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(54) Title: MULTI-COMPONENT HOST MATERIAL AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

(57) Abstract: The present invention relates to an organic electroluminescent device comprising at least one light-emitting layer between an anode and a cathode, wherein the light-emitting layer comprises a host and a phosphorescent dopant; the host consists of multi-component host compounds; at least a first host compound of the multi-component host compounds is a bicarbazole derivative containing pyridine, and a second host compound is a carbazole derivative including a nitrogen-containing heteroaryl group. According to the present invention, an organic electroluminescent device using the multi-component host compounds has high efficiency and long lifespan compared to a conventional device using one component of a host.



Description

Title of Invention: MULTI-COMPONENT HOST MATERIAL AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

Technical Field

- [1] The present invention relates to a multi-component host material and an organic electroluminescent device comprising the same.

Background Art

- [2] An electroluminescent (EL) device is a self-light-emitting device with the advantages of providing a wider viewing angle, a greater contrast ratio, and a faster response time. The first organic EL device was developed by Eastman Kodak, by using small aromatic diamine molecules and aluminum complexes as materials for forming a light-emitting layer (see Appl. Phys. Lett. 51, 913, 1987).
- [3] An organic EL device changes electric energy into light by the application of electric voltage to an organic light-emitting material, and commonly comprises an anode, a cathode, and an organic layer formed between the two electrodes. The organic layer of the organic EL device may be composed of a hole injection layer (HIL), a hole transport layer (HTL), an electron blocking layer (EBL), a light-emitting layer (EML) (containing host and dopant materials), an electron buffer layer, a hole blocking layer (HBL), an electron transport layer (ETL), an electron injection layer (EIL), etc.; the materials used in the organic layer can be classified into a hole injection material, a hole transport material, an electron blocking material, a light-emitting material, an electron buffer material, a hole blocking material, an electron transport material, an electron injection material, etc., depending on functions. In the organic EL device, holes from an anode and electrons from a cathode are injected into a light-emitting layer by electric voltage, and an exciton having high energy is produced by the recombination of holes and electrons. The organic light-emitting compound moves into an excited state by the energy and emits light from energy when the organic light-emitting compound returns to the ground state from the excited state.
- [4] The most important factor determining luminous efficiency in an organic EL device is light-emitting materials. The light-emitting materials are required to have the following features: high quantum efficiency, high movement degree of an electron and a hole, and formability of a uniform and stable layer. The light-emitting materials are classified into blue light-emitting materials, green light-emitting materials, and red light-emitting materials according to the light-emitting color, and further include yellow light-emitting materials or orange light-emitting materials. Furthermore, the

light-emitting material is classified into a host material and a dopant material in a functional aspect. Recently, an urgent task is the development of an organic EL device having high efficiency and long operating lifespan. In particular, the development of highly excellent light-emitting material compared to conventional light-emitting materials is urgently required considering the EL properties necessary for medium- and large-sized OLED panels. For this, preferably, as a solvent in a solid state and an energy transmitter, a host material should have high purity and a suitable molecular weight in order to be deposited under vacuum. Furthermore, a host material is required to have high glass transition temperature and pyrolysis temperature for guaranteeing thermal stability, high electrochemical stability for long lifespan, easy formability of an amorphous thin film, good adhesion with adjacent layers, and no movement between layers.

[5] A mixed system of a dopant/host material can be used as a light-emitting material to improve color purity, luminous efficiency, and stability. Generally, the device having the most excellent EL properties comprises the light-emitting layer, wherein a dopant is doped onto a host. If the dopant/host material system is used, the selection of the host material is important because the host material greatly influences efficiency and performance of a light-emitting device.

[6] WO 2013/1 12557 A1 discloses organic EL devices comprising a dopant and multi-component host. The above literature uses a host having a carbazole-carbazole skeleton as a first host and a benzothiophene, benzofuran, dibenzothiophene, or dibenzofuran-based compound as a second host.

[7] The present inventors have found that an organic EL device which uses a multi-component host as a host, which has a bicarbazole derivative containing pyridine and a carbazole derivative including a nitrogen-containing heteroaryl group, has high efficiency and long lifespan.

Disclosure of Invention

Technical Problem

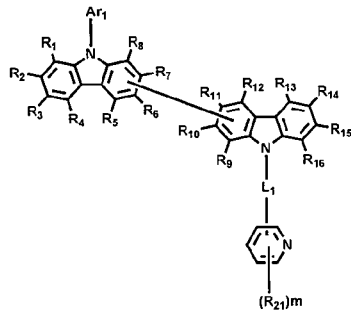
[8] The object of the present invention is to provide an organic EL device having high efficiency and long lifespan.

Solution to Problem

[9] The above objective can be achieved by an organic EL device comprising at least one light-emitting layer between an anode and a cathode, wherein the light-emitting layer comprises a host and a phosphorescent dopant; the host consists of multi-component host compounds; at least a first host compound of the multi-component host compounds is represented by the following formula 1 which is a bicarbazole derivative containing pyridine, and a second host compound is represented by the following

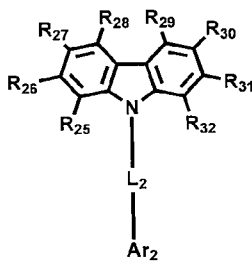
formula 2 which is a carbazole derivative including a nitrogen-containing heteroaryl group:

[10]



(1)

[11]



(2)

[12] Wherein

[13] Ar₁ represents a substituted or unsubstituted (C6-C30)aryl group;

[14] L₁ and L₂ each independently represent a single bond, or a substituted or unsubstituted (C6-C30)arylene group, wherein the substituent(s) of the substituted arylene group is independently selected from the group consisting of 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, and a substituted or unsubstituted mono- or di-(C6-C30)arylamino group; or are linked between adjacent substituents to form a substituted or unsubstituted mono- or polycyclic, (C3-C30) alicyclic or aromatic ring whose carbon atom(s) ring may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

[15] R₁ to R₁₆, R₂₁, and R₂₅ to R₃₂ 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 unsub-

stituted di(C1-C30)alkyl(C6-C30)arylsilyl group, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino group; or are linked between adjacent substituents to form a substituted or unsubstituted mono- or polycyclic, (C3-C30) alicyclic or aromatic ring whose carbon atom(s) ring may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

[16] one of R₅ to R₈ is linked to one of R₉ to R₁₂ via a single bond;

[17] Ar₂ represents a substituted or unsubstituted nitrogen-containing 5- to 30-membered heteroaryl group;

[18] m represents 0, 1, 2, 3 or 4;

[19] the heteroaryl group contains at least one hetero atom selected from B, N, O, S, Si, and P; and

[20] the heteroaryl group is a monocyclic-based heteroaryl group, such as pyrrolyl, imidazolyl, pyrazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., or a fused ring-based heteroaryl group, such as benzoimidazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, naphthyridinyl, phenanthridinyl, etc., which may be substituted with a (C6-C20)aryl group, a tri(C6-C12)arylsilyl group, a S- or O-containing 5- to 15-membered heteroaryl group, a (C6-C15)aryl group substituted with a (C1-C6)alkyl group, or a (C6-C15)aryl group substituted with a cyano group.

Advantageous Effects of Invention

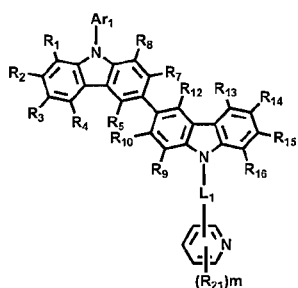
[21] According to the present invention, an organic EL device having high efficiency and long lifespan is provided and the production of a display device or a lighting device is possible by using the organic EL device.

Mode for the Invention

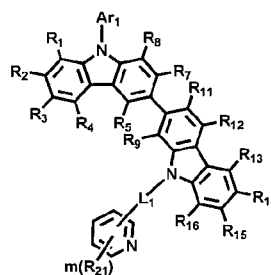
[22] Hereinafter, the present invention will be described in detail. However, the following description is intended to explain the invention, and is not meant in any way to restrict the scope of the invention.

[23] The compound of formula 1 may be represented by the following formula 3, 4, 5, or 6:

[24]

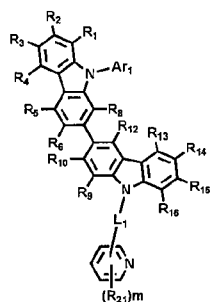


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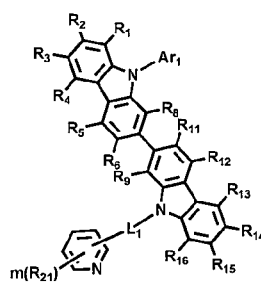


(4)

[25]



(5)



(6)

[26] Wherein

[27] Ar₁, L₁, R₁ to R₁₆, R_{2i}, and m are as defined in claim 1.

[28] In formula 1, Ar₁ may represent a substituted or unsubstituted (C6-C30)aryl group; preferably, a substituted or unsubstituted (C6-C18)aryl group.

[29] In formulae 1 and 2, L₁ and L₂ each independently may represent a single bond, or a substituted or unsubstituted (C6-C30)arylene group; and preferably, a single bond, or a substituted or unsubstituted (C6-C18)arylene group.

[30] In formula 2, Ar₂ may represent a substituted or unsubstituted nitrogen-containing 5- to 30-membered heteroaryl group; preferably, a monocyclic-based heteroaryl group, such as pyrrolyl, imidazolyl, pyrazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., or a fused ring-based heteroaryl group, such as benzoimidazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolyl, quinazolyl, quinoxalyl, carbazolyl, naphthyridinyl, phenanthridinyl, etc.; and more preferably, triazinyl, pyrimidinyl, quinolyl, quinazolyl, quinoxalyl, or naphthyridinyl.

[31] In formula 2, R₂₅ to R₃₂ each independently may 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, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino group; or may be linked between adjacent substituents to form a substituted or unsubstituted mono- or polycyclic, (C3-C30) alicyclic or aromatic ring whose carbon atom(s) ring may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur; and preferably, hydrogen, a cyano group, a substituted or unsubstituted tri(C6-C10)arylsilyl group, a (C6-C15)aryl group which is unsubstituted or substituted with a tri(C6-C10)arylsilyl group, or a 10- to 20-membered heteroaryl group which is unsubstituted or substituted with a (C6-C15)aryl group.

[32] Herein, "(C1-C30)alkyl(ene)" is meant to be a linear or branched alkyl(ene) having 1

to 30 carbon atoms, 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, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes vinyl, 1-propenyl, 2-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 2-methylbut-2-enyl, etc. "(C2-C30)alkynyl" is a linear or branched alkynyl having 2 to 30 carbon atoms, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes ethynyl, 1-propynyl, 2-propynyl, 1-butyne, 2-butyne, 3-butyne, 1-methylpent-2-ynyl, etc. "(C3-C30)cycloalkyl" is a mono- or polycyclic hydrocarbon having 3 to 30 carbon atoms, in which the number of carbon atoms is preferably 3 to 20, more preferably 3 to 7, and includes cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, etc. "3- to 7-membered heterocycloalkyl" is a cycloalkyl having at least one heteroatom selected from the group consisting of B, N, O, S, Si, and P, preferably O, S, and N, and 3 to 7, preferably 5 to 7 ring backbone atoms, and includes tetrahydrofuran, pyrrolidine, thiolan, tetrahydropyran, etc.

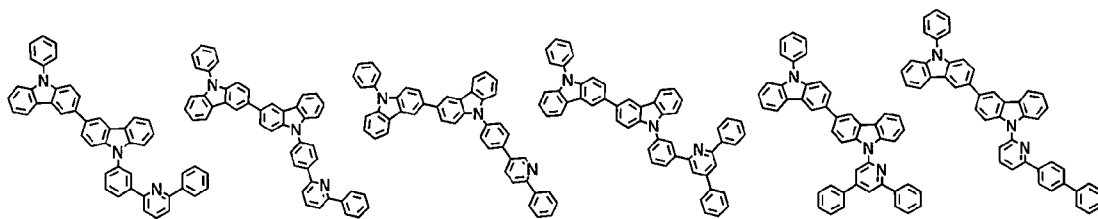
"(C6-C30)aryl(ene)" is a monocyclic or fused ring derived from an aromatic hydrocarbon having 6 to 30 carbon atoms, in which the number of carbon atoms is preferably 6 to 20, more preferably 6 to 15, and includes phenyl, biphenyl, terphenyl, naphthyl, fluorenyl, phenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, etc. "3- to 30-membered heteroaryl(ene)" is an aryl group having at least one, preferably 1 to 4 heteroatom selected from the group consisting of B, N, O, S, Si, and P, and 3 to 30 ring backbone atoms; is a monocyclic ring, or a fused ring condensed with at least one benzene ring; has preferably 3 to 20, more preferably 3 to 15 ring backbone atoms; may be partially saturated; may be one formed by linking at least one heteroaryl or aryl group to a heteroaryl group via a single bond(s); and includes a monocyclic ring-type heteroaryl, such as furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., and a fused ring-type heteroaryl, such as benzofuranyl, benzothiophenyl, isobenzofuranyl, dibenzofuranyl, dibenzothiophenyl, benzoimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, phenoxazinyl, phenanthridinyl, benzodioxolyl, etc. "Nitrogen-containing 5- to 30-membered heteroaryl(ene) group" is an aryl group having at least one heteroatom N and 5 to 30 ring backbone atoms. 5 to 20 ring backbone atoms and 1 to 4 heteroatom are preferable, and 5 to 15 ring backbone atoms are more preferable. It is a monocyclic ring, or a fused ring condensed with at least one benzene ring; may be partially saturated; may be one

formed by linking at least one heteroaryl or aryl group to a heteroaryl group via a single bond(s); and includes a monocyclic ring-type heteroaryl, 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, phenanthridinyl, etc. "Halogen" includes F, Cl, Br, and I.

- [33] 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. Substituents of the substituted alkyl(ene) group, the substituted alkenyl group, the substituted alkynyl group, the substituted cycloalkyl group, the substituted aryl(ene) group, the substituted heteroaryl(ene) group, the substituted trialkylsilyl group, the substituted triarylsilyl group, the substituted dialkylarylsilyl group, the substituted mono- or di-arylamino group, or the substituted mono- or polycyclic, (C3-C30) alicyclic or aromatic ring in the above formulae are each independently at least one selected from the group consisting of deuterium; a halogen; a cyano group; a carboxyl group; a nitro group; a hydroxyl group; a (C1-C30)alkyl group; a halo(C1-C30)alkyl group; a (C2-C30)alkenyl group; a (C2-C30)alkynyl group; a (C1-C30)alkoxy group; a (C1-C30)alkylthio group; a (C3-C30)cycloalkyl group; a (C3-C30)cycloalkenyl group; a 3- to 7-membered heterocycloalkyl group; a (C6-C30)aryloxy group; a (C6-C30)arylthio group; a 3- to 30-membered heteroaryl group which is unsubstituted or substituted with a (C6-C30)aryl group; a (C6-C30)aryl group which is unsubstituted or substituted with a 3- to 30-membered heteroaryl group; a tri(C1-C30)alkylsilyl group; a tri(C6-C30)arylsilyl group; a di(C1-C30)alkyl(C6-C30)arylsilyl group; a (C1-C30)alkyldi(C6-C30)arylsilyl group; an amino group; a mono- or di(C1-C30)alkylamino group; a mono- or di(C6-C30)arylamino group; a (C1-C30)alkyl(C6-C30)arylamino group; a (C1-C30)alkylcarbonyl group; a (C1-C30)alkoxycarbonyl group; a (C6-C30)arylcarbonyl group; a di(C6-C30)arylboronyl group; a di(C1-C30)alkylboronyl group; a (C1-C30)alkyl(C6-C30)arylboronyl group; a (C6-C30)aryl(C1-C30)alkyl group; and a (C1-C30)alkyl(C6-C30)aryl group.

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

[35]



H1-1

H1-2

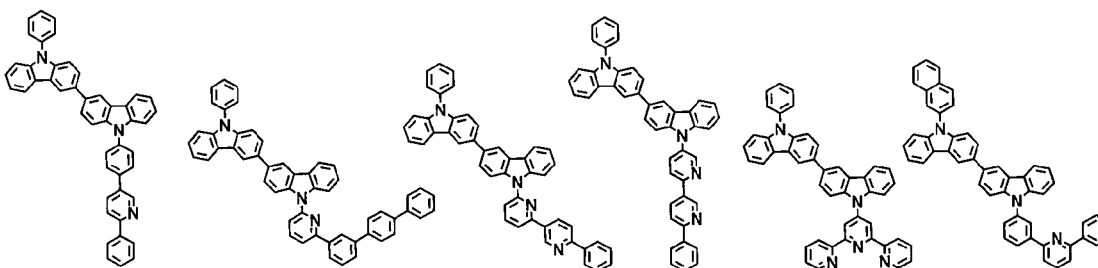
H1-3

H1-4

H1-5

H1-6

[36]



H1-7

H1-8

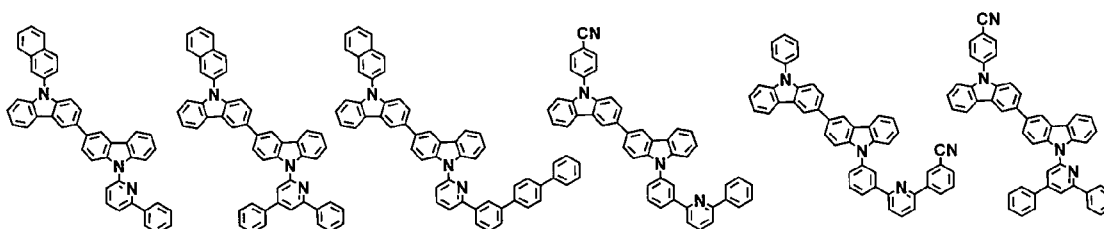
H1-9

H1-10

H1-11

H1-12

[37]



H1-13

H1-14

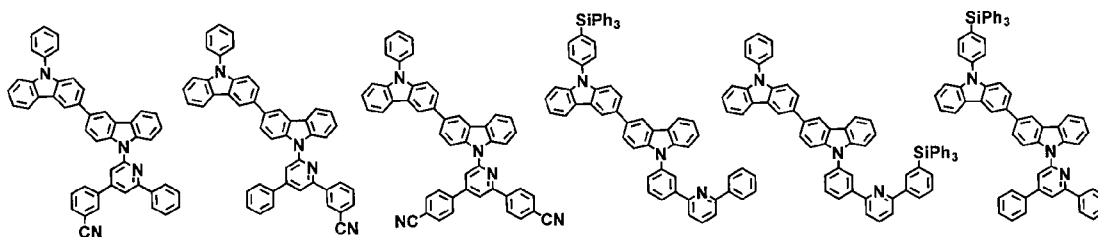
H1-15

H1-16

H1-17

H1-18

[38]



H1-19

H1-20

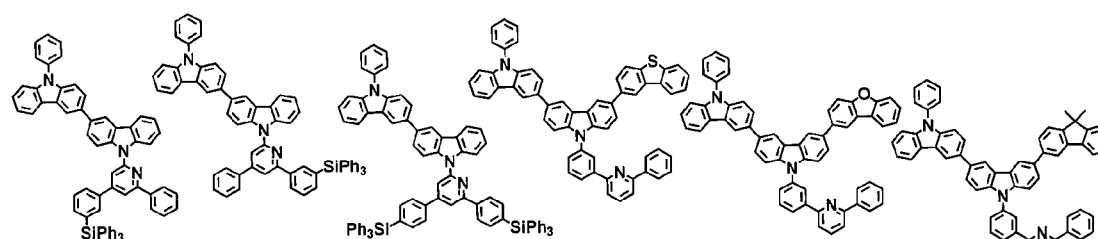
H1-21

H1-22

H1-23

H1-24

[39]



H1-25

H1-26

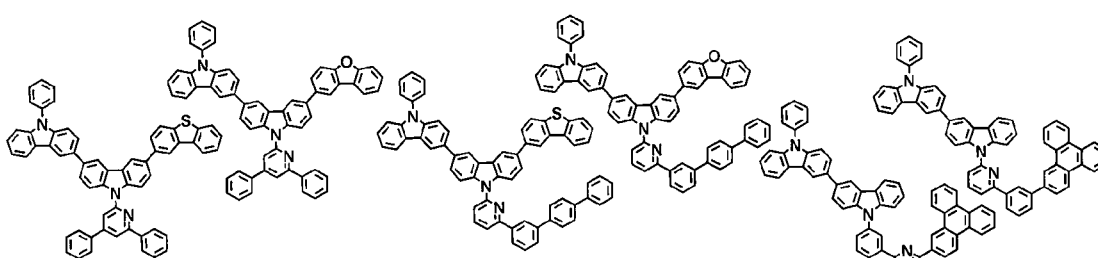
H1-27

H1-28

H1-29

H1-30

[40]



H1-31

H1-32

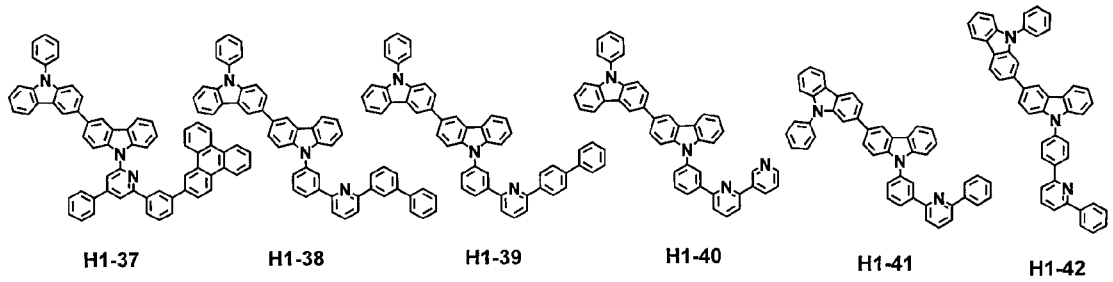
H1-33

H1-34

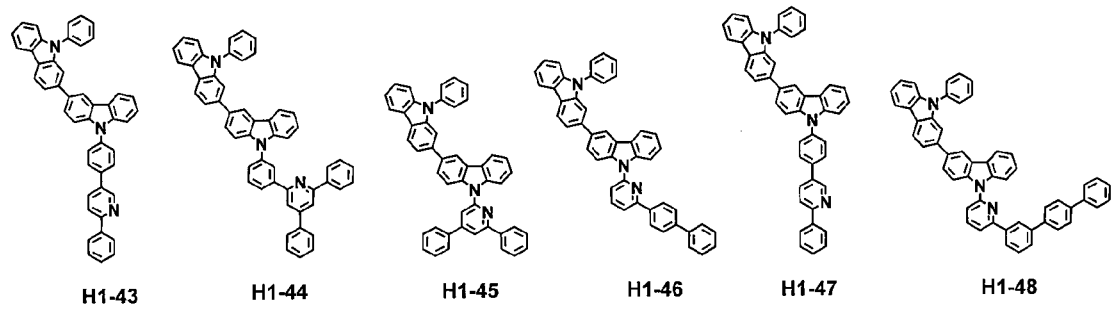
H1-35

H1-36

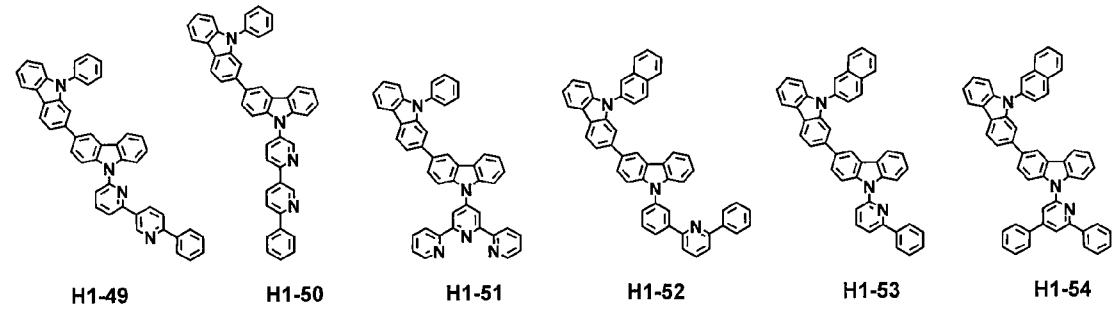
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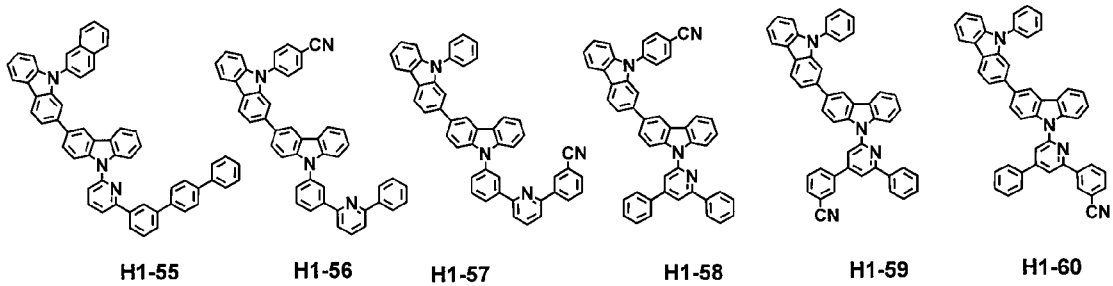
[42]



