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(54) Title: ORGANIC ELECTROLUMINESCENT COMPOUND AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

(57) Abstract: The present disclosure relates to an organic electroluminescent compound and an organic electroluminescent device comprising the same. The organic electroluminescent compound according to the present disclosure is capable of producing an organic electroluminescent device with reasonably improved color purity and efficiency.

Description

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

Technical Field

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

Background Art

[2] Among display devices, an electroluminescent device (EL device) is a self-light-emitting device which has advantages in that it provides a wider viewing angle, a greater contrast ratio, and a faster response time. 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 [Appl. Phys. Lett. 51, 913, 1987].

[3] An organic electroluminescent device (OLED) has a structure comprising an anode, a cathode, and an organic layer between the anode and the cathode, wherein the organic layer may comprise a hole injection layer, a hole transport layer, an electron blocking layer, a light-emitting layer, a hole blocking layer, an electron transport layer, an electron injection layer, etc. In the organic electroluminescent device, when a voltage is applied, holes and electrons are injected from the anode and the cathode, respectively, to the light-emitting layer, in which excitons having high energies are formed by a recombination of the holes and the electrons. The excition's energy puts the organic luminescent compound in an excited state, and light is emitted by energy released while returning from the excited state to a ground state. Accordingly, the most important factor determining luminous efficiency in an organic electroluminescent device is a light-emitting material.

[4] The EL material can be categorized into a host material and a dopant material according to their functions. Generally, a device having the most excellent EL characteristic has a structure comprising a light-emitting layer formed by doping a dopant to a host. A host/dopant system is for increasing light-emitting efficiency by energy transfer from a host to a dopant. The host and dopant materials greatly influence the efficiency and lifespan of the EL device when using a dopant/host material system.

[5] Until now, iridium(III) complexes have been widely known as a dopant of phosphorescent materials, and bis(2-(2'-benzothienyl)-pyridinato-N,C3')iridium(acetylacetonate) ((acac)Ir(btp)$_2$), tris(2-phenylpyridine)iridium (Ir(ppy)$_3$) and

bis(4,6-difluorophenylpyridinato-N,C2)picolinate iridium (Firpic) as red, green, and blue light-emitting material, respectively.

[6] However, considering EL characteristic requirements for a middle or large-sized panel of OLED, a development of a dopant compound of iridium complexes providing more excellent EL performance, such as long lifespan, high efficiency and high color purity, is still needed.

[7] In particular, in order to realize full color display, to which an organic EL device is applied, a pixel configured to emit a particular color called "saturated" color is required. In particular, saturated red, green, and blue pixels are required. These saturated colors can be measured by using a CIE coordinate publicly known in the art.

[8] In order to express more various colors, a color purity of each of red, green, and blue should be high. In case of red color, the closer to the red color coordinate near 0.680 (CIE X-coordinate standard), the higher the color purity is. Accordingly, a requirement for a suitable dopant compound is increased.

[9] U.S. patent No. 7,951,472 discloses iridium complexes having 2-phenylquinoline-based ligand as a dopant compound of OLED, but iridium complexes having fused azabenzofluorene is not disclosed.

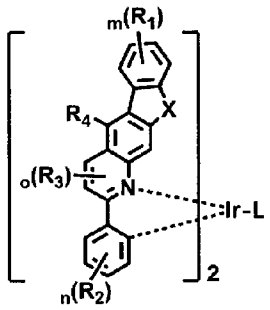
Disclosure of Invention

Technical Problem

[10] The object of the present disclosure is first, to provide compounds capable of producing an organic electroluminescent device with excellent color purity and efficiency, and second, to provide an organic electroluminescent device comprising the compounds.

Solution to Problem

[11] As a result of intensive studies to achieve the technical objects above, the present inventors found that the object can be achieved by an organic electroluminescent compound represented by the following formula 1:

[12] 

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

[13] wherein

[14] X represents $CR_{11}R_{12}$, O or S;

[15] R_1 to R_3, each independently, represent hydrogen, deuterium, a substituted or unsub-

stituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl;

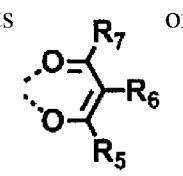
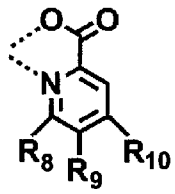
[16] R_4 represents hydrogen, or a substituted or unsubstituted (C1-C10)alkyl;

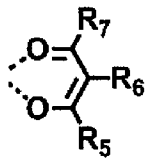
[17] R_{11} and R_{12}, each independently, represent a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl;

[18] m and n, each independently, represent an integer of 0 to 4;

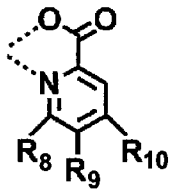
[19] o represents an integer of 0 to 2;

[20] where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different;

[21] L represents  or  ;

[22] where L is  ,

[23] R_5 to R_7, each independently, represent hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl;

[24] where L is  ,

[25] R_8 to R_{10}, each independently, represent hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl; or may be linked to an adjacent substituent to form a substituted or unsubstituted 9- to 20-membered heteroaryl including the pyridine ring linked to R_8 to R_{10}; and

[26] the heteroaryl may comprise one or more hetero atoms selected from a nitrogen, an oxygen, and a sulfur, in addition to the nitrogen atom of the pyridine ring.

Advantageous Effects of Invention

[27] By using a compound according to the present disclosure, an organic electroluminescent device showing significant improvement in color purity and efficiency can be prepared.

Mode for the Invention

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

[29] The present disclosure relates to a compound represented by formula 1 above, an organic electroluminescent material comprising said compound, and an organic electroluminescent device comprising said compound.

[30] Hereinafter, the compound represented by formula 1 of the present disclosure will be specifically described in detail.

[31] Herein, "(C1-C10)alkyl" indicates a linear or branched alkyl having 1 to 10 carbon atoms, in which the number of carbon atoms is preferably 1 to 5, and more preferably 1 to 4, and includes, as a specific example, methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, sec-butyl, tert-butyl, n-pentyl, 1-methylbutyl, 2-methylbutyl, 3-methylbutyl, 1,1-dimethylpropyl, 1,2-dimethylpropyl, 2,2-dimethylpropyl, and 1-ethylpropyl. Herein, "(C6-C30)aryl" indicates a monocyclic or fused ring radical derived from an aromatic hydrocarbon having 6 to 30 ring backbone carbon atoms, in which the number of ring backbone carbon atoms is preferably 6 to 20, more preferably 6 to 15, and includes, as a specific example, phenyl, biphenyl, terphenyl, naphthyl, binaphthyl, phenylnaphthyl, naphthylphenyl, phenylterphenyl, fluorenyl, phenylfluorenyl, benzofluorenyl, dibenzofluorenyl, phenanthrenyl, phenylphenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, etc.

[32] Herein, "3- to 30-membered heteroaryl" indicates an aryl group having 3 to 30 ring backbone atoms, including at least one hetero atom selected from the group consisting of B, N, O, S, Si, and P, in which, the number of ring backbone atoms is preferably 9 to 20, and more preferably 9 to 16, and the number of hetero atoms is preferably 1 to 4. Herein, heteroaryl may be a monocyclic ring, or a fused ring condensed with at least one benzene ring; may be partially saturated; and the heteroaryl 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.

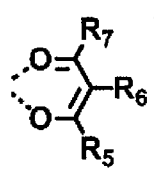
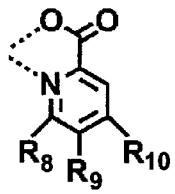
[33] Herein, "substituted" in the expression "substituted or unsubstituted" means that hydrogen atom in a certain functional group is replaced with another atom or another functional group, i.e. a substituent. In R_1 to R_{12} of formula 1 of the present disclosure, the substituents of the substituted alkyl, the substituted aryl, or the substituted heteroaryl each independently, are at least one selected from the group consisting of

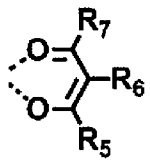
deuterium; a halogen; a cyano; a carboxyl; a nitro; a hydroxyl; a (C1-C30)alkyl; a halo(C1-C30)alkyl; a (C2-C30)alkenyl; a (C2-C30)alkynyl; a (C1-C30)alkoxy; a (C1-C30)alkylthio; a (C3-C30)cycloalkyl; a (C3-C30)cycloalkenyl; a 3- to 7-membered heterocycloalkyl; a (C6-C30)aryloxy; a (C6-C30)arylthio; a 3- to 30-membered heteroaryl unsubstituted or substituted with a (C6-C30)aryl; a (C6-C30)aryl unsubstituted or substituted with a (C1-C30)alkyl, a cyano, a 3- to 30-membered heteroaryl or a tri(C6-C30)arylsilyl; a tri(C1-C30)alkylsilyl; a tri(C6-C30)arylsilyl; a di(C1-C30)alkyl(C6-C30)arylsilyl; a (C1-C30)alkyldi(C6-C30)arylsilyl; an amino; a mono- or di- (C1-C30)alkylamino; a mono- or di- (C6-C30)arylamino; a (C1-C30)alkyl(C6-C30)arylamino; a (C1-C30)alkylcarbonyl; a (C1-C30)alkoxycarbonyl; a (C6-C30)arylcarbonyl; a di(C6-C30)arylboronyl; a di(C1-C30)alkylboronyl; a (C1-C30)alkyl(C6-C30)arylboronyl; a (C6-C30)aryl(C1-C30)alkyl; and a (C1-C30)alkyl(C6-C30)aryl; preferably, are each independently, deuterium or a (C1-C6)alkyl.

[34] In formula 1, X represents $CR_{11}R_{12}$, O or S.

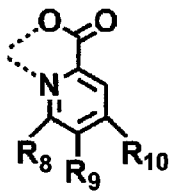
[35] In formula 1, R_1 to R_3 are each independently hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl; preferably, hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl; more preferably, hydrogen, an unsubstituted (C1-C4)alkyl, or a (C6-C15)aryl unsubstituted or substituted with a (C1-C4)alkyl. For example, R_1 to R_3 may be each independently hydrogen, methyl, isobutyl, tert-butyl, or phenyl unsubstituted or substituted with methyl, isobutyl, or tert-butyl.

[36] In formula 1, R_4 represents hydrogen, or a substituted or unsubstituted (C1-C10)alkyl; and preferably, hydrogen.

[37] In formula 1, L represents  or .

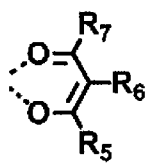
[38] In formula 1, if L is , R_5 to R_7 are each independently hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl; preferably, hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C15)aryl; more preferably, hydrogen, an unsubstituted (C1-C15)alkyl, or an unsubstituted (C6-C15)aryl. For

example, L may be hydrogen, methyl, isobutyl, tert-butyl, pentyl, or phenyl.

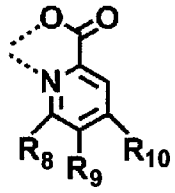
[39] In formula 1, if L is , R_8 to R_{10} may be each independently hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl or at least two of R_8 to R_{10} may be linked to each other as an adjacent substituent to form a substituted or unsubstituted 9- to 20-membered heteroaryl including the pyridine ring linked to R_8 to R_{10}, and the heteroaryl may comprise one or more hetero atoms selected from a nitrogen, an oxygen, and a sulfur in addition to the nitrogen atom of the pyridine ring; preferably, hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl or at least two of R_8 to R_{10} may be linked to an adjacent substituent to form a 9- to 16-membered heteroaryl which includes the pyridine ring linked to R_8 to R_{10} and is unsubstitued or substituted with a (C1-C15)alkyl, and the heteroaryl may comprise one or more hetero atoms selected from a nitrogen, an oxygen, and a sulfur in addition to the nitrogen atom of the pyridine ring; and for example, hydrogen, methyl, or phenyl substituted with methyl or at least two of R_8 to R_{10} may be linked to each other as an adjacent substituent to form a quinoline which includes the pyridine ring linked to R_8 to R_{10} and is unsubstituted or substituted with a (C1-C6)alkyl.

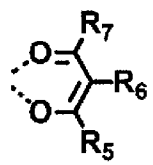
[40] In formula 1, R_{11} and R_{12} are each independently, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl. R_{11} and R_{12} each independently may be preferably a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl; more preferably, a (C1-C4)alkyl unsubstituted or substituted with deuterium, or an unsubstituted (C6-C15)aryl; and for example, methyl unsubstituted or substituted with deuterium, ethyl unsubstituted or substituted with deuterium, or phenyl.

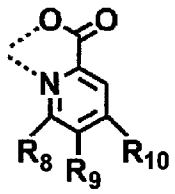
[41] In formula 1, m and n, each independently, represent an integer of 0 to 4; o represents an integer of 0 to 2; and where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different.

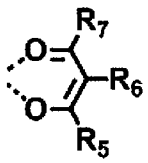
[42] According to one embodiment of the present disclosure, in formula 1, X may represent $CR_{11}R_{12}$, O or S; R_1 to R_3 may be each independently hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl; R_4 may represent hydrogen; L may represent ; R_5 to R_7 may be each independently

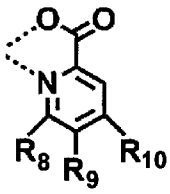
hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C15)aryl; R_{11} and R_{12} may be each independently, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl; m and n, each independently, represent an integer of 0 to 4; o represents an integer of 0 to 2; and where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different.

[43] According to another embodiment of the present disclosure, in formula 1, X may represent $CR_{11}R_{12}$, O or S; R_1 to R_3 may be each independently hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl; R_4 may represent hydrogen; L may represent ; R_8 to R_{10} may be each independently hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl, or at least two of R_8 to R_{10} may be linked to each other as an adjacent substituent to form a 9- to 16-membered heteroaryl which includes the pyridine ring linked to R_8 to R_{10} and is unsubstitued or substituted with a (C1-C15)alkyl, and the heteroaryl may comprise one or more hetero atoms selected from a nitrogen, an oxygen, and a sulfur in addition to a nitrogen atom of the pyridine ring; R_{11} and R_{12} may be each independently, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl; m and n, each independently, may represent an integer of 0 to 4; o may represent an integer of 0 to 2; and where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different.

[44] According to another embodiment of the present disclosure, in formula 1, X may represent $CR_{11}R_{12}$, O or S; R_1 to R_3 may be each independently hydrogen, an unsubstituted (C1-C4)alkyl, or a (C6-C15)aryl unsubstituted or substituted with a (C1-C4)alkyl; R_4 may represent hydrogen; L may represent ; R_5 to R_7 may be each independently hydrogen, an unsubstituted (C1-C15)alkyl, or an unsubstituted (C6-C15)aryl; R_{11} and R_{12} may be each independently a (C1-C4)alkyl unsubstituted or substituted with deuterium, or an unsubstituted (C6-C15)aryl; m and n, each independently, may represent an integer of 0 to 4; o may represent an integer of 0 to 2; and where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different.

[45] According to another embodiment of the present disclosure, in formula 1, X may represent $CR_{11}R_{12}$, O or S; R_1 to R_3 may be each independently hydrogen, an unsubstituted (C1-C4)alkyl, or a (C6-C15)aryl unsubstituted or substituted with a (C1-C4)alkyl; R_4 may represent hydrogen; L may represent ; R_8 to R_{10} may be each independently hydrogen, methyl, or phenyl substituted with methyl, or at least two of R_8 to R_{10} may be linked to each other as an adjacent substituent to form a quinoline which includes the pyridine ring linked to R_8 to R_{10} and is unsubstituted or substituted with a (C1-C6)alkyl; R_{11} and R_{12} may be each independently, a (C1-C4)alkyl unsubstituted or substituted with deuterium, or an unsubstituted (C6-C15)aryl; m and n, each independently, may represent an integer of 0 to 4; o may represent an integer of 0 to 2; and where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different.

