Title: POLYMER, AND ORGANIC PHOTOELECTRIC DEVICE COMPRISING THE SAME

Abstract: The present invention provides a polymer that easily dissolves in an organic solvent, and that is applicable as a host material of an emission layer of an organic photoelectric device since it emits fluorescence and phosphorescence at a red wavelength through a blue wavelength.
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[Invention Title]

POLYMER, AND ORGANIC PHOTOELECTRIC DEVICE COMPRISING THE SAME

[Technical Field]

The present invention relates to a polymer and an organic photoelectric device including the same. More particularly, the present invention relates to a polymer that easily dissolves in an organic solvent, and that is applicable as a host material of an emission layer of an organic photoelectric device since it emits fluorescence and phosphorescence at a red wavelength through a blue wavelength, and an organic photoelectric device including the same.

[Background Art]

An organic photoelectric device has been highlighted as the next generation display device. The organic photoelectric device can be driven at a low voltage, and can solve various problems of a liquid crystal display (LCD), such that is difficult to make it thinner and have a wide viewing angle and rapid response speed. The organic photoelectric device of a middle size or less also has equivalent or better image quality to a liquid crystal display (LCD) compared to other displays, and its manufacturing process is very simple. Therefore, it is evaluated to be advantageous in terms of cost in the future.

An organic photoelectric device includes an organic light emitting material between a rear plate including ITO transparent electrode patterns
as an anode on a transparent glass substrate and an upper plate including
a metal electrode as a cathode on a substrate. When a predetermined
voltage is applied between the transparent electrode and the metal
electrode, current flows through the organic light emitting material to emit
light.

Such an organic light emitting material for an organic photoelectric
device was firstly developed by Eastman Kodak, Inc., in 1987. The
material is a low molecular aromatic diamine and aluminum complex as an

C. W. Tang et al. firstly disclosed a practicable device as an organic
photoelectric device in 1987 (Applied Physics Letters, 51 12, 913-915,
1987).

According to the reference, the organic layer has a structure in
which a thin film (hole transport layer (HTL)) of a diamine derivative and a
thin film of tris(8-hydroxy-quinolate)aluminum (Alq₃) are laminated. The
Alq₃ thin film functions as an electron transporting emission layer.

Generally, an organic photoelectric device 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 include 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 inhibition layer or a hole inhibition 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 emission may be classified as a fluorescent material including singlet excitons and a phosphorescent material including triplet excitons according to the light emitting mechanism.

Recently, it is has become known that a phosphorescent light emitting material can be used for a light emitting material of an organic photoelectric device in addition to the fluorescent light emitting material (D. F. O'Brien et al., Applied Physics Letters, 74 3, 442-444, 1999; M. A. Baldo et al., Applied Physics letters, 75 1, 4-6, 1999). Such a phosphorescent material emits light by transiting the electrons from a ground state to an excited state, non-radiance transiting of a singlet exciton to a triplet exciton through intersystem crossing, and transiting a triplet exciton to a ground state to emit light.

When the triplet exciton is transited, it cannot directly transit to the ground state. Therefore, the electron spin is flipped, and then it is transited to the ground state so that it provides a characteristic of extending
the lifetime (emission lifetime) to more than that of fluorescent emission.

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.

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 photoelectric device.

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 a phosphorescent light emitting material is used, it has advantages in an increase in luminous efficiency of around four times that of the fluorescent light emitting material.

In the above-mentioned organic photoelectric device, a light emitting colorant (dopant) may be added in an emission layer (host) in order to increase the efficiency and stability in the emission state.

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-dicarbazole biphenyl (CBP) having a glass transition temperature of 110°C or less and excessively high symmetry. Thereby, it tends to crystallize and cause problems such as a short and a pixel defect 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.

[Disclosure]

[Technical Problem]

One embodiment of the present invention provides a polymer that
easily dissolves in an organic solvent, and is applicable as a host material of an emission layer of an organic photoelectric device since it emits fluorescence and phosphorescence at a red wavelength through a blue wavelength.

[Technical Solution]

Another embodiment of the present invention provides an organic photoelectric device including the polymer.

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.

According to one embodiment of the present invention, provided is an organic compound represented by the following Formula 1:

[Chemical Formula 1]

In the above Formula 1,

$X_i$ to $X_{i_6}$ are independently selected from the group consisting of $CR^1$ and $N$,

$Ar_1$ to $Ar_3$, and $Z$ are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 arylene and a substituted or unsubstituted C2 to C30 heteroarylene,
R' is selected from the group consisting of hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C2 to C20 alkenyl, a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C20 alkoxy, a substituted or unsubstituted C6 to C20 aryloxy, a substituted or unsubstituted C2 to C20 heterooxy, a substituted or unsubstituted C3 to C40 silyloxy, a substituted or unsubstituted C1 to C20 acyl, a substituted or unsubstituted C2 to C20 alkoxy carbonyl, a substituted or unsubstituted C2 to C20 acyloxy, a substituted or unsubstituted C2 to C20 acylamino, a substituted or unsubstituted C2 to C20 alkoxy carbonyl amino, a substituted or unsubstituted C7 to C20 aryloxy carbonyl amino, a substituted or unsubstituted C1 to C20 sulfamoyl amino, a substituted or unsubstituted C1 to C20 sulfanyl, a substituted or unsubstituted C1 to C20 alkylthiol, a substituted or unsubstituted C6 to C20 arylthiol, a substituted or unsubstituted C1 to C20 hetero cycloalkyl thiol, a substituted or unsubstituted C1 to C20 ureide, a substituted or unsubstituted C1 to C20 phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl, and

m is an integer ranging from 0 to 4.

