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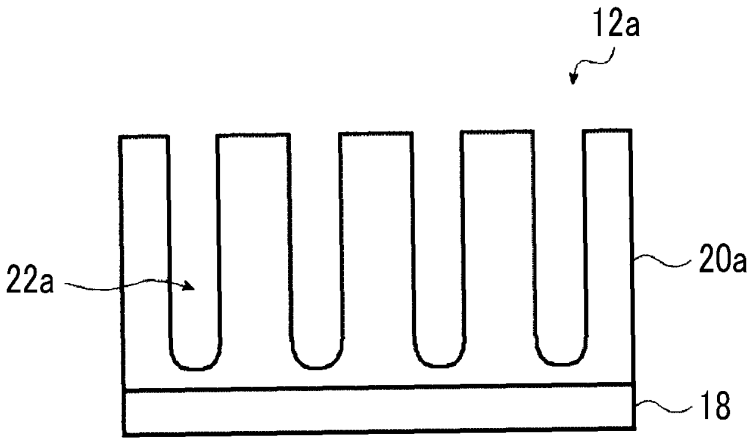
(54) **LITHOGRAPHIC PRINTING PLATE ORIGINAL PLATE, METHOD FOR PRODUCING LITHOGRAPHIC PRINTING PLATE AND LITHOGRAPHIC PRINTING METHOD**

(57) Provided are a planographic printing plate precursor including a support, and an image recording layer on the support, in which the image recording layer contains an infrared absorbing agent that is decomposed by exposure to infrared rays, a polymer having a structural unit formed of an aromatic vinyl compound, a polymerization initiator, and a polymerizable compound; a method of preparing a planographic printing plate using the planographic printing plate precursor; and a planographic printing method using the planographic printing plate precursor.

FIG. 1



EP 3 875 281 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present disclosure relates to a planographic printing plate precursor, a method of preparing a planographic printing plate, and a planographic printing method.

2. Description of the Related Art

[0002] A planographic printing plate is typically formed of a lipophilic image area that receives ink in the process of printing and a hydrophilic non-image area that receives dampening water. Planographic printing is a method of performing printing by utilizing the property that water and oil-based ink repel each other to generate a difference in adhesiveness of ink onto a surface of a planographic printing plate using a lipophilic image area of the planographic printing plate as an ink receiving unit and a hydrophilic non-image area as a dampening water receiving unit (ink non-receiving unit), allowing the ink to land only on an image area, and transferring the ink to a printing material such as paper.

[0003] In the related art, a planographic printing plate precursor (PS plate) obtained by providing a lipophilic photosensitive resin layer (image recording layer) on a hydrophilic support has been widely used in order to prepare such a planographic printing plate. A planographic printing plate is typically obtained by performing plate-making according to a method of exposing a planographic printing plate precursor through an original picture such as a lith film, allowing a part which is an image area of an image recording layer to remain, dissolving the other unnecessary part of the image recording layer in an alkaline developer or an organic solvent so that the part is removed, and exposing a surface of a hydrophilic support to form a non-image area.

[0004] Further, environmental problems related to a waste liquid associated with wet treatments such as a development treatment have been highlighted due to the growing interest in the global environment.

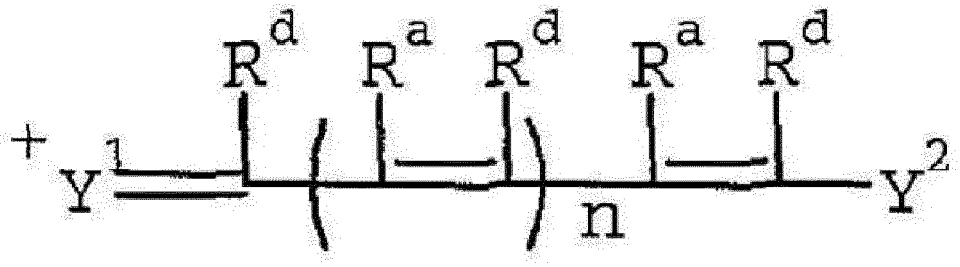
[0005] In order to deal with the above-described environmental problem, it is desired to simplify the process of development or plate-making or not to perform any treatment. As one of simple preparation methods, a method referred to as "on-press development" has been performed. That is, the on-press development is a method of exposing a planographic printing plate precursor, mounting the planographic printing plate precursor on a printing press without performing development of the related art, and removing an unnecessary part of an image recording layer, at an initial stage of a typical printing step.

[0006] In the present disclosure, a planographic printing plate precursor that can be used for such on-press development is referred to as an "on-press development type planographic printing plate precursor".

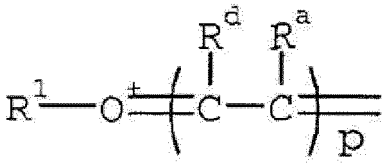
[0007] As a heat-sensitive image forming element used for a planographic printing plate precursor of the related art, those described in JP2008-544322A are exemplified.

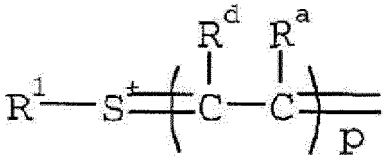
[0008] JP2008-544322A describes a heat-sensitive image forming element that contains an IR dye having a structure represented by Formula I.

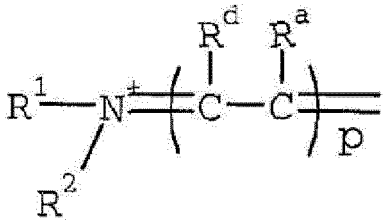
(Formula I)



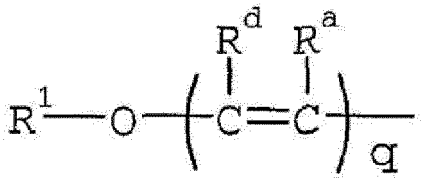
[0009] In the formula, $^{+}Y1=$ represents one of the following structures,

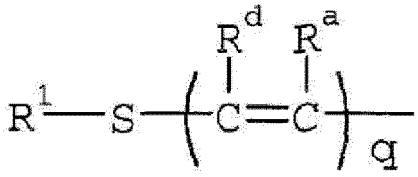


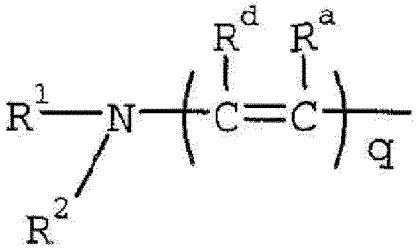




[0010] Y^{2-} represent one of the following structures,





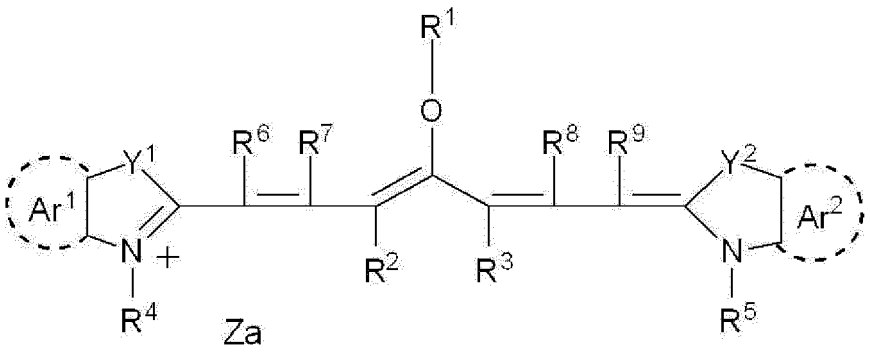


[0011] n represents 0, 1, 2, or 3, p and q each represent 0, 1, or 2, R^1 and R^2 each independently represent a hydrocarbon group which may be substituted, two of R^1's, R^2's, R^d's, and R^a's have atoms necessary to form a cyclic structure in a case where the two are bonded to each other, at least one of R^d's represents a group converted to a group that is an electron-donor stronger than R^d's by a chemical reaction induced by irradiation with IR or exposure to heat, at least one of R^a's represents a group converted to a group that is an electron-donor stronger than Ra's by a chemical reaction induced by irradiation with IR or exposure to heat, other R^d's and R^a's each represent a group selected from the group consisting of a hydrogen atom, a halogen atom, $-R^e$, $-OR^f$, $-SR^g$, and $-NR^uR^v$, where R^e, R^f, R^g, R^u, and R^v each independently represent an aliphatic hydrocarbon group which may be substituted or a (hetero)aryl group which may be substituted, and the conversion increases integrated light absorption of the dye in a range of 400 to 700 nm.

[0012] As a color developing composition used for a planographic printing plate precursor of the related art, those

described in WO2016/027886A are exemplified.

[0013] WO2016/027886A describes a color developing composition containing a compound represented by Formula 1.



(1)

[0014] In Formula 1, R^1 represents a group having a R^1-O bond that is cleaved by exposure to heat or infrared rays, R^2 and R^3 each independently represent a hydrogen atom or an alkyl group, R^2 and R^3 may be linked to each other to form a ring, Ar^1 and Ar^2 each independently represent a group that forms a benzene ring or a naphthalene ring, Y^1 and Y^2 each independently represent an oxygen atom, a sulfur atom, $-NR^0-$, or a dialkylmethylene group, R^4 and R^5 each independently represent an alkyl group, R^6 to R^9 each independently represent a hydrogen atom or an alkyl group, R^0 represents a hydrogen atom, an alkyl group, or an aryl group, and Za represents a counter ion that neutralizes an electric charge.

SUMMARY OF THE INVENTION

[0015] An object to be achieved by an aspect of the present invention is to provide a planographic printing plate precursor from which a planographic printing plate with excellent color developability and excellent printing durability is obtained even in a case where UV ink is used.

[0016] An object to be achieved by another aspect of the present invention is to provide a method of preparing a planographic printing plate using the planographic printing plate precursor and a planographic printing method using the planographic printing plate precursor.

[0017] The means for achieving the above-described object includes the following aspects.

<1> A planographic printing plate precursor comprising: a support; and an image recording layer on the support, in which the image recording layer comprises an infrared absorbing agent that is capable of being decomposed by exposure to infrared rays, a polymer having a structural unit formed of an aromatic vinyl compound, a polymerization initiator, and a polymerizable compound.

<2> The planographic printing plate precursor according to <1>, in which the polymer comprises polymer particles.

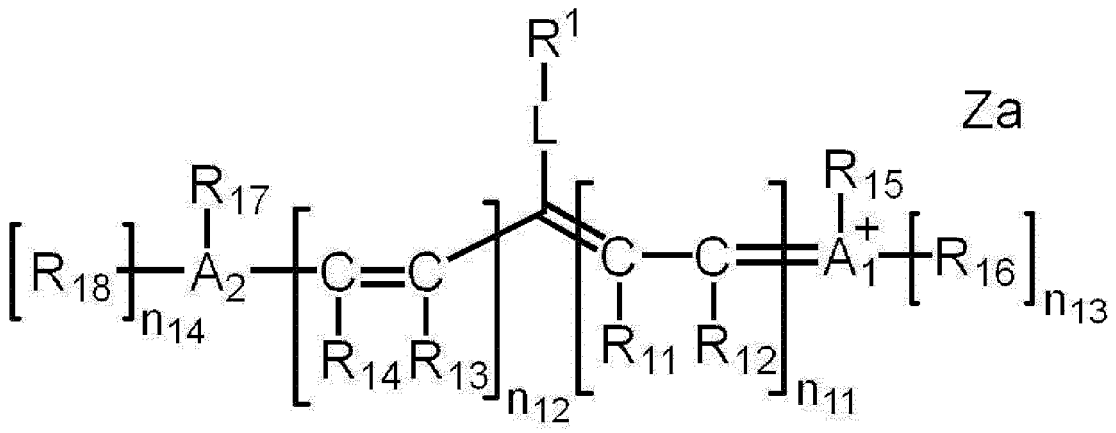
<3> The planographic printing plate precursor according to <1> or <2>, in which the polymer has a hydrophilic group.

<4> The planographic printing plate precursor according to <3>, in which the hydrophilic group has a polyalkyleneoxy structure.

<5> The planographic printing plate precursor according to any one of <1> to <4>, in which the infrared absorbing agent is an infrared absorbing agent that is decomposed due to heat, electron transfer, or both thereof caused by exposure to infrared rays.

<6> The planographic printing plate precursor according to any one of <1> to <5>, in which the infrared absorbing agent is a cyanine coloring agent.

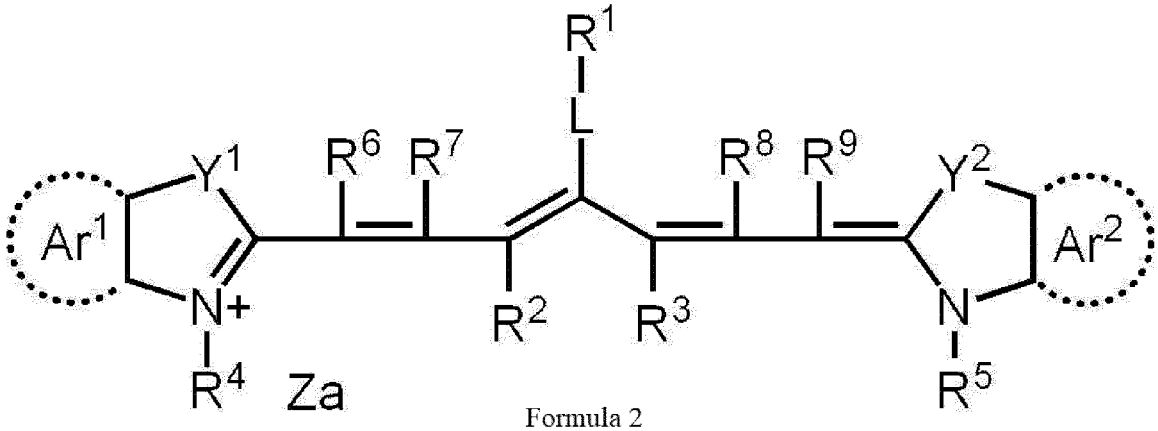
<7> The planographic printing plate precursor according to <6>, in which the cyanine coloring agent is a cyanine coloring agent represented by Formula 1.



Formula 1

In Formula 1, R^1 represents a group having an R^1-L bond that is capable of being cleaved by exposure to infrared rays, R_{11} to R_{18} each independently represent a hydrogen atom, a halogen atom, -Ra, -ORb, -SRc, or -NRdRe, Ra to Re each independently represent a hydrocarbon group, A_1, A_2, and a plurality of R_{11}'s to R_{18}'s may be linked to each other to form a monocycle or a polycycle, A_1 and A_2 each independently represent an oxygen atom, a sulfur atom, or a nitrogen atom, n_{11} and n_{12} each independently represent an integer of 0 to 5, where a total of n_{11} and n_{12} is 2 or greater, n_{13} and n_{14} each independently represent 0 or 1, L represents an oxygen atom, a sulfur atom, or $-NR^{10}-$, R^{10} represents a hydrogen atom, an alkyl group, or an aryl group, and Za represents a counter ion that neutralizes an electric charge.

<8> The planographic printing plate precursor according to <6> or <7>, in which the cyanine coloring agent is a cyanine coloring agent represented by Formula 2.



Formula 2

In Formula 2, R^1 represents a group having an R^1-L bond that is capable of being cleaved by exposure to infrared rays, R^2 and R^3 each independently represent a hydrogen atom or an alkyl group, R^2 and R^3 may be linked to each other to form a ring, Ar^1 and Ar^2 each independently represent a group forming a benzene ring or a naphthalene ring, Y^1 and Y^2 each independently represent an oxygen atom, a sulfur atom, $-NR^0-$, or a dialkylmethylene group, R^0 represents a hydrogen atom, an alkyl group, or an aryl group, R^4 and R^5 each independently represent an alkyl group, a $-CO_2M$ group, or a $-PO_3M_2$ group, M represents a hydrogen atom, a Na atom, a K atom, or an onium group, R^6 to R^9 each independently represent a hydrogen atom or an alkyl group, L represents an oxygen atom, a sulfur atom, or $-NR^{10}-$, R^{10} represents a hydrogen atom, an alkyl group, or an aryl group, and Za represents a counter ion that neutralizes an electric charge.

<9> The planographic printing plate precursor according to any one of <1> to <8>, in which an ethylenically unsaturated bond equivalent of the polymerizable compound is 200 g/mol or less.

<10> The planographic printing plate precursor according to any one of <1> to <9>, in which a weight-average molecular weight of the polymerizable compound is 1500 or less.

<11> The planographic printing plate precursor according to any one of <1> to <10>, in which the polymerizable

compound comprises a trifunctional or higher functional polymerizable compound.

<12> The planographic printing plate precursor according to any one of <1> to <11>, in which the polymerizable compound comprises a heptafunctional or higher functional polymerizable compound.

<13> The planographic printing plate precursor according to any one of <1> to <12>, in which the polymerizable compound comprises a decafunctional or higher functional polymerizable compound.

<14> The planographic printing plate precursor according to any one of <1> to <13>, in which a CLogP value of the polymerizable compound is 6 or less.

<15> The planographic printing plate precursor according to any one of <1> to <14>, in which the image recording layer comprises two or more kinds of polymerizable compounds.

<16> The planographic printing plate precursor according to any one of <1> to <15>, in which the polymerization initiator comprises an electron-donating polymerization initiator and an electron-accepting polymerization initiator.

<17> The planographic printing plate precursor according to <16>, in which the polymerization initiator comprises an onium salt compound as the electron-accepting polymerization initiator.

<18> The planographic printing plate precursor according to <16> or <17>, in which the polymerization initiator comprises a borate compound as the electron-donating polymerization initiator.

<19> The planographic printing plate precursor according to any one of <16> to <18>, in which a HOMO of the electron-donating polymerization initiator is -6.0 eV or greater.

<20> The planographic printing plate precursor according to any one of <16> to <19>, in which a LUMO of the electron-accepting polymerization initiator is -3.0 eV or less.

<21> The planographic printing plate precursor according to any one of <1> to <20>, in which the polymerization initiator comprises a compound in which an electron-donating polymerization initiator and an electron-accepting polymerization initiator form a counter salt.

<22> The planographic printing plate precursor according to any one of <1> to <21>, in which the image recording layer further comprises an acid color former.

<23> The planographic printing plate precursor according to any one of <1> to <22>, further comprising: an overcoat layer on the image recording layer.

<24> The planographic printing plate precursor according to any one of <1> to <23>, in which the aluminum support comprises an aluminum plate and an anodized aluminum film disposed on the aluminum plate, the anodized film is positioned closer to a side of the image recording layer than a side of the aluminum plate, the anodized film has micropores extending from a surface on the side of the image recording layer in a depth direction, and an average diameter of the micropores in the surface of the anodized film is greater than 10 nm and 100 nm or less.

<25> The planographic printing plate precursor according to <24>, in which the micropores are formed of large-diameter pores extending to a position at a depth of 10 nm to 1000 nm from the surface of the anodized film and small-diameter pores communicating with bottom portions of the large-diameter pores and extending to a position at a depth of 20 nm to 2000 nm from the communication positions, the average diameter of the large-diameter pores in the surface of the anodized film is in a range of 15 nm to 100 nm, and the average diameter of the small-diameter pores at the communication position is 13 nm or less.

<26> A method of preparing a planographic printing plate, comprising: a step of imagewise-exposing the planographic printing plate precursor according to any one of <1> to <25>; and a step of supplying at least one selected from the group consisting of printing ink and dampening water to remove an image recording layer of a non-image area on a printing press.

<27> A planographic printing method comprising: a step of imagewise-exposing the planographic printing plate precursor according to any one of <1> to <25>; a step of supplying at least one selected from the group consisting of printing ink and dampening water to remove an image recording layer of a non-image area on a printing press and preparing a planographic printing plate; and a step of performing printing using the obtained planographic printing plate.

[0018] According to an aspect of the present invention, it is possible to provide a planographic printing plate precursor from which a planographic printing plate with excellent color developability and excellent printing durability is obtained even in a case where UV ink is used.

[0019] According to another aspect of the present invention, it is possible to provide a method of preparing a planographic printing plate using the planographic printing plate precursor and a planographic printing method using the planographic printing plate precursor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Fig. 1 is a schematic cross-sectional view illustrating an embodiment of an aluminum support.
Fig. 2 is a schematic cross-sectional view illustrating another embodiment of an aluminum support.
Fig. 3 is a schematic view illustrating an anodization treatment device used for an anodization treatment in preparation of the aluminum support.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Hereinafter, the contents of the present disclosure will be described in detail. The description of constituent elements below is made based on representative embodiments of the present disclosure in some cases, but the present disclosure is not limited to such embodiments.

[0022] Further, in the present specification, a numerical range shown using "to" indicates a range including numerical values described before and after "to" as a lower limit and an upper limit.

[0023] In a numerical range described in a stepwise manner in the present specification, an upper limit or a lower limit described in one numerical range may be replaced with an upper limit or a lower limit in another numerical range described in a stepwise manner. Further, in a numerical range described in the present specification, an upper limit or a lower limit described in the numerical range may be replaced with a value described in an example.

[0024] Further, in a case where substitution or unsubstitution is not noted in regard to the notation of a "group" (atomic group) in the present specification, the "group" includes not only a group that does not have a substituent but also a group having a substituent. For example, the concept of an "alkyl group" includes not only an alkyl group that does not have a substituent (unsubstituted alkyl group) but also an alkyl group having a substituent (substituted alkyl group).

[0025] In the present specification, the concept of "(meth)acryl" includes both acryl and methacryl, and the concept of "(meth)acryloyl" includes both acryloyl and methacryloyl.

[0026] Further, the term "step" in the present specification indicates not only an independent step but also a step which cannot be clearly distinguished from other steps as long as the intended purpose of the step is achieved. Further, in the present disclosure, "% by mass" has the same definition as that for "% by weight", and "part by mass" has the same definition as that for "part by weight".

[0027] In the present disclosure, a composition may contain only one or two or more components in combination and a polymer may have only one or two or more structural units in combination, unless otherwise specified.

[0028] In the present disclosure, the amount of each component in a composition or each structural unit in a polymer indicates the total amount of a plurality of materials corresponding to each component in the composition or the total amount of a plurality of structural units corresponding to each structural unit in the polymer in a case where the composition contains a plurality of materials corresponding to each component described above or the polymer has a plurality of structural units corresponding to each structural unit described above, unless otherwise specified.

[0029] Further, in the present disclosure, a combination of two or more preferred embodiments is a more preferred embodiment.

[0030] Further, the weight-average molecular weight (Mw) and the number average molecular weight (Mn) in the present disclosure are molecular weights in terms of polystyrene used as a standard substance, which are detected by using tetrahydrofuran (THF) as a solvent, a differential refractometer, and a gel permeation chromatography (GPC) analyzer using TSKgel GMHxL, TSKgel G4000HxL, and TSKgel G2000HxL (all trade names, manufactured by Tosoh Corporation) as columns, unless otherwise specified.

[0031] In the present disclosure, the term "planographic printing plate precursor" includes not only a planographic printing plate precursor but also a key plate precursor. Further, the term "planographic printing plate" includes not only a planographic printing plate prepared by performing operations such as exposure and development on a planographic printing plate precursor as necessary but also a key plate. In a case of a key plate precursor, the operations of exposure, development, and the like are not necessarily required. Further, a key plate is a planographic printing plate precursor for attachment to a plate cylinder that is not used in a case where printing is performed on a part of a paper surface with one or two colors in color newspaper printing.

[0032] Further, in the present disclosure, "*" in a chemical structural formula represents a binding position with respect to another structure.

[0033] Hereinafter, the present disclosure will be described in detail.

(Planographic printing plate precursor)

[0034] A planographic printing plate precursor according to the embodiment of the present disclosure is a planographic printing plate precursor including a support, and an image recording layer on the support, in which the image recording layer contains an infrared absorbing agent that is decomposed by exposure to infrared rays, a polymer having a structural unit formed of an aromatic vinyl compound, a polymerization initiator, and a polymerizable compound.

[0035] Further, the planographic printing plate precursor according to the embodiment of the present disclosure can

be suitably used as an on-press development type planographic printing plate precursor.

[0036] As a result of intensive examination conducted by the present inventors, it was found that a planographic printing plate precursor from which a planographic printing plate with excellent color developability and excellent printing durability is obtained even in a case where UV ink (also referred to as an "ultraviolet curable ink") is used can be provided by employing the above-described configuration.

[0037] The detailed mechanism by which the above-described effect is obtained is not clear, but can be assumed as follows.

[0038] It is assumed that in a case where the image recording layer contains an infrared absorbing agent that is decomposed by exposure to infrared rays, a polymer having a structural unit formed of an aromatic vinyl compound, a polymerization initiator, and a polymerizable compound, the infrared absorbing agent or a decomposition product thereof promotes polymerization in a case of polymerization of the polymerizable compound, a highly polar film can be obtained by using the polymer having a structural unit formed of an aromatic vinyl compound, and thus the printing durability (also referred to as "UV printing durability") is excellent even in a case where UV ink is used. Further, it is assumed that the UV printing durability is further improved due to the intermolecular interaction between the decomposition product of the infrared absorbing agent and the structural unit formed of an aromatic vinyl compound, which is included in the polymer.

[0039] Further, it is assumed that the color developability is also excellent due to the intermolecular interaction between the decomposition product of the infrared absorbing agent and the structural unit formed of an aromatic vinyl compound, which is included in the polymer.

[0040] Further, the planographic printing plate precursor according to the embodiment of the present disclosure also has excellent temporal color developability after exposure and excellent developability.

[0041] Hereinafter, details of each constituent element in the planographic printing plate precursor according to the embodiment of the present disclosure will be described.

<Support>

[0042] The planographic printing plate precursor according to the embodiment of the present disclosure includes a support.

[0043] As the support, a support having a hydrophilic surface (also referred to as a "hydrophilic support") is preferable. As the hydrophilic surface, a surface whose contact angle with water is less than 10° is preferable, and a surface whose contact angle with water is less than 5° is more preferable.