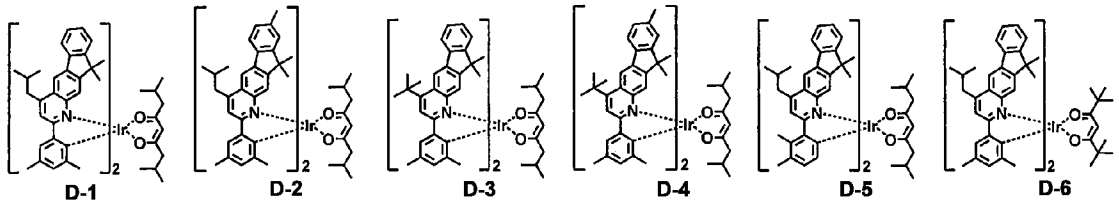
[46] According to another embodiment of the present disclosure, in formula 1, X may represent $CR_{11}R_{12}$, O or S; R_1 to R_3 may be each independently hydrogen, methyl, isobutyl, tert-butyl, or phenyl unsubstituted or substituted with methyl, isobutyl, or tert-butyl; R_4 may represent hydrogen; L may represent ; R_5 to R_7 may be each independently hydrogen, methyl, isobutyl, tert-butyl, pentyl, or phenyl; R_{11} and R_{12} may be each independently methyl unsubstituted or substituted with deuterium, ethyl unsubstituted or substituted with deuterium, or phenyl; m and n, each independently, may represent an integer of 0 to 4; o may represent an integer of 0 to 2; and where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different.

[47] According to another embodiment of the present disclosure, in formula 1, X may represent $CR_{11}R_{12}$, O or S; R_1 to R_3 may be each independently hydrogen, methyl, isobutyl, tert-butyl, or phenyl unsubstituted or substituted with methyl, isobutyl, or tert-butyl; R_4 may represent hydrogen; L may represent ; R_8 to R_{10} may be each independently hydrogen, methyl, or phenyl substituted with methyl; or at least two of R_8 to R_{10} may be linked to each other as an adjacent substituent to form a

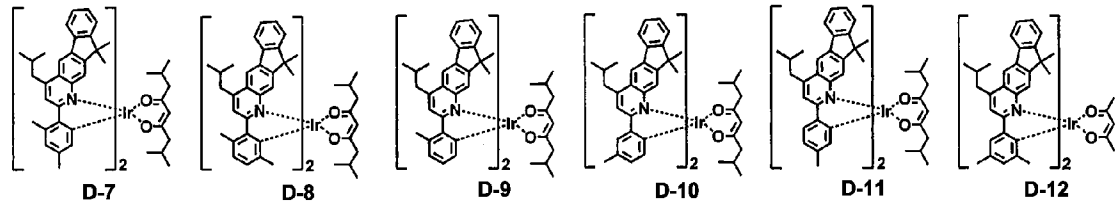
quinoline which includes the pyridine ring linked to R_8 to R_{10} and is unsubstituted or substituted with a (C1-C6)alkyl; R_{11} and R_{12} may be each independently methyl unsubstituted or substituted with deuterium, ethyl unsubstituted or substituted with deuterium, or phenyl; m and n, each independently, may represent an integer of 0 to 4; o may represent an integer of 0 to 2; and where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different.

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

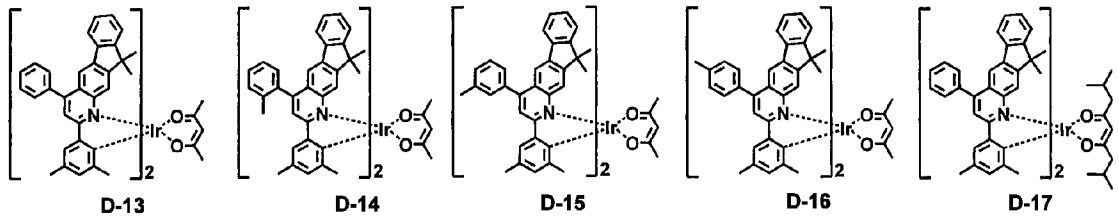
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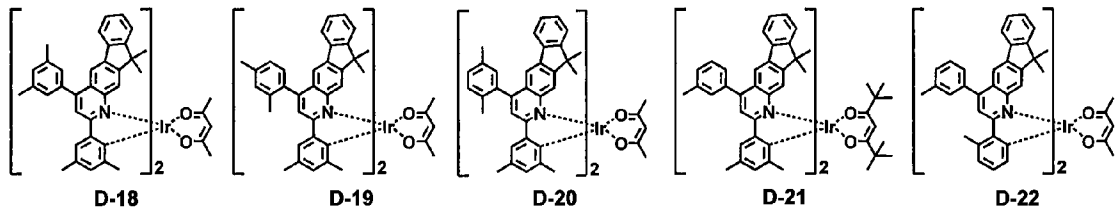
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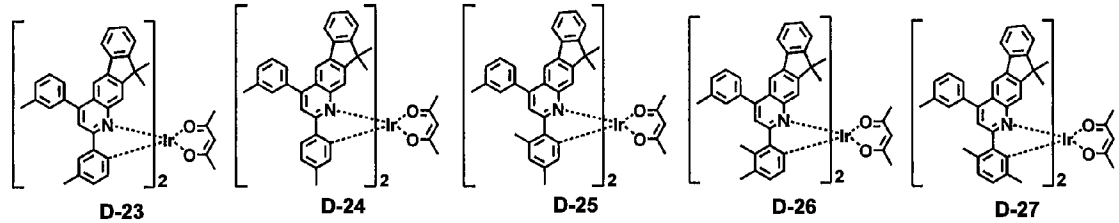
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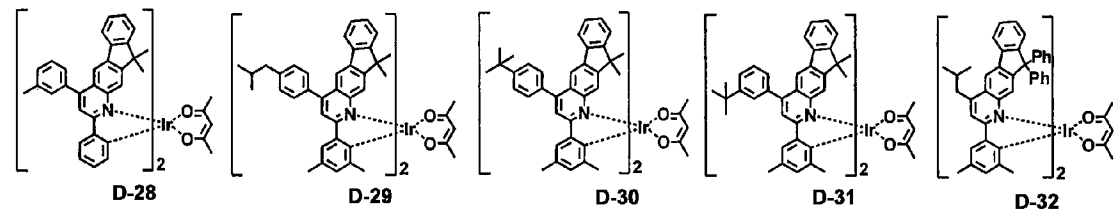
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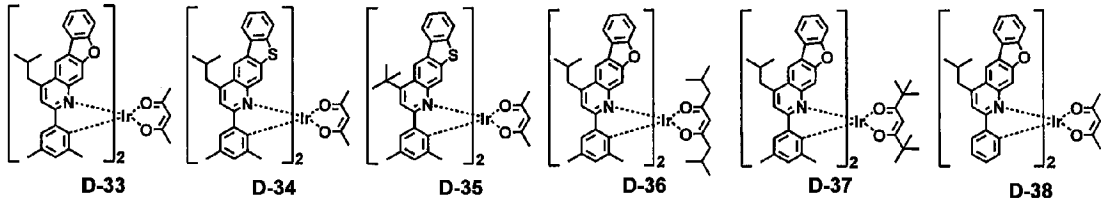
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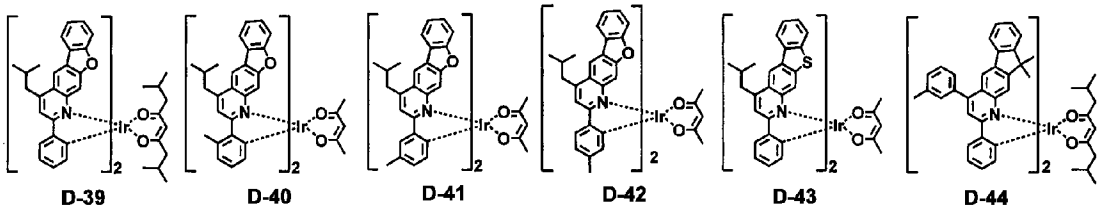
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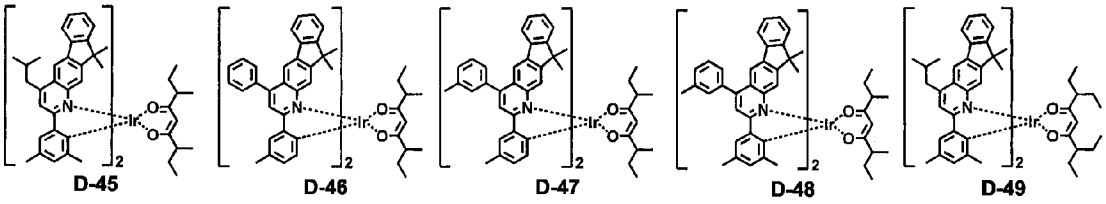
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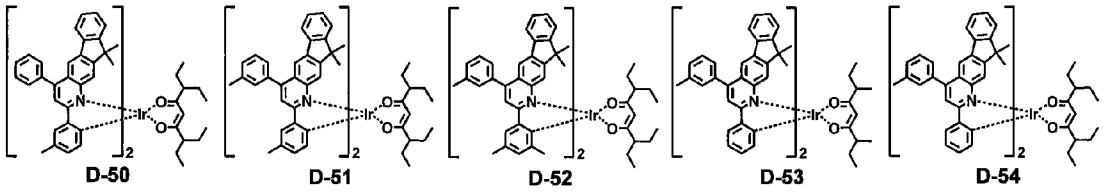
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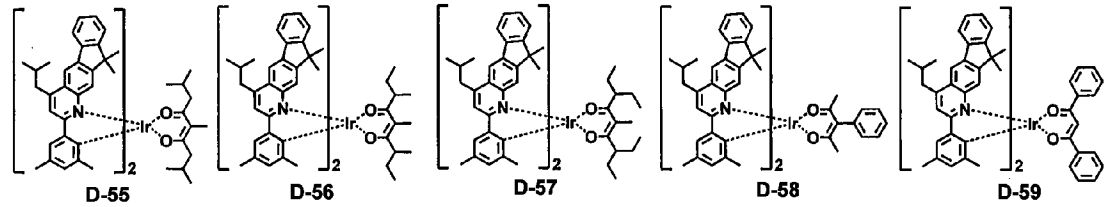
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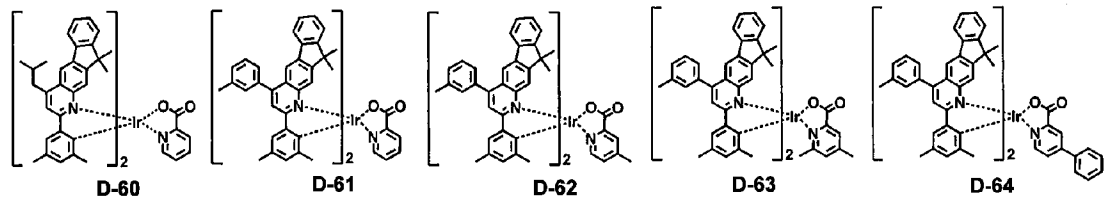
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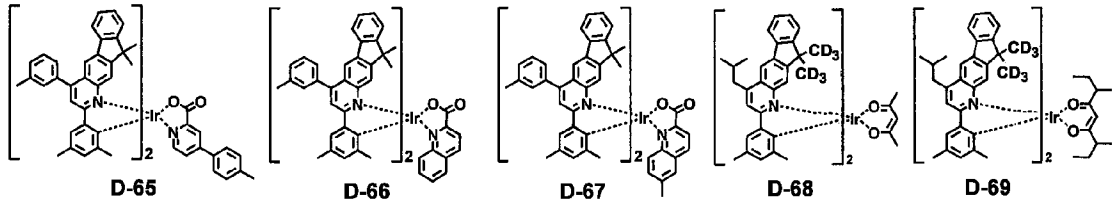
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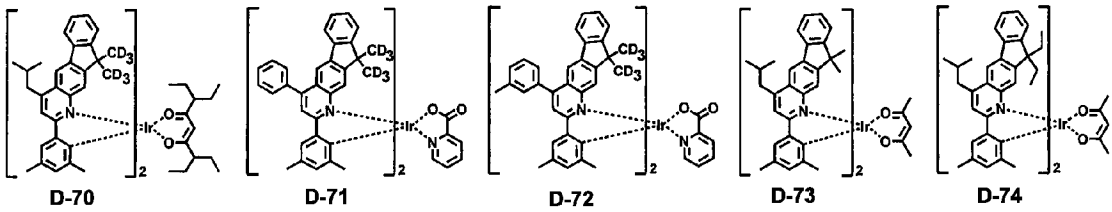


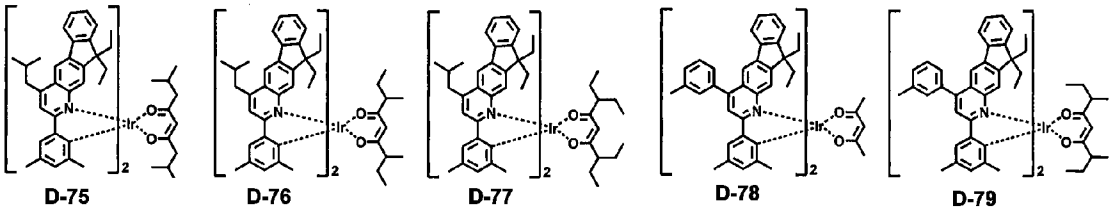
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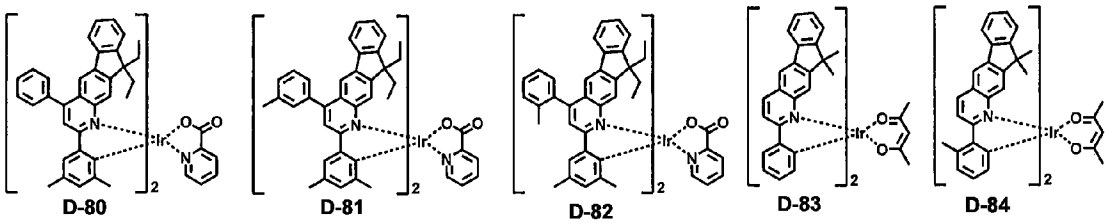


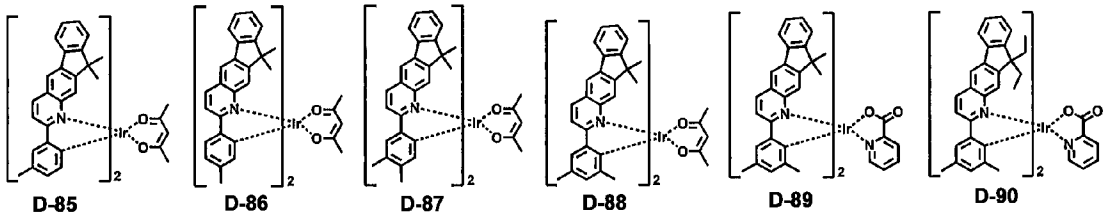
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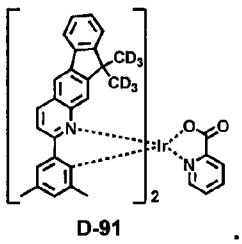


[62] 

[63] 

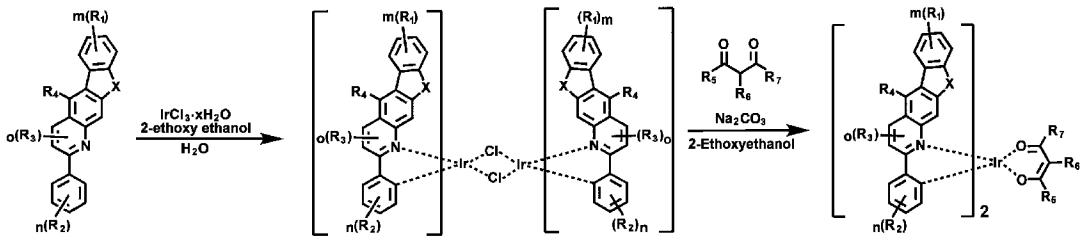
[64] 

[65] 

[66] 

[67] The compound according to the present disclosure may be produced by a synthetic method known to a person skilled in the art. For example, it may be produced by the following reaction scheme 1:

[68] [Reaction Scheme 1]

[69] 

[70] wherein, R_1 to R_7, X, m, n, and o are as defined in formula 1.

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

comprising the material.

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

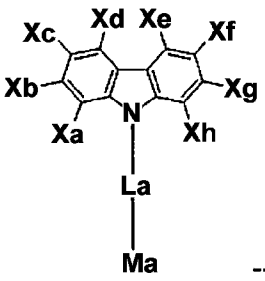
[73] The organic electroluminescent device of the present disclosure may comprise a first electrode, a second electrode, and at least one organic layer between the first and second electrodes. The organic layer may comprise at least one organic electroluminescent compound of formula 1.

