 nm as an electron injection layer 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 device was produced.

[177]

[178] **[Comparative Examples 1-1 to 1-4] Production of an OLED device**

[179] **comprising a second host compound of the present disclosure as a sole host**

[180] An OLED device was produced in the same manner as in Device Examples 1-1 to 1-27, except that only a second host compound of Comparative Examples 1-1 to 1-4 shown in Table 1 was used as a sole host for a light-emitting layer.

[181]

[182] **[Comparative Examples 2-1 to 2-4] Production of an OLED device**

[183] **comprising a first host compound of the present disclosure as a sole host**

[184] An OLED device was produced in the same manner as in Device Examples 1-1 to 1-27, except that only a first host compound of Comparative Examples 2-1 to 2-4 shown in Table 1 was used as a sole host for a light-emitting layer.

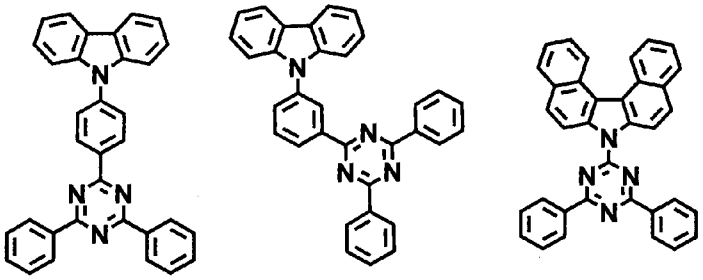
[185]

[186] **[Comparative Examples 3-1 to 3-3] Production of an OLED device**

[187] **comprising a first host compound of the present disclosure and a second host compound of a conventional organic electroluminescent compound as a host**

[188] An OLED device was produced in the same manner as in Device Examples 1-2 and 1-14, except that only any one of Com-1 to Com-3 below, which are conventional organic electroluminescent compounds, was used as a second host for a light-emitting layer.

[189]



Com-1 Com-2 Com-3

[190] The characteristics of the organic electroluminescent devices produced in Device Examples 1-1 to 1-27, and Comparative Examples 1-1 to 1-4, 2-1 to 2-4, and 3-1 to 3-3 are shown in Table 1 below.

[191] [Table 1]

	Host	Voltage [V]	Efficiency [cd/A]	Lifespan T97 [hr]	Color visualized by light-emission
Device Example 1-1	H-114:C-1	3.9	30.8	96	Red
Device Example 1-2	H-13:C-1	3.3	29.6	72	Red
Device Example 1-3	H-49:C-1	3.6	30.2	114	Red
Device Example 1-4	H-143:C-1	4.0	30.5	84	Red
Device Example 1-5	H-133:C-1	3.8	30.8	124	Red
Device Example 1-6	H-170:C-1	4.1	30.9	71	Red
Device Example 1-7	H-171:C-1	3.8	30.7	95	Red
Device Example 1-8	H-172:C-1	3.8	30.1	123	Red
Device Example 1-9	H-143:C-2	3.6	30.3	78	Red
Device Example 1-10	H-150:C-2	3.5	30.1	67	Red
Device Example 1-11	H-173:C-2	3.5	29.9	53	Red
Device Example 1-12	H-143:C-9	3.9	31.3	88	Red
Device Example 1-13	H-174:C-9	3.6	30	54	Red
Device Example 1-14	H-13:C-9	3.2	29.1	80	Red
Device Example 1-15	H-175:C-9	3.2	30.8	47	Red
Device Example 1-16	H-176:C-9	3.2	29.6	51	Red
Device Example 1-17	H-114:C-9	3.7	31.3	137	Red
Device Example 1-18	H-150:C-9	3.7	30.3	76	Red

[192]

Device Example 1-19	H-143:C-37	3.8	31.7	56	Red
Device Example 1-20	H-85:C-9	3.5	30.7	132	Red
Device Example 1-21	H-91:C-1	3.9	31.1	51	Red
Device Example 1-22	H-93:C-1	3.8	31.1	88	Red
Device Example 1-23	H-133:C-9	3.7	31.3	97	Red
Device Example 1-24	H-96:C-9	3.7	31.4	61	Red
Device Example 1-25	H-173:C-9	3.7	30.8	91	Red
Device Example 1-26	H-85:C-1	3.6	29.2	94	Red
Device Example 1-27	H-1:C-1	3.2	29.0	61	Red
Comparative Example 1-1	C-1	3.7	31.0	31	Red
Comparative Example 1-2	C-2	3.2	28.7	15	Red
Comparative Example 1-3	C-9	3.7	31	23	Red
Comparative Example 1-4	C-37	3.7	29.6	17	Red
Comparative Example 2-1	H-143	9.0	3.5	X	Red
Comparative Example 2-2	H-49	7.8	3.1	X	Red
Comparative Example 2-3	H-114	8.1	13.6	X	Red
Comparative Example 2-4	H-150	7.6	4.3	X	Red
Comparative Example 3-1	H-13:Com1	3.2	29.5	12	Red
Comparative Example 3-2	H-13:Com2	3.3	31.8	5	Red
Comparative Example 3-3	H-13:Com3	3.3	29.3	23	Red

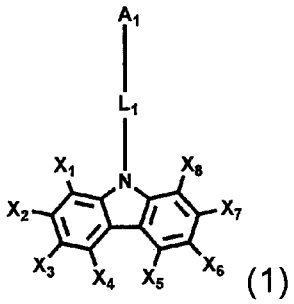
* X indicates that lifespan of the device cannot be measured since the time is too short.

[193] The driving voltage, the luminous efficiency and the color visualized by light-emission in Table 1 are based on a luminance of 1,000 nits of the organic electroluminescent devices, and the lifespan is the time taken to be 97% of the luminance when the early luminance at 5000 nits and a constant current is taken as 100% of the luminance.

[194] From Table 1 above, it can be seen that an organic electroluminescent device comprising a plurality of host materials of the present disclosure has long lifespan while maintaining high luminous efficiency compared to conventional devices using only a sole host or a conventional organic electroluminescent compound.