[0044] The water contact angle in the present disclosure is measured as a contact angle (after 0.2 seconds) of water droplets on the surface at 25°C using DM-501 (manufactured by Kyowa Interface Science Co., Ltd.).

[0045] The support of the planographic printing plate precursor according to the embodiment of the present disclosure can be appropriately selected from known supports for planographic printing plate precursors. As the support, an aluminum plate which has been subjected to a roughening treatment and an anodization treatment according to known methods is preferable.

[0046] The aluminum plate may be further subjected to a treatment appropriately selected from an expansion treatment or a sealing treatment of micropores of an anodized film described in JP2001-253181A or JP2001-322365A; a surface hydrophilization treatment using alkali metal silicate described in US2714066A, US3181461A, US3280734A, and US3902734A; or a surface hydrophilization treatment using polyvinyl phosphonic acid described in US3276868A, US4153461A, and US4689272Aas necessary.

[0047] The center line average roughness of the support is preferably in a range of 0.10 μm to 1.2 μm.

[0048] The support may have a back coat layer containing an organic polymer compound described in JP1993-045885A (JP-H05-045885A)) or an alkoxy compound of silicon described in JP1994-035174A (JP-H06-035174A) on the surface opposite to a side where the image recording layer is provided, as necessary.

[Preferred embodiment of support]

[0049] An example of a preferred embodiment of the aluminum support used in the present disclosure (the aluminum support according to this example is also referred to as a "support (1)") is described below.

[0050] That is, the support (1) includes an aluminum plate and an anodized aluminum film disposed on the aluminum plate, and the anodized film is positioned closer to a side of the image recording layer than a side of the aluminum plate, the anodized film has micropores extending from the surface on the side of the image recording layer in the depth direction, the average diameter of the micropores in the surface of the anodized film is greater than 10 nm and 100 nm or less, and the value of the brightness L* in the L*a*b* color system of the surface of the anodized film on the side of the image recording layer is in a range of 70 to 100.

[0051] Fig. 1 is a schematic cross-sectional view illustrating an embodiment of an aluminum support 12a.

[0052] The aluminum support 12a has a laminated structure in which an aluminum plate 18 and an anodized aluminum

film 20a (hereinafter, also simply referred to as an "anodized film 20a") are laminated in this order. Further, the anodized film 20a in the aluminum support 12a is positioned closer to the side of the image recording layer than the side of the aluminum plate 18. That is, it is preferable that the planographic printing plate precursor according to the embodiment of the present disclosure includes at least an anodized film, an image recording layer, and a water-soluble resin layer in order, on the aluminum plate.

- Anodized film -

[0053] Hereinafter, preferred embodiments of the anodized film 20a will be described.

[0054] The anodized film 20a is a film to be prepared on a surface of the aluminum plate 18 by performing an anodization treatment, and this film is substantially perpendicular to the film surface and has extremely fine micropores 22a uniformly distributed. The micropores 22a extend along the thickness direction (the aluminum plate 18 side) from the surface (the surface of the anodized film 20a on a side opposite to a side where the aluminum plate 18 is provided) of the anodized film 20a on the side of the image recording layer.

[0055] The average diameter (average opening diameter) of the micropores 22a in the surface of the anodized film 20a is preferably greater than 10 nm and 100 nm or less. From the viewpoint of the balance between the printing durability, the stain resistance, and the image visibility, the average diameter thereof is more preferably in a range of 15 nm to 60 nm, still more preferably in a range of 20 nm to 50 nm, and particularly preferably in a range of 25 nm to 40 nm. The diameter inside the pores may be larger or smaller than that of the surface layer.

[0056] In a case where the average diameter is greater than 10 nm, the printing durability and the image visibility are more excellent. Further, in a case where the average diameter thereof is 100 nm or less, the printing durability is more excellent.

[0057] The average diameter of micropores 22a is calculated as an arithmetic average value obtained by observing 4 sheets (N = 4) of the surfaces of the anodized film 20a using a field emission scanning electron microscope (FE-SEM) at a magnification of 150000, measuring the diameters of 50 micropores present in a range of 400×600 nm^2 in the obtained four sheets of images, and averaging the values.

[0058] Further, in a case where the shape of the micropores 22a is not circular, an equivalent circle diameter is used. The "equivalent circle diameter" is a diameter of a circle obtained by assuming the shape of an opening portion of a micropore as a circle having the same projected area as the projected area of the opening portion.

[0059] The depth of the micropores 22a is not particularly limited, but is preferably in a range of 10 nm to 3000 nm, more preferably in a range of 50 nm to 2000 nm, and still more preferably in a range of 300 nm to 1600 nm.

[0060] Further, the depth thereof is a value obtained by capturing (150000 times) an image of a cross section of the anodized film 20a, measuring the depth of 25 or more micropores 22a, and averaging the obtained values.

[0061] The shape of the micropores 22a is not particularly limited, and the shape thereof in Fig. 2 may be a substantially straight tubular shape (substantially cylindrical shape), but may be a conical shape whose diameter decreases toward the depth direction (thickness direction). Further, the shape of the bottom portion of the micropores 22a is not particularly limited, but may be a curved shape (projection shape) or a planar shape.

[0062] The value of the brightness L* in the L*a*b* color system of the surface of the aluminum support 12a on the side of the image recording layer (the surface of the anodized film 20a on the side of the image recording layer) is preferably in a range of 70 to 100. Here, from the viewpoint that the balance between the printing durability and the image visibility is more excellent, the value thereof is preferably in a range of 75 to 100 and more preferably in a range of 75 to 90.

[0063] The brightness L* is measured using a color difference meter Spectro Eye (manufactured by X-Rite Inc.).

[0064] In the support (1), a support in which the micropores are formed of large-diameter pores extending to a position at a depth of 10 nm to 1000 nm from the surface of the anodized film and small-diameter pores communicating with bottom portions of the large-diameter pores and extending to a position at a depth of 20 nm to 2000 nm from the communication positions, the average diameter of the large-diameter pores in the surface of the anodized film is in a range of 15 nm to 100 nm, and the average diameter of the small-diameter pores at the communication position is 13 nm or less is a preferred embodiment (hereinafter, a support according to the embodiment will also be referred to as a "support (2)").

[0065] Fig. 2 is a schematic cross-sectional view illustrating another embodiment of the aluminum support 12a other than the aluminum support illustrated in Fig. 1. A support B is an embodiment of the aluminum support 12a illustrated in Fig. 2.

[0066] In Fig. 2, an aluminum support 12b includes the aluminum plate 18 and an anodized film 20b having micropores 22b formed of large-diameter pores 24 and small-diameter pores 26.

[0067] The micropores 22b in the anodized film 20b are formed of large-diameter pores 24 extending to a position at a depth (depth D: see Fig. 2) of 10 nm to 1000 nm from the surface of the anodized film and small-diameter pores 26 communicating with bottom portions of the large-diameter pores 24 and extending to a position at a depth of 20 nm to

2000 nm from the communication positions.

[0068] Hereinafter, the large-diameter pores 24 and the small-diameter pores 26 will be described in detail.

[0069] The average diameter of the large-diameter pores 24 in the surface of the anodized film 20b is the same as the average diameter of the micropores 22a in surface of the anodized film 20a, which is greater than 10 nm and 100 nm or less, and the preferable ranges thereof are also the same as described above.

[0070] The method of measuring the average diameter of the large-diameter pores 24 in the surface of the anodized film 20b is the same as the method of measuring the average diameter of the micropores 22a in the surface of the anodized film 20a.

[0071] The bottom portions of the large-diameter pores 24 are positioned at a depth of 10 to 1000 nm (hereinafter, also referred to as a depth D) from the surface of the anodized film. That is, the large-diameter pores 24 are pores extending from the surface of the anodized film to a position at a depth of 10 nm to 1000 nm in the depth direction (thickness direction). The depth thereof is preferably in a range of 10 nm to 200 nm.

[0072] Further, the depth thereof is a value obtained by capturing (at a magnification of 150000) an image of a cross section of the anodized film 20b, measuring the depth of 25 or more large-diameter pores 24, and averaging the obtained values.

[0073] The shape of the large-diameter pores 24 is not particularly limited, and examples thereof include a substantially straight tubular shape (substantially cylindrical shape) and a conical shape whose diameter decreases toward the depth direction (thickness direction). Among these, a substantially straight tubular shape is preferable.

[0074] The small-diameter pores 26, as illustrated in Fig. 2, are pores communicating with the bottom portions of the large-diameter pores 24 and extending from the communication positions in the depth direction (thickness direction).

[0075] The average diameter of the small-diameter pores 26 in the communication position is preferably 13 nm or less. Further, the average diameter thereof is preferably 11 nm or less and more preferably 10 nm or less. The lower limit thereof is not particularly limited, but is 5 nm or greater in many cases.

[0076] The average diameter of small-diameter pores 26 is obtained as an arithmetic average value by observing 4 sheets (N = 4) of the surfaces of the anodized film 20a using a FE-SEM at a magnification of 150000, measuring the diameters of micropores (small-diameter pores) present in a range of 400 $\times$ 600 nm in the obtained four sheets of images, and averaging the values. In a case where the depth of the large-diameter pores is large, the average diameter of small-diameter pores may be acquired by cutting (for example, cutting the upper portion using argon gas) the upper portion (a region where large-diameter pores are present) of the anodized film 20b as necessary and observing the surface of the anodized film 20b using the above-described FE-SEM.

[0077] Further, in a case where the shape of the small-diameter pores 26 is not circular, an equivalent circle diameter is used. The "equivalent circle diameter" is a diameter of a circle obtained by assuming the shape of an opening portion of a micropore as a circle having the same projected area as the projected area of the opening portion.

[0078] The bottom portions of the small-diameter pores 26 are at a position extending from the communication positions with the large-diameter pores 24 to a depth of 20 to 2000 nm in the depth direction. That is, the small-diameter pores 26 are pores extending from the communication positions with the large-diameter pores 24 in the depth direction (thickness direction), and the depth of the small-diameter pores 26 is in a range of 20 nm to 2000 nm. Further, the depth thereof is preferably in a range of 500 to 1500 nm.

[0079] In addition, the depth thereof is a value obtained by capturing (50000 times) an image of a cross section of the anodized film 20b, measuring the depth of 25 or more small-diameter pores, and averaging the obtained values.

[0080] The shape of the small-diameter pores 26 is not particularly limited, and examples thereof include a substantially straight tubular shape (substantially cylindrical shape) and a conical shape whose diameter decreases toward the depth direction. Among these, a substantially straight tubular shape is preferable.

<Image recording layer>

[0081] The image recording layer in the planographic printing plate precursor according to the embodiment of the present disclosure contains an infrared absorbing agent that is decomposed by exposure to infrared rays, a polymer having a structural unit formed of an aromatic vinyl compound, a polymerization initiator, and a polymerizable compound.

[0082] In the planographic printing plate precursor according to the embodiment of the present disclosure, from the viewpoint of the on-press developability, it is preferable that the unexposed portion of the image recording layer can be removed by at least one selected from the group consisting of dampening water and printing ink.

[0083] Hereinafter, details of each component contained in the image recording layer will be described.

[Infrared absorbing agent decomposed by exposure to infrared rays]

[0084] The image recording layer in the planographic printing plate precursor according to the present disclosure contains an infrared absorbing agent that is decomposed by exposure to infrared rays (hereinafter, also referred to as

a "decomposable infrared absorbing agent").

[0085] It is preferable that the decomposable infrared absorbing agent contained in the image recording layer is an infrared absorbing agent having a function of absorbing infrared rays, being decomposed, and performing color development by exposure to infrared rays. Here, the "color development" indicates that absorption does not almost occur in the visible light region (a wavelength range of 400 nm or greater and less than 750 nm) before exposure to infrared rays, but absorption occurs in the visible light region due to exposure to infrared rays, and the color development also includes a case where absorption in a wavelength range lower than the visible light region increases the wavelength in the visible light region.

[0086] Hereinafter, a color developing compound formed such that a decomposable infrared absorbing agent absorbs infrared rays and decomposed by exposure to infrared rays is also referred to as a "color developing body of a decomposable infrared absorbing agent".

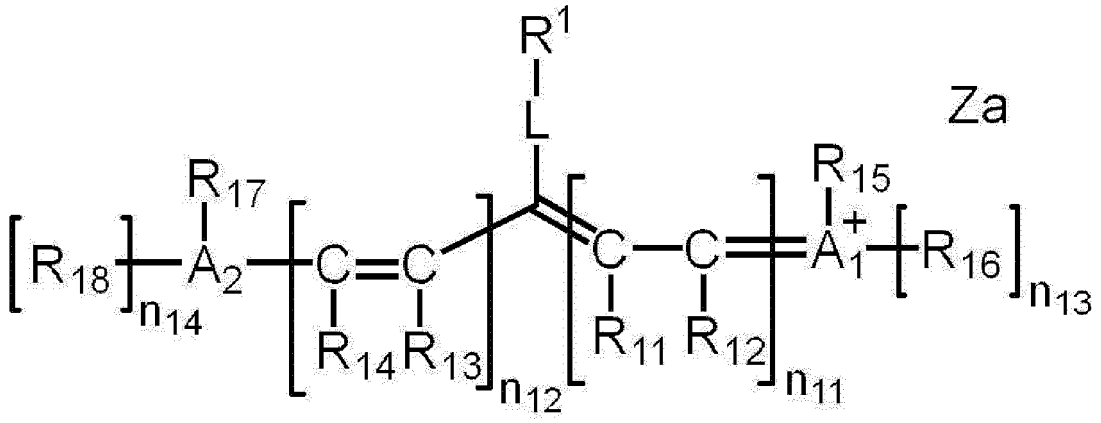
[0087] Further, it is preferable that the decomposable infrared absorbing agent has a function of absorbing infrared rays by exposure to infrared rays and converting the absorbed infrared rays to heat.

[0088] The decomposable infrared absorbing agent is not limited as long as the agent absorbs at least a part of light in the infrared wavelength range (wavelength of 750 nm to 1 mm) and is decomposed, and an infrared absorbing agent having a maximum absorption in a wavelength range of 750 nm to 1400 nm is preferable.

[0089] It is preferable that the decomposable infrared absorbing agent is an infrared absorbing agent that is decomposed due to heat, electron transfer, or both thereof caused by exposure to infrared rays and more preferable that the decomposable infrared absorbing agent is an infrared absorbing agent that is decomposed due to electron transfer caused by exposure to infrared rays. Here, the expression of "decomposed due to electron transfer" indicates that electrons excited to LUMO (lowest unoccupied molecular orbital) from HOMO (highest occupied molecular orbital) of the decomposable infrared absorbing agent by exposure to infrared rays show intramolecular electron transfer to an electron-accepting group (a group having a potential close to that of LUMO) in a molecule and decomposition occurs accordingly.

[0090] From the viewpoints of the color developability and the UV printing durability of the planographic printing plate to be obtained, a cyanine coloring agent that is decomposed by exposure to infrared rays is preferable as the decomposable infrared absorbing agent.

[0091] From the viewpoints of the color developability and the UV printing durability of the planographic printing plate to be obtained, a cyanine coloring agent represented by Formula 1 is more preferable as the cyanine coloring agent that is decomposed by exposure to infrared rays.



Formula 1

[0092] In Formula 1, R^1 represents a group having an R^1-L bond that is cleaved by exposure to infrared rays, R_{11} to R_{18} each independently represent a hydrogen atom, a halogen atom, -Ra, - ORb, -SRc, or -NRdRe, Ra to Re each independently represent a hydrocarbon group, A_1, A_2, and a plurality of R_{11}'s to R_{18}'s are linked to each other to form a monocycle or a polycycle, A_1 and A_2 each independently represent an oxygen atom, a sulfur atom, or a nitrogen atom, n_{11} and n_{12} each independently represent an integer of 0 to 5, where a total of n_{11} and n_{12} is 2 or greater, n_{13} and n_{14} each independently represent 0 or 1, L represents an oxygen atom, a sulfur atom, or -NR^{10}-, R^{10} represents a hydrogen atom, an alkyl group, or an aryl group, and Za represents a counter ion that neutralizes an electric charge.

[0093] In a case where the cyanine coloring agent represented by Formula 1 is exposed to infrared rays, the R^1-L bond is cleaved so that L is changed to =O, =S, or =NR^{10}, and thus a color developing body of the decomposable infrared absorbing agent is formed. R^1 is released to form a radical body or an ionic body. These contribute to the polymerization

of the polymerizable compound contained in the image recording layer.

[0094] In Formula 1, it is preferable that R_{11} to R_{18} each independently represent a hydrogen atom, -Ra, -ORb, -SRc, or -NRdRe.

[0095] As the hydrocarbon groups represented by Ra to Re, a hydrocarbon group having 1 to 30 carbon atoms (the number of carbon atoms) is preferable, a hydrocarbon group having 1 to 15 carbon atoms is more preferable, and a hydrocarbon group having 1 to 10 carbon atoms is still more preferable. The hydrocarbon group may be linear, branched, or cyclic.

[0096] R_{11} to R_{14} in Formula 1 each independently represent preferably a hydrogen atom or a hydrocarbon group, more preferably a hydrogen atom or an alkyl group, and still more preferably a hydrogen atom.

[0097] Further, it is preferable that R_{11} and R_{13} bonded to the carbon atoms which bond to the carbon atom to which L is bonded represent an alkyl group and more preferable that R_{11} and R_{13} are linked to each other to form a ring. The ring to be formed is preferably a 5-membered ring or a 6-membered ring and more preferably a 5-membered ring.

[0098] It is preferable that R_{12} bonded to the carbon atom to which A_1^+ is bonded and R_{14} bonded to the carbon atom to which A_2 is bonded are respectively linked to R_{15} and R_{17} to form a ring.

[0099] It is preferable that R_{15} in Formula 1 represents a hydrocarbon group. Further, it is preferable that R_{15} and R_{12} bonded to the carbon atom to which A_1^+ is bonded are linked to each other to form a ring. As the ring to be formed, an indolium ring, a pyrylium ring, a thiopyrylium ring, a benzoxazoline ring, or a benzoimidazoline ring is preferable. Among these, from the viewpoint of the color developability, an indolium ring is more preferable.

[0100] It is preferable that R_{17} in Formula 1 represents a hydrocarbon group. Further, it is preferable that R_{17} and R_{14} bonded to the carbon atom to which A_2 is bonded are linked to each other to form a ring. As the ring to be formed, an indole ring, a pyran ring, a thiopyran ring, a benzoxazole ring, or a benzimidazole ring is preferable. Among these, from the viewpoint of the color developability, an indole ring is more preferable.

[0101] It is preferable that R_{15} and R_{17} in Formula 1 represent the same group, and in a case where R_{15} and R_{17} each form a ring, it is preferable to form the same ring.

[0102] It is preferable that R_{16} and R_{18} in Formula 1 represent the same group.

[0103] Further, from the viewpoint of improving the water solubility of the compound represented by Formula 1, R_{16} and R_{18} each independently represent preferably an alkyl group containing a (poly)oxyalkylene group or an alkyl group having an anion structure, more preferably an alkyl group containing an alkoxyalkyl group, a carboxylate group, or a sulfonate group, and still more preferably an alkyl group containing a sulfonate group at the terminal. As the alkyl group, an alkyl group having 1 to 10 carbon atoms is preferable, and an alkyl group having 1 to 4 carbon atoms is more preferable.

[0104] The counter cation of the anion structure may be a cation that can be contained in R^1-L in Formula 1 or A_1^+ or may also be an alkali metal cation or an alkaline earth metal cation.

[0105] The counter cation of the sulfonate group may be a cation that can be contained in R^1-L in Formula 1 or A_1^+ or may also be an alkali metal cation or an alkaline earth metal cation.

[0106] Further, from the viewpoints of increasing the maximum absorption wavelength of the compound represented by Formula 1 and the color developability and the printing durability of the planographic printing plate, it is preferable that R_{16} and R_{18} each independently represent an alkyl group or an alkyl group having an aromatic ring. As the alkyl group, an alkyl group having 1 to 10 carbon atoms is preferable, an alkyl group having 1 to 4 carbon atoms is more preferable, and a methyl group or an ethyl group is still more preferable. As the alkyl group having an aromatic ring, an alkyl group having an aromatic ring at the terminal is preferable, and a 2-phenylethyl group, a 2-naphthalenylethyl group, or a 2-(9-anthracenyl)ethyl group is more preferable.

[0107] Both n_{11} and n_{12} in Formula 1 represent preferably an integer of 0 to 5, more preferably an integer of 1 to 3, still more preferably 1 or 2, and particularly preferably 2 at the same time.

[0108] A_1 and A_2 in Formula 1 each independently represent an oxygen atom, a sulfur atom, or a nitrogen atom and preferably a nitrogen atom.

[0109] It is preferable that both A_1 and A_2 in Formula 1 represent the same atom at the same time.

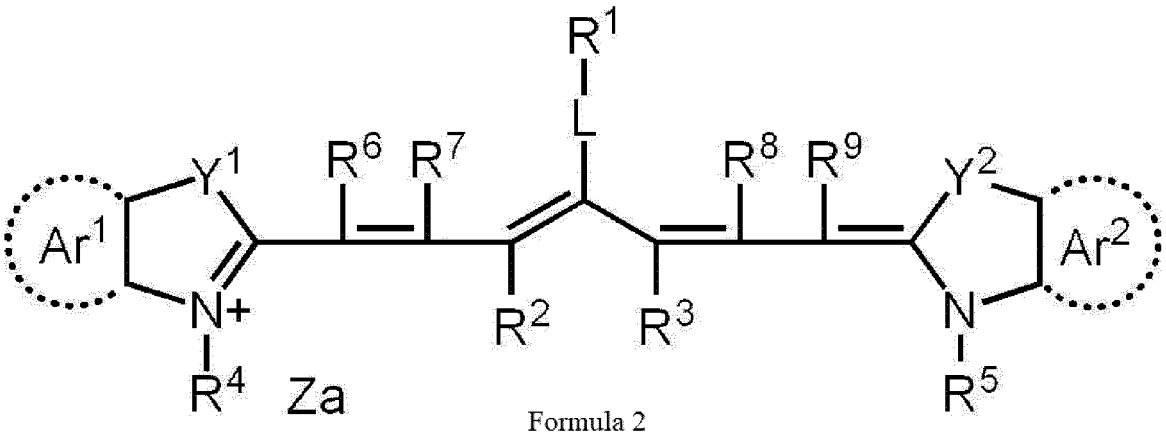
[0110] Za in Formula 1 represents a counter ion that neutralizes the electric charge. In a case where Za represents an anionic species, examples thereof include a sulfonate ion, a carboxylate ion, a tetrafluoroborate ion, a hexafluorophosphate ion, a hexafluoroantimonate ion, a p-toluenesulfonate ion, and a perchlorate ion. Among these, a hexafluorophosphate ion or a hexafluoroantimonate ion is preferable. In a case where Za represents a cationic species, examples thereof include an alkali metal ion, an alkaline earth metal ion, an ammonium ion, a pyridinium ion, and a sulfonium ion. Among these, a sodium ion, a potassium ion, an ammonium ion, a pyridinium ion, or a sulfonium ion is preferable, and a sodium ion, a potassium ion, or an ammonium ion is more preferable.

[0111] R_{11} to R_{18} and R^1-L may have an anion structure or a cation structure, and in a case where all R_{11} to R_{18} and R^1-L represent a charge-neutral group, Za represents a monovalent counter anion. However, for example, in a case where R_{11} to R_{18} and R^1-L have two or more anion structures, Za may represent a counter cation.

[0112] Further, in a case where the cyanine coloring agent represented by Formula 1 is a charge-neutral structure in the entire compound, Za is not present.

[0113] In Formula 1, the group in which the R^1-L bond is cleaved by exposure to infrared rays represented by R^1 will be described in detail below.

[0114] From the viewpoints of the color developability and the UV printing durability of the planographic printing plate to be obtained, a cyanine coloring agent represented by Formula 2 is more preferable as the cyanine coloring agent decomposed by exposure to infrared rays.



Formula 2

[0115] In Formula 2, R^1 represents a group having an R^1-L bond that is cleaved by exposure to infrared rays, R^2 and R^3 each independently represent a hydrogen atom or an alkyl group, R^2 and R^3 may be linked to each other to form a ring, Ar^1 and Ar^2 each independently represent a group forming a benzene ring or a naphthalene ring, Y^1 and Y^2 each independently represent an oxygen atom, a sulfur atom, $-NR^0-$, or a dialkylmethylene group, R^0 represents a hydrogen atom, an alkyl group, or an aryl group, R^4 and R^5 each independently represent an alkyl group, a $-CO_2M$ group, or a $-PO_3M_2$ group, M represents a hydrogen atom, a Na atom, a K atom, or an onium group, R^6 to R^9 each independently represent a hydrogen atom or an alkyl group, L represents an oxygen atom, a sulfur atom, or $-NR^{10}-$, R^{10} represents a hydrogen atom, an alkyl group, or an aryl group, and Za represents a counter ion that neutralizes an electric charge.

[0116] In Formula 2, as the alkyl group as R^2 to R^9 and R^0, an alkyl group having 1 to 30 carbon atoms is preferable, an alkyl group having 1 to 15 carbon atoms is more preferable, and an alkyl group having 1 to 10 carbon atoms is still more preferable. The alkyl group may be linear, branched, or cyclic.

[0117] Specific examples of the alkyl group include a methyl group, an ethyl group, a propyl group, a butyl group, a pentyl group, a hexyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group, a tridecyl group, a hexadecyl group, an octadecyl group, an eicosyl group, an isopropyl group, an isobutyl group, an s-butyl group, a tert-butyl group, an isopentyl group, a neopentyl group, a 1-methylbutyl group, an isohexyl group, a 2-ethylhexyl group, a 2-methylhexyl group, a cyclohexyl group, a cyclopentyl group, and a 2-norbornyl group.

[0118] Among the above-described alkyl groups, a methyl group, an ethyl group, a propyl group, or a butyl group is preferable.