[74] One of the first and second electrodes may be an anode, and the other may be a cathode. The organic layer may comprise a light-emitting layer, and may further comprise at least one layer selected from a hole injection layer, a hole transport layer, a hole auxiliary layer, a light-emitting auxiliary layer, an electron transport layer, an electron injection layer, an interlayer, a hole blocking layer, an electron buffer layer, and an electron blocking layer.

[75] Herein, the light-emitting auxiliary layer may be placed between the anode and the light-emitting layer, or the cathode and the light-emitting layer, which may be used for facilitating the injection and/or transport of the hole or for blocking the overflow of the electron when placed between the anode and the light-emitting layer, or which may be used for facilitating the injection and/or transport of the electron or for blocking the overflow of the hole when placed between the cathode and the light-emitting layer. In addition, the hole auxiliary layer is placed between the hole transport layer (or the hole injection layer) and the light-emitting layer, which may exhibit facilitating a transport rate (or injection rate) of a hole or blocking a hole, thereby controlling a charge balance. In addition, the electron blocking layer is placed between the hole transport layer (or the hole injection layer) and the light-emitting layer, which prevents light leakage by blocking the overflow of the electron from the light-emitting layer and confining excitons in the light-emitting layer. If two or more hole transport layers are included, the additional hole transport layer(s), which is (are) included in addition to the hole transport layer, may be used as the hole auxiliary layer or electron blocking layer. The hole auxiliary layer or the electron blocking layer provides excellent efficiencies and improved lifespan of an organic electroluminescent device.

[76] The compound represented by formula 1 of the present disclosure is a dopant material, which may be included in the light-emitting layer. In addition, the light-emitting layer may further include one or more host materials.

[77] The host compounds which are capable of being used with the compound of the present disclosure may be the following compounds represented by formula 2.

[78] 

----------(2)

[79] wherein

[80] Ma represents a substituted or unsubstituted, nitrogen-containing 5- to 11-membered heteroaryl;

[81] La represents a single bond, or a substituted or unsubstituted (C6-C30)arylene;

[82] Xa to Xh, each independently, represent hydrogen, deuterium, a halogen, a cyano, a substituted or unsubstituted (C1-C30)alkyl, a substituted or unsubstituted (C2-C30)alkenyl, a substituted or unsubstituted (C2-C30)alkynyl, a substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted (C6-C60)aryl, a substituted or unsubstituted 3- to 30-membered heteroaryl, a substituted or unsubstituted tri(C1-C30)alkylsilyl, a substituted or unsubstituted tri(C6-C30)arylsilyl, a substituted or unsubstituted di(C1-C30)alkyl(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyldi(C6-C30)arylsilyl, a substituted or unsubstituted (C1-C30)alkyl(C6-C30)arylamino, or a substituted or unsubstituted mono- or di-(C6-C30)arylamino; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted (C3-C30) mono- or polycyclic, alicyclic or aromatic ring, whose carbon atom(s) may be replaced with at least one hetero atom selected from the group consisting of nitrogen, oxygen, and sulfur; and

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

[84] In formula 2, the substituents of a substituted alkyl, a substituted alkenyl, a substituted alkynyl, a substituted cycloalkyl, a substituted aryl, a substituted heteroaryl, a substituted trialkylsilyl, a substituted triarylsilyl, a substituted dialkylarylsilyl, a substituted alkyldiarylsilyl, a substituted alkylarylamino, a substituted monoarylamino, a substituted diarylamino, or a substituted mono- or polycyclic, alicyclic or aromatic ring may be each independently, at least one selected from the group consisting of deuterium; a halogen; a cyano; a carboxyl; a nitro; a hydroxyl; a (C1-C30)alkyl; a halo(C1-C30)alkyl; a (C2-C30)alkenyl; a (C2-C30)alkynyl; a (C1-C30)alkoxy; a (C1-C30)alkylthio; a (C3-C30)cycloalkyl; a (C3-C30)cycloalkenyl; a 3- to 7-membered heterocycloalkyl; a (C6-C30)aryloxy; a (C6-C30)arylthio; a 3- to 30-membered heteroaryl unsubstituted or substituted with a tri(C6-C30)arylsilyl, a (C6-C30)aryl, a (C1-C30)alkyl(C6-C30)aryl, or a tri(C6-C30)arylsilyl(C6-C30)aryl; a (C6-C30)aryl unsubstituted or substituted with a (C1-C30)alkyl, a halogen, a

(C6-C30)aryl or a 3- to 30-membered heteroaryl; a tri(C1-C30)alkylsilyl; a tri(C6-C30)arylsilyl; a di(C1-C30)alkyl(C6-C30)arylsilyl; a (C1-C30)alkyldi(C6-C30)arylsilyl; an amino; a mono- or di- (C1-C30)alkylamino; a mono- or di- (C6-C30)arylamino; a (C1-C30)alkyl(C6-C30)arylamino; a (C1-C30)alkylcarbonyl; a (C1-C30)alkoxycarbonyl; a (C6-C30)arylcarbonyl; a di(C6-C30)arylboronyl; a di(C1-C30)alkylboronyl; a (C1-C30)alkyl(C6-C30)arylboronyl; a (C6-C30)aryl(C1-C30)alkyl; and a (C1-C30)alkyl(C6-C30)aryl.

[85] In formula 2, La may represent preferably, a single bond, or a substituted or unsubstituted (C6-C12)arylene; and more preferably, a single bond, or a (C6-C12)arylene unsubstituted or substituted with a tri(C6-C10)arylsilyl. Specifically, La may represent a single bond, a substituted or unsubstituted phenylene, a substituted or unsubstituted naphthylene, or a substituted or unsubstituted biphenylene.

[86] In formula 2, Ma may represent preferably, a substituted or unsubstituted, nitrogen-containing 5- to 11-membered heteroaryl; and more preferably, a nitrogen-containing 6- to 11-membered heteroaryl unsubstitued or substituted with a cyano, a (C1-C6)alkyl, a tri(C6-C12)arylsilyl, a (C6-C18)aryl, or a 5- to 15-membered heteroaryl.

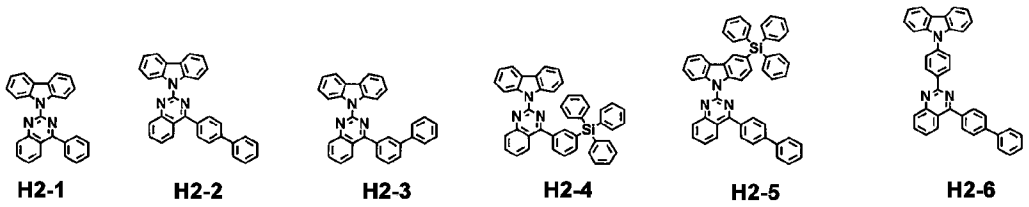
[87] Specifically, Ma may represent a substituted or unsubstituted pyrrolyl, a substituted or unsubstituted imidazolyl, a substituted or unsubstituted pyrazolyl, a substituted or unsubstituted triazinyl, a substituted or unsubstituted tetrazinyl, a substituted or unsubstituted triazolyl, a substituted or unsubstituted tetrazolyl, a substituted or unsubstituted pyridyl, a substituted or unsubstituted pyrazinyl, a substituted or unsubstituted pyrimidinyl, a substituted or unsubstituted pyridazinyl, a substituted or unsubstituted benzimidazolyl, a substituted or unsubstituted isoindolyl, a substituted or unsubstituted indolyl, a substituted or unsubstituted indazolyl, a substituted or unsubstituted benzothiadiazolyl, a substituted or unsubstituted quinolyl, a substituted or unsubstituted isoquinolyl, a substituted or unsubstituted cinnolinyl, a substituted or unsubstituted quinazolinyl, a substituted or unsubstituted naphthyridinyl, or a substituted or unsubstituted quinoxalinyl. More specifically, Ma may represent a substituted or unsubstituted triazinyl, a substituted or unsubstituted pyrimidinyl, a substituted or unsubstituted pyridyl, a substituted or unsubstituted quinolyl, a substituted or unsubstituted isoquinolyl, a substituted or unsubstituted quinazolinyl, a substituted or unsubstituted naphthyridinyl, or a substituted or unsubstituted quinoxalinyl.

[88] Preferably, Xa to Xh, each independently, may represent hydrogen, a cyano, a substituted or unsubstituted (C6-C15)aryl, a substituted or unsubstituted 6- to 20-membered heteroaryl, or a substituted or unsubstituted tri(C6-C15)arylsilyl; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted 6- to

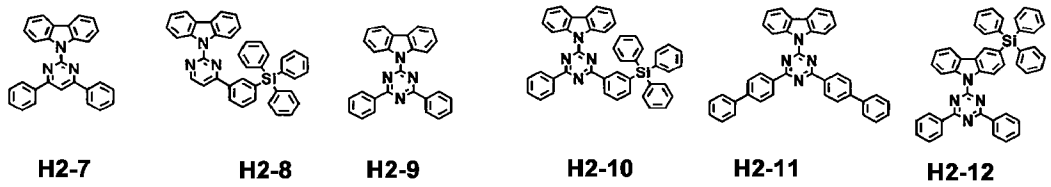
20-membered, mono- or polycyclic aromatic ring, whose carbon atom(s) may be replaced with at least one hetero atom selected from the group consisting of nitrogen, oxygen, and sulfur. More preferably, Xa to Xh, each independently, may represent hydrogen, a cyano, a (C6-C15)aryl unsubstituted or substituted with a tri(C6-C12)arylsilyl, or a 10- to 20-membered heteroaryl unsubstituted or substituted with a (C6-C12)aryl; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted benzene, a substituted or unsubstituted indole, a substituted or unsubstituted benzoindole, a substituted or unsubstituted indene, a substituted or unsubstituted benzofuran, or a substituted or unsubstituted benzothiophene. Specifically, at least one of Xa to Xh, for example, Xb, Xc, Xf, or Xg, each independently, may represent a substituted or unsubstituted dibenzothiophene, a substituted or unsubstituted dibenzofuran, a substituted or unsubstituted carbazole, or a substituted or unsubstituted benzocarbazole; or may be linked to an adjacent substituent(s) to form a substituted or unsubstituted benzene, a substituted or unsubstituted indole, a substituted or unsubstituted benzindole, a substituted or unsubstituted indene, a substituted or unsubstituted benzofuran, or a substituted or unsubstituted benzothiophene.

[89] More specifically, the compound of formula 2 includes the following, but is not limited thereto.

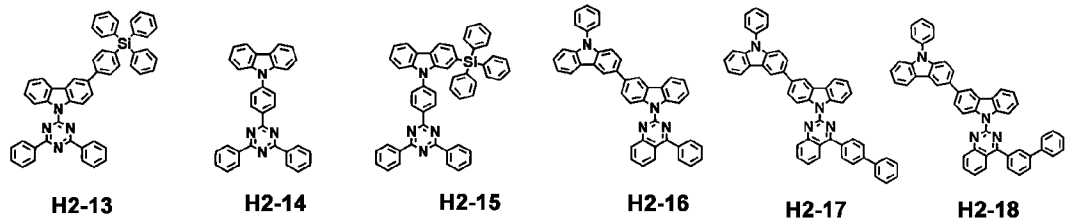
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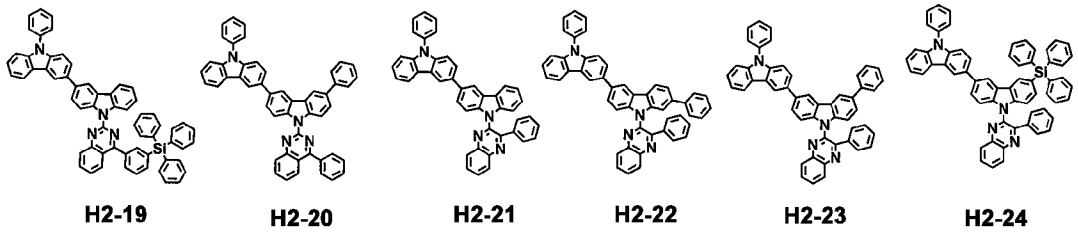
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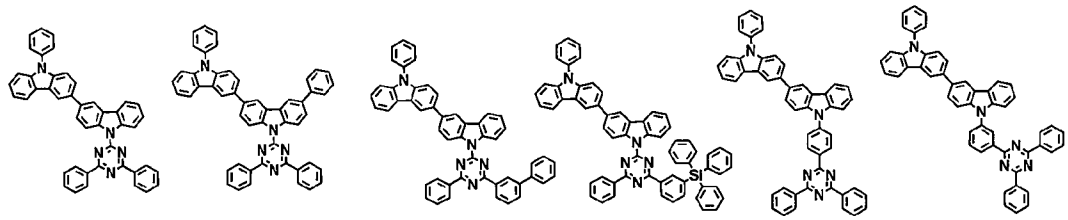
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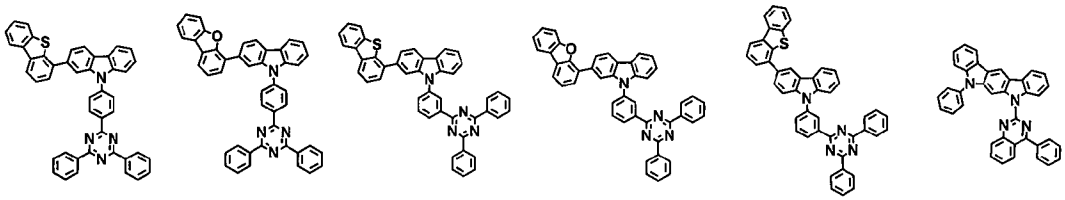


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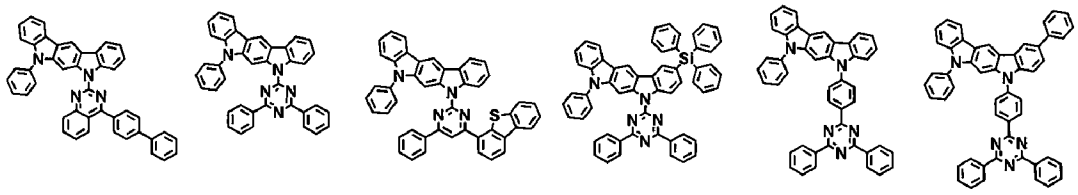
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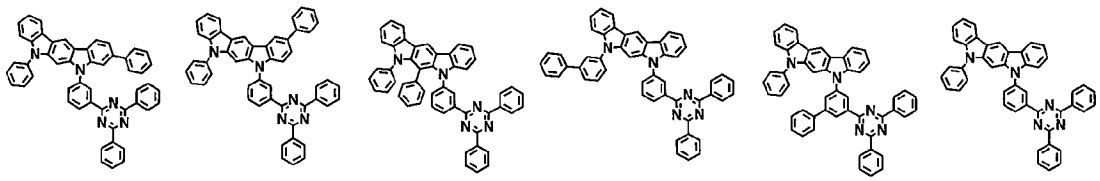
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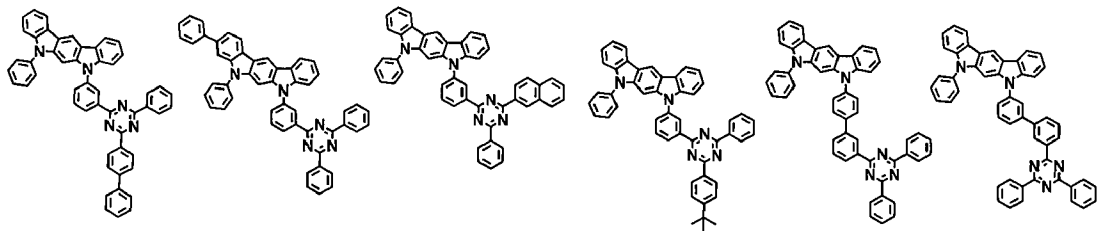
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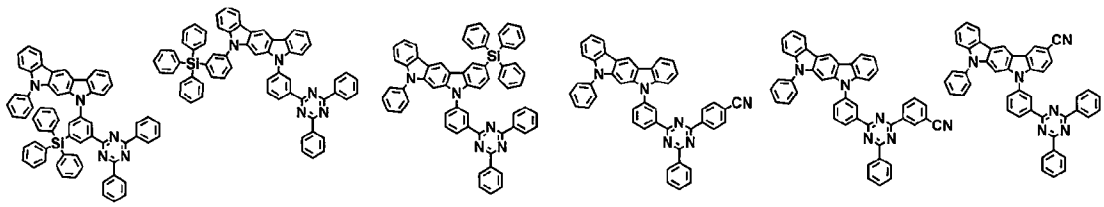
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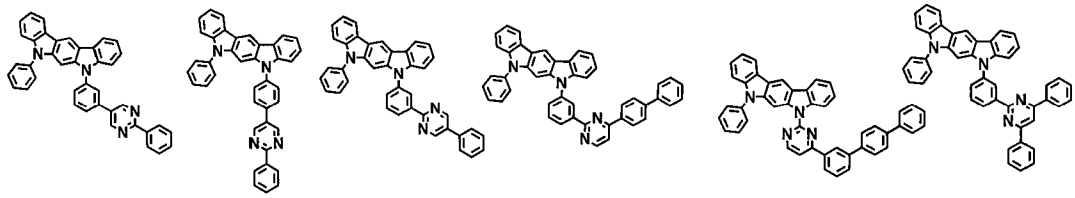
H2-49 H2-50 H2-51 H2-52 H2-53 H2-54

