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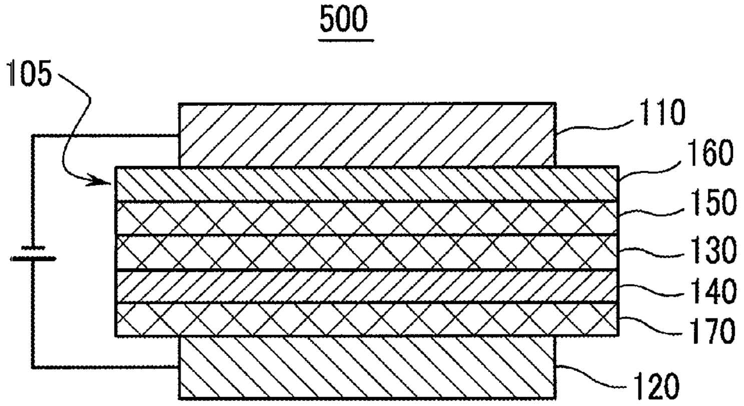
[Continued on next page]

(54) Title: MATERIAL FOR ORGANIC PHOTOELECTRIC DEVICE INCLUDING ELECTRON TRANSPORTING UNIT AND HOLE TRANSPORTING UNIT, AND ORGANIC PHOTOELECTRIC DEVICE INCLUDING THE SAME

FIG. 5



(57) Abstract: The material for an organic photoelectric device is a phosphorescent material having thermal stability due to a glass transition temperature (Tg) of 120° C or more and a thermal decomposition temperature of 400° C or more. The material is capable of realizing a high efficiency organic photoelectric device The material for an organic photoelectric device includes a bipolar organic compound including both a hole transporting unit and an electron transporting unit. An organic photoelectric device including a material for the organic photoelectric device is also provided.

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TITLE OF THE INVENTION

MATERIAL FOR ORGANIC PHOTOELECTRIC DEVICE INCLUDING ELECTRON TRANSPORTING UNIT AND HOLE TRANSPORTING UNIT, AND ORGANIC PHOTOELECTRIC DEVICE INCLUDING THE SAME

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates to a material for an organic photoelectric device and an organic photoelectric device including the same. More particularly, the present invention relates to a material for an organic photoelectric device having thermal stability due to a glass transition temperature (Tg) of 120° C or more and a thermal decomposition temperature of 400° C or more, having bipolar characteristics due to good hole and electron transporting properties, and being capable of realizing high efficiency of an organic photoelectric device, and an organic photoelectric device including the same.

(b) Description of the Related Art

A photoelectric device is, in a broad sense, a device for transforming photo energy to electrical energy, and conversely, for transforming electrical energy to photo energy. The photoelectric device may be exemplified by an organic light emitting diode, a solar cell, a transistor, and so on.

Particularly, among these photoelectric devices, the organic light emitting device employing organic light emitting diodes (OLED) has recently drawn attention due to the increase in demand for flat panel displays.

The organic light emitting device transforms electrical energy into light by applying current to an organic light emitting material. It has a structure in which a functional organic material layer is interposed between an anode and a cathode.

The organic light emitting diode has similar electrical characteristics to those of light emitting diodes (LED) in which holes are injected from an anode and electrons are injected from a cathode, then the holes and electrons move to opposite electrodes and are recombined to form excitons having high energy. The formed excitons generate lights having a certain wavelength while shifting to a ground state.

Generally, the organic light emitting diode is composed of an anode of a transparent electrode, an organic thin layer of a light emitting region, and a metal electrode (cathode) formed on a glass substrate, in that order. The organic thin layer may includes an emission layer, a hole injection layer (HIL), a hole transport layer (HTL), an electron transport layer (ETL), or an electron injection layer (EIL). It may further include an electron blocking layer or a hole blocking layer due to the emission characteristics of the emission layer.

When the organic light emitting diode is applied with an electric field, the holes and electrons are injected from the anode and the cathode, respectively. The injected holes and electrons are recombined on the emission layer though the hole transport layer (HTL) and the electron transport layer (ETL) to provide light emitting excitons.

The provided light emitting excitons emit light by transiting to the ground state.

The light emitting may be classified as a fluorescent material including singlet excitons and a phosphorescent material including triplet excitons.

In other words, the duration of fluorescent emission is extremely short at several nanoseconds, but the duration of phosphorescent emission is relatively long such as at several microseconds, so that it provides a characteristic of extending the lifetime (emission duration) to more than that of the fluorescent emission.

In addition, evaluating quantum mechanically, when holes injected from the anode are recombined with electrons injected from the cathode to provide light emitting excitons, the singlet and the triplet are produced in a ratio of 1:3, in which the triplet light emitting excitons are produced at three times the amount of the singlet light emitting excitons in the organic light emitting diode.

Accordingly, the percentage of the singlet exited state is 25% (the triplet is 75%) in the case of a fluorescent material, so it has limits in luminous efficiency. On the other hand, in the case of a phosphorescent material, it can utilize 75% of the triplet exited state and 25% of the singlet exited state, so theoretically the internal quantum efficiency can reach up to 100%. When phosphorescent light emitting material is used, it has advantages in an increase in luminous efficiency of around four times than that of the fluorescent light emitting material.

In this structure, the efficiency and properties of the light emission diodes are dependent on the host material in the emission layer. According to studies regarding the emission layer (host), the organic host material can be exemplified by a material including naphthalene, anthracene, phenanthrene, tetracene, pyrene, benzopyrene, chrysene, pycene, carbazole, fluorene, biphenyl, terphenyl, triphenylene oxide, dihalobi phenyl, trans-stilbene, and 1,4-diphenylbutadiene.

Generally, the host material includes 4,4-N,N-dicarbazolebiphenyl (CBP) having a glass transition temperature of 110° C or less and a thermal decomposition temperature of 400° C or less, in which the thermal stability is low and the symmetry is excessively high. Thereby, it tends to crystallize and cause problems such as a short and a pixel defection according to results of thermal resistance tests of the devices.

In addition, most host materials including CBP are materials in which the hole transporting property is greater than the electron transporting property. In other words, as the injected hole transportation is faster than the injected electron transportation, the excitons are ineffectively formed in the emission layer. Therefore, the resultant device has deteriorated luminous efficiency.

Accordingly, in order to realize a highly efficient and long lifetime organic light emitting device, it is required to develop a phosphorescent host material having high electrical and thermal stability and that is capable of transporting both holes and electrons.

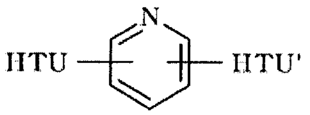
SUMMARY OF THE INVENTION

According to one embodiment of the present invention, provided is a material for an organic photoelectric device having thermal stability due to a glass transition temperature (Tg) of 120° C or more and a thermal decomposition temperature of 400° C or more, having bipolar characteristics due to good hole and electron transporting properties, and being capable of realizing a high efficiency organic photoelectric device. According to another embodiment of the present invention, provided is an organic photoelectric device having high luminous efficiency and a long life-span.

The embodiments of the present invention are not limited to the above technical purposes, and a person of ordinary skill in the art can understand other technical purposes.

One embodiment of the present invention provides a material for an organic photoelectric device that includes the compound represented by the following Formula 1. The material is a bipolar organic compound including both a hole transporting unit and an electron transporting unit.

[Chemical Formula 1]



Wherein, in the above Formula 1,

the pyridine (C_6H_5N) is an electron transporting unit,

the HTU and HTU' independently are as a hole transporting unit, and

the HTU and HTU' are the same or different.

Another embodiment of the present invention provides an organic photoelectric device that includes an anode, a cathode, and organic thin layers disposed between the anode and cathode. The organic thin layer includes the above material for an organic photoelectric device.

Hereinafter, other embodiments of the present invention will be described in detail.

The material for an organic photoelectric device can provide an organic photoelectric device having high luminous efficiency at a low driving voltage.

BRIEF DESCRIPTION OF THE DRAWINGS

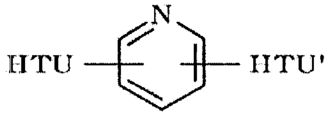
FIGS. 1 to 5 are cross-sectional views showing organic photoelectric devices including organic compounds according to various embodiments of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Exemplary embodiments of the present invention will hereinafter be described in detail. However, these embodiments are only exemplary, and the present invention is not limited thereto.

The material for an organic photoelectric device according to one embodiment of the present invention includes a compound represented by the following Formula 1. The material is a bipolar organic compound including both a hole transporting unit and an electron transporting unit.

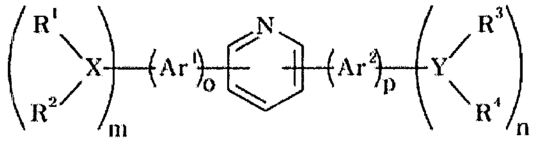
[Chemical Formula 1]



In the above Formula 1, the pyridine (C_6H_5N) is an electron transporting unit, the HTU and HTU' independently are a hole transporting unit, and the HTU and HTU' are the same or different.

The organic compound of the above Formula 1 is exemplified by the organic compound of the following Formula 2.

[Chemical Formula 2]



In the above Formula 2, X and Y are independently selected from the group consisting of nitrogen (N), sulfur (S), and oxygen (O).

Ar^1 and Ar^2 are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 alkylene, a substituted or unsubstituted C2 to C30 heteroaryl, and a substituted or unsubstituted C2 to C30 heteroarylene.

R^1 to R^4 are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C2 to C30 heteroarylene, a substituted or unsubstituted C1 to C30 alkyl, and a substituted or unsubstituted C1 to C30 alkylene. Alternately, R^1 and R^2 form a cyclic ring or R^3 and R^4 form a cyclic ring.

When X is sulfur or oxygen, R^2 is a unshared electron pair, and when Y is sulfur or oxygen, R^4 is a unshared electron pair.

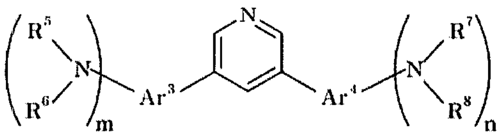
m and n are independently integers ranging from 0 to 3, m+n is more than or equal to 1, and o and p are integers ranging from 0 to 2.

In the present specification, when specific definition is not provided, the term “substituted” refers to one substituted with at least a substituent selected from the group consisting of a halogen, a cyano, a hydroxy, an amino, a C1 to C30 alkyl, a C3 to C30 cycloalkyl, a C6 to C30 aryl, and a C2 to C30 heteroaryl.

In the present specification, when specific definition is not provided, the term “hetero” refers to one including 1 to 3 heteroatoms selected from the group consisting of nitrogen (N), oxygen (O), sulfur (S), phosphorus (P), and Si (silicon) instead of carbon.

In the above Formula 2, when X and Y are nitrogen, and o and p are 1, the organic compound having the above Formula 2 may be represented by the following Formula 3.

[Chemical Formula 3]



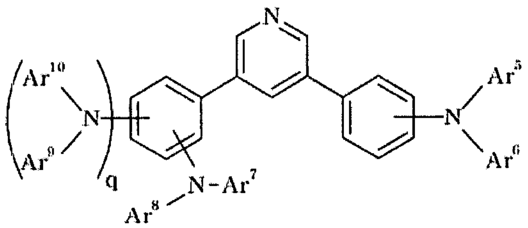
In the above Formula 3, Ar^3 and Ar^4 are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 alkylene, a substituted or unsubstituted C2 to C30 heteroaryl, and a substituted or unsubstituted C2 to C30 heteroarylene.

R^5 to R^8 are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C2 to C30 heteroarylene, a substituted or unsubstituted C1 to C30 alkyl, and a substituted or unsubstituted C1 to C30 alkylene. Alternately, R^5 and R^6 form a cyclic ring or R^7 and R^8 form a cyclic ring.

m and n are independently integers ranging from 0 to 3, and m+n is more than or equal to 1.

In the above Formula 3, when m+n is more than or equal to 2 and Ar^3 and Ar^4 are phenyl, the organic compound having the above Formula 3 may be represented by the following Formula 4.

[Chemical Formula 4]

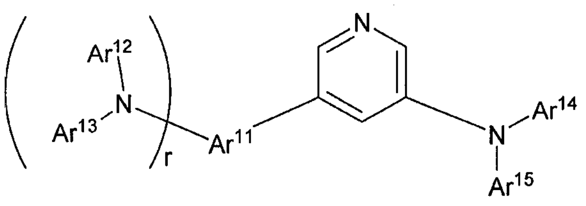


In the above Formula 4, Ar^5 to Ar^{10} are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 alkylene, a substituted or unsubstituted C2 to C30 heteroaryl, and a substituted or unsubstituted C2 to C30 heteroarylene. Alternately, Ar^5 and Ar^6 form a cyclic ring, Ar^7 and Ar^8 form a cyclic ring, or Ar^9 and Ar^{10} form a cyclic ring.

q is an integer ranging from 0 to 2.