[0119] The alkyl group may have a substituent. Examples of the substituent include an alkoxy group, an aryloxy group, an amino group, an alkylthio group, an arylthio group, a halogen atom, a carboxy group, a carboxylate group, a sulfo group, a sulfonate group, an alkyloxycarbonyl group, an aryloxycarbonyl group, and a group obtained by combining these groups.

[0120] As the aryl group represented by R^0, an aryl group having 6 to 30 carbon atoms is preferable, an aryl group having 6 to 20 carbon atoms is more preferable, and an aryl group having 6 to 12 carbon atoms is still more preferable.

[0121] Further, the aryl group may have a substituent. Examples of the substituent include an alkyl group, an alkoxy group, an aryloxy group, an amino group, an alkylthio group, an arylthio group, a halogen atom, a carboxy group, a carboxylate group, a sulfo group, a sulfonate group, an alkyloxycarbonyl group, an aryloxycarbonyl group, and a group obtained by combining these groups.

[0122] Specific examples thereof include a phenyl group, a naphthyl group, a p-tolyl group, a p-chlorophenyl group, a p-fluorophenyl group, a p-methoxyphenyl group, a p-dimethylaminophenyl group, a p-methylthiophenyl group, and p-phenylthiophenyl group.

[0123] Among the above-described aryl groups, a phenyl group, a p-methoxyphenyl group, a p-dimethylaminophenyl group, or a naphthyl group is preferable.

[0124] It is preferable that R^2 and R^3 are linked to each other to form a ring.

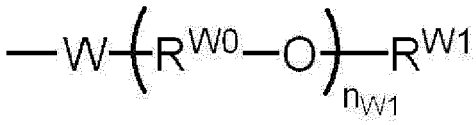
[0125] In a case where R^2 and R^3 are linked to each other to form a ring, a 5-membered ring or a 6-membered ring is preferable, and a 5-membered ring is particularly preferable.

[0126] Y^1 and Y^2 each independently represent an oxygen atom, a sulfur atom, $-NR^0-$, or a dialkylmethylene group,

preferably -NR^0- or a dialkylmethylene group, and more preferably a dialkylmethylene group.

[0127] R^0 represents a hydrogen atom, an alkyl group, or an aryl group and preferably an alkyl group.

[0128] The alkyl group represented by R^4 or R^5 may be substituted alkyl. Examples of the substituted alkyl group represented by R^4 or R^5 include a group represented by any of Formulae (a1) to (a4).



(a1)

$$-R^{W2}-CO_2M \qquad (a2)$$

$$—R^{W3}-PO_3M_2 \qquad (a3)$$

$$—R^{W4}-SO_3M \qquad (a4)$$

[0129] In Formulae (a1) to (a4), R^{W0} represents an alkylene group having 2 to 6 carbon atoms, W represents a single bond or an oxygen atom, n_{w1} represents an integer of 1 to 45, R^{W1} represents an alkyl group having 1 to 12 carbon atoms or -C(=O)-R^{W5}, R^{W5} represents an alkyl group having 1 to 12 carbon atoms, R^{W2} to R^{W4} each independently represent a single bond or an alkylene group having 1 to 12 carbon atoms, and M represents a hydrogen atom, a Na atom, a K atom, or an onium group.

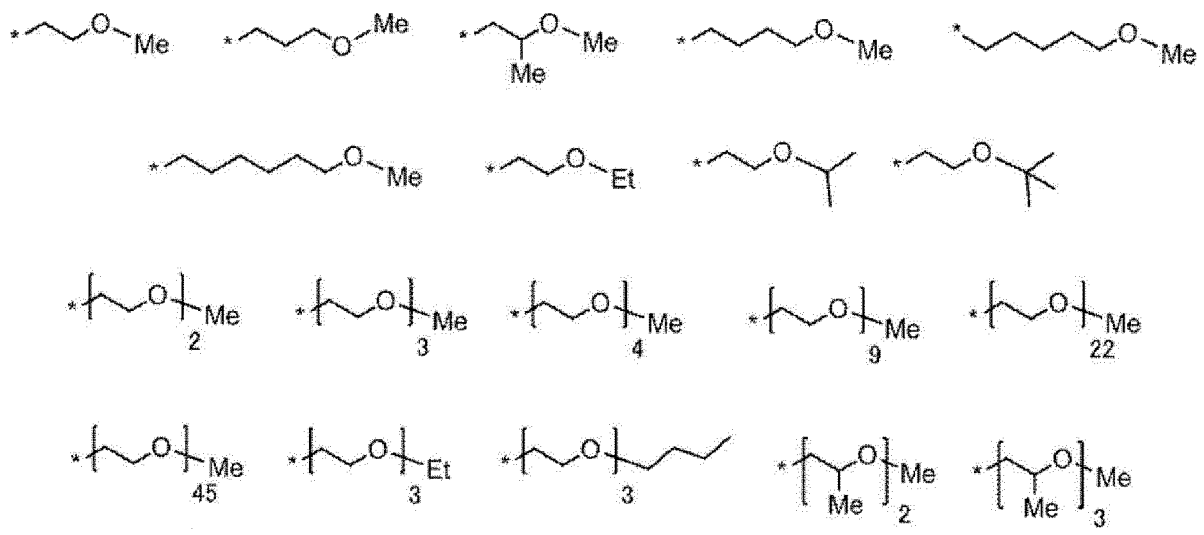
[0130] In Formula (a1), specific examples of the alkylene group represented by R^{W0} include an ethylene group, an n-propylene group, an isopropylene group, an n-butylene group, an isobutylene group, an n-pentylene group, an isopentylene group, an n-hexyl group, and an isohexyl group. Among these, an ethylene group, an n-propylene group, an isopropylene group, or an n-butylene group is preferable, and an n-propylene group is particularly preferable.

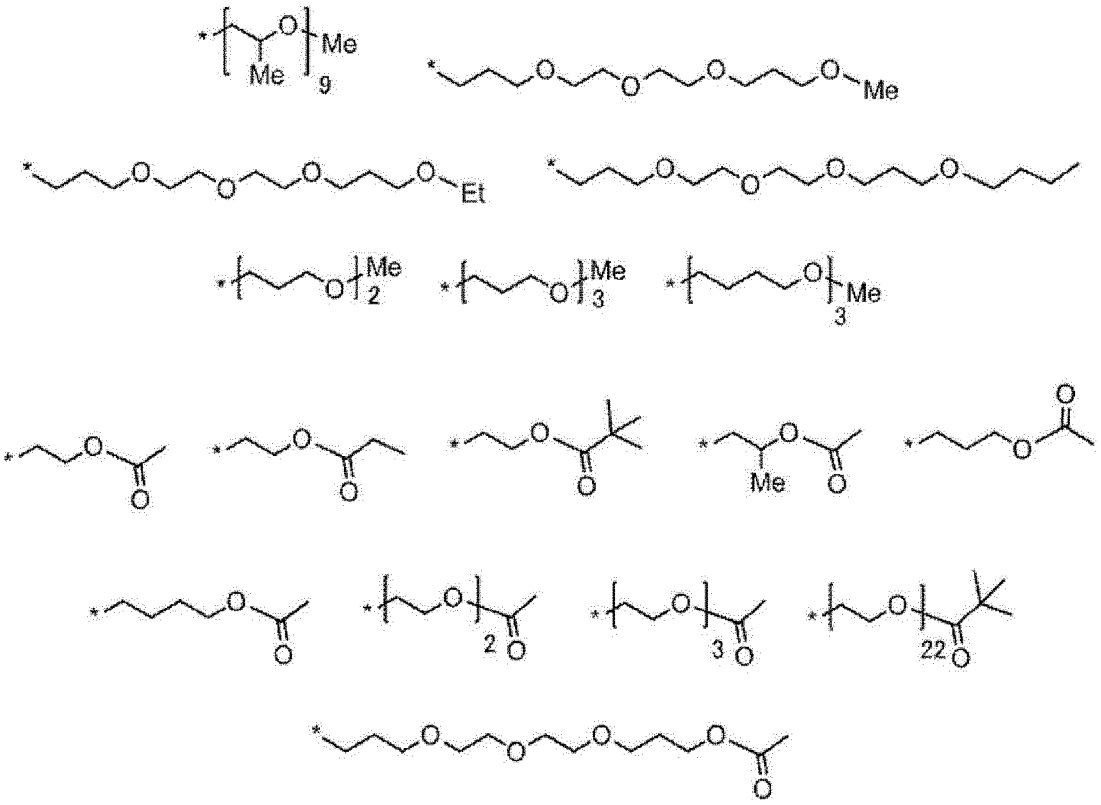
n_{w1} represents preferably 1 to 10, more preferably 1 to 5, and particularly preferably 1 to 3.

[0131] Specific examples of the alkyl group represented by R^{W1} include a methyl group, an ethyl group, an n-propyl group, an isopropyl group, an n-butyl group, an isobutyl group, a tert-butyl group, an n-pentyl group, an isopentyl group, a neopentyl group, an n-hexyl group, an n-octyl group, and an n-dodecyl group. Among these, a methyl group, an ethyl group, an n-propyl group, an isopropyl group, an n-butyl group, or a tert-butyl group is preferable, a methyl group or an ethyl group is more preferable, and a methyl group is particularly preferable.

[0132] The alkyl group represented by R^{W5} has the same definition as that for the alkyl group represented by R^{W1}, and the preferred embodiment thereof is the same as the preferred embodiment of the alkyl group represented by R^{W1}.

[0133] Specific examples of the group represented by Formula (a1) will be described below, but the present disclosure is not limited thereto. In the following structural formulae, Me represents a methyl group, Et represents an ethyl group, and "*" represents a bonding site.





[0134] In Formulae (a2) to (a4), specific examples of the alkylene group represented by R^{W2} to R^{W4} include a methylene group, an ethylene group, an n-propylene group, an isopropylene group, an n-butylene group, an isobutylene group, an n-pentylene group, an isopentylene group, an n-hexyl group, an isohexyl group, an n-octylene group, and an n-dodecylene group. Among these, an ethylene group, an n-propylene group, an isopropylene group, or an n-butylene group is preferable, and an ethylene group or an n-propylene group is particularly preferable.

[0135] In Formula (a3), two M's may be the same as or different from each other.

[0136] In the Formulae (a2) to (a4), examples of the onium group represented by M include an ammonium group, an iodonium group, a phosphonium group, and a sulfonium group.

[0137] Among the groups represented by the Formulae (a1) to (a4), the group represented by Formula (a1) or Formula (a4) is preferable.

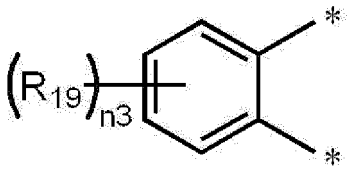
[0138] In Formula 2, it is preferable that R^4 and R^5 each represent an unsubstituted alkyl group. It is preferred that both R^4 and R^5 represent the same group.

[0139] R^6 to R^9 each independently represent a hydrogen atom or an alkyl group and preferably a hydrogen atom.

[0140] Ar^1 and Ar^2 each independently represent a group that forms a benzene ring or a naphthalene ring. The benzene ring and the naphthalene ring may have a substituent. Examples of the substituent include an alkyl group, an alkoxy group, an aryloxy group, an amino group, an alkylthio group, an arylthio group, a halogen atom, a carboxy group, a carboxylate group, a sulfo group, a sulfonate group, an alkyloxycarbonyl group, an aryloxycarbonyl group, an acyloxy group, a phosphonic acid group, and a group obtained by combining these groups. As the substituent, an alkyl group is preferable.

[0141] Further, from the viewpoints of increasing the maximum absorption wavelength of the compound represented by Formula 2 and the color developability and the printing durability of the planographic printing plate, Ar^1 and Ar^2 each independently represent preferably a naphthalene ring or a group that forms a benzene ring containing an alkyl group or an alkoxy group as a substituent, more preferably a naphthalene ring or a group that forms a benzene ring containing an alkoxy group as a substituent, and particularly preferably a naphthalene ring or a group that forms a benzene ring containing a methoxy group as a substituent.

[0142] In Formula 2, it is preferable that Ar^1 or Ar^2 represents a group that forms a group represented by Formula (b1).



(b1)

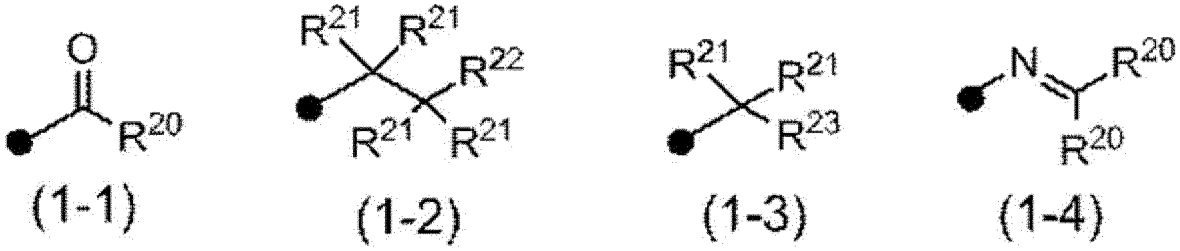
[0143] In Formula (b1), R^{19} represents an alkyl group having 1 to 12 carbon atoms. n3 represents an integer of 1 to 4. "*" represents a bonding site.

[0144] Za represents a counter ion for neutralizing the electric charge. Here, in a case where the compound represented by Formula 2 has a corresponding ionic substituent in the structure thereof and the neutralization of the electric charge is not required, Za is not necessary. In a case where Za represents an anionic species, examples thereof include a sulfonate ion, a carboxylate ion, a tetrafluoroborate ion, a hexafluorophosphate ion, a hexafluoroantimonate ion, a p-toluenesulfonate ion, and a perchlorate ion. Among these, a hexafluorophosphate ion or a hexafluoroantimonate ion is preferable. In a case where Za represents a cationic species, examples thereof include an alkali metal ion, an alkaline earth metal ion, an ammonium ion, a pyridinium ion, and a sulfonium ion. Among these, a sodium ion, a potassium ion, an ammonium ion, a pyridinium ion, or a sulfonium ion is preferable, and a sodium ion, a potassium ion, or an ammonium ion is more preferable.

[0145] R^1 to R^9, R^0, Ar^1, Ar^2, Y^1, and Y^2 may have an anion structure or a cation structure, and in a case where all R^1 to R^9, R^0, Ar^1, Ar^2, Y^1, and Y^2 represent a charge-neutral group, Za represents a monovalent counter anion. However, for example, in a case where R^1 to R^9, R^0, Ar^1, Ar^2, Y^1, and Y^2 have two or more anion structures, Za may represent a counter cation.

[0146] In Formulae 1 and 2, the group represented by R^1, in which the R^1-L bond is cleaved by exposure to infrared rays, will be described below.

[0147] In a case where L in Formula 1 or Formula 2 represents an oxygen atom, from the viewpoint of the color developability, R^1 represents preferably a group represented by any of Formulae (1-1) to (1-7) and more preferably a group represented by any of Formulae (1-1) to (1-3).



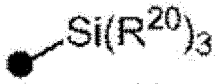
(1-1)

(1-2)

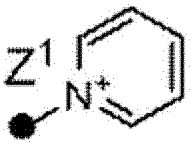
(1-3)

(1-4)

(1-5)



(1-6)



(1-7)

[0148] In Formulae (1-1) to (1-7), "•" represents a bonding site with respect to the oxygen atom represented by L in Formula 1 or Formula 2, R^{20}'s each independently represent a hydrogen atom, an alkyl group, an alkenyl group, an aryl group, $-OR^{24}$, $-NR^{25}R^{26}$, or $-SR^{27}$, R^{21}'s each independently represent a hydrogen atom, an alkyl group, or an aryl group, R^{22} represents an aryl group, $-OR^{24}$, $-NR^{25}R^{26}$, $-SR^{27}$, $-C(=O)R^{28}$, $-OC(=O)R^{28}$, or a halogen atom, R^{23} represents an aryl group, an alkenyl group, an alkoxy group, or an onium group, R^{24} to R^{27} each independently represent a hydrogen atom, an alkyl group, or an aryl group, R^{28} represents an alkyl group, an aryl group, $-OR^{24}$, $-NR^{25}R^{26}$, or $-SR^{27}$, and Z^1 represents a counter ion for neutralizing the electric charge.

[0149] The preferred embodiment in a case where R^{20}, R^{21}, and R^{24} to R^{28} represent an alkyl groups is the same as the preferred embodiment of the alkyl group as R^2 to R^9 and R^0.

[0150] The number of carbon atoms of the alkenyl group as R^{20} and R^{23} is preferably in a range of 1 to 30, more preferably in a range of 1 to 15, and still more preferably in a range of 1 to 10.

[0151] The preferred embodiment in a case where R^{20} to R^{28} represent an aryl group is the same as the preferred

embodiment of the aryl group as R^0.

[0152] From the viewpoint of the color developability, R^{20} in Formula (1-1) represents preferably an alkyl group, an alkenyl group, an aryl group, $-OR^{24}$, $-NR^{25}R^{26}$, or $-SR^{27}$, more preferably an alkyl group, $-OR^{24}$, $-NR^{25}R^{26}$, or $-SR^{27}$, still more preferably an alkyl group or $-OR^{24}$, and particularly preferably $-OR^{24}$.

[0153] Further, R^{20} in Formula (1-1) represents an alkyl group, the alkyl group may be an alkyl group having an arylthio group, an alkyloxycarbonyl group, or an arylsulfonyl group at the α-position and preferably having an arylthio group or an alkyloxycarbonyl group at the α-position.

[0154] In a case where R^{20} in Formula (1-1) represents $-OR^{24}$, R^{24} represents preferably an alkyl group, more preferably an alkyl group having 1 to 8 carbon atoms, still more preferably an isopropyl group or a tert-butyl group, and particularly preferably a t-butyl group.

[0155] In a case where R^{20} in Formula (1-1) represents an alkenyl group, the alkenyl group may be an alkenyl group containing an aryl group or a hydroxyaryl group.

[0156] From the viewpoint of the color developability, it is preferable that R^{21} in Formula (1-2) represents a hydrogen atom.

[0157] From the viewpoint of the color developability, R^{22} in Formula (1-2) represents preferably $-C(=O)OR^{24}$, $-OC(=O)OR^{24}$, or a halogen atom and more preferably $-C(=O)OR^{24}$, or $-OC(=O)OR^{24}$. In a case where R^{22} in Formula (1-2) represents $-C(=O)OR^{24}$, or $-OC(=O)OR^{24}$, it is preferable that R^{24} represents an alkyl group.

[0158] From the viewpoint of the color developability, it is preferable that R^{21}'s in Formula (1-3) each independently represent a hydrogen atom or an alkyl group and more preferable that at least one R^{21} in Formula (1-3) represents an alkyl group.

[0159] Further, as the alkyl group represented by R^{21}, an alkyl group having 1 to 10 carbon atoms is preferable, and an alkyl group having 3 to 10 carbon atoms is more preferable.

[0160] Further, as the alkyl group represented by R^{21}, a branched or cyclic alkyl group is preferable, and an isopropyl group, a cyclopentyl group, a cyclohexyl group, or a tert-butyl group is more preferable. Further, it is preferable that the alkyl group as R^{21} is a secondary or tertiary alkyl group.

[0161] Further, from the viewpoint of the color developability, R^{23} in Formula (1-3) represents preferably an aryl group, an alkoxy group, or an onium group, more preferably a p-dimethylaminophenyl group, or a pyridinium group, and still more preferably a pyridinium group.

[0162] Examples of the onium group as R^{23} include a pyridinium group, an ammonium group, and a sulfonium group. The onium group may have a substituent. Examples of the substituent include an alkyl group, an alkoxy group, an aryloxy group, an amino group, an alkylthio group, an arylthio group, a halogen atom, a carboxy group, a sulfo group, an alkyloxycarbonyl group, an aryloxycarbonyl group, and a group obtained by combining these groups. Among these, an alkyl group, an aryl group, or a group obtained by combining these groups is preferable.

[0163] Among these, a pyridinium group is preferable, a N-alkyl-3-pyridinium group, a N-benzyl-3-pyridinium group, a N-(alkoxypolyalkyleneoxyalkyl)-3-pyridinium group, a N-alkoxycarbonylmethyl-3-pyridinium group, a N-alkyl-4-pyridinium group, a N-benzyl-4-pyridinium group, a N-(alkoxypolyalkyleneoxyalkyl)-4-pyridinium group, a N-alkoxycarbonylmethyl-4-pyridinium group, or a N-alkyl-3,5-dimethyl-4-pyridinium group is more preferable, a N-alkyl-3-pyridinium group or a N-alkyl-4-pyridinium group is still more preferable, a N-methyl-3-pyridinium group, a N-octyl-3-pyridinium group, a N-methyl-4-pyridinium group, or a N-octyl-4-pyridinium group is particularly preferable, and a N-octyl-3-pyridinium group or a N-octyl-4-pyridinium group is most preferable.

[0164] Further, in a case where R^{23} represents a pyridinium group, examples of the counter anion include a sulfonate ion, a carboxylate ion, a tetrafluoroborate ion, a hexafluorophosphate ion, a hexafluoroantimonate ion, a p-toluenesulfonate ion, and a perchlorate ion. Among these, a p-toluenesulfonate ion, a hexafluorophosphate ion, or a hexafluoroantimonate ion is preferable.

[0165] From the viewpoint of the color developability, it is preferable that R^{20} in Formula (1-4) represents an alkyl group or an aryl group and more preferable that one of two R^{20}'s represents an alkyl group and the other represents an aryl group. Two R^{20}'s may be linked to each other to form a ring.

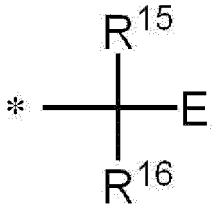
[0166] From the viewpoint of the color developability, R^{20} in Formula (1-5) represents preferably an alkyl group or an aryl group, more preferably an aryl group, and still more preferably a p-methylphenyl group.

[0167] From the viewpoint of the color developability, R^{20}'s in Formula (1-6) each independently represent an alkyl group or an aryl group and more preferably a methyl group or a phenyl group.

[0168] From the viewpoint of the color developability, Z^1 in Formula (1-7) may represent a counter ion for neutralizing the electric charge, and the entire compound may be included in Za.

[0169] Z^1 represents preferably a sulfonate ion, a carboxylate ion, a tetrafluoroborate ion, a hexafluorophosphate ion, a hexafluoroantimonate ion, a p-toluenesulfonate ion, or a perchlorate ion and more preferably a p-toluenesulfonate ion, a hexafluorophosphate ion, or a hexafluoroantimonate ion.

[0170] In a case where L in Formula 1 or 2 represents an oxygen atom, from the viewpoint of the color developability, it is more preferable that R^1 represents a group represented by Formula (5).



(5)

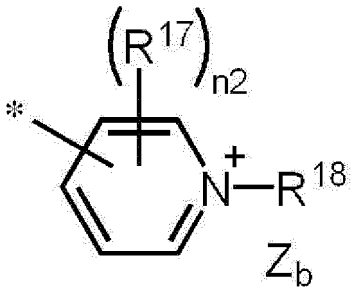
[0171] In Formula (5), R^{15} and R^{16} each independently represent a hydrogen atom, an alkyl group, or an aryl group, E represents an onium group, and "*" represents a bonding site with respect to the oxygen atom represented by L in Formula 1 or 2.

[0172] The alkyl group represented by R^{15} or R^{16} has the same definition as that for the alkyl group represented by R^2 to R^9 and R^0, and the preferred embodiment thereof is also the same as the preferred embodiment of the alkyl group represented by R^2 to R^9 and R^0.

[0173] The aryl group represented by R^{15} or R^{16} has the same definition as that for the aryl group represented by R^0, and the preferred embodiment thereof is also the same as the preferred embodiment of the aryl group represented by R^0.

[0174] The onium group represented by E has the same definition as that for the onium group represented by R^{23}, and the preferred embodiment thereof is also the same as the preferred embodiment of the onium group represented by R^{23}.

[0175] In Formula (5), as the onium group represented by E, a pyridinium group represented by Formula (6) is preferable.



(6)

[0176] In Formula (6), R^{17} represents a halogen atom, an alkyl group, an aryl group, a hydroxy group, or an alkoxy group, and in a case where a plurality of R^{17}'s are present, the plurality of R^{17}'s may be the same as or different from each other, or the plurality of R^{17}'s may be linked to each other to form a ring. n2 represents an integer of 0 to 4. R_{18} represents an alkyl group or an aryl group. Z_b represents a counter ion for neutralizing the electric charge.

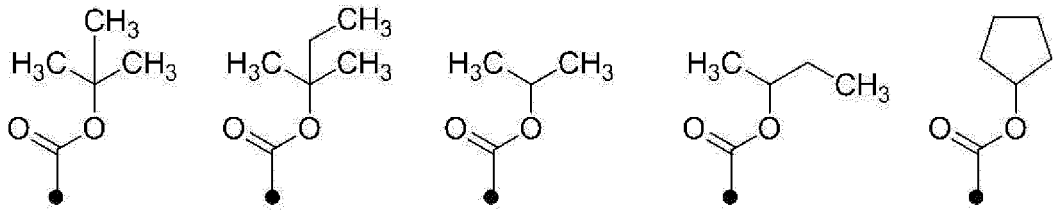
[0177] The alkyl group or the aryl group represented by R^{17} or R^{18} has the same definition as that for the alkyl group as R^2 to R^9 and R^0 or the aryl group as R^0, and the preferred embodiment thereof is the same as the preferred embodiment of the alkyl group as R^2 to R^9 and R^0 or the aryl group as R^0.