[99]



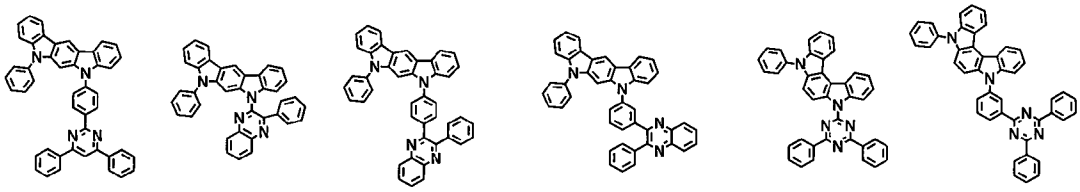
H2-55 H2-56 H2-57 H2-58 H2-59 H2-60

[100]



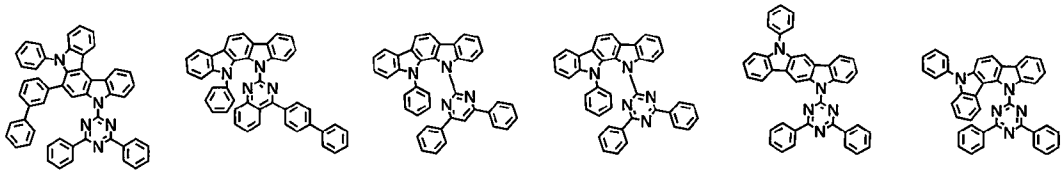
H2-61 H2-62 H2-63 H2-64 H2-65 H2-66

[101]



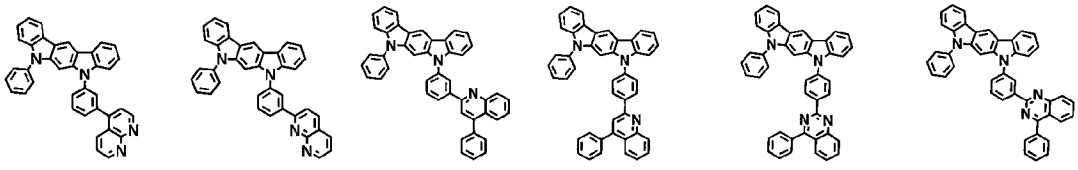
H2-67 H2-68 H2-69 H2-70 H2-71 H2-72

[102]



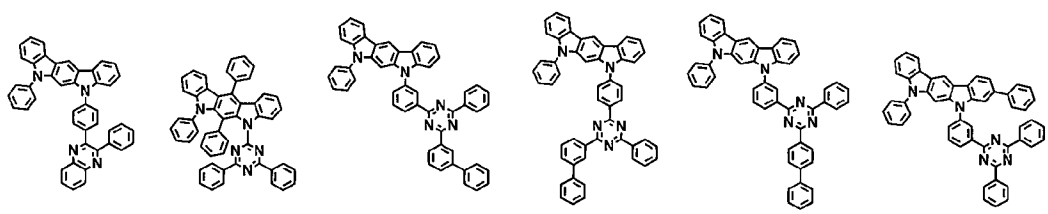
H2-73 H2-74 H2-75 H2-76 H2-77 H2-78

[103]



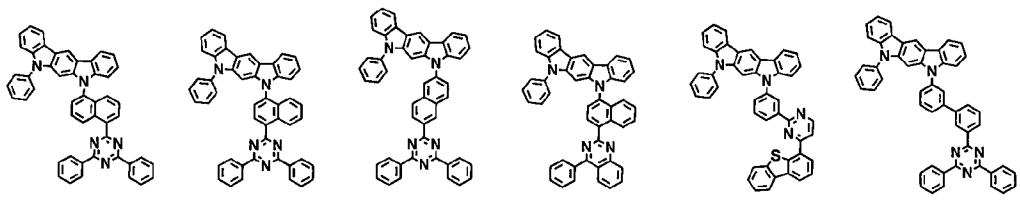
H2-79 H2-80 H2-81 H2-82 H2-83 H2-84

[104]



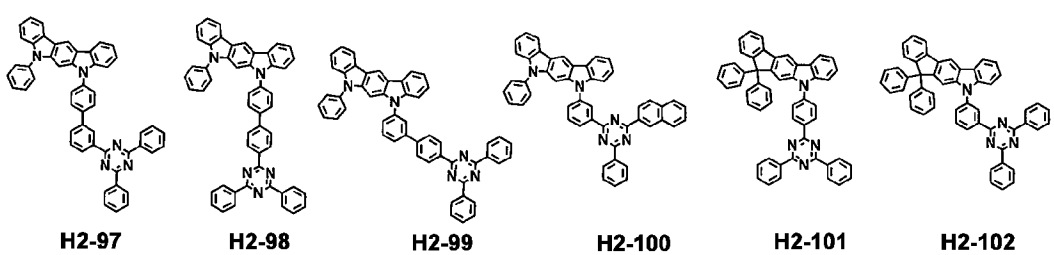
H2-85 H2-86 H2-87 H2-88 H2-89 H2-90

[105]



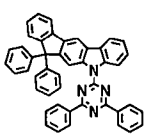
H2-91 H2-92 H2-93 H2-94 H2-95 H2-96

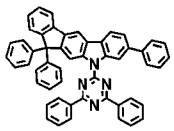
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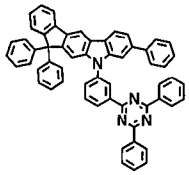


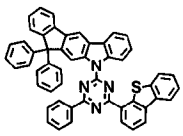
H2-97 H2-98 H2-99 H2-100 H2-101 H2-102

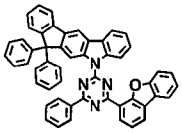
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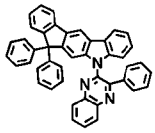

H2-103


H2-104

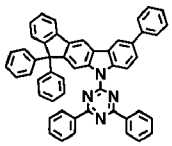

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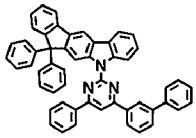

H2-106

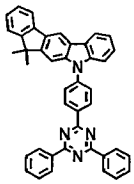

H2-107

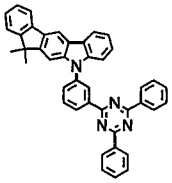

H2-108

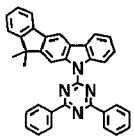
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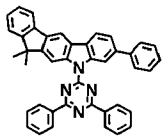

H2-109


H2-110

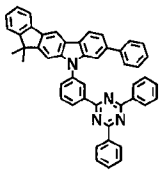

H2-111

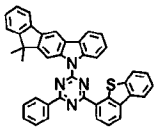

H2-112

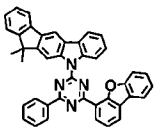

H2-113

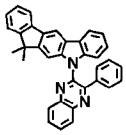

H2-114

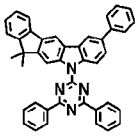
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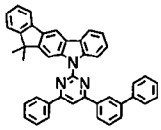

H2-115


H2-116

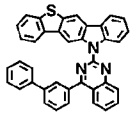

H2-117

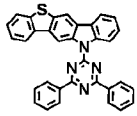

H2-118

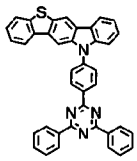

H2-119

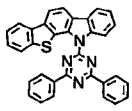

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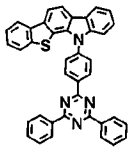
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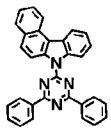

H2-121


H2-122

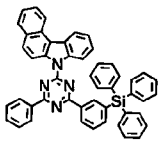

H2-123

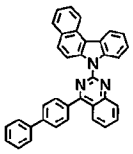

H2-124

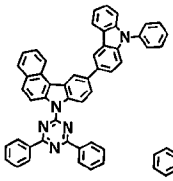

H2-125

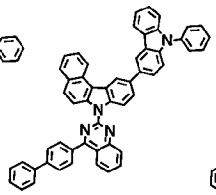

H2-126

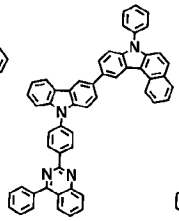
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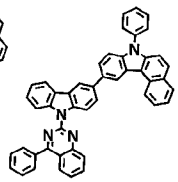

H2-127


H2-128

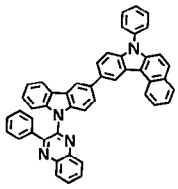

H2-129

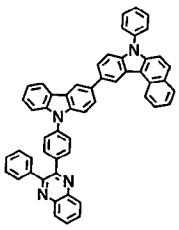

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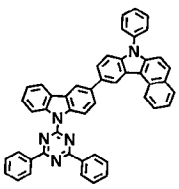

H2-131

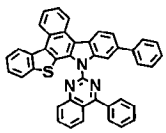

H2-132

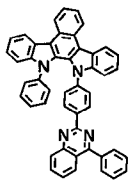
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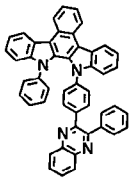

H2-133


H2-134

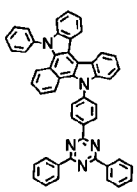

H2-135

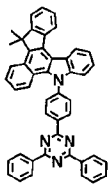

H2-136

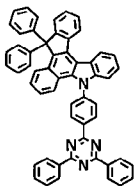

H2-137

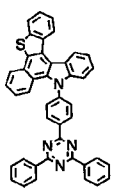

H2-138

[113]


H2-139


H2-140

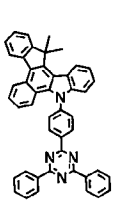

H2-141

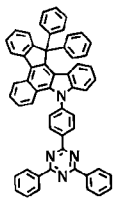

H2-142

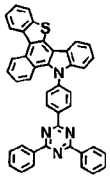
H2-143

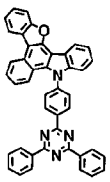
H2-144

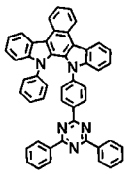
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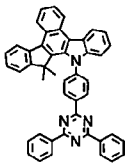

H2-145


H2-146

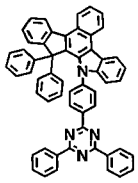

H2-147

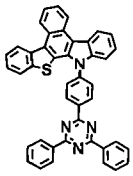

H2-148

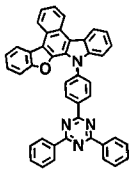

H2-149

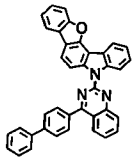

H2-150

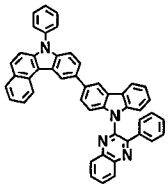
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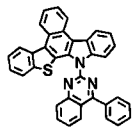

H2-151


H2-152

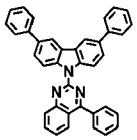

H2-153

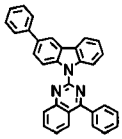

H2-154

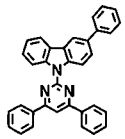

H2-155

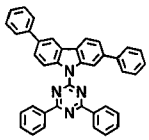

H2-156

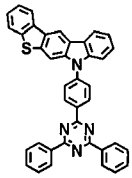
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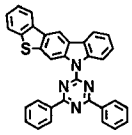

H2-157


H2-158

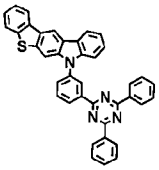

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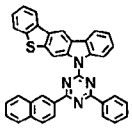

H2-160

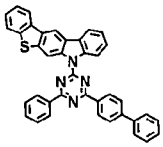

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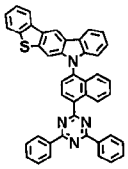

H2-162

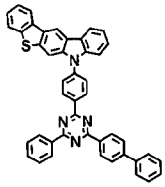
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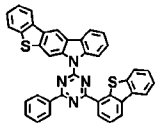

H2-163


H2-164

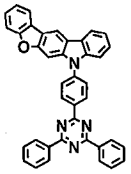

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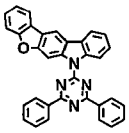

H2-166

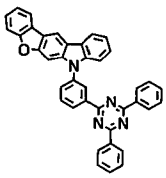

H2-167

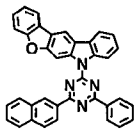

H2-168

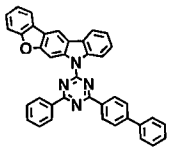
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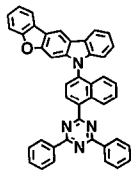

H2-169


H2-170

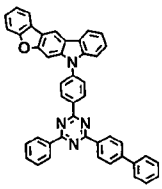

H2-171

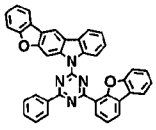

H2-172

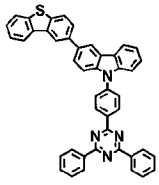

H2-173

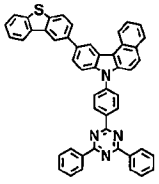

H2-174

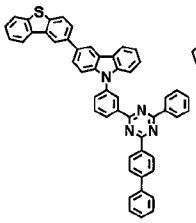
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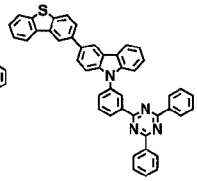

H2-175


H2-176

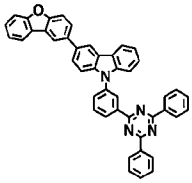

H2-177

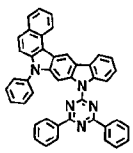

H2-178

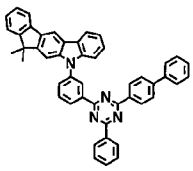

H2-179

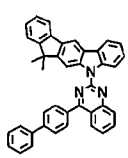

H2-180

[120]


H2-181


H2-182

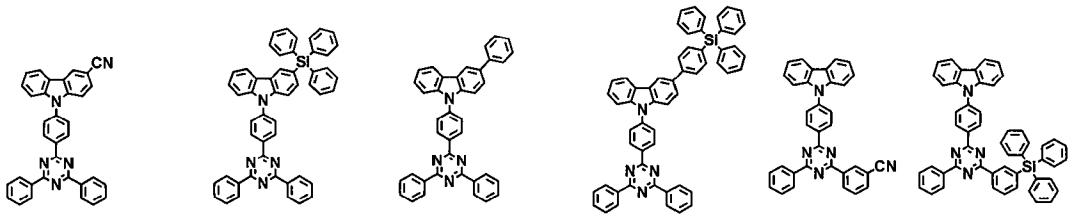

H2-183


H2-184

H2-185

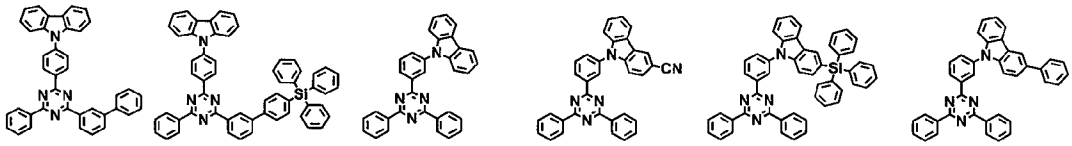
H2-186

[121]



