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(54) Title: VINYL-BASED POLYMER WITH SILICON OR/AND TIN AND ORGANIC LIGHT EMISSION DIODE USING THE SAME

(57) Abstract: Disclosed herein is a vinyl-based polymer with silicon and/or tin for an organic layer of an OLED. The polymer is soluble in an organic solvent and can emit fluorescent and phosphorescent light from red to blue wavelengths so as to be used for a host material of an organic light emitting layer in the OLED.

【DESCRIPTION】

【Invention Title】

VINYL-BASED POLYMER WITH SILICON OR/AND TIN AND ORGANIC LIGHT EMISSION DIODE USING THE SAME

【Technical Field】

The present invention relates to a vinyl-based polymer comprising silicon and/or tin, and more particularly to a vinyl-based polymer comprising silicon and tin used to form a light emitting layer of an organic light emitting diode.

【Background Art】

An Organic Light Emitting Diode (OLED) has various advantages over a Thin Film Transistor-Liquid Crystal Display (TFT-LCD), such as lower voltage requirement for driving, slim shape, wide viewing angle, faster response time, etc. Furthermore, the OLED provides equivalent or superior image quality, especially in small and medium sizes, to the TFT-LCD and is produced via a simple manufacturing process which leads to a competitive price as compared to other types of display devices. With such advantages, it has been spotlighted as a next step in display technology.

The OLED includes a lower substrate where an Indium Tin Oxide (ITO) transparent electrode pattern is formed as an anode on a transparent glass substrate, an upper substrate where a metal electrode is formed as a cathode on a substrate, and an organic light emitting material disposed between the upper and lower substrates. With this configuration, when voltage is applied between the transparent electrode and the metal electrode, current flows through the organic light emitting material, so that the OLED emits light.

Organic light emitting materials used for OLEDs were first developed in 1987 by the Eastman Kodak Company using small molecules such as aromatic diamines and an aluminum complex as a light emitting layer material (Applied

Physics Letters, Vol. 51, p 913, 1987). Also, OLEDs using such materials were first reported as a device with practical performance by C. W. Tang, et al. [Applied Physics Letters, Vol. 51, No. 12, pp 913-915, 1987].

Those documents disclose an organic light emitting layer which has a stacked structure of a diamine derivative thin film (hole transport layer) and an Alq3(tris(8-hydroxy-quinolate)aluminum) thin film (electron transportable light emitting layer).

The foregoing materials for the light emitting layer are all polymers which are soluble in common solvents, unlike low molecular weight light emitting materials, and can form a light emitting layer by coating methods.

Recently, a variety of polymeric light emitting materials have been proposed (e.g. Advanced Materials, Vol.12, pp 1737-1750, 2000).

In the case of manufacturing a device using the polymeric light emitting material by coating, the polymeric light emitting material provides merits in that manufacturing processes can be simplified and in that large scale devices can be easily made, unlike when low molecular vacuum deposition is employed.

When an electric field is applied to an OLED such that holes and electrons are injected from an anode and a cathode, the holes and electrons are recombined into excitons in a light emitting layer.

Then, the excitons emit light when returning to the ground state.

Light emission mechanisms can be divided into two categories: fluorescence using singlet excitons and phosphorescence using triplet excitons.

Recently, reports have been made that a phosphorescent material as well as a fluorescent material can be used as a light emitting material for an OLED (by D.F. O'Brien et al., Applied Physics Letters, 74 (3), pp 442-444, 1999; M.A. Baldo et al., Applied Physics Letters, 75 (1), pp 4-6, 1999). Phosphorescence is based on the following mechanism: after transition of electrons from the ground state to the excited state, non-emissive transition of singlet excitons to triplet excitons occurs through intersystem crossing, and then, transition of triplet excitons to the ground state occurs while emitting light.

Here, since the triplet excitons are spin-forbidden directly to the ground

state in transition, they undergo transition to the ground state after flipping of electron spins. Thus, phosphorescence has a longer lifetime (emission time) than fluorescence.

That is, fluorescence has an emission duration of just several nano seconds, whereas phosphorescence has a relatively long duration of several micro seconds.

In view of quantum mechanics, when holes from the anode and electrons from the cathode are recombined into the excitons in an OLED, the generation ratio of singlet to triplet is 1:3, which means three times as many triplet excitons are generated as singlet electrons.

Hence, in fluorescence, 25% of the excitons are in an excited singlet state (75% in a triplet state), thereby limiting the emission efficiency. In phosphorescence, however, 75% of the excitons in the triplet state can be used along with 25% of the excitons in the excited singlet state, which enables 100% internal quantum efficiency to be obtained in theory.

Thus, a phosphorescent material can provide about three times higher emission efficiency than a fluorescent material in practical use.

For the OLED having the structure described above, a luminescent pigment (dopant) can be added to the light emitting layer (host) to improve efficiency and stability of light emission.

In this case, the efficiency and performance of the light emitting device can vary depending on what type of host is used for the light emitting layer. As proposed from studies on the light emitting layer (host), examples of an monomolecular organic host material include naphthalene, anthracene, phenanthrene, tetracene, pyrene, benzopyrene, chrysene, picene, carbazole, fluorine, biphenyl, terphenyl, triphenylene oxide, dihalobiphenyl, trans-stilbene, and 1,4-diphenylbutadiene.

A polymer host can also make an idential function through synthesis of polymers comprising the molecules as proposed above as examples.

Although advances have been achieved in the field of OLED technology, there is a need of further improvements in emission efficiency, color purity, and electrical stability.

Moreover, the current advances in technology are insufficient to realize a

large-scale light emitting device.

Thus, there is still a need of a polymeric light emitting material that can solve the problems of the conventional materials as described above.

【Disclosure】

【Technical Problem】

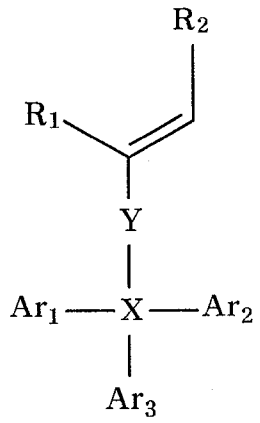
Therefore, the present invention is conceived in view of the above problems of the conventional technique, and it is an aspect of the present invention to provide a vinyl-based polymer comprising silicon and/or tin for an organic layer of an OLED, which is soluble in an organic solvent and can emit fluorescent and phosphorescent light from red to blue wavelengths so as to be used for a host material of an organic light emitting layer in the OLED.

【Technical Solution】

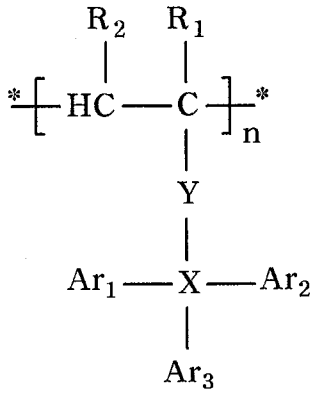
In accordance with an aspect of the present invention, the above and other objects can be accomplished by the provision of a vinyl-based polymer comprising silicon and/or tin for an organic layer of an OLED, which includes a repeat unit represented by the following General Formula 2 and formed by polymerization of a monomer represented by the following General Formula 1.

In accordance with another aspect of the present invention, a vinyl-based polymer comprising silicon and/or tin for an organic layer of an OLED includes a repeat unit represented by the following General Formula 2 and formed by polymerization of a monomer represented by the following General Formula 1, and a repeat unit represented by the following General Formula 4 and formed by polymerization of a monomer represented by the following General Formula 3.

[General Formula 1]



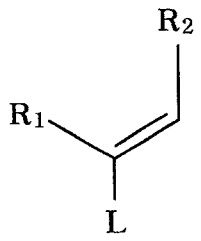
[General Formula 2]

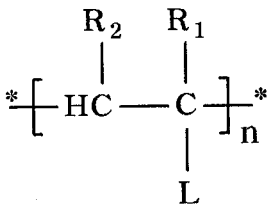


(in General Formulas 1 and 2, X represents silicon (Si) or tin (Sn); Ar_1, Ar_2, and Ar_3 may be the same or different and each represents a C1-C30 substituted or non-substituted alkyl group, a C1-C30 substituted or non-substituted acyl group, a C1-C30 substituted or non-substituted alkoxycarbonyl group, a C1-C30 substituted or non-substituted alkoxy group, a C2-C30 substituted or non-substituted alkenyl group, a C2-C30 substituted or non-substituted alkynyl group, a C2-C30 substituted or non-substituted alkylcarboxyl group, a C6-C30 substituted or non-substituted aryl group, a C6-C30 substituted or non-substituted aralkyl group, a C6-C30 substituted or non-substituted aralkyloxy group, a C2-C30 substituted or non-substituted heteroaryl group, a C2-C30 substituted or non-substituted heteroaryloxy group, a C6-C30 substituted or non-substituted aryloxy group, and a C4-C30 substituted or non-substituted cycloalkyl group; Y is single-bonded and represents an alkylene group (preferably C1-C20, more preferably C1-C12, and even more preferably C1-C8, e.g., methylene, ethylene, propylene, and the like), an arylene group (preferably C6-C30, more preferably C6-C20, and even more preferably C6-C12, e.g., phenylene, biphenylene, naphthalene, and the like), an oxyalkylene group (preferably C1-C20, more preferably C1-C12, and even more preferably C1-C8, e.g., oxymethylene, oxyethylene, and the like), an oxyarylene group (preferably C6-C20, more preferably C6-C16, and even more preferably C6-C12, e.g., oxyphenylene, oxybiphenylene, oxynaphthalene, and the like), an oxycarbonyl group, an amide group, a urethane group, and the like, and such divalent organic groups may also be

displaced by the foregoing substituted groups; and R_1 and R_2 may be the same or different and each represents a hydrogen atom or a univalent substitution group, namely an alkyl group (preferably C1-C20), an alkenyl group (preferably C2-C20), an aryl group (preferably C6-C30), an alkoxy group (preferably C1-C20), an aryloxy group (preferably C6-C20), a hetero-oxy group (preferably C2-C20), a silyloxy group (preferably C3-C40), an acyl group (preferably C1-C20), an alkoxycarbonyl group (preferably C2-C20), an acyloxy group (preferably C2-C20), an acylamino group (preferably C2-C20), an alkoxycarbonylamino group (preferably C2-C20), an anyloxycarbonylamino group (preferably C7-C20), a sulfamoylamino group (preferably C1-C20), a sulfonyl group (preferably C0-C20), an alkylthio group (preferably C1-C20), an arylthio group (preferably C6-C20), a heterocyclic thiol group (preferably C1-C20), a sulfonyl group (preferably C1-C20), an ureide group (preferably C1-C20), a phosphoamide group (preferably C1-C20), a hydroxyl group, a halogen, a cyano group, a sulfone group, a carboxyl group, a nitro group, a heteroatom, a silyl group (preferably C3-C40), or the like.)

[General Formula 3] [General Formula 4]





(in General Formulas 3 and 4, L represents carbazole, triphenylamine, phenyl, naphthyl, anthracenyl, pyridyl, or the like which can be substituted by a group selected from the group consisting of a cyano group (-CN), a hydroxyl group (-OH), a C1-C30 alkoxycarbonyl group displaceable by a C1-C6 alkoxycarbonyl group, a C1-C30 (di-)alkylaminocarbonyl group, a C1-C30 alkylcarbonyl group, a halogen, a hydroxyl group, a silyl group, a C1-C30 alkyl group, a C6-C18 aryl group, a C1-C30 alkoxy group, a C1-C30 alkoxycarbonyl group, a C1-C30 acyloxy group, and a C1-C30 alkylcarbonyl group; and R_1 and R_2 may be the same or different and each represents a hydrogen atom or a univalent substitution group, namely an alkyl

group (preferably C1-C20), an alkenyl group (preferably C2-C20), an aryl group (preferably C6-C30), an alkoxy group (preferably C1-C20), an aryloxy group (preferably C6-C20), a hetero-oxy group (preferably C2-C20), a silyloxy group (preferably C3-C40), an acyl group (preferably C1-C20), an alkoxycarbonyl group (preferably C2-C20), an acyloxy group (preferably C2-C20), an acylamino group (preferably C2-C20), an alkoxycarbonylamino group (preferably C2-C20), an anyloxycarbonylamino group (preferably C7-C20), a sulfamoylamino group (preferably C1-C20), a sulfonyl group (preferably C0-C20), an alkylthio group (preferably C1-C20), an arylthio group (preferably C6-C20), a heterocyclic thiol group (preferably C1-C20), a sulfonyl group (preferably C1-C20), an ureide group (preferably C1-C20), a phosphoamide group (preferably C1-C20), a hydroxyl group, a halogen, a cyano group, a sulfone group, a carboxyl group, a nitro group, a heteroatom, a silyl group (preferably C3-C40), or the like.)

【Advantageous Effects】

According to the exemplary embodiments of the present invention, since a vinyl-based polymer comprising silicon and/or tin is soluble in an organic solvent and can emit fluorescent and phosphorescent light from red to blue wavelengths, the polymer can be used for a host material of an organic light emitting layer in an OLED.

【Description of Drawings】

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a cross-sectional view of a conventional OLED including a substrate, anode, hole transport layer, light emitting layer, electron transport layer, and cathode;

Fig. 2 is a 1H-NMR spectrum of Monomer M-5 in Example 9;

Fig. 3 is a PL spectrum of Polymer P-4 in Example 14;

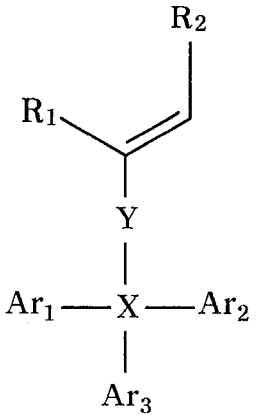
Fig. 4 is a graph depicting the relationship between luminance and voltage in a device having the structure Al (1000Å)/ LiF (10Å)/ Alq3 (200Å)/ Balq (50Å)/ EML (P-4+Ir(ppy)3)/ PEDOT/ ITO (1500Å); and

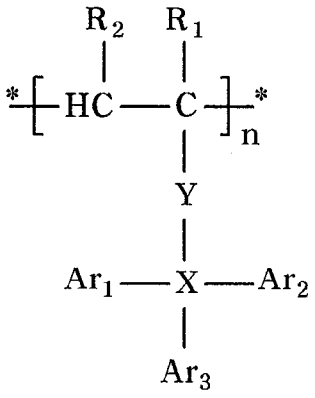
Fig. 5 is a graph depicting the relationship between luminance and voltage in a device having the structure Al (1000Å)/ LiF (10Å)/ Alq3 (200Å)/ Balq (50Å)/ EML (P-4+CBP+Ir(ppy)3)/ PEDOT/ ITO (1500Å).

【Best Mode】

According to a first embodiment of the present invention, a vinyl-based polymer comprising silicon and/or tin for an organic layer of an OLED comprises a repeat unit represented by the following General Formula 2 and formed by polymerization of a monomer represented by the following General Formula 1.