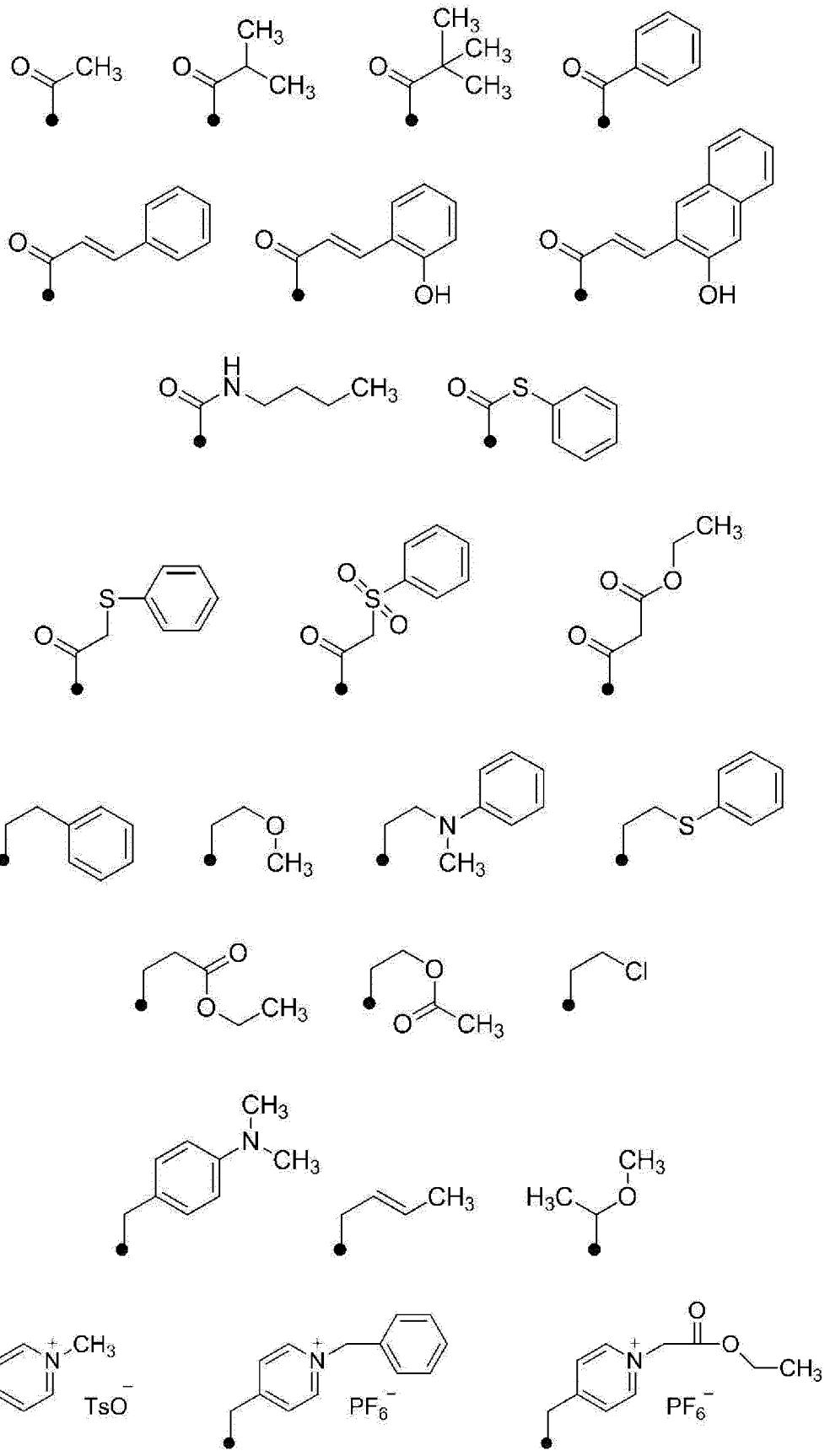
[0178] As the alkoxy group represented by R^{17}, an alkoxy group having 1 to 10 carbon atoms is preferable, and examples thereof include a methoxy group, an ethoxy group, an n-propoxy group, an isopropoxy group, an n-butoxy group, an isobutoxy group, and a tert-butoxy group.

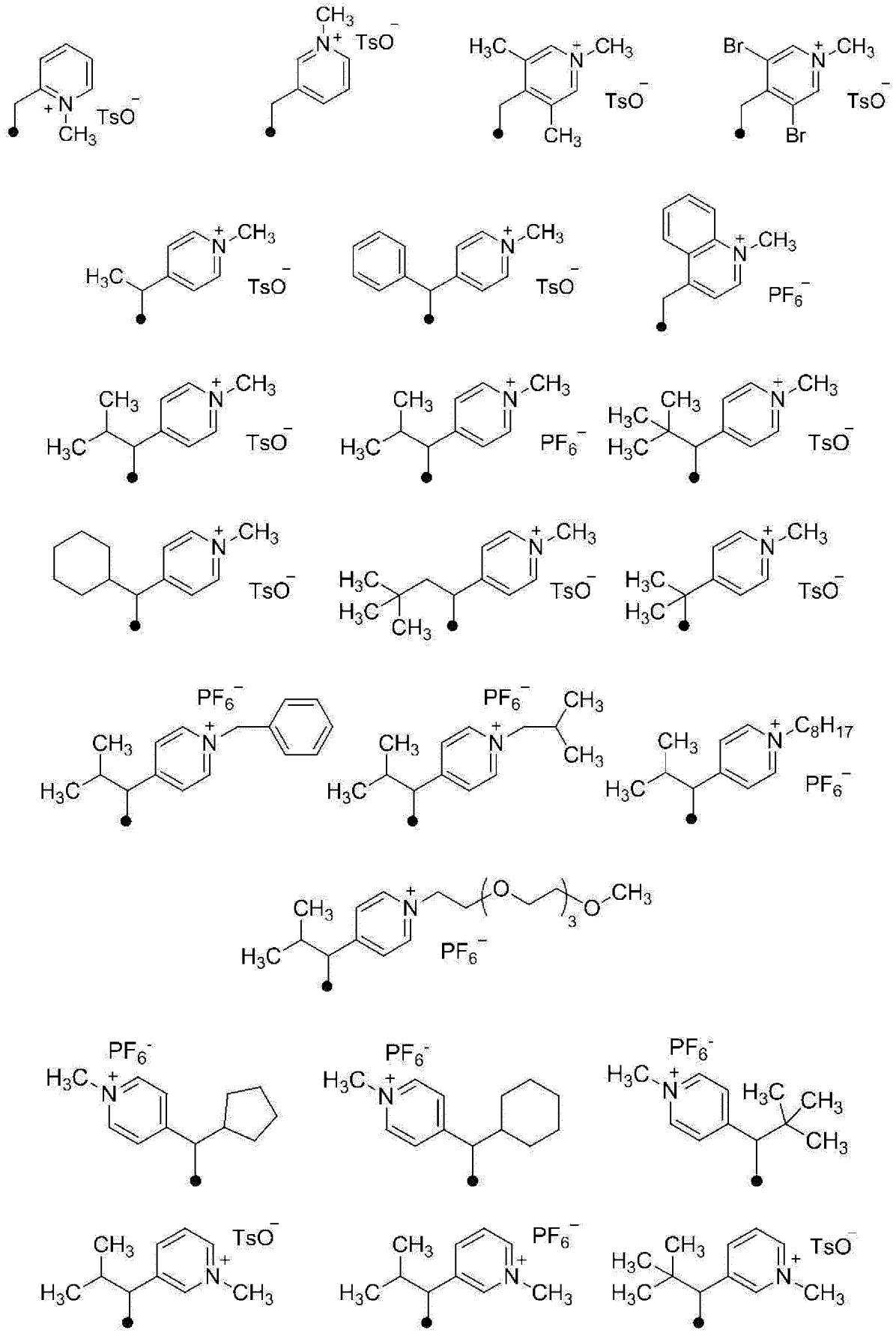
[0179] It is preferable that n2 represents 0.

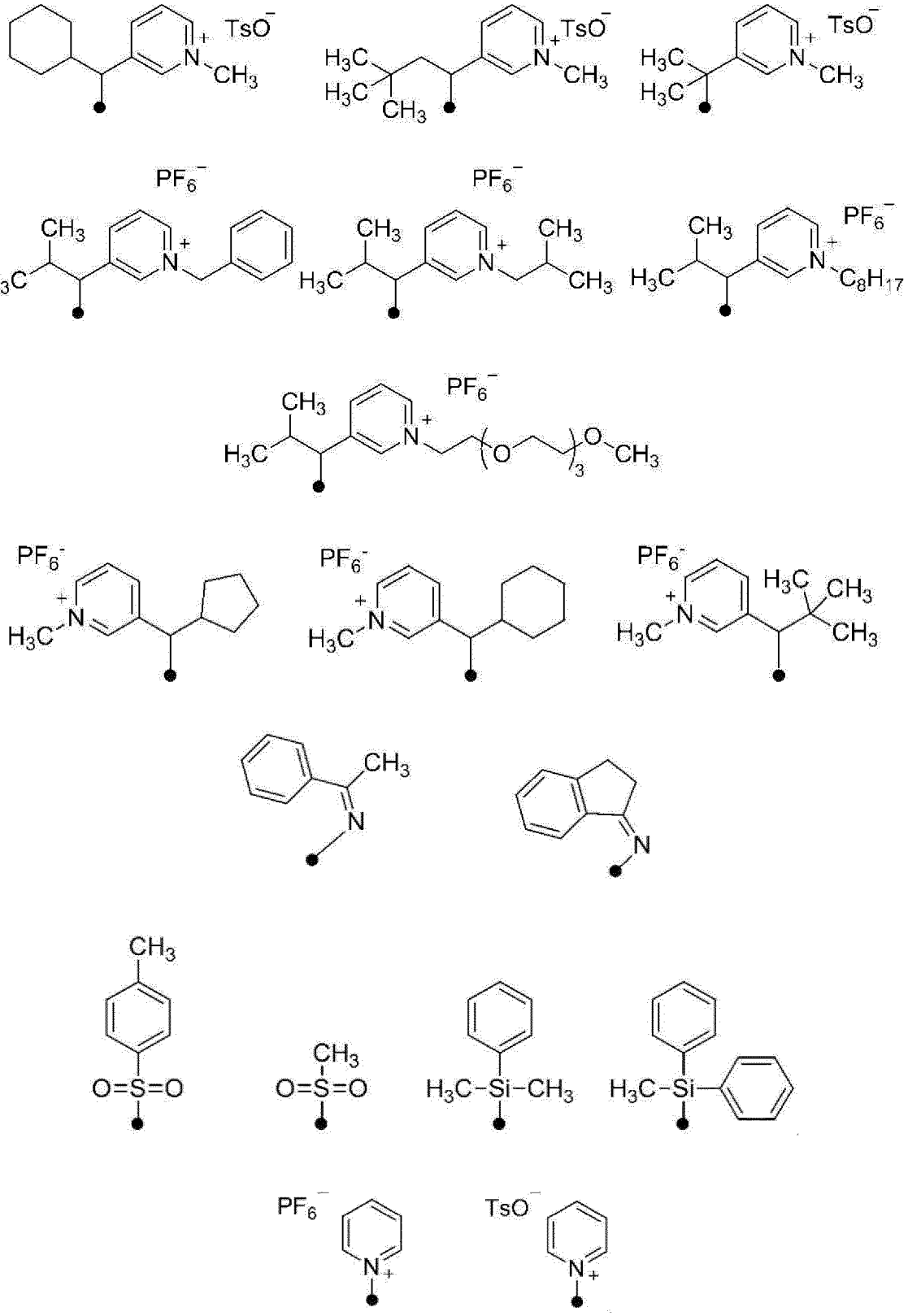
[0180] The counter ion for neutralizing the electric charge represented by Z_b has the same definition as that for Z^1 in Formula (1-7), and the preferred embodiment thereof is the same as the preferred embodiment of Z^1 in Formula (1-7).

[0181] Hereinafter, in a case where L in Formula 1 or 2 represents an oxygen atom, specific examples of the group represented by R^1 are described below, but the present disclosure is not limited thereto. In the following structural formulae, TsO^- represents a tosylate anion, and "•" represents a bonding site with respect to an oxygen atom represented by L in Formula 1 or Formula 2.



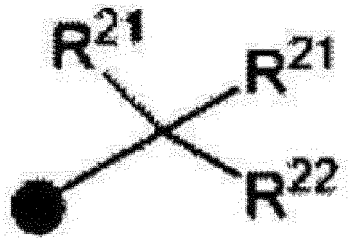






[0182] In a case where L represents an oxygen atom and R^1 represents an aryl group or a linear alkyl group, cleavage of the R^1-O bond due to exposure to infrared rays does not occur.

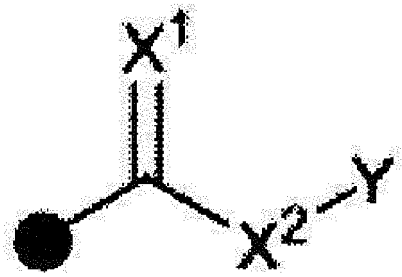
[0183] In a case where L in Formula 1 or 2 represents a sulfur atom, it is preferable that R^1 represents a group represented by Formula (2-1).



Formula (2-1)

[0184] In Formula (2-1), "•" represents a bonding site with respect to the sulfur atom represented by L in Formula 1 or 2, R^{21}'s each independently represent a hydrogen atom, an alkyl group, or an aryl group, and R^{22} represents an aryl group, an alkenyl group, an alkoxy group, or an onium group.

[0185] In a case where L in Formula 1 or 2 represents $-NR^{10}-$, it is preferable that R^1 bonded to N represents a group represented by Formula (3-1).



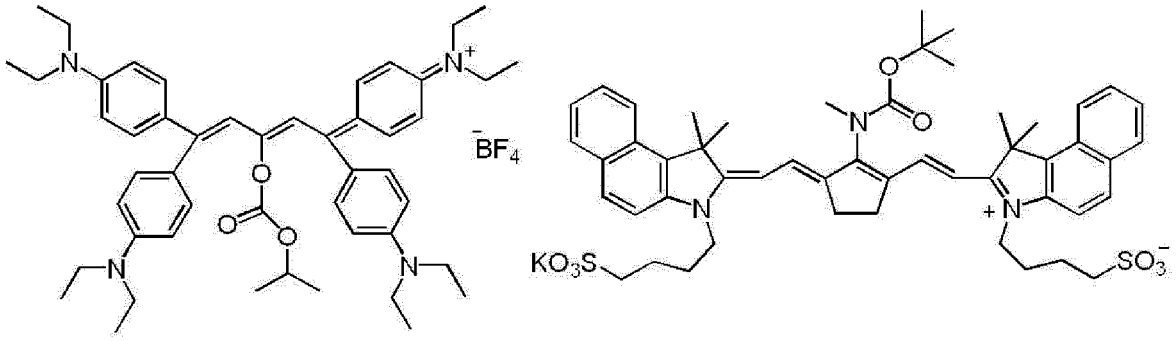
Formula (3-1)

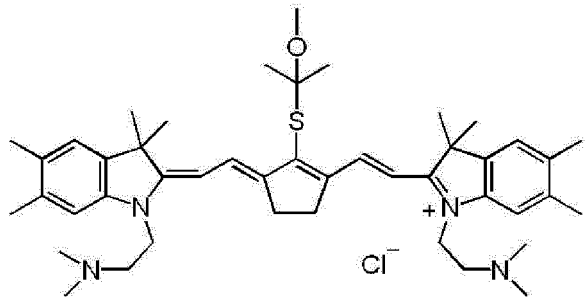
[0186] In Formula (3-1), "•" represents a bonding site with respect to a nitrogen atom contained in L in Formula 1 or 2, X^1 and X^2 each independently represent an oxygen atom or a sulfur atom, and Y represents a group represented by Formula (2-1).

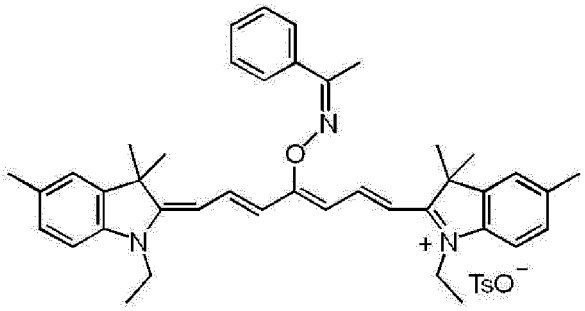
[0187] In Formula (2-1), the alkyl group, the aryl group, the alkenyl group, the alkoxy group, and the onium group represented by R^{21} and R^{22} can refer to the description of the alkyl group, the aryl group, the alkenyl group, the alkoxy group, and the onium group described in Formulae (1-1) to (1-7).

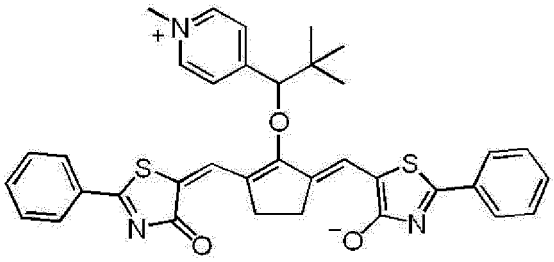
[0188] In Formula 1 or 2, from the viewpoint of improving the printing durability, it is preferable that L represents a sulfur atom or $-NR^{10}-$ and R^{10} represents a hydrogen atom, an alkyl group, or an aryl group.

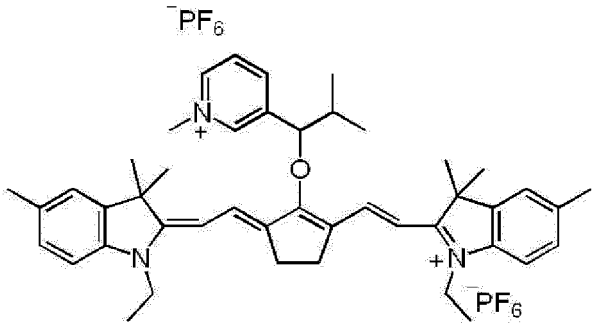
[0189] Specific examples of the compound represented by Formula 1 or 2 will be described below, but the present disclosure is not limited thereto. In the following structural formulae, Ph represents a methyl group.

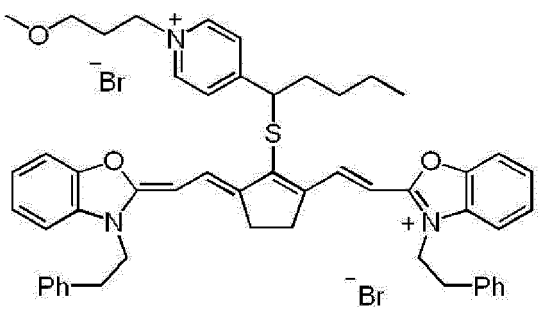


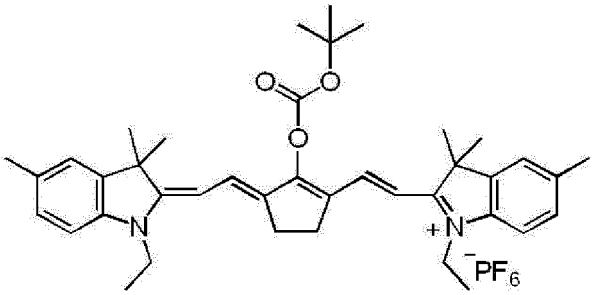


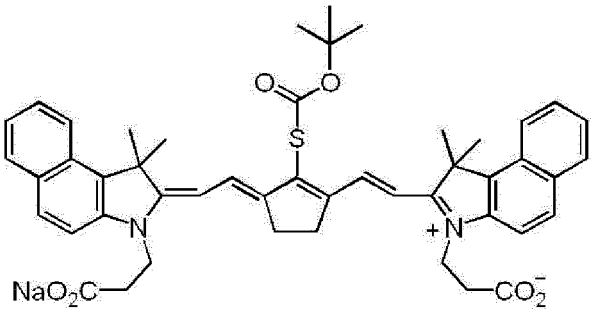


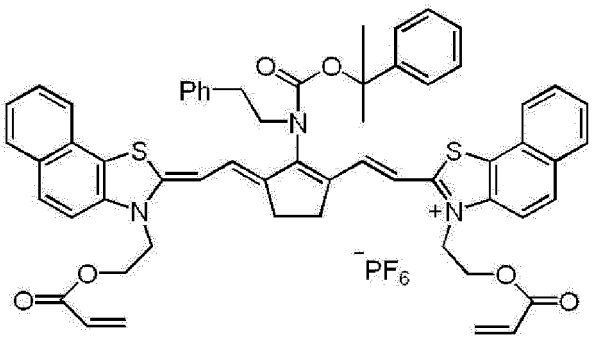


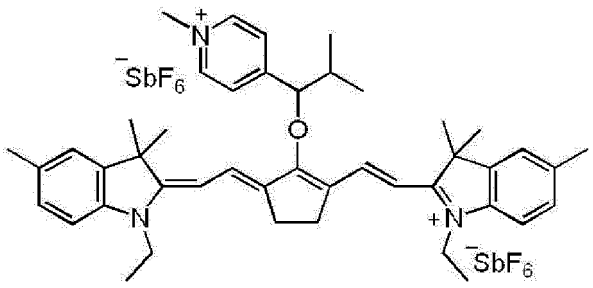












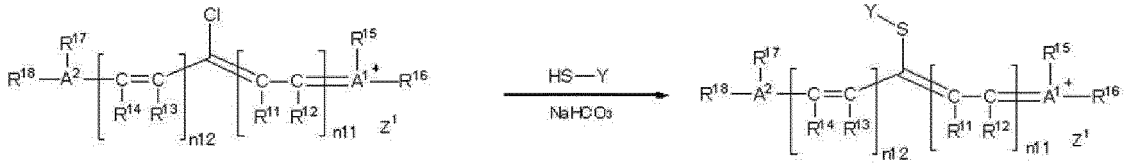
[0190] Further, as the infrared absorbing agent that is decomposed by exposure to infrared rays, those described in JP2008-544322A or WO2016/027886A can be suitably used.

[0191] The compound represented by Formula 1 or 2 can be synthesized by applying a known method.

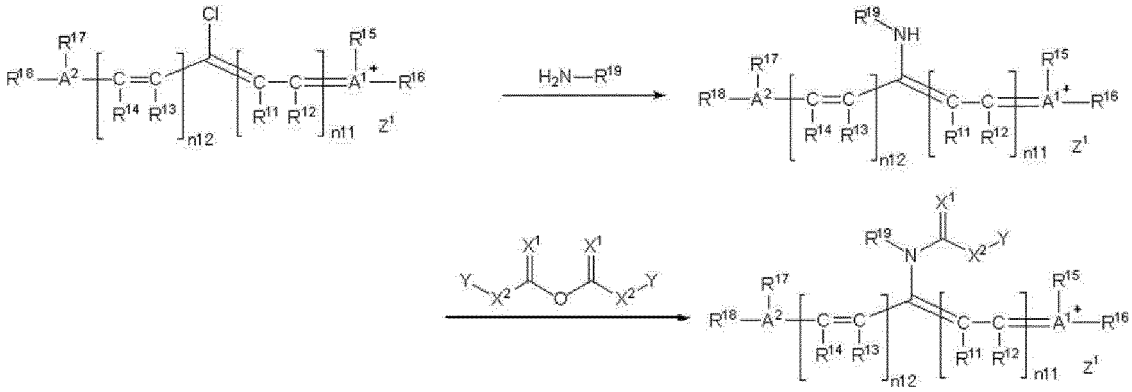
[0192] The compound represented by Formula 1 can be synthesized according to the following scheme 1 or scheme 2. For example, in a case of a compound in which L in Formula 1 represents a sulfur atom and R^1 represents a group represented by Formula (2-1), a method in conformity with the following scheme 1 is suitably used. Further, in a case of a compound in which L in Formula 1 represents $-NR^{10}-$ and R^1 bonded to N represents a group represented by Formula (3-1), a method in conformity with the following scheme 2 is suitably used.

[0193] In the following schemes 1 and 2, the respective reference numerals are the same as the reference numerals in Formulae 1, (2-1), and (3-1).

(Scheme 1)

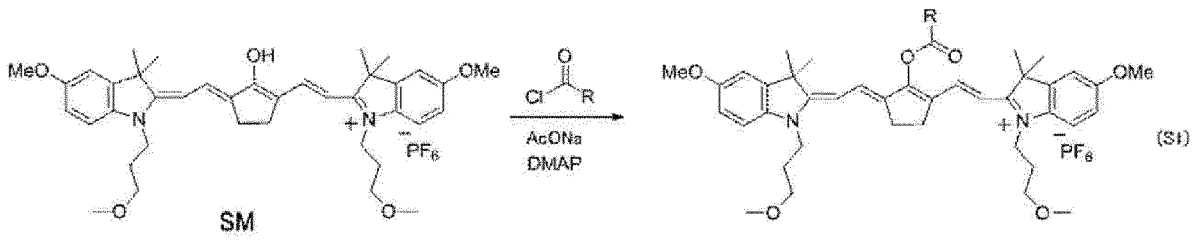


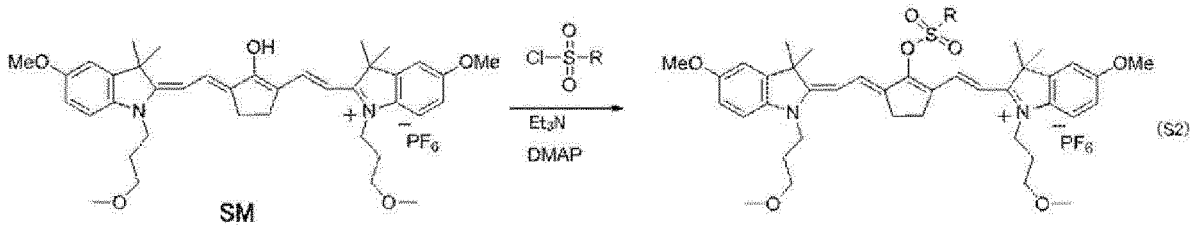
(Scheme 2)

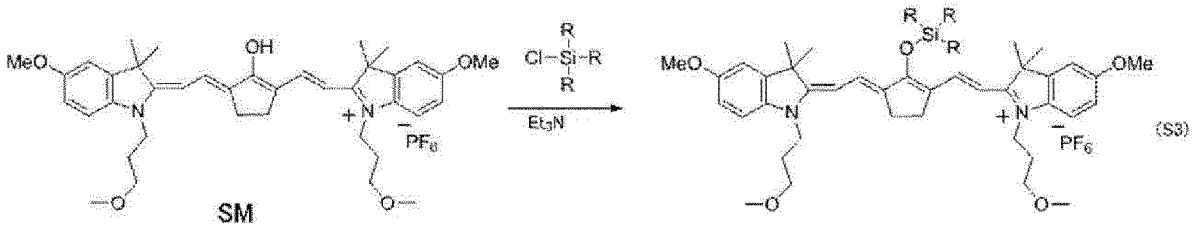


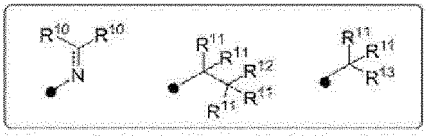
[0194] Further, for example, as a method of introducing a group represented by Formula (1-1), (1-5), or (1-6), a synthetic scheme represented by any of Formulae (S1) to (S3) is suitably used. Further, as a method of introducing a group represented by any of Formulae (1-2) to (1-4), a synthetic scheme represented by Formula (S4) is suitably used.