According to another embodiment of the present invention, provided is a polymer represented by the following Formulae 23 to 28:
In the above Formulae 23 to 28,
Xi to Xi₆ are independently selected from the group consisting of CR¹ and N,

Z is selected from the group consisting of a substituted or unsubstituted C6 to C30 arylene and a substituted or unsubstituted C2 to C30 heteroarylene,

R₅ to R₇ and R’ are selected from the group consisting of hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C2 to C20 alkenyl, a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C20 alkoxy, a substituted or unsubstituted C6 to C20 aryloxy, a substituted or unsubstituted C2 to C20 heterooxy, a substituted or unsubstituted C3 to C40 silyloxy, a substituted or unsubstituted C1 to C20 acyl, a substituted or unsubstituted C2 to C20 alkoxy carbonyl, a substituted or unsubstituted C2 to C20 acyloxy, a substituted or unsubstituted C2 to C20 acylamino, a substituted or unsubstituted C2 to C20 alkoxy carbonyl amino, a substituted or unsubstituted C7 to C20 aryloxy carbonyl amino, a substituted or unsubstituted C1 to C20 sulfonyl, a substituted or unsubstituted C1 to C20 alkylthiol, a substituted or unsubstituted C6 to C20 arylthiol, a substituted or unsubstituted C1 to C20 hetero cycloalkyl thiol, a substituted or unsubstituted C1 to C20 ureide, a substituted or unsubstituted C1 to C20 phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl,
n_5 \text{ to } n_7 \text{ are independently integers ranging from 0 to 5, and}
m \text{ is an integer ranging from 0 to 4.}

According to further embodiment of the present invention, provided is an organic photoelectric device that includes an organic thin layer disposed between a pair of electrodes. The organic thin layer includes the above polymer.

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

[Advantageous Effects]

The polymer easily dissolves in an organic solvent, and is applicable as a host material of an emission layer of an organic photoelectric device since it emits fluorescence and phosphorescence at a red wavelength through a blue wavelength.

[Brief Description of the Drawings]

FIG. 1 is a cross-sectional view showing an organic photoelectric device according to one embodiment of the present invention.

FIG. 2 is a graph showing the photoluminescence (PL) wavelength of the polymer according to Example 6.

FIG. 3 shows a ^1H-NMR spectrum of the organic compound according to Example 6.

FIG. 4 is a graph showing current density of the organic photoelectric device including the polymer according to Example 6.

FIG. 5 is a graph showing voltage-luminance of the organic
photoelectric device including the polymer according to Example 6.

description of Reference Numerals Indicating Primary Elements in
the Drawings>

11: substrate  12: anode
13: hole transport layer (HTL)  14: organic emission layer
15: electron transport layer (ETL)  16: cathode

[Best Mode]

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 but rather is defined by the
scope of the appended claims.

A polymer according to one embodiment of the present invention is
represented by the following Formula 1:

[Chemical Formula 1]

In the above Formula 1,

Xi to X16 are independently selected from the group consisting of
CR1 and N,

Ar1 to Ar3, and Z are independently selected from the group
consisting of a substituted or unsubstituted C6 to C30 arylene and a
substituted or unsubstituted C2 to C30 heteroarylene,

R^1 is are independently selected from the group consisting of hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C2 to C20 alkenyl, a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C20 alkoxy, a substituted or unsubstituted C6 to C20 arylxy, a substituted or unsubstituted C2 to C20 heterooxy, a substituted or unsubstituted C3 to C40 silyloxy, a substituted or unsubstituted C1 to C20 acyl, a substituted or unsubstituted C2 to C20 alkoxy carbonyl, a substituted or unsubstituted C2 to C20 acyloxy, a substituted or unsubstituted C2 to C20 acylamino, a substituted or unsubstituted C7 to C20 aryloxy carbonyl amino, a substituted or unsubstituted C1 to C20 sulfamoyl amino, a substituted or unsubstituted C1 to C20 sulfonyl, a substituted or unsubstituted C1 to C20 alkylthiol, a substituted or unsubstituted C6 to C20 arylthiol, a substituted or unsubstituted C1 to C20 hetero cycloalkyl thiol, a substituted or unsubstituted C1 to C20 ureide, a substituted or unsubstituted C1 to C20 phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl, and

m is an integer ranging from 0 to 4.

In one embodiment, Ar_1 to Ar_3 are independently selected from the group consisting of a substituted or unsubstituted carbazole, a substituted
or unsubstituted arylamine, a substituted or unsubstituted phenyl, a substituted or unsubstituted tolyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted stilbene, a substituted or unsubstituted fluorenyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted terphenyl, a substituted or unsubstituted pyrenyl, a substituted or unsubstituted diphenyl anthracenyl, a substituted or unsubstituted dinaphthylanthracenyl, a substituted or unsubstituted pentacenyl, a substituted or unsubstituted bromophenyl, a substituted or unsubstituted hydroxyphenyl, a substituted or unsubstituted thiophene, a substituted or unsubstituted pyrrolyl, a substituted or unsubstituted pyridyl, a substituted or unsubstituted azobenzenyl, and a substituted or unsubstituted ferrocenyl.

In one embodiment, Z is selected from the group consisting of a substituted or unsubstituted phenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted fluorenyl, a substituted or unsubstituted thiophene, a substituted or unsubstituted pyrrolyl, a substituted or unsubstituted pyridyl, a substituted or unsubstituted aryloxadiazole, a substituted or unsubstituted triazole, a substituted or unsubstituted carbazole, a substituted or unsubstituted arylamine, and a substituted or unsubstituted arylsilane.

As used herein, the substituted arylene and substituted heteroarylene respectively refer to an arylene and a heteroarylene substituted with a C1 to C30 alkyl, a halogen, a C1 to C30 haloalkyl, a C6 to C30 aryl, or a C2 to C30 heteroaryl.
As used herein, the substituted alkyl, substituted alkenyl, substituted aryl, substituted heteroaryl, substituted alkoxy, substituted aryl oxy, substituted hetero oxy, substituted silyl oxy, substituted acyl, substituted alkoxy carbonyl, substituted acyl oxy, substituted acyl amino, substituted alkoxy carbonyl amino, substituted aryl oxycarbonylamino, substituted sulfamoyl amino, substituted sulfonyl, substituted alkylthiol, substituted aryl thiol, substituted hetero cycloalkyl thiol, substituted ureide, substituted phosphoric acid amide, and substituted silyl respectively refer to an alkyl, alkenyl, an aryl, a heteroaryl, an alkoxy, an aryl oxy, a heterooxy, a silyl oxy, an acyl, an alkoxy carbonyl, an acyl oxy, an acyl amino, an alkoxy carbonyl amino, an aryl oxycarbonylamino, a sulfamoyl amino, a sulfonyl, an alkylthiol, an aryl thiol, a hetero cycloalkyl thiol, a ureide, a phosphoric acid amide, and silyl substituted with a C1 to C30 alkyl, a halogen, a C1 to C30 haloalkyl, a C6 to C30 aryl, or a C2 to C30 heteroaryl.