In the above Formula 3, when m+n is more than or equal to 2, o is 1, and p is 0, the organic compound having the above Formula 3 may be represented by the following Formula 5.

[Chemical Formula 5]

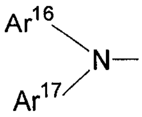


In the above Formula 5, Ar^{11} to Ar^{15} are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 alkylene, a substituted or unsubstituted C2 to C30 heteroaryl, and a substituted or unsubstituted C2 to C30 heteroarylene. Alternately, Ar^{12} and Ar^{13} form a cyclic ring, or Ar^{14} and Ar^{15} form a cyclic ring.

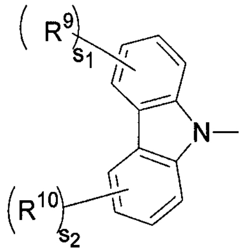
r is an integer ranging from 0 to 2.

In the organic compound of the above Formula 2, at least one substituent selected from the group consisting of XR^1R^2, YR^3R^4, and a combination thereof may be selected from the following Formulae 6a to 6d.

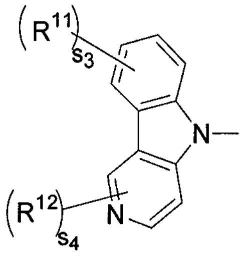
[Chemical Formula 6a]



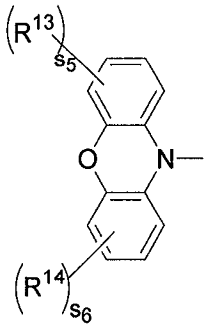
[Chemical Formula 6b]



[Chemical Formula 6c]



[Chemical Formula 6d]



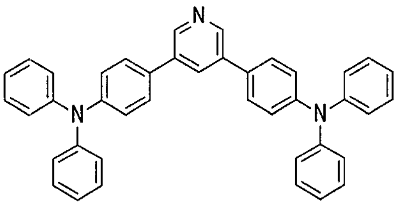
In the above Formulae 6a to 6d, Ar^{16} and Ar^{17} are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl and a substituted or unsubstituted C2 to C30 heteroaryl.

R^9 to R^{14} are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C2 to C20 alkoxy, and $SiR_{15}R_{16}R_{17}$ (where R_{15} to R_{17} are independently selected from the group consisting of a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C3 to C30 cycloalkyl, a nitrile, a cyano, a nitro, a carbonyl, and an amide). s_1 to s_6 are independently integers ranging from 0 to 4.

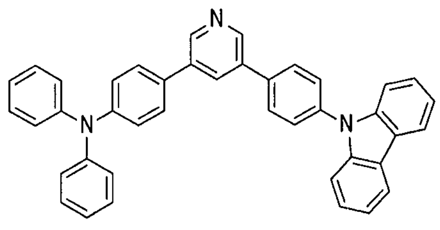
The organic compounds having the above Formulae 1 to 5 have thermal stability such as a glass transition temperature (Tg) of 120° C or more, and a thermal decomposition temperature (Td) of 400° C or more.

The organic compounds having the above Formula 2 may be selected from the group consisting of the following compounds (1) to (41), and combinations thereof, but are not limited thereto.

Compound (1)

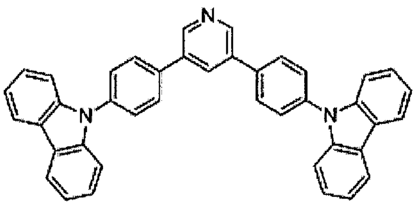


Compound (2)

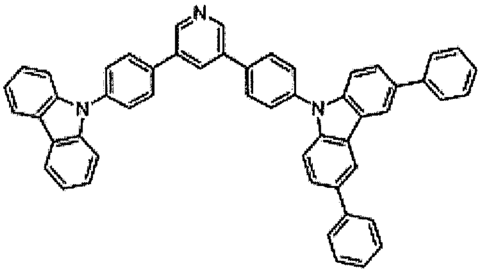


Compound (3)

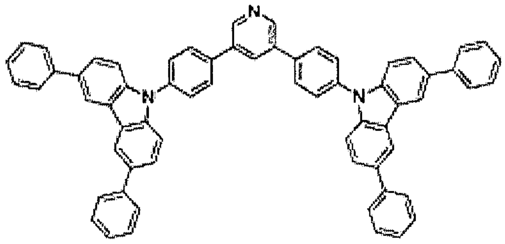
Compound (4)



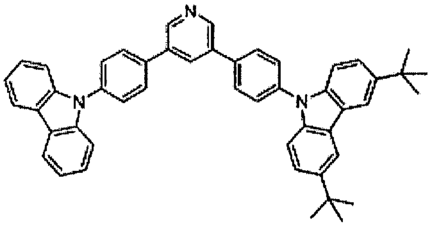
Compound (5)



Compound (6)



Compound (7)



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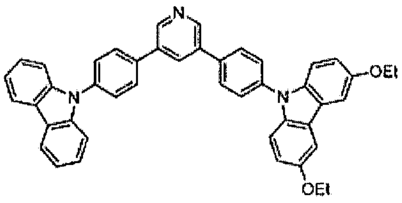

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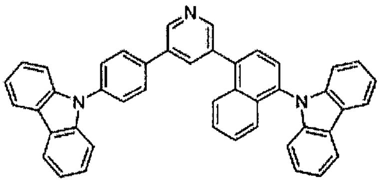

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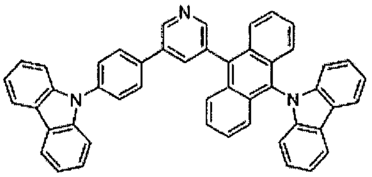
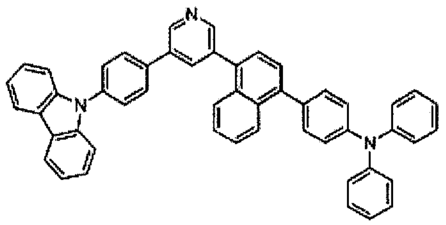
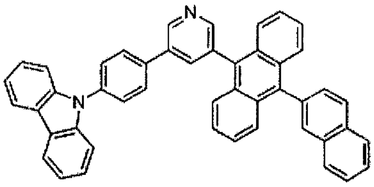


Compound (11)



Compound (12)



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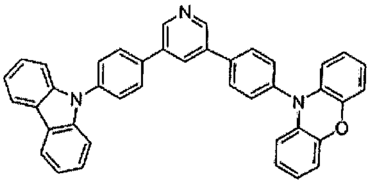

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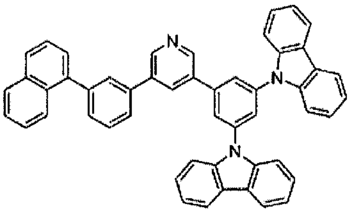
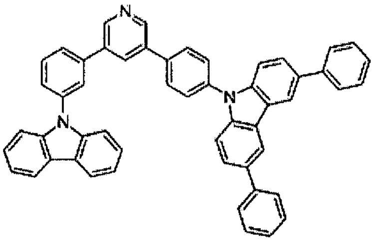
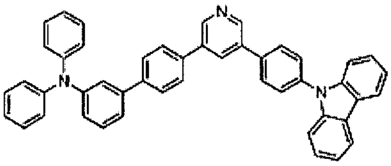


Compound (15)



Compound (16)



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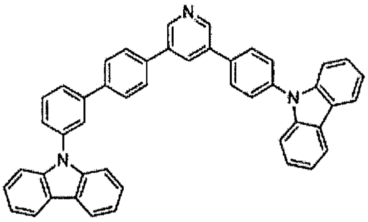
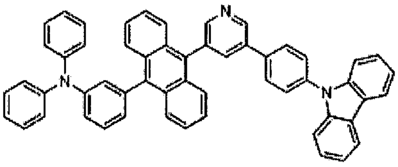


Compound (18)



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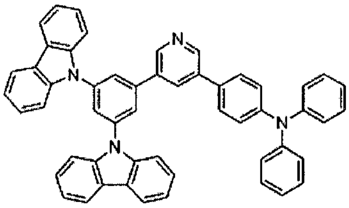
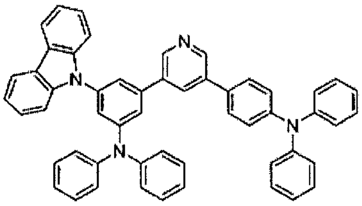
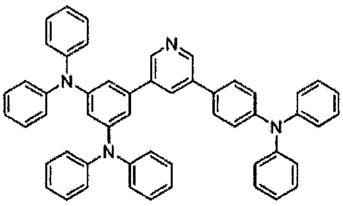


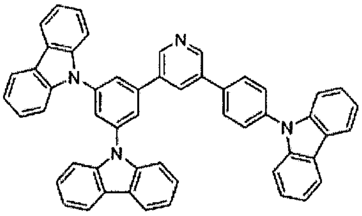
Compound (20)



Compound (21)



Compound (22)



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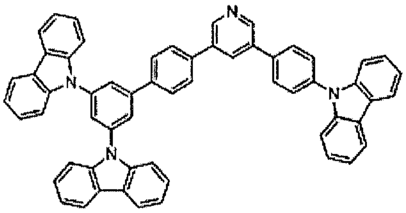

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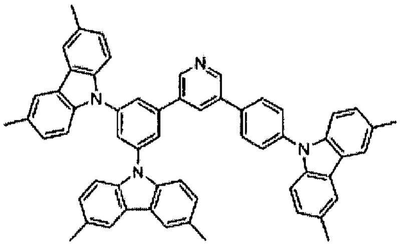

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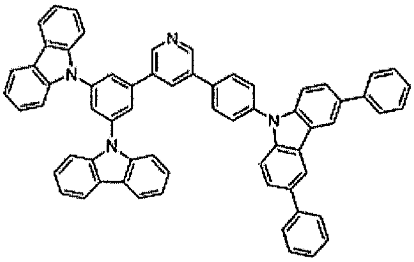

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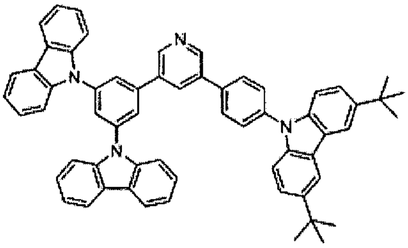

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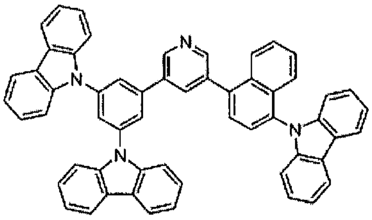

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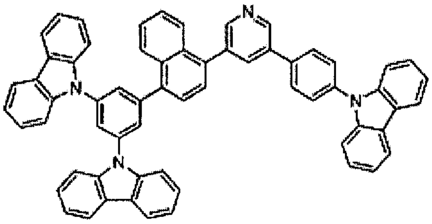

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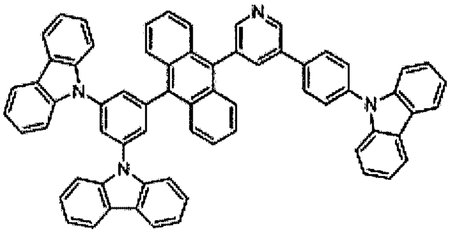

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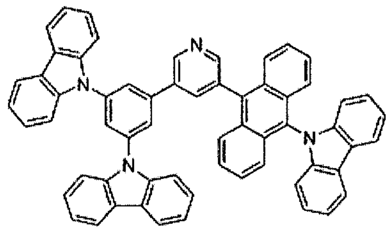

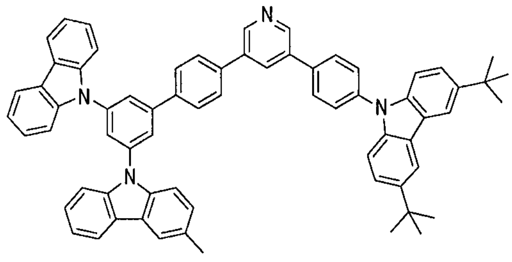

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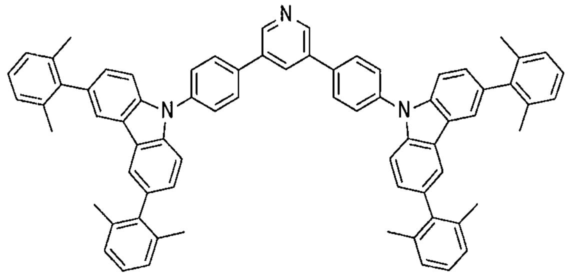