Claims

[Claim 1] An organic electroluminescent device comprising at least one light-emitting layer disposed between an anode and a cathode, wherein the light-emitting layer comprises a host and a phosphorescent dopant, wherein the host comprises a plurality of host compounds, wherein at least a first host compound of a plurality of host compounds is represented by the following formula 1:



(1)

wherein

A_1 represents a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (5- to 30-membered)heteroaryl group, and A_1 may be linked to X_1 or X_8;

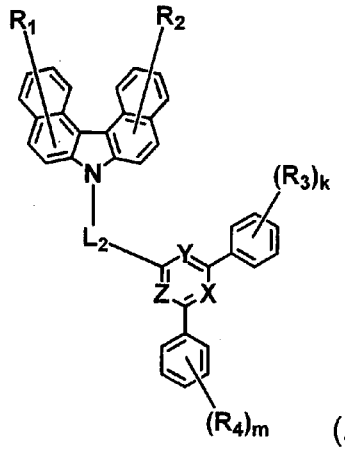
L_1 represents a single bond, or a substituted or unsubstituted (C6-C30)arylene group;

X_1 to X_8, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur;

R_5 to R_9, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to

7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (3- to 30-membered)heteroaryl group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur;

and a second host compound is represented by the following formula 2:



(2)

X, Y and Z, each independently, represent N or CR_{10}; provided that at least one of X, Y and Z represent N;

L_2 represents a substituted or unsubstituted (C6-C30)arylene group;

R_1 to R_4, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, $-NR_{11}R_{12}$, or $-SiR_{13}R_{14}R_{15}$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur;

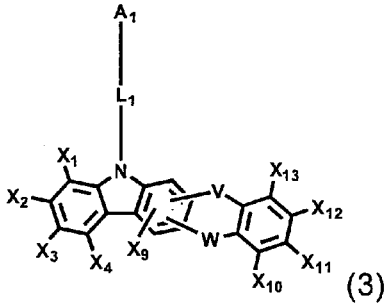
R_{10} to R_{15}, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsub-

stituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (3- to 30-membered)heteroaryl group;

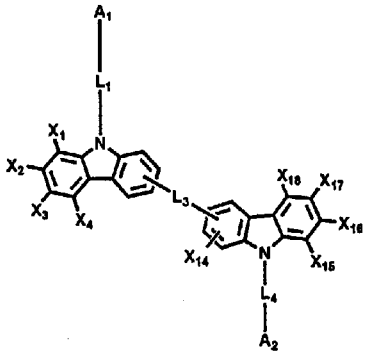
k and m, each independently, represent an inter of 1 to 5; and where k or m represents an integer of 2 or more, each of R_3 or R_4 may be the same or different; and

the heteroaryl and the heterocycloalkyl, each independently, contain at least one heteroatom selected from B, N, O, S, Si, and P.

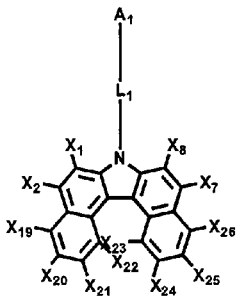
[Claim 2] The organic electroluminescent device according to claim 1, wherein formula 1 is represented by any one of the following formulae 3 to 5:



(3)



(4)



(5)

wherein

V and W represent a single bond or NR_{16}; provided that both V and W are not a single bond or NR_{16};

R_{16} represents hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted (3- to 30-membered)heteroaryl group;

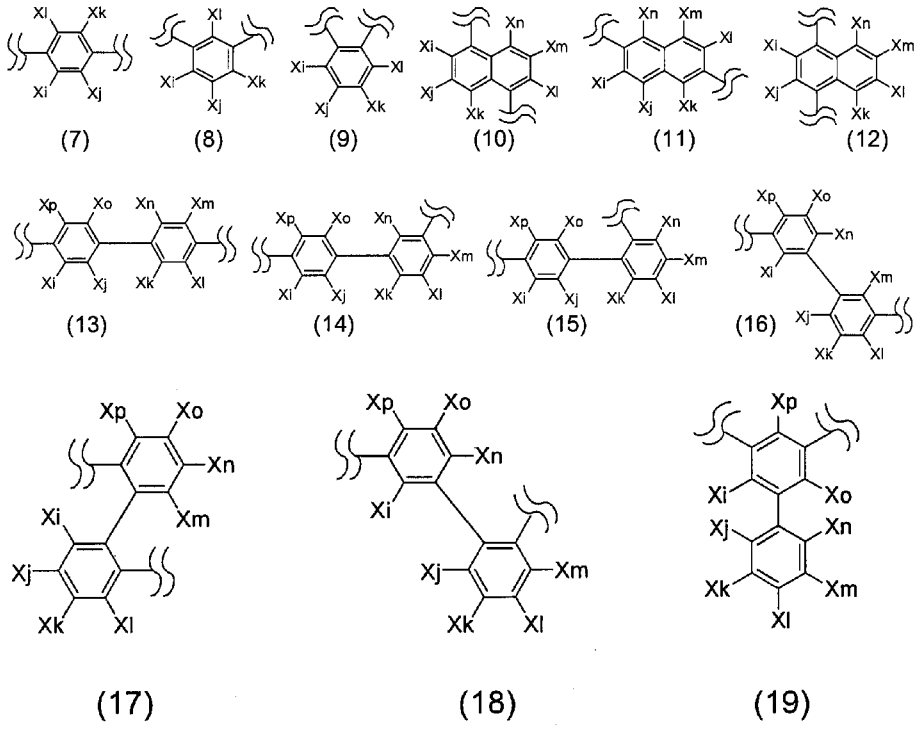
A_2 represents a substituted or unsubstituted (C6-C30)aryl group, and A_2 may be linked to X_{14} or X_{15};

L_3 and L_4, each independently, represent a single bond, or a substituted or unsubstituted (C6-C30)arylene group;

X_9 to X_{26}, each independently, represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted (3- to 7-membered)heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, $-NR_5R_6$, or $-SiR_7R_8R_9$; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur;

A_1, L_1, X_1 to X_4, X_7, X_8, and R_5 to R_9 are as defined in claim 1.

[Claim 3] The organic electroluminescent device according to claim 1, wherein L_2 in formula 2 is represented by any one of the following formulae 7 to 19:



wherein

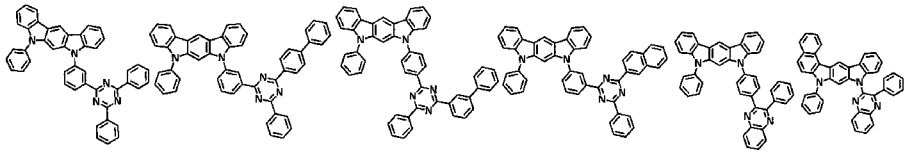
Xi to Xp, each independently, represent hydrogen, deuterium, a

halogen, a cyano group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C2-C30)alkenyl group, a substituted or unsubstituted (C2-C30)alkynyl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C6-C60)aryl group, a substituted or unsubstituted (3- to 30-membered)heteroaryl group, a substituted or unsubstituted tri(C1-C30)alkylsilyl group, a substituted or unsubstituted tri(C6-C30)arylsilyl group, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl group, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl group, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino group; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic (C3-C30), alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one heteroatom selected from nitrogen, oxygen, and sulfur.