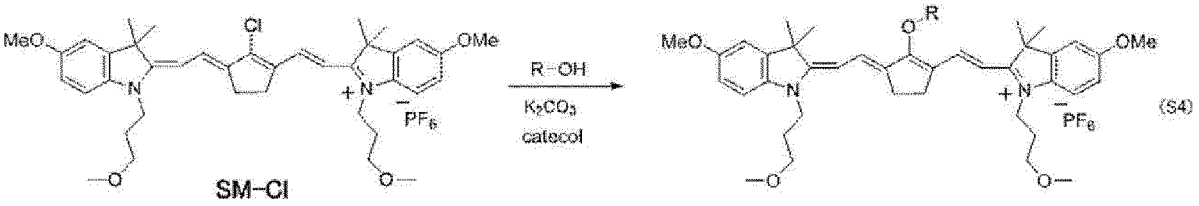
[0195] In the following formula, DMAP represents N, N-dimethylamino-4-pyridine, AcONa represents sodium acetate, NEt_3 represents triethylamine, and catecol represents catechol. Further, R represents a group corresponding to each portion in Formula 2.











[0196] The decomposable infrared absorbing agent may be used alone or in combination of two or more kinds thereof.

[0197] The content of the decomposable infrared absorbing agent in the image recording layer is preferably in a range of 0.1% by mass to 95% by mass, more preferably in a range of 0.5% by mass to 40% by mass, and still more preferably in a range of 1% by mass to 20% by mass with respect to total mass of the image recording layer.

[0198] The decomposable infrared absorbing agent has excellent infrared absorbing performance, and thus functions as an infrared absorbing agent satisfactorily. Therefore, in a case where the decomposable infrared absorbing agent is used for the image recording layer of the planographic printing plate precursor, it is practically unnecessary to use infrared absorbing agents other than the decomposable infrared absorbing agent, but the image recording layer may contain other infrared absorbing agents.

[Other infrared absorbing agents]

[0199] The image recording layer may contain infrared absorbing agents other than the decomposable infrared absorbing agent.

[0200] Examples of other infrared absorbing agents include pigments and dyes.

[0201] As dyes used as other infrared absorbing agents, commercially available dyes and known dyes described in the literatures such as "Dye Handbook" (edited by the Society of Synthetic Organic Chemistry, Japan, published in 1970) can be used. Specific examples thereof include dyes such as an azo dye, a metal complex salt azo dye, a pyrazolone azo dye, a naphthoquinone dye, an anthraquinone dye, a phthalocyanine dye, a carbonium dye, a quinone imine dye, a methine dye, a cyanine dye, a squarylium coloring agent, a pyrylium salt, and a metal thiolate complex.

[0202] Among the above-described dyes, a cyanine coloring agent, a squarylium coloring agent, a pyrylium salt, a nickel thiolate complex, and an indolenine cyanine coloring agent are particularly preferable. Further, other examples thereof include a cyanine coloring agent and an indolenine cyanine coloring agent. Among these, a cyanine coloring agent is particularly preferable.

[0203] Specific examples of the cyanine coloring agent include compounds described in paragraphs 0017 to 0019 of JP2001-133969A and compounds described in paragraphs 0016 to 0021 of JP2002-023360A and paragraphs 0012 to

0037 of JP2002-040638A, preferred examples thereof include compounds described in paragraphs 0034 to 0041 of JP2002-278057A and paragraphs 0080 to 0086 of JP2008-195018A, and particularly preferred examples thereof include compounds described in paragraphs 0035 to 0043 of JP2007-090850A and compounds described in paragraphs 0105 to 0113 of JP2012-206495A.

[0204] Further, compounds described in paragraphs 0008 and 0009 of JP1993-005005A (JP-H05-005005A) and paragraphs 0022 to 0025 of JP2001-222101A can be preferably used.

[0205] As the pigments, compounds described in paragraphs 0072 to 0076 of JP2008-195018A are preferable.

[0206] Other infrared absorbing agents may be used alone or in combination of two or more kinds thereof. Further, pigments and dyes may be used in combination as other infrared absorbing agents.

[0207] From the viewpoints of the color developability and the UV printing durability of the planographic printing plate to be obtained, it is preferable that the content of other infrared absorbing agents in the image recording layer is smaller than the content of the decomposable infrared absorbing agent and more preferable that the image recording layer does not contain other infrared absorbing agents.

[Polymer having structural unit formed of aromatic vinyl compound]

[0208] The image recording layer used in the present disclosure contains a polymer having a structural unit formed of an aromatic vinyl compound.

[0209] From the viewpoints of the developability, the color developability, and the UV printing durability of the planographic printing plate to be obtained, it is preferable that the polymer having a structural unit formed of an aromatic vinyl compound further has a structural unit formed of an acrylonitrile compound.

[0210] Hereinafter, the polymer having a structural unit formed of an aromatic vinyl compound is also referred to as a specific polymer.

- Structural unit formed of aromatic vinyl compound -

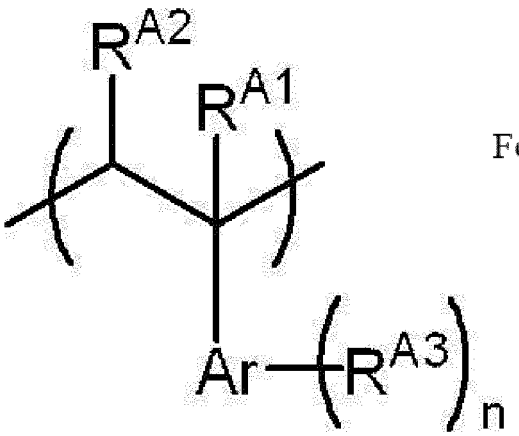
[0211] The specific polymer has a structural unit formed of an aromatic vinyl compound.

[0212] The aromatic vinyl compound may be a compound having a structure in which a vinyl group is bonded to an aromatic ring, and examples thereof include a styrene compound and a vinylnaphthalene compound. Among these, a styrene compound is preferable, and styrene is more preferable.

[0213] Examples of the styrene compound include styrene, p-methylstyrene, p-methoxystyrene, β-methylstyrene, p-methyl-β-methylstyrene, α-methyl styrene, and p-methoxy-β-methylstyrene. Among these, styrene is preferable.

[0214] Examples of the vinylnaphthalene compound include 1-vinylnaphthalene, methyl-1-vinylnaphthalene, β-methyl-1-vinylnaphthalene, 4-methyl-1-vinylnaphthalene, and 4-methoxy-1-vinylnaphthalene. Among these, 1-vinylnaphthalene is preferable.

[0215] Further, preferred examples of the structural unit formed of the aromatic vinyl compound include a structural unit represented by Formula A1.



Formula A1

[0216] In Formula A1, R^{A1} and R^{A2} each independently represent a hydrogen atom or an alkyl group, Ar represents an aromatic ring group, R^{A3} represents a substituent, and n represents an integer less than or equal to the number of substituents of Ar.

[0217] In Formula A1, R^{A1} and R^{A2} each independently represent preferably a hydrogen atom or an alkyl group having 1 to 4 carbon atoms, more preferably a hydrogen atom or a methyl group, and still more preferably a hydrogen atom.

[0218] In Formula A1, Ar represents preferably a benzene ring or a naphthalene ring and more preferably a benzene ring.

[0219] In Formula A1, R^{A3} represents preferably an alkyl group or an alkoxy group, more preferably an alkyl group having 1 to 4 carbon atoms or an alkoxy group having 1 to 4 carbon atoms, and still more preferably a methyl group or a methoxy group.

[0220] In Formula A1, in a case where a plurality of R^{A3}'s are present, the plurality of R^{A3}'s may be the same as or different from each other.

[0221] In Formula A1, n represents preferably an integer of 0 to 2, more preferably 0 or 1, and still more preferably 0.

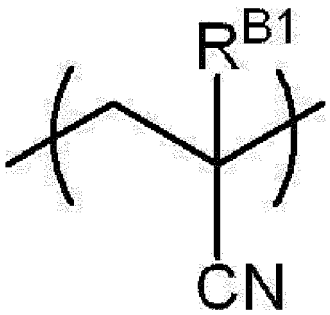
[0222] The content of the structural unit formed of an aromatic vinyl compound in the specific polymer is preferably in a range of 15% by mass to 85% by mass and more preferably in a range of 30% by mass to 70% by mass with respect to the total mass of the specific polymer.

- Structural unit formed of acrylonitrile compounds -

[0223] From the viewpoints of the developability, the color developability, and the UV printing durability of the planographic printing plate to be obtained, it is preferable that the specific polymer further has a structural unit formed of an acrylonitrile compound.

[0224] Examples of the acrylonitrile compound include (meth)acrylonitrile. Among examples, acrylonitrile is preferable.

[0225] Further, preferred examples of the structural unit formed of the acrylonitrile compound include a structural unit represented by Formula B1.



Formula B1

[0226] In Formula B1, R^{B1} represents a hydrogen atom or an alkyl group.

[0227] In Formula B1, R^{B1} represents preferably a hydrogen atom or an alkyl group having 1 to 4 carbon atoms, more preferably a hydrogen atom or a methyl group, and still more preferably a hydrogen atom.

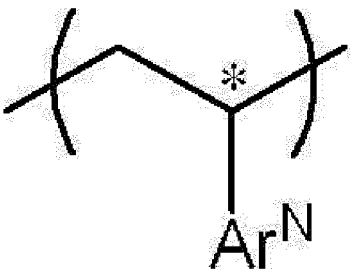
[0228] The content of the structural unit formed of an acrylonitrile compound in the specific polymer is preferably in a range of 5% by mass to 85% by mass and more preferably in a range of 8% by mass to 70% by mass with respect to the total mass of the specific polymer.

- Structural unit formed of N-vinyl heterocyclic compound -

[0229] From the viewpoints of the UV printing durability and the chemical resistance, it is preferable that the specific polymer further has a structural unit formed of a N-vinyl heterocyclic compound.

[0230] Examples of the N-vinyl heterocyclic compound include N-vinylpyrrolidone, N-vinylcarbazole, N-vinylpyrrole, N-vinylphenothiazine, N-vinylsuccinimide, N-vinylphthalimide, N-vinylcaprolactam, and N-vinylimidazole. Among these, N-vinylpyrrolidone is preferable.

[0231] Further, preferred examples of the structural unit formed of the N-vinyl heterocyclic compound include a structural unit represented by Formula C1.



Formula C1

[0232] In Formula C1, Ar^N represents a heterocyclic structure having a nitrogen atom, and the nitrogen atom in Ar^N is bonded to the carbon atom represented by "*".

[0233] In Formula C1, as the heterocyclic structure represented by Ar^N, a pyrrolidone ring, a carbazole ring, a pyrrole ring, a phenothiazine ring, a succinimide ring, a phthalimide ring, a caprolactam ring, or an imidazole ring is preferable, and a pyrrolidone ring is more preferable.

[0234] Further, the heterocyclic structure represented by Ar^N may have a known substituent.

[0235] The content of the structural unit formed of the N-vinyl heterocyclic compound in the specific polymer is preferably in a range of 5% by mass to 70% by mass and more preferably in a range of 10% by mass to 60% by mass with respect to the total mass of the specific polymer.

- Structural unit containing ethylenically unsaturated group -

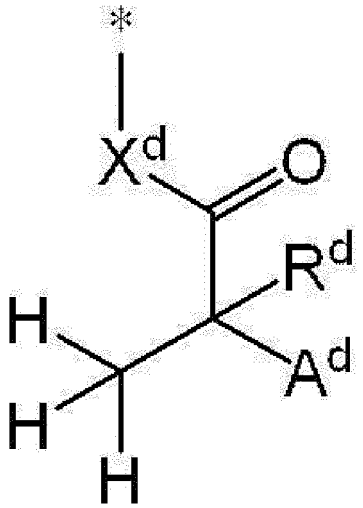
[0236] The specific polymer may further have a structural unit containing an ethylenically unsaturated group.

[0237] The ethylenically unsaturated group is not particularly limited, and examples thereof include a vinyl group, an allyl group, a vinylphenyl group, a (meth)acrylamide group, or a (meth)acryloyloxy group. Among these, from the viewpoint of the reactivity, a (meth)acryloyloxy group is preferable.

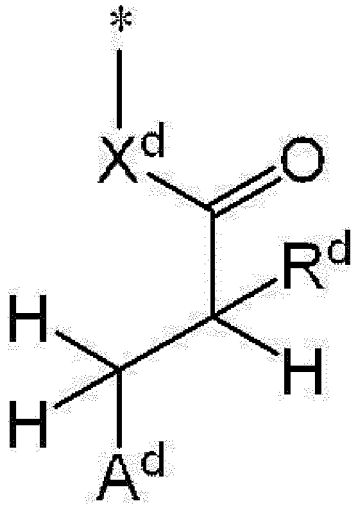
[0238] The structural unit containing an ethylenically unsaturated group can be introduced to the specific polymer by a polymer reaction or copolymerization. Specifically, the introduction can be carried out by, for example, a method of allowing a compound (such as glycidyl methacrylate) containing an epoxy group and an ethylenically unsaturated group to react with a polymer to which a structural unit containing a carboxy group such as methacrylic acid has been introduced or a method of allowing a compound (such as 2-isocyanatoethyl methacrylate) containing an isocyanate group and an ethylenically unsaturated group to react with a polymer to which a structural unit containing a group having active hydrogen such as a hydroxy group has been introduced.

[0239] Further, the structural unit containing an ethylenically unsaturated group may be introduced to the specific polymer according to, for example, a method of allowing a compound containing a carboxy group and an ethylenically unsaturated group to react with a polymer to which a structural unit containing an epoxy group such as glycidyl (meth)acrylate has been introduced.

[0240] Further, the structural unit containing an ethylenically unsaturated group may be introduced to the specific polymer using, for example, a monomer having a partial structure represented by Formula d1 or Formula d2. Specifically, for example, the structural unit containing an ethylenically unsaturated group is introduced to the specific polymer by forming an ethylenically unsaturated group on a partial structure represented by Formula d1 or Formula d2 through an elimination reaction using a base compound, after the polymerization carried out using at least the monomer described above.



Formula d1



Formula d2

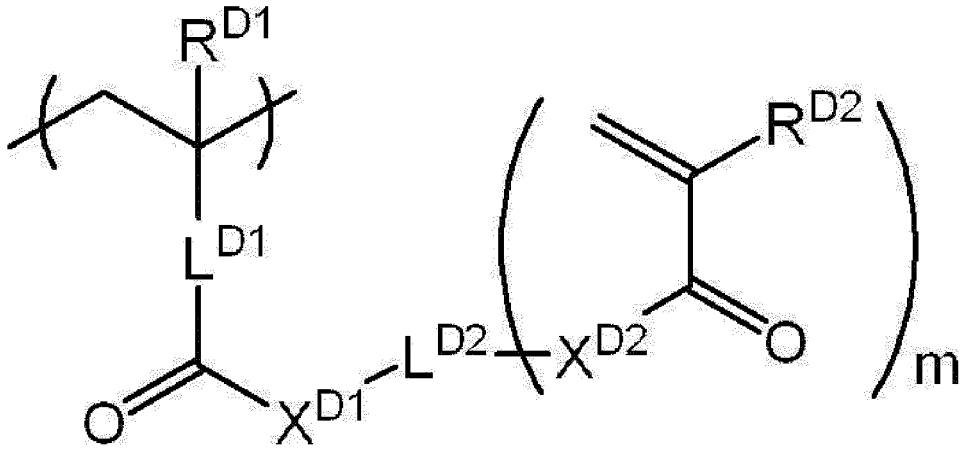
[0241] In Formulae d1 and d2, R^d represents a hydrogen atom or an alkyl group, A^d represents a halogen atom, X^d represents -O- or -NRN-, R^N represents a hydrogen atom or an alkyl group, and * represents a bonding site with respect to another structure.

[0242] In Formulae d1 and d2, it is preferable that R^d represents a hydrogen atom or a methyl group.

[0243] In Formulae d1 and d2, it is preferable that A^d represents a chlorine atom, a bromine atom, or an iodine atom.

[0244] In Formulae d1 and d2, it is preferable that X^d represents -O-. In a case where X^d represents $-NR^N-$, R^N represents preferably a hydrogen atom or an alkyl group having 1 to 4 carbon atoms and more preferably a hydrogen atom.

[0245] Examples of the structural unit containing an ethylenically unsaturated group include a structural unit represented by Formula D1.



Formula D1

[0246] In Formula D1, L^{D1} represents a single bond or a divalent linking group, L^{D2} represents an (m + 1)-valent linking group, X^{D1} and X^{D2} each independently represent -O- or $-NR^N-$, R^N represents a hydrogen atom or an alkyl group, R^{D1} and R^{D2} each independently represent a hydrogen atom or a methyl group, and m represents an integer of 1 or greater.

[0247] In Formula D1, it is preferable that L^{D1} represents a single bond. In a case where L^{D1} represents a divalent linking group, an alkylene group, an arylene group, or a divalent group in which two or more of these groups are bonded to each other is preferable, and an alkylene group having 2 to 10 carbon atoms or a phenylene group is more preferable.

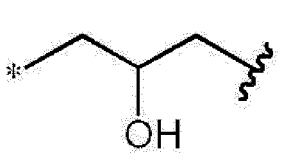
[0248] In Formula D1, it is preferable that L^{D2} represents a group represented by any of Formulae D2 to D6.

[0249] In Formula D1, it is preferable that both X^{D1} and X^{D2} represent -O-. Further, in a case where at least one of X^{D1} or X^{D2} represents $-NR^N-$, R^N represents preferably a hydrogen atom or an alkyl group having 1 to 4 carbon atoms and more preferably a hydrogen atom.

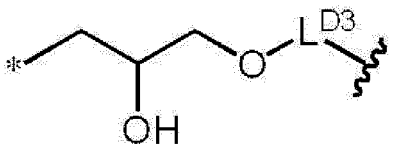
[0250] In Formula D1, it is preferable that R^{D1} represents a methyl group.

[0251] In Formula D1, it is preferable that at least one of m R^{D2}'s represents a methyl group.

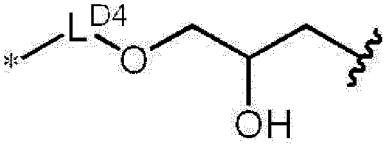
[0252] In Formula D1, m represents preferably an integer of 1 to 4, more preferably 1 or 2, and still more preferably 1.



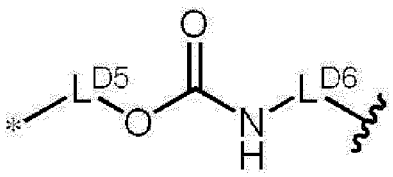
Formula D2



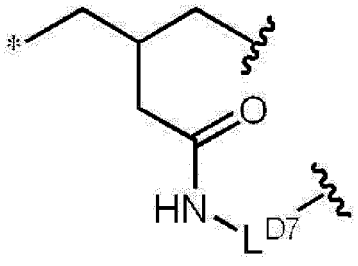
Formula D3



Formula D4



Formula D5



Formula D6

[0253] In Formulae D2 to D6, L^{D3} to L^{D7} represent a divalent linking group, L^{D5} and L^{D6} may be different from each other, "*" represents a bonding site with respect to X^{D1} in Formula D1, and the wavy line represents a bonding site with respect to X^{D2} in Formula D1.

[0254] In Formula D3, L^{D3} represents preferably an alkylene group, an arylene group, or a group in which two or more of these groups are bonded to each other and more preferably an alkylene group having 1 to 10 carbon atoms, a phenylene group, or a group in which two or more of these groups are bonded to each other.

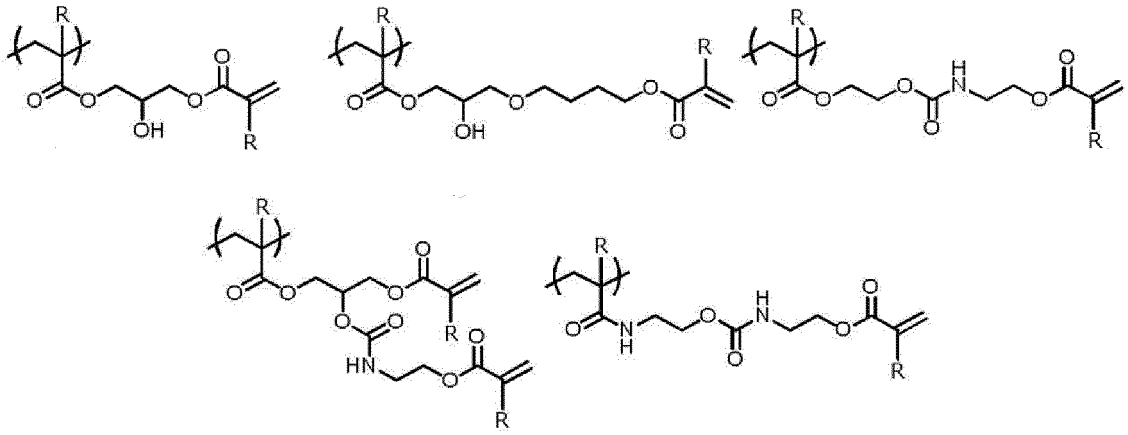
[0255] In Formula D4, L^{D4} represents preferably an alkylene group, an arylene group, or a group in which two or more of these groups are bonded to each other and more preferably an alkylene group having 1 to 10 carbon atoms, a phenylene group, or a group in which two or more of these groups are bonded to each other.

[0256] In Formula D5, L^{D5} represents preferably an alkylene group, an arylene group, or a group in which two or more of these groups are bonded to each other and more preferably an alkylene group having 1 to 10 carbon atoms, a phenylene group, or a group in which two or more of these groups are bonded to each other.

[0257] In Formula D6, L^{D6} represents preferably an alkylene group, an arylene group, or a group in which two or more of these groups are bonded to each other and more preferably an alkylene group having 1 to 10 carbon atoms, a phenylene group, or a group in which two or more of these groups are bonded to each other.

[0258] In Formula D7, L^{D7} represents preferably an alkylene group, an arylene group, or a group in which two or more of these groups are bonded to each other and more preferably an alkylene group having 1 to 10 carbon atoms, a phenylene group, or a group in which two or more of these groups are bonded to each other.

[0259] Specific examples of the structural unit having an ethylenically unsaturated group are described below, but the structural unit having an ethylenically unsaturated group contained in the polymer is not limited thereto. In the specific examples shown below, R's each independently represent a hydrogen atom or a methyl group.



[0260] The content of the structural unit having an ethylenically unsaturated group in the specific polymer is preferably in a range of 5% by mass to 60% by mass and more preferably in a range of 10% by mass to 30% by mass with respect to the total mass of the specific polymer.

- Structural unit containing acidic group -

[0261] The specific polymer may have a structural unit containing an acidic group, but from the viewpoint of the on-press developability, it is preferable that the specific polymer does not have a structural unit containing an acidic group.

[0262] Specifically, the content of the structural unit containing an acidic group in the specific polymer is preferably 20% by mass or less, more preferably 10% by mass or less, and still more preferably 5% by mass or less with respect to the total mass of the specific polymer. The lower limit of the content thereof is not particularly limited and may be 0% by mass.

[0263] Further, the acid value of the specific polymer is preferably 160 mgKOH/g or less, more preferably 80 mgKOH/g or less, and still more preferably 40 mgKOH/g or less. The lower limit of the acid value thereof is not particularly limited, and may be 0 mgKOH/g.

[0264] In the present disclosure, the acid value is acquired by a measuring method in conformity with JIS K0070: 1992.

- Structural unit containing hydrophobic group -

[0265] From the viewpoint of the ink impressing property, the specific polymer may have a structural unit containing a hydrophobic group.

[0266] Examples of the hydrophobic group include an alkyl group, an aryl group and an aralkyl group.

[0267] As the structural unit containing a hydrophobic group, a structural unit formed of an alkyl(meth)acrylate compound, an aryl(meth)acrylate compound, or an aralkyl(meth)acrylate compound is preferable, and a structural unit formed of an alkyl(meth)acrylate compound is more preferable.

[0268] The number of carbon atoms in the alkyl group in the alkyl (meth)acrylate compound is preferably in a range of 1 to 10. The alkyl group may be linear or branched and may have a cyclic structure. Examples of the alkyl (meth)acrylate compound include methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, cyclohexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, and dicyclopentanyl (meth)acrylate.

[0269] The aryl group in the aryl (meth)acrylate compound preferably has 6 to 20 carbon atoms and is more preferably a phenyl group. Further, the aryl group may have a known substituent. Preferred examples of the aryl (meth)acrylate compound include phenyl (meth)acrylate.

[0270] The carbon number of the alkyl group in the aralkyl (meth)acrylate compound is preferably in a range of 1 to 10. The alkyl group may be linear or branched and may have a cyclic structure. Further, the aryl group in the aralkyl(meth)acrylate compound preferably has 6 to 20 carbon atoms and is more preferably a phenyl group. Preferred examples of the aralkyl (meth)acrylate compound include benzyl (meth)acrylate.