[General Formula 1] [General Formula 2]





(in General Formulas 1 and 2, X represents silicon (Si) or tin (Sn); Ar_1, Ar_2, and Ar_3 may be the same or different and each represents a C1-C30 substituted or non-substituted alkyl group, a C1-C30 substituted or non-substituted acyl group, a C1-C30 substituted or non-substituted alkoxycarbonyl group, a C1-C30 substituted or non-substituted alkoxy group, a C2-C30 substituted or non-substituted alkenyl group, a C2-C30 substituted or non-substituted alkynyl group, a C2-C30 substituted

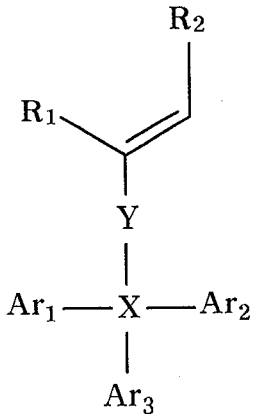
or non-substituted alkylcarboxyl group, a C6-C30 substituted or non-substituted aryl group, a C6-C30 substituted or non-substituted aralkyl group, a C6-C30 substituted or non-substituted aralkyloxy group, a C2-C30 substituted or non-substituted heteroaryl group, a C2-C30 substituted or non-substituted heteroaryloxy group, a C6-C30 substituted or non-substituted aryloxy group, and a C4-C30 substituted or non-substituted cycloalkyl group; Y is single-bonded and represents an alkylene group (preferably C1-C20, more preferably C1-C12, and even more preferably C1-C8, e.g., methylene, ethylene, propylene, and the like), an arylene group (preferably C6-C30, more preferably C6-C20, and even more preferably C6-C12, e.g., phenylene, biphenylene, naphthalene, and the like), an oxyalkylene group (preferably C1-C20, more preferably C1-C12, and even more preferably C1-C8, e.g., oxymethylene, oxyethylene, and the like), an oxyarylene group (preferably C6-C20, more preferably C6-C16, and even more preferably C6-C12, e.g., oxyphenylene, oxybiphenylene, oxynaphthalene, and the like), an oxycarbonyl group, an amide group, a urethane group, or the like, and such divalent organic groups may also be displaced by the foregoing substituted groups; and R_1 and R_2 may be the same or different and each represents a hydrogen atom or a univalent substitution group, namely an alkyl group (preferably C1-C20), an alkenyl group (preferably C2-C20), an aryl group (preferably C6-C30), an alkoxy group (preferably C1-C20), an aryloxy group (preferably C6-C20), a hetero-oxy group (preferably C2-C20), a silyloxy group (preferably C3-C40), an acyl group (preferably C1-C20), an alkoxycarbonyl group (preferably C2-C20), an acyloxy group (preferably C2-C20), an acylamino group (preferably C2-C20), an alkoxycarbonylamino group (preferably C2-C20), an anyloxycarbonylamino group (preferably C7-C20), a sulfamoylamino group (preferably C1-C20), a sulfonyl group (preferably C0-C20), an alkylthio group (preferably C1-C20), an arylthio group (preferably C6-C20), a heterocyclic thiol group (preferably C1-C20), a sulfonyl group (preferably C1-C20), an ureide group (preferably C1-C20), a phosphoamide group (preferably C1-C20), a hydroxyl group, a halogen, a cyano group, a sulfone group, a carboxyl group, a nitro group, a heteroatom, a silyl group (preferably C3-C40), or the like.)

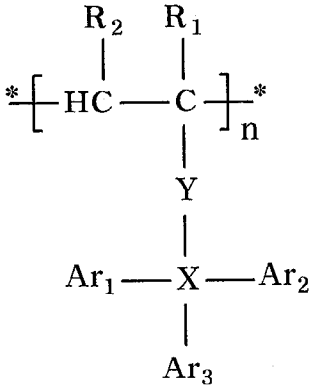
【Mode for Invention】

According to a first embodiment of the present invention, a vinyl-based polymer comprising silicon and/or tin for an organic layer of an OLED comprises a repeat unit represented by the following General Formula 2 and formed by polymerization of a monomer represented by the following General Formula 1.

According to a second embodiment of the present invention, a vinyl-based polymer comprising silicon and/or tin for an organic layer of an OLED comprises a repeat unit represented by the following General Formula 2 and formed by polymerization of a monomer represented by the following General Formula 1, and a repeat unit represented by the following General Formula 4 and formed by polymerization of a monomer represented by the following General Formula 3.

[General Formula 1] [General Formula 2]

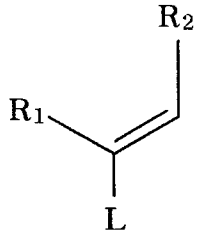




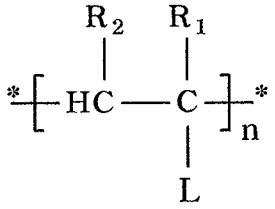
(in General Formulas 1 and 2, X represents silicon (Si) or tin (Sn); Ar_1, Ar_2, and Ar_3 may be the same or different and each represents a C1-C30 substituted or non-substituted alkyl group, a C1-C30 substituted or non-substituted acyl group, a C1-C30 substituted or non-substituted alkoxycarbonyl group, a C1-C30 substituted or non-substituted alkoxy group, a C2-C30 substituted or non-substituted alkenyl group, a C2-C30 substituted or non-substituted alkynyl group, a C2-C30 substituted or non-substituted alkylcarboxyl group, a C6-C30 substituted or non-substituted aryl group, a C6-C30 substituted or non-substituted aralkyl group, a C6-C30 substituted

or non-substituted aralkyloxy group, a C2-C30 substituted or non-substituted heteroaryl group, a C2-C30 substituted or non-substituted heteroaryloxy group, a C6-C30 substituted or non-substituted aryloxy group, and a C4-C30 substituted or non-substituted cycloalkyl group; Y is single-bonded and represents an alkylene group (preferably C1-C20, more preferably C1-C12, and even more preferably C1-C8, e.g., methylene, ethylene, propylene, and the like), an arylene group (preferably C6-C30, more preferably C6-C20, and even more preferably C6-C12, e.g., phenylene, biphenylene, naphthalene, and the like), an oxyalkylene group (preferably C1-C20, more preferably C1-C12, and even more preferably C1-C8, e.g., oxymethylene, oxyethylene, and the like), an oxyarylene group (preferably C6-C20, more preferably C6-C16, and even more preferably C6-C12, e.g., oxyphenylene, oxybiphenylene, oxynaphthalene, and the like), an oxycarbonyl group, an amide group, a urethane group, and the like, and such divalent organic groups may also be displaced by the foregoing substituted groups; and R_1 and R_2 may be the same or different and each represents a hydrogen atom or a univalent substitution group, namely an alkyl group (preferably C1-C20), an alkenyl group (preferably C2-C20), an aryl group (preferably C6-C30), an alkoxy group (preferably C1-C20), an aryloxy group (preferably C6-C20), a hetero-oxy group (preferably C2-C20), a silyloxy group (preferably C3-C40), an acyl group (preferably C1-C20), an alkoxycarbonyl group (preferably C2-C20), an acyloxy group (preferably C2-C20), an acylamino group (preferably C2-C20), an alkoxycarbonylamino group (preferably C2-C20), an anyloxycarbonylamino group (preferably C7-C20), a sulfamoylamino group (preferably C1-C20), a sulfonyl group (preferably C0-C20), an alkylthio group (preferably C1-C20), an arylthio group (preferably C6-C20), a heterocyclic thiol group (preferably C1-C20), a sulfonyl group (preferably C1-C20), an ureide group (preferably C1-C20), a phosphoamide group (preferably C1-C20), a hydroxyl group, a halogen, a cyano group, a sulfone group, a carboxyl group, a nitro group, a heteroatom, a silyl group (preferably C3-C40), or the like.)

[General Formula 3]



[General Formula 4]



(in General Formulas 3 and 4, L represents carbazole, triphenylamine, phenyl, naphthyl, anthracenyl, pyridyl, or the like which can be substituted by a group selected from the group consisting of a cyano group (-CN), a hydroxyl group (-OH), a C1-C30 alkoxycarbonyl group displaceable by a C1-C6 alkoxycarbonyl group, a C1-C30 (di-)alkylaminocarbonyl group, a C1-C30 alkylcarbonyl group, a halogen, a hydroxyl group, a silyl group, a C1-C30 alkyl group, a C6-C18 aryl group, a C1-C30 alkoxy group, a C1-C30 alkoxycarbonyl group, a C1-C30 acyloxy group, and a C1-C30 alkylcarbonyl group; and R_1 and R_2 may be the same or different and each represents a hydrogen atom or a univalent substitution group, namely an alkyl group (preferably C1-C20), an alkenyl group (preferably C2-C20), an aryl group (preferably C6-C30), an alkoxy group (preferably C1-C20), an aryloxy group (preferably C6-C20), a hetero-oxy group (preferably C2-C20), a silyloxy group (preferably C3-C40), an acyl group (preferably C1-C20), an alkoxycarbonyl group (preferably C2-C20), an acyloxy group (preferably C2-C20), an acylamino group (preferably C2-C20), an alkoxycarbonylamino group (preferably C2-C20), an anyloxycarbonylamino group (preferably C7-C20), a sulfamoylamino group (preferably C1-C20), a sulfonyl group (preferably C0-C20), an alkylthio group (preferably C1-C20), an arylthio group (preferably C6-C20), a heterocyclic thiol group (preferably C1-C20), a sulfonyl group (preferably C1-C20), an ureide group (preferably C1-C20), a phosphoamide group (preferably C1-C20), a hydroxyl group, a halogen, a cyano group, a sulfone group, a carboxyl group, a nitro group, a heteroatom, a silyl group (preferably C3-C40), or the like.)

As described above, both Reaction Schemes 1 and 2 of the present invention

are required to comprise the repeat unit represented by General Formula 2 and formed by polymerizing the monomer represented by General Formula 1.

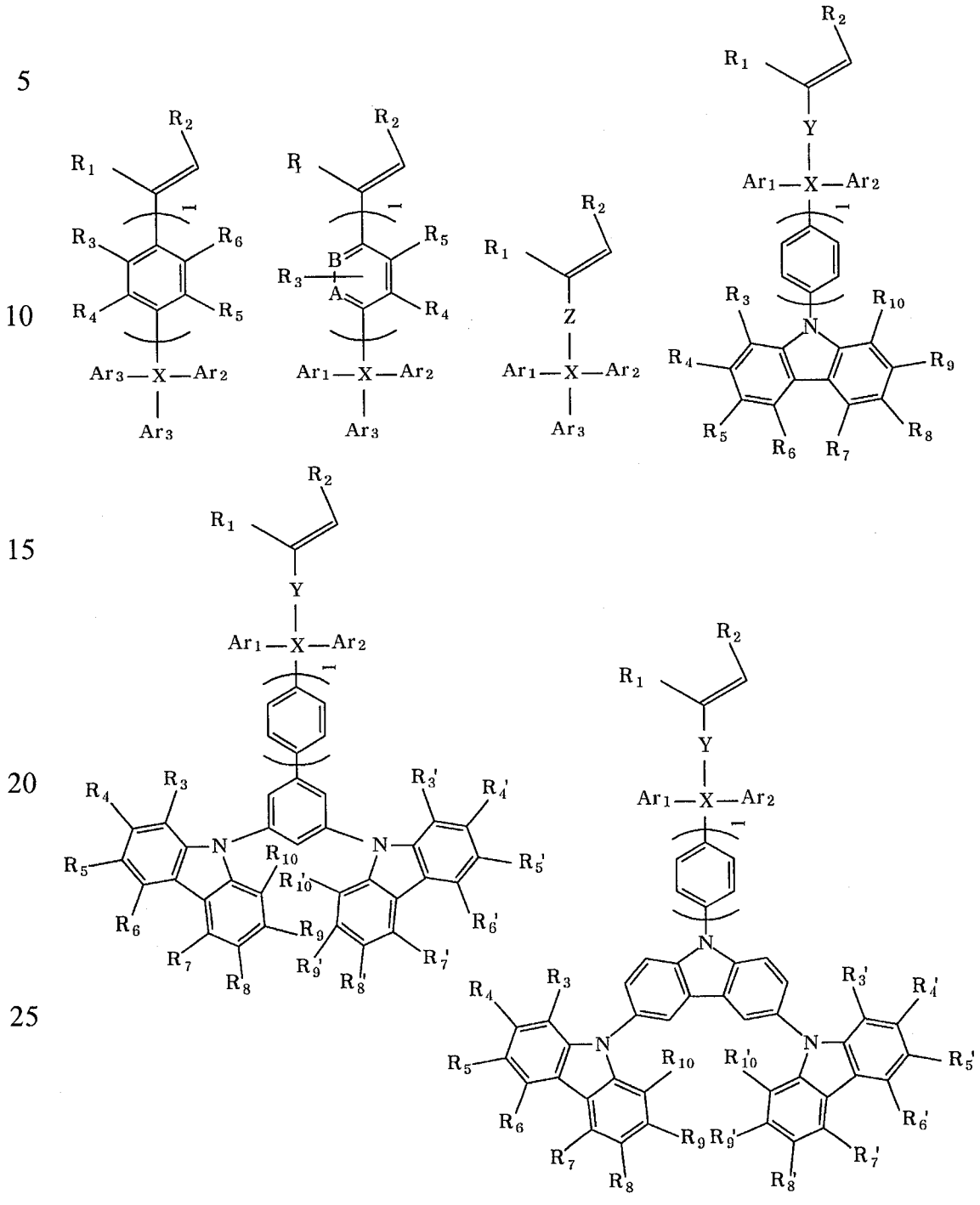
Here, when the repeat unit represented by General Formula 2 and the repeat unit represented by General Formula 4 are mixed into a copolymer, each of the repeat unit in General Formula 2 and the repeat unit in General Formula 4 is provided in an amount of at least 0.5% by weight or more relative to the entire polymer.

That is, whether in a polymer of the repeat unit represented by General Formula 2 or in a copolymer of the repeat unit represented by General Formula 2 and the repeat unit represented by General Formula 4, a polymer according to the present invention is required to comprise the repeat unit represented by General Formula 2. In particular, in the case of the copolymer of the repeat unit represented by General Formula 2 and the repeat unit represented by General Formula 4, each of the repeat units forms at least 0.5% by weight or more of the entire polymer.

Thus, all polymers comprising at least 0.5 wt% or more of the repeat unit represented by General Formula 2 and the repeat unit represented by General Formula 4 to form the copolymer should be construed to fall within the scope of the appended claims of the present invention.

The monomer represented by General Formula 1 may specifically be represented by the following General Formula 5, more specifically by the following Chemical Formula 1.