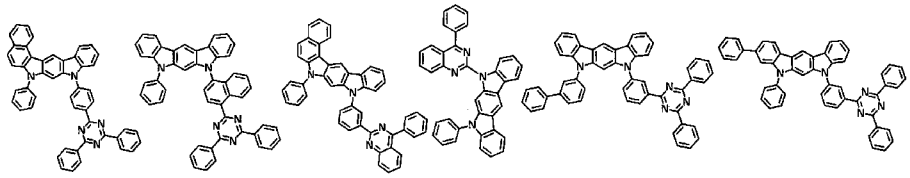
[Claim 4] The organic electroluminescent device according to claim 1, wherein the substituents of the substituted alkyl group, the substituted cycloalkyl group, the substituted cycloalkenyl group, the substituted heterocycloalkyl group, the substituted aryl(ene) group, the substituted heteroaryl group, and the substituted mono- or polycyclic, alicyclic or aromatic ring in A_1, L_1, L_2, X_1 to X_8, and R_1 to R_{15}, 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 (C6-C30)aryl; a (C6-C30)aryl unsubstituted or substituted with a cyano, a (3- to 30-membered)heteroaryl or tri(C6-C30)arylsilyl; 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 mono- or di- (C1-C30)alkyl(C6-C30)aryl.

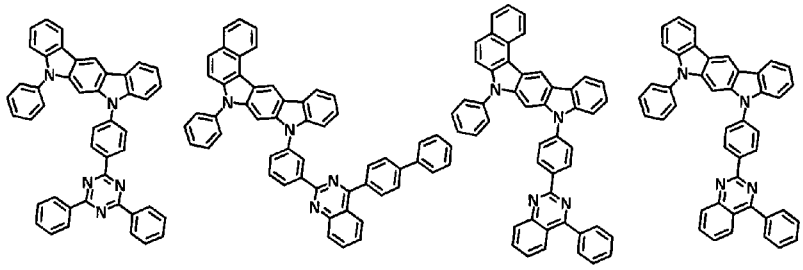
[Claim 5] The organic electroluminescent device according to claim 1, wherein the compound represented by formula 1 is selected from the group consisting of:



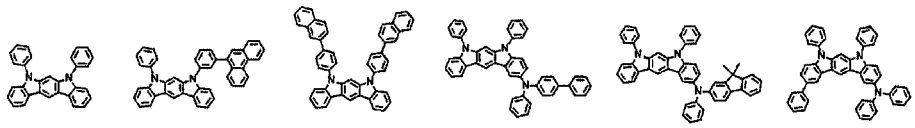
H-1 H-2 H-3 H-4 H-5 H-6



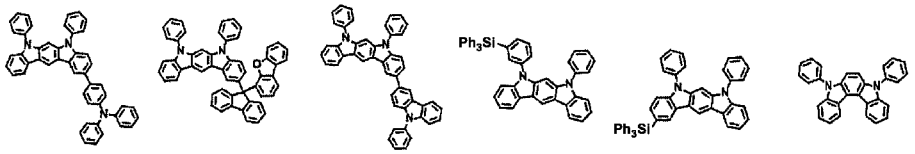
H-7 H-8 H-9 H-10 H-11 H-12



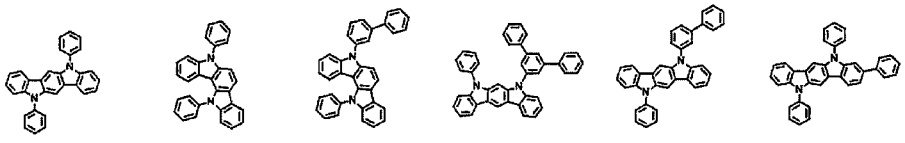
H-13 H-14 H-15 H-16



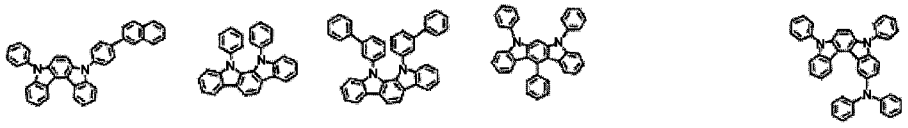
H-19 H-20 H-21 H-22 H-23 H-24



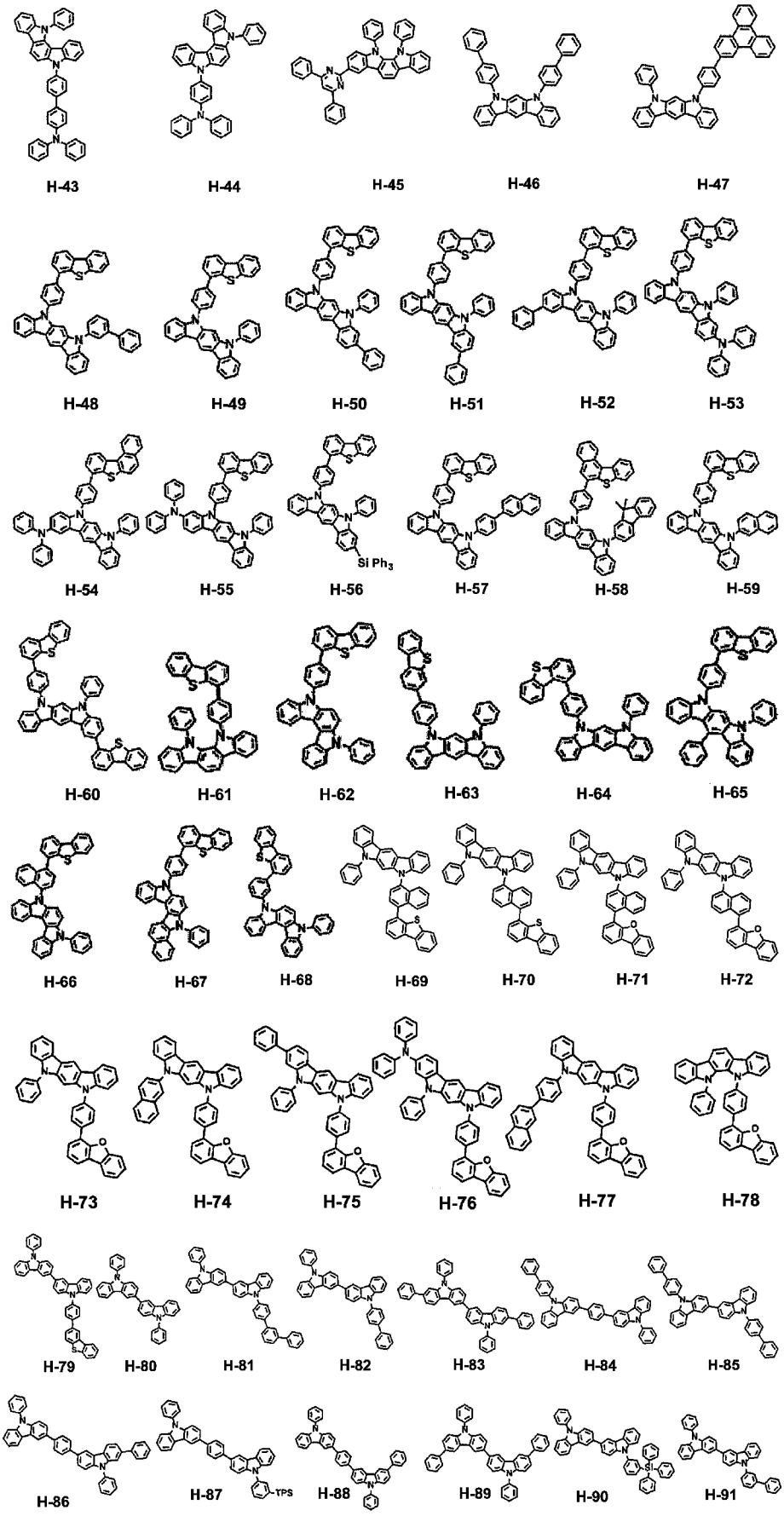
H-25 H-26 H-27 H-28 H-29 H-30



H-31 H-32 H-33 H-34 H-35 H-36



H-37 H-38 H-39 H-40 H-42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H-56
Si Ph3
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H-58
H-59
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H-62
H-63
H-64
H-65
H-66
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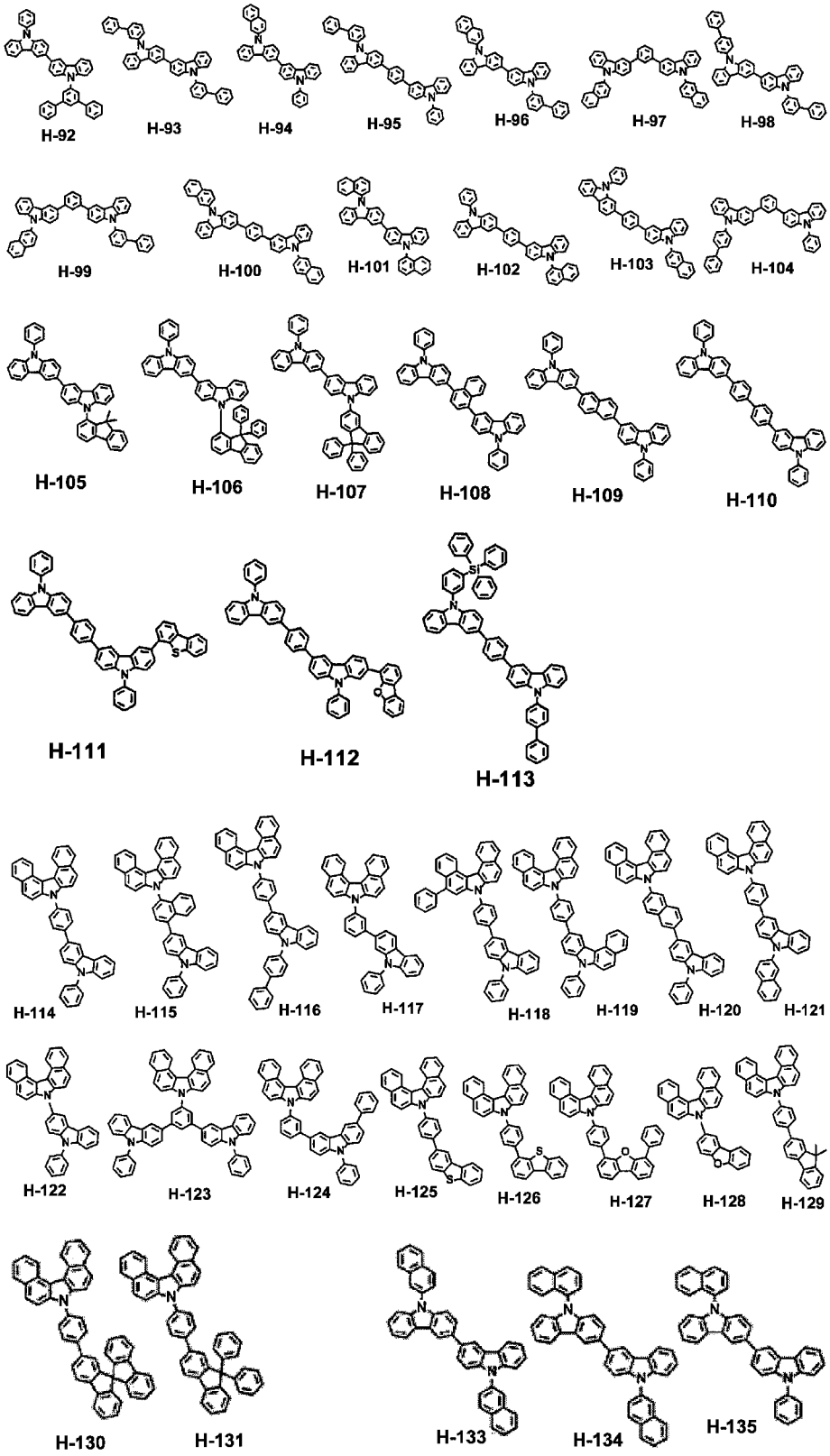
H-91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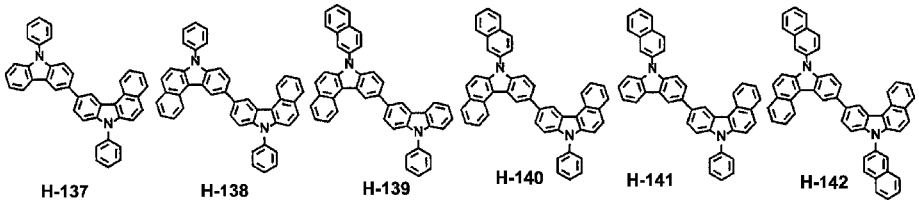
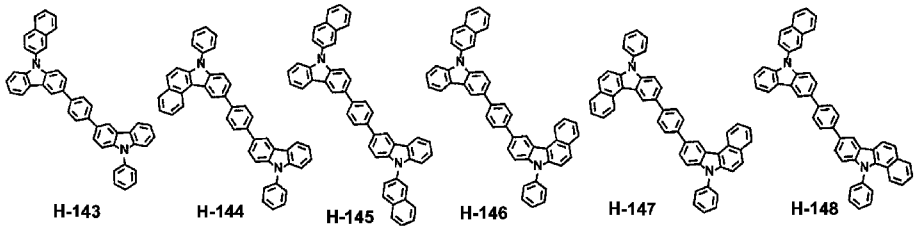
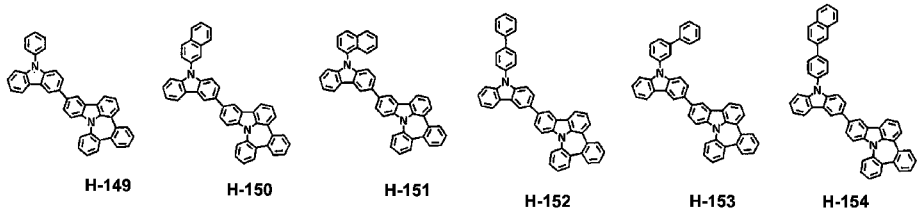
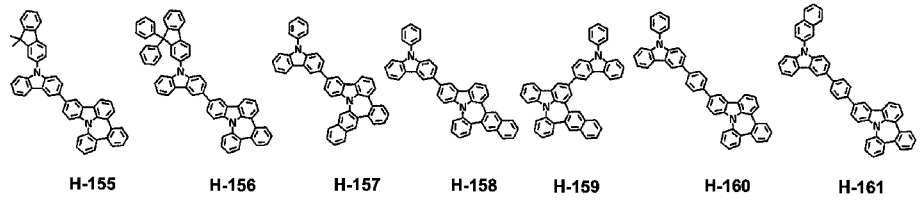
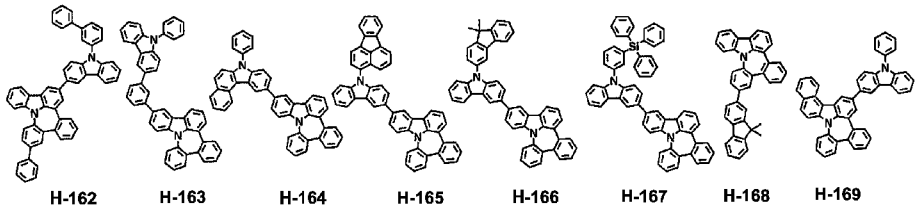
H-135