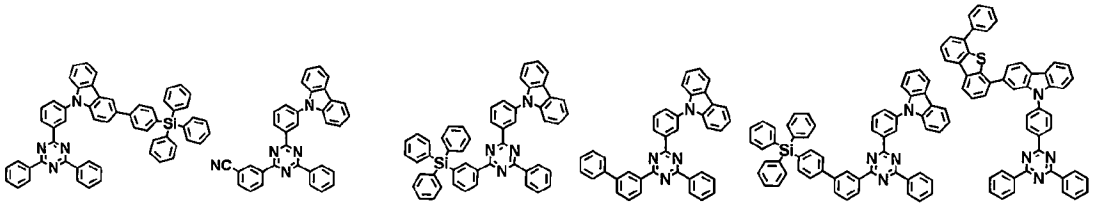
H2-187 H2-188 H2-189 H2-190 H2-191 H2-192

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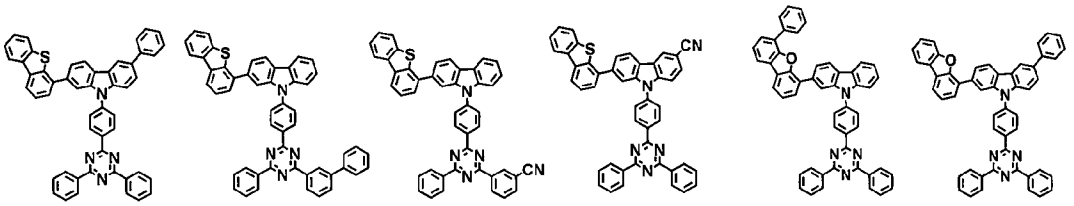
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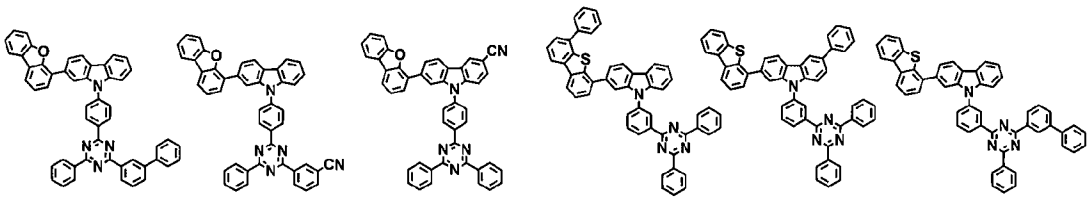
H2-199 H2-200 H2-201 H2-202 H2-203 H2-204

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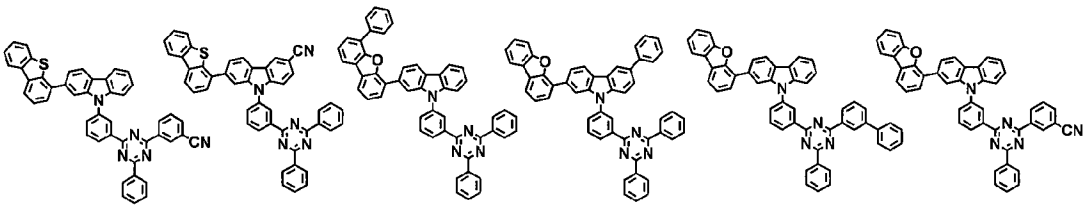
H2-205 H2-206 H2-207 H2-208 H2-209 H2-210

[125]



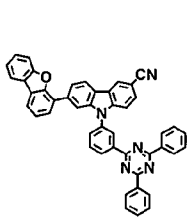
H2-211 H2-212 H2-213 H2-214 H2-215 H2-216

[126]

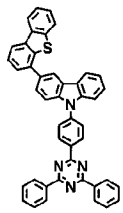


H2-217 H2-218 H2-219 H2-220 H2-221 H2-222

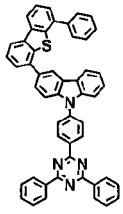
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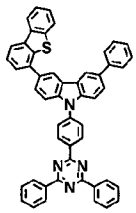
H2-223



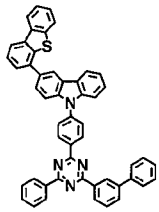
H2-224



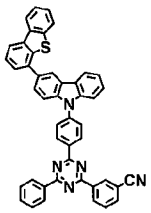
H2-225



H2-226

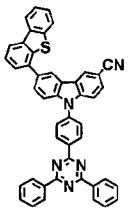


H2-227

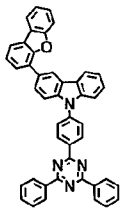


H2-228

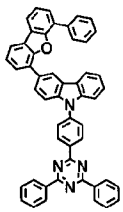
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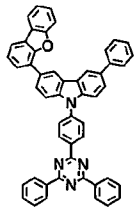
H2-229



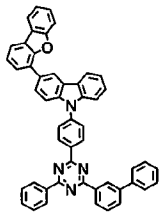
H2-230



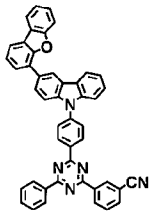
H2-231



H2-232

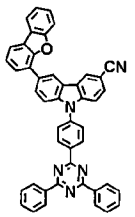


H2-233

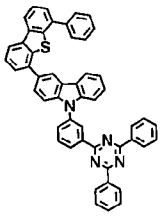


H2-234

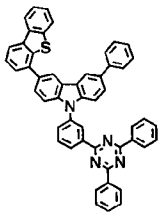
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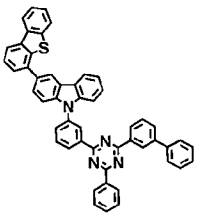
H2-235



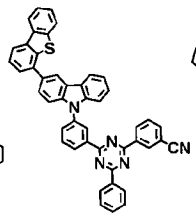
H2-236



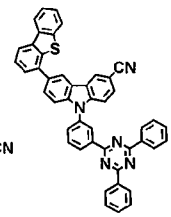
H2-237



H2-238

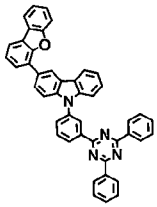


H2-239

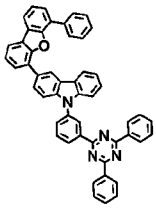


H2-240

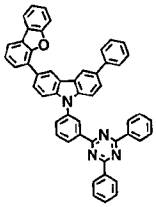
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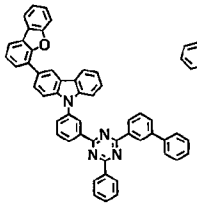
H2-241



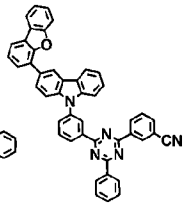
H2-242



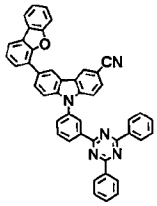
H2-243



H2-244

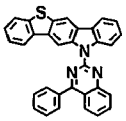


H2-245

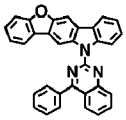


H2-246

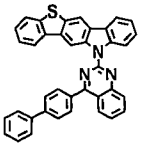
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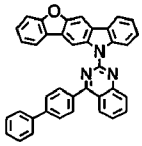
H2-247



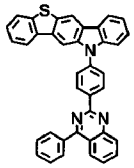
H2-248



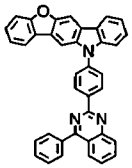
H2-249



H2-250

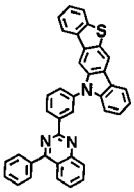


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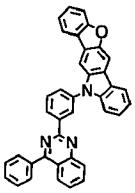


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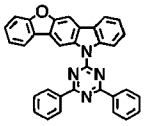
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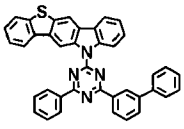
H2-253



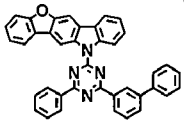
H2-254



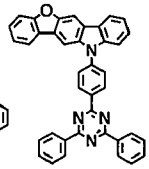
H2-255



H2-256

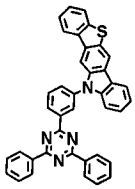


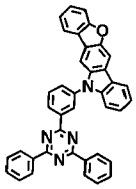
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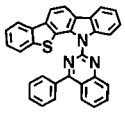


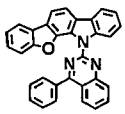
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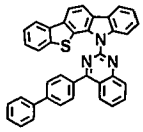
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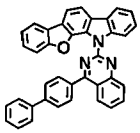

H2-259


H2-260

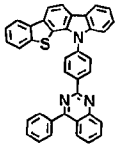

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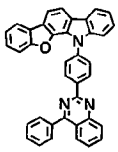

H2-262

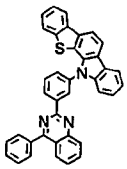

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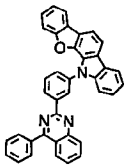

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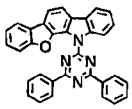
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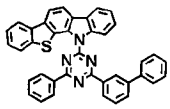

H2-265


H2-266

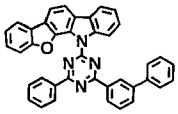

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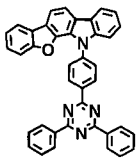

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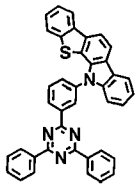

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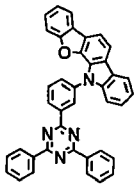

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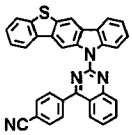
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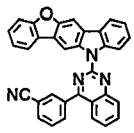

H2-271


H2-272

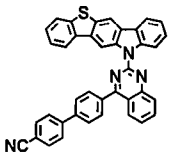

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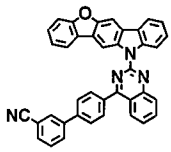

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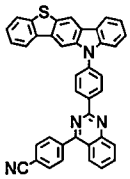

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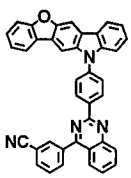

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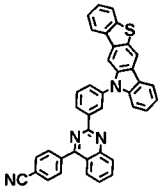
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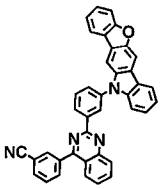

H2-277


H2-278

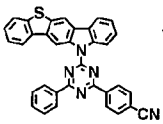

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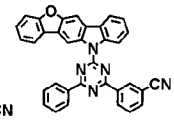

H2-280

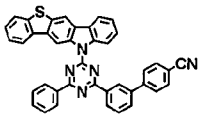

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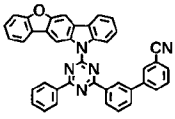

H2-282

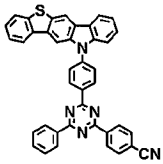
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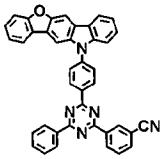

H2-283


H2-284

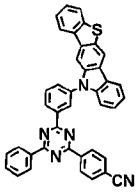

H2-285

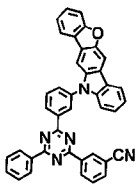

H2-286

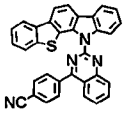

H2-287

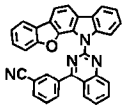

H2-288

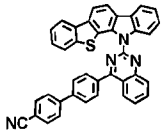
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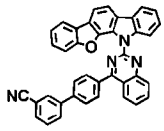

H2-289


H2-290

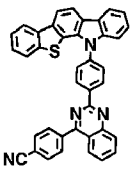

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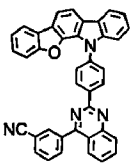

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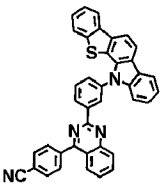

H2-293

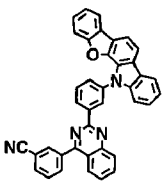

H2-294

[139]


H2-295


H2-296

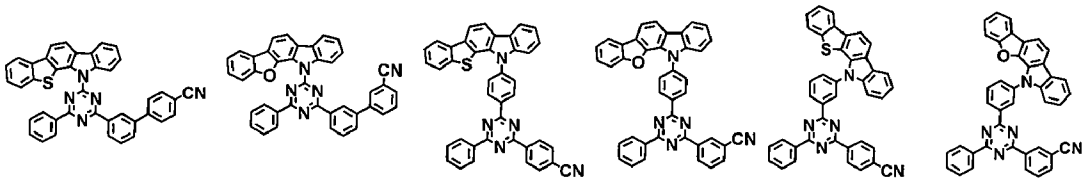

H2-297


H2-298

H2-299

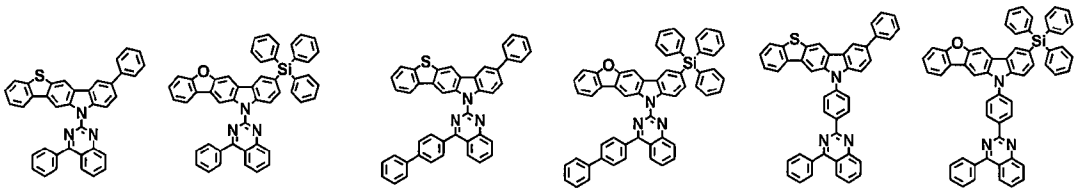
H2-300

[140]



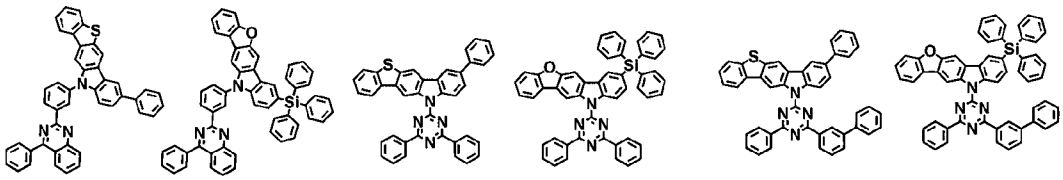
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[141]



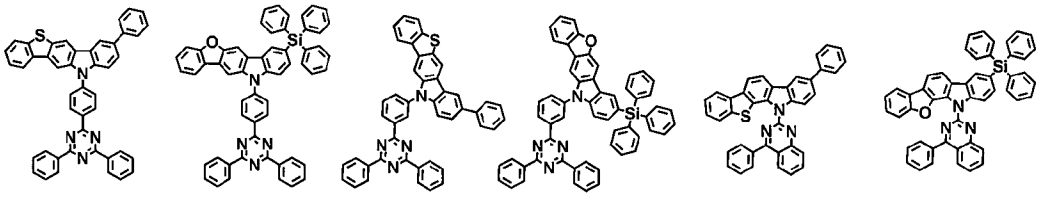
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[142]



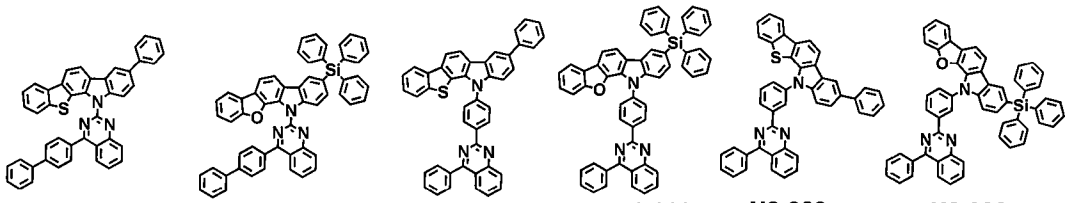
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[143]



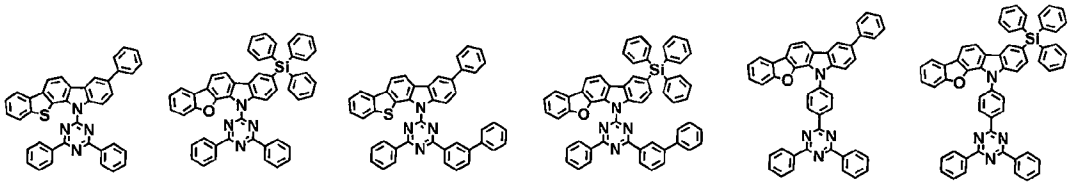
H2-319 H2-320 H2-321 H2-322 H2-323 H2-324