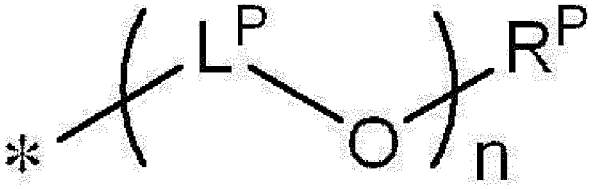
[0271] The content of the structural unit containing a hydrophobic group in the specific polymer is preferably in a range of 5% by mass to 50% by mass and more preferably in a range of 10% by mass to 30% by mass with respect to the total mass of the specific polymer.

- Structural unit containing hydrophilic group -

[0272] From the viewpoint of improving the printing durability, the chemical resistance, and the on-press developability, the specific polymer may have a structural unit containing a hydrophilic group.

[0273] Examples of the hydrophilic group include -OH, -CN, $-CONR^1R^2$, $-NR^2COR^1$ (R^1 and R^2 each independently represent a hydrogen atom, an alkyl group, an alkenyl group, or an aryl group, and R^1 and R^2 may be bonded to each other to form a ring), $-NR^3R^4$, $-N^+R^3R^4R^5X^-$ (R^3 to R^5 each independently represent an alkyl group having 1 to 8 carbon atoms, and X^- represents a counter anion), and a group represented by Formula PO.

[0274] Among these hydrophilic groups, -OH, $-CONR^1R^2$, or a group represented by Formula PO is preferable, -OH or a group represented by Formula PO is more preferable, and -OH is still more preferable.



Formula PO

[0275] In Formula PO, L^P's each independently represent an alkylene group, R^P represents a hydrogen atom or an alkyl group, and n represents an integer of 1 to 100.

[0276] In Formula PO, L^P's each independently represent preferably an ethylene group, a 1-methylethylene group, or a 2-methylethylene group and more preferably an ethylene group.

[0277] In Formula PO, R^P represents preferably a hydrogen atom or an alkyl group having 1 to 18 carbon atoms, more preferably a hydrogen atom or an alkyl group having 1 to 10 carbon atoms, still more preferably a hydrogen atom or an alkyl group having 1 to 4 carbon atoms, and particularly preferably a hydrogen atom or a methyl group.

[0278] In Formula PO, n represents preferably an integer of 1 to 10 and more preferably an integer of 1 to 4.

[0279] As the structural unit containing a hydrophilic group, a structural unit formed of a hydroxyalkyl (meth)acrylate compound is preferable, and a structural unit formed of a hydroxyethyl (meth)acrylate compound is more preferable.

[0280] Further, from the viewpoints of the on-press developability, the UV printing durability, a property of suppressing UV plate skipping, and a specific color impressing property, as the hydrophilic group, a polyalkylene oxide structure is preferable, and a polyethylene oxide structure, a polypropylene oxide structure, or a polyethylene/propylene oxide structure is more preferable.

[0281] Further, from the viewpoints of the on-press developability and a property of suppressing development scum in a case of on-press developability, as the polyalkylene oxide structure, the structural unit has preferably a polypropylene oxide structure and more preferably a polyethylene oxide structure and a polypropylene oxide structure.

[0282] The content of the structural unit containing a hydrophilic group in the specific polymer is preferably in a range of 5% by mass to 60% by mass and more preferably in a range of 10% by mass to 30% by mass with respect to the total mass of the specific polymer.

- Other structural units -

[0283] The specific polymer may further have other structural units. The specific polymer may have structural units other than the above-described structural units as other structural units without particular limitation, and examples thereof include structural units formed of an acrylamide compound, a vinyl ether compound, and the like.

[0284] Examples of the acrylamide compound include (meth)acrylamide, N-methyl (meth)acrylamide, N-ethyl (meth)acrylamide, N-propyl (meth)acrylamide, N-butyl (meth)acrylamide, N,N'-dimethyl (meth)acrylamide, N,N'-diethyl (meth)acrylamide, N-hydroxyethyl (meth)acrylamide, N-hydroxypropyl (meth)acrylamide, and N-hydroxybutyl (meth)acrylamide.

[0285] Examples of the vinyl ether compound include methyl vinyl ether, ethyl vinyl ether, propyl vinyl ether, n-butyl vinyl ether, tert-butyl vinyl ether, 2-ethylhexyl vinyl ether, n-nonyl vinyl ether, lauryl vinyl ether, cyclohexyl vinyl ether, cyclohexyl methyl vinyl ether, 4-methylcyclohexyl methyl vinyl ether, benzyl vinyl ether, dicyclopentenyl vinyl ether, 2-dicyclopentenoxyethyl vinyl ether, methoxyethyl vinyl ether, ethoxyethyl vinyl ether, butoxyethyl vinyl ether, methoxyethoxyethyl vinyl ether, ethoxyethoxyethyl vinyl ether, methoxypolyethylene glycol vinyl ether, tetrahydrofurfuryl vinyl ether, 2-hydroxyethyl vinyl ether, 2-hydroxypropyl vinyl ether, 4-hydroxybutyl vinyl ether, 4-hydroxymethylcyclohexylmethyl vinyl ether, diethylene glycol monovinyl ether, polyethylene glycol vinyl ether, chloroethyl vinyl ether, chlorobutyl vinyl ether, chloroethoxyethyl vinyl ether, phenylethyl vinyl ether, and phenoxy polyethylene glycol vinyl ether.

[0286] The content of other structural units in the specific polymer is preferably in a range of 5% by mass to 50% by mass and more preferably in a range of 10% by mass to 30% by mass with respect to the total mass of the specific polymer.

- Method of producing specific polymer -

[0287] The method of producing the specific polymer is not particularly limited, and the specific polymer can be produced by a known method.

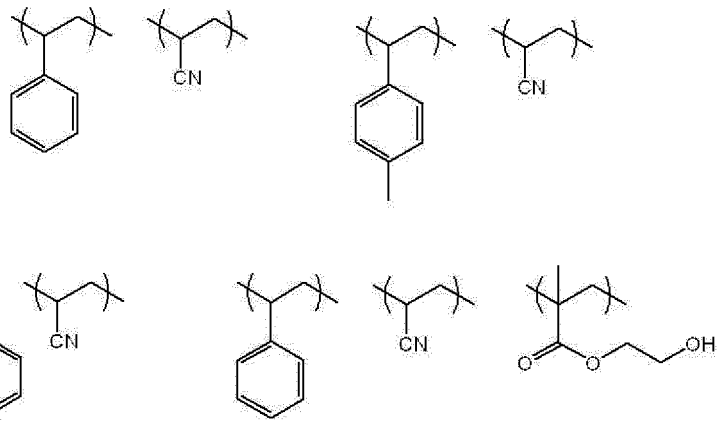
[0288] For example, the specific polymer is obtained by polymerizing a styrene compound, an acrylonitrile compound, and as necessary, at least one selected from the group consisting of the N-vinyl heterocyclic compound, a compound used to form the structural unit containing an ethylenically unsaturated group, a compound used to form the structural unit containing an acidic group, a compound used to form the structural unit containing a hydrophobic group, and a compound used to form other structural units described above, according to a known method.

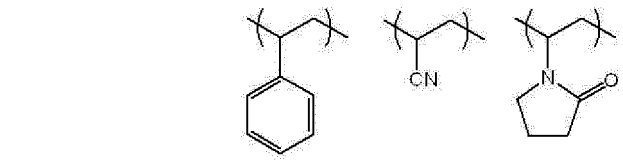
- Molecular weight -

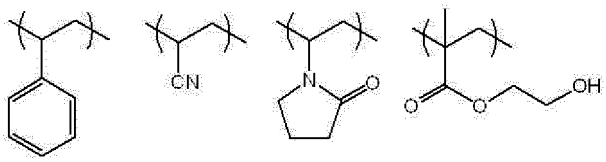
[0289] The weight-average molecular weight of the specific polymer is preferably in a range of 3000 to 300000 and more preferably in a range of 5000 to 100000.

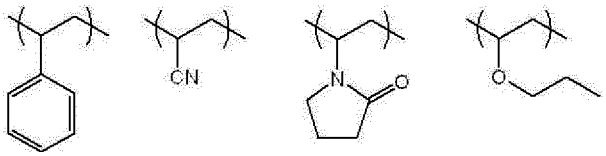
- Specific examples -

[0290] Specific examples of the specific polymer are shown below, but the specific polymer used in the present disclosure is not limited thereto.




CN
N
O


CN
N
O
O
O
OH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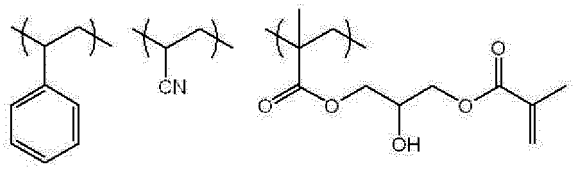
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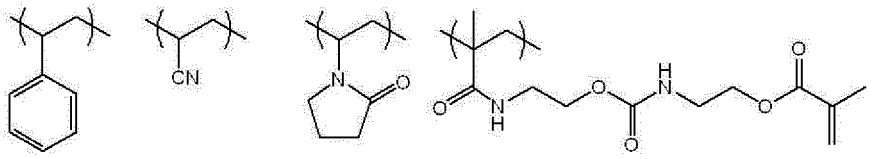
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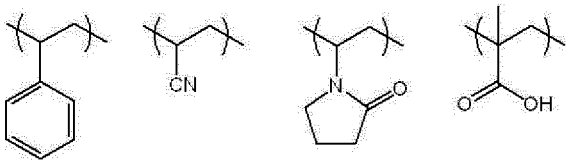
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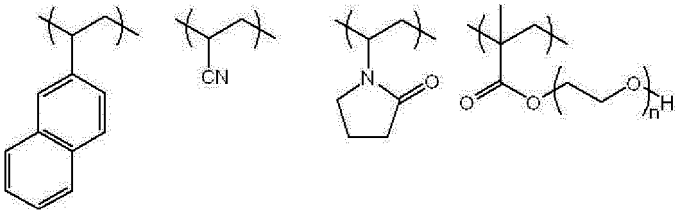
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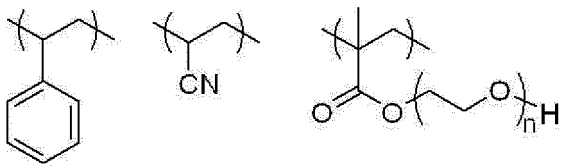
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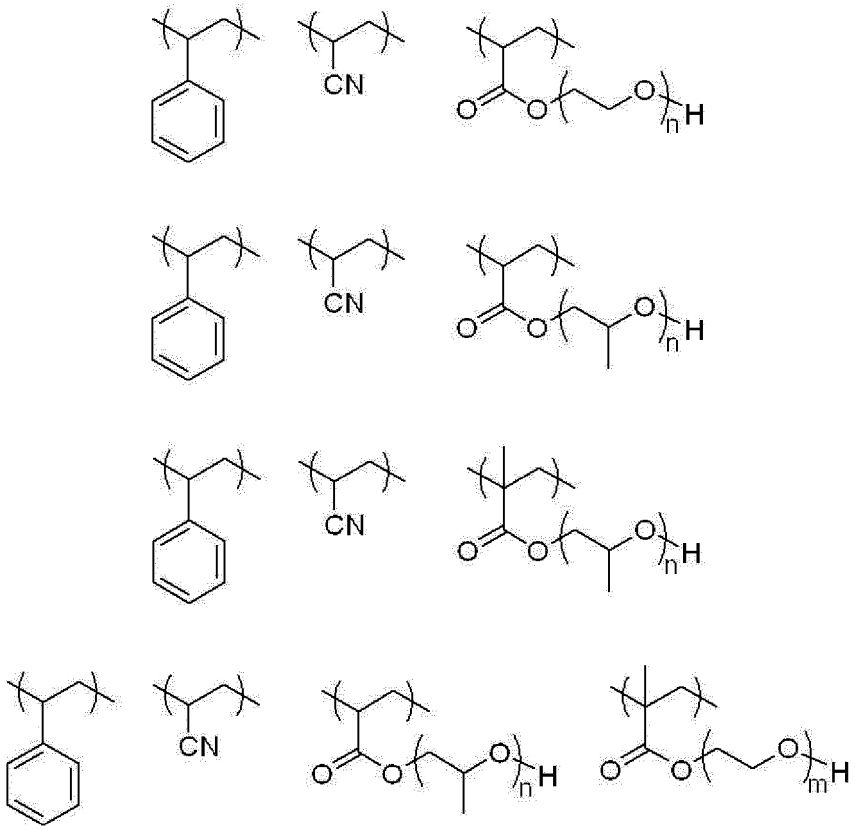


[0291] Further, in the specific examples, the content of each structural unit can be appropriately changed based on the preferable range of the content of each structural unit described above. Further, m and n each independently represent an integer of 1 or greater.

[0292] Further, the weight-average molecular weight of each compound shown in the specific examples above can be appropriately changed based on the preferable range of the weight-average molecular weight of the specific polymer described above.

[0293] In the present disclosure, the specific polymer may be a binding resin that is not in the form of particles or may be in the form of particles.

[0294] Further, it is preferable that the specific polymer contains polymer particles.

[0295] Further, from the viewpoints of the printing durability and the solvent resistance, it is preferable that the polymer particles have a hydrophobic main chain and both a structural unit (i) containing a pendant-cyano group directly bonded to the hydrophobic main chain and a structural unit (ii) containing a pendant group having a hydrophilic polyalkylene oxide segment.

[0296] As the hydrophobic main chain, an acrylic resin chain is preferably exemplified.

[0297] Preferred examples of the pendant-cyano group include -[$CH_2CH(C^{\circ}N)$-] and - [$CH_2C(CH_3)(C{\equiv}N)$-].

[0298] Further, the structural unit having a pendant-cyano group can be easily derived from an ethylene-based unsaturated monomer such as acrylonitrile or methacrylonitrile or a combination of these.

[0299] Further, as the alkylene oxide in the hydrophilic polyalkylene oxide segment, ethylene oxide or propylene oxide is preferable and ethylene oxide is more preferable.

[0300] The repetition number of alkylene oxide structures in the hydrophilic polyalkylene oxide segment is preferably in a range of 10 to 100, more preferably in a range of 25 to 75, and still more preferably in a range of 40 to 50.

[0301] As the resin particles which have a hydrophobic main chain and both the structural unit (i) containing a pendant-cyano group directly bonded to the hydrophobic main chain and the structural unit (ii) containing a pendant group having a hydrophilic polyalkylene oxide segment, those described in paragraphs 0039 to 0068 of JP2008-503365A are preferably exemplified.

[0302] The average particle diameter of the polymer particles is preferably in a range of 0.01 μm to 3.0 μm, more preferably in a range of 0.03 μm to 2.0 μm, and still more preferably in a range of 0.10 μm to 1.0 μm. In a case where the average particle diameter thereof is in the above-described range, excellent resolution and temporal stability are obtained.

[0303] The average primary particle diameter of the particles in the present disclosure is obtained by measuring the

diameter of each particle according to a light scattering method or capturing an electron micrograph of the particles and measuring the particle diameters of a total of 5000 particles on the photograph, and calculating the average value thereof. Further, the particle diameter of a spherical particle having the same particle area as the particle area on the photograph is set as the particle diameter of a non-spherical particle.

[0304] Further, the average particle diameter in the present disclosure is the volume average particle diameter unless otherwise specified.

- Content -

[0305] The image recording layer may contain only one or a combination of two or more kinds of specific polymers.

[0306] The content of the specific polymer is preferably in a range of 5% by mass to 95% by mass, more preferably in a range of 7% by mass to 80% by mass, and still more preferably in a range of 10% by mass to 60% by mass with respect to the total mass of the image recording layer.

[Polymerization initiator]

[0307] The image recording layer contains a polymerization initiator.

[0308] The polymerization initiator indicates a compound that initiates and promotes polymerization of a polymerizable compound. As the polymerization initiator, a known thermal polymerization initiator, a compound having a bond with small bond dissociation energy, a photopolymerization initiator, an electron-accepting polymerization initiator described below, an electron-donating polymerization initiator described below, or the like can be used. Specifically, radical polymerization initiators described in paragraphs 0092 to 0106 of JP2014-104631A can be used.

[0309] Preferred examples of compounds in the polymerization initiators include onium salts. Among these, iodonium salts and sulfonium salts are particularly preferable. Specific preferred examples of the compounds in each of the salts are the compounds described in paragraphs 0104 to 0106 of JP2014-104631A.

[0310] The content of the polymerization initiator is preferably in a range of 0.1% by mass to 50% by mass, more preferably in a range of 0.5% by mass to 30% by mass, and particularly preferably in a range of 0.8% by mass to 20% by mass with respect to the total mass of the image recording layer. In a case where the content thereof is in the above-described range, improved sensitivity and improved stain resistance of a non-image area during printing are obtained.

[0311] Further, the polymerization initiator may be used alone or in combination of two or more kinds thereof, but from the viewpoints of the color developability, the temporal color developability after exposure, the developability, and the UV printing durability of the planographic printing plate to be obtained, it is preferable that the polymerization initiator in the image recording layer contains an electron-donating polymerization initiator and an electron-accepting polymerization initiator.

[0312] Further, from the viewpoints of the color developability, the temporal color developability after exposure, the developability, and the UV printing durability of the planographic printing plate to be obtained, it is preferable that the polymerization initiator includes a compound in which an electron-donating polymerization initiator and an electron-accepting polymerization initiator form a counter salt.

- Electron-donating polymerization initiator -

[0313] From the viewpoints of the color developability, the temporal color developability after exposure, the developability, and the UV printing durability of the planographic printing plate to be obtained, it is preferable that the image recording layer contains an electron-donating polymerization initiator as the polymerization initiator described above.

[0314] The electron-donating polymerization initiator is considered to contribute to improvement of the chemical resistance and the printing durability of the planographic printing plate. Examples of the electron-donating polymerization initiator include the following 5 kinds of agents.

(i) Alkyl or arylate complex: It is considered that a carbon-hetero bond is cleaved by oxidation to generate an active radical. Specific examples thereof include a borate compound.

(ii) Aminoacetic acid compound: It is considered that a C-X bond on a carbon adjacent to nitrogen is cleaved by oxidation to generate an active radical. It is preferable that X represents a hydrogen atom, a carboxy group, a trimethylsilyl group, or a benzyl group. Specific examples thereof include N-phenylglycines (the phenyl group may have a substituent) and N-phenyliminodiacetic acid (the phenyl group may have a substituent).

(iii) Sulfur-containing compound: The nitrogen atom of the above-described aminoacetic acid compound can be replaced with a sulfur atom to generate an active radical by the same action as described above. Specific examples thereof include phenylthioacetic acid (the phenyl group may have a substituent).

(iv) Tin-containing compound: The nitrogen atom of the above-described aminoacetic acid compound can be replaced

with a tin atom to generate an active radical by the same action as described above.

(v) Sulfinates: An active radical can be generated by oxidation. Specific examples thereof include sodium arylsulfinate.

[0315] Among these electron-donating polymerization initiators, it is preferable that the image recording layer contains a borate compound.

[0316] As the borate compound, a tetraaryl borate compound or a monoalkyltriaryl borate compound is preferable. Further, from the viewpoint of the stability of the compound, a tetraaryl borate compound is more preferable, and a tetraphenyl borate compound is particularly preferable.

[0317] The counter cation of the borate compound is not particularly limited, and an alkali metal ion or a tetraalkylammonium ion is preferable, and a sodium ion, a potassium ion, or a tetrabutylammonium ion is more preferable.

[0318] Specific preferred examples of the borate compound include sodium tetraphenyl borate.

[0319] Further, from the viewpoints of the chemical resistance and the printing durability, the highest occupied molecular orbital (HOMO) of the electron-donating polymerization initiator used in the present disclosure is preferably -6.0 eV or greater, more preferably -5.95 eV or greater, and still more preferably -5.93 eV or greater.

[0320] Further, the upper limit thereof is preferably -5.00 eV or less and more preferably -5.40 eV or less.

[0321] In the present disclosure, the highest occupied molecular orbital (HOMO) and the lowest unoccupied molecular orbital (LUMO) are calculated by the following method.

[0322] First, the counter anion in the compound to be calculated is ignored.

[0323] Quantum chemistry calculation software Gaussian09 is used, and structural optimization is performed by DFT (B3LYP/6 - 31G (d)).

[0324] The molecular orbital (MO) energy calculation is performed by DFT (B3LYP/6 - 31 + G (d, p)/CPCM (solvent = methanol)) using the structure obtained by the structure optimization described above.

[0325] The MO energy Ebare (unit: hartree) obtained by the MO energy calculation is converted to Escaled (unit: eV) used as the values of HOMO and LUMO in the present disclosure according to the following equation.

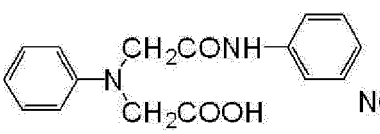
$$\text{Escaled} = 0.823168 \times 27.2114 \times \text{Ebare} - 1.07634$$

[0326] Further, 27.2114 is a coefficient for simply converting hartree to eV, 0.823168 and - 1.07634 are adjustment coefficients for determining the calculation of HOMO and LUMO of the compound to be calculated so as to match measured values.

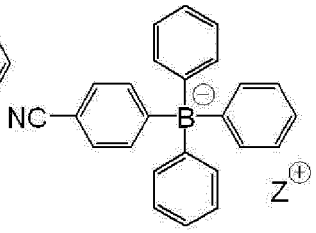
[0327] B-1 to B-8 and other compounds are shown below as specific preferred examples of the electron-donating polymerization initiator, but it goes without saying that the present invention is not limited thereto. Further, in the following chemical formulae, Bu represents an n-butyl group, and Z represents a counter cation.

[0328] Examples of the counter cation represented by Z include Na^+, K^+, and $N^+(Bu)_4$. Further, Bu represents an n-butyl group.

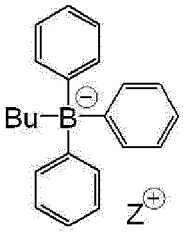
[0329] Further, suitable examples of the counter cation represented by Z include an onium ion in the electron-accepting polymerization initiator described below.



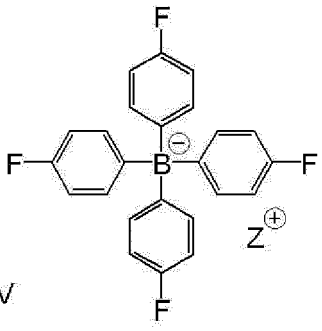
B-1



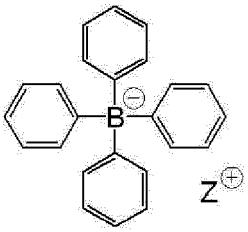
B-2
HOMO=-6.052eV



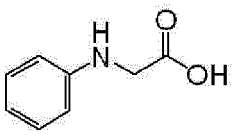
B-3
HOMO=-5.772eV



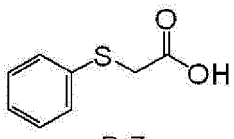
B-4
HOMO=-5.957eV



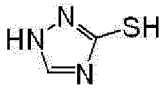
B-5
HOMO=-5.905eV



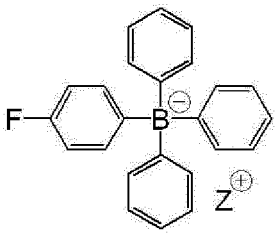
B-6

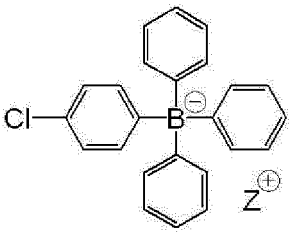


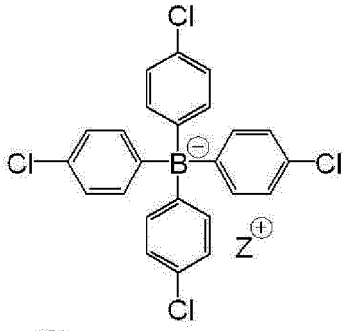
B-7

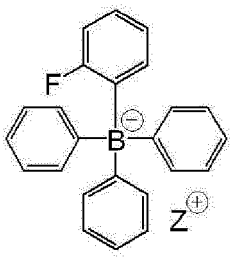


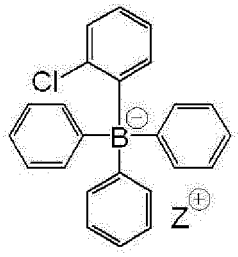
B-8

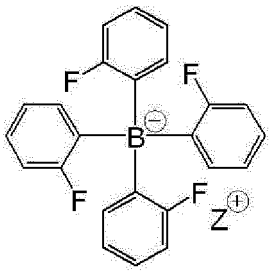


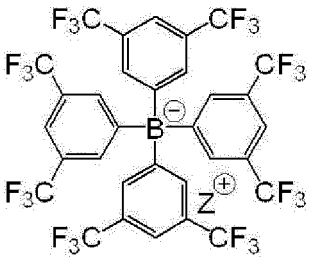


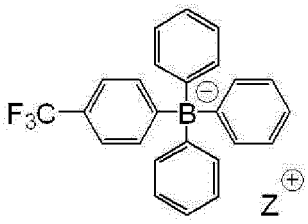


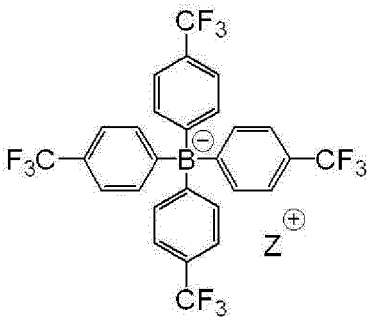


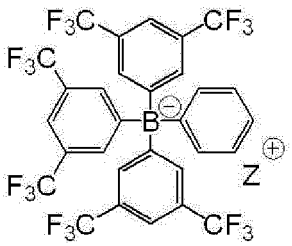


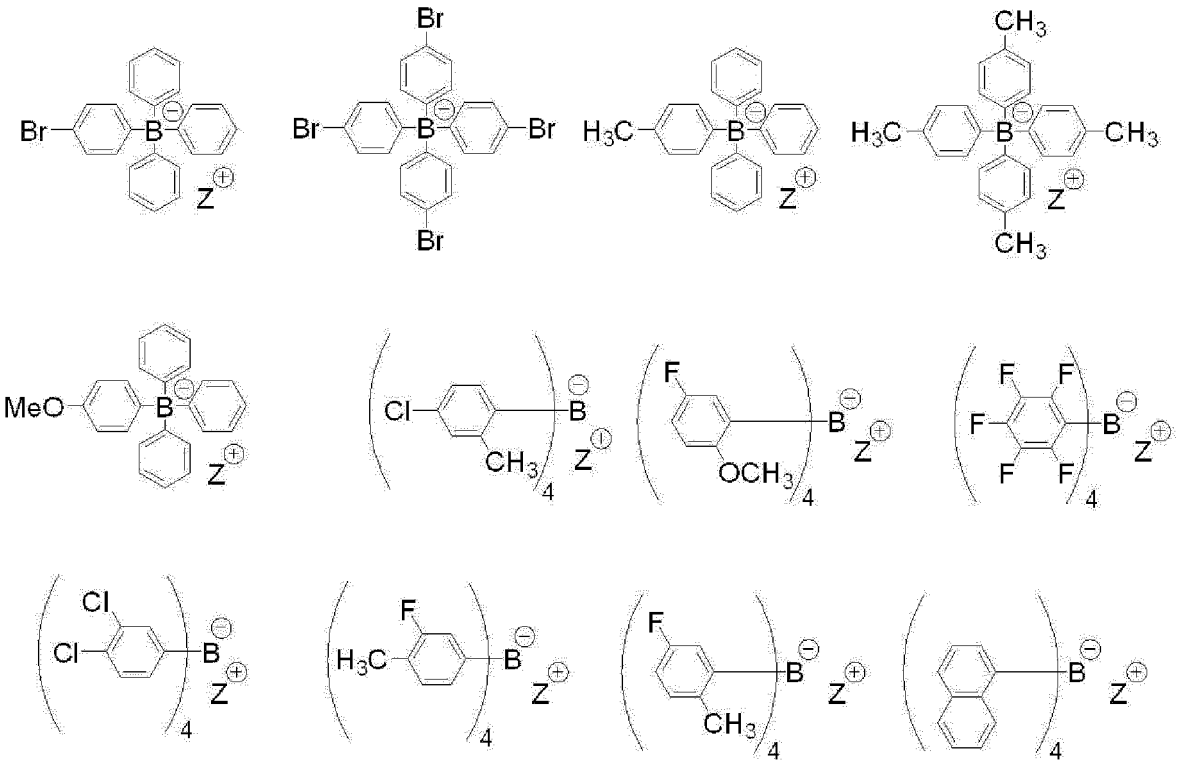












[0330] The electron-donating polymerization initiator may be used alone or in combination of two or more kinds thereof.