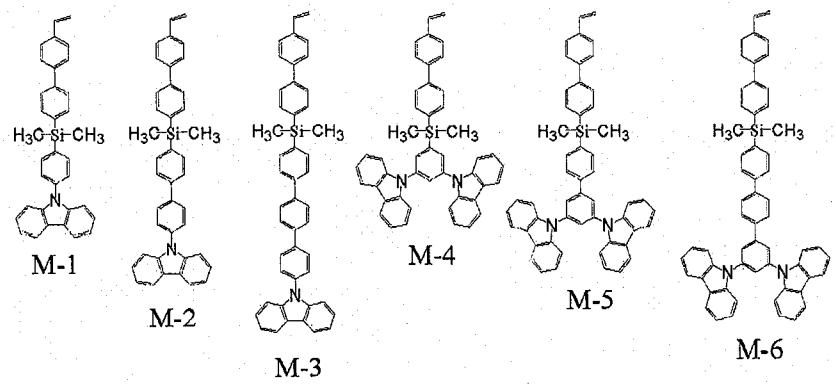
[General Formula 5]

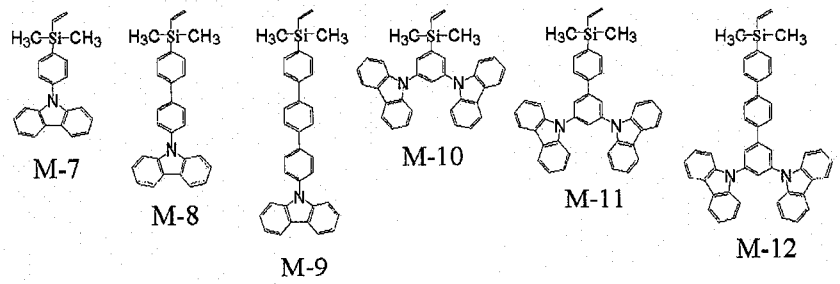


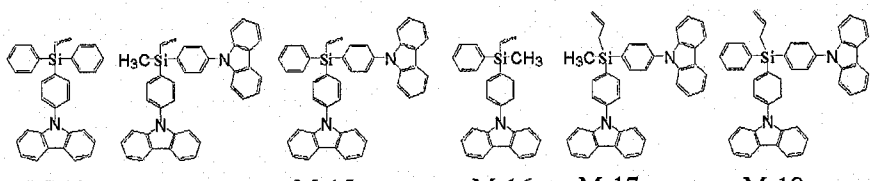
(In General Formula 5, each of X, Y, Ar_1, Ar_2, Ar_3 R_1, and R_2 represents the same as in General Formula 1; Z is not present or a C1-C30 substituted or non-substituted alkyl group, a C1-C30 substituted or non-substituted acyl group, a C1-C30 substituted or non-substituted alkoxycarbonyl group, a C1-C30 substituted or non-substituted alkoxy group, a C2-C30 substituted or non-substituted alkenyl group, a C2-C30 substituted or non-substituted alkynyl group, a C2-C30 substituted or non-substituted alkylcarboxyl group, and a substituted or non-substituted cycloalkyl group.

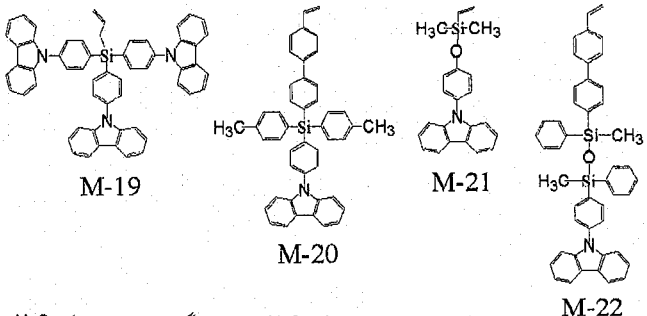
At least one of A and B includes a nitrogen atom; and R_3-R_{10} and R_3'-R_{10}' may be the same or different and each represents a C1-C30 substituted or non-substituted alkyl group, a C1-C30 substituted or non-substituted acyl group, a C1-C30 substituted or non-substituted alkoxycarbonyl group, a C1-C30 substituted or non-substituted alkoxy group, a C2-C30 substituted or non-substituted alkenyl group, a C2-C30 substituted or non-substituted alkynyl group, a C2-C30 substituted or non-substituted alkylcarboxyl group, a C6-C30 substituted or non-substituted aryl group, a C6-C30 substituted or non-substituted aralkyl group, a C6-C30 substituted or non-substituted aralkyloxy group, a C2-C30 substituted or non-substituted heteroaryl group, a C2-C30 substituted or non-substituted heteroaryloxy group, a C6-C30 substituted or non-substituted aryloxy group, a C4-C30 substituted or non-substituted cycloalkyl group, -N(R)(R′) (where R and R′ independently represent hydrogen, a C1-C30 alkyl group, a C6-C30 aryl group, or a C2-C30 heteroaryl group), a cyano group, a hydroxyl group, and a carboxyl group. Here, two or more neighboring groups of R_3-R_{10}' may be connected to form a ring. l is an integer from 0 to 10.)

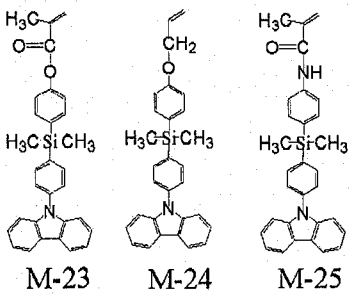
[Chemical formula 1]





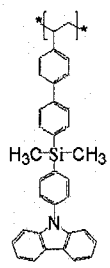






The repeat unit represented by General Formula 2 obtained by polymerizing the monomer represented by General Formula 1 may be specifically represented by the following Chemical Formula 2, and a repeat unit obtained by polymerization of a monomer represented by General Formula 5 may be specifically represented by the following Chemical Formula 3.

[Chemical Formula 2]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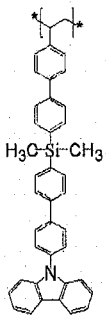
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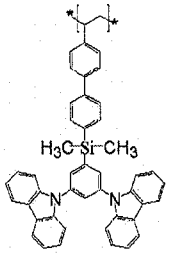
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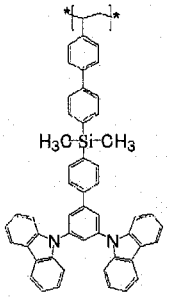
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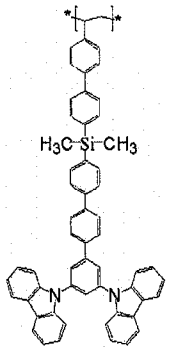
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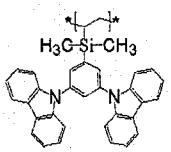
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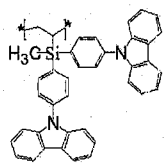
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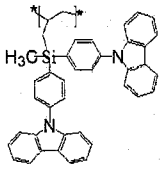
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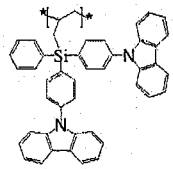
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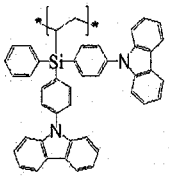
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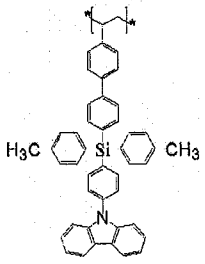
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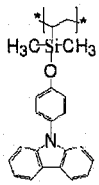
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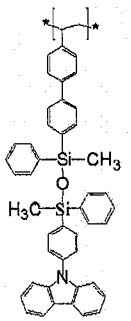
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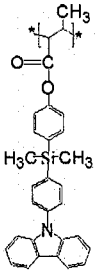
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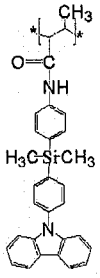
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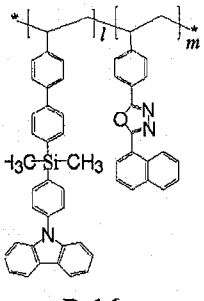
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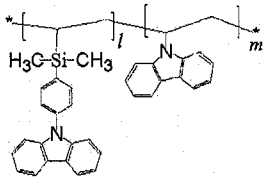
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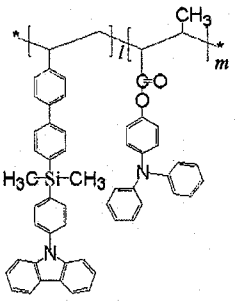
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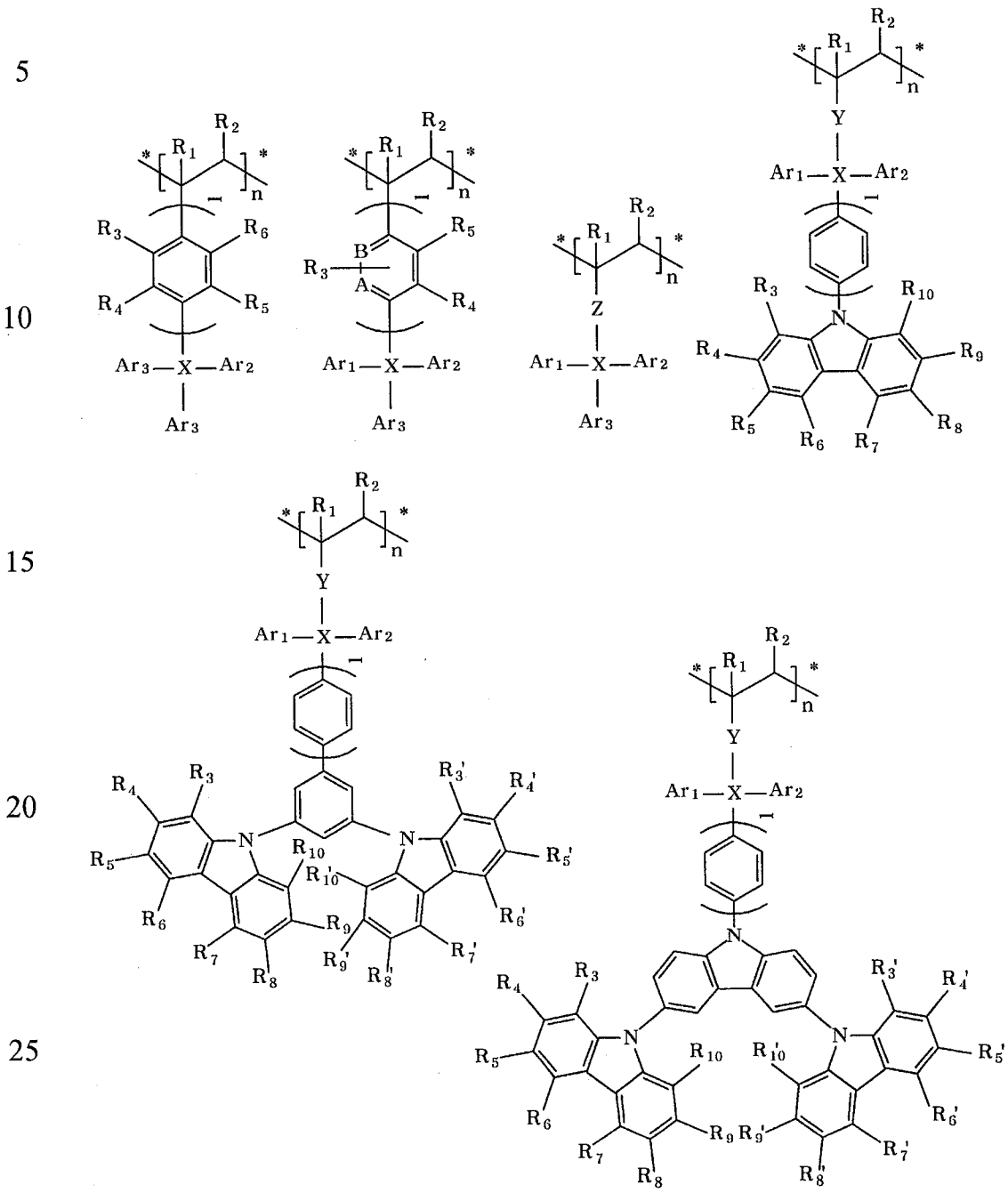
[Chemical Formula 3]

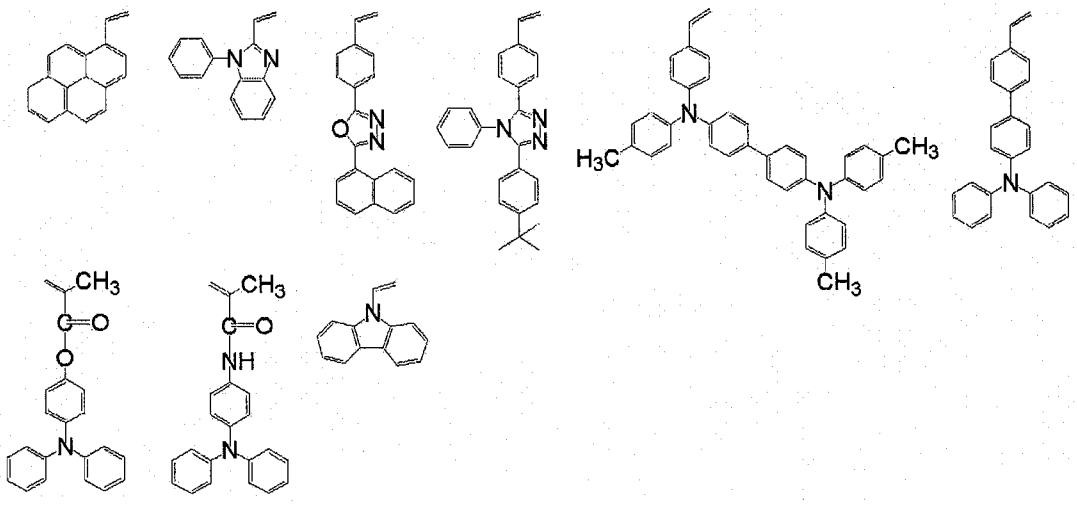


(In Chemical Formula 3, X, Y, Ar_1, Ar_2, Ar_3, R_1-R_{10}', and l each represent the same groups as in General Formula 5, and n is an integer from 1 to 1,000,000.)

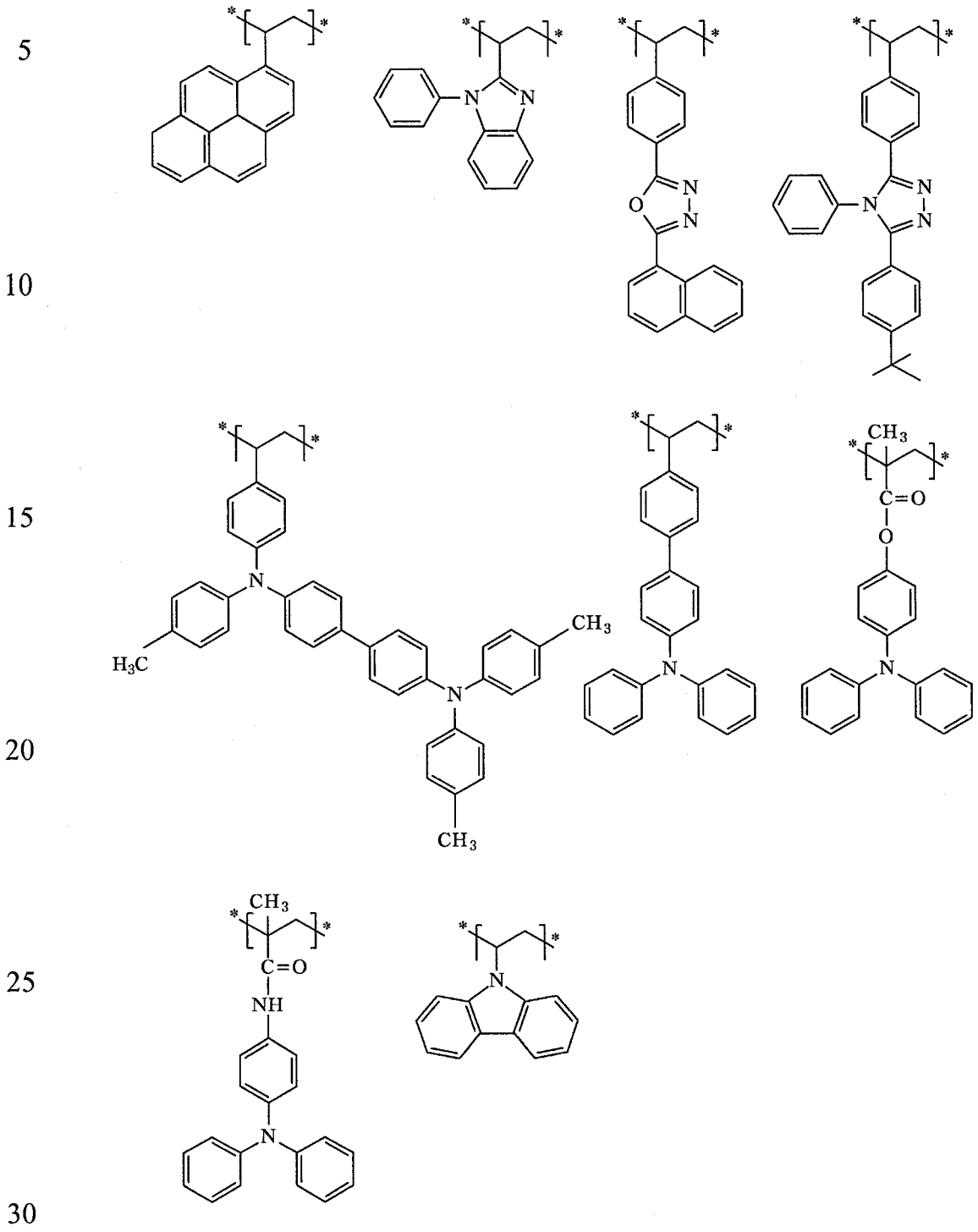
The monomer represented by General Formula 3 may be specifically

represented by the following Chemical Formula 4, and the repeat unit represented by General Formula 4 may be specifically represented by the following Chemical Formula 5.