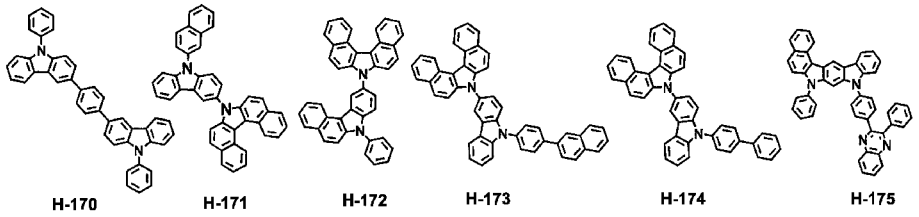


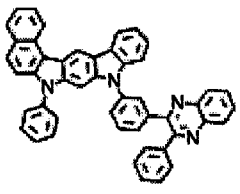






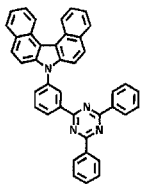


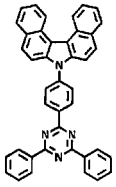


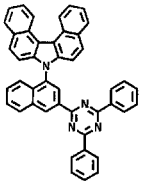


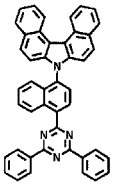
H-176

[Claim 6] The organic electroluminescent device according to claim 1, wherein the compound represented by formula 2 is selected from the group consisting of:


C-1


C-2


C-3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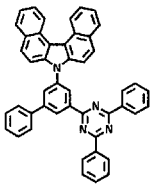
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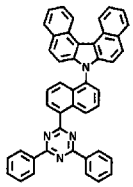
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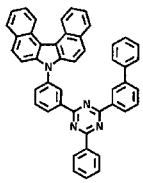
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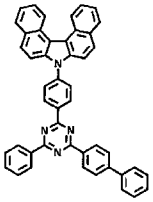
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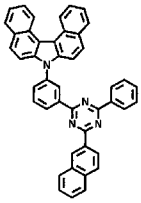
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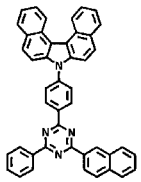
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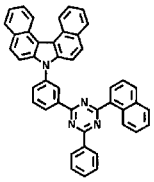
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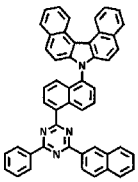
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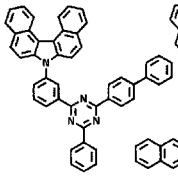
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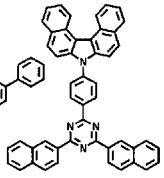
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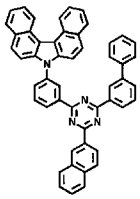
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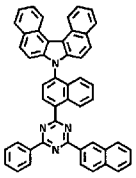
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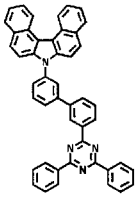
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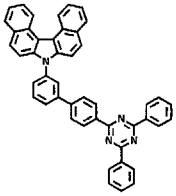
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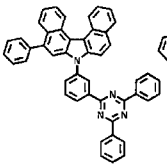
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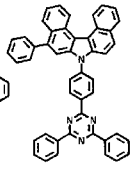
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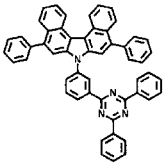
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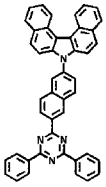
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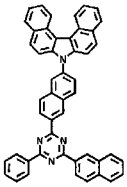
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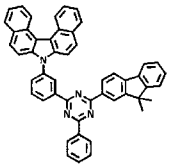
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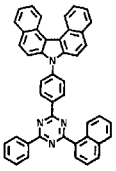
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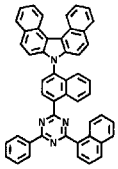
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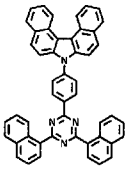
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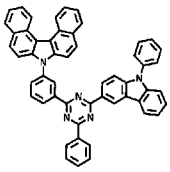
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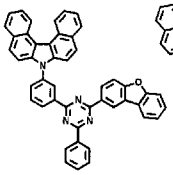
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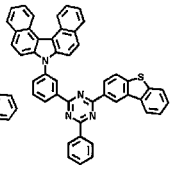
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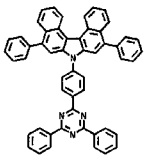
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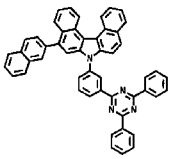
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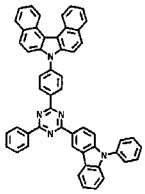
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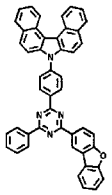
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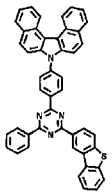
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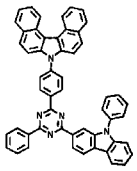
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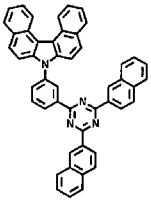
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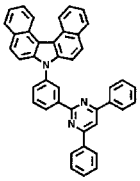
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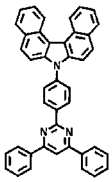
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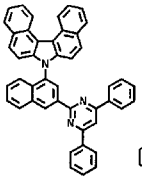
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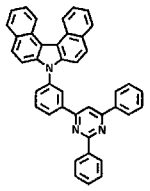