As used herein, the substituted carbazole, substituted arylamine, substituted phenyl, substituted tolyl, substituted naphthyl, substituted stilbene, substituted fluorenyl, substituted anthracenyl, substituted terphenyl, substituted pyrenyl, substituted diphenylanthracenyl, substituted dinaphthylanthracenyl, substituted pentacenyl, substituted bromophenyl, substituted hydroxyphenyl, substituted thienyl, substituted pyridyl, substituted azobenzenyl, and substituted ferrocenyl refers to a carbazole, an arylamine, a phenyl, a tolyl, a naphthyl, a stilbene, a fluorenyl, an
anthracenyl, a terphenyl, a pyrenyl, a diphenylanthracenyl, a
dinaphthylanthracenyl, a pentacenyl, a bromophenyl, a hydroxyphenyl, a
thienyl, a pyridyl, azobenzenyl, and ferrocenyl substituted with a C1 to C30
alkyl, a halogen, a C1 to C30 haloalkyl, a C6 to C30 aryl, or a C2 to C30
heteroaryl.

As used herein, the substituted thiophene, substituted pyrrol,
substituted pyridine, substituted aryloxadiazole, substituted triazole, and
substituted arylsilane refer to a thiophene, a pyrrol, a pyridine, an
aryloxadiazole, a triazole and an arylsilane substituted with a C1 to C30
alkyl, a halogen, a C1 to C30 haloalkyl, a C6 to C30 aryl, or a C2 to C30
heteroaryl.

In the present specification, the term "hetero" refers to one
including 1 to 3 heteroatoms selected from the group consisting of nitrogen
(N), oxygen (O), sulfur (S), and phosphorus (P), and the remainder being
carbon.

Z is preferably selected from the group consisting of compounds
represented by the following Formulae 2 to 22:

[Chemical Formula 2]
[Chemical Formula 3]

[Chemical Formula 4]

[Chemical Formula 5]

[Chemical Formula 6]

[Chemical Formula 7]

[Chemical Formula 8]
In the above Formulae 2 to 22,

R₁ to R₄₈ are independently selected from the group consisting of a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C₁ to C20 alkyl, a substituted or unsubstituted C₂ to C20
alkenyl, a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C20 alkoxy, a substituted or unsubstituted C6 to C20 aryloxy, a substituted or unsubstituted C2 to C20 heterooxy, a substituted or unsubstituted C3 to C40 silyl oxy, a substituted or unsubstituted C1 to C20 acyl, a substituted or unsubstituted C2 to C20 alkoxy carbonyl, a substituted or unsubstituted C2 to C20 acyl oxy, a substituted or unsubstituted C2 to C20 acyl amino, a substituted or unsubstituted C2 to C20 alkoxy carbonyl amino, a substituted or unsubstituted C7 to C20 aryl oxycarbonylamino, a substituted or unsubstituted C1 to C20 sulfamoyl amino, a substituted or unsubstituted C1 to C20 sulfonyl, a substituted or unsubstituted C6 to C20 aryl thiol, a substituted or unsubstituted C1 to C20 hetero cyclo alkyl thiol, a substituted or unsubstituted C1 to C20 ureide, a substituted or unsubstituted C1 to C20 phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl,

\(Y_i\) is selected from the group consisting of a single bond, O, S, NR\(^n\), SiR\(^1\)R\(^n\), and CR\(^n\)R\(^n\),

R\(^n\) and R\(^n\)\(^i\) are independently selected from the group consisting of hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C6 to C30 aryl, and a substituted or unsubstituted C2 to C30 heteroaryl,

\(n_{42}\) and \(n_{43}\) are independently integers ranging from 0 to 5,

\(n_i\) to \(n_3\), \(n_{16}\), \(n_{17}\), \(n_2\)\(^i\), \(n_2\)\(^i\)\(^2\), \(n_2\)\(^i\)\(^2\)\(^i\), \(n_{29}\), \(n_{30}\) to \(n_{32}\), \(n_{35}\) to \(n_{38}\), \(n_{39}\), and \(n_{40}\) are
independently integers ranging from 0 to 4,

\[ n_5, n_6, n_7, n_9, n_{10} \text{ to } n_{12}, n_{13}, n_{20} \text{ to } n_{28}, n_{33}, n_{34}, n_{4i}, \text{ and } n_{44} \text{ are independently integers ranging from 0 to 3}, \]

\[ n_8, n_{13} \text{ to } n_{15}, \text{ and } n_{19} \text{ are independently integers ranging from 0 to 2}, \]

and

\[ n_4 \text{ is 0 or 1}. \]

The polymer represented by the above Formula 1 may include polymers represented by the following Formulae 23 to 28.

[Chemical Formula 23]
In the above Formulae 23 to 28,

\(X_i\) to \(X_i_6\) are independently selected from the group consisting of

- \(CRI\) and \(N\),
- \(Z\) is selected from the group consisting of a substituted or unsubstituted C6 to C30 arylene and a substituted or unsubstituted C2 to C30 heteroarylene,
- \(R_5\) to \(R_7\) and \(RI\) are independently selected from the group consisting of hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C2 to C20 alkenyl, a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C20 alkoxy, a substituted or unsubstituted C6 to C20 aryloxy, a substituted or unsubstituted C2 to C20 heterooxy, a substituted or unsubstituted C3 to C40 silyloxy, a substituted or unsubstituted C1 to C20 acyl, a substituted or unsubstituted C2 to C20 alkoxy carbonyl, a substituted or unsubstituted C2 to C20 acyloxy, a substituted or
unsubstituted C2 to C20 acylamino, a substituted or unsubstituted C2 to C20 alkoxy carbonyl amino, a substituted or unsubstituted C7 to C20 aryloxy carbonyl amino, a substituted or unsubstituted C1 to C20 sulfamoyl amino, a substituted or unsubstituted C1 to C20 sulfanyl, a substituted or unsubstituted C1 to C20 alkylthiol, a substituted or unsubstituted C6 to C20 arylthiol, a substituted or unsubstituted C1 to C20 heterocycloalkyl thiol, a substituted or unsubstituted C1 to C20 ureide, a substituted or unsubstituted C1 to C20 phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl,

\[ n_5 \text{ to } n_7 \text{ are integers ranging from } 0 \text{ to } 5, \text{ and} \]
\[ m \text{ is an integer ranging from } 0 \text{ to } 4. \]

In the above Formulae 23 to 28, specific examples of Z are the same as in Chemical Formula 1.