[Chemical Formula 4]



[Chemical Formula 5]



Here, General Formula 5 and Chemical Formula 1 are only illustrative examples of General Formula 1, the repeat unit represented by Chemical Formula 2 is only an illustrative example of General Formula 2, the monomer represented by Chemical Formula 4 is only an illustrative example of General Formula 3, and a repeat unit represented by Chemical Formula 5 is only an illustrative example of an General Formula 4. Chemical Formulas 1 to 5 are only illustrative examples serving to provide a detailed description of General Formulas 1 to 4.

In the present invention, a polymerization method is not limited to a specific one. A general method, such as radical polymerization, cation polymerization, anion polymerization, living cation polymerization, living anion polymerization, coordination polymerization, etc., can be used. Preferably, radical polymerization, cation polymerization, and living cation polymerization are used.

With such methods, a polymer can be obtained by adjusting reaction temperature, reaction solvent, reaction time, reaction initiator, etc.

Although the molecular weight of the polymer according to the present invention can be varied depending on polymerization methods and conditions, the polymer has a weight average molecular weight preferably ranging from 1,000 to 5,000,000, more preferably from 2,000 to 2,000,000, and even more preferably from 3,000 to 1,000,000.

The polymer has a number average molecular weight ranging preferably from 500 to 2,000,000, more preferably from 1,000 to 1,000,000, and even more preferably from 2,000 to 500,000.

The weight average molecular weight over the number average molecular weight is preferably from 1 to 20, more preferably from 1 to 15, and even more preferably from 1 to 10.

Although regularity of a substituent group of the polymer according to the present invention with respect to direction, i.e., tacticity, varies depending on polymerization methods and conditions, the regularity may be syndiotactic, isotactic, a combination of syndiotactic and isotactic, atactic, and the like.

Further, a terminal of the polymer is not limited to any specific one.

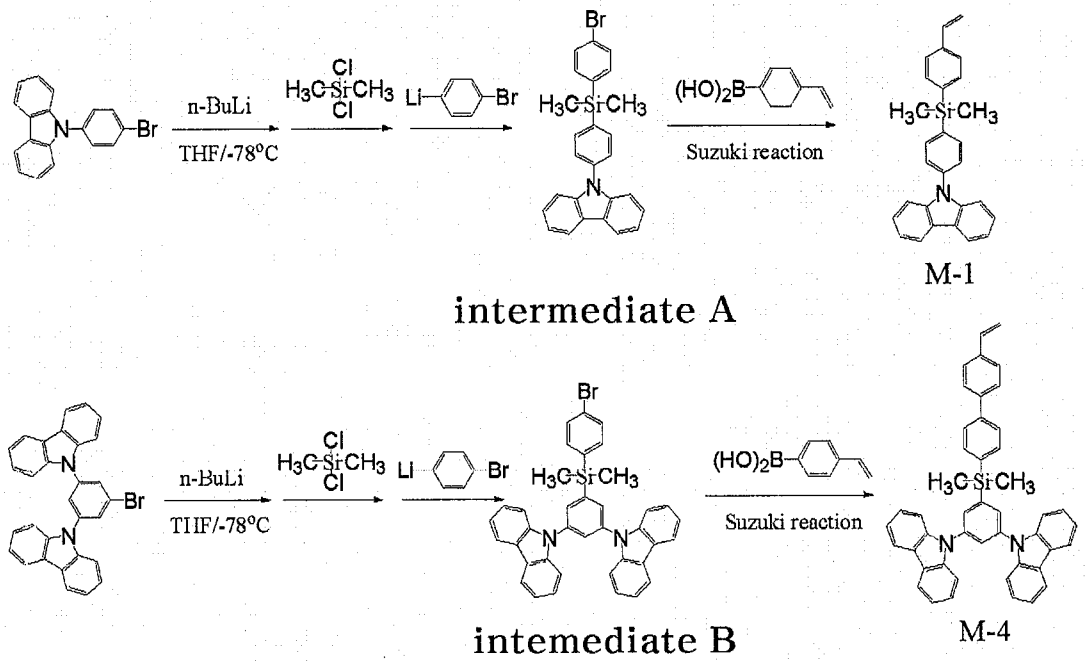
Hereinafter, a synthesis method of a compound and a polymer represented

by General Formulas 1 and 2 is illustrated in detail with the following Reaction Schemes 1 to 4.

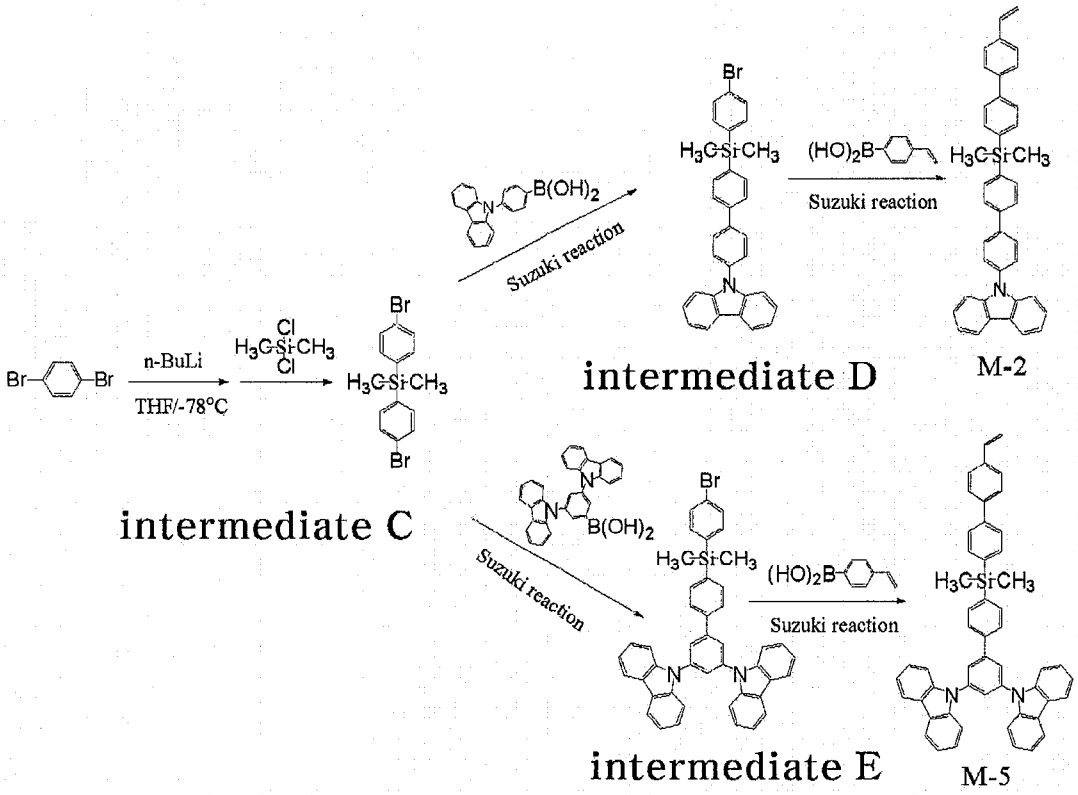
In addition to the method according to the following Reaction Schemes, a monomer comprising silicon and/or tin of the present invention and a polymer thereof may be prepared by other methods so long as the final product has the same structure as the monomer or the polymer.

Thus, in the reaction for preparing a monomer comprising silicon and/or tin of the present invention and a (co)polymer formed by polymerizing the monomer, a solvent, reaction temperature, concentration, catalyst, and the like do not need to be specifically limited, and a preparation yield need not be specifically limited, either.

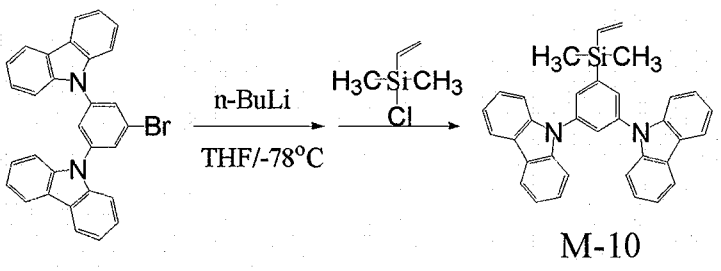
[Reaction Scheme 1]



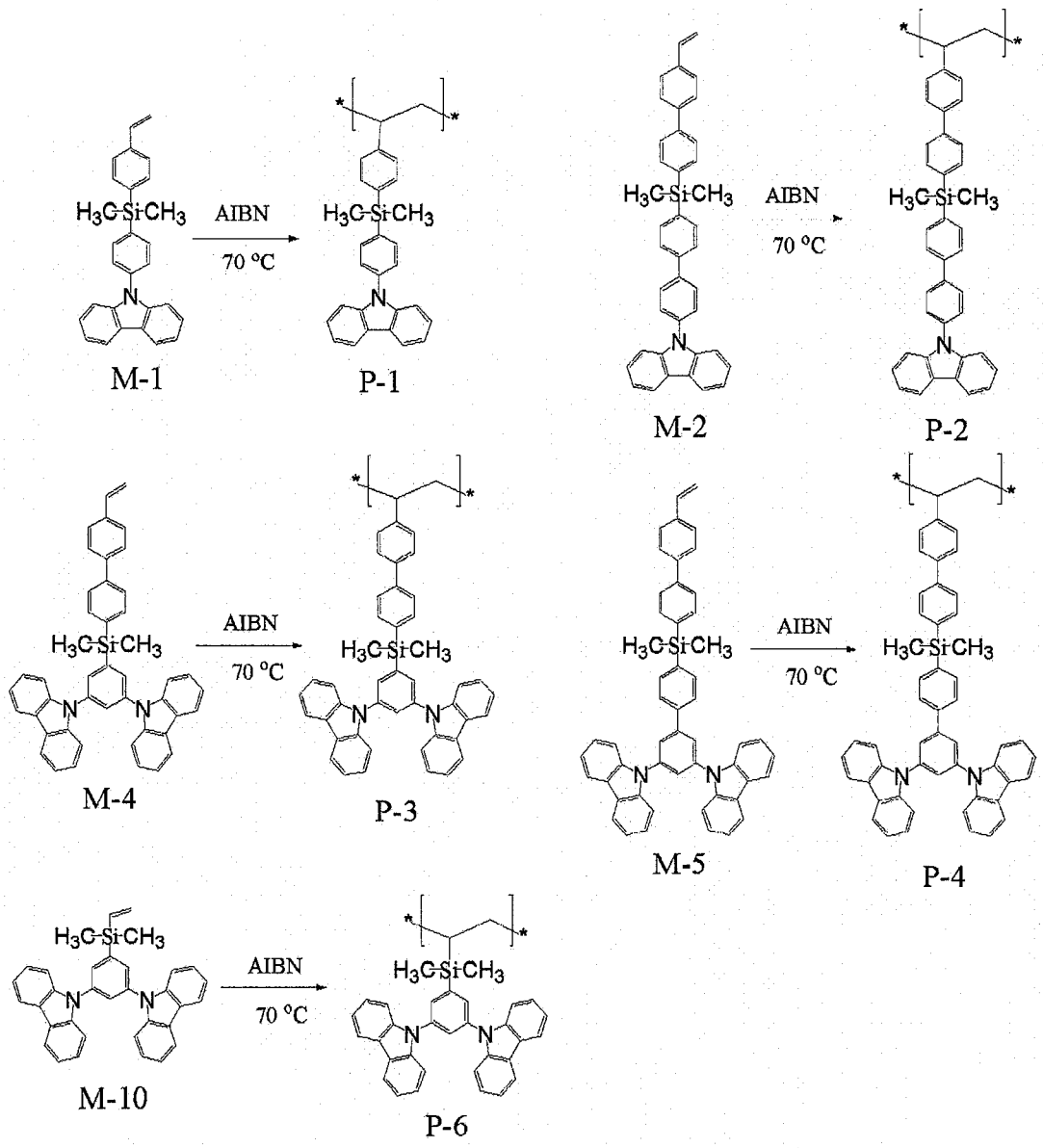
[Reaction Scheme 2]



[Reaction Scheme 3]



[Reaction Scheme 4]



In an OLED, the polymer according to the present invention can be used for a material of a light emitting layer, a hole injection material, a hole transport material, an electron transport material, an electron injection material, an interlayer, and a material for a hole blocking layer. Preferably, the polymer is used for a host material of the light emitting layer.

The OLED of the present invention optionally includes an interlayer, a hole transport layer, and an electron transport layer in addition to general components

including an anode, a light emitting layer, and a cathode.

Fig. 1 is a cross-sectional view of an OLED including a substrate, anode, hole transport layer, light emitting layer, electron transport layer, and cathode.

A method of manufacturing an electroluminescent display employing an organic electroluminescent polymer according to the present invention will be described with reference to Fig. 1.

First, a substrate 11 is coated with an electrode material for an anode 12.

Here, the substrate 11 employs a typical substrate for an OLED, and is preferably a glass substrate or a transparent plastic substrate which ensures excellent transparency, a smooth surface, easy handling, and waterproofing.

Examples of the electrode material for the anode 12 include indium tin oxide (ITO), tin oxide (SnO_2), zinc oxide (ZnO), etc., which are transparent and have excellent conductivity.

A hole transport layer 13 is formed on the anode 12 by vacuum deposition, sputtering or spin coating, and a light emitting layer 14 is formed thereon by vacuum deposition, spin coating or solution coating such as ink-jet printing.

An electron transport layer 15 is formed on the light emitting layer 14 before forming a cathode 16.

Here, the light emitting layer 14 has a thickness of 5㎚ to 1㎛, preferably 10 to 500nm, and each of the hole transport layer 13 and the electron transport layer 15 has a thickness of 10~10,000Å.

The electron transport layer 15 can be formed of a material generally used in the art by vacuum deposition, sputtering or spin coating.

The hole transport layer 13 and electron transport layer 15 serve to enhance luminous recombination in a light emitting polymer by efficiently transferring carriers to the light emitting polymer.