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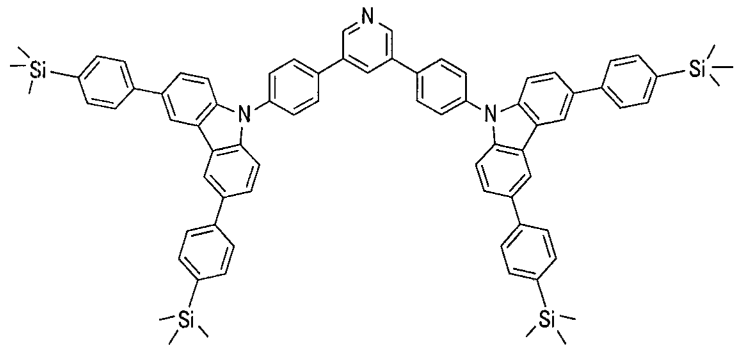
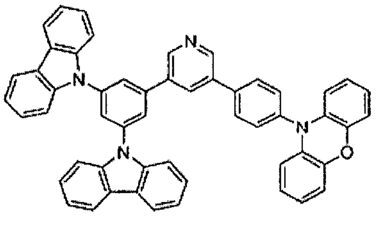
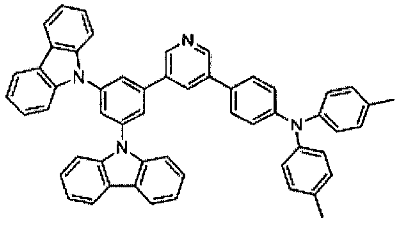


Compound (33)

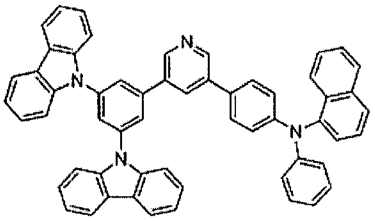
Compound (34)





Compound (35)

Compound (36)



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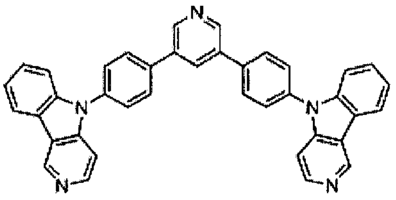

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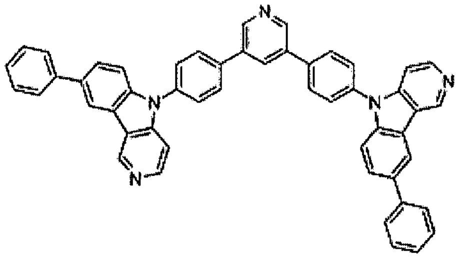

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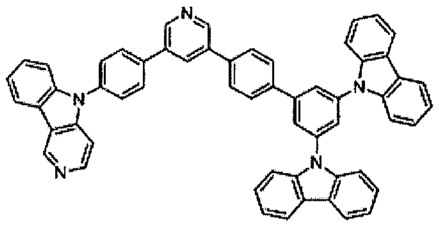
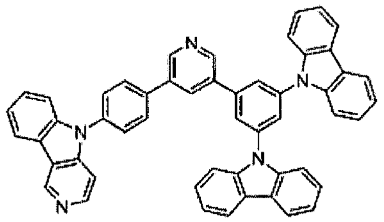


Compound (40)



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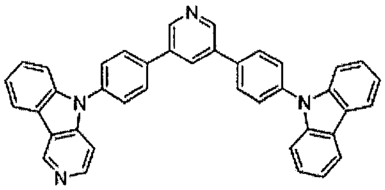
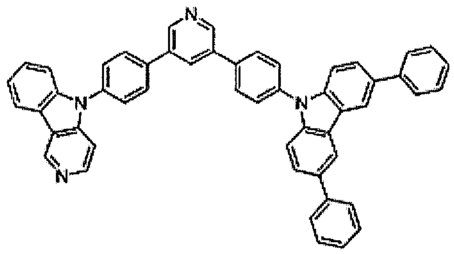
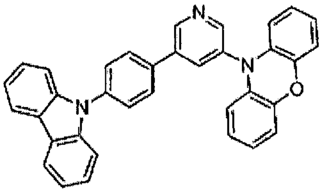


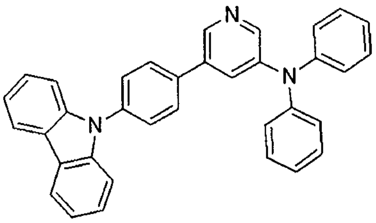


The organic compounds having the above Formula 5 may be selected from the group consisting of the following compounds (42) to (52), and combinations thereof, but are not limited thereto.

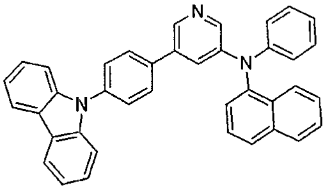
Compound (42) Compound (43)



Compound (44)



Compound (45)



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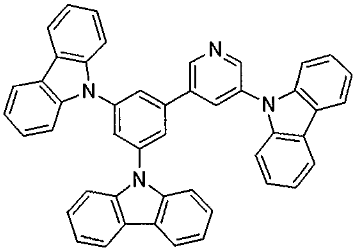

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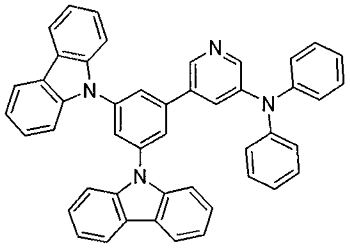
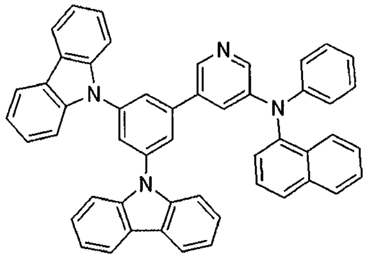
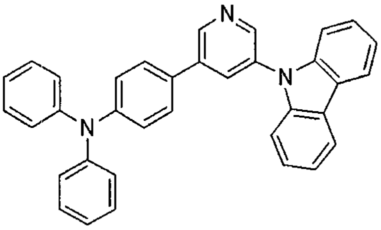


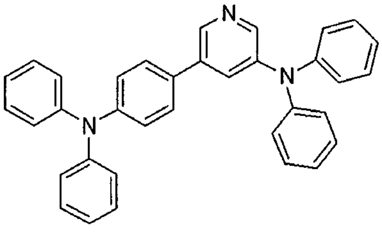
Compound (48)



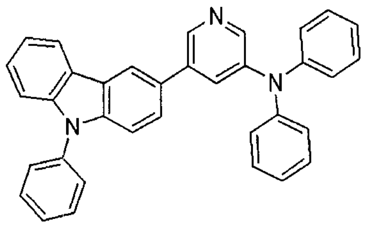
Compound (49)



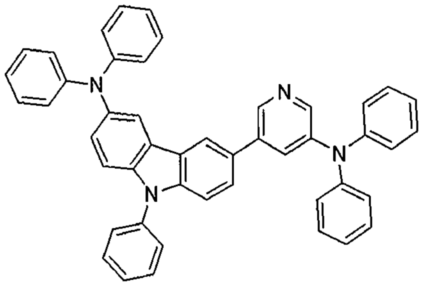
Compound (50)

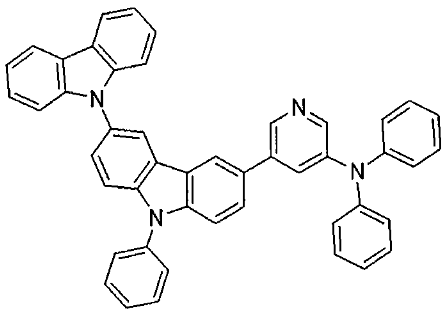


Compound (51)



Compound (52)





The exemplary organic compound may be used by itself, but it is generally used as a host material that is capable of binding with a dopant.

The dopant is a compound having a high emission property, by itself. However, it is usually added to a host in a minor amount, so it is also called a guest or dopant. In other words, the dopant is a material that is doped to the host material to emit light, and generally includes a metal complex that emits light due to multiplet excitation into a triplet or higher state.

When the organic compounds represented by the above Formulae 1 to 5 are used for a light emitting host material, all red (R), green (G), and blue (B) colors and white (W) fluorescent or phosphorescent dopant materials are available for a dopant. According to one embodiment, the dopant includes a phosphorescent dopant material. Generally, the material should satisfy the requirement to have a high light emitting quantum efficiency, to be rarely agglomerated, and to be distributed uniformly in the host material.

According to one embodiment, the phosphorescent dopant is an organic metal compound including at least element selected from the group consisting of Ir, Pt, Os, Ti, Zr, Hf, Eu, Tb, Tm, and combinations thereof.

Specifically, the red phosphorescent dopant may include PtOEP, $Ir(Piq)_2(acac)$ (Piq=1-phenylisoquinoline, acac=pentane-2,4-dione), $Ir(Piq)_3$, and RD 61 from UDC; the green phosphorescent dopant may include $Ir(PPy)_3$(PPy=2-phenylpyridine), $Ir(PPy)_2(acac)$, and GD48 from UDC; and the blue phosphorescent dopant may include $(4,6\text{-}F_2PPy)_2Irpic$ (reference: Appl. Phys. Lett., 79, 2082-2084, 2001).

FIGS. 1 to 5 are cross-sectional views showing organic photoelectric devices including the organic compounds according to various embodiments of the present invention.

An organic photoelectric device according to one embodiment of the present invention includes at least one layer of an organic thin layer interposed between an anode and a cathode. The anode includes a transparent electrode such as ITO (indium tin oxide), and the cathode includes a metal electrode such as aluminum.

Referring to FIG. 1, the organic photoelectric device 100 includes an organic thin layer 105 including only an emission layer 130.

Referring to FIG. 2, a double-layered organic photoelectric device 200 includes an organic thin layer 105 including an emission layer 230 including an electron transport layer (ETL) (not shown), and a hole transport layer (HTL) 140. The hole transport layer (HTL) 140 is a separate layer having an excellent binding property with a transparent electrode such as ITO or a excellent hole transporting property.

Referring to FIG. 3, a three-layered organic photoelectric device 300 includes the organic thin layer 105 including an electron transport layer (ETL) 150, an emission layer 130, and a hole transport layer (HTL) 140. The emission layer 130 is independently installed, and layers having an excellent electron transporting property or an excellent hole transporting property are separately stacked.

As shown in FIG. 4, a four-layered organic photoelectric device 400 includes the organic thin layer 105 including an electron injection layer (EIL) 160, an emission layer 130, a hole transport layer (HTL) 140, and a hole injection layer (HIL) 170 for binding with the cathode of ITO, different from the structure of the three-layered organic photoelectric device 300 shown in FIG. 3.

As shown in FIG. 5, a five layered organic photoelectric device 500 includes the organic thin layer 105 including an electron transport layer (ETL) 150, an emission layer 130, a hole transport layer (HTL) 140, and a hole injection layer (HIL) 170, and further includes an electron injection layer (EIL) 160 to achieve the low voltage.

In order to form the organic thin layer 105 having one through five layers, the method may follow a dry coating method such as evaporation, sputtering, plasma plating, and ion plating, or a wet coating method such as spin coating, dipping, and flow coating.

In one embodiment of the present invention, at least one layer selected from the group consisting of the emission layer, electron transport layer (ETL), electron injection layer (EIL), hole transport layer (HTL), hole injection layer (HIL), hole blocking layer, and combination thereof includes a material for the organic photoelectric device.

The organic thin layer includes the phosphorescent light emitting compound such as a metal complex that emits light due to the multiple excitation into a triplet or higher state.

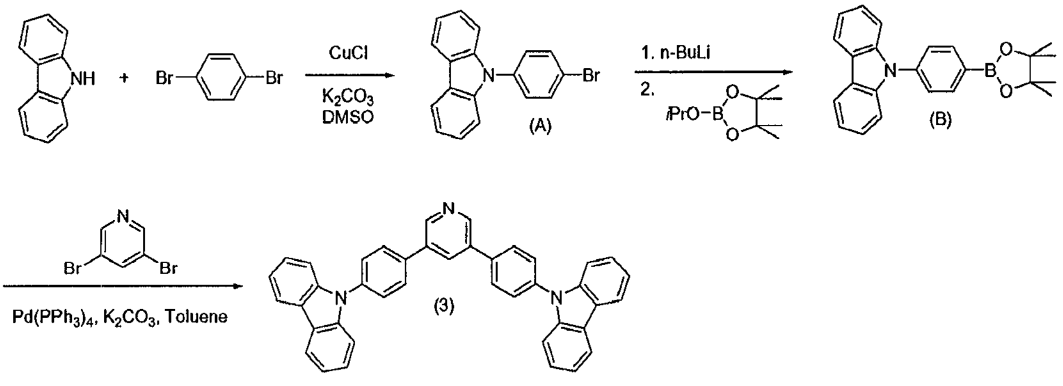
The following examples illustrate the present invention in more detail. However, it is understood that the present invention is not limited by these examples.