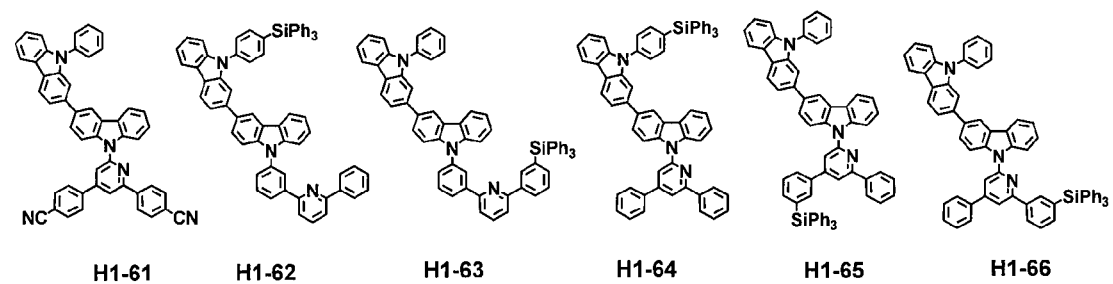
[43]



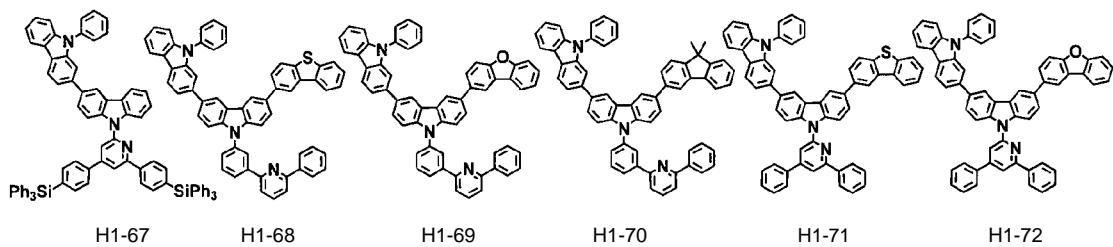
[44]



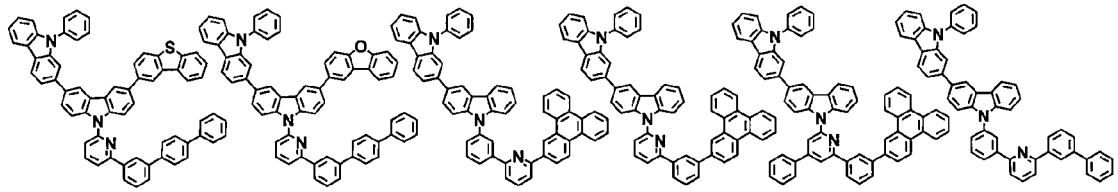
[45]



[46]



[47]



H1-73

H1-74

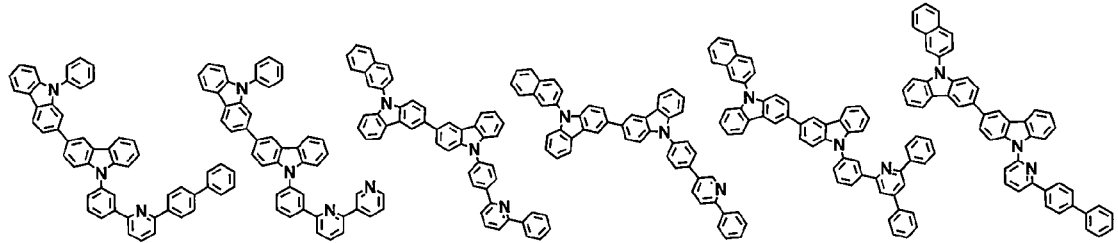
H1-75

H1-76

H1-77

H1-78

[48]



H1-79

H1-80

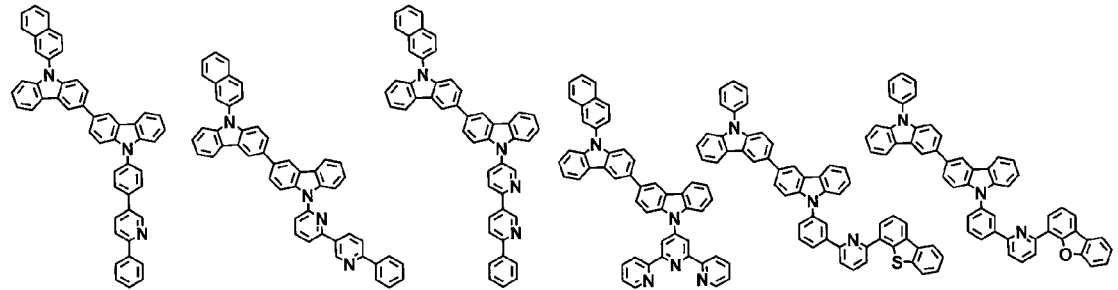
H1-81

H1-82

H1-83

H1-84

[49]



H1-85

H1-86

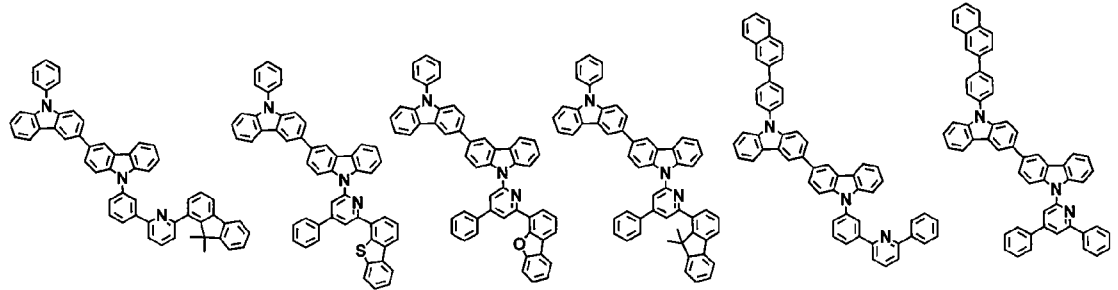
H1-87

H1-88

H1-89

H1-90

[50]



H1-91

H1-92

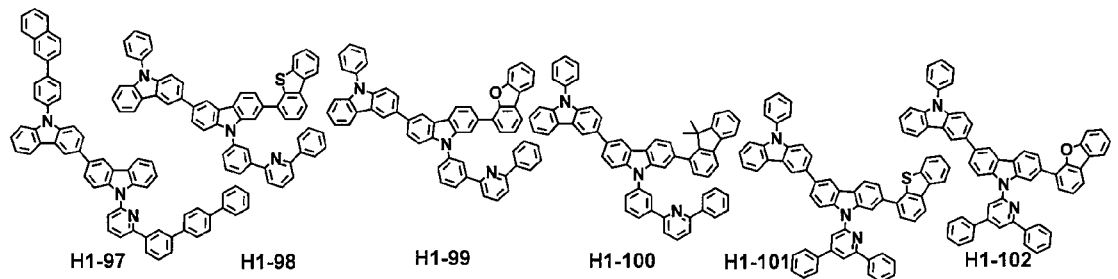
H1-93

H1-94

H1-95

H1-96

[51]



H1-97

H1-98

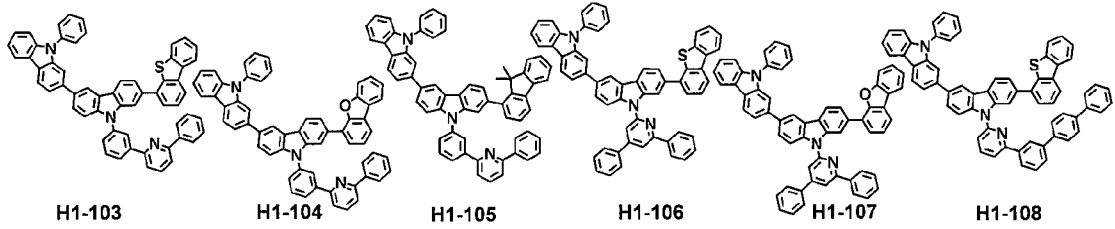
H1-99

H1-100

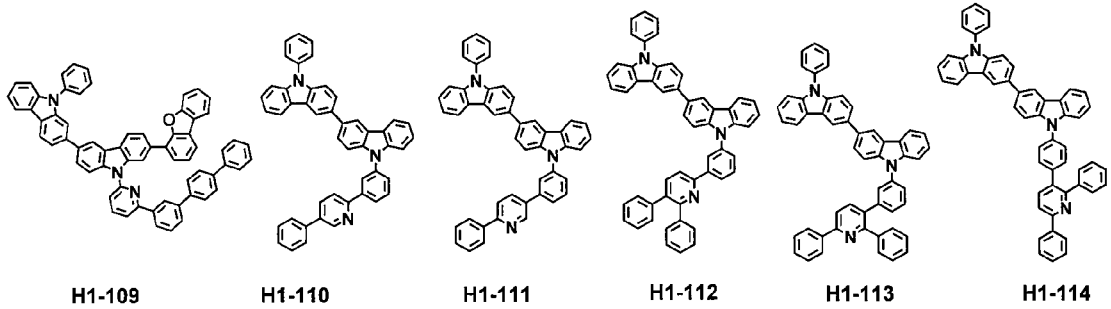
H1-101

H1-102

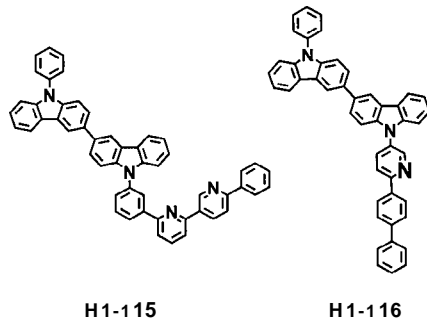
[52]



[53]

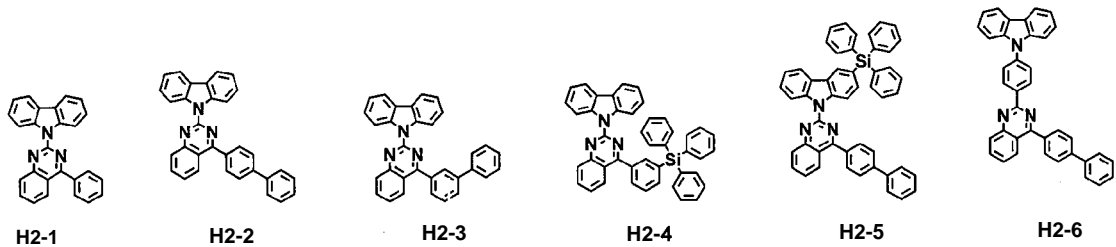


[54]

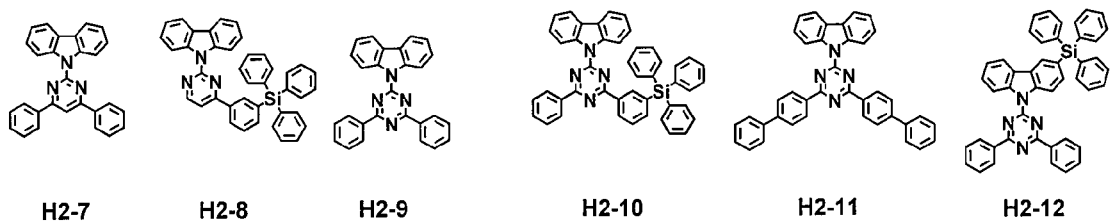


[55] The compound of formula 2 as a second host compound may be selected from the group consisting of the following compounds, but is not limited thereto:

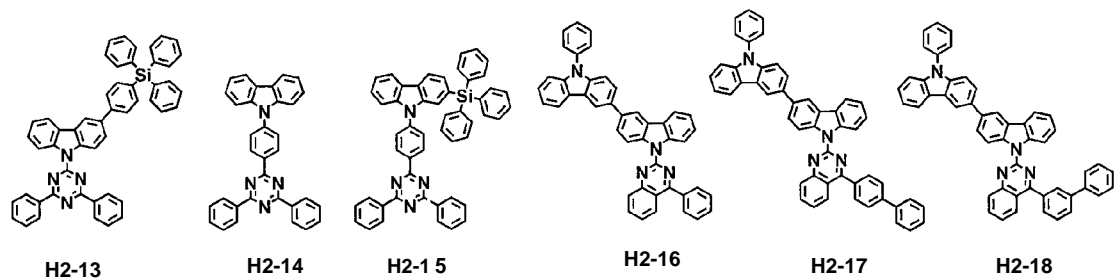
[56]



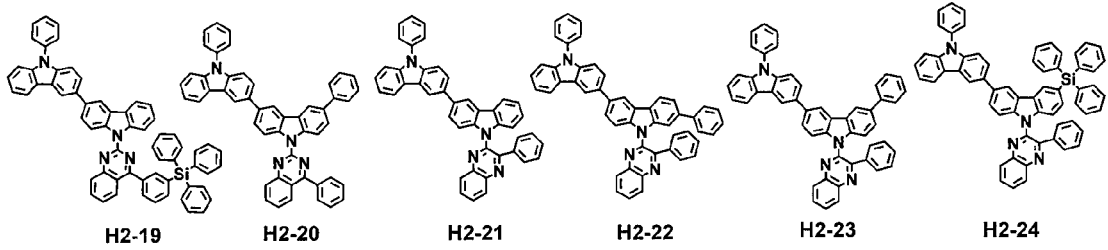
[57]



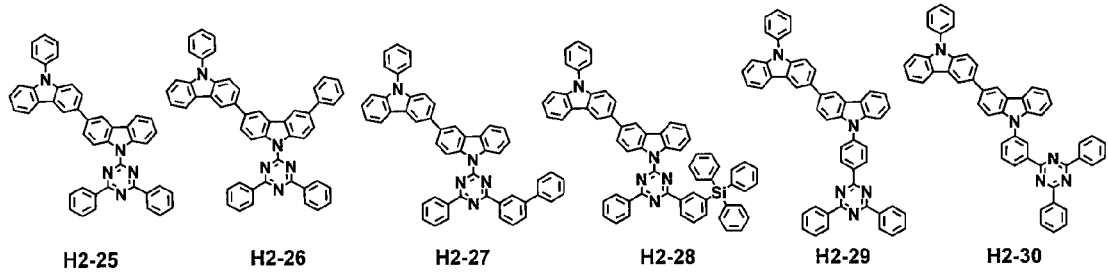
[58]



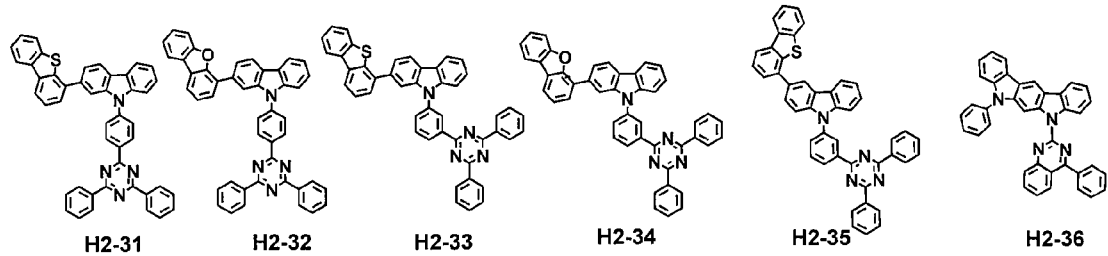
[59]



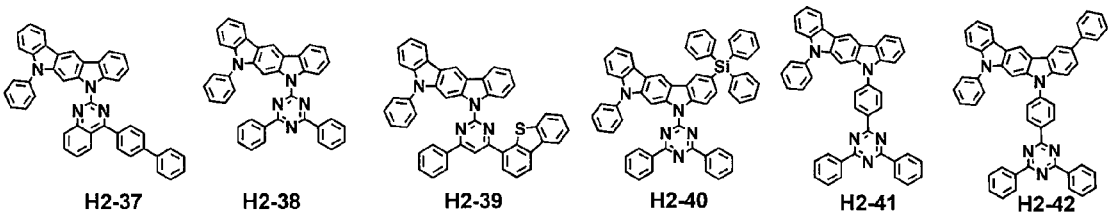
[60]



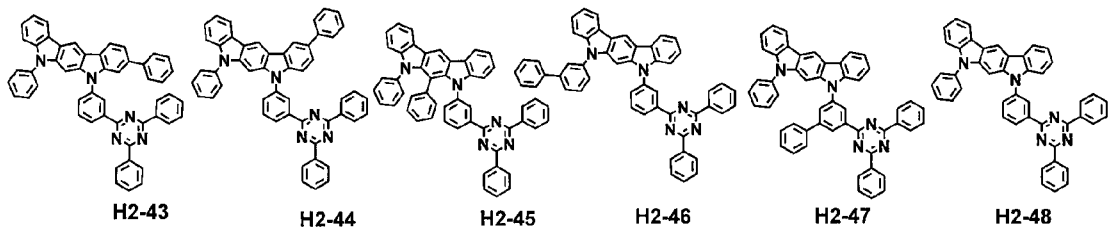
[61]



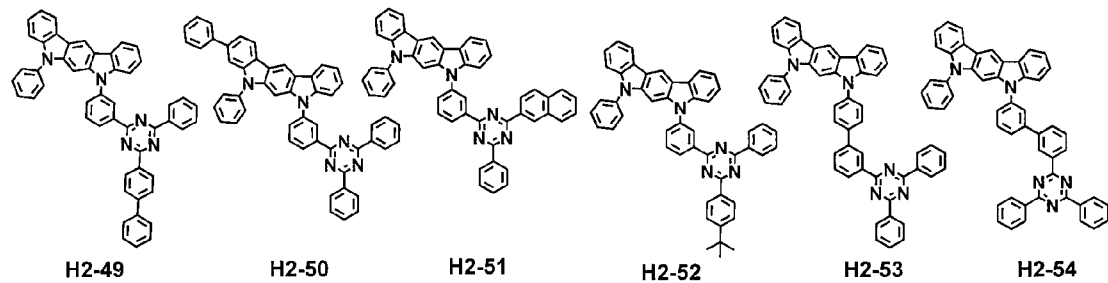
[62]



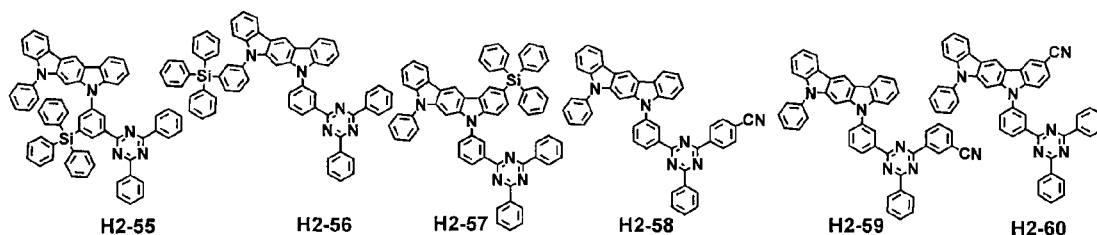
[63]



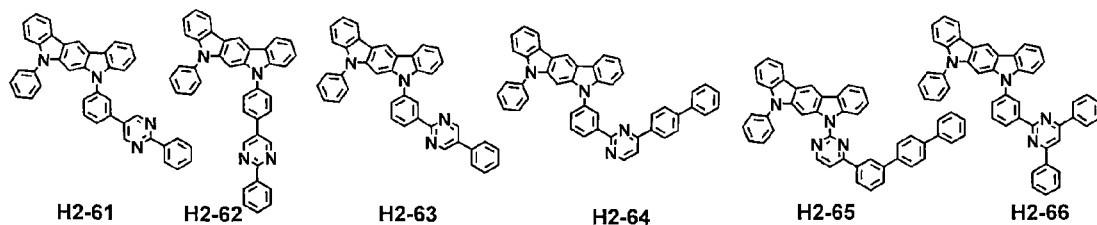
[64]



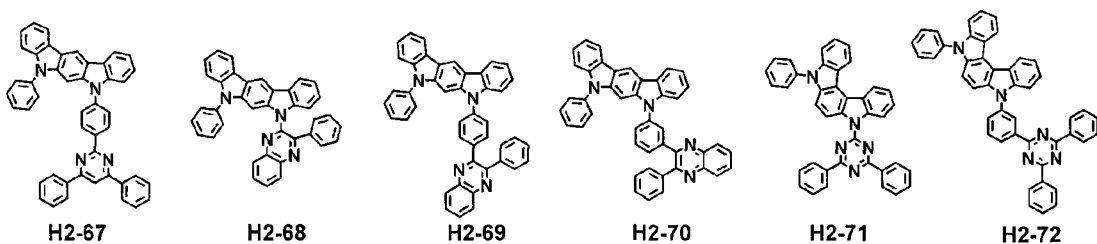
[65]



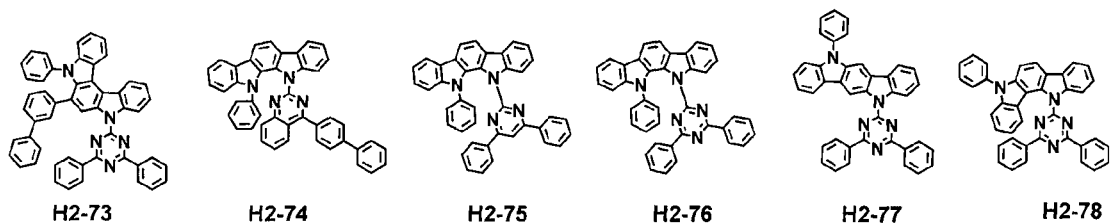
[66]



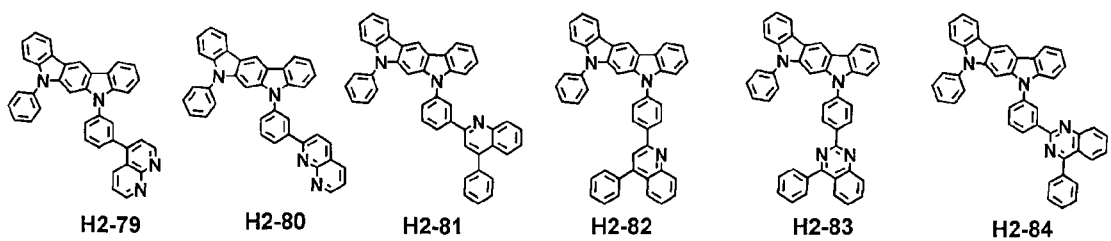
[67]