More specific examples of the above formula 23 to 28 may include polymers represented by the following Formulae 29 to 73.

[Chemical Formula 29]
[Chemical Formula 39]

[Chemical Formula 40]
[Chemical Formula 47]

[Chemical Formula 48]
[Chemical Formula 49]

[Chemical Formula 50]

[Chemical Formula 51]
[Chemical Formula 64]

[Chemical Formula 65]

[Chemical Formula 66]
[Chemical Formula 67]

[Chemical Formula 68]

[Chemical Formula 69]
The polymers may be prepared using a generally-used preparation method of polymers without limitation. In one embodiment, the preparation method may be Yamamoto reactions, Suzuki reactions, Stille reactions, Ullman reactions, or so on.

Reaction temperatures, reaction solvents, and reaction times of the
preparation method can be adjusted to provide the above organic compounds.

The polymer may have various molecular weights according to polymerization methods and conditions, but has a weight average molecular weight of 1000 to 5,000,000, preferably 2000 to 2,000,000, and more preferably 3000 to 1,000,000.

The polymer may have a number average molecular weight of 500 to 2,000,000, preferably 1000 to 1,000,000, and more preferably 2000 to 500,000.

When the polymer has a weight average molecular weight of 1000 to 5,000,000, or a number average molecular weight of 500 to 2,000,000, the polymer can provide a thin film having good film characteristics.

A ratio of the weight average molecular weight/number average molecular weight may be 1 to 20, preferably 1 to 15, and more preferably 1 to 10. When the ratio of the weight average molecular weight/number average molecular weight is near 1, a polymer is theoretically synthesized well.

Another embodiment of the present invention provides an organic photoelectric device that includes an organic layer including the above-described organic compounds between a pair of electrodes. In one embodiment, the organic photoelectric device may be an organic light emitting diode.

The organic layer may be an emission layer, a hole injection layer
(HIL), a hole transport layer (HTL), an electron transport layer (ETL), an electron injection layer (EIL), an interlayer, and a hole blocking layer. In another embodiment, the emission layer is appropriate for the organic layer.

The organic photoelectric device may further selectively include an interlayer, a hole transport layer (HTL), and an electron transport layer (ETL) as well as a basic device structure of anode/emission layer/cathode.

FIG. 1 is a cross-sectional schematic view of the organic photoelectric device according to one embodiment. FIG. 1 shows an organic photoelectric device including a substrate 11, an anode 12, a hole transport layer (HTL) 13, an emission layer 14, an electron transport layer (ETL) 15, and a cathode 16.

Referring to FIG. 1, the organic photoelectric device may be fabricated using the organic compounds as follows.

First, an anode 12 material is coated on an upper side of the substrate 11.

The substrate 11 is a glass substrate or a transparent plastic substrate having excellent general transparence, face smoothness, handling ease, and water repellency.

The anode 12 material may include transparent and highly conductive indium tin oxide (ITO), tin oxide (SnC\(_2\)), zinc oxide (ZnO), or so on.

Then, a hole transport layer (HTL) 13 is disposed on the anode 12
using vacuum deposition, sputtering, or spin coating, and an emission layer 14 is disposed on the hole transport layer (HTL) 13 using vacuum deposition, or a solution coating method such as spin coating, InkJet printing, and so on.

An electron transport layer (ETL) 15 is disposed between the emission layer 14 and a cathode 16.

The emission layer 14 has a thickness ranging from 5nm to 1 µm, and preferably 10 to 500 nm, and the hole transport layer (HTL) 13 and electron transport layer (ETL) 15 respectively have a thickness ranging from 10 to 1000 nm.

The electron transport layer (ETL) 15 is formed using vacuum deposition, sputtering, or spin coating of generally-used electron transport layer (ETL) 15 materials.

The hole transport layer (HTL) 13 and electron transport layer (ETL) 15 play roles of efficiently transporting a carrier to the emission layer 14 to heighten light emitting recombination in the emission layer 14.

The hole transport layer (HTL) 13 material includes, but is not limited to, poly (3,4-ethylenedioxy-thiophene) (PEDOT) doped with poly(styrenesulfonic acid) (PSS), and N,N'-bis(3-methylphenyl)-N,N-diphenyl-[1,1'-biphenyl]-4,4'-diamine (TPD).

The electron transport layer (ETL) 15 material includes, but is not limited to, aluminum trihydroxyquinoline (Alq₃), a 1,3,4-oxadiazole derivative such as 2-(4-biphenylyl-5-phenyl-1,3,4-oxadiazole (PBD), a
quinoxaline derivative such as 1,3,4-tris[(3-phenyl-6-trifluoromethyl)quinoxalin-2-yl] benzene (TPQ), and a triazole derivative.

The polymer may be mixed with a phosphorescent light emitting organic compound. The phosphorescent organic compound may be a phosphorescent light emitting organic metal complex from its triplet state, and is preferably a metal complex of at least one group VHI metal ion according to the periodic table of Gregor Johann Mendel. The group W metal ion includes a metal ion selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, and Pt, and is preferably Ir or Pt.

Examples of the metal complex may be represented by the following Formulae 74 to 76, but are not limited thereto.

[Chemical Formula 74]

[Chemical Formula 75]
When the organic layer including the organic compound is formed using a solution coating, another low molecular host material can be included along with the organic compound. Examples of the low molecular host material include the compounds of the following Formulae 77 to 80, but are not limited thereto.

[Chemical Formula 77]

[Chemical Formula 78]

[Chemical Formula 79]

[Chemical Formula 80]

The polymer may be used by mixing with polymers having
conjugated double bonds such as fluorine-based polymers, polyphenylenevinylene-based polymers, and polyparaphenylene-based polymers, and also by mixing with binder resins.

The binder resins may include polyvinylcarbazole (PVK), polycarbonate, polyester, polyan arylate, polystyrene, acryl polymers, methacryl polymers, polybutyral, polyvinylacetate, diallylphthalate polymers, phenol resins, epoxy resins, silicone resins, polysulfone resins, or urea resins, and these resins can be used singularly and in combinations.

Selectively, a hole blocking layer may be disposed using vacuum deposition to limit a transport speed of holes into the emission layer 14 and thus to increase recombination opportunity of electrons and holes.