1. Synthesis of material for an organic photoelectric device

(Example 1: Synthesis of compound (3))

Compound (3) as a material for an organic photoelectric device was synthesized as shown in the following Reaction Scheme 1.

[Reaction Scheme 1]



Step 1: Synthesis of Intermediate (A)

50.8g (304mmol) of carbazole, 71.6g (304mmol) of 1,4-dibromobenzene, 3.76g (38 mmol) of cuprous chloride, and 83.9g (607mmol) of potassium carbonate were suspended in 322ml of dimethylsulfoxide, and heated and refluxed under a nitrogen atmosphere for 8 hours. The reaction fluid was cooled to room temperature and recrystallized with methanol.

The precipitated crystals were separated by filtration and the obtained residue was purified by silica gel column chromatography, providing 59.9g of the intermediate (A) (yield 61.3%).

Step 2: Synthesis of Intermediate (B)

37.8g (117mmol) of the intermediate (A) was dissolved in 378ml of tetrahydrofuran, then 100.5ml (161mmol) of n-butyl lithium hexane solution (1.6M) was added thereto under an argon atmosphere at -70°C. The obtained solution was agitated at -70°C to 40°C for 1 hour. The reaction fluid was frozen to -70°C, and 47.9ml (235mmol) of isopropyl tetramethyl dioxaborolane was slowly added thereto in a dropwise fashion. The obtained solution was agitated at -70°C for 1 hour and heated to room temperature, and then agitated for 6 hours. To the obtained reaction solution, 200ml of water was added and agitated for 20 minutes.

The reaction solution was separated into two liquid layers, and an organic layer thereof was dried with anhydrous sodium sulfate. After the organic solvent was removed under a reduced pressure, the obtained residue was purified with silica gel column chromatography to provide 28.9g of the intermediate (B) (yield 66.7%).

Step 3: Synthesis of Compound (3)

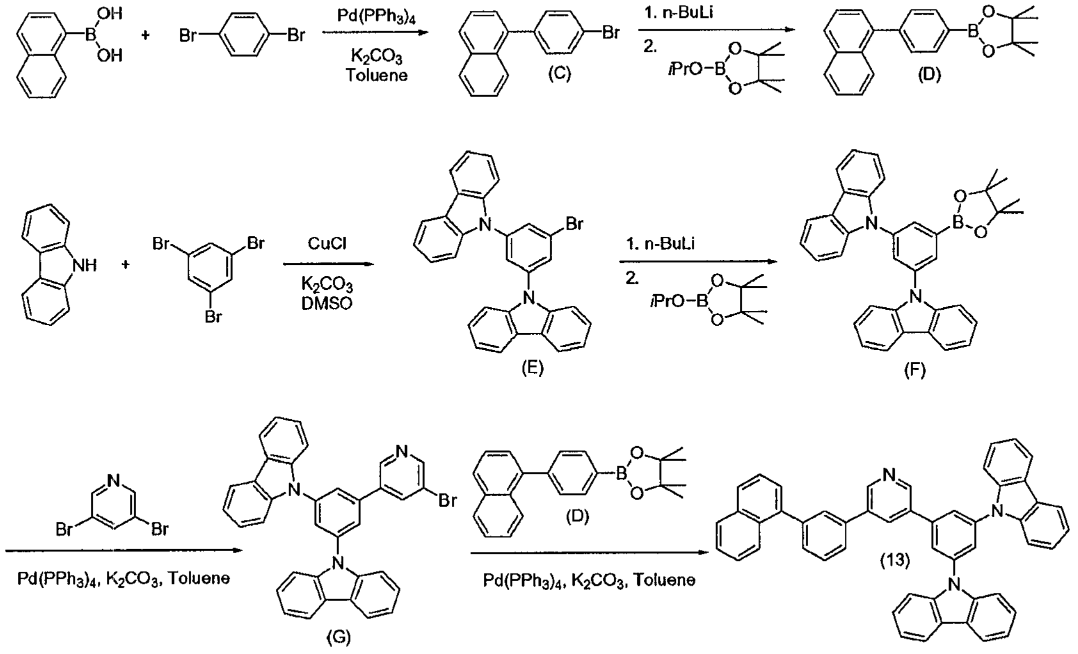
10.3g (28mmol) of the intermediate (B), 3.0g (13mmol) of 3,5-dibromopyridine, and 0.73g (0.6mmol) of tetrakis-(triphenyl phosphine) palladium were suspended in 90 ml of tetrahydrofuran and 60ml of toluene, then added with a solution of 7.0g (51mmol) of potassium carbonate dissolved in 60ml of water. The obtained mixture was heated and refluxed for 9 hours.

The reaction fluid was separated into two layers, and an organic layer thereof was cleaned with a sodium chloride saturated aqueous solution and dried with anhydrous sodium sulfate. Subsequently, the organic solvent was removed by distillation under reduced pressure, and the residue was recrystallized with toluene. The precipitated crystals were separated by filtration and cleaned with toluene to provide 5.5g (77.3%) of the compound (3).

(Example 2: Synthesis of Compound (13))

Compound (13) as a material for an organic photoelectric device was synthesized as shown in the following Reaction Scheme 2.

[Reaction Scheme 2]



Step 1: Synthesis of Intermediate (C)

15g (63mmol) of 1,4-dibromobenzene, 7.66g (44mmol) of 1-naphthaleneboron acid, 17.58g (127mmol) of potassium carbonate, and 1.83g (50mmol) of tetrakis-(triphenylphosphine) palladium were suspended in a mixed solvent including 200ml of tetrahydrofuran, 200ml of toluene, and 50 ml of purified water, and heated and refluxed under a nitrogen atmosphere for 24 hours.

The reaction fluid was cooled to room temperature, and separated into two layers. Then, the solvent of an organic layer thereof was removed under a reduced pressure to provide a fluid. The fluid was separated by column chromatography (hexane) to remove the solvent and to provide 15g of a gel intermediate (C) at a yield of 83%.

Step 2: Synthesis of Intermediate (D)

7g (24mmol) of the intermediate (C) was dissolved in 50ml of tetrahydrofuran, and added with 15ml (24mmol) of an n-butyl lithium hexane solution (1.6M) under an argon atmosphere at -70°C. The obtained solution was agitated at -70°C for 30 minutes, and the reaction fluid was slowly added with 47.9ml (235mmol) of isopropyl tetramethyl dioxaborolane in a dropwise fashion. After the obtained solution was agitated at -70°C for 1 hour, it was heated to room temperature and agitated for 6 hours. To the obtained reaction solution, 200ml of water was added and agitated for 20 minutes.

After the reaction solution was separated into two liquid layers, an organic solvent thereof was removed under a reduced pressure. The obtained residue was purified with silica gel column chromatography to provide 6g of the intermediate (D) at a yield of 73%.

Step 3: Synthesis of Intermediate (E)

40.4g (241mmol) of carbazole, 38.0g (121mmol) of 1,3,5-tribromobenzene, 2.99g (30 mmol) of cuprous chloride, and 66.7g (483mmol) of potassium carbonate were suspended in 171ml of dimethylsulfoxide, and heated and refluxed under a nitrogen atmosphere for 8 hours.

The reaction fluid was cooled to room temperature and recrystallized with methanol. The precipitated crystals were separated by filtration, and the obtained residue was purified with silica gel column chromatography to provide 36.7g of the intermediate (E) at a yield of 62.4%.

Step 4: Synthesis of Intermediate (F)

35.0g (72mmol) of the intermediate (E) was dissolved in 350 ml of tetrahydrofuran and added with 61.5ml (98mmol) of an n-butyllithium hexane solution (1.6M) under an argon atmosphere at -70°C. The obtained solution was agitated at -70°C to 40°C for 1 hour. The reaction flux was frozen to -70°C and slowly added with 29.3ml (144mmol) of isopropyl tetramethyl dioxaborolane in a dropwise fashion. The obtained solution was agitated at -70°C for 1 hour, and heated to room temperature and agitated for 6 hours. The obtained reaction solution was added with 200ml of water and agitated for 20 minutes.

After the reaction solution was separated into two liquid layers, an organic layer thereof was dried with anhydrous sodium sulfate. After the organic solvent was removed under a reduced pressure, the obtained residue was purified with silica gel column chromatography to provide 25.1g (yield 65.4%) of the intermediate (F).

Step 5: Synthesis of Intermediate (G)

45.1g (84mmol) of the intermediate (F), 20.0g (84mmol) of 3,5-dibromopyridine, and 2.44g (2.1mmol) of tetrakis-(triphenyl phosphine) palladium were suspended in 600ml of tetrahydrofuran and 400 ml of toluene, and then the suspension was added with a solution in which 23.3 g (169mmol) of potassium carbonate was dissolved in 400ml of water. The obtained mixture was heated and refluxed for 9 hours. The reaction fluid was separated into two layers, and an organic layer thereof was cleaned with a sodium chloride saturated aqueous solution and dried with anhydrous sodium sulfate.

The organic solvent was removed by distillation under a reduced pressure, and the residue was recrystallized by toluene. The precipitated crystals were separated by filtration and cleansed with toluene to provide 30.7g (64.4%) of the intermediate (G).

Step 6: Synthesis of Compound (13)

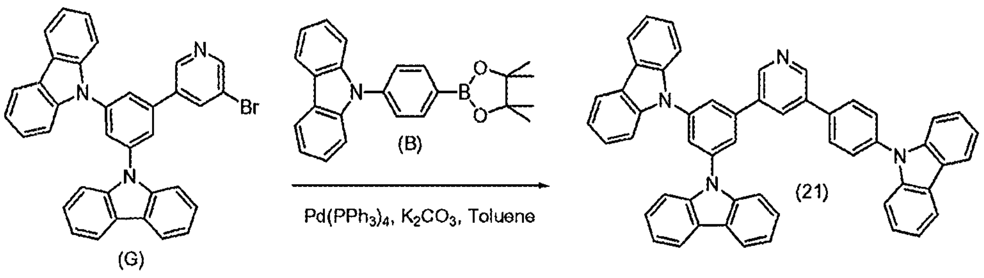
4g (7mmol) of intermediate (G), 2.81g (8.5mmol) of the intermediate (D), 1.96g (14mmol) of potassium carbonate, and 0.41g (0.3mmol) of tetrakis-(triphenylphosphine) palladium were suspended in 200ml of toluene, 200ml of tetrahydrofuran, and 50ml of purified water, then heated and agitated for 24 hours.

After the reaction temperature was lowered to room temperature, the resultant was separated to two layers and a solvent of an organic layer thereof was removed under a reduced pressure. The obtained residue was purified by silica gel column chromatography to provide 4g (82%) of the compound (13).

(Example 3: Synthesis of Compound (21))

Compound (21) as a material for an organic photoelectric device was synthesized in accordance with a process as shown in the following Reaction Scheme 3.

[Reaction Scheme 3]



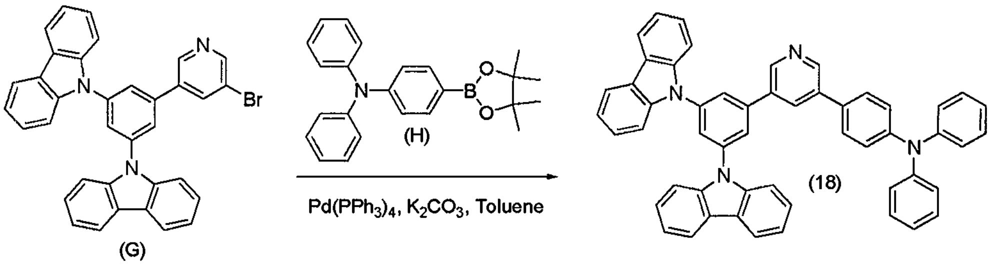
8.64g (23mmol) of the intermediate (B), 12.0g (21mmol) of the intermediate (G), and 0.74g (0.6mmol) of tetrakis-(triphenylphosphine)palladium were suspended in 360ml of tetrahydrofuran and 240 ml of toluene, and it was added with a solution of 5.88g (43mmol) of sodium carbonate dissolved in 240ml of water. The obtained mixture was heated and refluxed for 9 hours.