[0331] From the viewpoints of the color developability, the temporal color developability after exposure, the developability, and the UV printing durability of the planographic printing plate to be obtained, the content of the electron-donating polymerization initiator is preferably in a range of 0.01% by mass to 30% by mass, more preferably in a range of 0.05% by mass to 25% by mass, and still more preferably in a range of 0.1% by mass to 20% by mass with respect to the total mass of the image recording layer.

- Electron-accepting polymerization initiator -

[0332] From the viewpoints of the color developability and the UV printing durability of the planographic printing plate to be obtained, it is preferable that the image recording layer contains an electron-accepting polymerization initiator as the polymerization initiator.

[0333] The electron-accepting polymerization initiator used in the present disclosure is a compound that generates polymerization initiating species such as a radical or a cation by light, heat, or the energy of both light and heat and can be appropriately selected from known thermal polymerization initiators, compounds having bonds with small bond dissociation energy, and photopolymerization initiators and then used.

[0334] As the electron-accepting polymerization initiator, a radical polymerization initiator is preferable, and an onium salt compound is more preferable.

[0335] Further, an infrared photosensitive polymerization initiator is preferable as the electron-accepting polymerization initiator.

[0336] The electron-accepting polymerization initiator may be used alone or in combination of two or more kinds thereof.

[0337] Examples of the radical polymerization initiator include an organic halide (a), a carbonyl compound (b), an azo compound (c), an organic peroxide (d), a metallocene compound (e), an azide compound (f), a hexaaryl biimidazole compound (g), a disulfone compound (i), an oxime ester compound (j), and an onium salt compound (k).

[0338] As the organic halide (a), for example, the compounds described in paragraphs 0022 to 0023 of JP2008-195018A are preferable.

[0339] As the carbonyl compound (b), for example, the compounds described in paragraph 0024 of JP2008-195018A are preferable.

[0340] As the azo compound (c), for example, the azo compounds and the like described in JP1996-108621A (JP-H08-108621A) can be used.

[0341] As the organic peroxide (d), for example, the compounds described in paragraph 0025 of JP2008-195018A are preferable.

[0342] As the metallocene compound (e), for example, the compounds described in paragraph 0026 of JP2008-195018A are preferable.

[0343] Examples of the azide compound (f) include compounds such as 2,6-bis(4-azidobenzylidene)-4-methylcyclohexanone.

[0344] As the hexaarylbiimidazole compound (g), for example, the compounds described in paragraph 0027 of JP2008-195018A are preferable.

[0345] Examples of the disulfone compound (i) include the compounds described in JP1986-166544A (JP-S61-166544A) and JP2002-328465A.

[0346] As the oxime ester compound (j), for example, the compounds described in paragraphs 0028 to 0030 of JP2008-195018A are preferable.

[0347] Among the above-described electron-accepting polymerization initiators, an oxime ester compound and an onium salt compound are preferable from the viewpoint of the curability. Among these, from the viewpoint of the printing durability, an onium salt compound is preferable, an iodonium salt compound, a sulfonium salt compound, or an azinium salt compound is more preferable, an iodonium salt compound or a sulfonium salt compound is still more preferable, and an iodonium salt compound is particularly preferable.

[0348] Hereinafter, specific examples of these compounds will be described, but the present disclosure is not limited thereto.

[0349] As an example of the iodonium salt compound, a diaryl iodonium salt compound is preferable, and particularly a diphenyl iodonium salt compound substituted with an electron-donating group such as an alkyl group or an alkoxyl group is more preferable. Further, an asymmetric diphenyl iodonium salt compound is preferable. Specific examples thereof include diphenyliodonium=hexafluorophosphate, 4-methoxyphenyl-4-(2-methylpropyl)phenyliodonium=hexafluorophosphate, 4-(2-methylpropyl)phenyl-p-tolyliodonium=hexafluorophosphate, 4-hexyloxyphenyl-2,4,6-trimethoxyphenyliodonium=hexafluorophosphate, 4-hexyloxyphenyl-2,4-diethoxyphenyliodonium=tetrafluoroborate, 4-octyloxyphenyl-2,4,6-trimethoxyphenyliodonium=1-perfluorobutane sulfonate, 4-octyloxyphenyl-2,4,6-trimethoxyphenyliodonium=hexafluorophosphate, and bis(4-t-butylphenyl)iodonium=hexafluorophosphate.

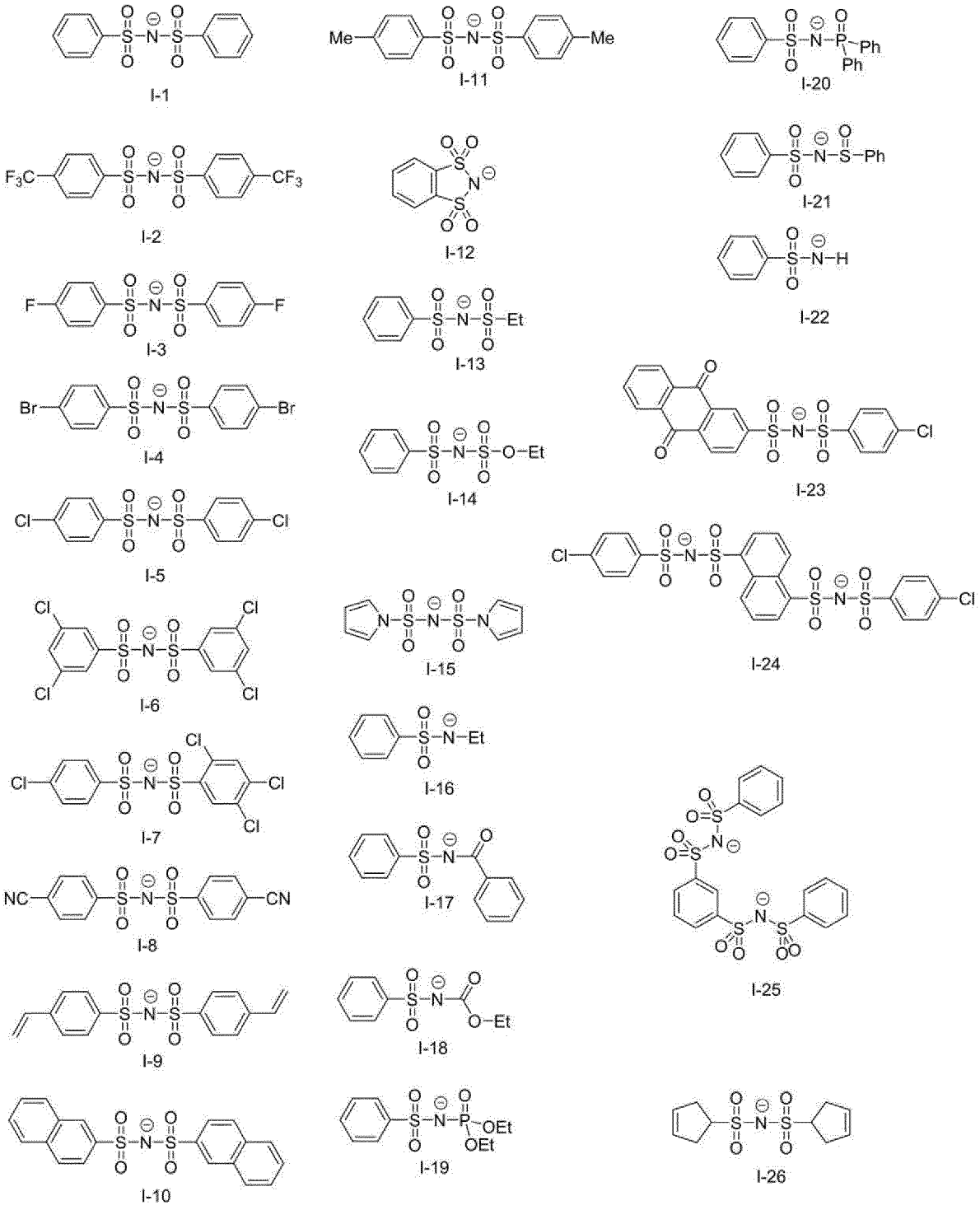
[0350] As an example of the sulfonium salt compound, a triarylsulfonium salt compound is preferable, a triarylsulfonium salt compound in which at least some groups on an aromatic ring such as electron-withdrawing groups have been substituted with halogen atoms is particularly preferable, and a triarylsulfonium salt compound in which the total number of halogen atoms substituted on an aromatic ring is 4 or greater is still more preferable. Specific examples thereof include triphenylsulfonium=hexafluorophosphate, triphenylsulfonium=benzoylformate, bis(4-chlorophenyl)phenylsulfonium=benzoylformate, bis(4-chlorophenyl)-4-methylphenylsulfonium=tetrafluoroborate, tris(4-chlorophenyl)sulfonium=3,5-bis(methoxycarbonyl)benzene sulfonate, tris(4-chlorophenyl)sulfonium=hexafluorophosphate, and tris(2,4-dichlorophenyl)sulfonium=hexafluorophosphate.

[0351] Further, as the counter anion of the iodonium salt compound and the sulfonium salt compound, a sulfonamide anion or a sulfonimide anion is preferable, and a sulfonimide anion is more preferable.

[0352] As the sulfonamide anion, an aryl sulfonamide anion is preferable.

[0353] Further, as the sulfonimide anion, a bisaryl sulfonimide anion is preferable.

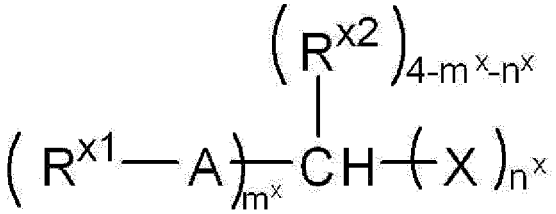
[0354] Specific examples of the sulfonamide anion or the sulfonimide anion are shown below, but the present disclosure is not limited thereto. In the specific examples below, Ph represents a phenyl group, Me represents a methyl group, and Et represents an ethyl group.



[0355] Further, as the electron-accepting polymerization initiator, from the viewpoints of the color developability, the temporal color developability after exposure, the developability, and the UV printing durability of the planographic printing plate precursor to be obtained, a halogenated alkyl polymerization initiator is preferable.

[0356] As the halogenated alkyl polymerization initiator, a halogenated alkyl sulfone compound is preferable, a trihalogenated methyl sulfone compound is more preferable, and a tribromomethyl sulfone compound is particularly preferable.

[0357] Further, as the halogenated alkyl polymerization initiator, a compound represented by Formula (I) can be suitably used.



(I)

[0358] In the formula, X represents a halogen atom, and specific examples thereof include a fluorine atom, a chlorine atom, a bromine atom and an iodine atom. Among these, a chlorine atom or a bromine atom is preferable from the viewpoint of excellent sensitivity, and a bromine atom is particularly preferable.

[0359] A represents a divalent linking group selected from the group consisting of -CO-, -SO-, $-SO_2-$, -PO-, and $-PO_2-$. Among these, -CO-, -SO-, or $-SO_2-$ is more preferable, and -CO- or $-SO_2-$ is particularly preferable. R^{X1} and R^{X2} each independently represent a hydrogen atom or a monovalent hydrocarbon group having 1 to 20 carbon atoms.

[0360] Examples of the hydrocarbon constituting the hydrocarbon group include the hydrocarbons described in paragraphs 0013 and 0014 of JP2002-162741A, and specific examples of the hydrocarbon include an aliphatic hydrocarbon having 1 to 30 carbon atoms such as methane, ethane, propane, butane, hexane, nonane, decane, octadecane, cyclopentane, cyclohexane, adamantane, norbornane, decahydronaphthalene, tricyclo[5.2.1.$0^{2,6}$]decane, ethylene, propylene, 1-butene, 1-hexene, 1-heptadecene, 2-butene, 2-hexene, 4-nonene, 7-tetradecene, butadiene, piperylene, 1,9-decadiene, cyclopentene, cyclohexene, cyclooctene, 1,4-cyclohexadiene, 1, 5-cyclooctadiene, 1,5,9-cyclododecatriene, norbornylene, octahydronaphthalene, bicyclo[2.2.1]hepta-2,5-diene, acetylene, 1-propine, or 2-hexine; and an aromatic hydrocarbon such as benzene, naphthalene, anthracene, indene, or fluorene.

[0361] One or more carbon atoms constituting such a hydrocarbon group may be substituted with hetero atoms selected from an oxygen atom, a nitrogen atom, and a sulfur atom.

[0362] Examples of the substituent include a monovalent non-metal atomic group excluding hydrogen, and specific examples thereof include a halogen atom (-F, -Br, -Cl, or -I), a hydroxy group, an alkoxy group, an aryloxy group, a mercapto group, an alkylthio group, an arylthio group, an alkyldithio group, an aryldithio group, an amino group, a N-alkylamino group, a N,N-dialkylamino group, a N-arylamino group, a N,N-diarylamino group, a N-alkyl-N-arylamino group, an acyloxy group, a carbamoyloxy group, a N-alkylcarbamoyloxy group, a N-arylcarbamoyloxy group, N,N-dialkylcarbamoyloxy group, a N,N-diarylcarbamoyloxy group, a N-alkyl-N-arylcarbamoyloxy group, an alkylsulfoxy group, an arylsulfoxy group, an acylthio group, an acylamino group, a N-alkylacylamino group, a N-arylacylamino group, a ureido group, a N'-alkylureido group, a N',N'-dialkylureido group, a N'-arylureido group, a N',N'-diarylureido group, a N'-alkyl-N'-arylureido group, a N-alkylureido group, a N-arylureido group, a N'-alkyl-N-alkylureido group, a N'-alkyl-N-arylureido group, a N',N'-dialkyl-N-alkylureido group, a N',N'-dialkyl-N-arylureido group, a N'-aryl-N-alkylureido group, a N'-aryl-N-arylureido group, a N',N'-diaryl-N-alkylureido group, a N',N'-diaryl-N-arylureido group, a N'-alkyl-N'-aryl-N-alkylureido group, a N'-alkyl-N'-aryl-N-arylureido group, an alkoxycarbonylamino group, an aryloxycarbonylamino group, a N-alkyl-N-alkoxycarbonylamino group, a N-alkyl-N-aryloxycarbonylamino group, a N-aryl-N-alkoxycarbonylamino group, a N-aryl-N-aryloxycarbonylamino group, a formyl group, an acyl group, a carboxy group and a conjugate base group thereof, an alkoxycarbonyl group, an aryloxycarbonyl group, a carbamoyl group, a N-alkylcarbamoyl group, a N,N-dialkylcarbamoyl group, a N-arylcarbamoyl group, a N,N-diarylcarbamoyl group, a N-alkyl-N-arylcarbamoyl group, an alkylsulfinyl group, an arylsulfinyl group, an alkylsulfonyl group, an arylsulfonyl group, a sulfo group ($-SO_3H$) and a conjugate base group thereof, an alkoxysulfonyl group, an aryloxysulfonyl group, a sulfinamoyl group, a N-alkylsulfinamoyl group, a N,N-dialkylsulfinamoyl group, a N-arylsulfinamoyl group, a N,N-diarylsulfinamoyl group, a N-alkyl-N-arylsulfinamoyl group, a sulfamoyl group, a N-alkylsulfamoyl group, a N,N-dialkylsulfamoyl group, a N-arylsulfamoyl group, a N,N-diarylsulfamoyl group, a N-alkyl-N-arylsulfamoyl group, a N-acylsulfamoyl group and a conjugate base group thereof, a N-alkylsulfonylsulfamoyl group ($-SO_2NHSO_2$(alkyl)) and a conjugate base group thereof, a N-arylsulfonylsulfamoyl group ($-SO_2NHSO_2$(aryl)) and a conjugate base group thereof, a N-alkylsulfonylcarbamoyl group ($-CONHSO_2$(alkyl)) and a conjugate base group thereof, a N-arylsulfonylcarbamoyl group ($-CONHSO_2$(aryl)) and a conjugate base group thereof, an alkoxysilyl group ($-Si(Oalkyl)_3$), an aryloxysilyl group ($-Si(Oaryl)_3$), a hydroxysilyl group ($-Si(OH)_3$) and a conjugate base group thereof, a phosphono group ($-PO_3H_2$) and a conjugate base group thereof, a dialkylphosphono group ($-PO_3(alkyl)_2$), a diarylphosphono group ($-PO_3(aryl)_2$), an alkylarylphosphono group ($-PO_3$(alkyl)(aryl)), a monoalkylphosphono group ($-PO_3H$(alkyl)) and a conjugate base group thereof, a monoarylphosphono group ($-PO_3H$(aryl)) and a conjugate base group thereof, a phosphonooxy group ($-OPO_3H_2$) and a conjugate base group thereof, a dialkylphosphonooxy group ($-OPO_3(alkyl)_2$), a diallylphosphonooxy group ($-OPO_3(aryl)_2$), an alkylarylphosphonooxy group ($-OPO_3$(alkyl)(aryl)), a monoalkylphosphonooxy group ($-OPO_3H$(alkyl)) and a conjugate base group thereof, a monoarylphosphonooxy group ($-OPO_3H$(aryl)) and a conjugate base group thereof, a cyano group, a nitro group, a dialkylboryl group ($-B(alkyl)_2$), a diarylboryl group ($-B(aryl)_2$), an alkylarylboryl group (-B(alkyl)(aryl)), a dihydroxyboryl group ($-B(OH)_2$) and a conjugate base group thereof, an alkylhydroxyboryl group (-B(alkyl)(OH)) and a

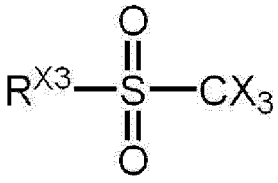
conjugate base group thereof, an arylhydroxyboryl group (-B(aryl)(OH)) and a conjugate base group thereof, an aryl group, an alkyl group, an alkenyl group, and an alkynyl group.

[0363] If possible, these substituents may be bonded to each other or bonded to a hydrocarbon group which has been substituted to form a ring, and the substituents may be further substituted.

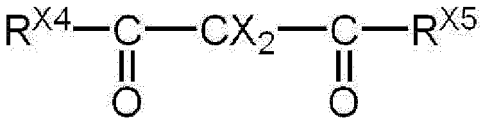
[0364] Preferred examples of the substituents include a halogen atom, an alkoxy group, an aryloxy group, an alkyl group, an alkenyl group, an alkynyl group, and an aryl group.

[0365] m^x and n^x each represent an integer of 1 to 3. Here, $m^x + n^x$ is 2 to 4. In terms of the sensitivity, it is preferable that m^x represents 1 and n^x represents 3, or m^x represents 2 and n^x represents 2. In a case where m^x and n^x represent 2 or greater, (R1-A) and X may be different from each other. Further, in a case where m^x represents 1 and n^x represents 1, R^{x2}s may be different from each other.

[0366] Among the compounds represented by Formula (I), compounds represented by Formulae (II) and (III) are preferable from the viewpoint of excellent visibility.



(II)

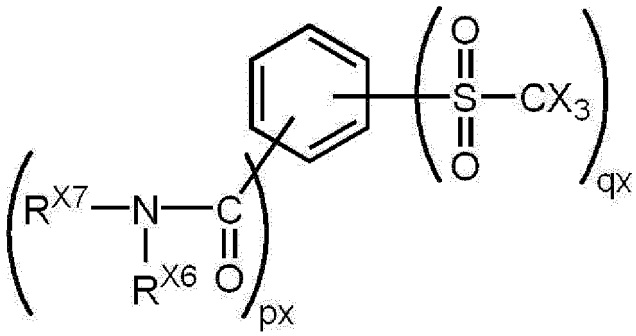


(III)

[0367] In Formulae (II) and (III), X has the same definition as that for X in Formula (I), and R^{X3}, R^{X4}, and R^{X5} each independently represent a monovalent hydrocarbon group having 1 to 20 carbon atoms.

[0368] Here, it is preferable that R^{X3}, R^{X4}, and R^{X5} represent an aryl group and more preferable that the aryl group is substituted with an amide group from the viewpoint that the balance between the sensitivity and the storability is excellent.

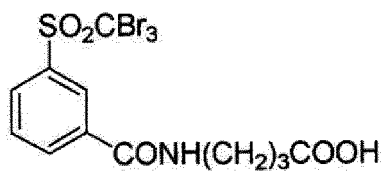
[0369] Among the compounds represented by Formulae (II) and (III), compounds represented by Formula (IV) are particularly preferable.



(IV)

[0370] In Formula (IV), R^{X6} and R^{X7} each independently represent a hydrogen atom or a monovalent hydrocarbon group having 1 to 20 carbon atoms, and px and qx each independently represent an integer of 1 to 5. Here, p + q is 2 to 6.