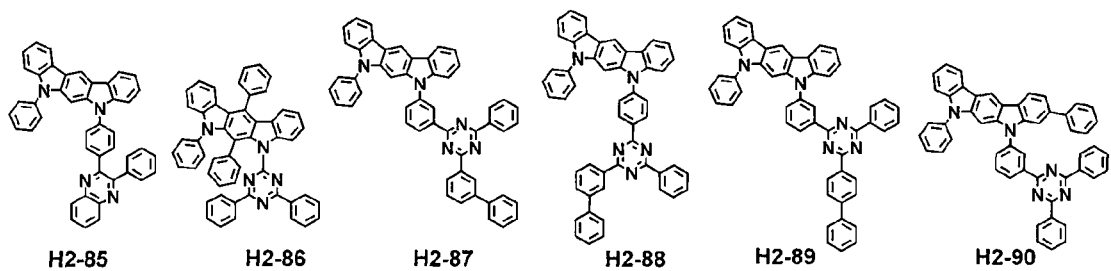
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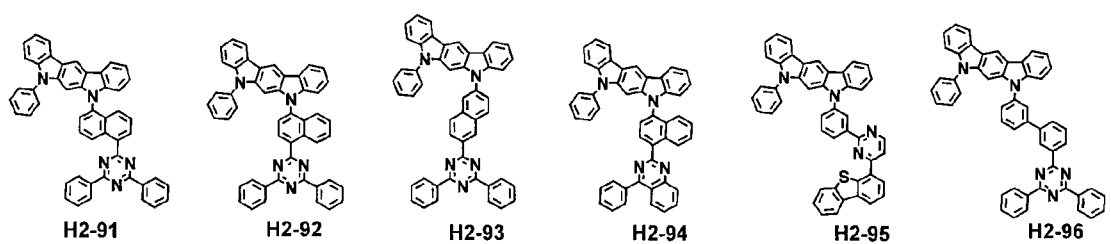
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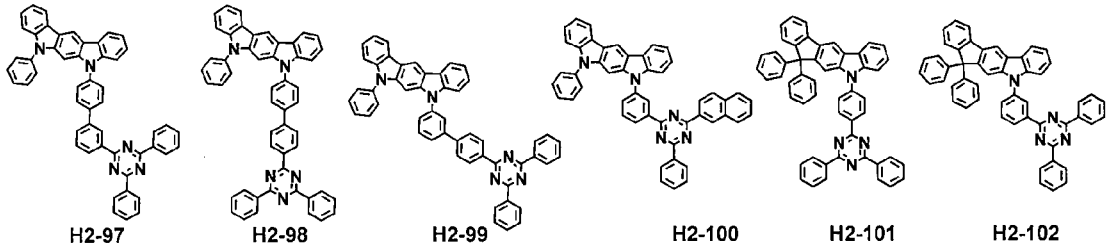
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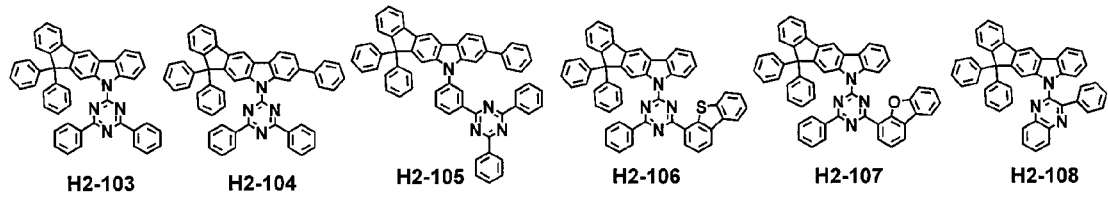
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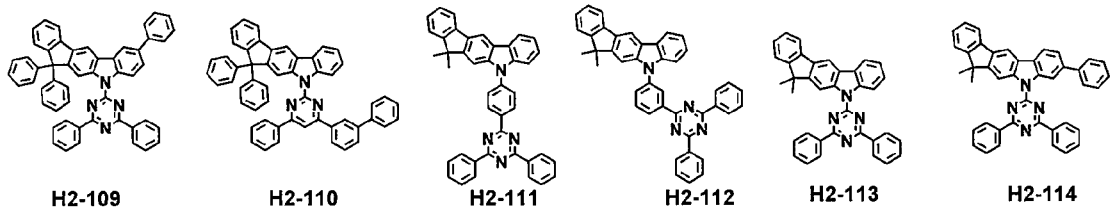
[72]



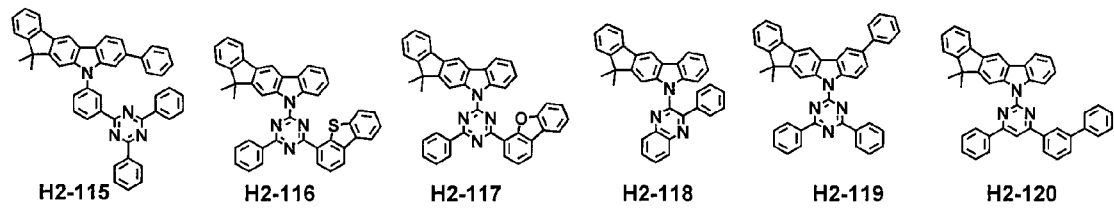
[73]



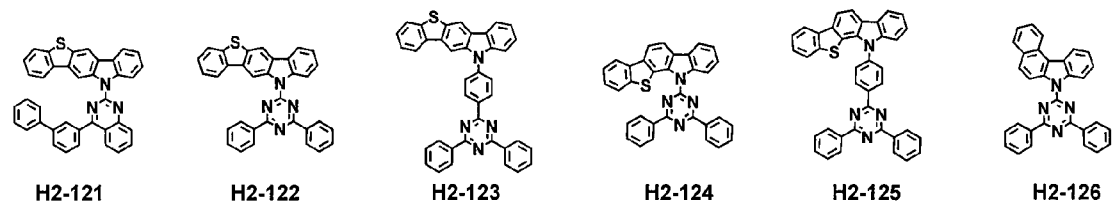
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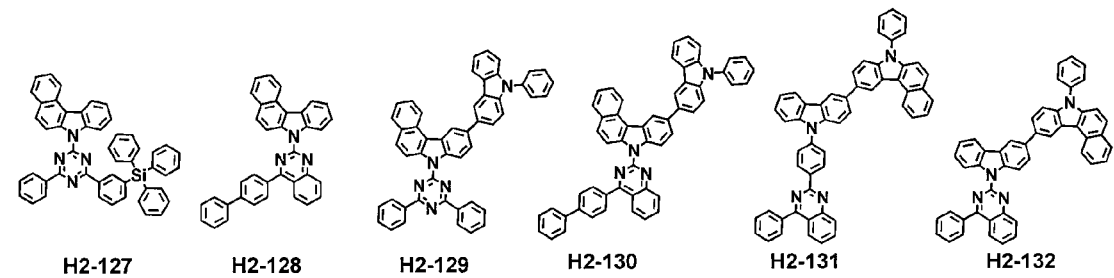
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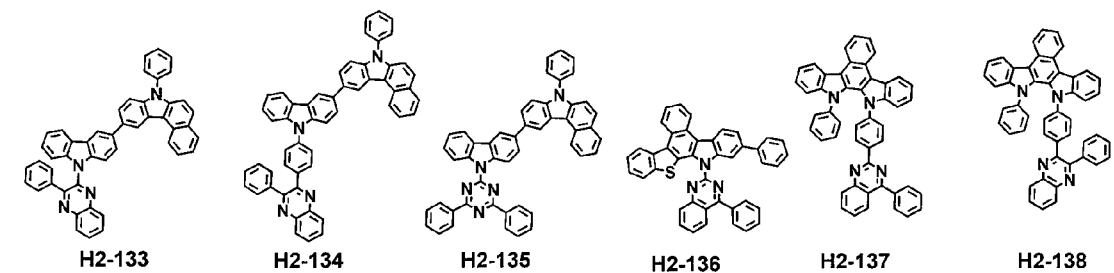
[76]



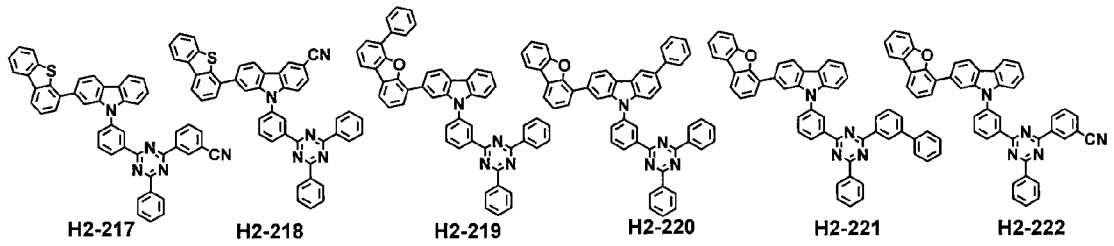
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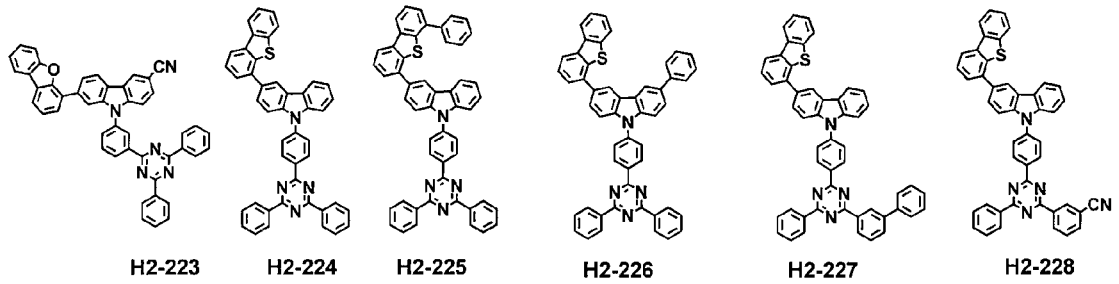
[78]



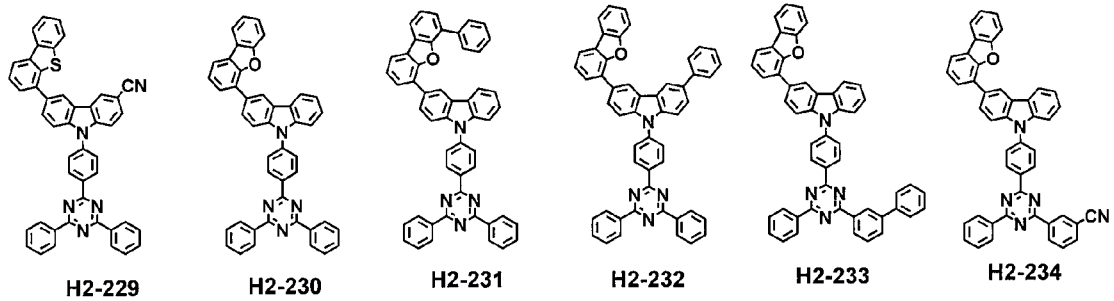
[91]



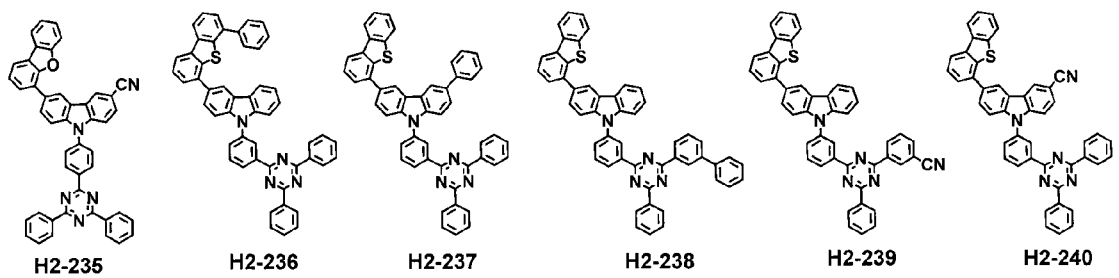
[92]



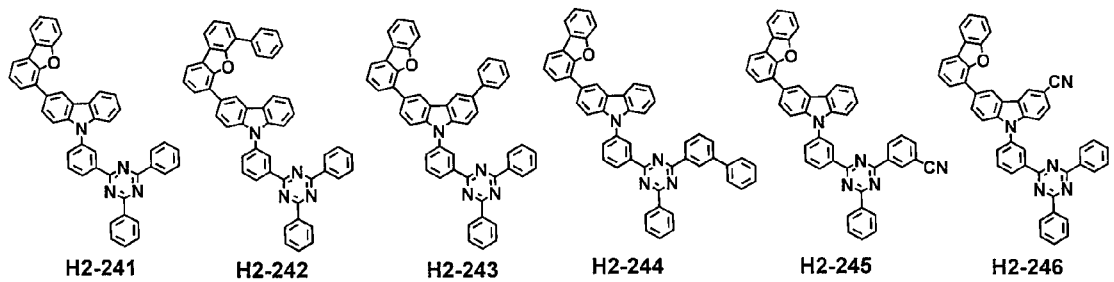
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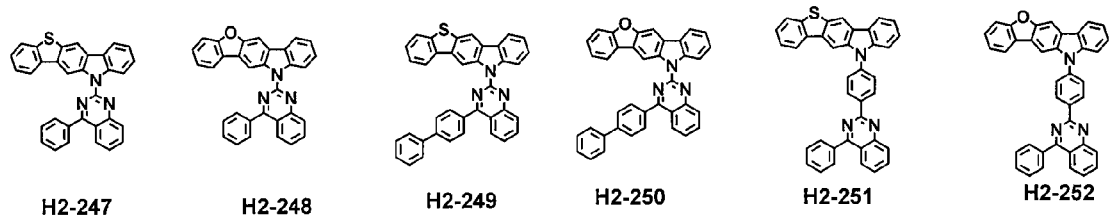
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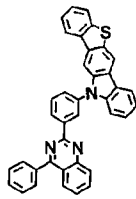
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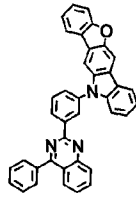
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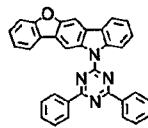
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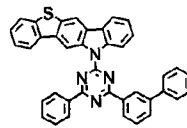
H2-253



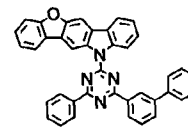
H2-254



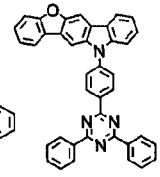
H2-255



H2-256

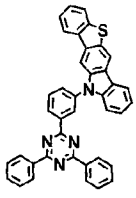


H2-257

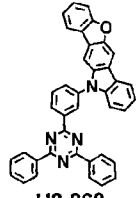


H2-258

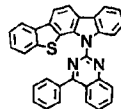
[98]



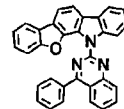
H2-259



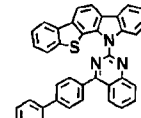
H2-260



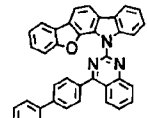
H2-261



H2-262

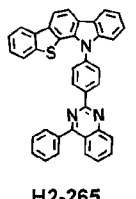


H2-263

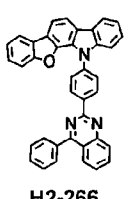


H2-264

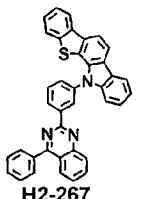
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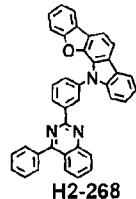
H2-265



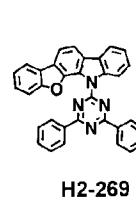
H2-266



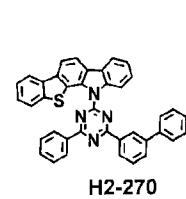
H2-267



H2-268

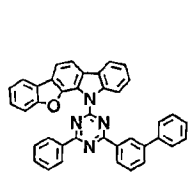


H2-269

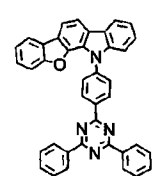


H2-270

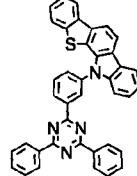
[100]



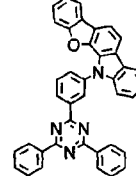
H2-271



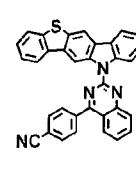
H2-272



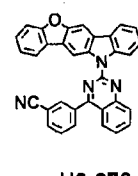
H2-273



H2-274

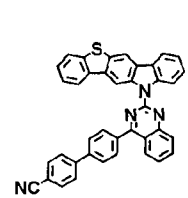


H2-275

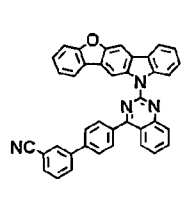


H2-276

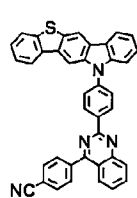
[101]



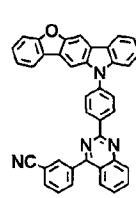
H2-277



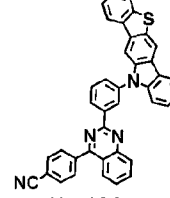
H2-278



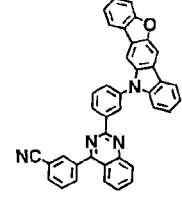
H2-279



H2-280

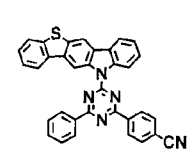


H2-281

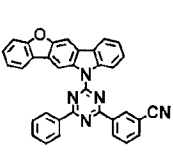


H2-282

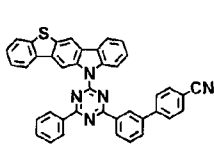
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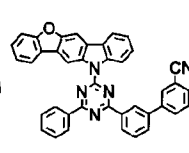
H2-283



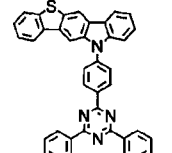
H2-284



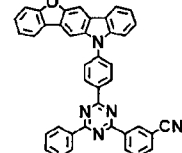
H2-285



H2-286

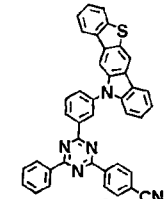


H2-287

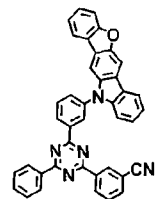


H2-288

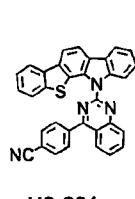
[103]



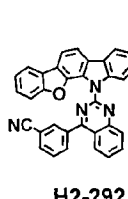
H2-289



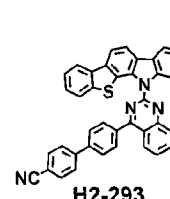
H2-290



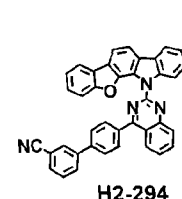
H2-291



H2-292

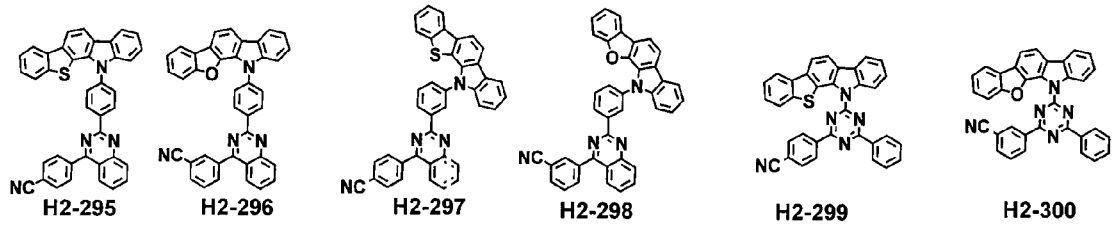


H2-293

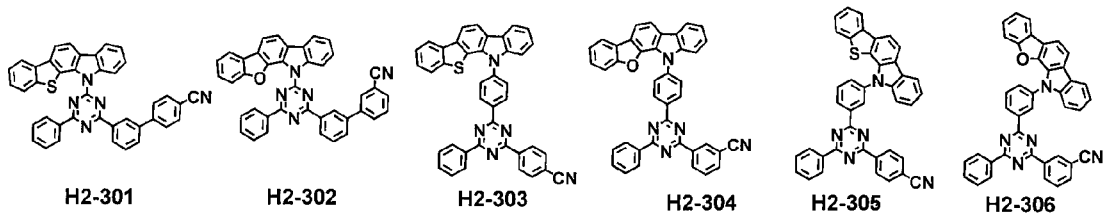


H2-294

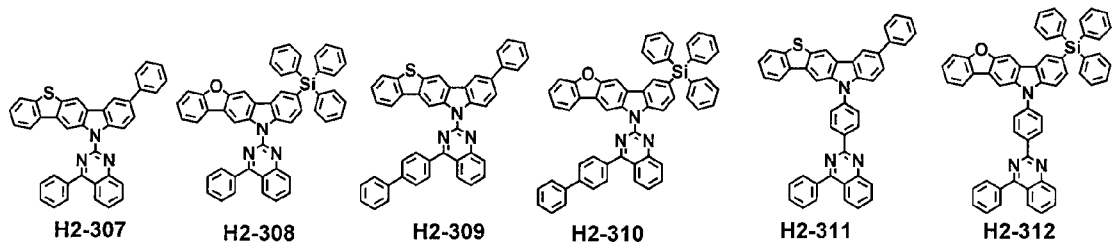
[104]



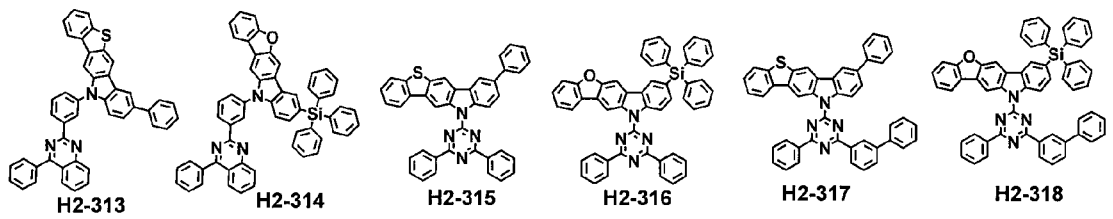
[105]



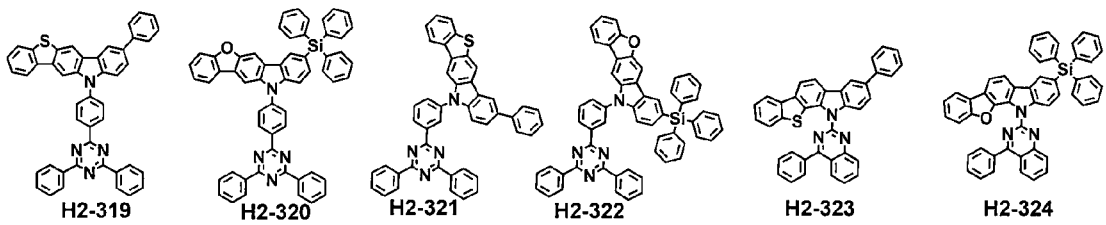
[106]