[144]



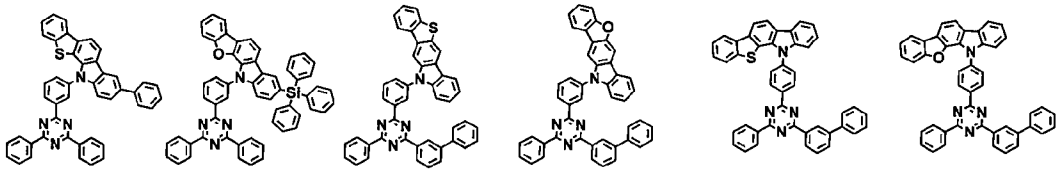
H2-325 H2-326 H2-327 H2-328 H2-329 H2-330

[145]



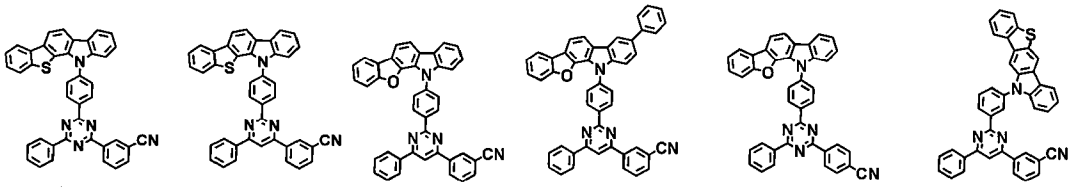
H2-331 H2-332 H2-333 H2-334 H2-335 H2-336

[146]



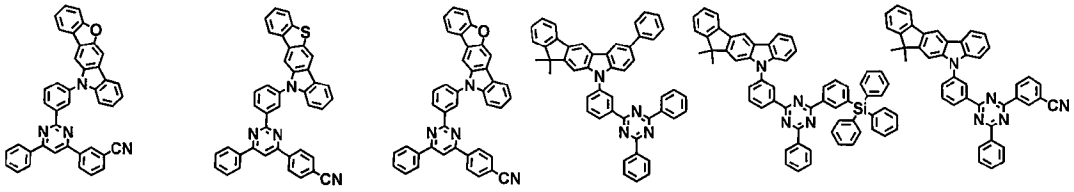
H2-337 H2-338 H2-339 H2-340 H2-341 H2-342

[147]



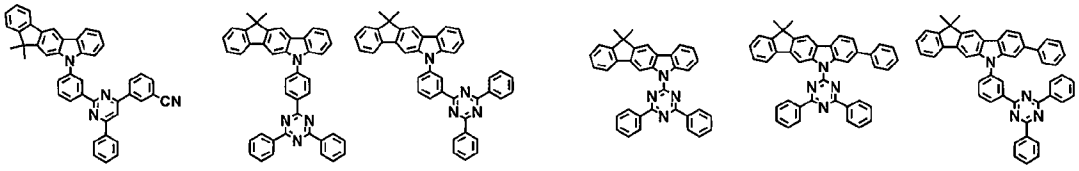
H2-343 H2-344 H2-345 H2-346 H2-347 H2-348

[148]



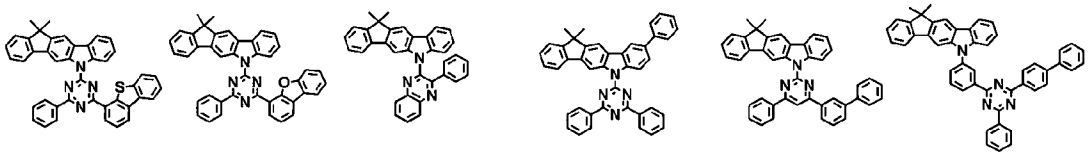
H2-349 H2-350 H2-351 H2-352 H2-353 H2-354

[149]



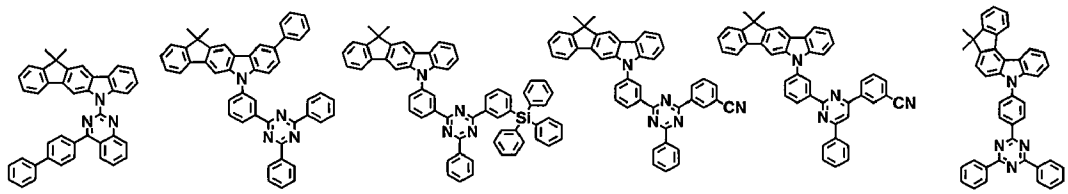
H2-355 H2-356 H2-357 H2-358 H2-359 H2-360

[150]



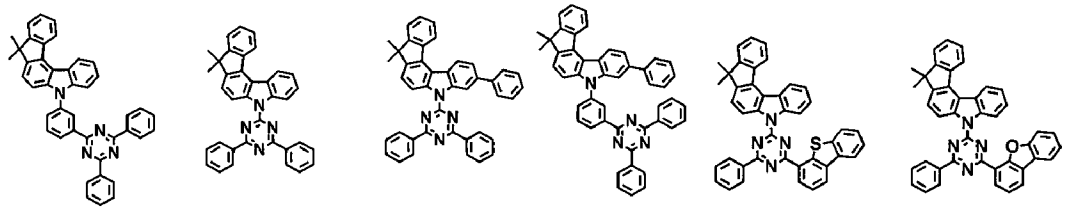
H2-361 H2-362 H2-363 H2-364 H2-365 H2-366

[151]



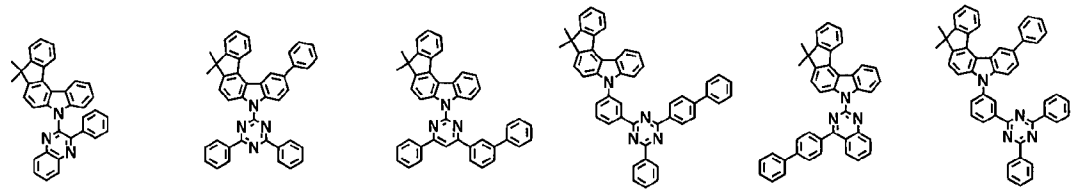
H2-367 H2-368 H2-369 H2-370 H2-371 H2-372

[152]



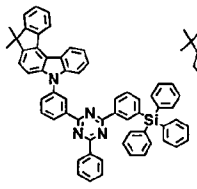
H2-373 H2-374 H2-375 H2-376 H2-377 H2-378

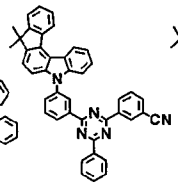
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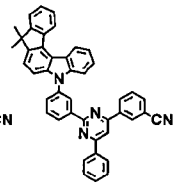


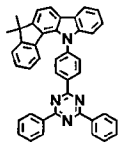
H2-379 H2-380 H2-381 H2-382 H2-383 H2-384

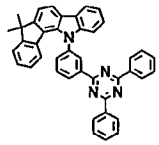
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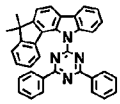

H2-385


H2-386

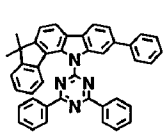

H2-387

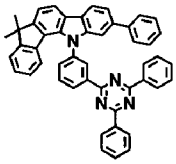

H2-388

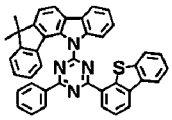

H2-389

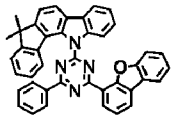

H2-390

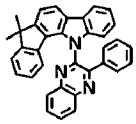
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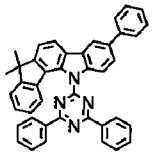

H2-391


H2-392

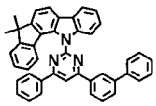

H2-393

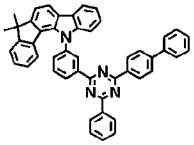

H2-394

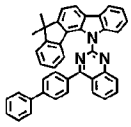

H2-395

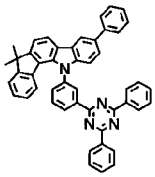

H2-396

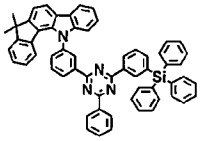
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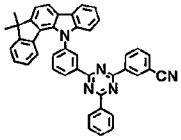

H2-397


H2-398

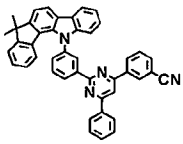

H2-399

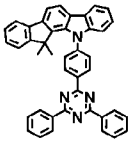

H2-400

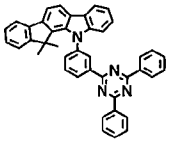

H2-401

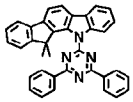

H2-402

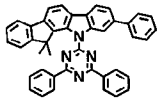
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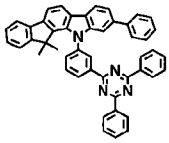

H2-403


H2-404

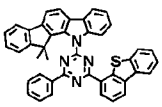

H2-405

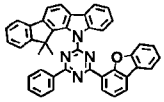

H2-406

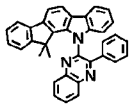

H2-407

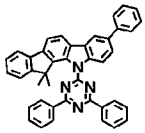

H2-408

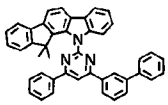
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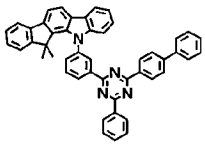

H2-409


H2-410

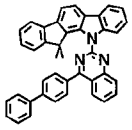

H2-411

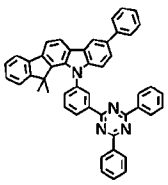

H2-412

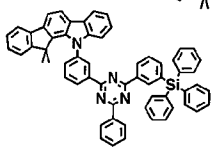

H2-413

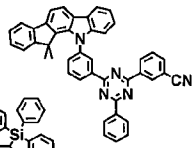

H2-414

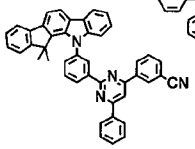
[159]

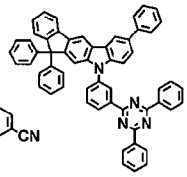

H2-415


H2-416

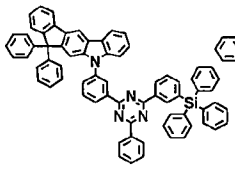

H2-417

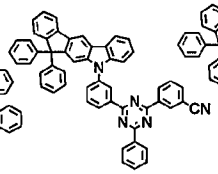

H2-418

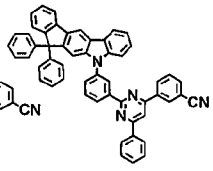

H2-419

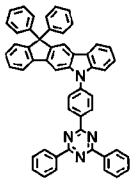

H2-420

[160]


H2-421


H2-422

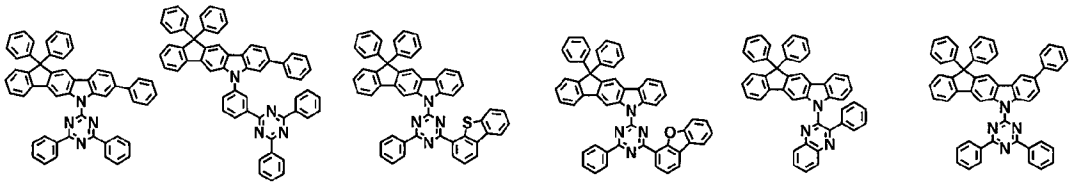

H2-423


H2-424

H2-425

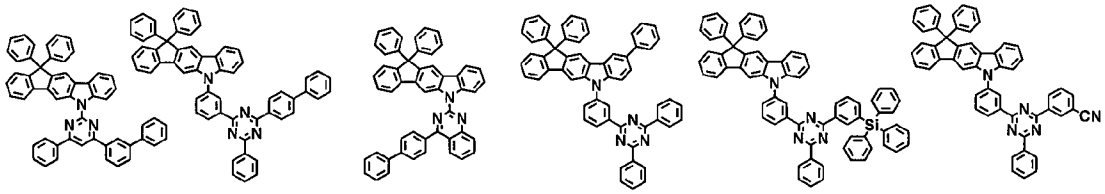
H2-426

[161]



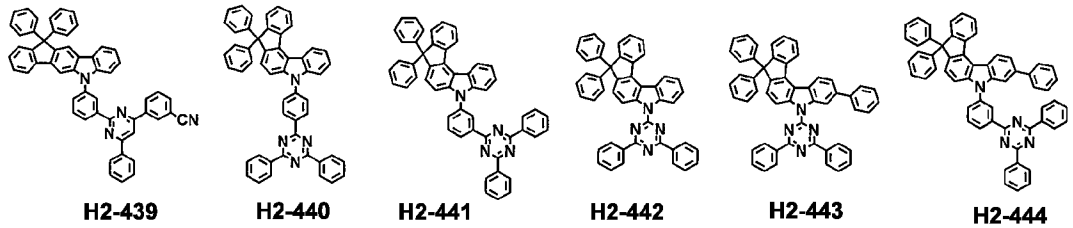
H2-427 H2-428 H2-429 H2-430 H2-431 H2-432

[162]



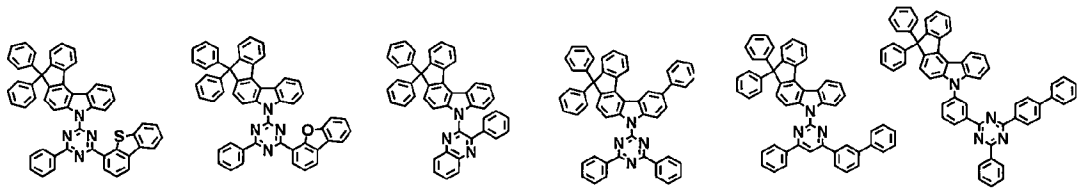
H2-433 H2-434 H2-435 H2-436 H2-437 H2-438

[163]



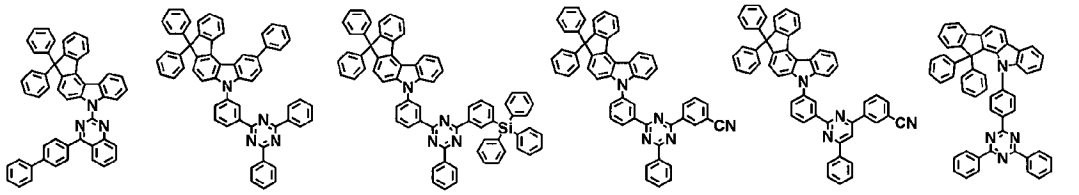
H2-439 H2-440 H2-441 H2-442 H2-443 H2-444

[164]



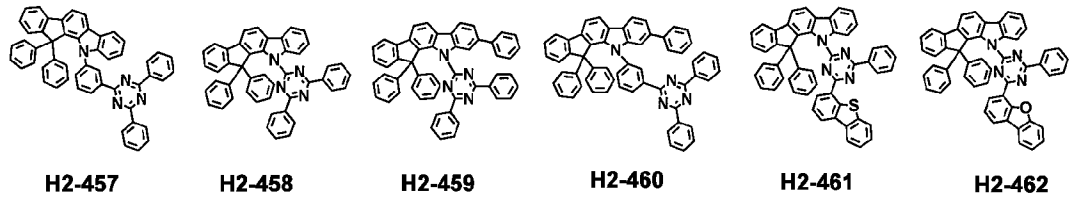
H2-445 H2-446 H2-447 H2-448 H2-449 H2-450

[165]



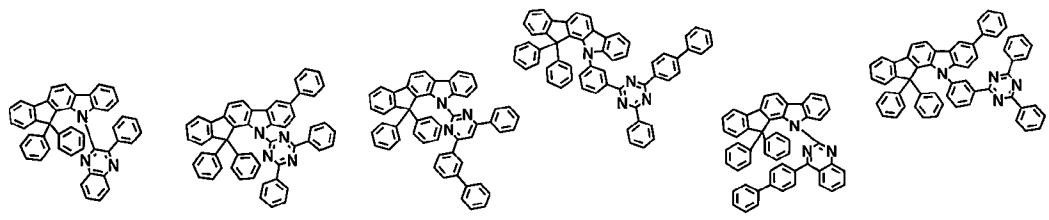
H2-451 H2-452 H2-453 H2-454 H2-455 H2-456