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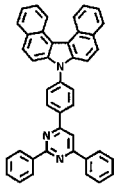

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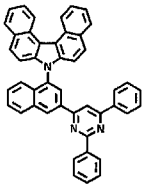

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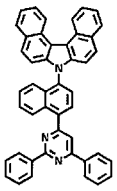

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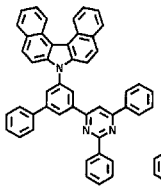

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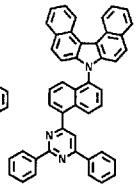

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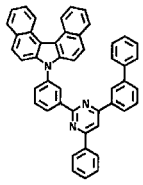

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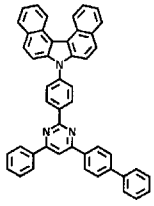

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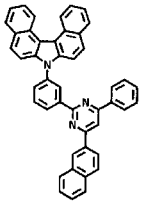

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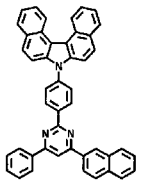

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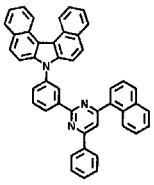

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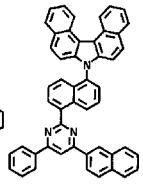

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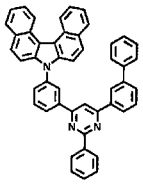

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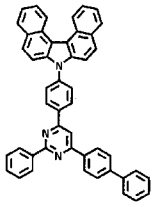

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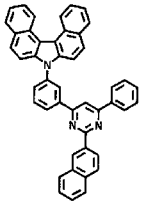

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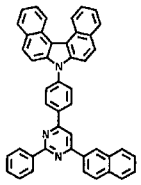

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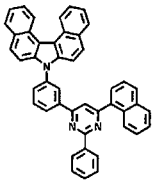

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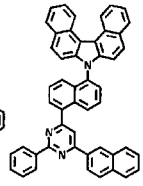

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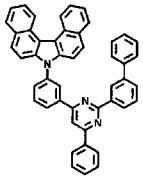

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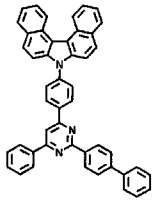

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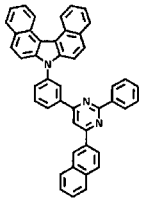

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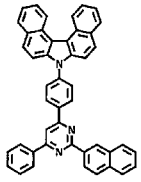

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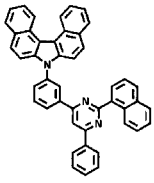

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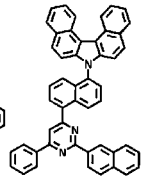

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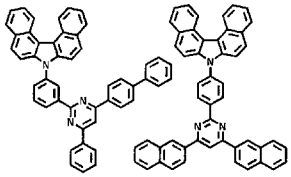

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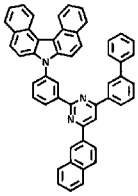

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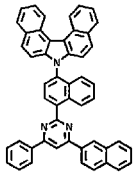

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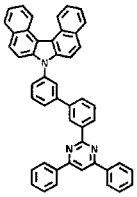

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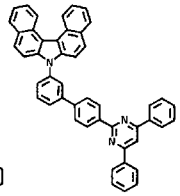

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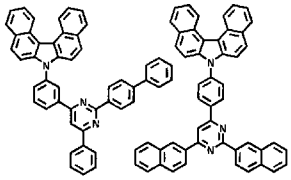

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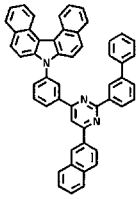
C-75



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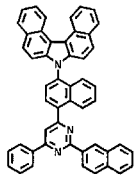

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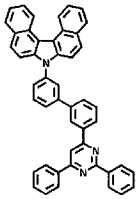

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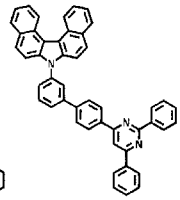

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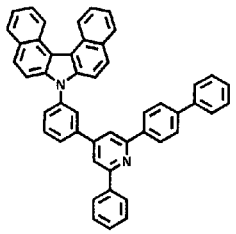

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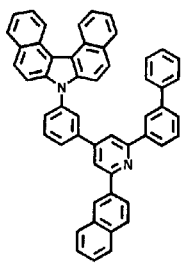

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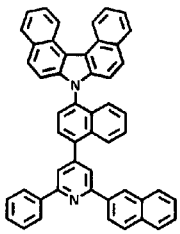

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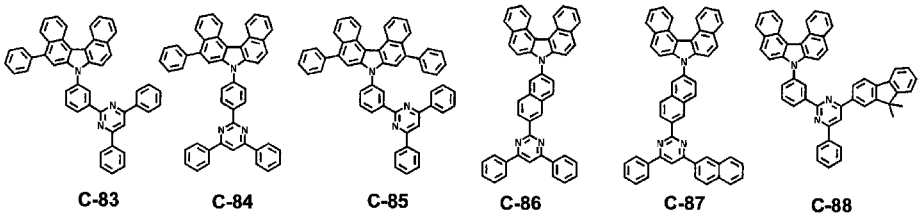