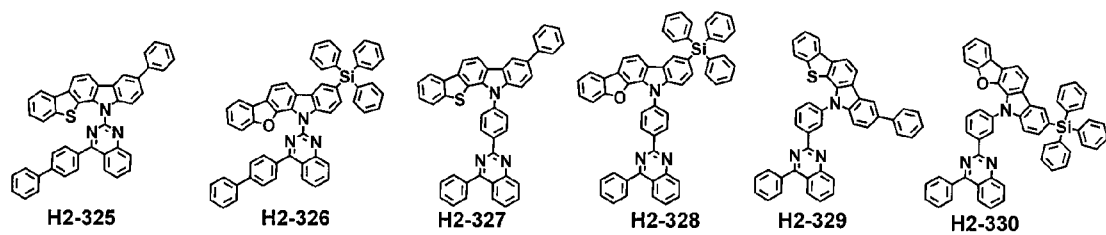
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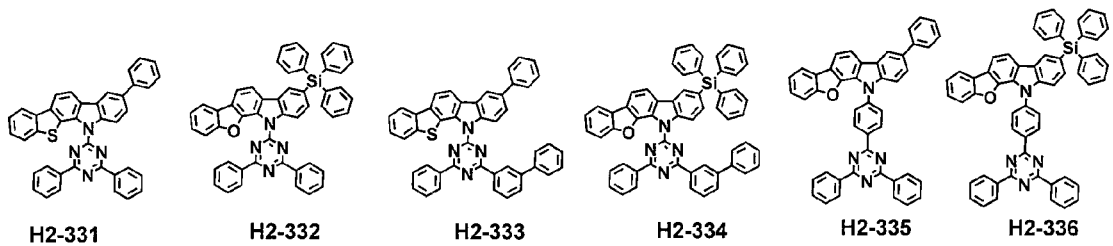
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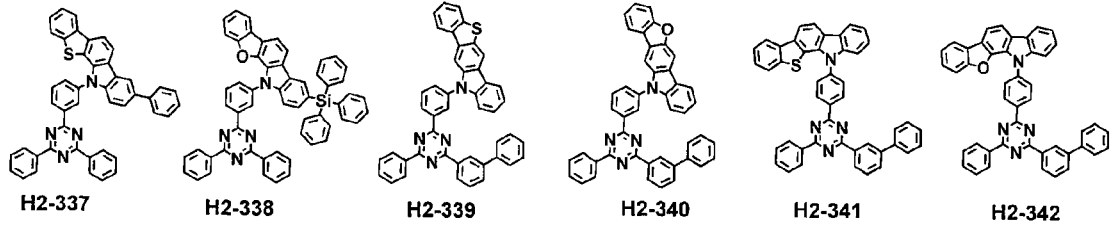
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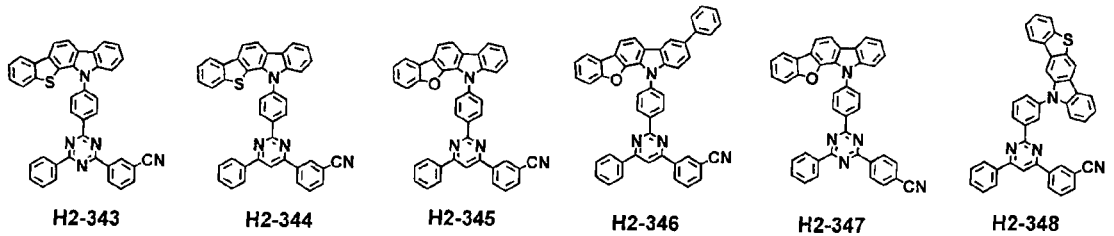
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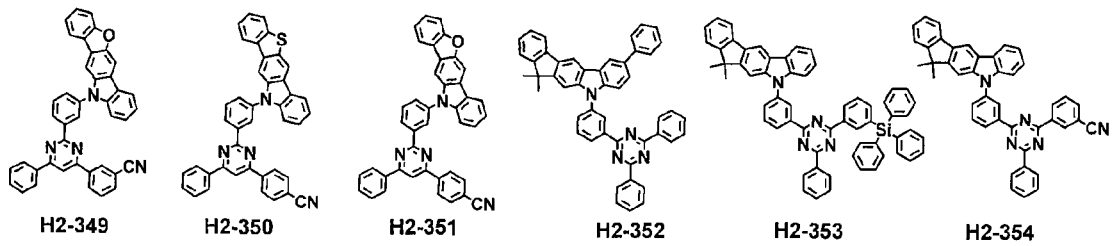
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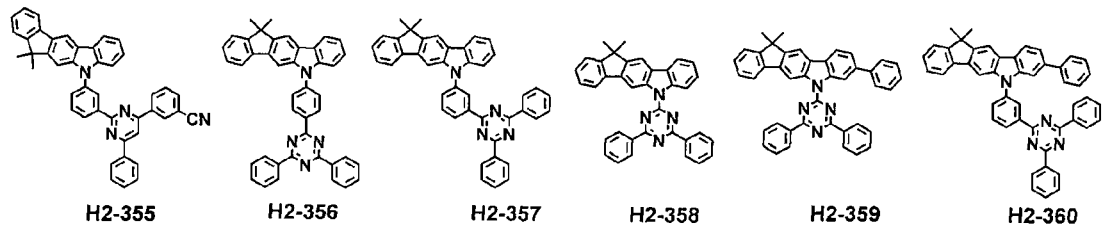
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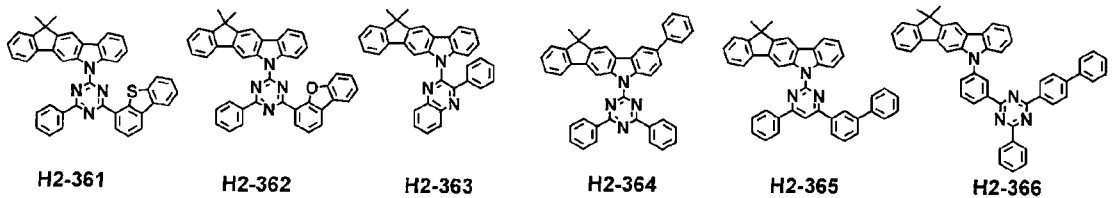
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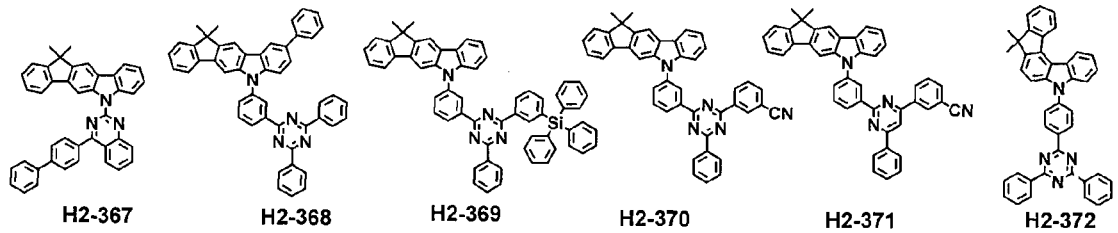
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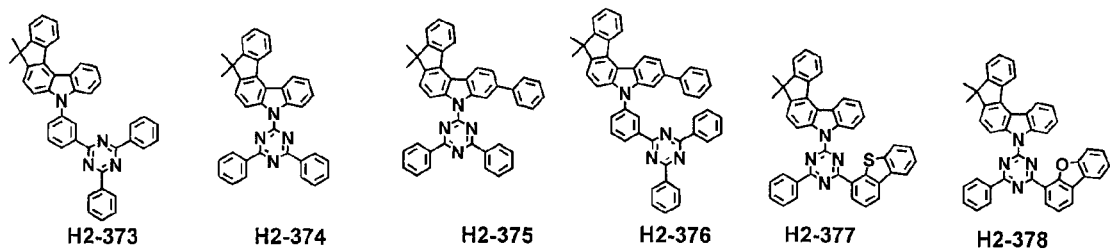
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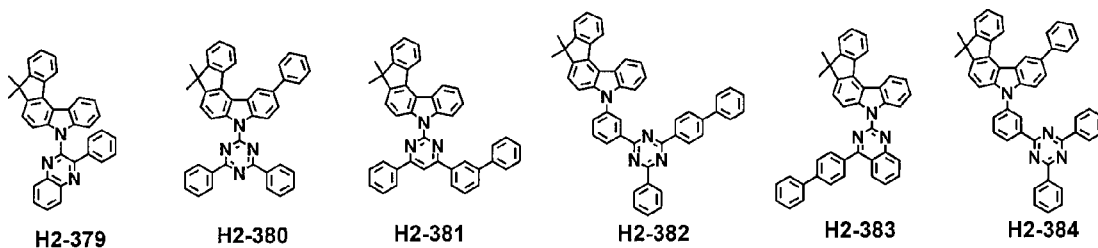
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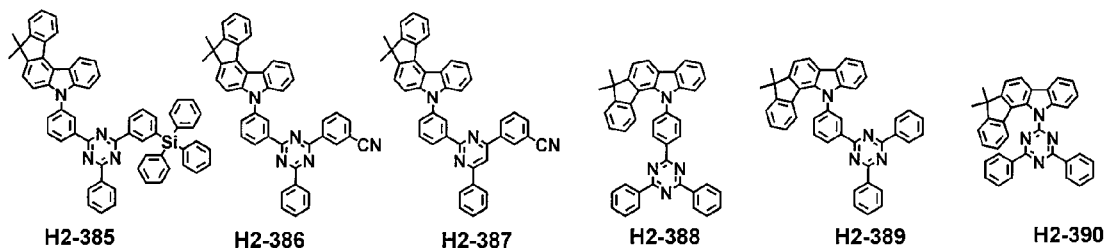
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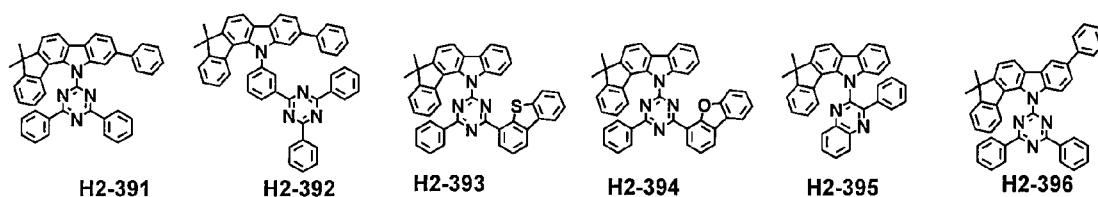
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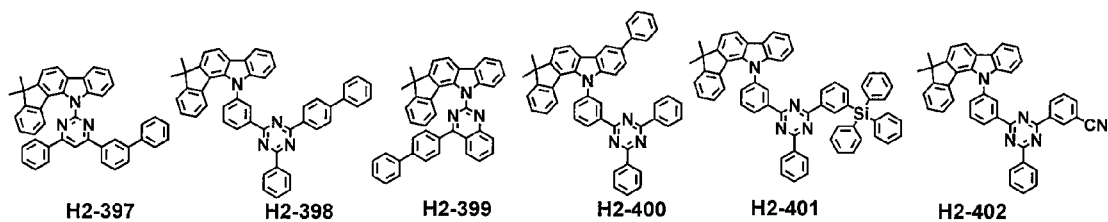
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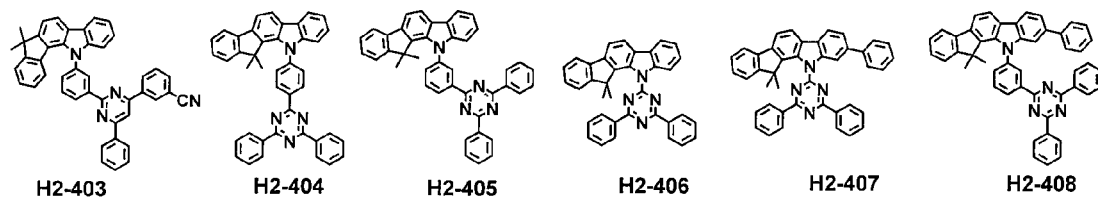
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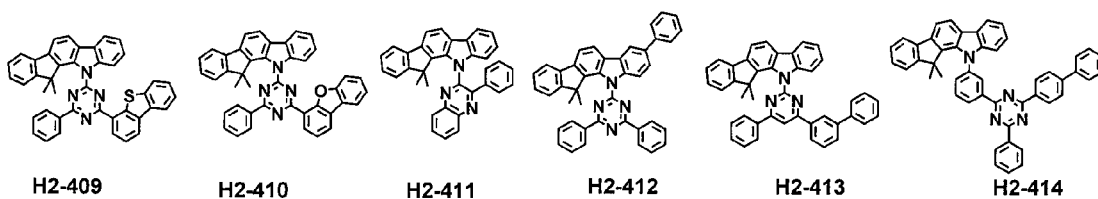
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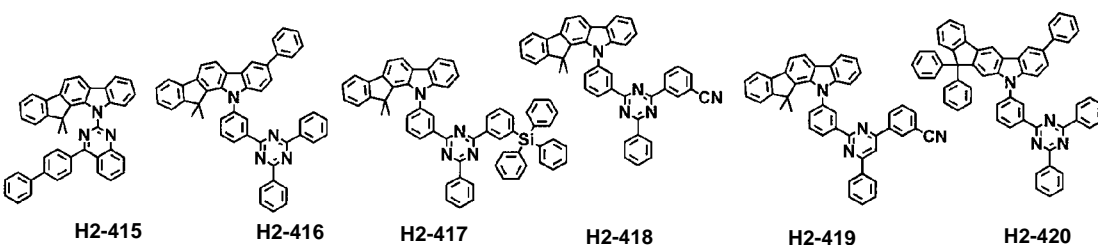
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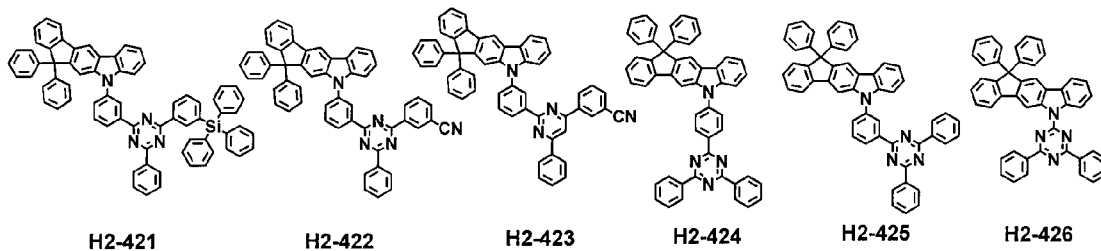
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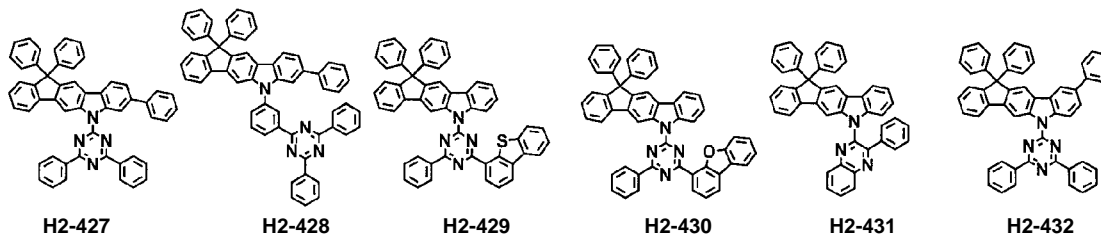
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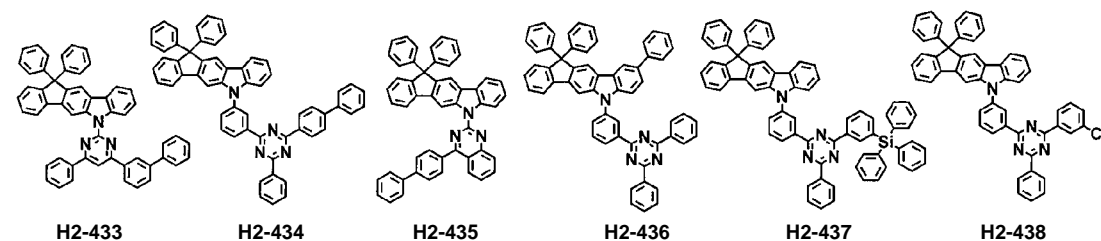
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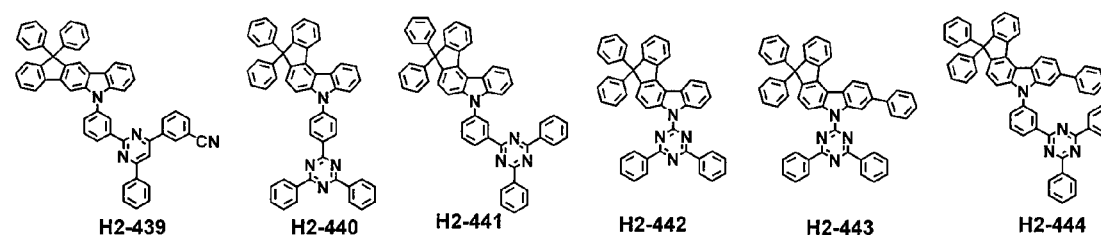
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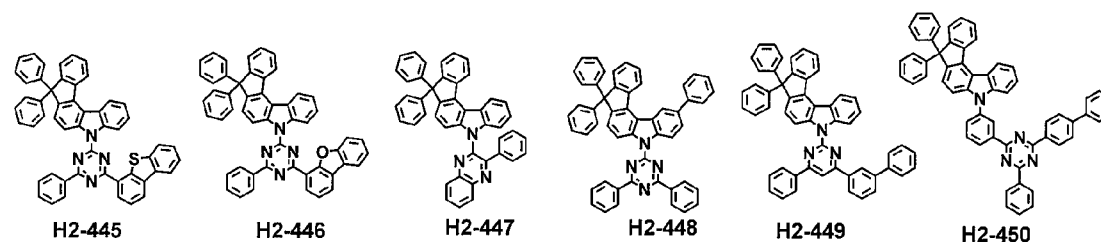
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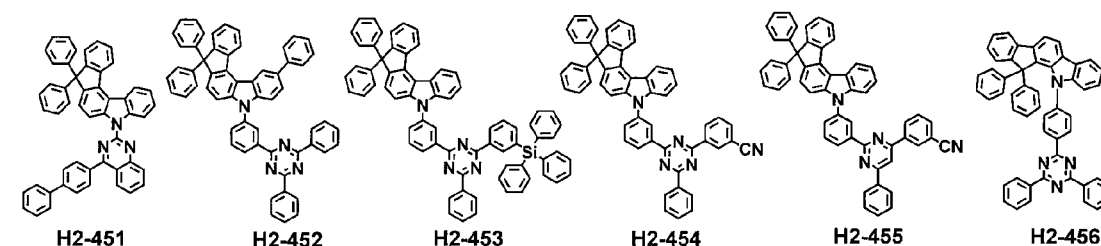
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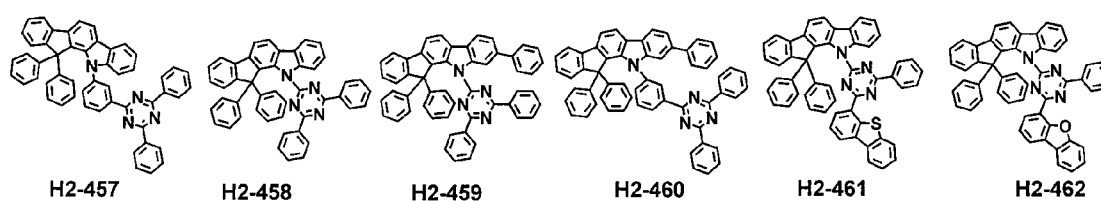
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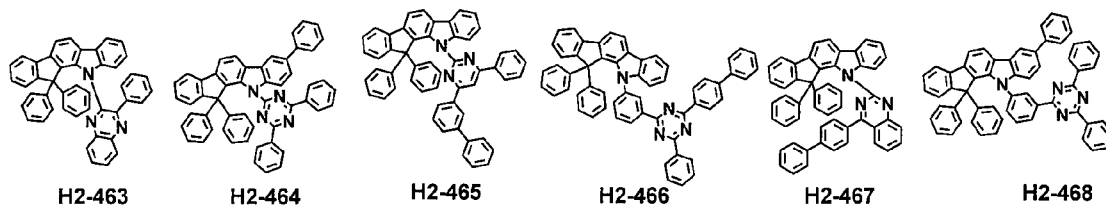
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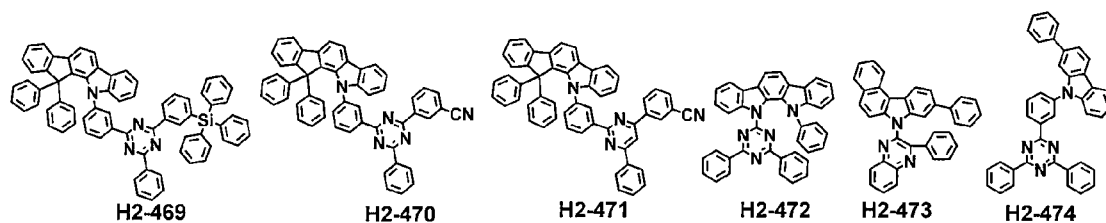
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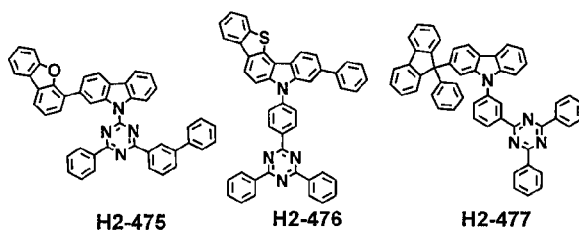
[132]



[133]



[134]



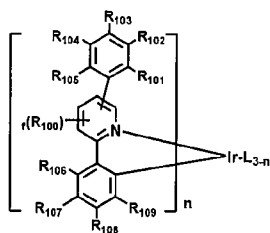
[135] The organic EL device according to the present invention may comprise an anode, a cathode, and at least one organic layer between the two electrodes, wherein the organic layer comprises a light-emitting layer, the light-emitting layer comprises a host and a phosphorescent dopant; the host consists of multi-component host compounds; at least a first host compound of the multi-component host compounds is represented by formula 1 which is a bicarbazole derivative containing pyridine, and a second host compound is represented by formula 2 which is a carbazole derivative including a nitrogen-containing heteroaryl group.

[136] The light-emitting layer means a layer that light is emitted therefrom and may be a single layer or multi-layers consisting of two or more layers. The doping concentration of dopant compounds to host compounds in the light-emitting layer is preferably less than 20 wt%.

[137] The dopants included in the organic EL device of the present invention are preferably one or more phosphorescent dopants. The phosphorescent dopant material applied to the organic EL device of the present invention is not specifically limited, but preferably may be selected from complex compounds of iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), more preferably ortho metallated complex compounds of iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), and even more preferably ortho metallated iridium complex compounds.

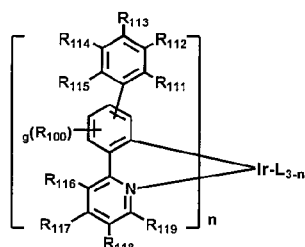
[138] The dopants included in the organic EL device of the present invention may be selected from the group consisting of the compounds represented by the following formulae 7 to 9:

[139]



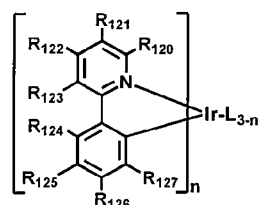
(7)

[140]



(8)

[141]

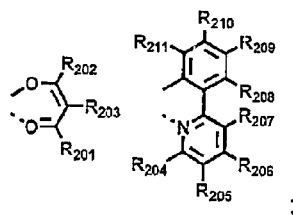


(9)

[142] Wherein

[143] L is selected from the following structures:

[144]



[145] Rioo represents hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl group, or a substituted or unsubstituted (C3-C30)cycloalkyl group;

[146] R₁₀₁ to R₁₀₉ and R₁₁₁ to R₁₂₃ each independently represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group unsubstituted or substituted with a halogen(s), a substituted or unsubstituted (C3-C30)cycloalkyl group, a cyano group, a substituted or unsubstituted (C1-C30)alkoxy group, or a substituted or unsubstituted (C6-C30)aryl group; R₁₂₀ to R₁₂₃ may be linked to an adjacent substituent(s) to form a substituted or unsubstituted fused ring, for example, quinoline;

[147] R₁₂₄ to R₁₂₇ each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, or a substituted or unsubstituted (C6-C30)aryl group; when R[^] to R₁₂₇ are aryl groups, they may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic, (C3-C30) alicyclic, aromatic, or a heteroaromatic ring, for example, fluorene, dibenzothiophene, or dibenzofuran;

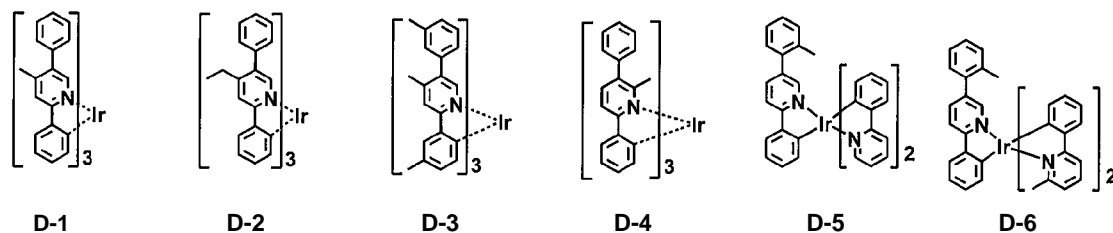
[148] $R_{2,oi}$ to $R_{2,ii}$ each independently represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group unsubstituted or substituted with a halogen(s), a substituted or unsubstituted (C3-C30)cycloalkyl group, or a substituted or unsubstituted (C6-C30)aryl group; $R_{2,0,8}$ to $R_{2,11}$ may be linked to an adjacent substituent(s) to form a substituted or unsubstituted mono- or polycyclic, (C3-C30) alicyclic, aromatic, or a heteroaromatic ring, for example, fluorene, dibenzothiophene, or dibenzofuran;

[149] 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 $R_{10,0}$ may be the same or different; and

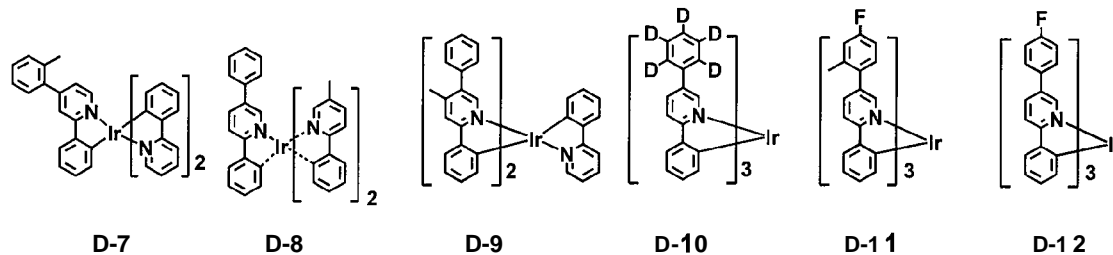
[150] n represents an integer of 1 to 3.