[166]



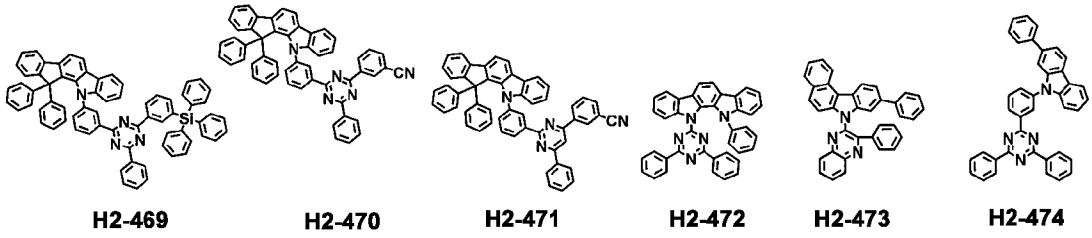
H2-457 H2-458 H2-459 H2-460 H2-461 H2-462

[167]



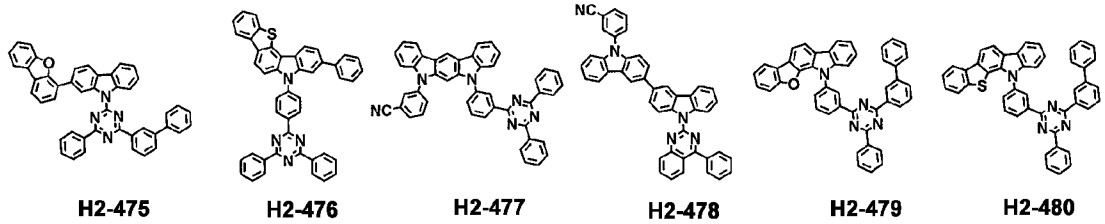
H2-463 H2-464 H2-465 H2-466 H2-467 H2-468

[168]



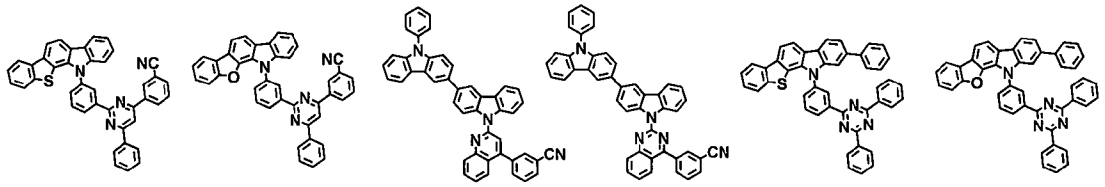
H2-469 H2-470 H2-471 H2-472 H2-473 H2-474

[169]



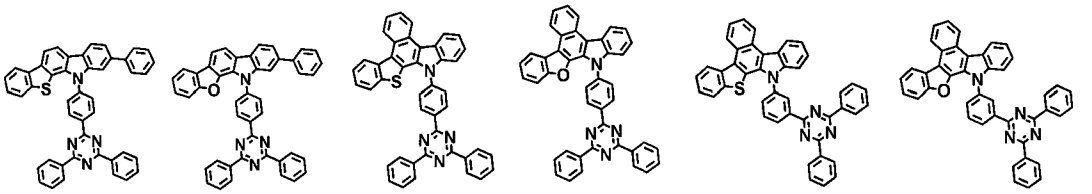
H2-475 H2-476 H2-477 H2-478 H2-479 H2-480

[170]



H2-481 H2-482 H2-483 H2-484 H2-485 H2-486

[171]



H2-487 H2-488 H2-489 H2-490 H2-491 H2-492

[172] According to another embodiment of the present disclosure, a combination of the compound represented by formula 1 and the compound represented by formula 2, and an organic electroluminescent device comprising the combination are provided.

[173] According to another embodiment of the present disclosure, a mixture or a composition for preparing an organic electroluminescent device is provided. The mixture or composition comprises the compound represented by formula 1. The mixture or composition may be for preparing a light-emitting layer of an organic electroluminescent device. The mixture or composition may comprise a host compound represented by formula 2, besides the compound of the present disclosure. In addition, the mixture or composition may comprise the compound represented by formula 1, which is combined with a host compound represented by formula 2. In addition, the mixture or composition may further comprise a conventional material which is included for preparing an organic electroluminescent device.

[174] The organic electroluminescent device of the present disclosure comprises the compound represented by formula 1, at the same time, the organic electroluminescent device comprises at least one compound selected from the group consisting of

arylamine-based compounds and styrylarylamine-based compounds.

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

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

[177] In the organic electroluminescent device of the present disclosure, preferably, at least one layer (hereinafter, "a surface layer") may be placed on an inner surface(s) of one or both electrode(s), selected from a chalcogenide layer, a metal halide layer, and a metal oxide layer. Specifically, a chalcogenide (includes oxides) layer of silicon or aluminum is preferably placed on an anode surface of an electroluminescent medium layer, and a metal halide layer or a metal oxide layer is preferably placed on a cathode surface of an electroluminescent medium layer. Such a surface layer provides operation stability for the organic electroluminescent device. Preferably, the chalcogenide includes SiO_X ($1 \leq X \leq 2$), AlO_X($1 \leq X \leq 1.5$), SiON, SiAlON, etc.; the metal halide includes LiF, MgF_2, CaF_2, a rare earth metal fluoride, etc.; and the metal oxide includes Cs_2O, Li_2O, MgO, SrO, BaO, CaO, etc.

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

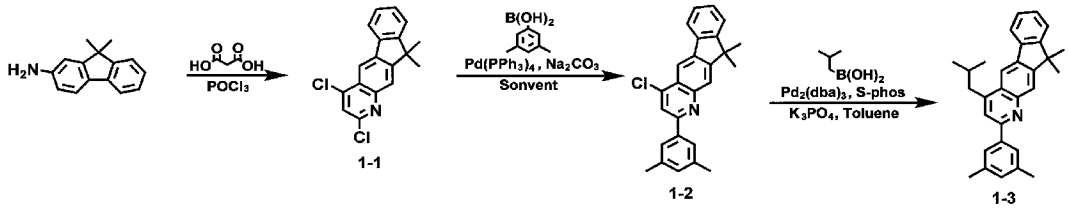
[179] In order to form each layer of the organic electroluminescent device of the present

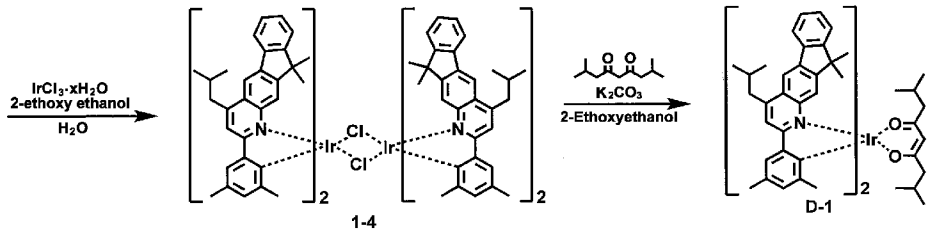
disclosure, dry film-forming methods such as vacuum evaporation, sputtering, plasma and ion plating methods, or wet film-forming methods such as ink jet printing, nozzle printing, slot coating, spin coating, dip coating, and flow coating methods can be used.

[180] When using a wet film-forming method, a thin film can be formed by dissolving or diffusing materials forming each layer into any suitable solvent such as ethanol, chloroform, tetrahydrofuran, dioxane, etc. The solvent can be any solvent where the materials forming each layer can be dissolved or diffused, and where there are no problems in film-formation capability.

[181] Hereinafter, the compound according to the present disclosure, the preparation method thereof, and the luminescent properties of the device will be explained in detail with reference to the following representative compounds.

[182] **Example 1: Praparation of compound D-1**

[183] 

[184] 

[185] 1) Preparation of compound 1-1

[186] After introducing malonic acid (38 g, 358 mmol) and $POCl_3$ (356 mL, 3822 mmol) into a reaction vessel, the mixture was stirred for 10 minutes at room temperature. After slowly adding 9,9-dimethyl-9H-fluorene-2-amine (50 g, 239 mmol) dropwise thereto, the mixture was stirred at 150℃. After slowly adding H_2O dropwise to the mixture, an extractioin with methylene chloride (MC) was conducted. After removing the solvent, the resultant was purified by column chromatography to obtain compound **1-1** (33.5 g, 45 %).

[187] 2) Preparation of compound 1-2

[188] After introducing compound 1-1 (16.5 g, 53 mmol), 3,5-dimethylphenylboronic acid (9.45 g, 63 mmol), $Pd(PPh_3)_4$ (1.82 g, 1.58 mmol), Na_2CO_3 (16.70 g, 157.53 mmol), toluene (214 mL), and H_2O (79 mL) into a reaction vessel, the mixture was under reflux at 120℃. The resultant was cooled to room temperature, extracted with ethyl acetate and H_2O, and then purified by column chromatography to obtain compound 1-2 (15.3 g, 76 %).

[189] 3) Preparation of compound 1-3

[190] After introducing compound 1-2 (15.3 g, 39.85 mmol), isobutyl boronic acid (8.198 g, 79.71 mmol), 2-dicyclohexylphosphino-2',6'-dimethoxybiphenyl(S-Phos) (1.30 g, 2.81 mmol), K_3PO_4 (41.43 g, 172.28 mmol), tris(dibenzylideneacetone)dipalladium(0)($Pd_2(dba)_3$) (1.46 g, 1.41 mmol), and toluene (266 mL) into the reaction vessel, the mixture was stirred for 12 hours. The resultant was cooled to room temperature, extracted with ethyl acetate and H_2O, and then purified by column chromatography to obtain compound 1-3 (15.1 g, 93 %).

[191] 4) Preparation of compound 1-4

[192] After introducing compound 1-3 (15.1 g, 37.23 mmol), $IrCl_3 \cdot xH_2O$ (5.05 g, 16.92 mmol), 2-ethoxy ethanol (130 mL), and H_2O (43.4 mL) into the reaction vessel, the mixture was under reflux for 24 hours at 130°C, and then the resultant was cooled to room temperature. After introducing H_2O, the mixture was stirred for 30 minutes, and then filtered to obtain compound 1-4 (7.9 g, 45 %) as solid.

[193] 5) Preparation of compound D-1

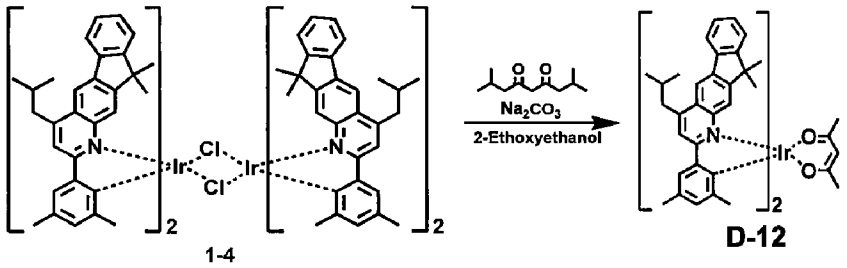
[194] After introducing compound 1-4 (3.5 g, 1.69 mmol), 2,8-dimethylnonane-4,6-dione (3.11 g, 16.88 mmol), K_2CO_3 (2.34 g, 16.88 mmol), and 2-ethoxyethanol (21 mL) into the reaction vessel, the mixture was reacted overnight at room temperature and filtered. The obtained solid was purified by column chromatography to obtain compound D-1 (0.7 g, 18 %).

[195]

	Molecular Weight (MW)	MP (℃)	UV (nm)	PL (nm)
D-1	1184.62	330	288	615

[196] **Example 2: Praparation of compound D-12**

[197]



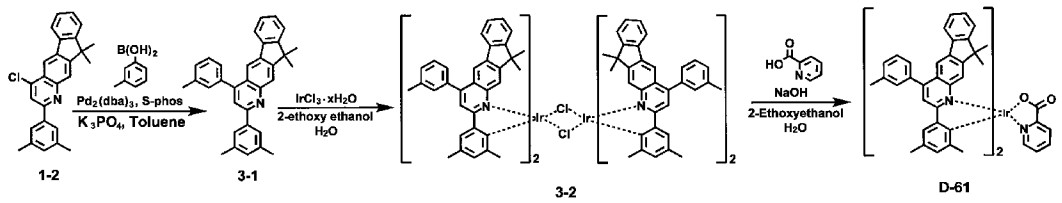
1-4 D-12

[198] After introducing compound 1-4 (7.9 g, 3.81 mmol), acetylacetone (3.8 g, 38.10 mmol), Na_2CO_3 (4.04 g, 38.10 mmol), and 2-ethoxyethanol (48 mL), the mixture was reacted overnight and then filtered. The obtained solid was purified by column chromatography to obtain compound D-12 (3 g, 36 %).

[199]

	MW	MP (℃)	UV (nm)	PL (nm)
D-12	1100.46	372	276	617

[200] **Example 3: Praparation of compound D-61**

[201] 

[202] 1) Preparation of compound 3-1

[203] After introducing compound 1-2 (67.2 g, 181.68 mmol), m-tolyl boronic acid (49.40 g, 363.35 mmol), tris(dibenzylideneacetone)dipalladium(0)($Pd_2(dba)_3$) (6.65 g, 7.27 mmol), K_3PO_4 (188.97 g, 890.23 mmol), 2-dicyclohexylphosphino-2',6'-dimethoxybiphenyl(s-phos) (6.00 g, 14.53 mmol), and toluene (1200 mL) into a 2L round-bottom flask, the mixture was stirred under reflux for 24 hours. After completion of the reaction, the reaction product was cooled to room temperature, then extracted with ethyl acetate and treated with $MgSO_4$. The reaction mixture was purified by column chromatography to obtain compound 3-1 (46 g, 58%).

[204] 2) Preparation of compound 3-2

[205] After introducing compound 3-1(46 g, 104.64 mmol), $IrCl_3 \cdot xH_2O$(14.22 g, 47.56 mmol), 2-ethoxyethanol (365 mL, 0.13 M), and H_2O(122 mL) into a 1L round-bottom flask under nitrogen atmosphere, the mixture was stirred under reflux for 24 hours. The reaction mixture was cooled to room temperature. The solvent was removed therefrom as much as possible, and then after adding water (500 mL), the mixture was stirred for 30 minutes. The reaction mixture was rinsed with methanol and hexane and dried to obtain compound 3-2 (50.7 g, 97%).

[206] 3) Preparation of compound D-61

[207] After introducing compound 3-2 (10 g, 4.53 mmol), picolinic acid (1.11 g, 9.05 mmol), NaOH(0.36 g, 9.05 mmol), 2-ethoxyethanol (105 mL, 0.043 M) and H_2O(10 mL) into a 250 mL round-bottom flask under nitrogen atmosphere, the mixture was stirred at room temperature for 24 hours. After completion of the reaction, water (330 mL) was added. Thereafter, the mixture was stirred for 30 minutes and then filtered. The obtained resultant was purified by column chromatography to obtain compound D-61(0.8 g, 30%).