A cathode 16 material is coated on the electron transport layer (ETL).

The cathode material may be lithium (Li), magnesium (Mg), calcium (Ca), aluminum (Al), Al:Li, Ba:Li, or Ca:Li having a small work function.

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

A person having ordinary skill in this art can sufficiently understand parts of the present invention that are not specifically described.

[Mode for Invention]

In the following Examples 1 to 5, monomers M-1 to M-5 for preparing a polymer according to one embodiment of the present invention
were respectively prepared as shown in Reaction Schemes 1 to 5.

Example 1: Synthesis of M-1

[Reaction Scheme 1]

6.0 g (17.79 mmol) of 9-(3-bromophenyl)-9-H-fluorene-9-ol (A) and 2.13 g (7.11 mmol) of 9-4-tert-butylphenyl)9-H-carbazole (B) were dissolved in 40 ml of dichloromethane under a nitrogen atmosphere, and 3 imL of a boron trifluoride diethylether complex (BF₃·OEt₂) was slowly added thereto. The mixture was agitated at room temperature for 12 hours, and 50 ml of water was added thereto, completing the reaction. The reactant was extracted with dichloromethane and washed four times with water. The extraction solution was dried with anhydrous magnesium sulfate. The dried solution was treated to remove a solvent under reduced pressure. The resulting product was purified through a silica gel column with a solvent of methylenechloride/hexane mixed in a ratio of 1:3, obtaining 5.0 g (56.2%) of white M-1.
Example 2: Synthesis of M-2

[Reaction Scheme 2]

6.0 g (17.79 mmol) of 9-(4-bromophenyl)-9-H-fluorene-9-ol (C) and 2.13 g (7.11 mmol) of 9-(4-tert-butylphenyl)-9-H-carbazole (B) were dissolved in 40 ml of dichloromethane under a nitrogen atmosphere, and 3 mL of a boron trifluoride diethyl ether complex (BF₃OET₂) was slowly added thereto. The mixture was agitated at room temperature for 12 hours, and 50 mL of water was added thereto, completing the reaction. The reactant was extracted with dichloromethane and washed four times with water. The extraction solution was dried with anhydrous magnesium sulfate. The dried solution was treated under reduced pressure to remove the solvent. The resulting product was purified through a silica gel column with a solvent of methylenechloride/hexane mixed in a ratio of 2:3, obtaining 5.0 g (75%) of white M-2.
Example 3: Synthesis of M-3

[Reaction Scheme 3]

\[ \text{D M-3} \]

3.0 g (8.89 mmol) of 9-(3-bromophenyl)-9-H-fluorene-9-ol (A) and 1.77 g (4.04 mmol) of a material D were dissolved in 50 mL of dichloromethane, and 1.5 mL of a boron trifluoride diethylether complex (BF\(_3\)·OEt\(_2\)) was slowly added thereto in a dropwise fashion. The mixture was agitated at room temperature for 12 hours, and 50 mL of water was added thereto, completing the reaction. The reactant was extracted with dichloromethane and washed four times with water. Then, the extraction solution was dried with anhydrous magnesium sulfate. The dried solution was treated under reduced pressure to remove the solvent and then purified through a silica gel column with a solvent of methylenechloride/hexane mixed in a ratio of 1:2, obtaining 3.3 g (75.8%) of white M-3.
Example 4: Synthesis of M-4

[Reaction Scheme 4]

![Reaction Scheme 4](image)

3.0 g (8.89 mmol) of 9-(4-bromophenyl)-9H-fluorene-9-ol and 1.77 g (4.04 mmol) of a material D were dissolved in 50 mL of dichloromethane, and 1.5 mL of a boron trifluoride diethyl ether complex (BF₃·OEt₂) was slowly added thereto in a dropwise fashion. The mixture was agitated at room temperature for 12 hours, and 50 mL of water was added thereto, completing the reaction. The reactant was extracted with dichloromethane and washed four times with water. The extraction solution was dried with anhydrous magnesium sulfate. The solution was treated to remove the solvent under reduced pressure and purified through a silica gel column with a solvent of methylene chloride/hexane mixed in a ratio of 1:2, obtaining 3.0 g (69%) of white M-4.
Example 5: Synthesis of M-5

[Reaction Scheme 5]

4.1 1 g (7.37 mmol) of a material E and 2.0 g (3.35 mmol) of a material F were dissolved in 40 ml. of dichloromethane under a nitrogen atmosphere, and 1.5 mL of a boron trifluoride diethylether complex (BF₃OEt₂) was slowly added thereto in a dropwise fashion. The mixture was agitated at room temperature for 12 hours, and 50 mL of water was added thereto, completing the reaction. The reactant was extracted with dichloromethane and washed four times with water. The extraction solution was dried with anhydrous magnesium sulfate. The dried solution was treated under reduced pressure to remove the solvent and purified through a silica gel column with a solvent of methylenechloride/hexane mixed in a ratio of 1:2, obtaining 4.1 g (73%) of white M-5.

In the following Examples 6 to 10, polymers CISH-1 to CISH-5 according to one embodiment of the present invention were respectively prepared as shown in Reaction Schemes 6 to 10.
Example 6: Synthesis of Polymer CISH-1

[Reaction Scheme 6]

0.7 g (0.41 mmol) of the monomer M-5 prepared under a nitrogen atmosphere, 279.4 mg of bis(1,5-cyclooctadiene)-nickel), 0.12 mL of cyclooctadiene, and 158 mg of 2,2'-bipyridine were dissolved in a mixed solvent of DMF/toluene (8 mL/4 mL) in a 100ml round flask with a thermometer, a reflux condenser, and an agitator. The solution was agitated at 70°C for 48 hours. The agitated reactant was precipitated in methanol, obtaining a white polymer. The polymer was filtered and dissolved in chloroform, and then reprecipitated in methanol.

The reprecipitated polymer was purified with acetone for 24 hours using a Soxhlet device, obtaining 0.4g of white CISH-1.