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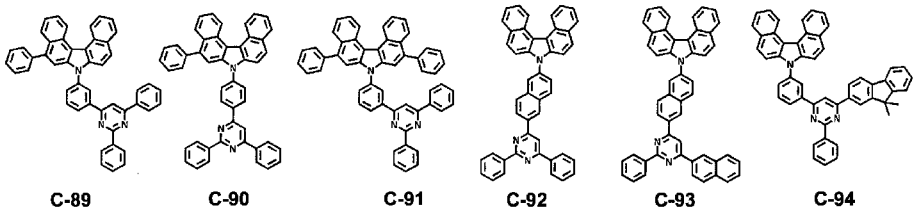

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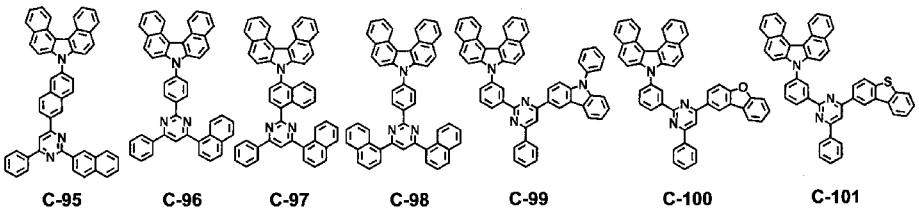

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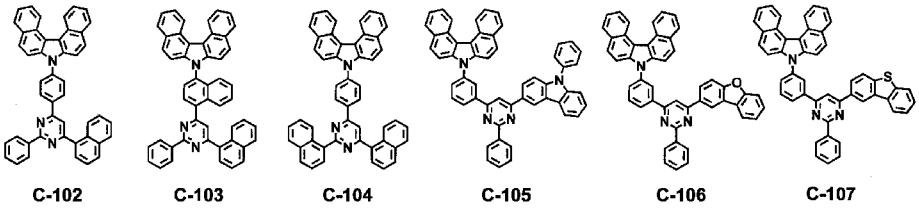

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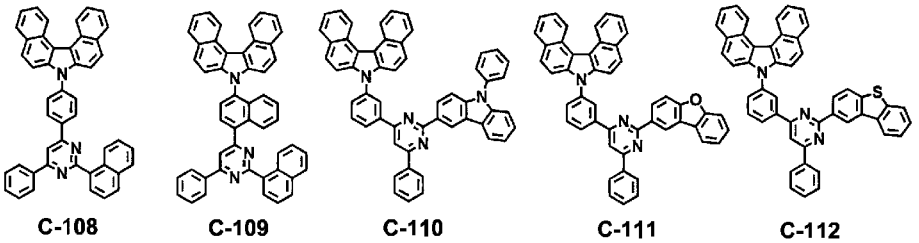

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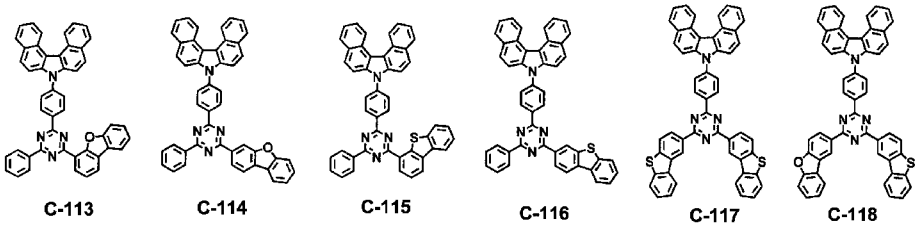

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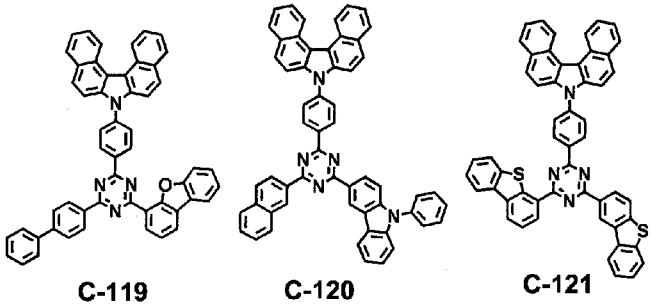

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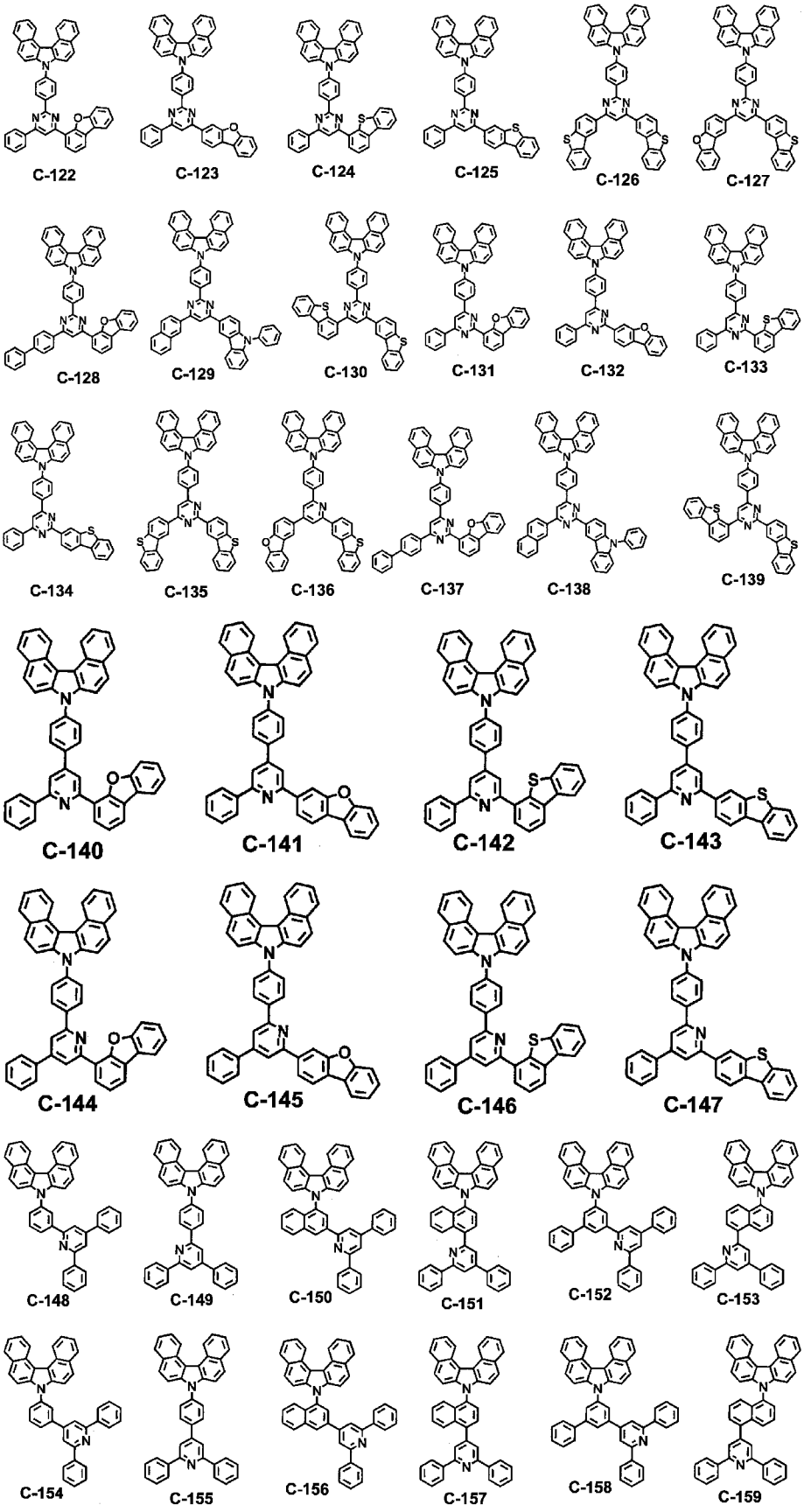
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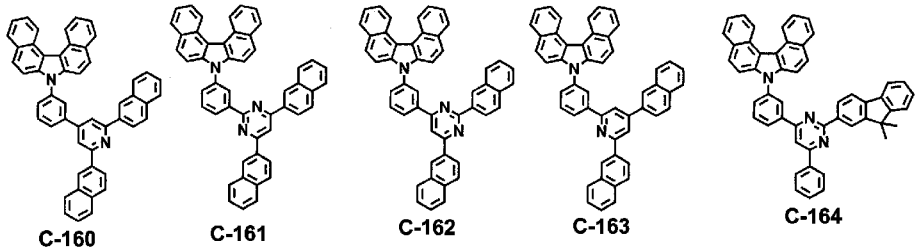