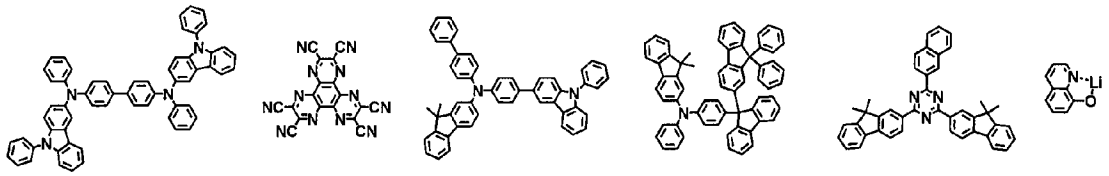
[208] **[Device Examples 1-1 and 1-2] Preparation of OLED comprising a dopant**

[209] **of the present disclosure**

[210] OLED comprising the organic electroluminescent compound of the present

disclosure was produced. A transparent electrode indium tin oxide (ITO) thin film (10 Ω/sq) on a glass substrate for an organic light-emitting diode (OLED) (Geomatec) was subjected to an ultrasonic washing with acetone, ethanol, and distilled water, sequentially, and then was stored in isopropanol. The ITO substrate was then mounted on a substrate holder of a vacuum vapor depositing apparatus. **HI-1** was introduced into a cell of the vacuum vapor depositing apparatus, and then the pressure in the chamber of said apparatus was controlled to 10^{-6} torr. Thereafter, an electric current was applied to the cell to evaporate the above introduced material, thereby forming a first hole injection layer having a thickness of 80 nm on the ITO substrate. **HI-2** was introduced into another cell of the vacuum vapor depositing apparatus, and was evaporated by applying an electric current to the cell, thereby forming a second hole injection layer having a thickness of 5 nm on the first hole injection layer. **HT-1** was introduced into a cell of the vaccum vapor depositing apparatus, and was evaporated by applying an electric current to the cell, thereby forming a first hole transport layer having a thickness of 10 nm on the second hole injection layer. **HT-2** was introduced into another cell of the vacuum vapor depositing apparatus, and was evaporated by applying an electric current to the cell, thereby forming a second hole transport layer having a thickness of 60 nm on the first hole transport layer. Then, the light-emitting layer on the hole injection layers and the hole transport layers was formed as follows. Compound **H2-16** was introduced into one cell of the vacuum vapor depositing apparatus as a host, and a dopant material shown in Table 1 below was introduced into another cell. Thereafter, the host material was evaporated, and simultaneously, the dopant material was evaporated at different rates from the host material, so that the dopant was deposited in a doping amount of 3 wt% based on the total amount of the host and dopant to form a light-emitting layer having a thickness of 40 nm on the second hole transport layer. **ET-1** and **EI-1** were introduced into two cells of the vacuum vapor depositing apparatus, respectively, and evaporated at a 1:1 rate to form an electron transport layer having a thickness of 30 nm on the light-emitting layer. After depositing **EI-1** as an electron injection layer having a thickness of 2 nm, an Al cathode having a thickness of 80 nm was then deposited by another vacuum vapor deposition apparatus on the electron injection layer to produce OLED.

[211]

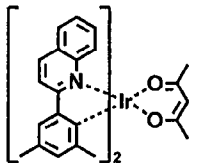


HI-1 HI-2 HT-1 HT-2 ET-1 EI-1

[212] **[Comparative Example 1-1] Preparation of OLED comprising a conventional**

[213] **dopant**

[214] OLED was produced in the same manner as in Device Example 1-1, except that compound RD-1 below was used as a dopant for a light-emitting layer.

[215] 

RD-1

[216] The evaluation result of the OLED prepared in Device Examples 1-1 and 1-2, and Comparative Example 1-1 above is shown in Table 1 below.

[217] [Table 1]

	Host	Dopant	Voltage (V)	Efficiency (cd/A)	Color Coordinate (x, y)	
Device Example 1-1	H2-16	D-12	4.2	32.7	668	331
Device Example 1-2	H2-16	D-1	4.1	34.0	669	330
Comparative Example 1-1	H2-16	RD-1	4.2	22.4	660	338

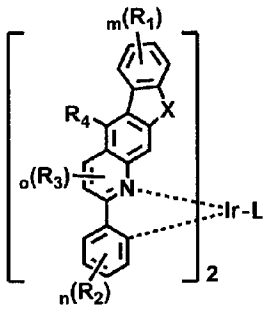
[218] By using an organic electroluminescent compound of the present disclosure, it is possible to provide an organic electroluminescent device with excellent efficiency and color purity compared to the conventional electroluminescent compound.

[219] This can be understood that an azabenzo[b]fluorene ligand of the Device Example attributes the organic electroluminescent device to have better efficiency compared to the quinoline ligand of the Comparative Example. Besides, the substituent (alkyl substituent in the Device Example above) is introduced on the outside of azabenzo[b]fluorene ligand according to the present disclosure, and it can be understood that the substituent applies a steric hindrance to the octahedral structure of the iridium complex, thereby reducing Triplet-Triplet Annihilation to maximize the characteristic which improves efficiency.

[220] Upon comparing the azabenzo[b]fluorene ligand of the present disclosure with an azabenzo[a]fluorene ligand, according to the quantum mechanics simulation results, the bond distance between the azabenzo[b]fluorene ligand and the iridium metal is shorter than the one between the azabenzo[a]fluorene ligand and the iridium metal. It can be predicted that the shorter the bond distance, the stronger the spin orbital coupling by an iridium atom is applied to have better efficiency.

Claims

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



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

wherein

X represents $CR_{11}R_{12}$, O or S;

R_1 to R_3, each independently, represent hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl;

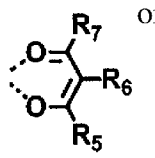
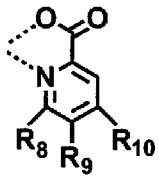
R_4 represents hydrogen, or a substituted or unsubstituted (C1-C10)alkyl;

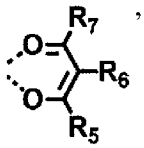
R_{11} and R_{12}, each independently, represent a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl;

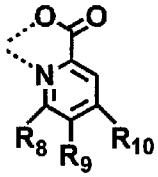
m and n, each independently, represent an integer of 0 to 4;

o represents an integer of 0 to 2;

where m, n or o is an integer of 2 or more, each of R_1, each of R_2, or each of R_3 may be the same or different;

L represents  or  ;

where L is  ,

R_5 to R_7, each independently, represent hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl; where L is  ,

R_8 to R_{10}, each independently, represent hydrogen, deuterium, a substituted or unsubstituted (C1-C10)alkyl, or a substituted or unsubstituted (C6-C30)aryl; or may be linked to an adjacent substituent to form a substituted or unsubstituted 9- to 20-membered heteroaryl including the pyridine ring linked to R_8 to R_{10}; and the heteroaryl may comprise one or more hetero atoms selected from a nitrogen, an oxygen, and a sulfur in addition to the nitrogen atom of the pyridine ring.

[Claim 2] The organic electroluminescent compound according to claim 1, wherein

R_{11} and R_{12} are each independently, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl.

[Claim 3] The organic electroluminescent compound according to claim 1, wherein

R_1 to R_3 are each independently hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl.

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

R_{11} and R_{12} are each independently, a (C1-C4)alkyl unsubstituted or substituted deuterium, or an unsubstituted (C6-C15)aryl;

R_1 to R_3 are each independently hydrogen, an unsubstituted (C1-C4)alkyl, or a (C6-C15)aryl unsubstituted or substituted with a (C1-C4)alkyl; and

R_4 is hydrogen.

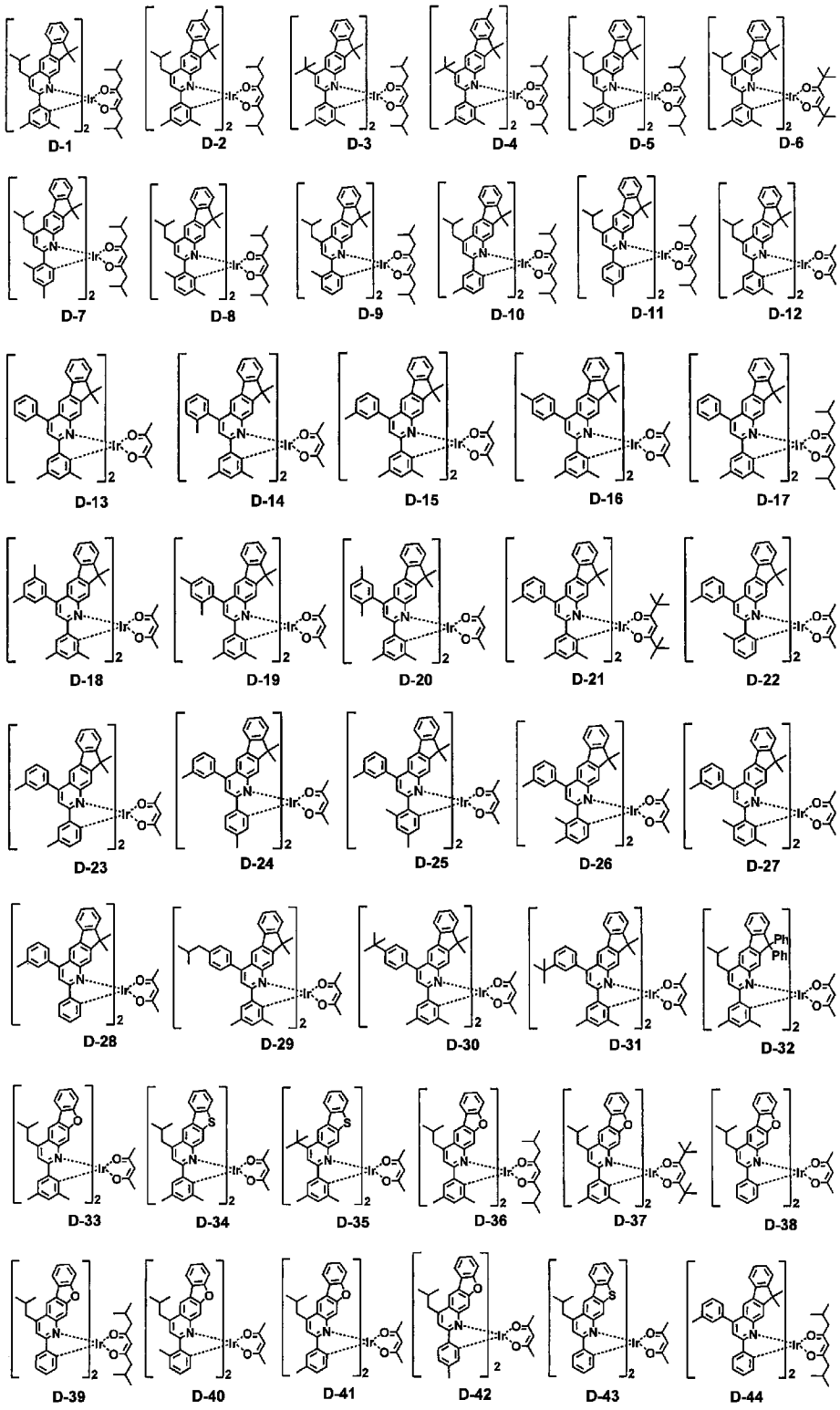
[Claim 5] The organic electroluminescent compound according to claim 1, wherein

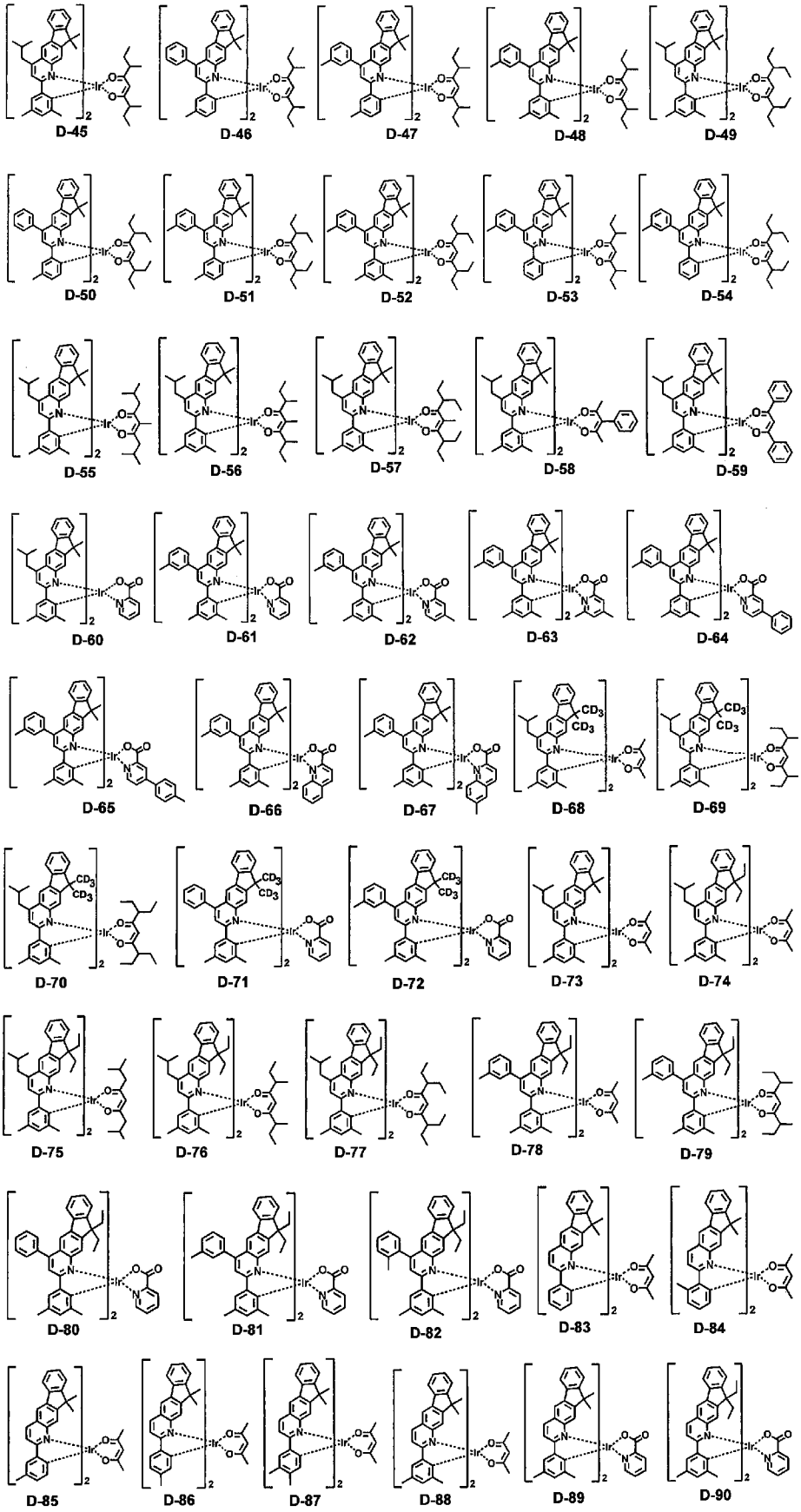
R_5 to R_7 are each independently hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C15)aryl.

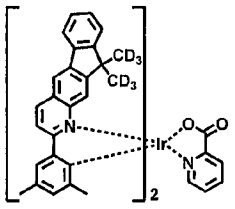
[Claim 6] The organic electroluminescent compound according to claim 1, wherein

R_8 to R_{10} are each independently hydrogen, a substituted or unsubstituted (C1-C5)alkyl, or a substituted or unsubstituted (C6-C20)aryl; or at least two of R_8 to R_{10} may be linked to each other as an adjacent substituent to form a 9- to 16-membered heteroaryl which includes the pyridine ring linked to R_8 to R_{10} and is unsubstitued or substituted with a (C1-C15)alkyl, and the heteroaryl may comprise one or more hetero atoms selected from a nitrogen, an oxygen, and a sulfur in addition to a nitrogen atom of the pyridine ring.

[Claim 7] The organic electroluminescent compound according to claim 1, wherein the compound represented by formula 1 is selected from the group consisting of:




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D-91 .

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2016/014435

A. CLASSIFICATION OF SUBJECT MATTER

C07F 15/00 (2006.01) ***C07D 413/00 (2006.01)*** ***C07D 419/14 (2006.01)*** ***H01L 51/50 (2006.01)*** ***C09K 11/06 (2006.01)*** ***C09K 11/62 (2006.01)***

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

STN Caplus: Sub-Structure based on formula 1 and applicant/inventor 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	

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

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"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)

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

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

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

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

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Date of the actual completion of the international search	Date of mailing of the international search report
7 February 2017	07 February 2017
Name and mailing address of the ISA/AU	**Authorised officer**
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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/KR2016/014435**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7951472 B2 (IGARASHI et al) 31 May 2011 See whole document.	1-8
A	WO 2015/056993 A1 (ROHM AND HASS ELECTRONICS MATERIALS KOREA LTD) 23 April 2015 See Whole document.	1-8

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/KR2016/014435**

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 7951472 B2	31 May 2011	US 2010171113 A1	08 Jul 2010
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		US 2010174071 A1	08 Jul 2010
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End of Annex

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