This polymer had a light-emitting maximum wavelength of 408 nm when in the chloroform solution.
Example 7: Synthesis of Polymer CISH-2

[Reaction Scheme 7]

0.6 g (0.35 mmol) of the monomer M-5, 0.17 g (0.35 mmol) of 9,9-dioctylfluorene-2,7-diboronic acid, and 0.05 g (0.043 mmol) of tetrakistriphenyl phosphine palladium were dissolved in 10 ml of tetrahydrofuran (THF) in a 100 ml round flask with a thermometer, a reflux condenser, and an agitator under an argon atmosphere, and 5 ml of 20% tetratriethyl ammonium hydroxide was added thereto. The resulting mixture was agitated at 75 °C for 48 hours. The agitated reactant was precipitated in methanol, preparing a light yellow polymer. The polymer was filtered and redissolved in chloroform, and then reprecipitated in methanol.

The reprecipitated polymer was purified for 24 hours with methanol using a Soxhlet device, obtaining 0.5g of light yellow CISH-2.
Example 8: Synthesis of Polymer CISH-3

[Reaction Scheme 8]

0.6 g (0.35 mmol) of the monomer M-5, 0.128 g (0.35 mmol) of 9-ethylhexylcarbazole-3,6-diboronic acid, and 0.05 g (0.043 mmol) of tetrakistriphenyl phosphine palladium were dissolved in 10 ml of tetrahydrofuran in a 100 ml round flask with a thermometer, a reflux condenser, and an agitator under an argon atmosphere, and 5 ml of 20% tetratriethyl ammonium hydroxide was added thereto. The resulting mixture was agitated at 75 °C for 48 hours. The agitated reactant was precipitated in methanol, obtaining a light yellow polymer. Then, it was filtered and dissolved in chloroform, and then reprecipitated in methanol.

The reprecipitated polymer was filtered and purified for 24 hours using a Soxhlet device, obtaining 0.44 g of light yellow CISH-3.
Example 9: Synthesis of Polymer CISH-4

[Reaction Scheme 9]

\[
\begin{array}{c}
\text{HO}_2\text{B-ZJ-B(OH)}_2 \\
\text{M-5} \\
\text{CISH-4}
\end{array}
\]

0.6 g (0.35 mmol) of the monomer M-5, 0.058 g (0.35 mmol) of 1,4-phenylene diboronic acid, and 0.05 g (0.043 mmol) of tetrakistriphenylphosphine palladium were dissolved in 10 ml of tetrahydrofuran in a 100 ml round flask with a thermometer, a reflux condenser, and an agitator under an argon atmosphere, and 5 mL of 20% tetratriethyl ammonium hydroxide was added thereto. The resulting mixture was agitated at 75 °C for 48 hours. The agitated reactant was precipitated in methanol, obtaining a light yellow polymer. It was filtered and redissolved in chloroform, and then reprecipitated in methanol.

The reprecipitated polymer was purified for 24 hours using a Soxhlet device, obtaining 0.35g of light yellow CISH-4.

**Characteristic evaluation of the polymers**

The prepared CISH-1 to CISH-4 were used to form thin films on glass substrates and measured regarding PL (photoluminescence) wavelength using HITACHI F-4500®. The result of the PL wavelength measurement of CISH-1 is provided in FIG. 2.
Referring to FIG. 2, the thin-filmed CISH-1 had a maximum light emitting wavelength of 414nm.

In addition, the CISH-1 of Example 6 was measured regarding $^1$H-NMR using Bruker 300MHz®. The result is shown in FIG. 3 ($^1$H-NMR (CD$_2$Cl$_2$, $\delta$, ppm): 8.34-7.03 (aromatic, 56H br, m); 1.5-1.12 (t-butyl, 36H))

Referring to FIG. 3, the polymer of Example 6 was identified as CISH-1.

**Fabrication of an organic photoelectric device**

An ITO substrate was used as an anode. The anode was spin-coated to form poly(3,4-ethylenedioxy-thiophene) (PEDOT) on the top thereof.

Next, an emission layer was formed on the surface of the PEDOT by doping Ir(mppy)$_3$ in CISH-1 in an amount 6 to 7%.

A 50Å thick hole blocking layer was formed on the emission layer by vacuum-depositing BAlq.

Then, a 200Å thick electron transport layer (ETL) was formed on the emission layer by vacuum-depositing Alq$_3$.

An organic photoelectric device was completed by sequentially vacuum-depositing 10Å of LiF and 1000Å of Al on the electron transport layer (ETL) to form a cathode.

The organic photoelectric device had five layers, including Al 1000Å/ LiF 10Å/ Alq$_3$ 200Å/ BAlq 50Å/ EML (CISH-1:CBP:Ir(mppy)$_3$)/ PEDOT/ ITO 1500Å.
Performance measurement of the organic photoelectric device

Each organic photoelectric device was measured regarding current density and luminance changes according to voltage change. The measurement method is as follows.

1) Measurement of current density change depending on voltage change

The prepared organic photoelectric devices were increased in voltage from 0V to 14V and measured regarding a current value in a unit device by using a current-voltage device (Keithley 2400®). Then, their current densities were measured by dividing the current value by area.

The organic photoelectric device including the CISH-1 was measured regarding current density change depending on voltage change. The result is provided in FIG. 4.

2) Measurement of luminance change depending on voltage change.

The organic photoelectric devices were increased in voltage from 0V to 14V and measured regarding luminance using a luminance meter (Minolta Cs-1000A®).

The luminance change result of the organic photoelectric device including the CISH-1 is shown in FIG. 5.

Referring to FIGS. 4 and 5, the CISH-1 turned out to be a good host material for an organic photoelectric device.

The present invention is not limited to the embodiments illustrated.
with the drawings and table, but can be fabricated into various modifications and equivalent arrangements included within the spirit and scope of the appended claims by a person who is ordinarily skilled in this field. Therefore, the aforementioned embodiments should be understood to be exemplary but not limiting the present invention in any way.
[CLAIMS]

[Claim 1]

A polymer of the following Formula 1:

[Chemical Formula 1]

wherein, in the above Formula 1,

$X_i$ to $X_{i_6}$ are independently selected from the group consisting of $CR^1$ and $N$,

$Ar_1$ to $Ar_3$, and $Z$ are independently selected from the group consisting of a substituted or unsubstituted C6 to C30 arylene and a substituted or unsubstituted C2 to C30 heteroarylene,