[151] The dopant material includes the following:

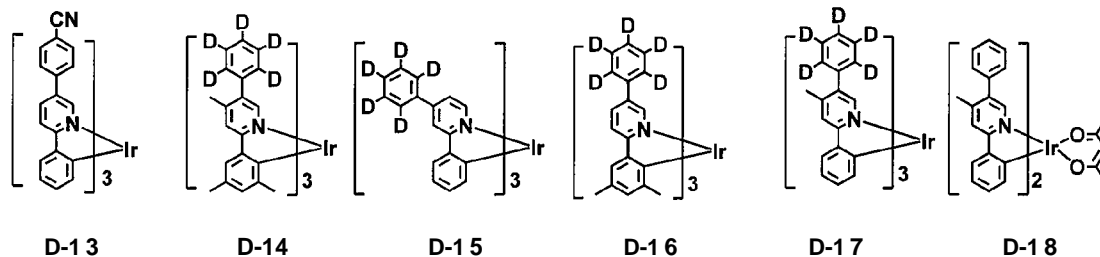
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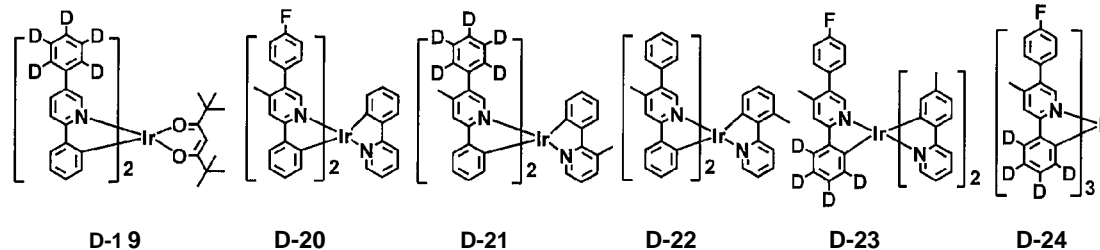
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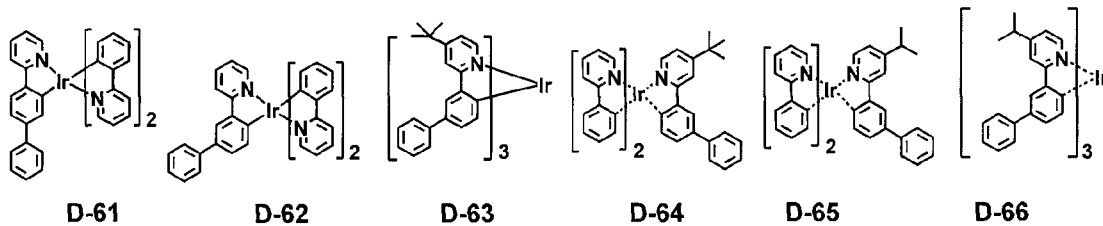
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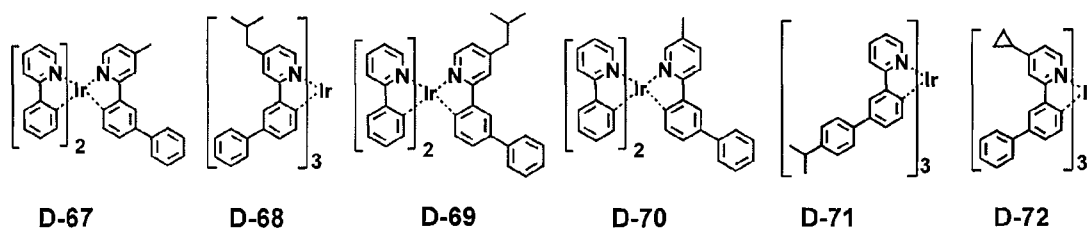
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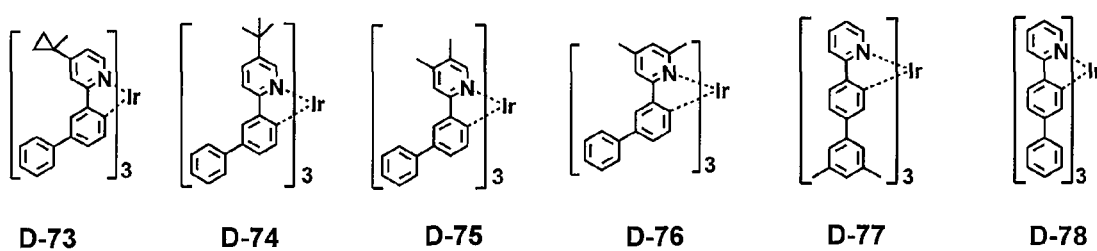
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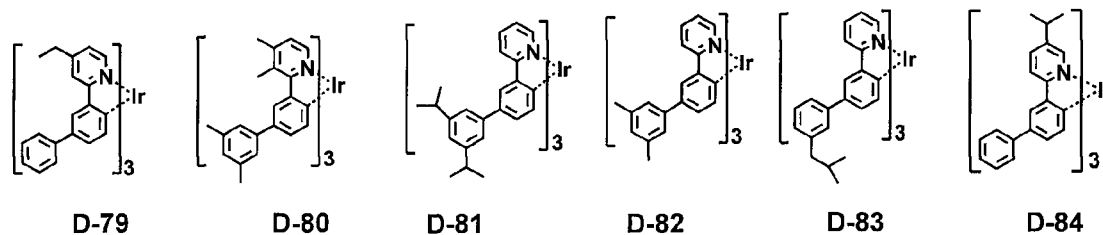
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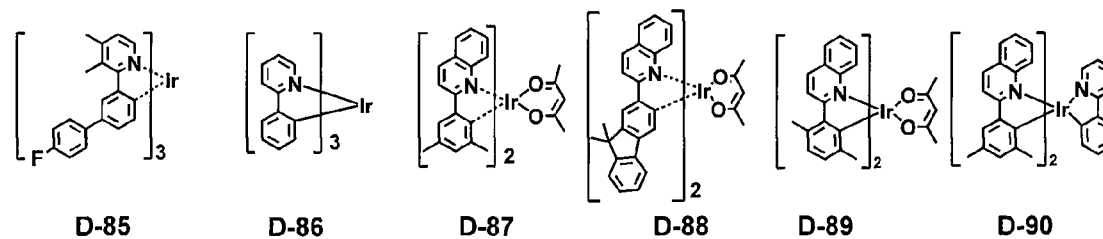
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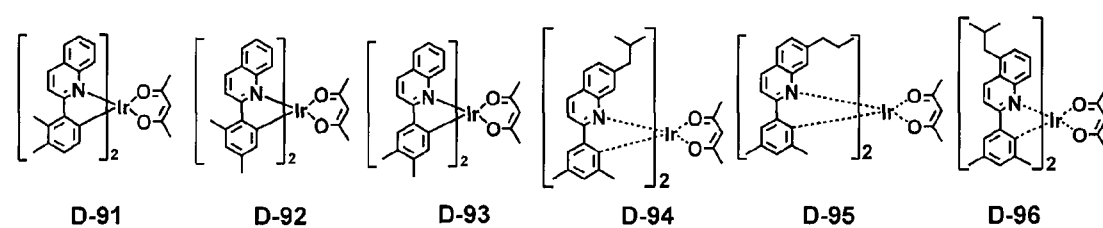
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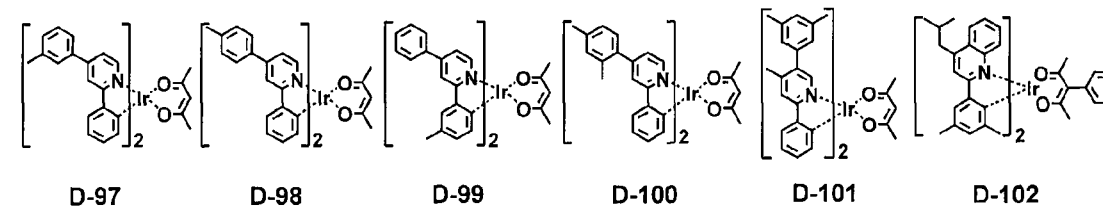
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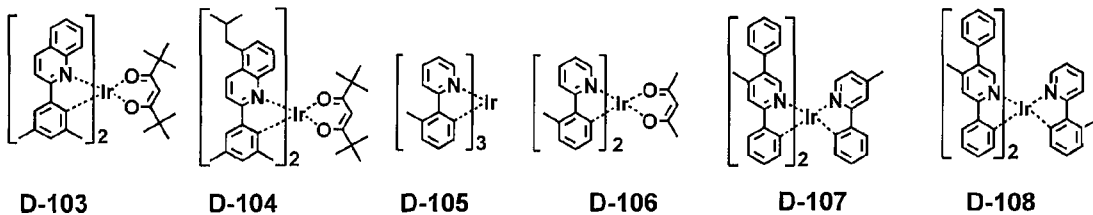
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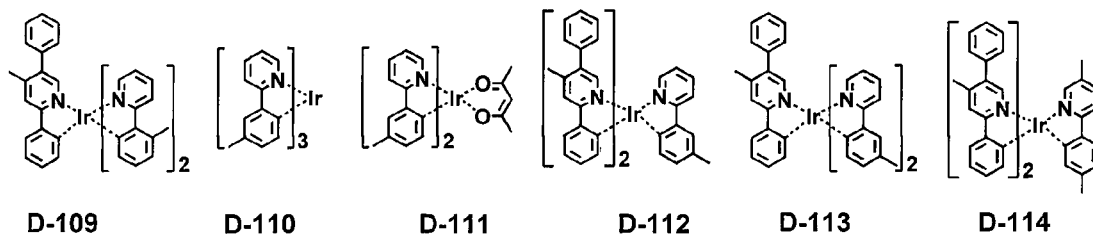
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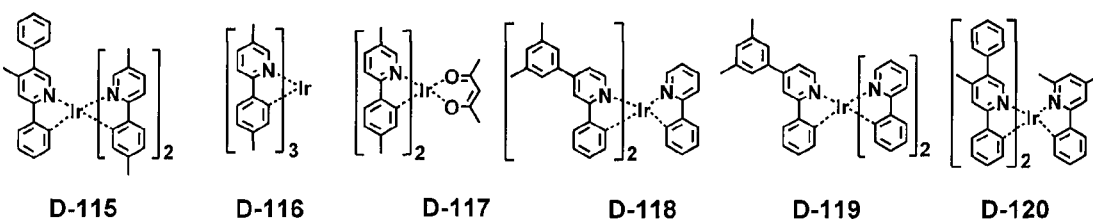
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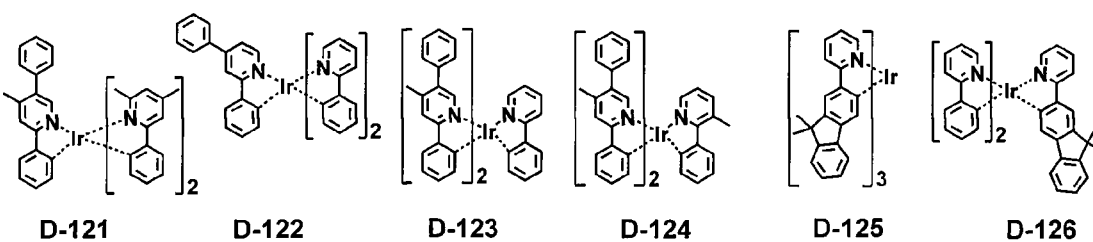
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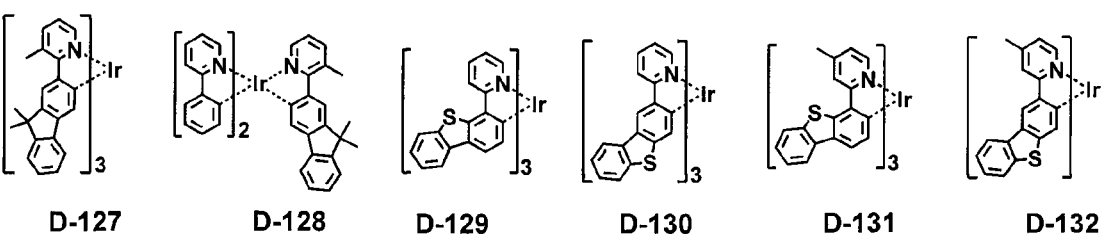
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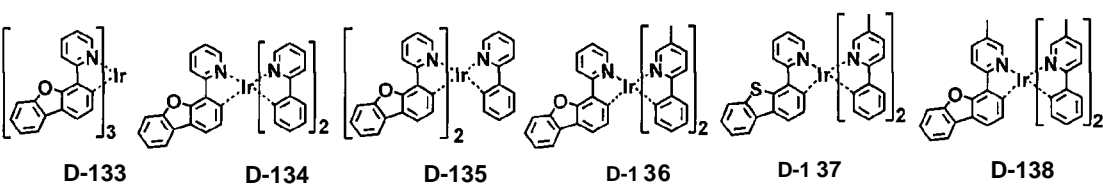
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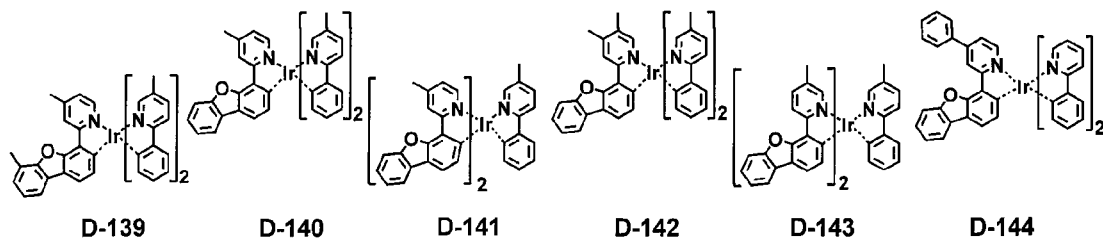
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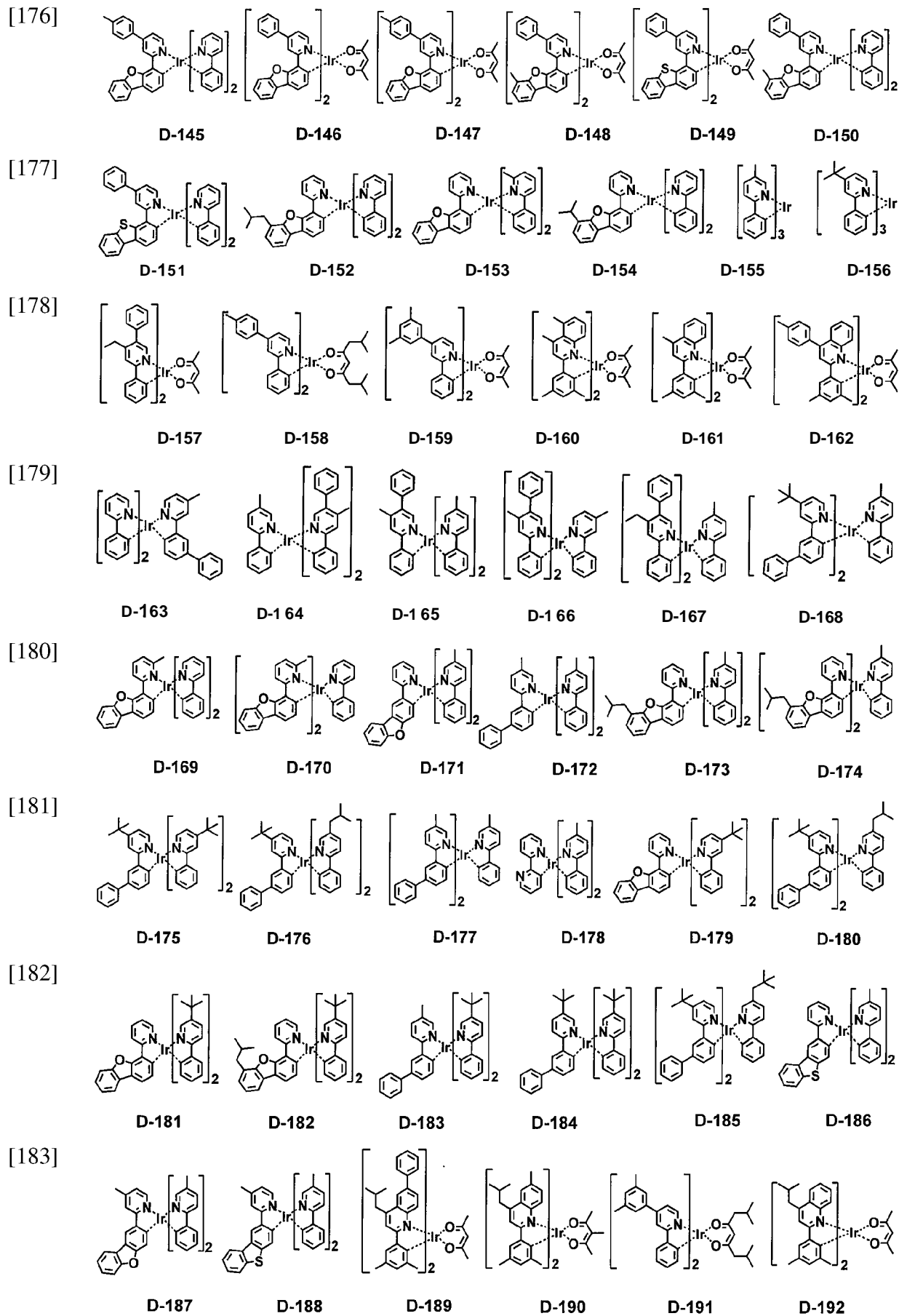


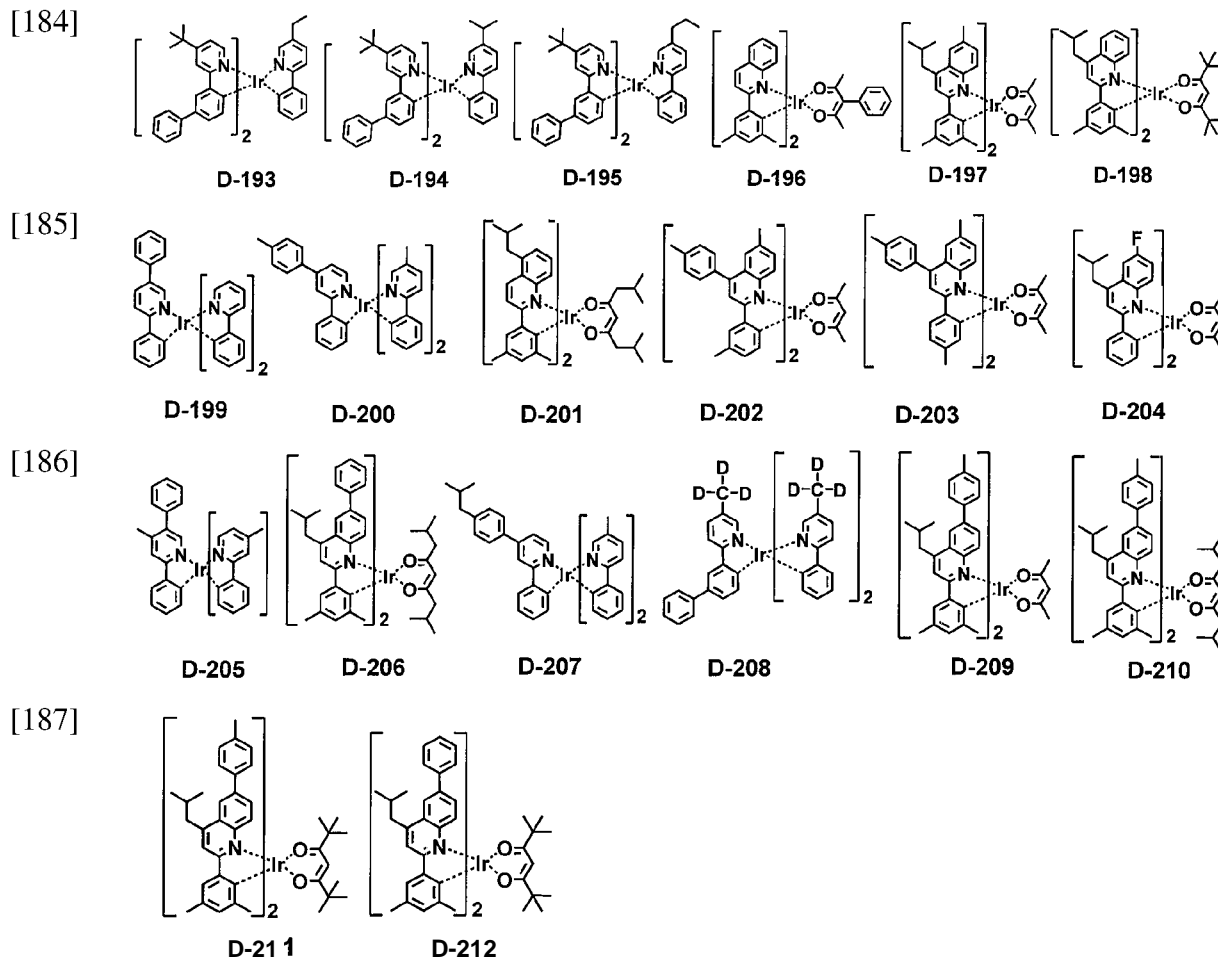
[174]



[175]







[188] The organic EL device of the present invention may further include at least one compound selected from the group consisting of arylamine-based compounds and styrylarylamine-based compounds in the organic layer.

[189] In the organic EL device of the present invention, 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 d-transition elements of the Periodic Table, or at least one complex compound comprising the metal.

[190] Preferably, in the organic EL device of the present invention, at least one layer (hereinafter, "a surface layer") selected from a chalcogenide layer, a metal halide layer and a metal oxide layer may be placed on an inner surface(s) of one or both electrode(s). Specifically, it is preferred that a chalcogenide (including oxides) layer of silicon or aluminum is placed on an anode surface of a light-emitting medium layer, and a metal halide layer or metal oxide layer is placed on a cathode surface of an electroluminescent medium layer. The surface layer provides operating stability for the organic EL device. Preferably, the chalcogenide includes SiO_x ($1 \leq x < 2$), AlO_x ($1 \leq x < 1.5$), 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.

[191] A hole injection layer, a hole transport layer, an electron injection layer, or their combinations can be used between an anode and a light-emitting layer. The hole injection layer may be multi-layers in order to lower a hole injection barrier (or hole injection voltage) from an anode to a hole transport layer or electron blocking layer, wherein each of the multi-layers simultaneously may use two compounds. The hole transport layer or the electron blocking layer may also be multi-layers.

[192] An electron buffer layer, a hole blocking layer, an electron transport layer, an electron injection layer, or their combinations can be used between a light-emitting layer and a cathode. The electron buffer layer may be multi-layers in order to control the injection of an electron and improve interface properties between the light-emitting layer and the electron injection layer, wherein each of the multi-layers simultaneously may use two compounds. The hole blocking layer or the electron transport layer may also be multi-layers, wherein each of the multi-layers may use a multi-component of compounds.

[193] Preferably, in the organic EL device of the present invention, 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 a light-emitting medium. Further, the hole transport compound is oxidized to a cation, and thus it becomes easier to inject and transport holes from the mixed region to a light-emitting medium. Preferably, the oxidative dopant includes various Lewis acids and acceptor compounds; and the reductive dopant includes alkali metals, alkali metal compounds, alkaline earth metals, rare-earth metals, and mixtures thereof. A reductive dopant layer may be employed as a charge-generating layer to prepare an organic EL device having two or more light-emitting layers and emitting white light.