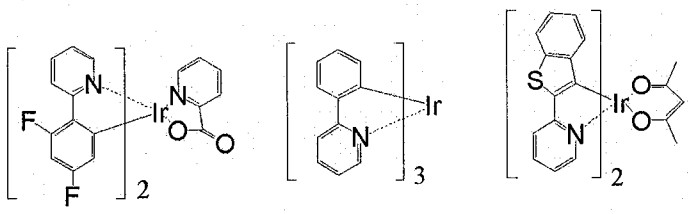
According to the present invention, materials for the hole transport layer 13 and electron transport layer 15 are not limited to particular ones. Examples of the material for the hole transport layer include PEDOT:PSS, which is poly(3,4-ethylenedioxy-thiophene) (PEDOT) doped with a (poly(styrene sulfonic acid) (PSS) layer, and N,N'-bis(3-methylphenyl)-N,N-diphenyl-[l,l'-biphenyl]-4,4'-diamine

(TPD). Further, examples of the material for the electron transport layer include aluminum trihydroxyquinoline (Alq3), PBD(2-(4-biphenylyl)-5-phenyl-1,3,4-oxadiazole), which is a 1,3,4-oxadiazole derivative, TPQ(1,3,4-tris[(3-penyl-6-trifluoromethyl)quinoxaline-2-yl]benzene), which is a quinoxaline derivative, and triazole derivatives.

The polymer of the present invention can be used in combination with a phosphorescent organic compound. Here, the phosphorescent organic compound is an organic metal complex that can be phosphorescent in a triplet state and contains a metal ion selected at least from Group VIII in the periodic table of Gregor Johann Mendel, i.e., Fe, Co, Ni, Ru, Ph, Os, Ir, and Pt. Preferably, the phosphorescent organic compound is a metal complex containing Ir or Pt ions.

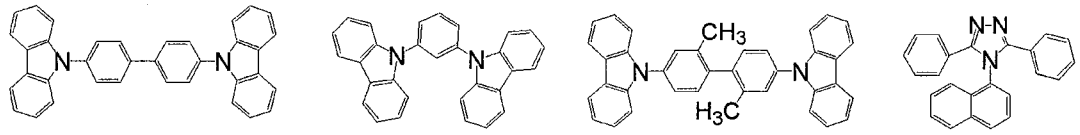
The following Chemical Formula 6 represents examples of the metal complex, but it should be noted that the present invention is not limited to these examples.

[Chemical formula 6]



When the polymer according to the present invention is subjected to solution coating to form a layer, it may be blended with a low molecular weight host. The following chemical formula 7 represents illustrative examples of the low molecular weight host, but it should be noted that the present invention is not limited to these examples.

[Chemical formula 7]



Further, the polymer may be blended with a polymer having a conjugated double bond, such as a fluorine-based polymer, polyphenylenevinylene, and polyparaphenylene. If necessary, it may be mixed with a binder resin.

Examples of the binder resin include polyvinylcarbazole, polycarbonate, polyester, polyarylate, polystyrene, acryl polymer, methacryl polymer, polybutyral, polyvinylacetal, diallylphthalate polymer, phenol resin, epoxy resin, silicone resin, polysulfone resin, urea resin, and the like. These resins may be used alone or in combinations thereof.

Optionally, a hole blocking layer of lithium fluoride (LiF) may further be formed by vacuum deposition and the like to control a hole-transport speed in the light emitting layer 14 and to increase recombination efficiency between electrons and holes.

Finally, the electron transport layer 15 is coated with an electrode material for the cathode 16.

Examples of the metal for the cathode includes lithium (Li), magnesium (Mg), calcium (Ca), aluminum (Al), and Al:Li, Ba:Li, Ca:Li, and the like, which have a low work function.

Hereinafter, illustrative examples for preparation of a vinyl-based monomer comprising silicon and/or tin and a copolymer formed by polymerizing the same according to the embodiments of the present invention will be described. However, it should be noted that the following examples are given by way of illustration only and do not limit the present invention.

Also, a description for the matter apparent to those skilled in the art will be omitted herein.

Example 1: Preparation of Intermediate A

N-(4-Bromophenyl) carbazole (5g, 15.51mmol) was dissolved in anhydrous diethyl ether (50ml) under a nitrogen atmosphere, followed by dropwise addition of n-butyl lithium (10.7ml, 17.06mmol) at -78℃ and stirring the mixture for one hour.

Dichloromethylsilane (2g, 15.51mmol) was added to anhydrous diethyl ether (30ml), followed by cooling to -78℃ and slowly dropping the produced carbazole product into the solution.

The mixture was stirred at -78℃ for 20 minutes and then stirred at room temperature for one hour.

After cooling the mixture to -78℃, 4-4'-dibromobenzene (3.65g, 15.51mmol) was dissolved in anhydrous diethyl ether (30ml) and n-butyl lithium (10.7ml, 17.06mmol) was added dropwise, followed by stirring for one hour.

The product was slowly dropped into a silicon compound. The resultant mixture was stirred at -78℃ for 20 minutes and then stirred at room temperature for 8 hours or more.

When the reaction was completed, extraction of the mixture was carried out with ethyl ether, followed by washing with water and 10% sodium bicarbonate several times and drying over anhydrous magnesium sulphate.

The resultant product was filtered to remove the solvent and refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/3), thereby obtaining 3.1g (43.8%) of Intermediate A.

Example 2: Preparation of Monomer M-1

3.1g (6.79mmol) of Intermediate A, 1.0g (6.79mmol) of vinylphenylboronic acid, and 0.15g of tetrakistriphenylphosphine palladium were dissolved in tetrahydrofuran (THF) under an argon atmosphere in a 250ml round-bottom flask equipped with a thermometer, a reflux condenser, and a stirrer. Then, 20ml of 2M potassium carbonate was added to the dissolved mixture and refluxed at 75℃ for 48 hours.

When the reaction was completed, the resultant solution was cooled to room temperature, followed by extraction with methylene chloride several times and

washing the extracted substance with water several times.

After removal of water using anhydrous magnesium sulphate, the extracted substance was filtered to remove the solvent. The resultant product was refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/3), thereby obtaining 2.32g (71.3%) of Monomer M-1.

The monomer had a maximum luminous wavelength of 348nm in its solution state.

Example 3: Preparation of Intermediate B

9-(3-Bromo-5-(9H-carbazole-9-yl)phenyl-9H-carbazole (10g, 20.5mmol) was dissolved in anhydrous diethyl ether (60ml) under a nitrogen atmosphere, followed by dropwise addition of n-butyl lithium (15.4ml, 24.6mmol) at -78℃ and stirring the mixture for one hour.

Dichloromethylsilane (2.91g, 22.5mmol) was added to anhydrous diethyl ether (50ml), followed by cooling to -78℃ and slowly dropping the produced carbazole product into the solution.

The mixture was stirred at -78℃ for 20 minutes and then stirred at room temperature for one hour.

After cooling the mixture down to -78°C, 4-4′-dibromobenzene (5.3g, 22.5mmol) was dissolved in anhydrous diethyl ether (50ml) and n-butyl lithium (16.87ml, 27mmol) was added dropwise, followed by stirring for one hour.

The product was slowly dropped into a silicon compound. The resultant mixture was stirred at -78℃ for 20 minutes and then stirred at room temperature for 8 hours or more.

When the reaction was completed, extraction of the mixture was carried out with ethyl ether, followed by washing with water and 10% sodium bicarbonate several times and drying with anhydrous magnesium sulphate.

The resultant product was filtered to remove the solvent, refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/2), and recrystallized in hexane, thereby obtaining 2.28g (41.4%) of Intermediate B.

Example 4: Preparation of Monomer M-4 in Chemical Formula 1

3.0g (4.82mmol) of the intermediate B, 0.75g (5.06mmol) of vinylphenylboronic acid, and 0.13g of tetrakistriphenylphosphine palladium were dissolved in THF under an argon atmosphere in a 250ml round-bottom flask equipped with a thermometer, a reflux condenser, and a stirrer. Then, 20ml of 2M potassium carbonate was added to the dissolved mixture and refluxed at 75℃ for 48 hours.

When the reaction was completed, the resultant solution was cooled to room temperature, followed by extraction with methylene chloride several times and washing the extracted substance with water several times.

After removal of water using anhydrous magnesium sulphate, the extracted substance was filtered to remove the solvent. The resultant product was refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/2), thereby obtaining 1.37g (43.4%) of Monomer M-2.

The monomer had a maximum luminous wavelength of 346nm in its solution state.

Example 5: Preparation of Intermediate C

4-4'-dibromobenzene (20.0g, 84.77mmol) was dissolved in anhydrous diethyl ether (80ml) under a nitrogen atmosphere, followed by dropwise addition of n-butyl lithium (63.5ml, 101.7mmol) at -78℃ and stirring the mixture for one hour.

Dichloromethylsilane (4.75g, 36.8mmol) was added to anhydrous diethyl ether (40ml), followed by cooling to -78℃ and slowly dropping the produced carbazole product into the solution.

The mixture was stirred at -78°C for 20 minutes and then stirred at room temperature for one hour.

When the reaction was completed, extraction of the mixture was carried out with ethyl ether, followed by washing with water and 10% sodium bicarbonate several times and drying with anhydrous magnesium sulphate.

The resultant product was filtered to remove the solvent, refined on a silica gel column using a solvent of hexane, and recrystallized in hexane, thereby

obtaining 6.4g (47%) of Intermediate C as white crystals.

Example 6: Preparation of Intermediate D

4.0g (10.08mmol) of the intermediate C, 9-(4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)phenyl)-9H-carbazole (10.5mmol), and 0.22g of tetrakistriphenylphosphine palladium were dissolved in THF under an argon atmosphere in a 250ml round-bottom flask equipped with a thermometer, a reflux condenser, and a stirrer. Then, 20ml of 2M potassium carbonate was added to the dissolved mixture and refluxed at 75℃ for 48 hours.

When the reaction was completed, the resultant solution was cooled to room temperature, followed by extraction with methylene chloride several times and washing the extracted substance with water several times.

After removal of water using anhydrous magnesium sulphate, the extracted substance was filtered to remove the solvent. The resultant product was refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/2), thereby obtaining 2.8g (50.0%) of Intermediate D.

Example 7: Preparation of Monomer M-2 in Chemical Formula 1

2.53g (4.75mmol) of the intermediate D, 0.77g (5.22mmol) of vinylphenylboronic acid, and 0.12g of tetrakistriphenylphosphine palladium were dissolved in THF under an argon atmosphere in a 250ml round-bottom flask equipped with a thermometer, a reflux condenser, and a stirrer. Then, 20ml of 2M potassium carbonate was added to the dissolved mixture and refluxed at 75℃ for 48 hours.

When the reaction was completed, the resultant solution was cooled to room temperature, followed by extraction with methylene chloride several times and washing the extracted substance with water several times.

After removal of water using anhydrous magnesium sulphate, the extracted substance was filtered to remove the solvent. The resultant product was refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/3), thereby obtaining 1.7g (64.4%) of Monomer M-2.

The monomer had a maximum luminous wavelength of 370nm in its solution state.

Example 8: Preparation of Intermediate E

4.0g (10.8mmol) of the intermediate C, 3-(9H-carbazole-9-yl)-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)phenyl)-9H-carbazole (10.5mmol), and 0.22g of tetrakistriphenylphosphine palladium were dissolved in THF under an argon atmosphere in a 250ml round-bottom flask equipped with a thermometer, a reflux condenser, and a stirrer. Then, 20ml of 2M potassium carbonate was added to the dissolved mixture and refluxed at 75℃ for 48 hours.

When the reaction was completed, the resultant solution was cooled to room temperature, followed by extraction with methylene chloride several times and washing the extracted substance with water several times.

After removal of water using anhydrous magnesium sulphate, the extracted substance was filtered to remove the solvent. The resultant product was refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/2), thereby obtaining 3.5g (47.8%) of Intermediate E.

Example 9: Preparation of Monomer M-5 in Chemical Formula 1

3.0g (4.29mmol) of the intermediate E, 0.7g (4.72mmol) of vinylphenylboronic acid, and 0.1g of tetrakistriphenylphosphine palladium were dissolved in THF under an argon atmosphere in a 250ml round-bottom flask equipped with a thermometer, a reflux condenser, and a stirrer. Then, 20ml of 2M potassium carbonate was added to the dissolved mixture and refluxed at 75℃ for 48 hours.

When the reaction was completed, the resultant solution was cooled to room temperature, followed by extraction with methylene chloride several times and washing the extracted substance with water several times.

After removal of water using anhydrous magnesium sulphate, the extracted substance was filtered to remove the solvent. The resultant product was refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/3),

thereby obtaining 1.87g (60.5%) of Monomer M-5.

The monomer had a maximum luminous wavelength of 380nm in its solution state.

Example 10: Preparation of Monomer M-10 in Chemical Formula 1

9-(3-Bromo-5-(9H-carbazole-9-yl)phenyl-9H-carbazole (10.2mmol) was dissolved in anhydrous diethyl ether (50ml) under a nitrogen atmosphere, followed by adding n-butyl lithium (7.1ml, 11.2mmol) by drops at -78℃ and stirring for one hour.

Chlorodimethylvynylsilane (1.23g, 10.2mmol) was added to anhydrous diethyl ether (20ml), followed by cooling to -78℃ and slowly dropping the afore-prepared product into the solution.

The mixture was stirred at -78°C for 20 minutes and then stirred at room temperature for one hour. When the reaction was completed, extraction of the mixture was carried out with ethyl ether, followed by washing with water and 10% sodium bicarbonate several times and drying with anhydrous magnesium sulphate.

The resultant product was filtered to remove the solvent and refined on a silica gel column using a blended solvent of methylene chloride/hexane (1/3), thereby obtaining 2.9g (58%) of Monomer M-10.

Example 11: Preparation of Polymer P-1 in Chemical Formula 2

0.7g (1.45mmol) of Monomer M-1 and 2.4mg (0.014mmol) of AIBN were dissolved in 2.5ml of NMP under a nitrogen atmosphere. The mixture was degassed by a freeze-pump-thaw process and stirred at 70 ℃ for 48 hours. Then, the reactant was precipitated in methanol to obtain a white polymer.

The resultant product was filtered and re-dissolved in chloroform to be re-precipitated.

The re-precipitated polymer was filtered and refined using acetone in a Soxhlet device for 24 hours, thereby obtaining 0.45g of a polymer.

The polymer had a maximum luminous wavelength of 348nm in its solution state.

Example 12: Preparation of Polymer P-2 in Chemical Formula 2

0.7g (1.26mmol) of Monomer M-2 and 2.0mg (0.012mmol) of AIBN were dissolved in 2.5ml of NMP under a nitrogen atmosphere. The mixture was degassed by a freeze-pump-thaw process and stirred at 70℃ for 48 hours. Then, the reactant was precipitated in methanol to obtain a white polymer.

The polymer was filtered and re-dissolved in chloroform to be re-precipitated.

Then, the re-precipitated polymer was filtered and refined using acetone in a Soxhlet device for 24 hours, thereby obtaining 0.23g of a polymer.

The polymer had a maximum luminous wavelength of 370nm in its solution state.

Example 13: Preparation of Polymer P-3 in Chemical Formula 2

0.7g (1.08mmol) of Monomer M-4 and 1.7mg (0.010mmol) of AIBN were dissolved in 2.3ml of NMP under a nitrogen atmosphere. The mixture was degassed by a freeze-pump-thaw process and stirred at 70℃ for 48 hours. Then, the reactant was precipitated in methanol to obtain a white polymer.

The polymer was filtered and re-dissolved in chloroform to be re-precipitated.

Then, the re-precipitated polymer was filtered and refined using acetone in a Soxhlet device for 24 hours, thereby obtaining 0.42g of a polymer.