After the reaction fluid was separated into two layers, an organic layer thereof was washed with a sodium chloride saturated aqueous solution and dried with anhydrous sodium sulfate. After the organic solvent was removed by distillation under a reduced pressure, the residue was recrystallized with toluene. The precipitated crystals were separated by filtration and washed with toluene to provide 9.8g (63.4%) of the compound (21). MS(ESI) m/z 727.24 $(M+H)^+$

(Example 4: Synthesis of Compound (18))

Compound (18) as a material for an organic photoelectric device was synthesized as shown in the following Reaction Scheme 4.

[Reaction Scheme 4]

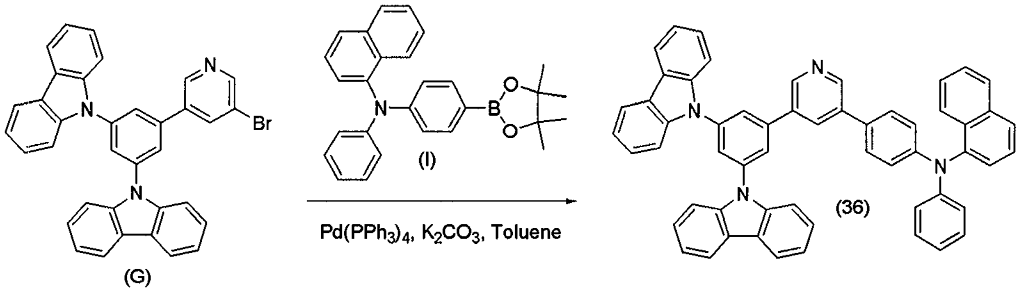


The compound 18 was synthesized according to the same method as in Example 3, except that an intermediate (H) was used instead of the intermediate (B). MS(ESI) m/z 729.25 $(M+H)^+$

(Example 5: Synthesis of Compound (36))

The compound (36) as a material for an organic photoelectric device was synthesized as shown in the following Reaction Scheme 5.

[Reaction Scheme 5]

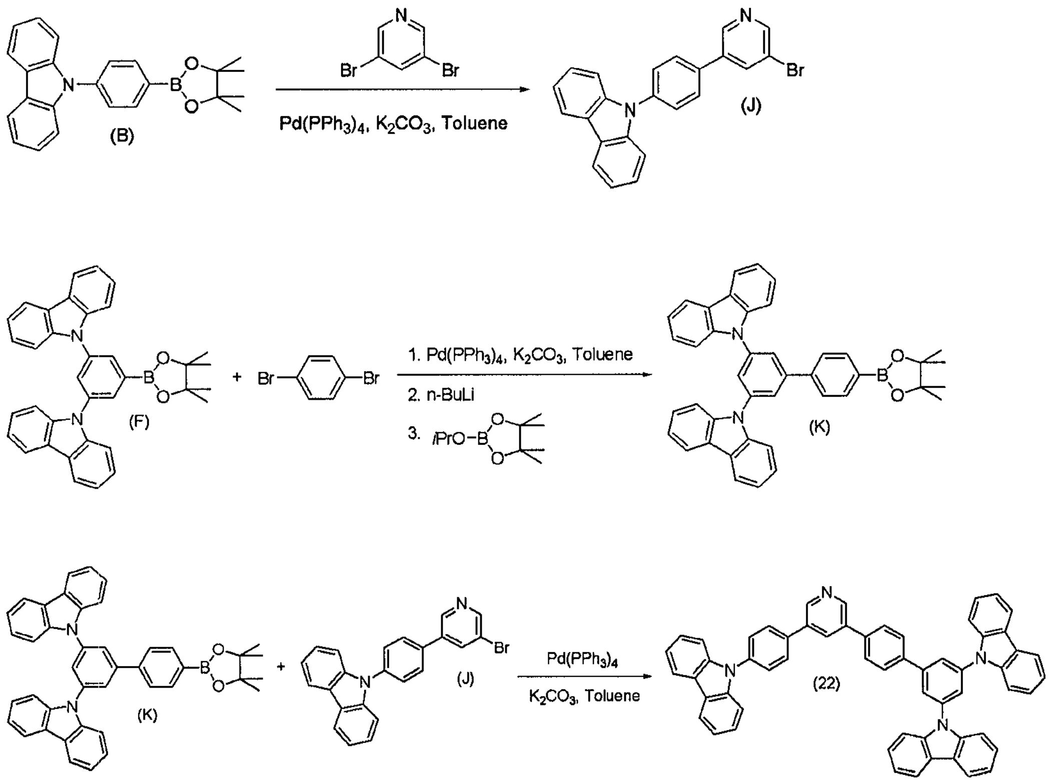


A compound (36) was prepared in accordance with the same procedure as in Example 3, except that an intermediate (I) was used instead of the intermediate (B). MS(ESI) m/z 779.26 $(M+H)^+$

(Example 6: Synthesis of Compound (22))

Compound (22) was synthesized in accordance with the following Reaction Scheme 6.

[Reaction Scheme 6]



Step 1: Synthesis of Intermediate (J)

10.3g of the intermediate (B) synthesized in Example 1, 3.0g of 3,5-dibromopyridine, and 0.73g of tetrakis-(triphenylphosphine) palladium were suspended in 90 ml of tetrahydrofuran and 60ml of toluene, then added with a solution of 7.0g of potassium carbonate dissolved in 60ml of water. The obtained mixture was heated and refluxed for 9 hours.

The reaction fluid was separated into two layers, and an organic layer thereof was cleaned with a sodium chloride saturated aqueous solution and dried with anhydrous sodium sulfate. Subsequently, the organic solvent was removed by distillation under reduced pressure, and the residue was recrystallized with toluene. The precipitated crystals were separated by filtration and cleaned with toluene to provide 5.5g of the intermediate (J).

Step 2: Synthesis of Intermediate (K)

10.3g of the intermediate (F) synthesized in Example 2, 3.0g of 1,4-dibromobenzene, 17.58g of potassium carbonate, and 0.73g of tetrakis-(triphenylphosphine) palladium were suspended in 200ml of tetrahydrofuran, 200ml of toluene, and 50 ml of purified water, and heated and refluxed under a nitrogen atmosphere for 24 hours.

15ml of an n-butyl lithium hexane solution (1.6M) was added and then the obtained solution was agitated at -70°C for 30 minutes, and the reaction fluid was slowly added with 47.9ml (235mmol) of isopropyl tetramethyl dioxaborolane in a dropwise fashion. After the obtained solution was agitated at -70°C for 1 hour, it was heated to room temperature and agitated for 6 hours. To the obtained reaction solution, 200ml of water was added and agitated for 20 minutes. After the reaction solution was separated into two liquid layers, an organic solvent thereof was removed under a reduced pressure. The obtained residue was purified with silica gel column chromatography to provide 6g of the intermediate (K).

Step 3: Synthesis of Compound (22)

10.3g of the intermediate (J) synthesized at Step 1, 12.0g of the intermediate (K), and 0.74g of tetrakis-(triphenylphosphine) palladium were suspended in 90 ml of tetrahydrofuran and 60ml of toluene, then added with a solution of 5.88g of potassium carbonate dissolved in 240ml of water. The obtained mixture was heated and refluxed for 9 hours.

The reaction fluid was separated into two layers, and an organic layer thereof was cleaned with a sodium chloride saturated aqueous solution and dried with anhydrous sodium sulfate. Subsequently, the organic solvent was removed by distillation under reduced pressure, and the residue was recrystallized with toluene. The precipitated crystals were separated by filtration and cleaned with toluene to provide 9.8g of the compound (22). MS(ESI) m/z 803.26 $(M+H)^+$

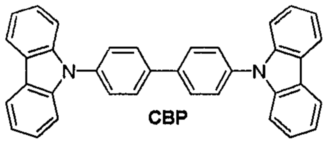
2. Measurement of glass transition temperature and thermal decomposition temperature

Organic compounds synthesized from Examples 1 to 3 and comparative material of CBP were measured for glass transition temperature (Tg) and thermal decomposition temperature Td through differential scanning calorimetry (DSC) and thermalgravimetry (TGA), and the results are shown in the following Table 1.

Table 1

Material	Compound 3	Compound 13	Compound 21	CBP
Tg (°C)	120	144	164	110
Td (°C)	436	510	500	392

In Table 1, CBP is a compound represented by the following Formula.



CBP

Referring to Table 1, the organic compounds according to the above Examples of the present invention had a glass transition temperature (Tg) of 120°C or more and a thermal decomposition temperature (Td) of 430°C or more according to the DSC and TGA measurement results, which shows that the organic compounds had much higher thermal stability than that of the comparative material, CBP.

3. Fabrication of phosphorescent green-emitting organic photoelectric device, and evaluation thereof

Organic compounds prepared from Examples 1 to 6 and comparative material, CBP, were used as a host, and $Ir(PPy)_3$ was used as a dopant to provide a phosphorescent green-emitting organic photoelectric device. The obtained device was analyzed for characteristics thereof.

ITO was provided in a thickness of 1000Å for an anode, and aluminum (Al) was provided in a thickness of 1000Å for a cathode.

The method of manufacturing an organic photoelectric device may be described in detail as follows: cutting an ITO glass substrate having a sheet resistance value of $15\Psi/cm^2$ into a size of 50mm × 50mm × 0.7mm for a cathode; ultrasonic wave cleaning the same in acetone, isopropyl alcohol, and pure water for 15 minutes, respectively; and UV ozone cleaning for 30 minutes.

N,N'-di(1-naphthyl)-N,N'-diphenylbenzidine (NPD) was deposited on the upper surface of the substrate under the conditions of a vacuum degree of 650×10^{-7}Pa and a deposition speed of 0.1 to 0.3nm/s to provide a hole transport layer (HTL).

Subsequently, under the same vacuum deposition condition, the host material and the phosphorescent dopant were simultaneously deposited to provide an emission layer having a thickness of 300Å. During this process, a phosphorescent dopant of $Ir(PPy)_3$ was deposited at the same time, and the adding amount of the phosphorescent dopant was adjusted to 5 wt%.

Bis(2-methyl-8-quinolinolate)-4-(phenylphenolate)aluminum (BAlq) and Alq_3 were deposited on the upper surface of the emission layer under the same vacuum deposition conditions to provide a hole blocking layer and an electron transport layer (ETL). On the upper surface of the electron transport layer (ETL), LiF and Al were sequentially deposited to provide an organic photoelectric device having the following structure A.

Structure A: NPD 700Å/EML (5wt%, 300Å)/BAlq 50Å/Alq_3 200Å/LiF 5Å/Al

Organic photoelectric devices having the structures B and C were fabricated in accordance with the same process as in the above. TCTA denotes 4,4',4”-tris(N-carbazolyl)triphenylamine (4,4',4”-tris(N-carbazolyl)triphenylamine).

Structure B: NPD 700Å/EML (5wt%, 300Å)/Alq_3 250Å/LiF 5Å/Al

Structure C: NPD 600Å/TCTA 100Å/EML (5wt%, 300Å)/Alq_3 250Å/LiF

5Å/Al

Current density, luminance, and luminous efficiency of each organic photoelectric device in accordance with voltage were measured. Specific measurements were performed as follows.

1) Current density according to voltage change

Each of obtained organic photoelectric devices was measured for a current value passing through the unit device using a current-voltage meter (Keithley 2400) while increasing the voltage from 0V to 10V. The results are calculated by dividing the measured current value by the area.

2) Luminance according to a voltage change

Each of obtained organic photoelectric devices was measured for luminance by a luminance meter (Minolta Cs-1000A) while increasing the voltage from 0V to 10V.

3) Luminous efficiency measurement

Luminous efficiency was calculated from the luminance, current density, and voltage.

Luminous efficiency of the organic photoelectric device having the structure A is shown in the following Table 2. Luminance, driving voltages, and color coordinates are also shown in the following Table 2.

Table 2

	Host material	Luminance (nit)	Driving voltage (V)	Luminous efficiency (lm/W)	Color coordinate (x, y)
Example 1	Compound 3	100	4.1	17	0.31, 0.60
Example 2	Compound 13	100	5.0	22	0.32, 0.60
Example 3	Compound 21	100	4.3	30	0.32, 0.60
Example 6	Compound 22	100	3.9	36	0.32, 0.62
Comparative Example 1	CBP	100	6.1	14	0.30, 0.59

As shown in Table 2, devices including hosts of the organic compounds according to the above Examples of the present invention had driving voltages of 5V or less (3.9-5.0V), which were around 2V less than that of comparative material at the same luminance of 100nit, and improved luminous efficiency that was significantly more than that of comparative material.

The following Table 3 shows the results of measuring characteristics of the organic photoelectric device having structure B.