[194] In order to form each layer constituting the organic EL device of the present invention, dry film-forming methods, such as vacuum deposition, sputtering, plasma, ion plating methods, etc., or wet film-forming methods, such as ink jet printing, nozzle printing, slot printing, spin coating, dip coating, flow coating methods, etc., can be used. When forming a layer by using a first host and a second host according to the present invention, co-deposition or mixed-deposition may be used.

[195] When using a wet film-forming method, a thin film is formed by dissolving or dispersing the material constituting each layer in suitable solvents, such as toluene, xylene, anisole, chlorobenzene, ethanol, chloroform, tetrahydrofuran, dioxane, etc. The solvents are not specifically limited as long as the material constituting each layer is

soluble or dispersible in the solvents and the solvents do not cause any problems in forming a layer.

[196] Furthermore, a display device or a light device can be produced by using the organic EL device of the present invention.

[197] Hereinafter, luminous properties of the devices comprising the host compounds of the present invention will be explained in detail with reference to the following examples. According to the present invention, the organic EL devices having high efficiency and long lifespan are provided. The host materials comprising at least two kinds of the derivatives may be deposited by at least two methods including the following methods:

[198] 1. Co-deposition: At least two different materials are added into separate crucibles and electric current is simultaneously applied to the two or more cells to evaporate the materials.

[199] 2. Mixed-deposition: At least two different materials are mixed in one crucible prior to deposition and electric current is then applied to the one cell to evaporate the materials.

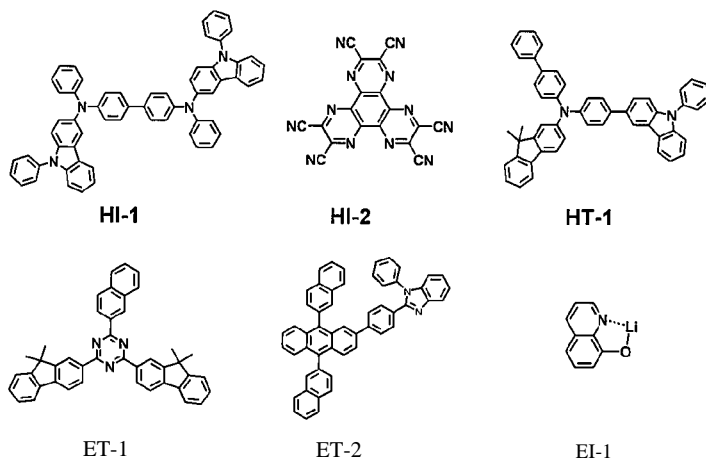
[200]

[201] Device Examples 1-1 to 1-12: Production of an PLED device by co-deposition of the first host compound and the second host compound according to the present invention as a host

[202] OLED devices comprising the luminous material of the present invention were produced as follows: A transparent electrode indium tin oxide (ITO) thin film (10 Ω /sq) on a glass substrate for an OLED device (Samsung Corning, Republic of Korea) was subjected to an ultrasonic washing with trichloroethylene, acetone, ethanol, and distilled water, sequentially, and was then stored in isopropanol. Next, the ITO substrate was mounted on a substrate holder of a vacuum vapor depositing apparatus. HI-1 was introduced into a cell of the vacuum vapor depositing apparatus, and the pressure in the chamber of the apparatus was then controlled to 10^{-6} torr. Thereafter, an electric current was applied to the cell to evaporate the introduced material, thereby forming a first hole injection layer (HIL) HI-1 having a thickness of 80 nm on the ITO substrate. HI-2 was then introduced into another cell of the vacuum vapor depositing apparatus, and an electric current was applied to the cell to evaporate the introduced material, thereby forming a second hole injection layer (HIL) HI-2 having a thickness of 3 to 5 nm on the first hole injection layer (HIL) HI-1. HT-1 was introduced into another cell of the vacuum vapor depositing apparatus. Afterward, an electric current was applied to the cell to evaporate the introduced material, thereby forming a hole transport layer (HTL) HT-1 having a thickness of 25 to 40 nm on hole injection layer HI-2. After forming the hole injection layer and the hole transport layer, a light-

emitting layer (EML) was then deposited as follows. The first and second host compounds disclosed in Table 1 below as a host were introduced into two cells of the vacuum vapor depositing apparatus, respectively, and a dopant material recited in Table 1 below was introduced into another cell. The two host materials were evaporated at the same rates of 1:1, and the dopant material was evaporated at a different rate and deposited in a doping amount of 15 wt%, based on the total weight of the host and dopant, to form a light-emitting layer having a thickness of 40 nm on the hole transport layer HT-1. Next, ET-1 or ET-2 and EI-1 were evaporated at the rates of 5:5 to 4:6 on another two cells to form an electron transport layer (ETL) having a thickness of 30 to 35 nm on the light-emitting layer. After depositing EI-1 having a thickness of 2 nm as an electron injection layer (EIL) on the electron transport layer, an Al cathode was then deposited by another vacuum vapor deposition apparatus on the electron injection layer. Thus, an OLED device was produced.

[203]



[204] Comparative Examples 1-1 to 1-4: Production of an OLED device by using only the first host compound according to the present invention as a host

[205] OLED devices were produced in the same manner as in Device Examples 1-1 to 1-12, except that only the first host compounds of Comparative Examples 1-1 to 1-4 disclosed in Table 1 below were used as a host in a light-emitting layer.

[206]

[207] Comparative Examples 2-1 to 2-7: Production of an OLED device by using only the second host compound according to the present invention as a host

[208] OLED devices were produced in the same manner as in Device Examples 1-1 to 1-12, except that only the second host compounds of Comparative Examples 2-1 to 2-7 disclosed in Table 1 below were used as a host in a light-emitting layer.

[209] The detailed components for constituting the devices of the Device and Comparative Examples are as provided in Table 1 below.

[210]

Table 1

	HIL (HI-1) (nm)	HIL (HI-2) (nm)	HTL (HT-1) (nm)	EML (Host + Dopant) (40nm, 15%)		ETL (ET-1 or ET-2:EI-1) (nm)	EIL (EI-1) (nm)
Device Example 1-1	80	3	40	H1-1: H2-31 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-2	80	3	40	H1-1: H2-34 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-3	80	3	40	H1-1: H2-48 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-4	80	3	40	H1-1: H2-101 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-5	80	3	40	H1-1: H2-195 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-6	80	3	40	H1-1: H2-356 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-7	80	3	40	H1-1: H2-476 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-8	80	3	40	H1-1: H2-477 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-9	80	3	40	H1-2: H2-31 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-10	80	3	40	H1-5: H2-31 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-11	80	3	40	H1-116: H2-31 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2
Device Example 1-12	80	3	40	H1-8: H2-31 (1:1)	D-25	ET-1:EI-1 (35, 4:6)	2

[211]

Comparative Example 1-1	80	3	25	H1-5	D-1	ET-2:EI-1 (35, 4:6)	2
Comparative Example 1-2	80	5	25	H1-8	D-1	ET-2:EI-1 (30, 5:5)	2
Comparative Example 1-3	80	3	40	H1-1	D-25	ET-1:EI-1 (35, 4:6)	2
Comparative Example 1-4	80	5	25	H1-116	D-25	ET-2:EI-1 (30, 5:5)	2
Comparative Example 2-1	80	3	40	H2-31	D-25	ET-1:EI-1 (35, 4:6)	2
Comparative Example 2-2	80	3	40	H2-34	D-25	ET-1:EI-1 (35, 4:6)	2
Comparative Example 2-3	80	3	40	H2-48	D-25	ET-1:EI-1 (35, 4:6)	2
Comparative Example 2-4	80	3	40	H2-101	D-25	ET-1:EI-1 (35, 4:6)	2
Comparative Example 2-5	80	3	25	H2-195	D-1	ET-2:EI-1 (35, 4:6)	2
Comparative Example 2-6	80	3	40	H2-476	D-1	ET-1:EI-1 (35, 4:6)	2
Comparative Example 2-7	80	3	40	H2-477	D-1	ET-1:EI-1 (35, 4:6)	2

[212]

The driving voltage at a luminance of 1,000 nit, luminous efficiency, CIE color coordinate, and the lifespan taken to be reduced from 100% to 90% of a luminance of 15,000 nit at the constant current of the OLED devices produced in Device Examples 1-1 to 1-12, Comparative Examples 1-1 to 1-4, and Comparative Examples 2-1 to 2-7

are as provided in Table 2 below.

[213]

Table 2

	Host	Dopant	Voltage (V)	Efficiency (cd/A)	Color Coordinate (x, y)		Lifespan (hr)
Device Example 1-1	H1-1: H2-31 (1:1)	D-25	3.1	57.1	306	657	103
Device Example 1-2	H1-1: H2-34 (1:1)	D-25	3.3	52.3	306	656	65
Device Example 1-3	H1-1: H2-48 (1:1)	D-25	2.9	52.4	304	656	60
Device Example 1-4	H1-1: H2-101 (1:1)	D-25	3.1	53.6	307	653	41
Device Example 1-5	H1-1: H2-195 (1:1)	D-25	3.4	53.7	305	655	57
Device Example 1-6	H1-1: H2-356 (1:1)	D-25	3.4	54.7	308	655	39
Device Example 1-7	H1-1: H2-476 (1:1)	D-25	3.1	55.6	308	655	33
Device Example 1-8	H1-1: H2-477 (1:1)	D-25	3.2	53.8	307	653	52
Device Example 1-9	H1-2: H2-31 (1:1)	D-25	3.2	54	307	656	93
Device Example 1-10	H1-5: H2-31 (1:1)	D-25	2.9	51.3	302	657	132
Device Example 1-11	H1-116: H2-31 (1:1)	D-25	3.0	52.4	303	657	66
Device Example 1-12	H1-8: H2-31 (1:1)	D-25	3.3	52.2	305	656	110

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Comparative Example 1-1	H1-5	D-1	3.6	57.3	333	634	10
Comparative Example 1-2	H1-8	D-1	5.0	37.2	353	616	68
Comparative Example 1-3	H1-1	D-25	6.2	4.2	298	653	X*
Comparative Example 1-4	H1-116	D-25	4.0	26.3	305	652	10
Comparative Example 2-1	H2-31	D-25	2.7	44.8	314	652	29
Comparative Example 2-2	H2-34	D-25	2.7	49.2	312	652	38
Comparative Example 2-3	H2-48	D-25	2.6	49.6	314	652	45
Comparative Example 2-4	H2-101	D-25	2.8	50.3	315	651	6
Comparative Example 2-5	H2-195	D-1	2.8	49.6	330	636	97
Comparative Example 2-6	H2-476	D-1	3.2	32.6	333	648	15
Comparative Example 2-7	H2-477	D-1	2.6	45	323	652	14

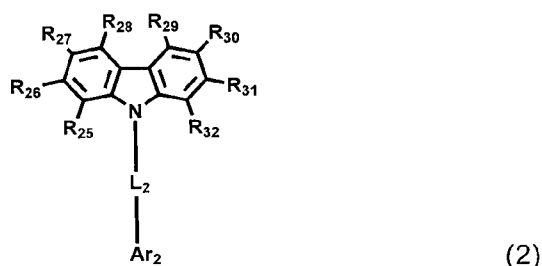
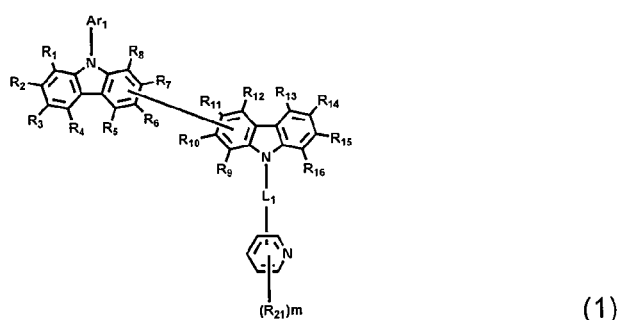
[215]

Note: X* means "immeasurable." (It was not possible to measure the lifespan at a luminance of 15,000 nit of the device of Comparative Example 1-3 of Table 2 above since the device of Comparative Example 1-3 has very low efficiency.)

Claims

[Claim 1]

An organic electroluminescent device comprising at least one light-emitting layer between an anode and a cathode, wherein the light-emitting layer comprises a host and a phosphorescent dopant; the host consists of multi-component host compounds; at least a first host compound of the multi-component host compounds is represented by the following formula 1 which is a bicarbazole derivative containing pyridine, and a second host compound is represented by the following formula 2 which is a carbazole derivative including a nitrogen-containing heteroaryl group:



Wherein

Ar₁ represents a substituted or unsubstituted (C6-C30)aryl group; L₁ and L₂ each independently represent a single bond, or a substituted or unsubstituted (C6-C30)arylene group, wherein the substituent(s) of the substituted arylene group is independently selected from the group consisting of 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, and a substituted

or unsubstituted mono- or di-(C6-C30)arylamino group; or are linked between adjacent substituents to form a substituted or unsubstituted mono- or polycyclic, (C3-C30) alicyclic or aromatic ring whose carbon atom(s) ring may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

R_i to R_{16} , R_{2i} , and R_{25} to R_{32} 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, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino group; or are linked between adjacent substituents to form a substituted or unsubstituted mono- or polycyclic, (C3-C30) alicyclic or aromatic ring whose carbon atom(s) ring may be replaced with at least one hetero atom selected from nitrogen, oxygen, and sulfur;

one of R_5 to R_8 is linked to one of R_9 to R_{12} via a single bond;

Ar_2 represents a substituted or unsubstituted, nitrogen-containing 5- to 30-membered heteroaryl group;

m represents 0, 1, 2, 3 or 4;

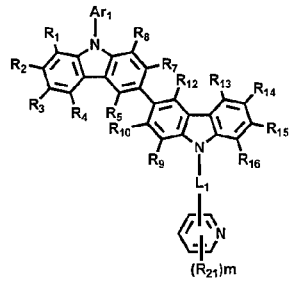
the heteroaryl group contains at least one hetero atom selected from B, N, O, S, Si and P; and

the heteroaryl group is a monocyclic-based heteroaryl group selected from the group consisting of pyrrolyl, imidazolyl, pyrazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, pyridyl, pyrazinyl, pyrimidinyl, and pyridazinyl, or a fused ring-based heteroaryl group selected from the group consisting of benzoimidazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazoliny, quinoxaliny, carbazolyl, naphthyridinyl, and phenanthridinyl, which may be substituted with a (C6-C20)aryl group, a tri(C6-C12)arylsilyl group, a S- or O-containing 5- to 15-membered heteroaryl group, a (C6-C15)aryl group substituted with a (C1-C6)alkyl group, or a (C6-C15)aryl group substituted with a cyano group.

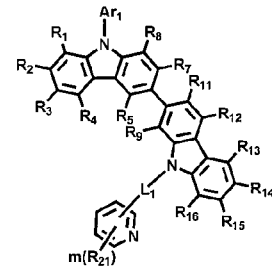
[Claim 2]

The organic electroluminescent device according to claim 1, wherein

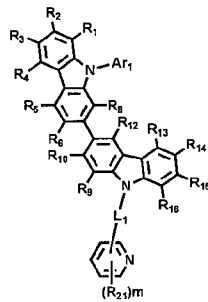
the compound of formula 1 is represented by one of the following formulae 3 to 6:



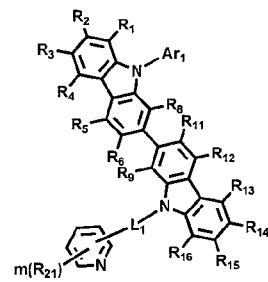
(3)



(4)



(5)



(6)

Wherein

Ar₁, L₁, R₁ to R₁₆, R₂₁ and m are as defined in claim 1.

[Claim 3]

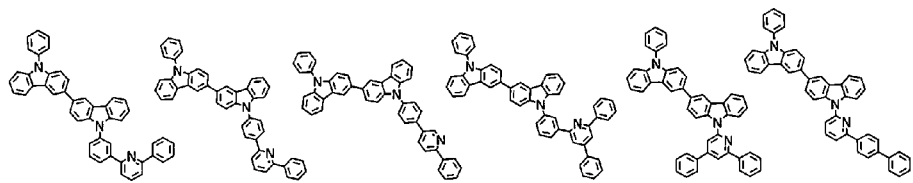
The organic electroluminescent device according to claim 1, wherein L₁ and L₂ in formulae 1 and 2 each independently represent a single bond, or a substituted or unsubstituted (C₆-C₁₈)arylene group.

[Claim 4]

The organic electroluminescent device according to claim 1, wherein Ar₂ in formula 2 is triazinyl, pyrimidinyl, quinolyl, quinazolinyl, quinoxalinyl, or naphthyridinyl.

[Claim 5]