The polymer had a maximum luminous wavelength of 346nm in its solution state.

Example 14: Preparation of Polymer P-4 in Chemical Formula 2

0.7g (0.97mmol) of Monomer M-5 and 1.6mg (0.0097mmol) of AIBN were dissolved in 2.3ml of NMP under a nitrogen atmosphere. The mixture was degassed by a freeze-pump-thaw process and stirred at 70℃ for 48 hours. Then, the reactant was precipitated in methanol to obtain a white polymer.

The polymer was filtered and re-dissolved in chloroform to be re-

precipitated.

Then, the re-precipitated polymer was filtered and refined using acetone in a Soxhlet device for 24 hours, thereby obtaining 0.49g of a polymer.

The polymer had a maximum luminous wavelength of 380nm in its solution state.

Example 15: Preparation of Polymer P-6 in Chemical Formula 2

0.8g (0.97mmol) of Monomer M-10 and 2.66mg (0.0162mmol) of AIBN were dissolved in 2.3ml of NMP under a nitrogen atmosphere. The mixture was degassed by a freeze-pump-thaw process and stirred at 70℃ for 48 hours. Then, the reactant was precipitated in methanol to obtain a white polymer.

The polymer was filtered and re-dissolved in chloroform to be re-precipitated.

The re-precipitated polymer was filtered and refined using acetone in a Soxhlet device for 24 hours, thereby obtaining 0.3g of a polymer.

Example 16: Evaluation of Characteristics of Device

An ITO substrate as an anode was treated by spin coating to form PEDOT. With a polymer host doped into the PEDOT with a dopant by 7%, a light emitting layer was formed on the PEDOT by spin coating. BAlq was vacuum-deposited on the light emitting layer to form a hole blocking layer having a thickness of 50Å. Then, Alq3 was vacuum-deposited on the light emitting layer to form an electron transport layer having a thickness of 200Å. On the electron transport layer were sequentially vacuum-deposited LiF to 10Å and Al to 1000Å to form a cathode, thereby producing an OLED.

The OLED manufactured according to this example had a threshold voltage, and driving voltage, current efficiency and power efficiency at 1000nit, as shown in Table 1.

Structure of Evaluated Device: Al(1000Å)/ LiF (10Å)/ Alq3 (200Å)/ Balq (50Å)/ EML (polymer host+Ir(ppy)3)/ PEDOT/ ITO (1500Å)

[Table 1]

Kind of Device	Compound	Von	At 1000nit		
			V	cd/A	Im/W
Green	P-1	4.6	12.3	4.7	1.2
	P-2	4.0	11.9	4.0	1.0
	P-3	4.2	10.3	7.8	2.4

Example 17: Evaluation of Characteristics of Device

An ITO substrate as an anode was treated with spin coating to form PEDOT. With the mixture of P-4 and CBP in the weight ratio of 1:2 doped into the PEDOT with a dopant by 7%, a light emitting layer was formed on the PEDOT by spin coating. BAlq was vacuum-deposited on the light emitting layer to form a hole blocking layer having a thickness of 50Å. Then, Alq3 was vacuum-deposited on the light emitting layer to form an electron transport layer having a thickness of 200Å. On the electron transport layer were sequentially vacuum-deposited LiF to 10Å and Al to 1000Å to form a cathode, thereby producing an OLED. A comparative device included PVK as a polymer host.

Structure of Evaluated Device: Al(1000Å)/ LiF (10Å)/ Alq3 (200Å)/ Balq (50Å)/ EML (P-4+CBP+Ir(ppy)3)/ PEDOT/ ITO (1500Å)

Structure of Comparative Device: Al(1000Å)/ LiF (10Å)/ Alq3 (200Å)/ Balq (50Å)/ EML (PVK+CBP+Ir(ppy)3)/ PEDOT/ ITO (1500Å)

The OLED manufactured according to the foregoing examples had a threshold voltage, and driving voltage, current efficiency and power efficiency of 1000 nit, as shown in Table 2.

[Table 2]

Kind of Device	Compound	Von	At 1000nit		
			V	cd/A	Im/W
Green	PVK	4	7.4	15.3	6.63
	P-4	3.6	7.4	16.8	7.14

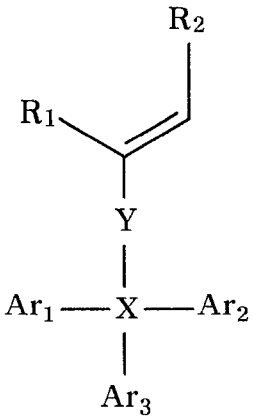
Although the exemplary embodiments of the invention have been illustrated with reference to the accompanying drawings, the present invention is not limited to

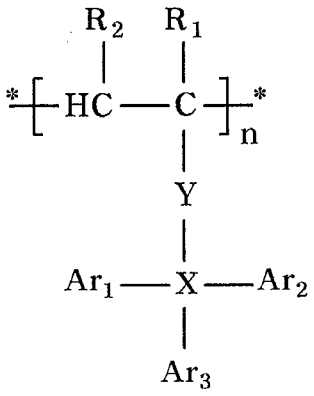
the embodiments and drawings. It should be understood that various modifications, changes, and substitutions can be made by those skilled in the art without departing from the spirit and scope of the present invention as disclosed in the accompanying claims. Therefore, it should be understood that the exemplary embodiments described above are given by way of illustration only and do not limit the scope of the present invention.

【CLAIMS】

【Claim 1】 A polymer for an organic layer of an organic light emitting diode comprising a repeat unit represented by the following General Formula 2 and formed by polymerization of a monomer represented by the following General Formula 1.

[General Formula 1] [General Formula 2]



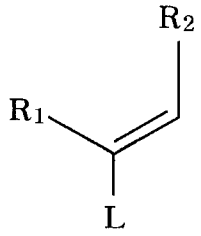


(in General Formulas 1 and 2, X represents silicon (Si) or tin (Sn); Ar_1, Ar_2, and Ar_3 may be the same or different and each represents a C1-C30 substituted or non-substituted alkyl group, a C1-C30 substituted or non-substituted acyl group, a C1-C30 substituted or non-substituted alkoxycarbonyl group, a C1-C30 substituted or non-substituted alkoxy group, a C2-C30 substituted or non-substituted alkenyl group, a C2-C30 substituted or non-substituted alkynyl group, a C2-C30 substituted or non-substituted alkylcarboxyl group, a C6-C30 substituted or non-substituted aryl group, a C6-C30 substituted or non-substituted aralkyl group, a C6-C30 substituted or non-substituted aralkyloxy group, a C2-C30 substituted or non-substituted heteroaryl group, a C2-C30 substituted or non-substituted heteroaryloxy group, a C6-C30 substituted or non-substituted aryloxy group, and a C4-C30 substituted or non-substituted cycloalkyl group; Y is single-bonded and represents an alkylene group (preferably C1-C20, more preferably C1-C12, and even more preferably C1-C8, e.g., methylene, ethylene, propylene, and the like), an arylene group (preferably

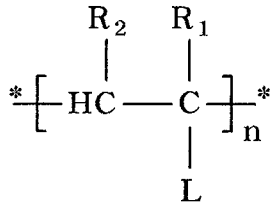
C6-C30, more preferably C6-C20, and even more preferably C6-C12, e.g., phenylene, biphenylene, naphthalene, and the like), an oxyalkylene group (preferably C1-C20, more preferably C1-C12, and even more preferably C1-C8, e.g., oxymethylene, oxyethylene, and the like), an oxyarylene group (preferably C6-C20, more preferably C6-C16, and even more preferably C6-C12, e.g., oxyphenylene, oxybiphenylene, oxynaphthalene, and the like), an oxycarbonyl group, an amide group, a urethane group, and the like, and such divalent organic groups may also be displaced by the foregoing substituted groups; and R_1 and R_2 may be the same or different and each represents a hydrogen atom or a univalent substitution group, namely an alkyl group (preferably C1-C20), an alkenyl group (preferably C2-C20), an aryl group (preferably C6-C30), an alkoxy group (preferably C1-C20), an aryloxy group (preferably C6-C20), a hetero-oxy group (preferably C2-C20), a silyloxy group (preferably C3-C40), an acyl group (preferably C1-C20), an alkoxycarbonyl group (preferably C2-C20), an acyloxy group (preferably C2-C20), an acylamino group (preferably C2-C20), an alkoxycarbonylamino group (preferably C2-C20), an anyloxycarbonylamino group (preferably C7-C20), a sulfamoylamino group (preferably C1-C20), a sulfonyl group (preferably C0-C20), an alkylthio group (preferably C1-C20), an arylthio group (preferably C6-C20), a heterocyclic thiol group (preferably C1-C20), a sulfonyl group (preferably C1-C20), an ureide group (preferably C1-C20), a phosphoamide group (preferably C1-C20), a hydroxyl group, a halogen, a cyano group, a sulfone group, a carboxyl group, a nitro group, a heteroatom, a silyl group (preferably C3-C40), or the like.)

【Claim 2】 A polymer for an organic layer of an organic light emitting diode comprising the repeat unit represented by General Formula 2 and formed by polymerization of the monomer represented by General Formula 1, and a repeat unit represented by the following General Formula 4 and formed by polymerization of a monomer represented by the following General Formula 3.

[General Formula 3]



[General Formula 4]



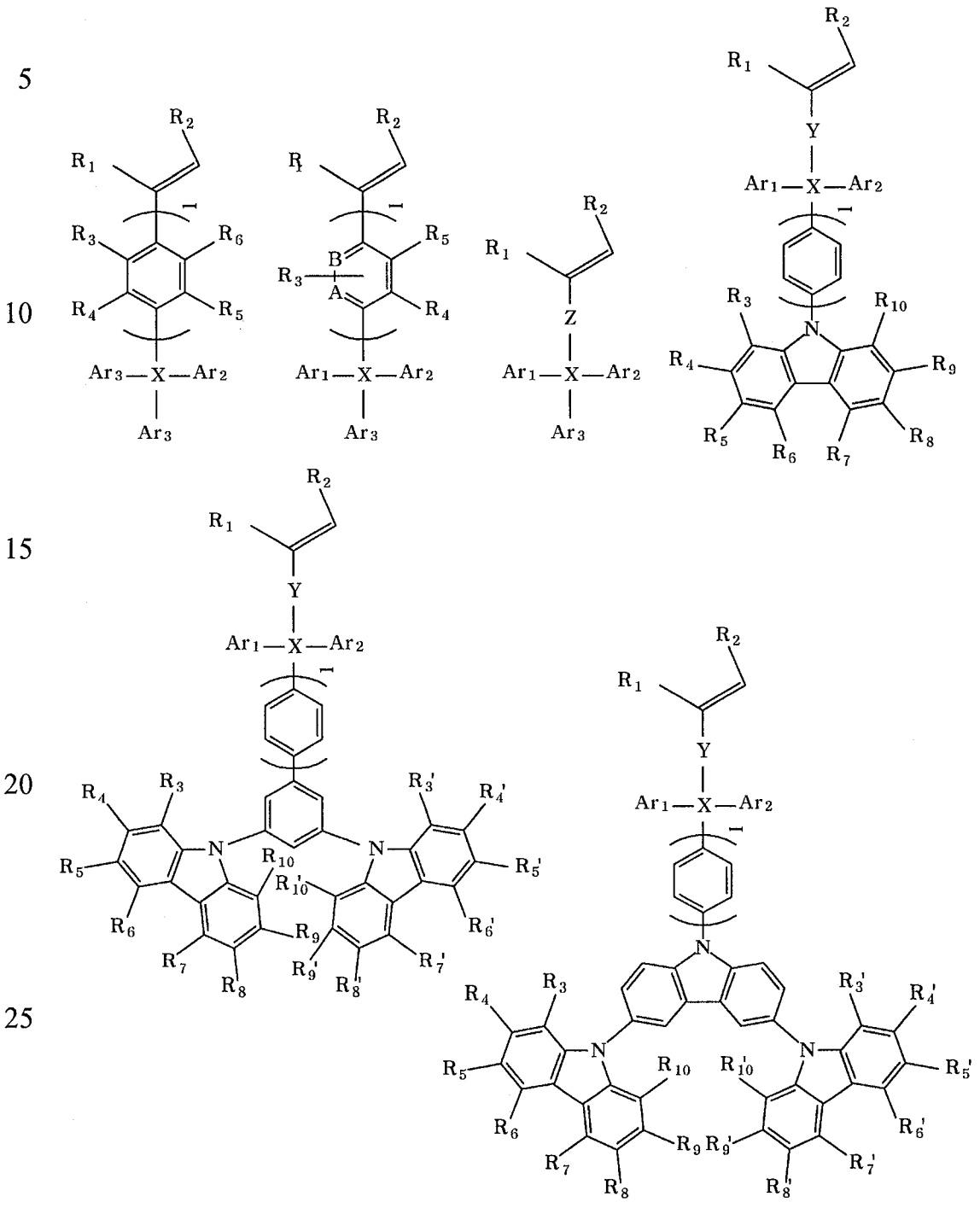
(in General Formulas 3 and 4, L represents carbazole, triphenylamine, phenyl, naphthyl, anthracenyl, pyridyl, or the like which can be substituted by a group selected from the group consisting of a cyano group (-CN), a hydroxyl group (-OH), a C1-C30 alkoxycarbonyl group displaceable by a C1-C6 alkoxycarbonyl group, a C1-C30 (di-)alkylaminocarbonyl group, a C1-C30 alkylcarbonyl group, a halogen, a hydroxyl group, a silyl group, a C1-C30 alkyl group, a C6-C18 aryl group, a C1-C30 alkoxy group, a C1-C30 alkoxycarbonyl group, a C1-C30 acyloxy group, and a C1-C30 alkylcarbonyl group; and R_1 and R_2 may be the same or different and each represents a hydrogen atom or a univalent substitution group, namely an alkyl group (preferably C1-C20), an alkenyl group (preferably C2-C20), an aryl group (preferably C6-C30), an alkoxy group (preferably C1-C20), an aryloxy group (preferably C6-C20), a hetero-oxy group (preferably C2-C20), a silyloxy group (preferably C3-C40), an acyl group (preferably C1-C20), an alkoxycarbonyl group (preferably C2-C20), an acyloxy group (preferably C2-C20), an acylamino group (preferably C2-C20), an alkoxycarbonylamino group (preferably C2-C20), an anyloxycarbonylamino group (preferably C7-C20), a sulfamoylamino group (preferably C1-C20), a sulfonyl group (preferably C0-C20), an alkylthio group (preferably C1-C20), an arylthio group (preferably C6-C20), a heterocyclic thiol group (preferably C1-C20), a sulfonyl group (preferably C1-C20), an ureide group (preferably C1-C20), a phosphoamide group (preferably C1-C20), a hydroxyl group, a halogen, a cyano group, a sulfone group, a carboxyl group, a nitro group, a heteroatom, a silyl group (preferably C3-C40), or the like.)

【Claim 3】 The polymer according to claim 2, wherein the repeat unit represented by General Formula 2 forms at least 0.5% by weight or more of the entire polymer.

【Claim 4】 The polymer according to claim 2, wherein the repeat unit represented by General Formula 4 forms at least 0.5% by weight or more of the entire polymer.

【Claim 5】 The polymer according to claim 1 or 2, wherein the monomer represented by General Formula 1 is selected from the group of monomers represented by the following General Formula 5.