Table 3

	Host material	Luminance	Driving voltage	Luminous efficiency	Color coordinate (x, y)
		nit	V	Lm/W	
Example 1	Compound 3	1000	8.6	7.4	0.26, 0.61
Example 3	Compound 21	1000	7.1	10.7	0.27, 0.61
Example 6	Compound 22	1000	7.2	9.7	0.27, 0.61
Comparative Example 1	CBP	1000	9.5	9.4	0.26, 0.63

As shown in Table 3, devices including hosts of the organic compounds according to the above Examples of the present invention improved device characteristics in that the driving voltages (7.1-8.6V) were decreased to around 2V less than that of the comparative material, and the luminous efficiency was significantly improved at the same luminance of 1000nit.

The following Table 4 shows the results for assessing characteristics of the organic photoelectric device having structure C.

Table 4

	Host material	Luminance	Driving voltage	Luminous efficiency		Color coordinate
		nit	V	cd/A	lm/W	(x, y)
Example 1	Compound (3)	1000	6.5	61.2	32.7	0.26, 0.61
Example 3	Compound (21)	1000	6.3	58.9	32.5	0.27, 0.61
Example 6	Compound (22)	1000	6.4	50.2	27.4	0.27, 0.61
Comparative Example 1	CBP	1000	7.8	42.9	19.1	0.26, 0.63

As shown in Table 4, devices including host materials of the organic compounds according to the above Examples of the present invention showed device characteristics in which the driving voltages (6.3-6.5V) were decreased to maximumally 1.4V less than that of the comparative material, and the luminous efficiency was significantly improved at the same luminance of 1000nit.

Furthermore, the flowing Table 4 shows results for assessing lifetime of the organic photoelectric device having structure C.

Table 5

	Host material	Initial luminance (nit)	Current (mA)	Half-life (hr)
Example 1	Compound (3)	3000	0.22	411
Example 6	Compound (22)	3000	0.26	205
Comparative Example 1	CBP	3000	0.46	82

As shown in Table 5, devices including a host of the organic compound according to one embodiment of the present invention improved the lifetime of the device to 500% of that of the comparative material.

4. Fabrication of phosphorescent red-emitting organic photoelectric device, and evaluation thereof

Organic compounds obtained from Examples 1 to 6 and a comparative material of CBP were used for a host material and Ir(Piq)$_3$ was used for a red dopant to provide a red phosphorescent organic photoelectric device having structure A, and the characteristics thereof were evaluated. The device was manufactured under the same conditions as in the green phosphorescent device. The obtained devices were measured for characteristics, and the results are shown in the following Table 6:

Table 6

	Host material	Luminance (nit)	Driving voltage (V)	Luminous efficiency (lm/W)	Color coordinate (x, y)
Example 4	Compound (18)	1000	9.5	1.9	0.68, 0.31
Example 5	Compound (36)	1000	8	2.7	0.68, 0.31
Comparative Example 1	CBP	1000	10	1.6	0.68, 0.32

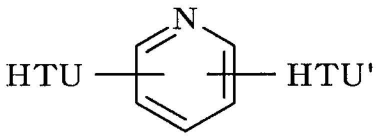
As shown in Table 6, devices including a host of organic compound according to one embodiment of the present invention improved device characteristics such as driving voltage and luminous efficiency compared to those of comparative material of CBP at the same luminance of 1000nit.

While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. A material for an organic photoelectric device comprising a compound represented by the following Formula 1, being a bipolar organic compound including both a hole transporting unit and an electron transporting unit:

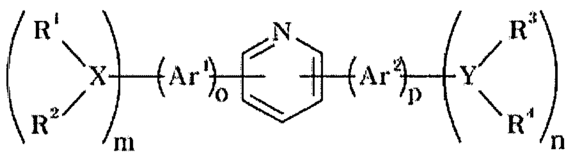
[Chemical Formula 1]



wherein, in the above Formula 1, the pyridine (C_6H_5N) is an electron transporting unit, the HTU and HTU' independently function as a hole transporting unit, and the HTU and HTU' are the same or different.

2. The material of claim 1, wherein the organic compound of the Formula 1 is the organic compound of the following Formula 2:

[Chemical Formula 2]



wherein, in the above Formula 2, X and Y are independently selected from the group consisting of nitrogen (N), sulfur (S), and oxygen (O),

Ar^1 and Ar^2 are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 alkylene, a substituted or unsubstituted C2 to C30 heteroaryl, and a substituted or unsubstituted C2 to C30 heteroarylene,

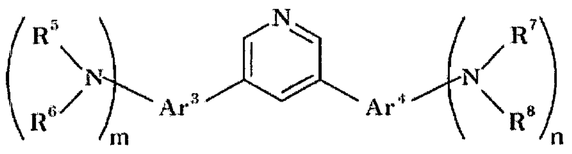
R^1 to R^4 are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C2 to C30 heteroarylene, a substituted or unsubstituted C1 to C30 alkyl, and a substituted or unsubstituted C1 to C30 alkylene, or R^1 and R^2 form a cyclic ring or R^3 and R^4 form a cyclic ring,

when X is sulfur or oxygen, R^2 is a unshared electron pair, and when Y is sulfur or oxygen, R^4 is a unshared electron pair, and

m and n are independently integers ranging from 0 to 3, m+n is more than or equal to 1, and o and p are integers ranging from 0 to 2.

3. The material for an organic photoelectric device of claim 1, wherein the bipolar organic compound having the above Formula 1 is represented by the following Formula 3:

[Chemical Formula 3]



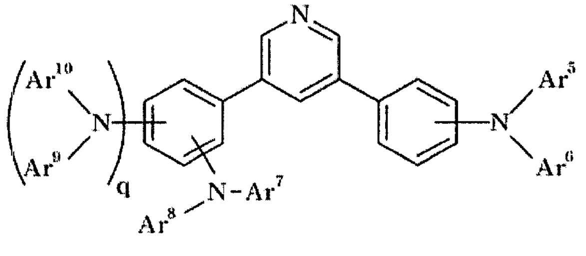
wherein, in the above Formula 3, Ar^3 and Ar^4 are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 alkylene, a substituted or unsubstituted C2 to C30 heteroaryl, and a substituted or unsubstituted C2 to C30 heteroarylene,

R^5 to R^8 are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C2 to C30 heteroarylene, a substituted or unsubstituted C1 to C30 alkyl, and a substituted or unsubstituted C1 to C30 alkylene, or R^5 and R^6 form a cyclic ring or R^7 and R^8 form a cyclic ring, and

m and n are independently integers ranging from 0 to 3, and m+n is more than or equal to 1.

4. The material for an organic photoelectric device of claim 1, wherein the organic compound of the Formula 1 is the organic compound of the following Formula 4:

[Chemical Formula 4]

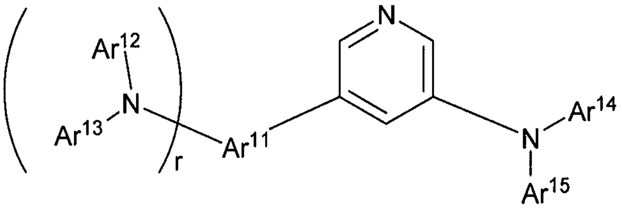


wherein, in the above Formula 4, Ar^5 to Ar^{10} are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 alkylene, a substituted or unsubstituted C2 to C30 heteroaryl, and a substituted or unsubstituted C2 to C30 heteroarylene, or Ar^5 and Ar^6 form a cyclic ring, Ar^7 and Ar^8 form a cyclic ring, or Ar^9 and Ar^{10} form a cyclic ring, and

q is an integer ranging from 0 to 2.

5. The material for an organic photoelectric device of claim 1, wherein the organic compound of the Formula 1 is the organic compound of the following Formula 5:

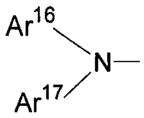
[Chemical Formula 5]



wherein, in the above Formula 5, Ar^{11} to Ar^{15} are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C6 to C30 arylene, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 alkylene, a substituted or unsubstituted C2 to C30 heteroaryl, and a substituted or unsubstituted C2 to C30 heteroarylene, or Ar^{12} and Ar^{13} form a cyclic ring, or Ar^{14} and Ar^{15} form a cyclic ring, and r is an integer ranging from 0 to 2.

6. The material for an organic photoelectric device of claim 2, wherein of XR^1R^2 and YR^3R^4 in the organic compound of the Formula 2 is represented by the following Formula 6a:

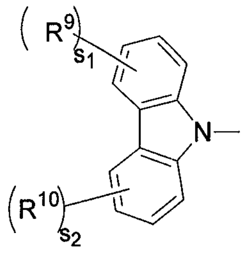
[Chemical Formula 6a]



wherein, in the above Formula 6a, Ar^{16} and Ar^{17} are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl and a substituted or unsubstituted C2 to C30 heteroaryl.

7. The material for an organic photoelectric device of claim 2, wherein of XR^1R^2 and YR^3R^4 in the organic compound of the Formula 2 is represented by the following Formula 6b:

[Chemical Formula 6b]



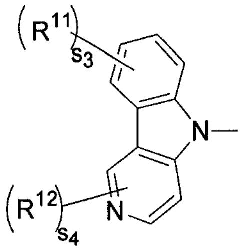
wherein, in the above Formula 6b, R^9 and R^{10} are independently substituents selected from the group consisting of a substituted or unsubstituted

C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C2 to C20 alkoxy, and $SiR_{15}R_{16}R_{17}$ (where R_{15} to R_{17} are independently selected from the group consisting of a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C3 to C30 cycloalkyl, a nitrile, a cyano, a nitro, a carbonyl, and an amide), and

s_1 and s_2 are independently integers ranging from 0 to 4.

8. The material for an organic photoelectric device of claim 2, wherein of XR^1R^2 and YR^3R^4 in the organic compound of the Formula 2 is represented by the following Formula 6c:

[Chemical Formula 6c]

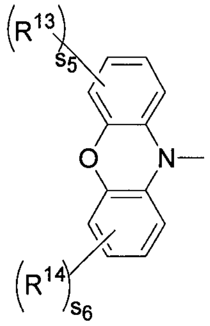


wherein, in the above Formula 6c, R^{11} and R^{12} are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C2 to C20 alkoxy, and $SiR_{15}R_{16}R_{17}$ (where R_{15} to R_{17} are independently selected from the group consisting of a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C3 to C30 cycloalkyl, a nitrile, a cyano, a nitro, a carbonyl, and an amide), and

s_3 and s_4 are independently integers ranging from 0 to 4.

9. The material for an organic photoelectric device of claim 2, wherein of XR^1R^2 and YR^3R^4 in the organic compound of the Formula 2 is represented by the following Formula 6d:

[Chemical Formula 6d]



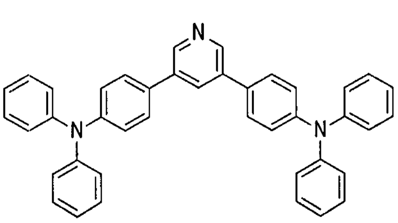
wherein, in the above Formula 6d,

R^{13} and R^{14} are independently substituents selected from the group consisting of a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C2 to C20 alkoxy, and $SiR_{15}R_{16}R_{17}$ (where R_{15} to R_{17} are independently selected from the group consisting of a substituted or unsubstituted C1 to C30 alkyl, a substituted or unsubstituted C1 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C3 to C30 cycloalkyl, a nitrile, a cyano, a nitro, a carbonyl, and an amide), and

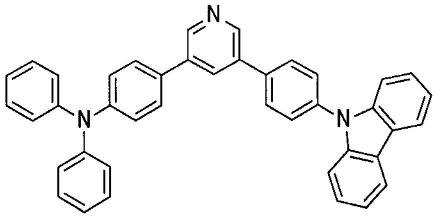
s_5 and s_6 are independently integers ranging from 0 to 4.