$R^1$ is selected from the group consisting of hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C2 to C20 alkenyl, a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C20 alkoxy, a substituted or unsubstituted C6 to C20 aryloxy, a substituted or unsubstituted C2 to C20 heterooxy, a substituted or unsubstituted C3 to C40 silyloxy, a substituted or unsubstituted C1 to C20 acyl, a substituted or
unsubstituted C2 to C20 alkoxy carbonyl, a substituted or unsubstituted C2 to C20 acyloxy, a substituted or unsubstituted C2 to C20 acylamino, a substituted or unsubstituted C2 to C20 alkoxy carbonyl amino, a substituted or unsubstituted C7 to C20 aryloxy carbonyl amino, a substituted or unsubstituted C1 to C20 acyloxy, a substituted or unsubstituted C1 to C20 acylamino, a substituted or unsubstituted C1 to C20 aryloxy carbonyl amino, a substituted or unsubstituted C7 to C20 aryloxy carbonyl amino, a substituted or unsubstituted C2 to C20 alkoxy carbonyl amino, a substituted or unsubsstituted C1 to C20 sulfamoyl amino, a substituted or unsubstituted C1 to C20 sulfonyl, a substituted or unsubstituted C1 to C20 alkylthiol, a substituted or unsubstituted C6 to C20 arylthiol, a substituted or unsubstituted C1 to C20 hetero cycloalkyl thiol, a substituted or unsubstituted C1 to C20 ureide, a substituted or unsubstituted C1 to C20 phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl, and

m is an integer ranging from 0 to 4.

[Claim 2]

The polymer of claim 1, wherein Ar1 to Ar3 are independently selected from the group consisting of a substituted or unsubstituted carbazole, a substituted or unsubstituted arylamine, a substituted or unsubstituted phenyl, a substituted or unsubstituted tolyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted stilbene, a substituted or unsubstituted fluorenyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted terphenyl, a substituted or unsubstituted pyrenyl, a substituted or unsubstituted diphenyl anthracenyl, a substituted or unsubstituted dinaphthylanthracenyl, a substituted or unsubstituted pentacenyl, a substituted or unsubstituted bromophenyl, a
substituted or unsubstituted hydroxyphenyl, a substituted or unsubstituted thienyl, a substituted or unsubstituted pyridyl, a substituted or unsubstituted azobenzenyl, and a substituted or unsubstituted ferroceny.

[Claim 3]

The polymer of claim 1, wherein Z is selected from the group consisting of a substituted or unsubstituted phenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted anthracenyl, a substituted or unsubstituted fluorenly, a substituted or unsubstituted thiophene, a substituted or unsubstituted pyrrol, a substituted or unsubstituted pyridine, a substituted or unsubstituted aryloxadiazole, a substituted or unsubstituted triazole, a substituted or unsubstituted carbazole, a substituted or unsubstituted arylamine, and a substituted or unsubstituted arylsilane.

[Claim 4]

The polymer of claim 1, wherein Z is selected from the group consisting of compounds represented by the following Formulae 2 to 22:

[Chemical Formula 2]

[Chemical Formula 3]
[Chemical Formula 4]

[Chemical Formula 5]

[Chemical Formula 6]

[Chemical Formula 7]

[Chemical Formula 8]

[Chemical Formula 9]
[Chemical Formula 15]

[Chemical Formula 16]

[Chemical Formula 17]

[Chemical Formula 18]

[Chemical Formula 19]
wherein, in the above Formulae 2 to 22,

Ri to R_{45} are independently selected from the group consisting of a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C 1 to C 20 alkyl, a substituted or unsubstituted C 2 to C 20 alkenyl, a substituted or unsubstituted C 6 to C 30 aryl, a substituted or unsubstituted C 2 to C 30 heteroaryl, a substituted or unsubstituted C 1 to C 20 alkoxy, a substituted or unsubstituted C 6 to C 20 aryloxy, a substituted or unsubstituted C 2 to C 20 heterooxy, a substituted or unsubstituted C 3 to
C40 silyl oxy, a substituted or unsubstituted C1 to C20 acyl, a substituted or unsubstituted C2 to C20 alkoxy carbonyl, a substituted or unsubstituted C2 to C20 acyl oxy, a substituted or unsubstituted C2 to C20 acyl amino, a substituted or unsubstituted C2 to C20 alkoxy carbonyl amino, a substituted or unsubstituted C7 to C20 aryl oxycarbonylamino, a substituted or unsubstituted C1 to C20 sulfamoyl amino, a substituted or unsubstituted C1 to C20 sulfanyl, a substituted or unsubstituted C1 to C20 aryl thiol, a substituted or unsubstituted C6 to C20 aryl thiol, a substituted or unsubstituted C1 to C20 hetero cyclo alkyl thiol, a substituted or unsubstituted C1 to C20 ureide, a substituted or unsubstituted C1 to C20 phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl,

Yi is selected from the group consisting of a single bond, O, S, NR", SiR"-R"-1, and CR"-R"-1,

R" and R"-1 are independently selected from the group consisting of hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C6 to C30 aryl, and a substituted or unsubstituted C2 to C30 heteroaryl,

n42 and n43 are independently integers ranging from 0 to 5,

ni to n3, n-6, n-7, n2i, n22, n2g, n3o to n32, n35 to n38, n39, n3g, and n4o are independently integers ranging from 0 to 4,

n5, n6, n7, n9, n10 to n12, n18, n2O, n23 to n2s, n33, n34, n4i, and n44 are independently integers ranging from 0 to 3,

n8, n3 to n15, and ni9 are independently integers ranging from 0 to 2,
and

\[ n_4 \text{ is 0 or 1.} \]

[Claim 5]

A polymer represented by one of the following Formulae 23 to 28:

[Chemical Formula 23]

[Chemical Formula 24]
wherein, in the above Formulae 23 to 28,

$X_i$ to $X_{i_6}$ are independently selected from the group consisting of $\text{CR}^1$ and $N$,

$Z$ is selected from the group consisting of a substituted or unsubstituted C6 to C30 arylene and a substituted or unsubstituted C2 to C30 heteroarylene,