[General Formula 5]

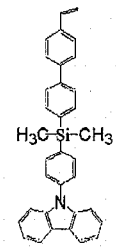


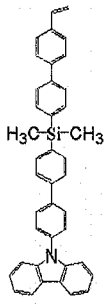
(In General Formula 5, X, Y, Ar_1, Ar_2, Ar_3 R_1, and R_2 each represent the

same groups as in General Formula 1; Z is not present or a C1-C30 substituted or non-substituted alkyl group, a C1-C30 substituted or non-substituted acyl group, a C1-C30 substituted or non-substituted alkoxycarbonyl group, a C1-C30 substituted or non-substituted alkoxy group, a C2-C30 substituted or non-substituted alkenyl group, a C2-C30 substituted or non-substituted alkynyl group, a C2-C30 substituted or non-substituted alkylcarboxyl group, and a substituted or non-substituted cycloalkyl group. At least one of A and B includes a nitrogen atom; and R_3-R_{10} and R_3'-R_{10}' may be the same or different and each represents a C1-C30 substituted or non-substituted alkyl group, a C1-C30 substituted or non-substituted acyl group, a C1-C30 substituted or non-substituted alkoxycarbonyl group, a C1-C30 substituted or non-substituted alkoxy group, a C2-C30 substituted or non-substituted alkenyl group, a C2-C30 substituted or non-substituted alkynyl group, a C2-C30 substituted or non-substituted alkylcarboxyl group, a C6-C30 substituted or non-substituted aryl group, a C6-C30 substituted or non-substituted aralkyl group, a C6-C30 substituted or non-substituted aralkyloxy group, a C2-C30 substituted or non-substituted heteroaryl group, a C2-C30 substituted or non-substituted heteroaryloxy group, a C6-C30 substituted or non-substituted aryloxy group, a C4-C30 substituted or non-substituted cycloalkyl group, -N(R)(R') (where R and R' independently represent hydrogen, a C1-C30 alkyl group, a C6-C30 aryl group, or a C2-C30 heteroaryl group), a cyano group, a hydroxyl group, and a carboxyl group. Here, two or more neighboring groups of R_3-R_{10}' may be connected to form a ring. l is an integer from 0 to 10.)

【Claim 6】 The polymer according to claim 1 or 2, wherein the monomer represented by General Formula 1 is selected from the group of monomers represented by the following Chemical Formula 1.

[Chemical formula 1]


M-1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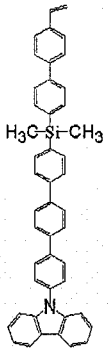
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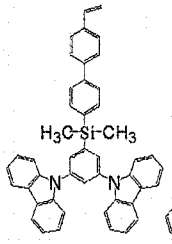
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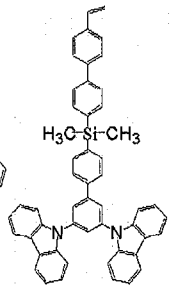
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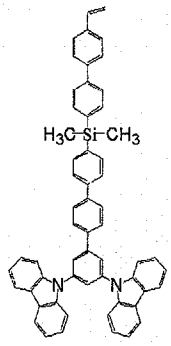
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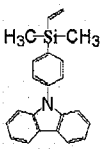
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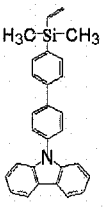
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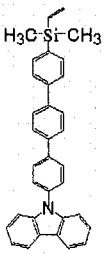
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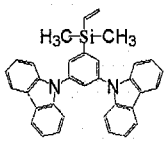
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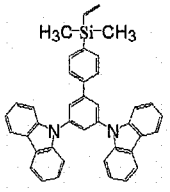
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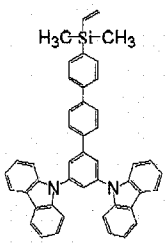
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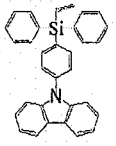
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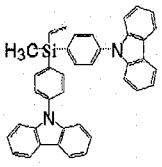
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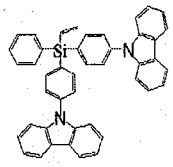
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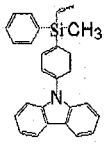
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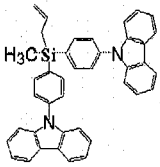
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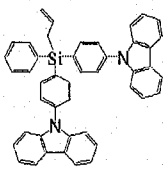
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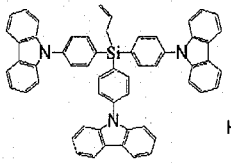
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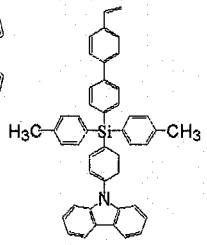
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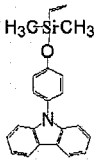
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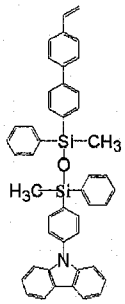
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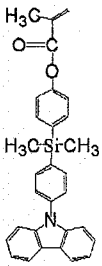
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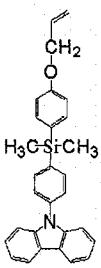
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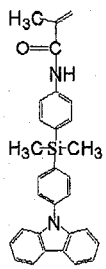
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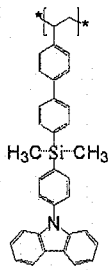
【Claim 7】 The polymer according to claim 1 or 2, wherein the repeat unit represented by General Formula 2 is selected from the group of repeat units represented by the following Chemical Formula 2.

[Chemical Formula 2]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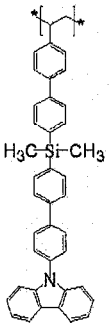
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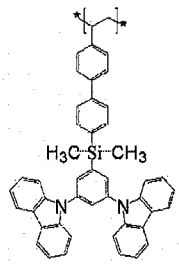
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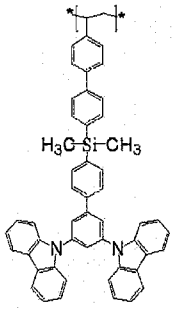
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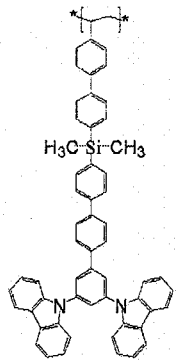
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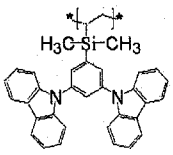
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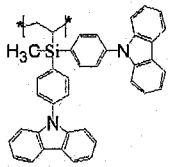
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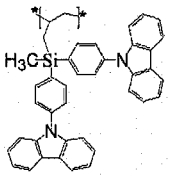
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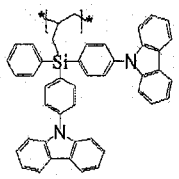
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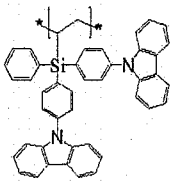
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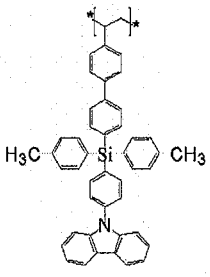
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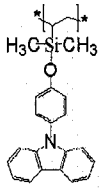
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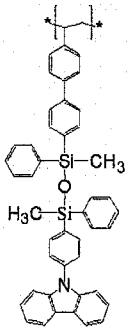
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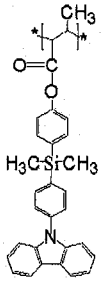
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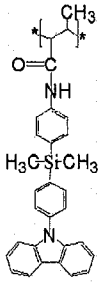
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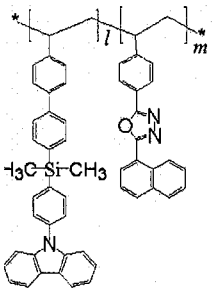
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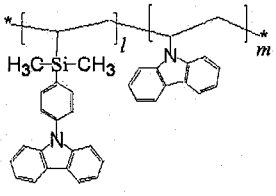
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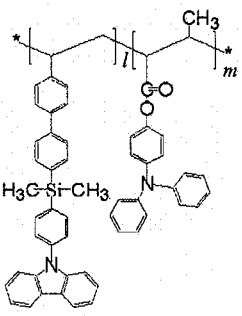
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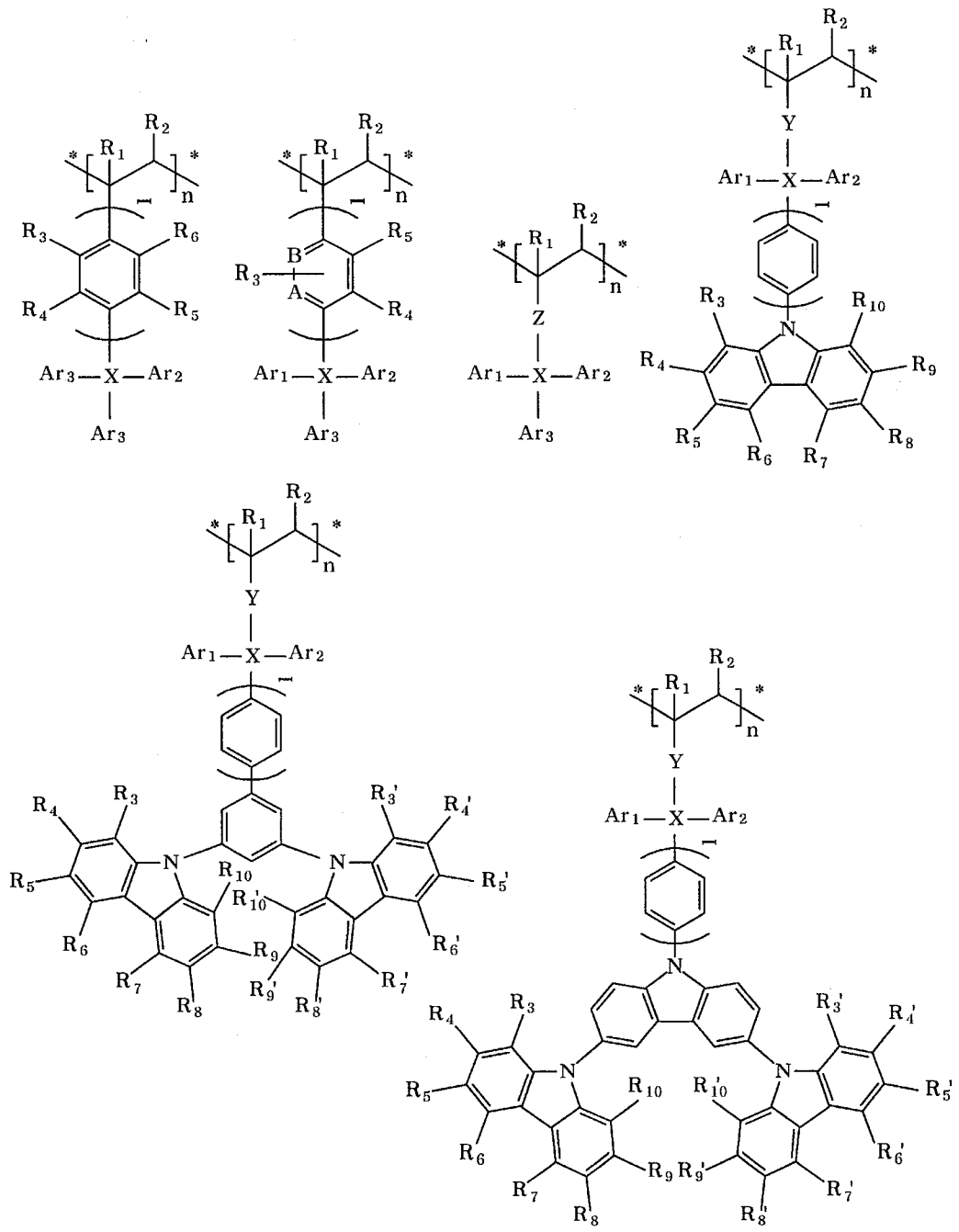
【Claim 8】 The polymer according to claim 5, wherein a repeat unit formed by polymerization of the monomers represented by General Formula 5 is represented by the following Chemical Formula 3.

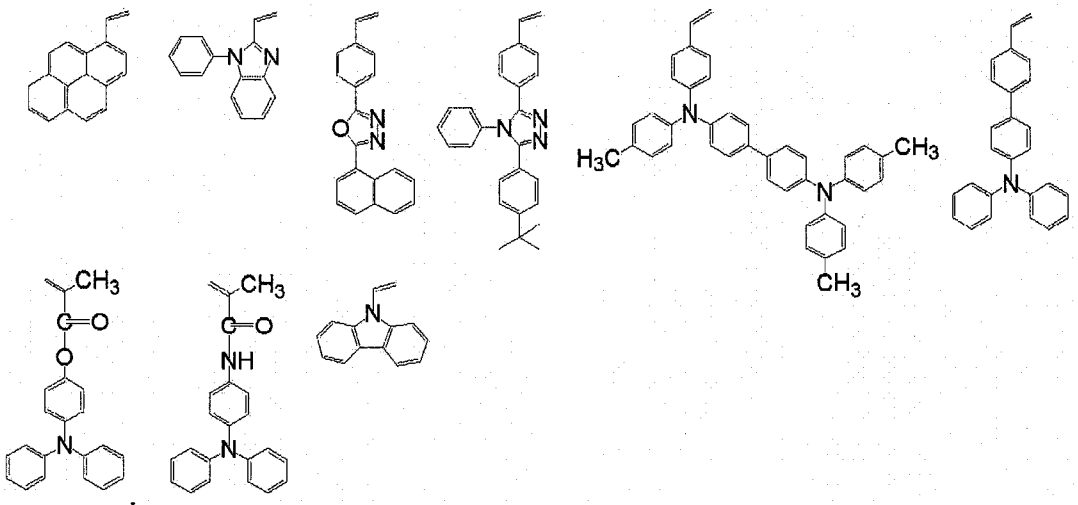
[Chemical Formula 3]



(In Chemical Formula 3, X, Y, Ar_1, Ar_2, Ar_3, R_1-R_{10}', and l each represents the same as in General Formula 5 of Claim 5, and n is an integer from 1 to 1,000,000.)