10. The material for an organic photoelectric device of claim 2, wherein the bipolar organic compound is selected from the group consisting of the following compounds (1) to (41), and combinations thereof:

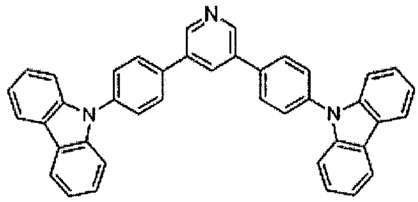
Compound (1)



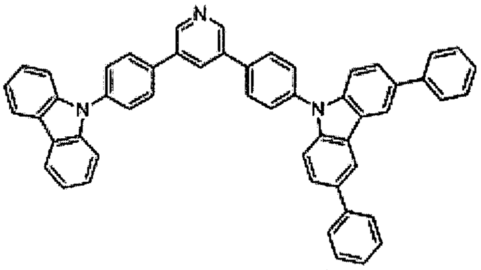
Compound (2)



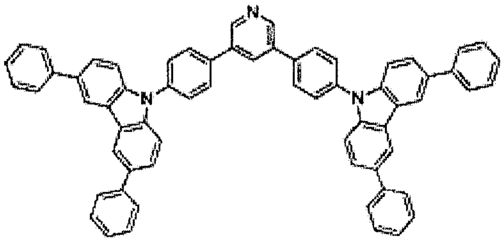
Compound (3)



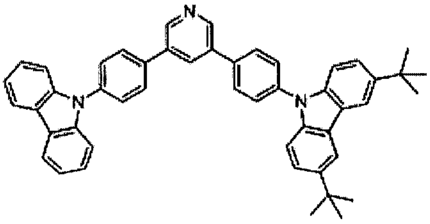
Compound (4)



Compound (5)

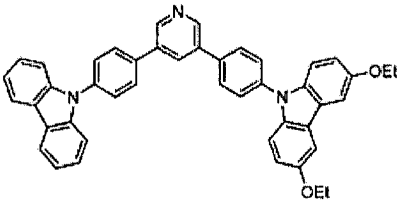


Compound (6)

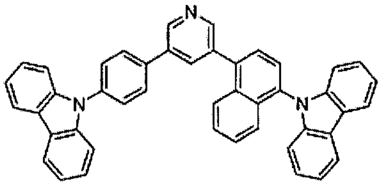


Compound (7)

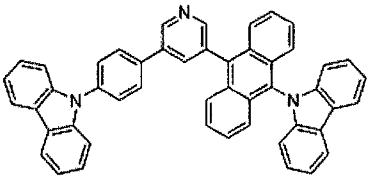
Compound (8)



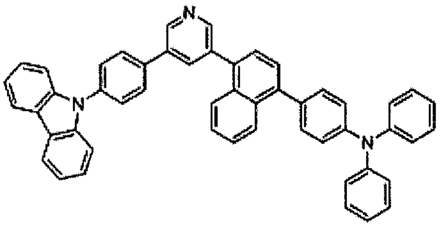
Compound (9)



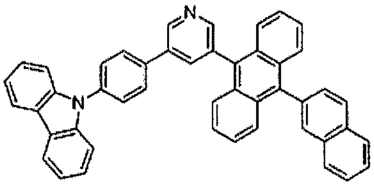
Compound (10)



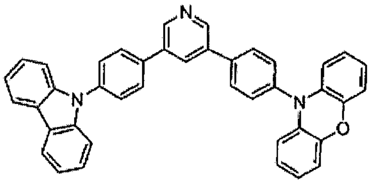
Compound (11)



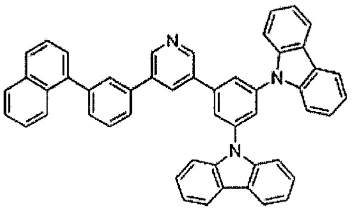
Compound (12)



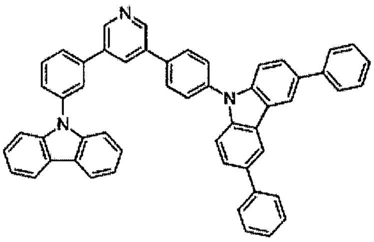
Compound (13)



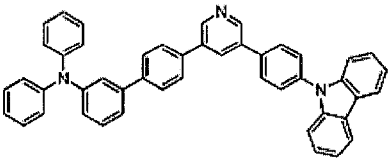
Compound (14)



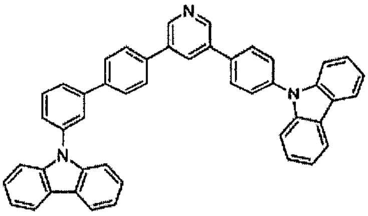
Compound (15)



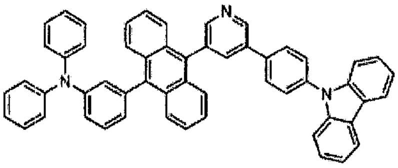
Compound (16)



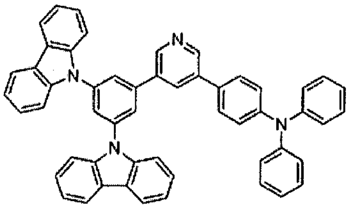
Compound (17)



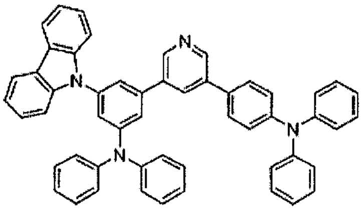
Compound (18)



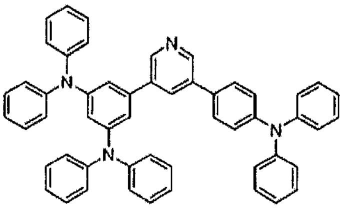
Compound (19)



Compound (20)



Compound (21)



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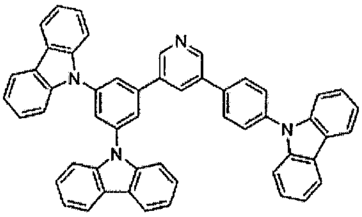

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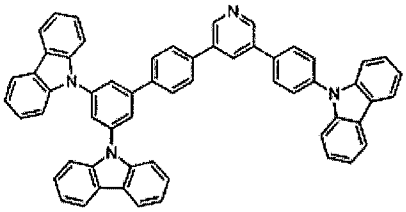

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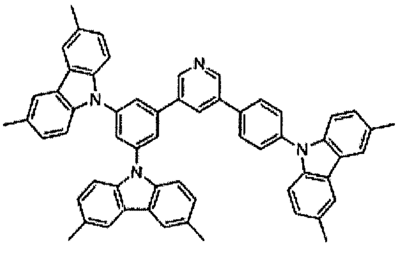

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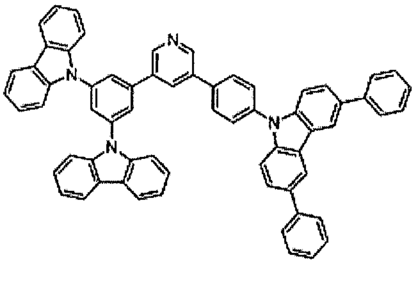

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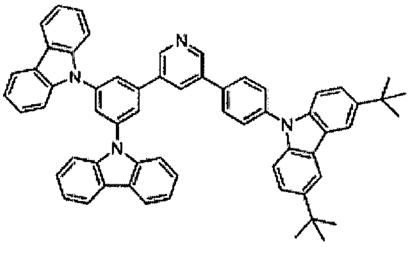

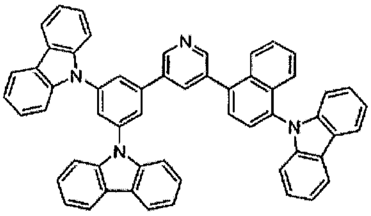

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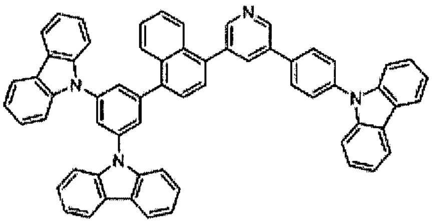

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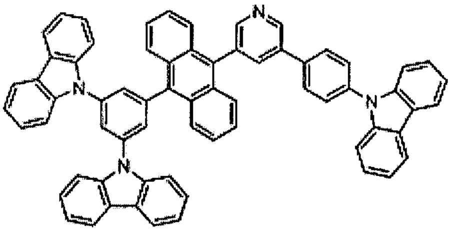

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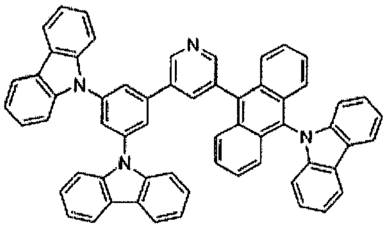

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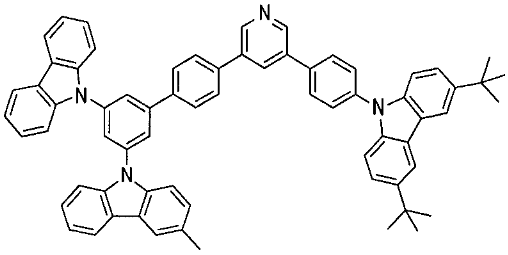

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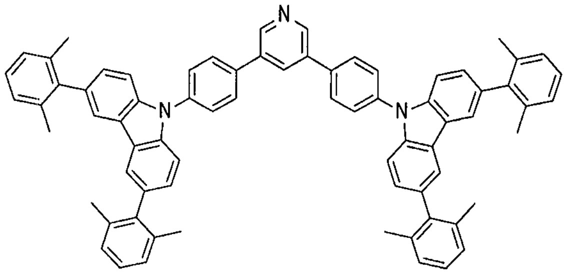

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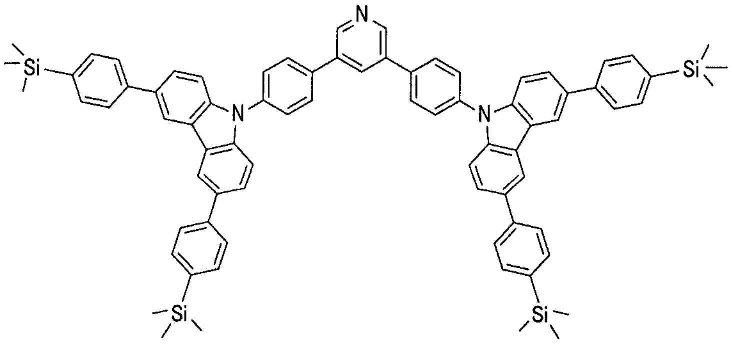

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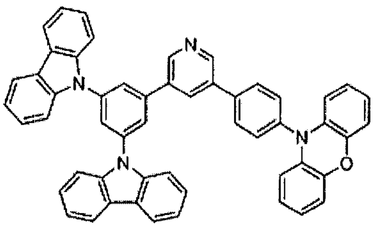

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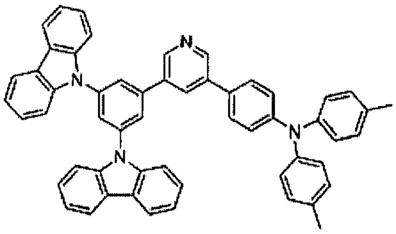

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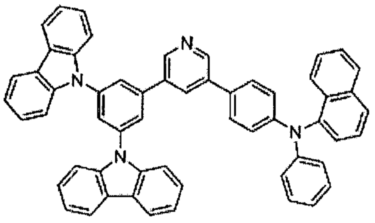

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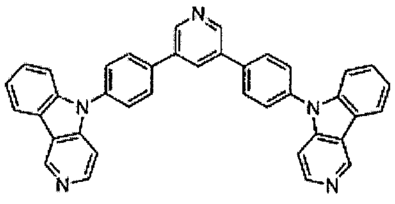

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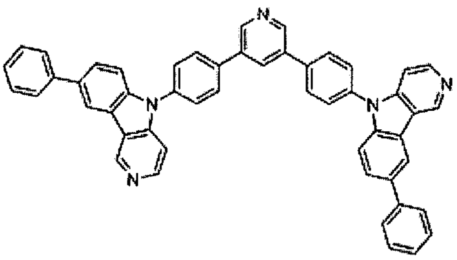

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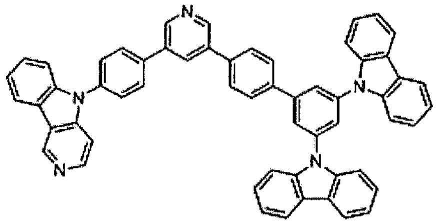

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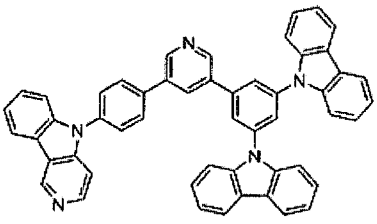

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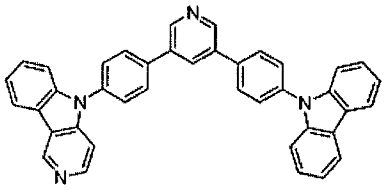