C-160 C-161 C-162 C-163 C-164

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2016/001102

A. CLASSIFICATION OF SUBJECT MATTER

C09K 11/06 (2006.01) ***C07D 209/82 (2006.01)*** ***C07D 401/10 (2006.01)*** ***C07D 403/10 (2006.01)*** ***C07D 403/14 (2006.01)***
C07D 405/14 (2006.01) ***C07D 407/10 (2006.01)*** ***C07D 409/10 (2006.01)*** ***C07D 409/14 (2006.01)*** ***C07D 487/02 (2006.01)***
C07F 7/10 (2006.01) ***H01L 27/32 (2006.01)*** ***H01L 51/54 (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 Registry, CAPlus: Structure search based on compounds of formula (2).

ESPACENET: Keyword search using applicant and inventor names.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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

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

* Special categories of cited documents:

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

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

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

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

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 March 2016	17 March 2016
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	Richard Cordiner AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832162

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	**PCT/KR2016/001102**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2013/105747 A1 (DUKSAN HIGH METAL CO., LTD.) 18 July 2013 Abstract; compounds 5-12 to 5-14, 6-12 to 6-14, 7-12 to 7-14, 8-12 to 8-14; pages 9-32, paragraph [32]	1-4
Y	WO 2014/092354 A1 (DOOSAN CORPORATION) 19 June 2014 Abstract; compounds 773-776 and 790-793 ; pages 17-42.	1-4
Y	WO 2013/109045 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 25 July 2013 Abstract; pages 8-13 and 16-18; paragraphs [90]-[124].	1-4
P,X	WO 2015/156587 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 15 October 2015 Abstract; Paragraphs [9]-[11], [23]-[24], and [30]-[32]; Compounds H2-48 to H2-50, H1-8, H1-161 to H1-163, and H2-496 to H2-659.	1-6
P,X	WO 2015/174738 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 19 November 2015 Abstract; Paragraphs [9] and [11]-[19]; Compounds H2-48 to H2-50 and H2-496 to H2-498.	1-4, 6

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/KR2016/001102**

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 2013/105747 A1	18 July 2013	WO 2013105747 A1	18 Jul 2013
		KR 20130083817 A	23 Jul 2013
WO 2014/092354 A1	19 June 2014	WO 2014092354 A1	19 Jun 2014
		KR 20140074729 A	18 Jun 2014
		KR 101571591 B1	24 Nov 2015
WO 2013/109045 A1	25 July 2013	WO 2013109045 A1	25 Jul 2013
		CN 104136440 A	05 Nov 2014
		KR 20130084093 A	24 Jul 2013
		TW 201335155 A	01 Sep 2013
		US 2014364625 A1	11 Dec 2014
WO 2015/156587 A1	15 October 2015	WO 2015156587 A1	15 Oct 2015
		KR 20150116776 A	16 Oct 2015
WO 2015/174738 A1	19 November 2015	WO 2015174738 A1	19 Nov 2015
		KR 20150130928 A	24 Nov 2015

End of Annex

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

专利名称(译)	多种主体材料和包含其的有机电致发光器件		
公开(公告)号	EP3268449A4	公开(公告)日	2018-11-21
申请号	EP2016765146	申请日	2016-02-02
[标]申请(专利权)人(译)	罗门哈斯电子材料有限公司		
申请(专利权)人(译)	罗门哈斯电子材料KOREA LTD.		
当前申请(专利权)人(译)	Rohm和哈斯电子材料公司		
[标]发明人	KIM BITNARI CHO SANG HEE KANG HEE RYONG HONG JIN RI		
发明人	KIM, BITNARI CHO, SANG-HEE KANG, HEE-RYONG HONG, JIN-RI		
IPC分类号	C09K11/06 C07D209/82 C07D401/10 C07D403/10 C07D403/14 C07D405/14 C07D407/10 C07D409/10 C07D409/14 C07D487/02 C07F7/10 H01L27/32 H01L51/54 H05B33/14		
CPC分类号	H01L51/0072 C07D209/80 C07D209/86 C07D403/10 C07D487/04 C07D487/06 C09K11/025 C09K11/06 C09K2211/1007 C09K2211/1029 C09K2211/1088 C09K2211/1092 C09K2211/185 H01L51/001 H01L51/0052 H01L51/0058 H01L51/0067 H01L51/0074 H01L51/0085 H01L51/5016 H01L2251/5384		
代理机构(译)	霍顿MARK PHILLIP		
优先权	1020160006579 2016-01-19 KR 1020150035281 2015-03-13 KR		
其他公开文献	EP3268449A1		
外部链接	Espacenet		

摘要(译)

本公开涉及多种主体材料和包含该主体材料的有机电致发光器件。通过包含多种主体材料的特定组合，本公开的有机电致发光器件可以在保持高发光效率的同时显示长寿命。