$R_5$ to $R_7$ and $R^1$ are independently selected from the group consisting of hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a
carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C2 to C20 alkenyl, a substituted or unsubstituted C6 to C30 aryl, a substituted or unsubstituted C2 to C30 heteroaryl, a substituted or unsubstituted C1 to C20 alkoxy, a substituted or unsubstituted C6 to C20 aryloxy, a substituted or unsubstituted C2 to C20 hetero氧, a substituted or unsubstituted C3 to C40 silyloxy, a substituted or unsubstituted C1 to C20 acyl, a substituted or unsubstituted C2 to C20 alkoxy carbonyl, a substituted or unsubstituted C2 to C20 acyloxy, a substituted or unsubstituted C2 to C20 acylamino, a substituted or unsubstituted C2 to C20 alkoxy carbonyl amino, a substituted or unsubstituted C7 to C20 aryloxy carbonyl amino, a substituted or unsubstituted C1 to C20 sulfamoyl amino, a substituted or unsubstituted C1 to C20 sulfanyl, a substituted or unsubstituted C1 to C20 alkylthiol, a substituted or unsubstituted C6 to C20 arylthiol, a substituted or unsubstituted C1 to C20 hetero cycloalkyl thiol, a substituted or unsubstituted C1 to C20 ureide, a substituted or unsubstituted C1 to C20 phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl,

\[ n_5 \text{ to } n_7 \text{ are integers ranging from 0 to 5, and } \]

\[ m \text{ is an integer ranging from 0 to 4.} \]

[Claim 6]

The polymer of claim 5, wherein Z is selected from the group consisting of a substituted or unsubstituted phenyl, a substituted or unsubstituted naphthyl, a substituted or unsubstituted anthracenyl, a
substituted or unsubstituted fluorenyl, a substituted or unsubstituted thiophene, a substituted or unsubstituted pyrrol, a substituted or unsubstituted pyridine, a substituted or unsubstituted aryloxadiazole, a substituted or unsubstituted triazole, a substituted or unsubstituted carbazole, a substituted or unsubstituted arylamine, and a substituted or unsubstituted arylsilane.

[Claim 7]

The polymer of claim 5, wherein Z is selected from the group consisting of compounds represented by the following Formulae 2 to 22:

[Chemical Formula 2]

[Chemical Formula 3]

[Chemical Formula 4]

[Chemical Formula 5]
[Chemical Formula 22]

wherein, in the above Formulae 2 to 22,

R_i to R_{4S} are independently selected from the group consisting of a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C_1 to C_20 alkyl, a substituted or unsubstituted C_2 to C_20 alkenyl, a substituted or unsubstituted C_6 to C_30 aryl, a substituted or unsubstituted C_2 to C_30 heteroaryl, a substituted or unsubstituted C_1 to C_20 alkoxy, a substituted or unsubstituted C_6 to C_20 aryloxy, a substituted or unsubstituted C_2 to C_20 heterooxy, a substituted or unsubstituted C_3 to C_40 silyl oxy, a substituted or unsubstituted C_1 to C_20 acyl, a substituted or unsubstituted C_2 to C_20 alkoxy carbonyl, a substituted or unsubstituted C_2 to C_20 acyl oxy, a substituted or unsubstituted C_2 to C_20 acyl amino, a substituted or unsubstituted C_2 to C_20 alkoxy carbonyl amino, a substituted or unsubstituted C_7 to C_20 aryl oxycarbonylamino, a substituted or unsubstituted C_1 to C_20 sulfamoyl amino, a substituted or unsubstituted C_1 to C_20 sulfonyl, a substituted or unsubstituted C_1 to C_20 alkylthiol, a substituted or unsubstituted C_6 to C_20 aryl thiol, a substituted or unsubstituted C_1 to C_20 hetero cyclo alkyl thiol, a substituted or unsubstituted C_1 to C_20 ureide, a substituted or unsubstituted C_1 to C_20
phosphoric acid amide, and a substituted or unsubstituted C3 to C40 silyl,

\[ \text{Y}_{i} \text{ is selected from the group consisting of a single bond, O, S, NR}^{+}, \]

\[ \text{SiR}^{+} \text{R}^{{}\text{Y}_{i}} \text{ and } \text{CR}^{+} \text{R}^{{}\text{Y}_{i}} \text{,} \]

\[ \text{R}^{{}\text{Y}_{i}} \text{ and R}^{{}\text{Y}_{i}} \text{ are independently selected from the group consisting of} \]

hydrogen, a halogen, a cyano, a hydroxyl, an amino, a nitro, a carboxyl, a substituted or unsubstituted C1 to C20 alkyl, a substituted or unsubstituted C6 to C30 aryl, and a substituted or unsubstituted C2 to C30 heteroaryl,

\[ \text{n}_{42} \text{ and } \text{n}_{43} \text{ are independently integers ranging from 0 to 5,} \]

\[ \text{n}_{i} \text{ to } \text{n}_{3}, \text{n}_{-16}, \text{n}_{17}, \text{n}_{21}, \text{n}_{22}, \text{n}_{29}, \text{n}_{30} \text{ to } \text{n}_{32}, \text{n}_{35} \text{ to } \text{n}_{38}, \text{n}_{39}, \text{ and } \text{n}_{40} \text{ are} \]

individually integers ranging from 0 to 4,

\[ \text{n}_{5}, \text{n}_{6}, \text{n}_{7}, \text{n}_{9}, \text{n}_{10} \text{ to } \text{n}_{12}, \text{n}_{18}, \text{n}_{20}, \text{n}_{23} \text{ to } \text{n}_{28}, \text{n}_{33}, \text{n}_{34}, \text{n}_{41}, \text{ and } \text{n}_{44} \text{ are} \]

individually integers ranging from 0 to 3,

\[ \text{n}_{8}, \text{n}_{13} \text{ to } \text{n}_{15}, \text{ and } \text{n}_{19} \text{ are independently integers ranging from 0 to 2,} \]

and

\[ \text{n}_{4} \text{ is } 0 \text{ or } 1. \]

[Claim 8]

The polymer of one of claims 1 to 7, wherein the polymer has weight average molecular weight of 1000 to 5,000,000.

[Claim 9]

The polymer of one of claims 1 to 7, wherein the polymer has number average molecular weight of 500 to 2,000,000.

[Claim 10]

An organic photoelectric device comprising
an organic layer between a pair of electrodes,

wherein the organic layer includes the polymer according to one of claims 1 to 7.

[Claim 11]

The organic photoelectric device of claim 10, wherein the organic layer is an emission layer.

[Claim 12]

The organic photoelectric device of claim 10, wherein the organic layer is selected from the group consisting of a hole injection layer (HIL), a hole transport layer (HTL), a hole blocking layer, and combinations thereof.

[Claim 13]

The organic photoelectric device of claim 10, wherein the organic layer is selected from the group consisting of an electron injection layer (EIL), an electron transport layer (ETL), an electron blocking layer, and combinations thereof.