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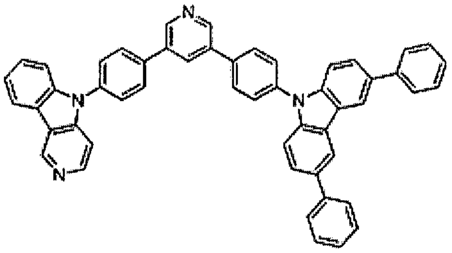
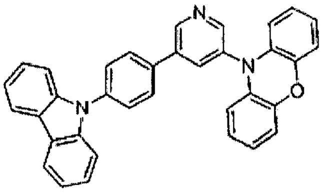
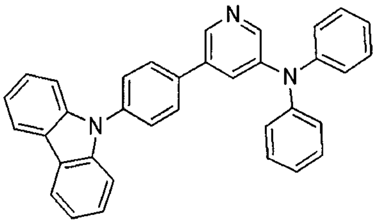


11. The material for an organic photoelectric device of claim 5, wherein the bipolar organic compound is selected from the group consisting of the following compounds (42) to (52), and combinations thereof:

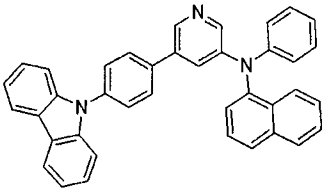
Compound (42)



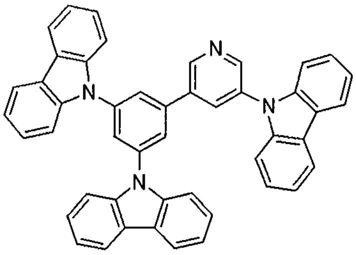
Compound (43)



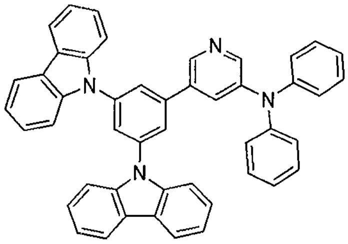
Compound (44)



Compound (45)



Compound (46)



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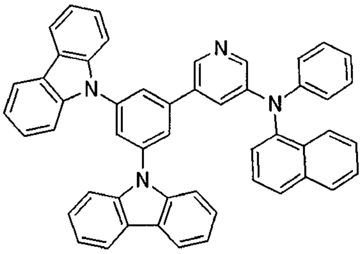
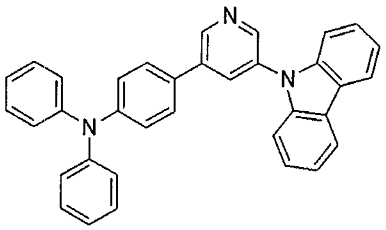


Compound (48)



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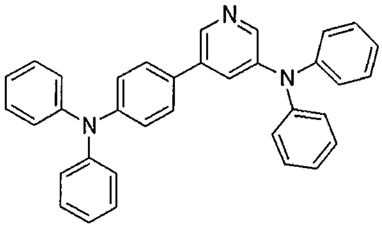
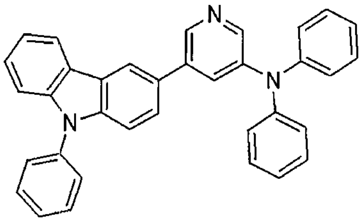
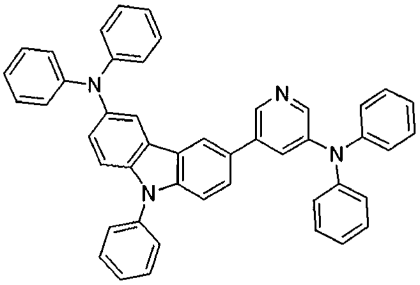


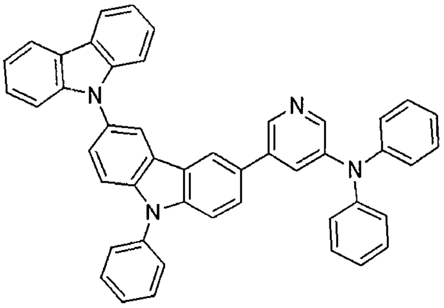
Compound (50)



Compound (51)



Compound (52)



12. The material for an organic photoelectric device of claim 1, wherein the dopant is a phosphorescent dopant selected from the group consisting of red, green, blue, and white phosphorescent dopants, and combinations thereof.

13. The material for an organic photoelectric device of claim 1, wherein

the dopant is a fluorescent dopant selected from the group consisting of red, green, blue, and white phosphorescent dopants, and combinations thereof.

14. An organic photoelectric device comprising

an anode, a cathode, and an organic thin layer disposed between the anode and cathode,

wherein the organic thin layer comprises the material according to one of claims 1 to 13.

15. The organic photoelectric device of claim 14, wherein the organic thin layer comprises:

an emission layer; and

at least one layer selected from the group consisting of a hole transport layer (HTL), a hole injection layer (HIL), an electron transport layer (ETL), an electron injection layer (EIL), and combinations thereof.

FIG. 1

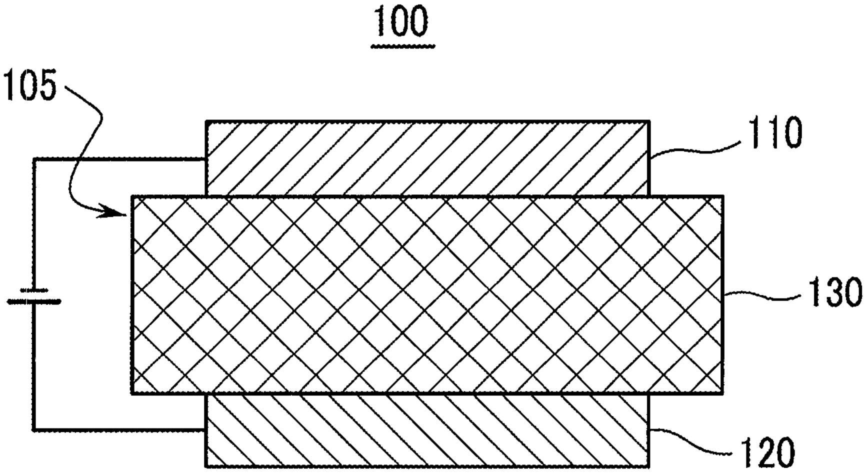


FIG. 2

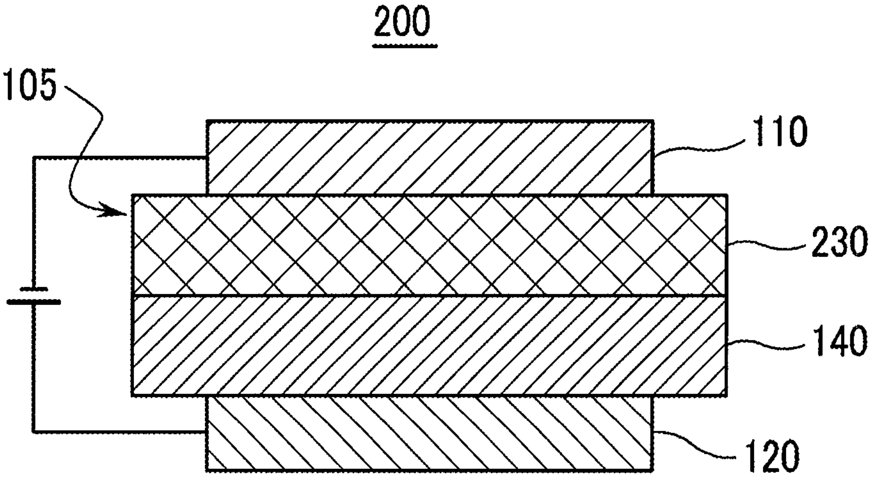


FIG. 3

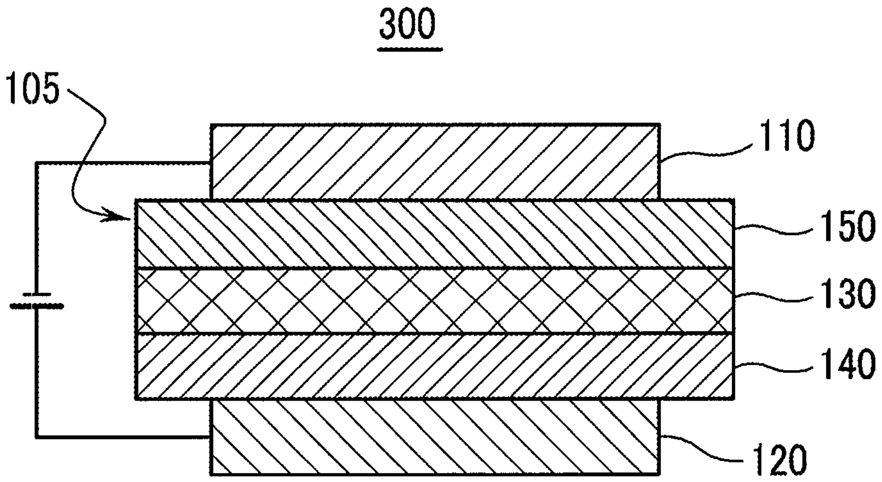


FIG. 4

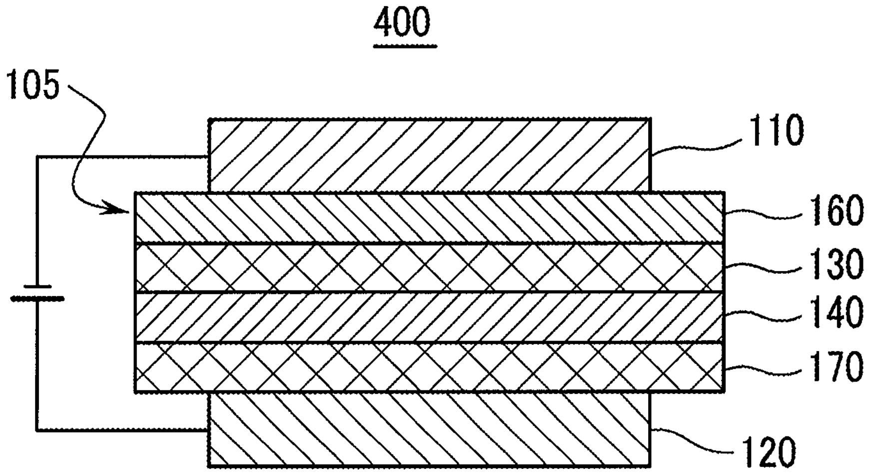
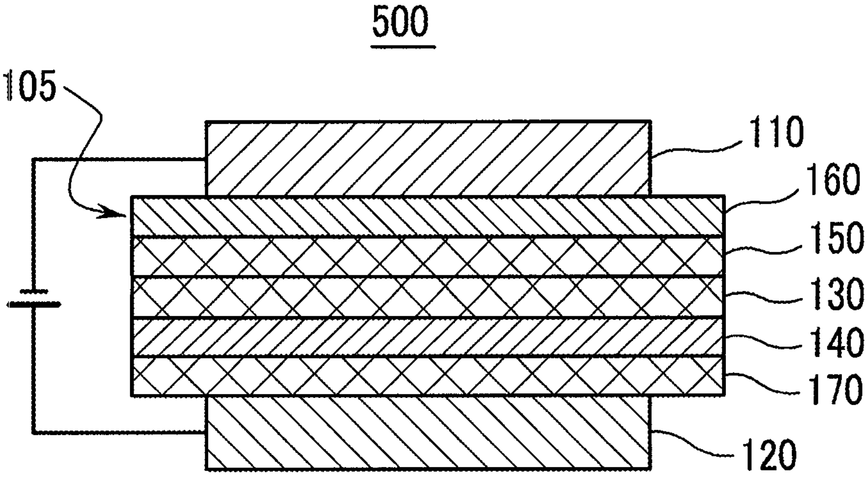


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/002098

A. CLASSIFICATION OF SUBJECT MATTER

C09K 11/06(2006.01)i

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)
IPC 8 C09K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2007-067383 A, (MITSUBISHI CHEMICALS CORP), 15 March 2007 (15.03.2007) see the abstract, paragraphs [12], [18], [19], [26], [27] and [51], claims 1-4.	1 - 15
A	WO 2006-067976 A1, (PIONEER CORPORATION & MITSUBISHI CHEMICAL CORPORATION), 29 June 2006 (29.06.2006) see the abstract, paragraphs [33]-[36], claims 1-4.	1 - 15
A	EP 1489155 A1, (IDEMITSU KOSAN CO., LTD.), 22 December 2004 (22.12.2004) see the abstract, claim 1.	1 - 15

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

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
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"&" document member of the same patent family

Date of the actual completion of the international search 27 AUGUST 2008 (27.08.2008)	Date of mailing of the international search report **27 AUGUST 2008 (27.08.2008)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer JOUNG, Meyoung Ju Telephone No. 82-42-481-8493

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