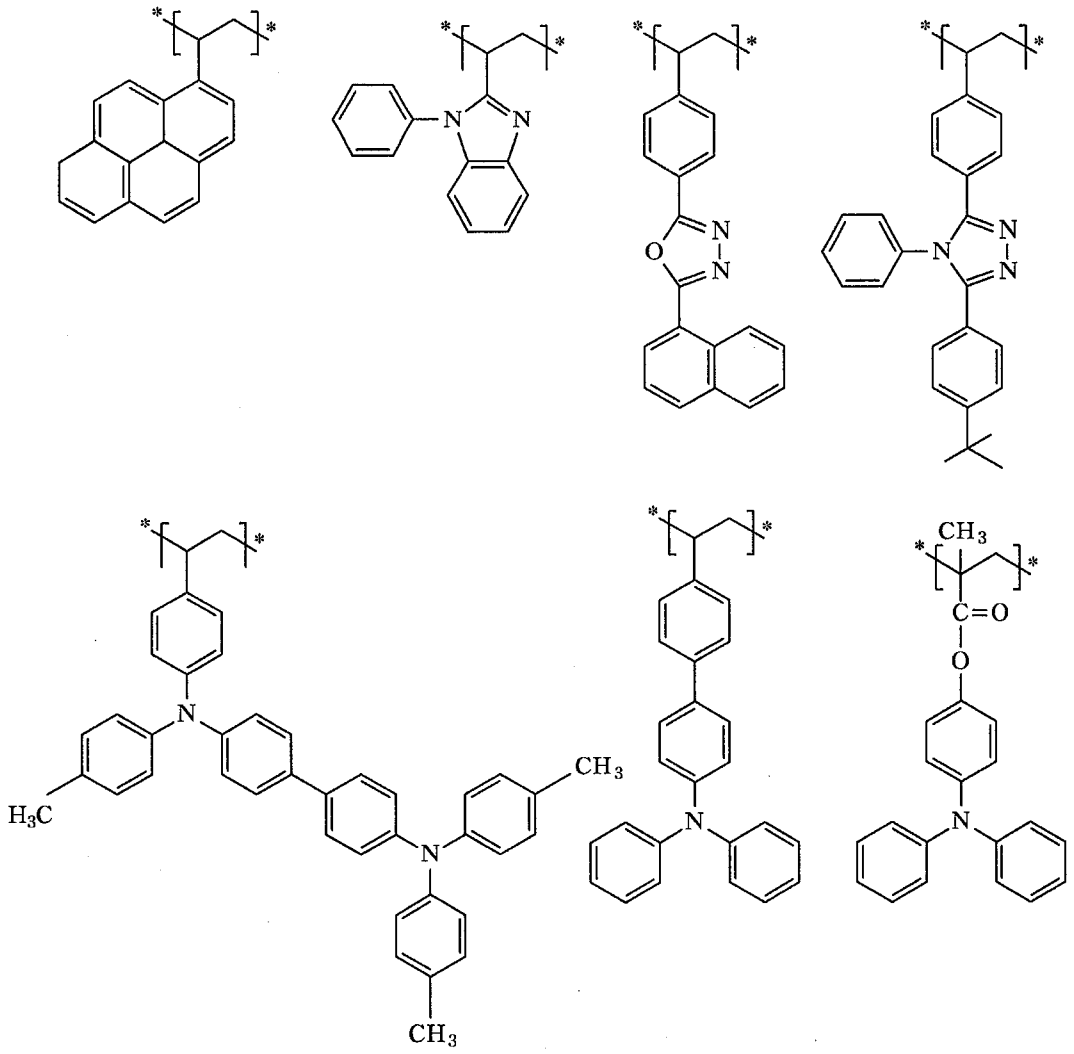
【Claim 9】 The polymer according to claim 1 or 2, wherein the monomer represented by General Formula 3 is represented by the following Chemical Formula 4.

[Chemical Formula 4]



【Claim 10】 The polymer according to claim 2, wherein the repeat unit represented by General Formula 4 is a repeat unit represented by the following Chemical Formula 5.

[Chemical Formula 5]

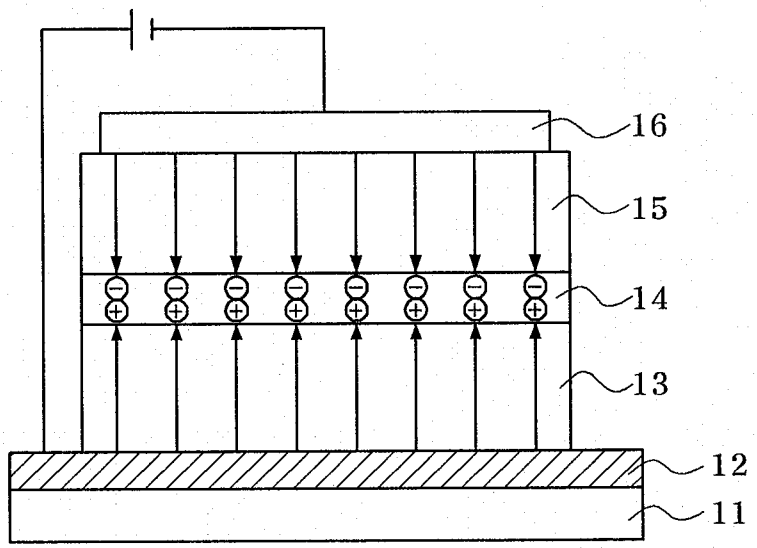


【Claim 11】 The polymer according to claim 1 or 2, wherein the polymer has a weight average molecular weight of 1,000 to 5,000,000.

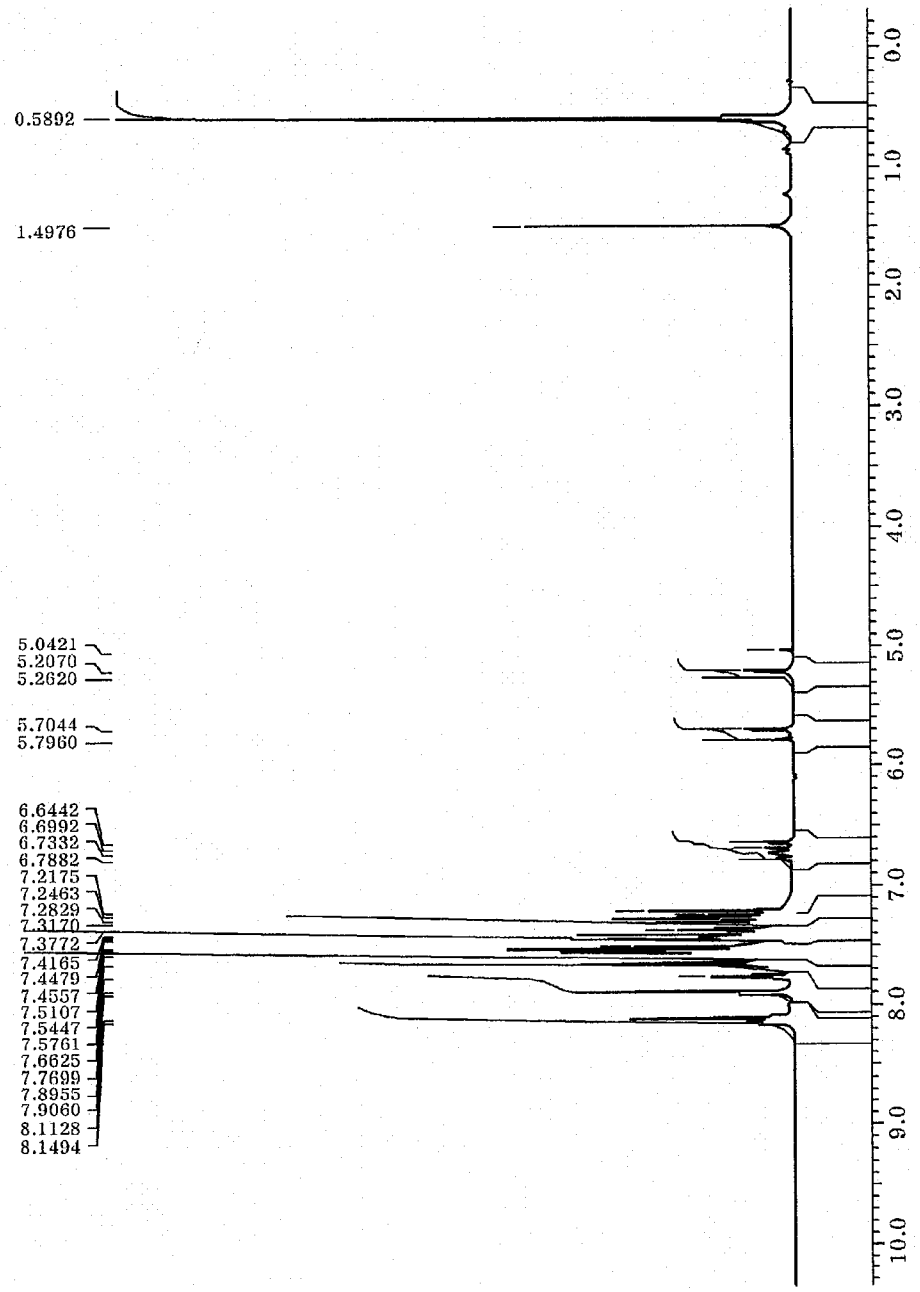
【Claim 12】 The polymer according to claim 1 or 2, wherein the polymer has a number average molecular weight of 500 to 2,000,000.

【Claim 13】 An organic light emitting diode comprising a pair of electrodes, and an organic layer containing the polymer according to any one of claims 1 to 12 as one component.

[FIG. 1]



[FIG. 2]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5.0421
5.2070
5.2620
5.7044
5.7960
6.6442
6.6992
6.7332
6.7882
7.2175
7.2463
7.2829
7.3170
7.3772
7.4165
7.4479
7.4557
7.5107
7.5447
7.5761
7.6625
7.7699
7.8955
7.9060
8.1128
8.1494
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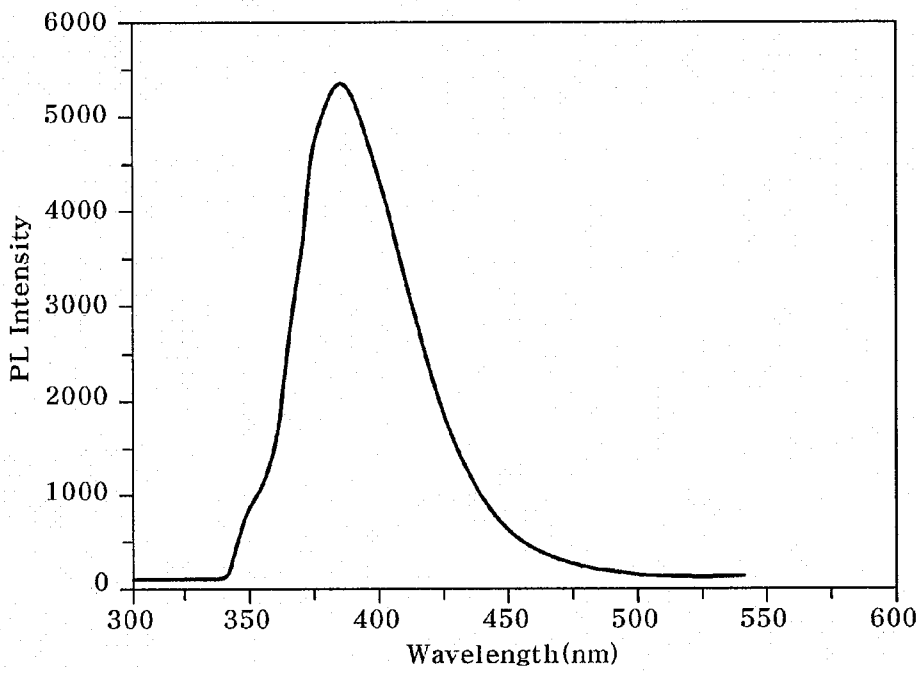
5.0
6.0
7.0
8.0
9.0
10.0

[FIG. 3]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4000
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2000
1000
0
PL Intensity
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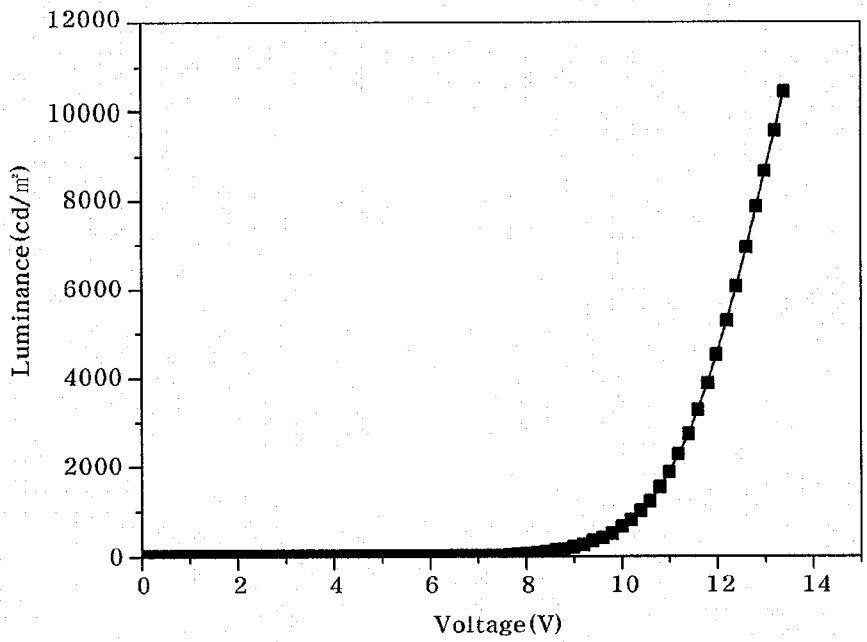
350
400
450
500
550
600
Wavelength(nm)

[FIG. 4]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10000
8000
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4000
2000
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2
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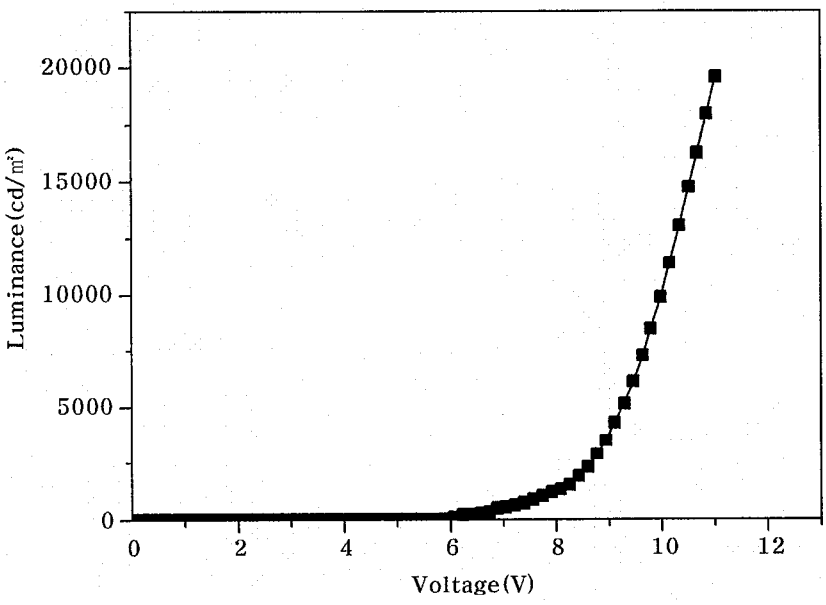
6
8
10
12
14
Voltage(V)

[FIG. 5]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12
Voltage(V)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/006828

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, H05B

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

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

eKIPASS (KIPO internal), USPAT, PAJ, REGISTRY and CAPLUS (STN)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5807945 A (CHEN et al.) 15.09.1998 See claim 1(especially the formula 10), column 12 and 22.	1-12
A	US 6368732 B1 (JIN et al.) 09.04.2002 See Abstract.	1-12
A	KR 1020000032068 A (SAMSUNG SDI CO., LTD.) 05.06.2000 See Abstract.	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 APRIL 2008 (04.04.2008)	**04 APRIL 2008 (04.04.2008)**

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

OH, Se Zu

Telephone No. 82-42-481-8156

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/006828

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 13
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2007/006828

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专利名称(译)	具有硅或/和锡的乙烯基聚合物和使用其的有机发光二极管		
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申请(专利权)人(译)	第一毛织INC.		
当前申请(专利权)人(译)	第一毛织INC.		
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优先权	1020070048246 2007-05-17 KR		
其他公开文献	EP2144973B1 EP2144973A4		
外部链接	Espacenet		

摘要(译)

本文公开了一种基于乙烯基的聚合物，其具有用于OLED的有机层的硅和/或锡。该聚合物可溶于有机溶剂中，并且可以发射从红色到蓝色波长的荧光和磷光，从而用于OLED中的有机发光层的主体材料。