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



H1-1

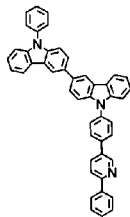
H1-2

H1-3

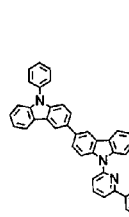
H1-4

H1-5

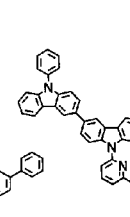
H1-6



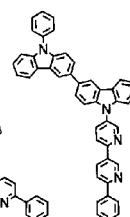
H1-7



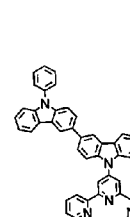
H1-8



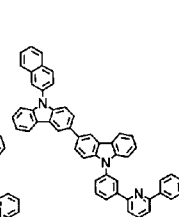
H1-9



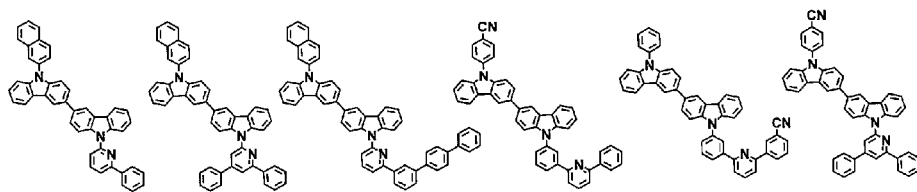
H1-10



H1-11



H1-12



H1-13

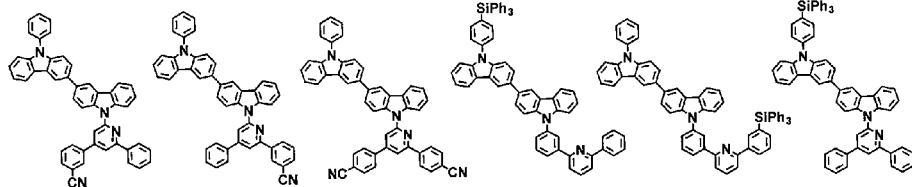
H1-14

H1-15

H1-16

H1-17

H1-18



H1-19

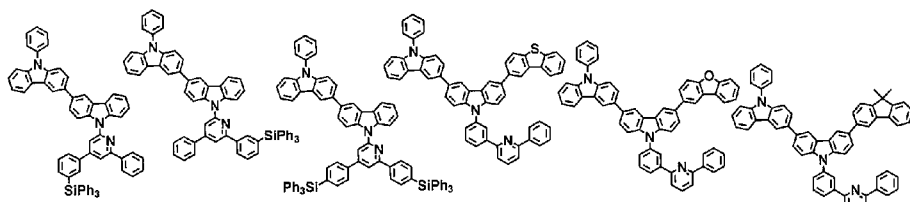
H1-20

H1-21

H1-22

H1-23

H1-24



H1-25

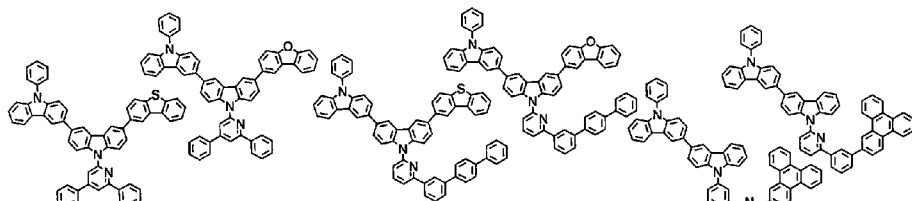
H1-26

H1-27

H1-28

H1-29

H1-30



H1-31

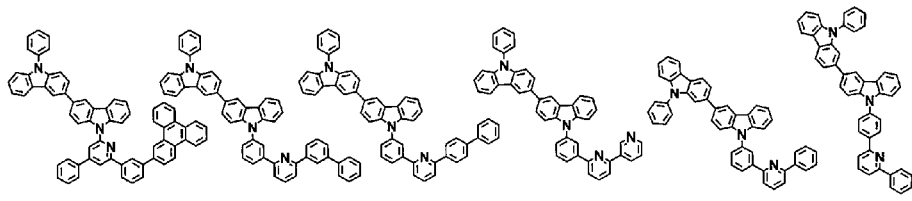
H1-32

H1-33

H1-34

H1-35

H1-36



H1-37

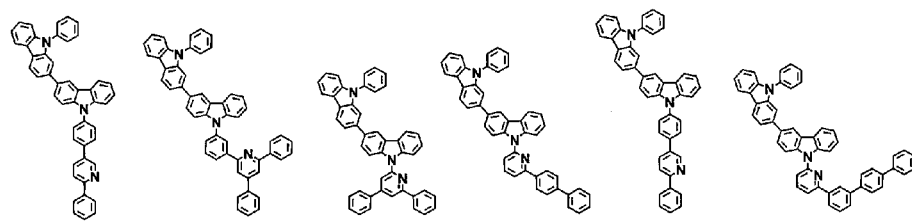
H1-38

H1-39

H1-40

H1-41

H1-42



H1-43

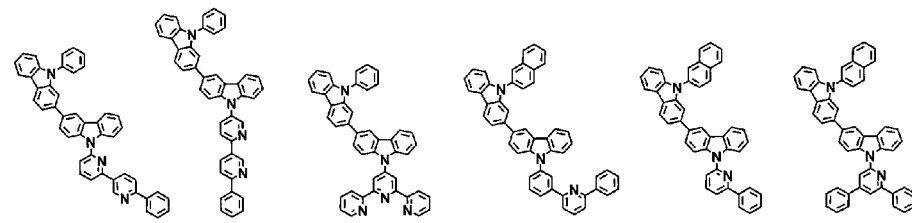
H1-44

H1-45

H1-46

H1-47

H1-48



H1-49

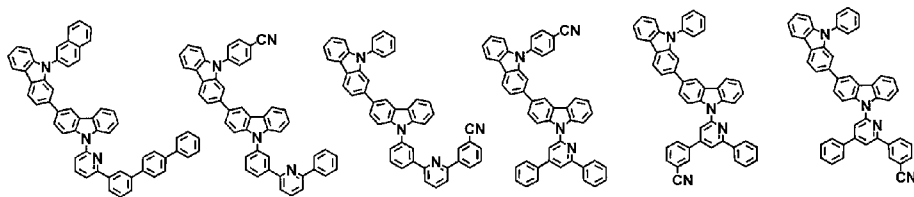
H1-50

H1-51

H1-52

H1-53

H1-54



H1-55

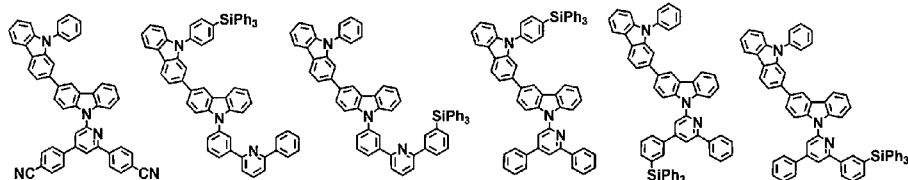
H1-56

H1-57

H1-58

H1-59

H1-60



H1-61

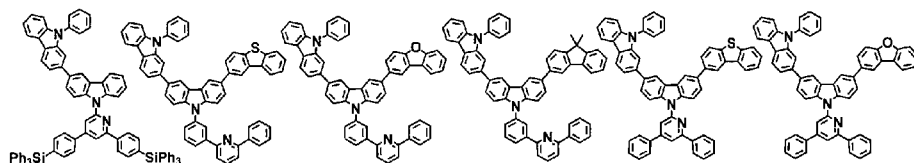
H1-62

H1-63

H1-64

H1-65

H1-66



H1-67

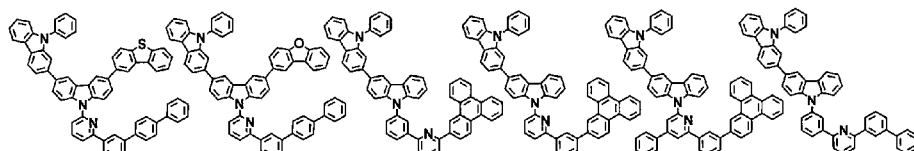
H1-68

H1-69

H1-70

H1-71

H1-72



H1-73

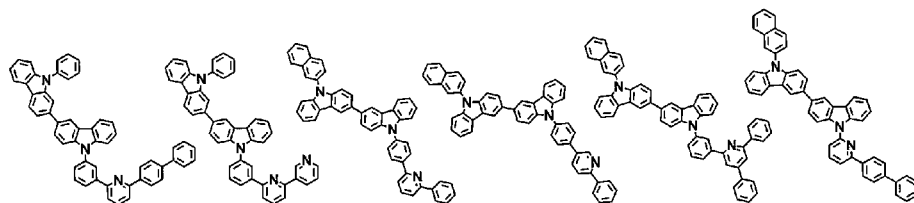
H1-74

H1-75

H1-76

H1-77

H1-78



H1-79

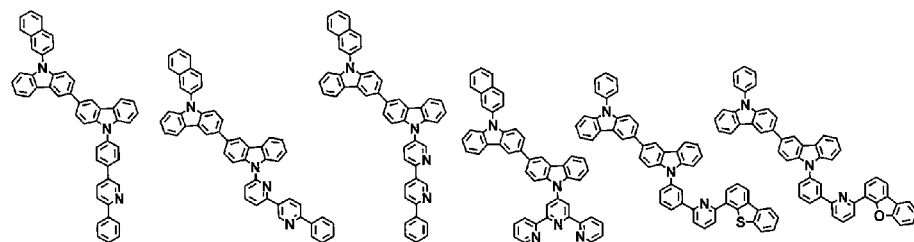
H1-80

H1-81

H1-82

H1-83

H1-84



H1-85

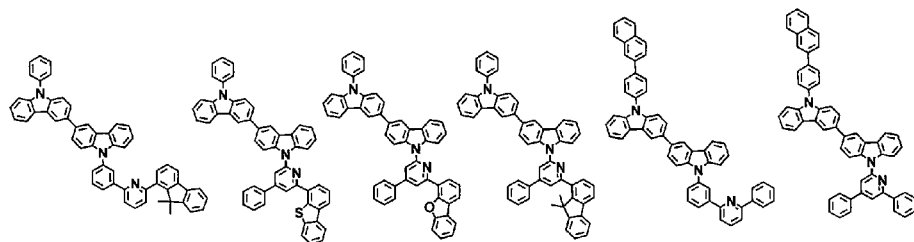
H1-86

H1-87

H1-88

H1-89

H1-90



H1-91

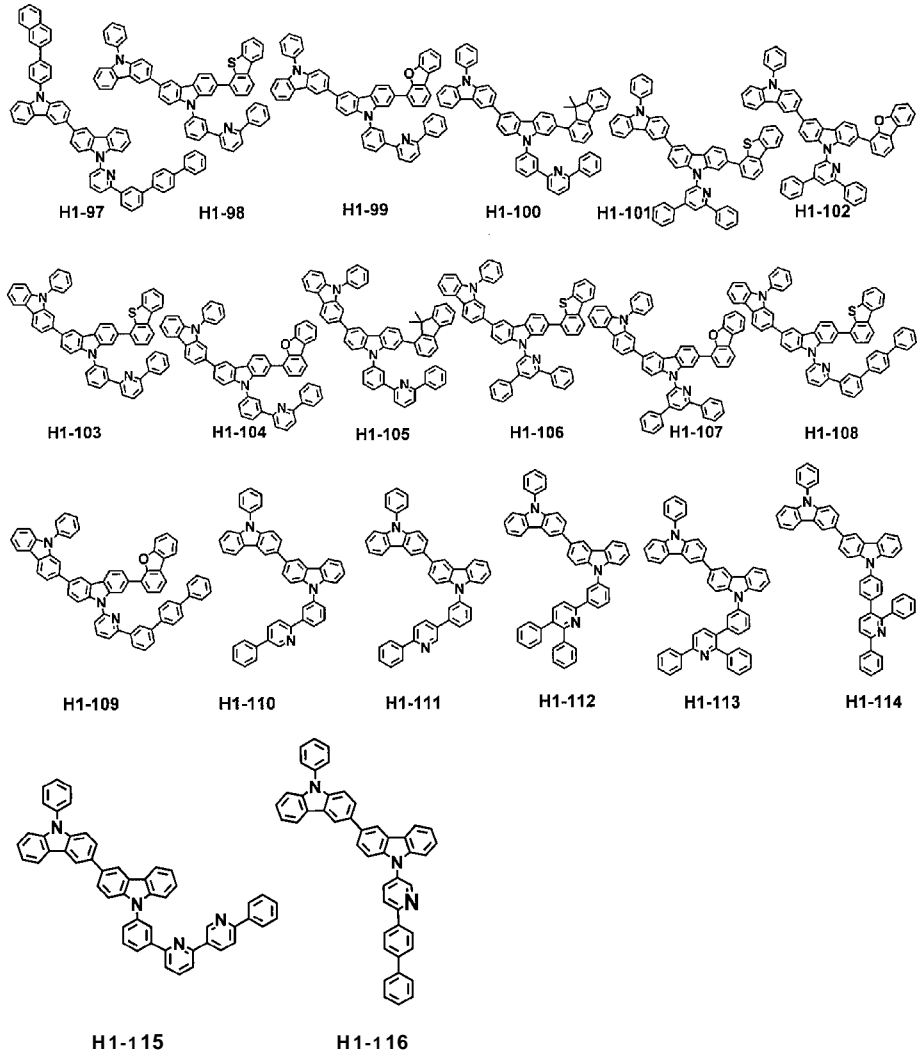
H1-92

H1-93

H1-94

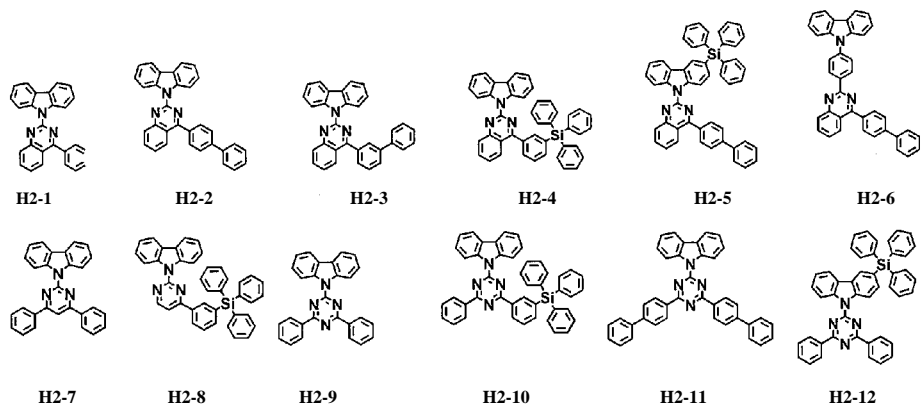
H1-95

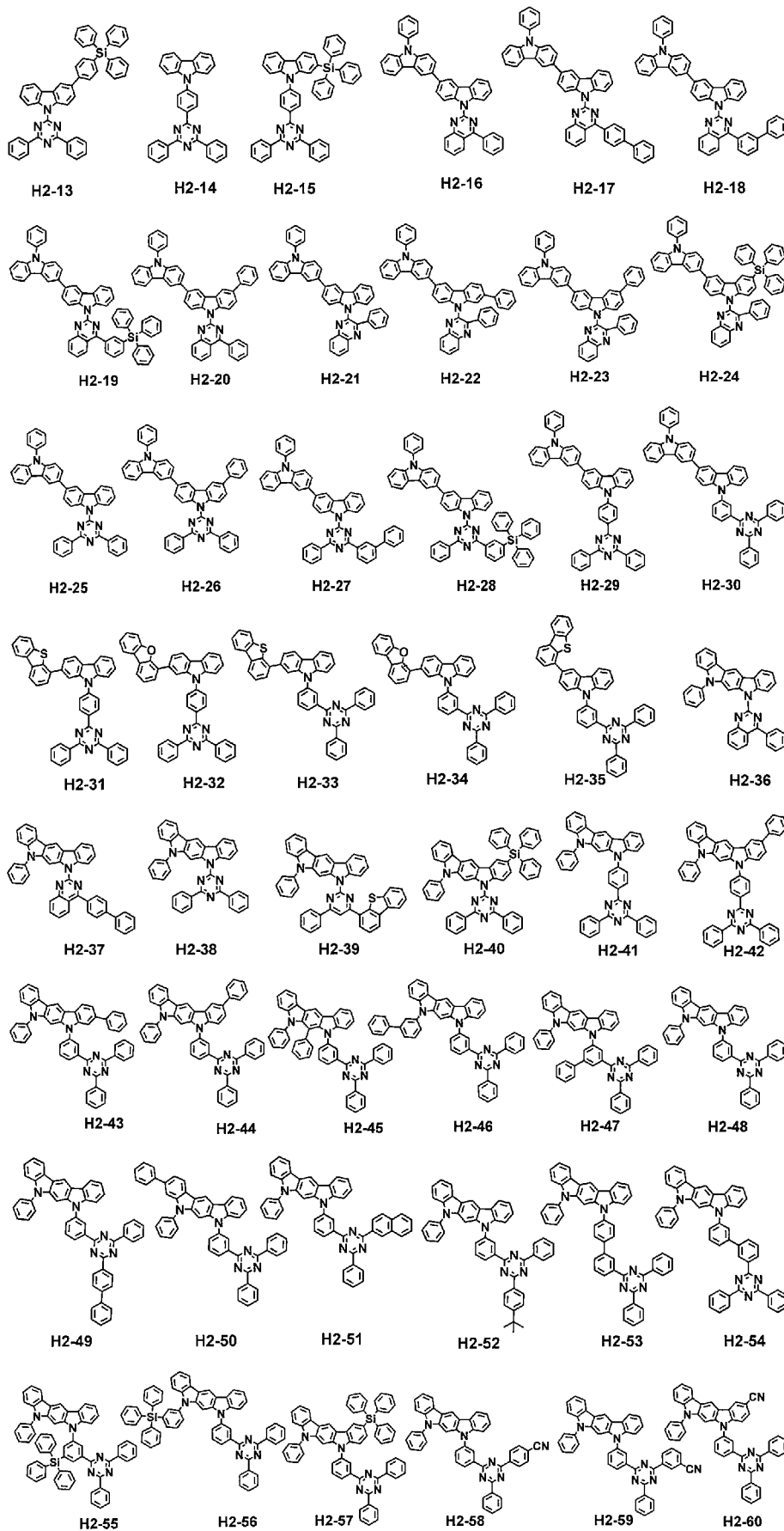
H1-96

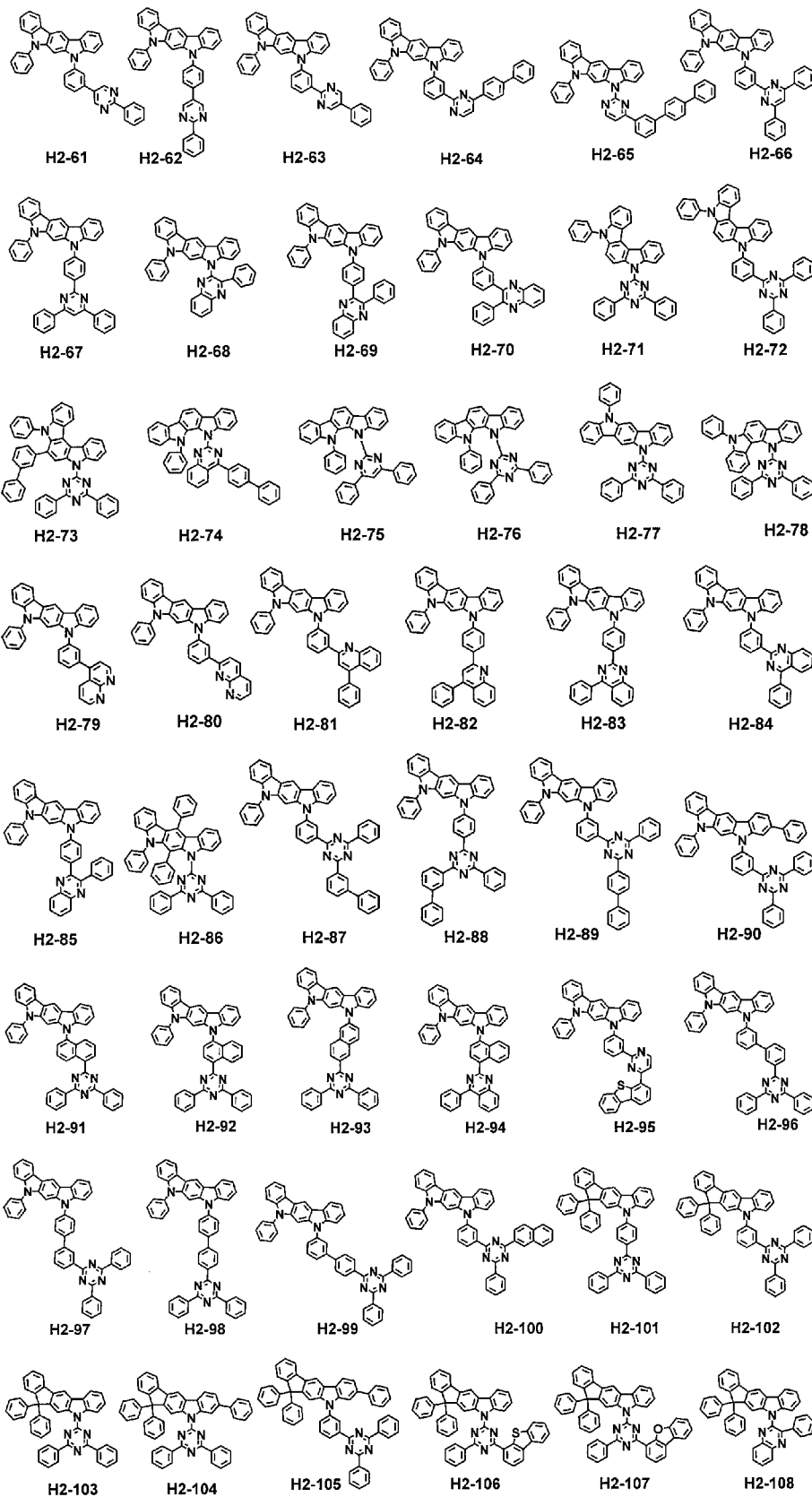


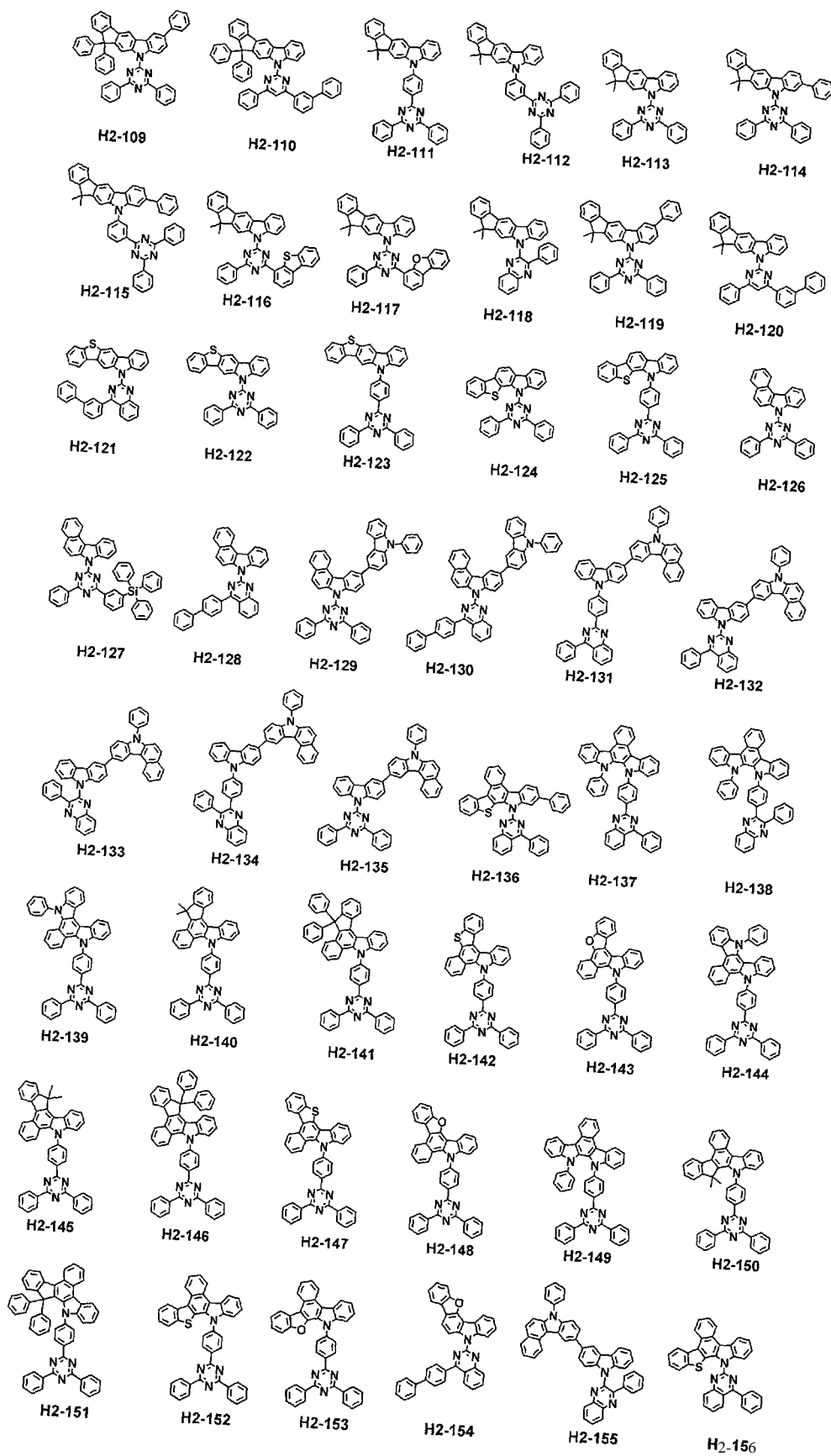
[Claim 6]

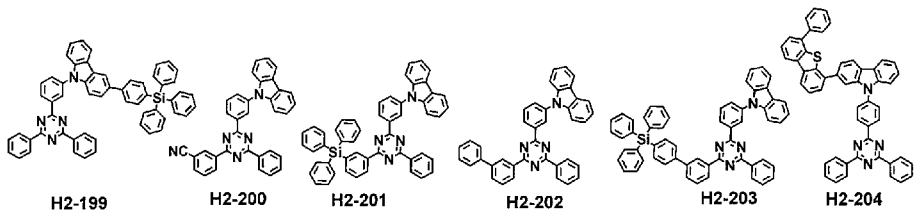
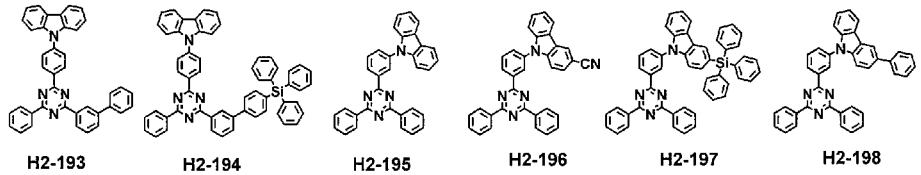
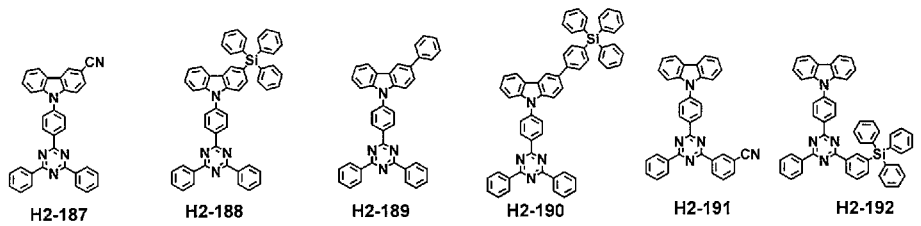
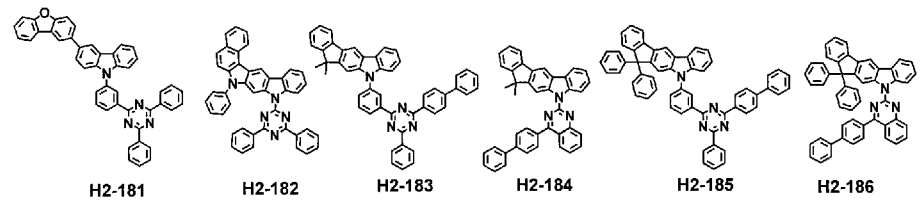
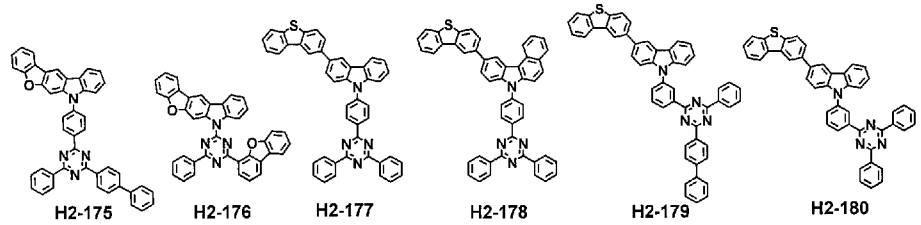
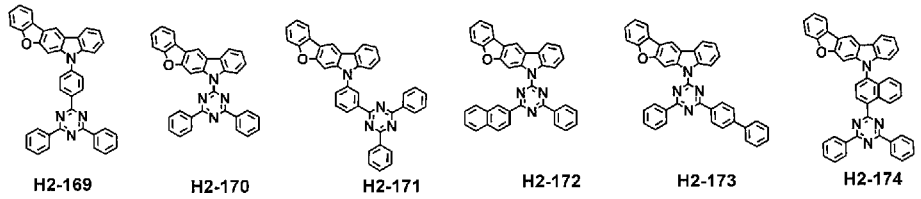
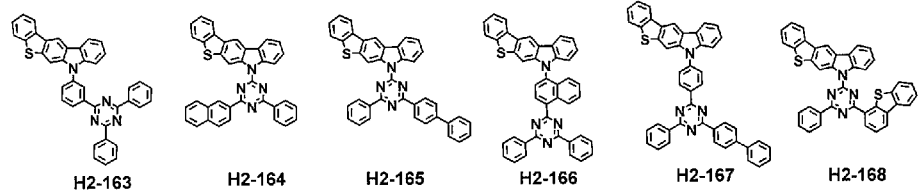
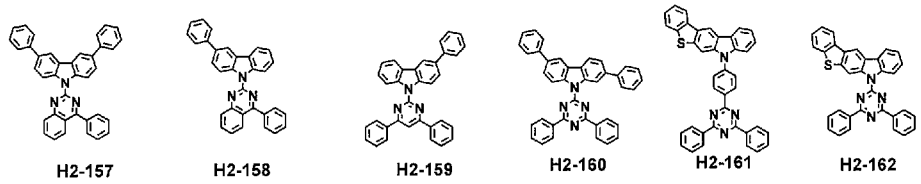
The organic electroluminescent device according to claim 1, wherein the second host compound represented by formula 2 is selected from the group consisting of the following compounds:

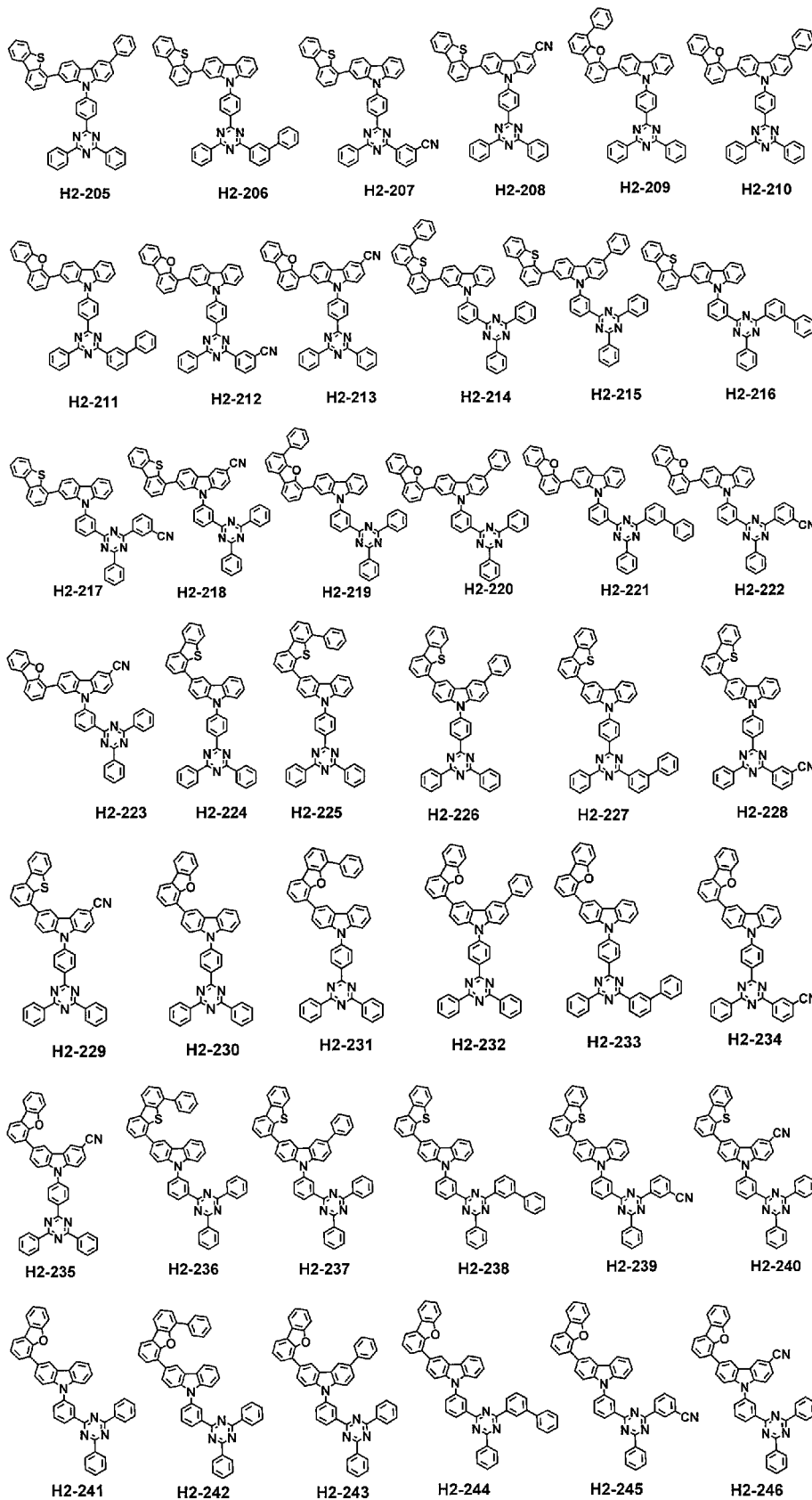


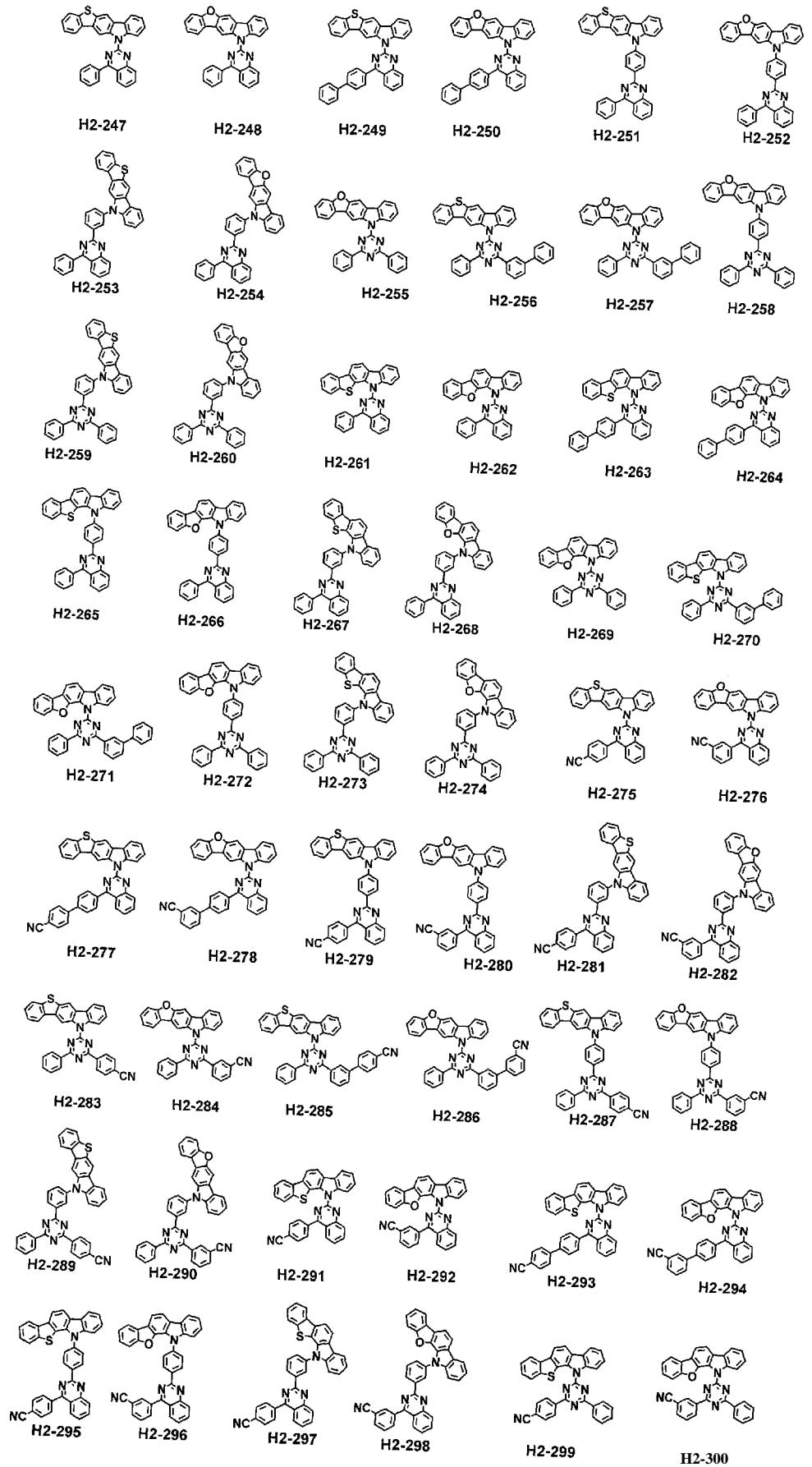


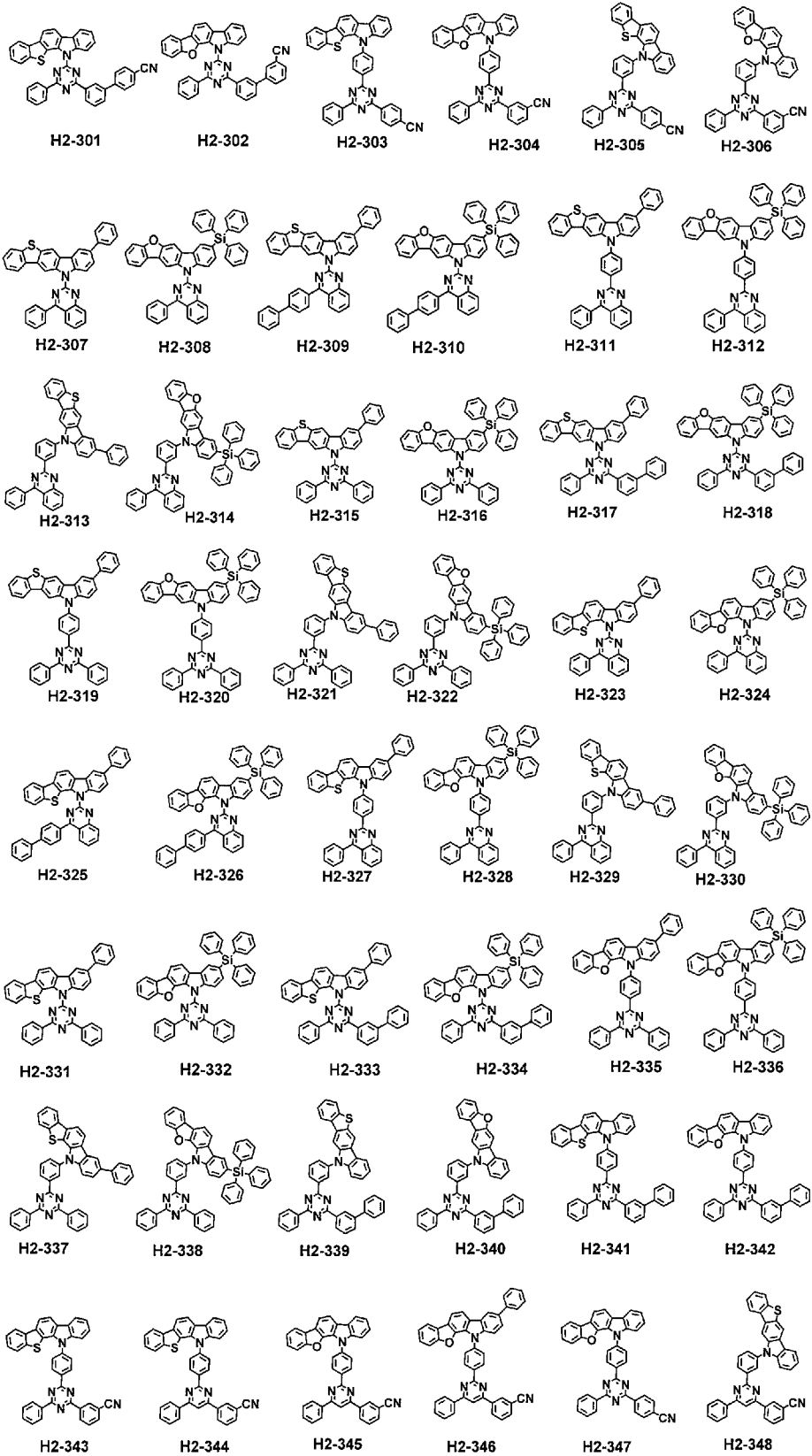


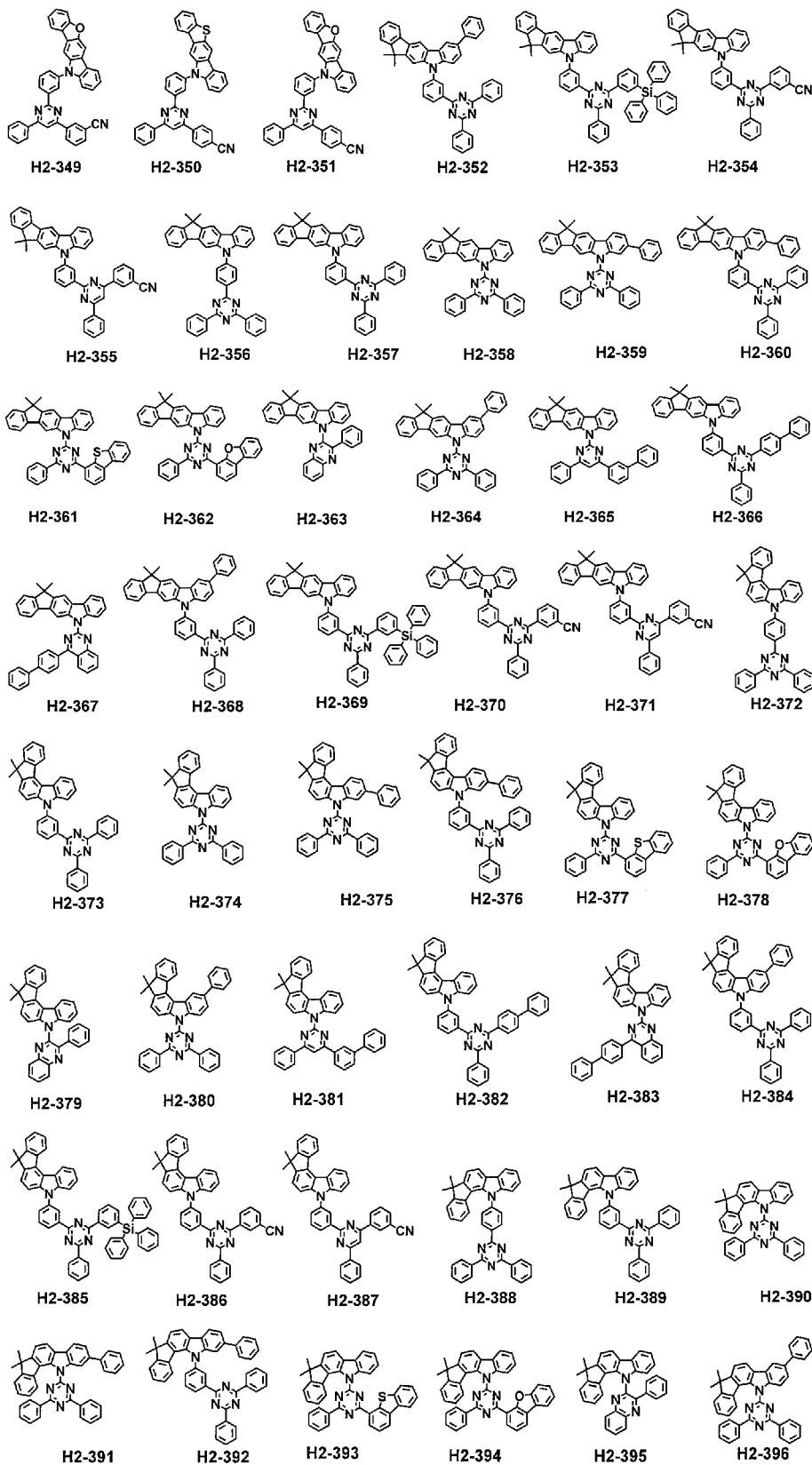


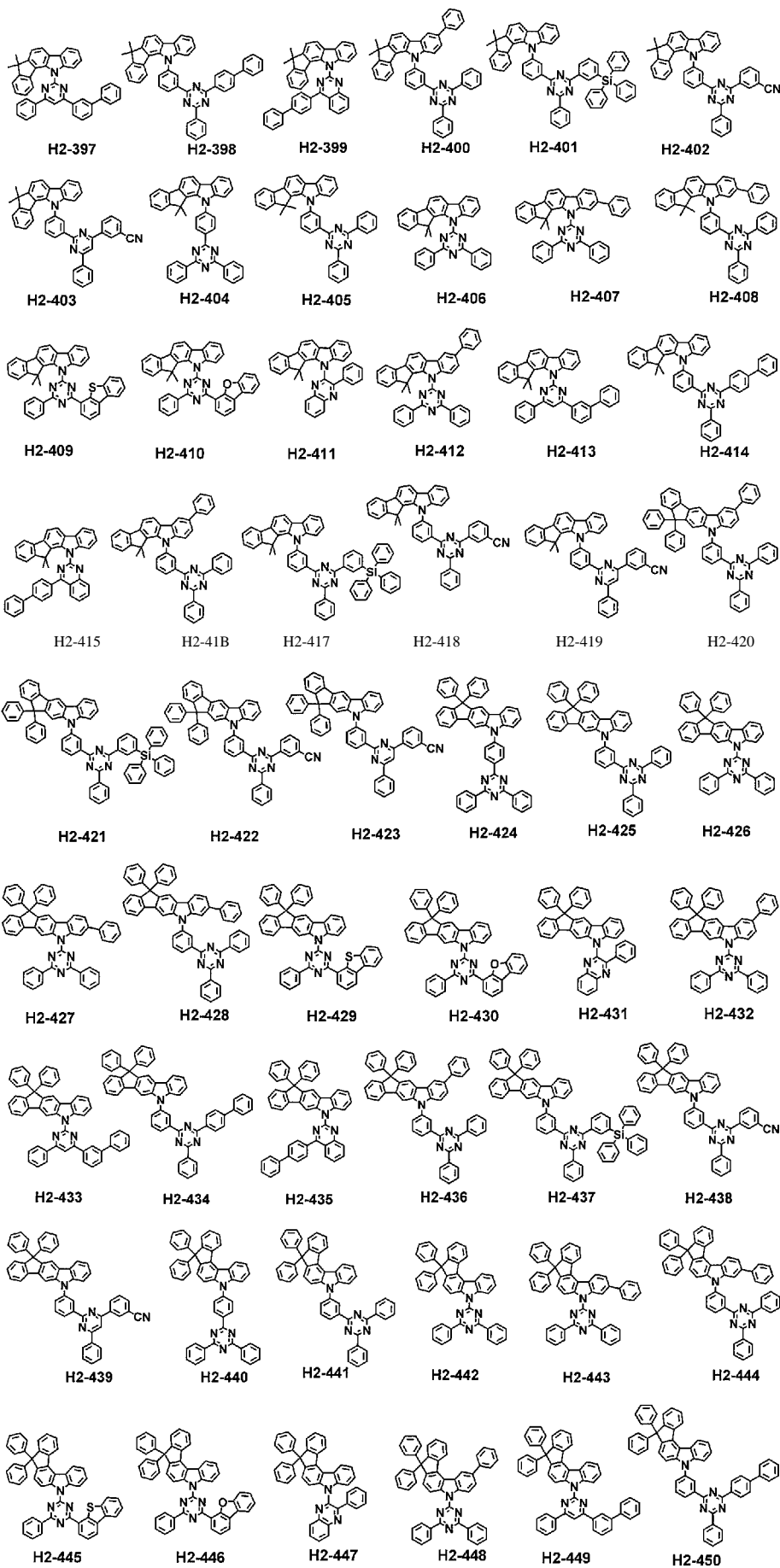


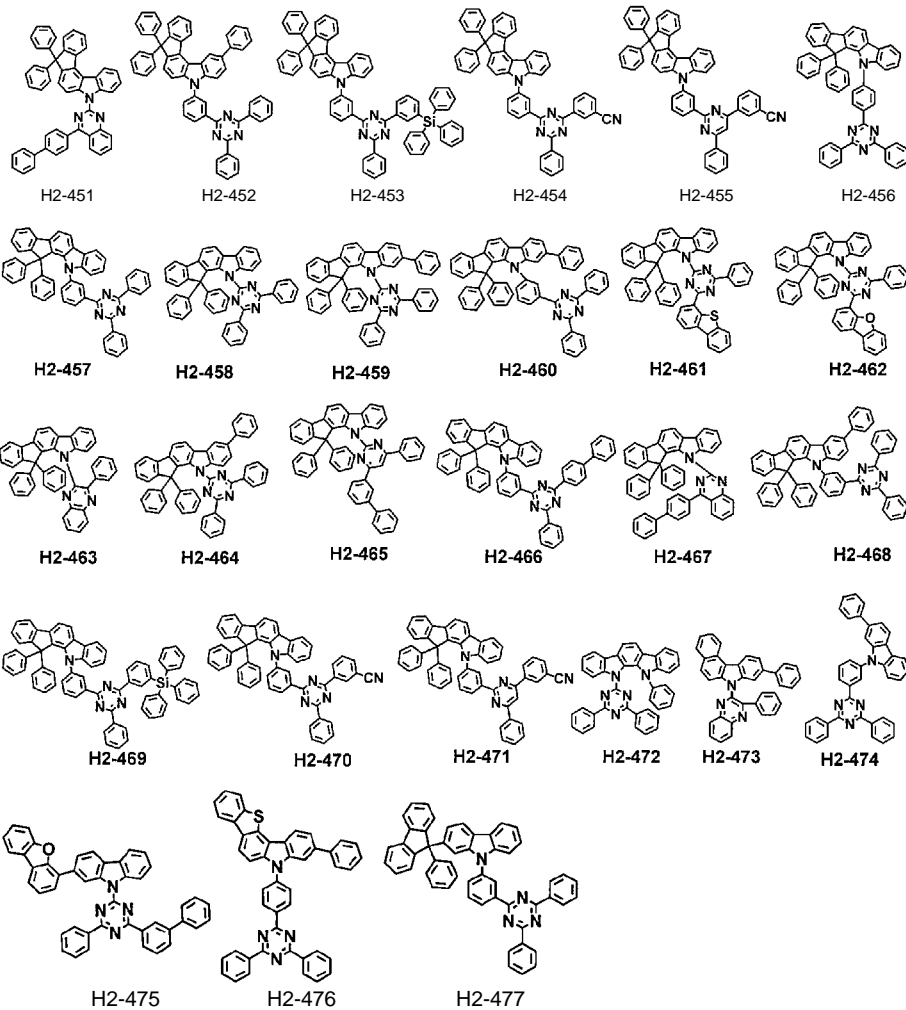












INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2015/004534

A. CLASSIFICATION OF SUBJECT MATTER

C09K 11/06 (2006.01) H01L 27/32 (2006.01) H01L 51/54 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

REGISTRY, CAPLUS: Sub-structure search based on formula (1).

ESPACENET, PATENTSCOPE: Inventor + applicant search.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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

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

* Special categories of cited documents:		
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

22 June 2015

Date of mailing of the international search report

22 June 2015

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INTERNATIONAL SEARCH REPORT

International application No.

C (Continuation).

DOCUMENTS CONSIDERED TO BE RELEVANT

PCT/KR2015/004534

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/0034940 A1 (YU et al) 06 February 2014 examples 1 to 5, paragraphs [0027]-[0029], [0137]-[0146]	1-6
X	WO 2013/12557 A1 (UNIVERSAL DISPLAY CORPORATION et al) 01 August 2013 abstract; examples	1-6
X	US 2013/023419 A1 (IDEMITSU KOSAN CO LTD) 12 September 2013 abstract; examples	1-6
X	WO 2013/147205 A1 (IDEMITSU KOSAN CO LTD) 03 October 2013 abstract; examples	1-6

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2015/004534

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
US 2014/0034940 A1	06 February 2014	CN 103443240 A	11 Dec 2013
		EP 2675867 A1	25 Dec 2013
		KR 20120140140 A	28 Dec 2012
		KR 101354638 B1	22 Jan 2014
		TW 201300389 A	01 Jan 2013
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US 2013/0234119 A1	12 September 2013	CN 103959503 A	30 Jul 2014
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WO 2013145923 A1	03 Oct 2013		
WO 2013/147205 A1	03 October 2013	US 2015060801 A1	05 Mar 2015

End of Annex

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

Form PCT/ISA/210 (Family Annex)(July 2009)

专利名称(译)	多组分主体材料和包含其的有机电致发光器件		
公开(公告)号	EP3140367A1	公开(公告)日	2017-03-15
申请号	EP2015789715	申请日	2015-05-07
[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)	罗门哈斯电子材料KOREA LTD.		
[标]发明人	AHN HEE CHOON KIM YOUNG KWANG MOON DOO HYEON LEE SU HYUN KIM CHI SIK LEE SEON WOO JUN JI SONG PARK KYOUNG JIN KIM NAM KYUN CHO YOUNG JUN CHOI KYUNG HOON SHIM JAE HOON DOH YOO JIN		
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IPC分类号	C09K11/06 H01L27/32 H01L51/54		
CPC分类号	C09K11/025 C09K11/06 C09K2211/1007 C09K2211/1029 C09K2211/185 H01L51/0067 H01L51/0072 H01L51/0073 H01L51/0074 H01L51/5016 H01L2251/5384 H01L51/0071 H01L51/0085		
代理机构(译)	MCLEAN , CRAIG SUTHERLAND		
优先权	1020140053997 2014-05-07 KR 1020150063037 2015-05-06 KR		
其他公开文献	EP3140367A4 EP3140367B1		
外部链接	Espacenet		
摘要(译)			

本发明涉及一种有机电致发光器件，其包括在阳极和阴极之间的至少一个发光层，其中所述发光层包含主体和磷光掺杂剂；宿主由多组分宿主化合物组成；至少第一种多组分主体化合物的主体化合物是含有吡啶的双咪唑啉衍生物，第二种主体化合物是含有含氮杂芳基的咪唑啉衍生物。根据本发明，与使用一种主体组分的常规装置相比，使用多组分主体化合物的有机电致发光装置具有高效率 and 长寿命。