[0371] Specific examples of the electron-accepting polymerization initiator represented by Formula (I) include compounds shown below, but the present disclosure is not limited thereto. In the specific examples below, Et represents an ethyl group, ^{n}Pr represents an n-propyl group, ^{n}Bu and $^nC_4H_9$ represent an n-butyl group, ^{t}Bu represents a t-butyl group, $^nC_5H_{11}$ represents an n-pentyl group, $^tC_5H_{11}$ represents a t-pentyl group (1,1-dimethylpropyl group), cHex represents a cyclohexyl group, $^nC_8H_{17}$ represents an n-octyl group, $^nC_{12}H_{25}$ represents an n-dodecyl group, and Ph represents a phenyl group.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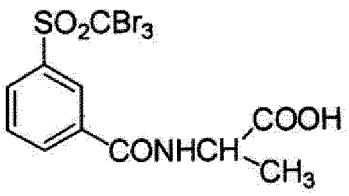
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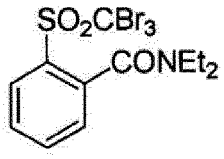
COOH
CH3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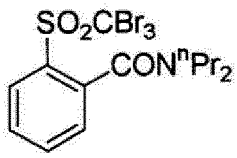
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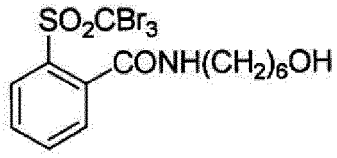
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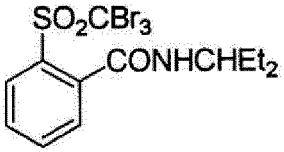
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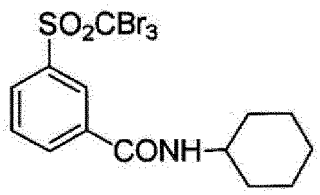
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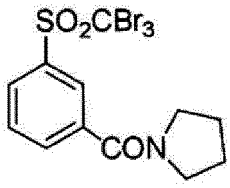
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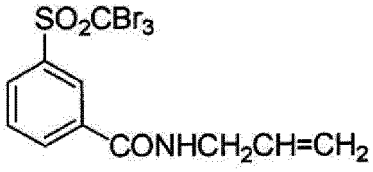
CON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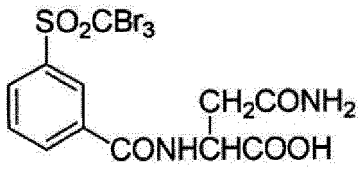
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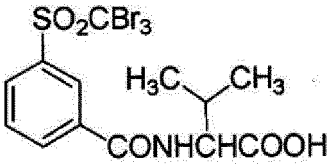
CONHCHCOOH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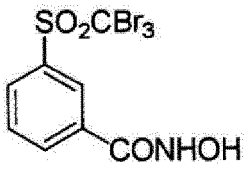
CH3
CONHCHCOOH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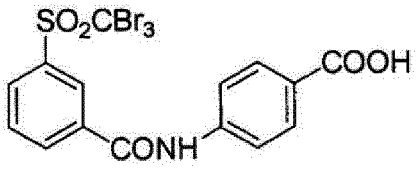
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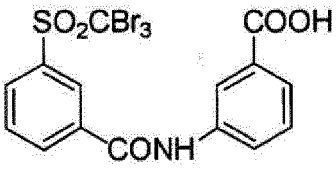
COOH
CONH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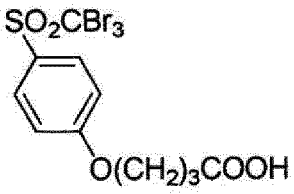
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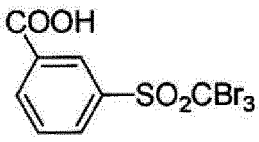
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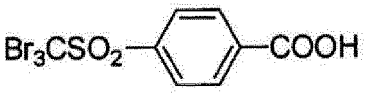
SO2CBr3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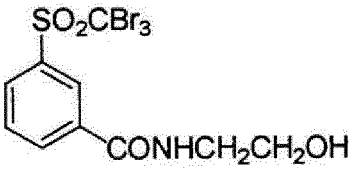
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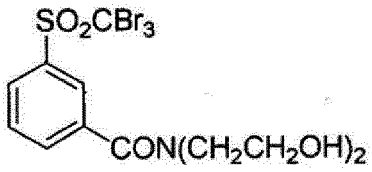
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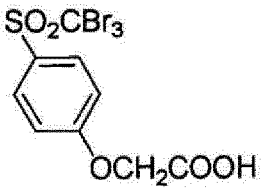
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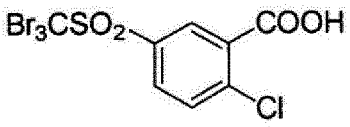
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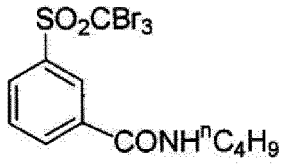
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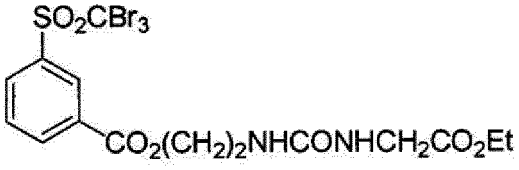
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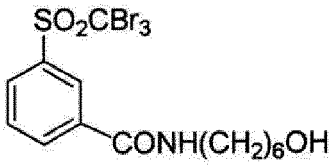
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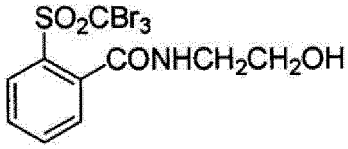
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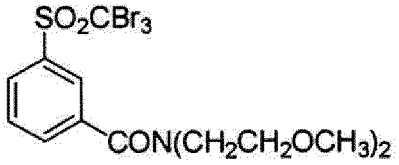
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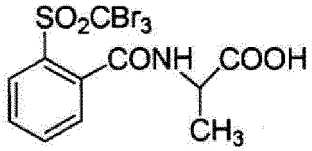
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COOH
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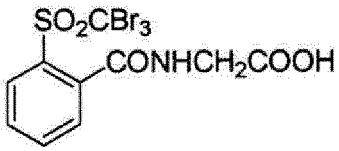
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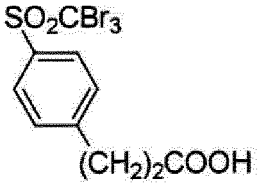
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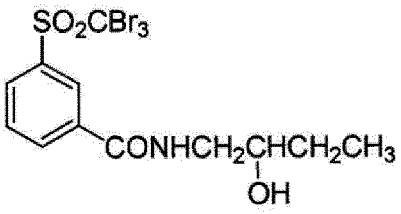
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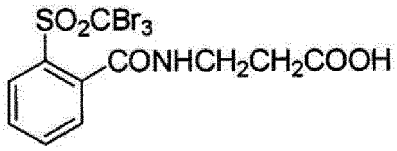
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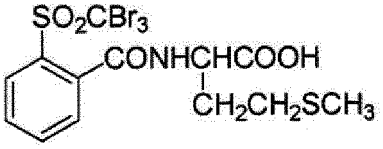
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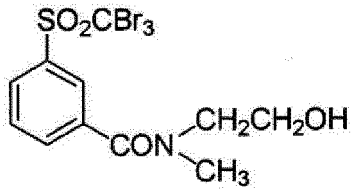
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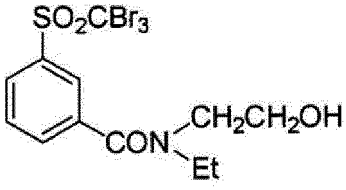
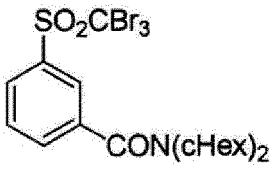
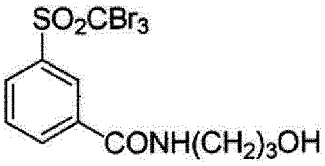
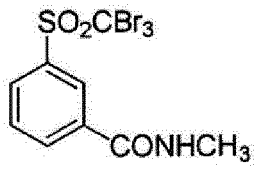
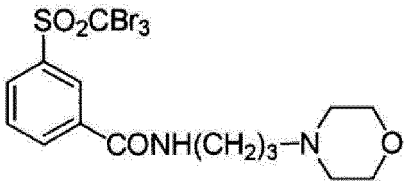
CH3

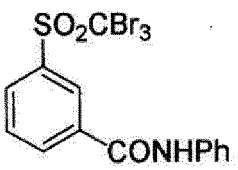

SO2CBr3
CON
CH2CH2OH
Et

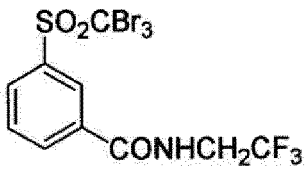

SO2CBr3
CON(cHex)2


SO2CBr3
CONH(CH2)3OH


SO2CBr3
CONHCH3


SO2CBr3
CONH(CH2)3
N
O


SO2CBr3
CONHPh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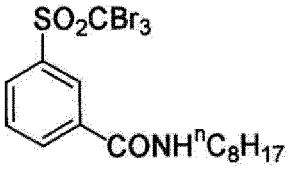
CONHCH2CF3


SO2CBr3
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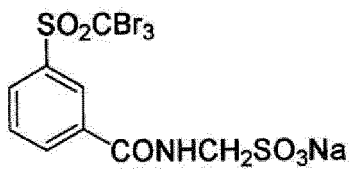
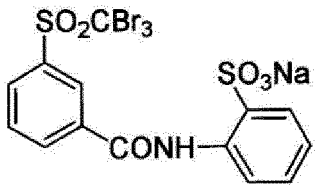
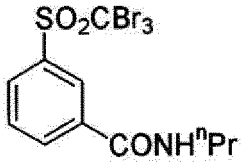
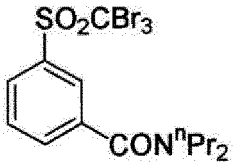

SO2CBr3
CONHCH2SO3Na


SO2CBr3
SO3Na
CONH


SO2CBr3
CONHnPr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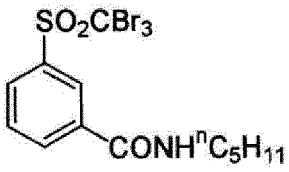
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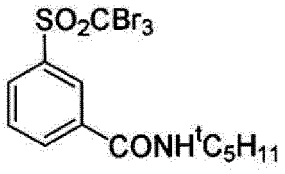
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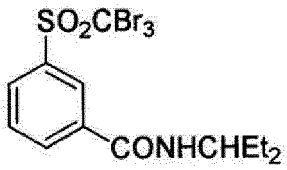
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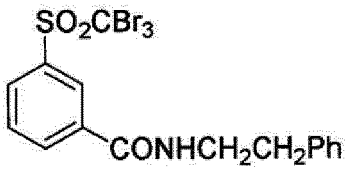
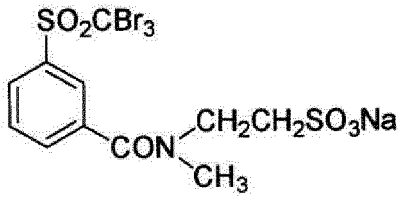
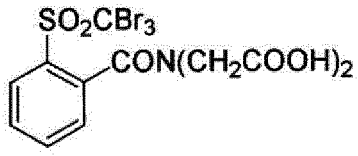
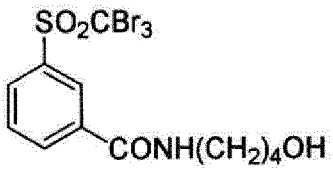
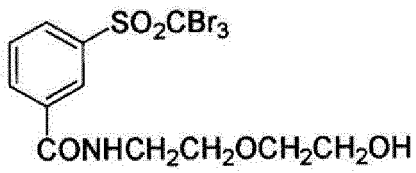
CONHCHEt2

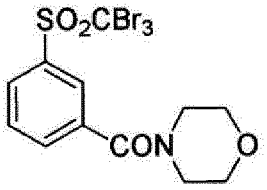

SO2CBr3
CONHCH2CH2Ph

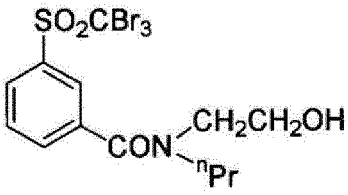

SO2CBr3
CON
CH2CH2SO3Na
CH3

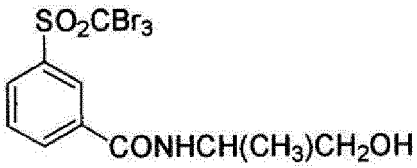

SO2CBr3
CON(CH2COOH)2

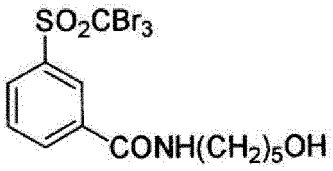

SO2CBr3
CONH(CH2)4OH

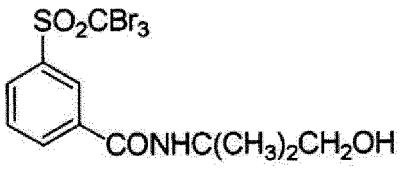

SO2CBr3
CONHCH2CH2OCH2CH2OH

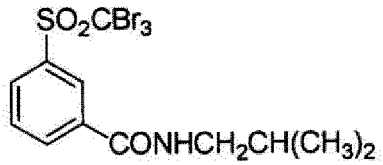

SO2CBr3
CON
O

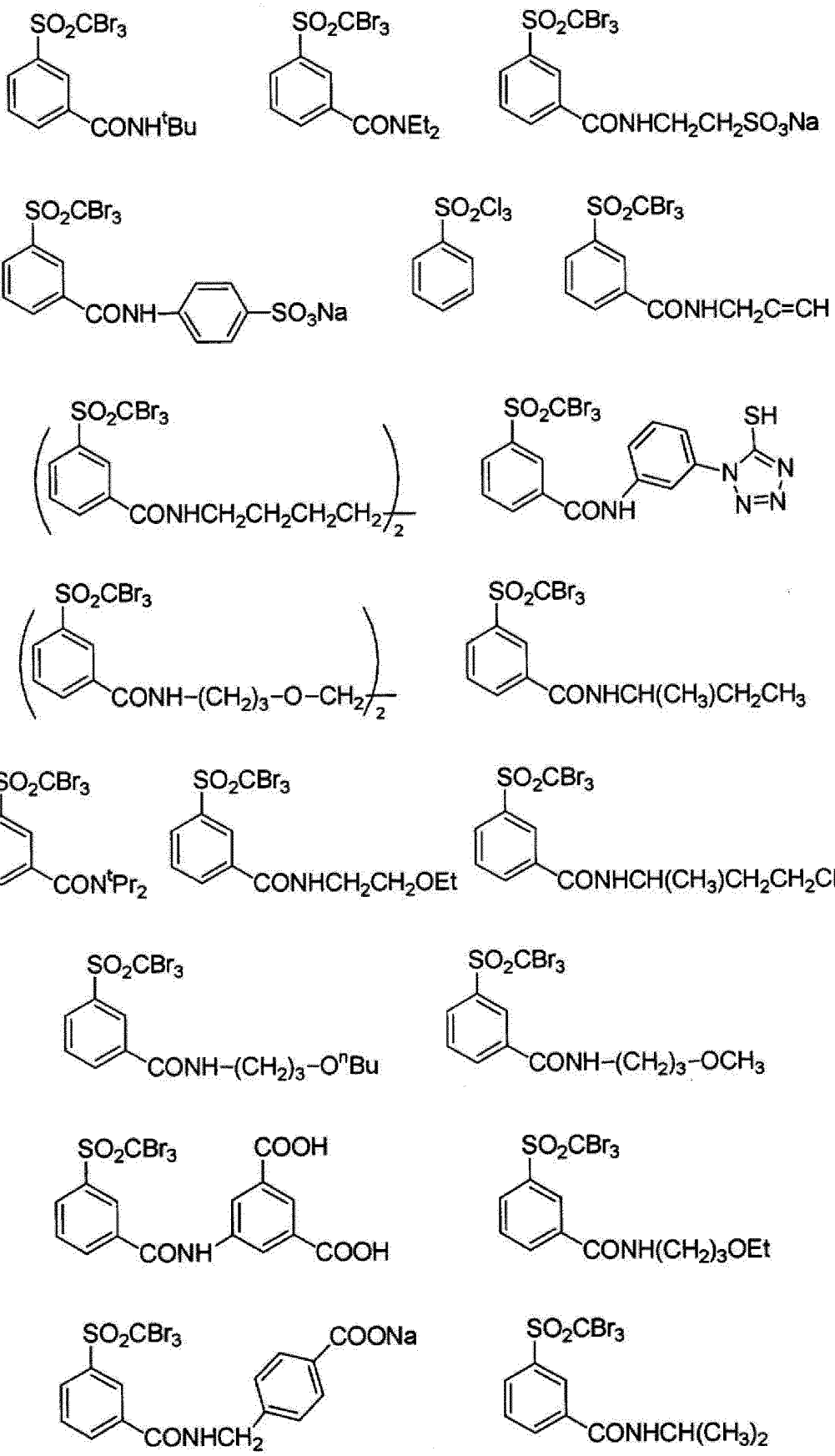

SO2CBr3
CON
CH2CH2OH
nPr

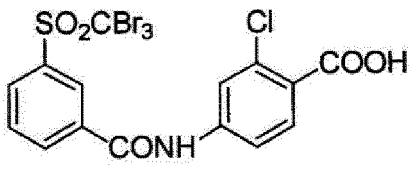

SO2CBr3
CONHCH(CH3)CH2OH

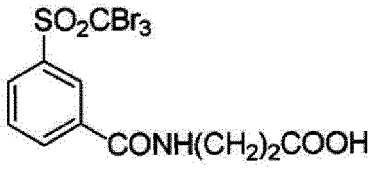

SO2CBr3
CONH(CH2)5OH

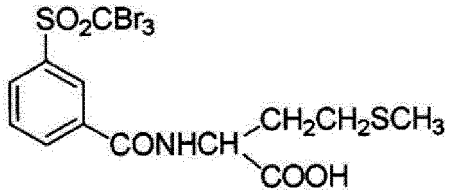

SO2CBr3
CONHC(CH3)2CH2OH

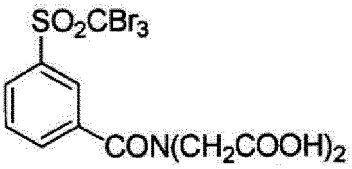

SO2CBr3
CONHCH2CH(CH3)2

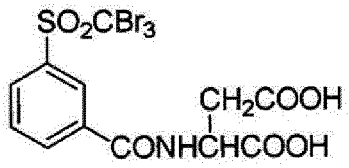


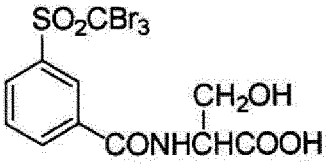

SO2CBr3
Cl
COOH
CONH

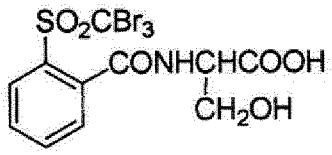

SO2CBr3
CONH(CH2)2COOH

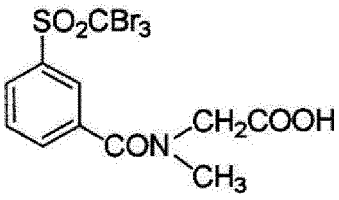

SO2CBr3
CONHCH
CH2CH2SCH3
COOH

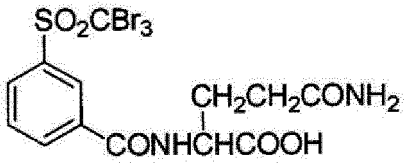

SO2CBr3
CON(CH2COOH)2


SO2CBr3
CH2COOH
CONHCHCOOH


SO2CBr3
CH2OH
CONHCHCOOH


SO2CBr3
CONHCHCOOH
CH2OH


SO2CBr3
CON
CH2COOH
CH3


SO2CBr3
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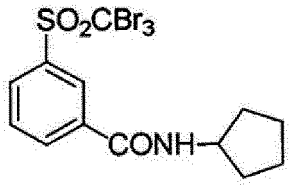
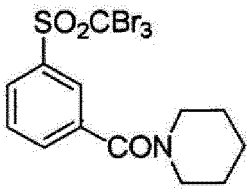
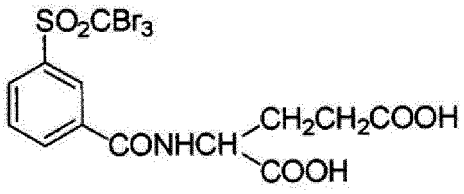
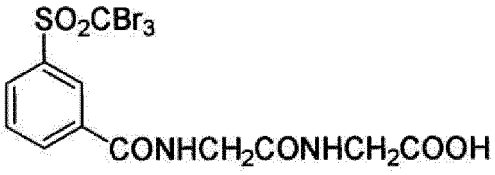
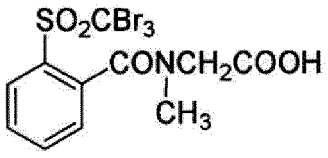
CONHCHCOOH

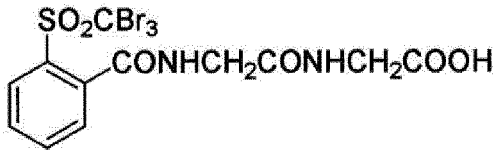

SO2CBr3
CONH

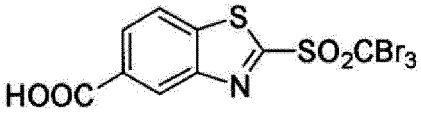

SO2CBr3
CON

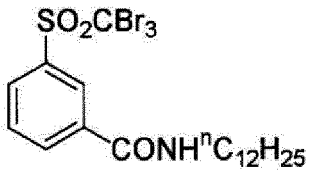

SO2CBr3
CONHCH
CH2CH2COOH
COOH


SO2CBr3
CONHCH2CONHCH2COOH


SO2CBr3
CONCH2COOH
CH3


SO2CBr3
CONHCH2CONHCH2COOH


HOOC
S
N
SO2CBr3


SO2CBr3
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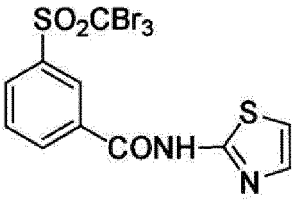
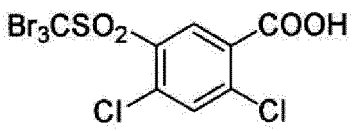
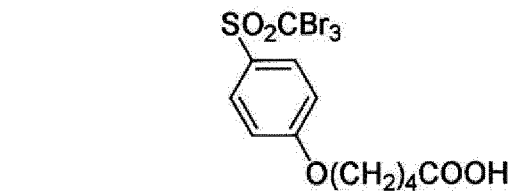
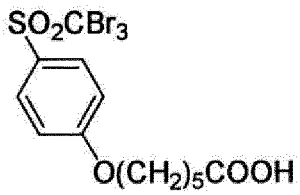
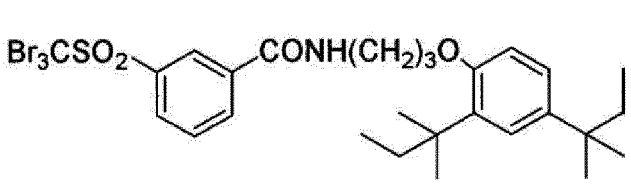
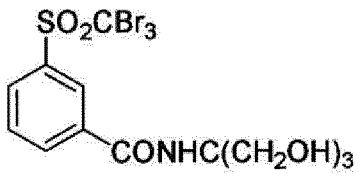

SO2CBr3
CONH
S
N

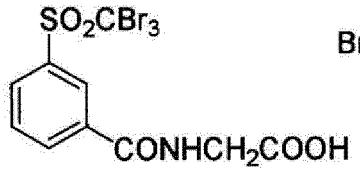

Br3CSO2
COOH
Cl
Cl

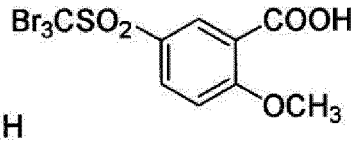


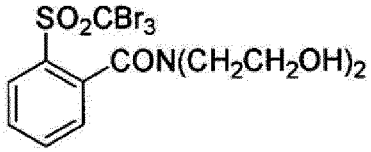


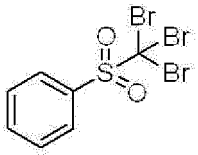












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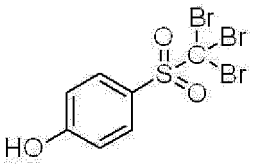
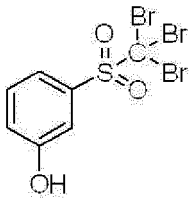


(IS-2)



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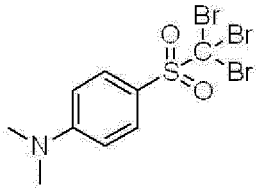

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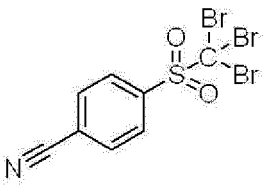

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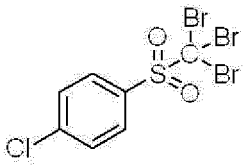

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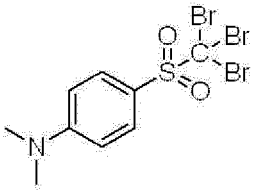

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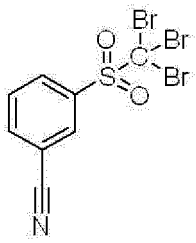

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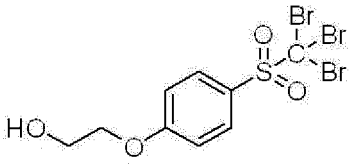

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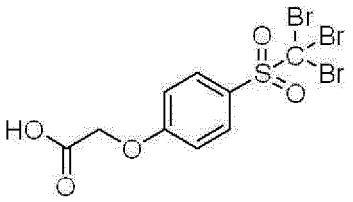

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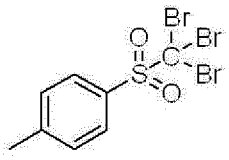

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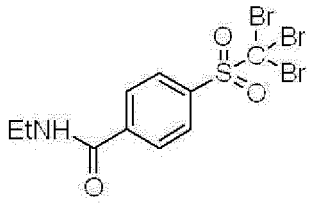

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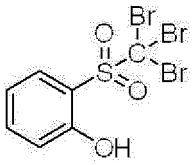

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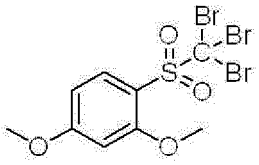


(IS-14)

[0372] Further, one preferred embodiment in the present disclosure is an embodiment in which the electron-accepting polymerization initiator and the electron-donating polymerization initiator form a salt.

[0373] Specific examples thereof include an embodiment in which the above-described onium compound is a salt of an onium ion and an anion (for example, a tetraphenylborate anion) in the electron-donating polymerization initiator. Further, more preferred examples thereof include an iodonium borate compound in which an iodonium cation (for example, a di-p-tolyl iodonium cation) in an iodonium salt compound described below and a borate anion in the above-described electron-donating polymerization initiator form a salt.

[0374] In the present disclosure, in a case where the image recording layer contains an onium ion and an anion in the above-described electron-donating polymerization initiator, the image recording layer contains an electron-accepting polymerization initiator and an electron-donating polymerization initiator.

[0375] From the viewpoints of the chemical resistance and the printing durability, the lowest unoccupied molecular orbital (LUMO) of the electron-accepting polymerization initiator is preferably -3.00 eV or less and more preferably -3.02 eV or less.

[0376] Further, the lower limit thereof is preferably -3.80 eV or greater and more preferably - 3.60 eV or greater.

[0377] The electron-accepting polymerization initiator may be used alone or in combination of two or more kinds thereof.

[0378] From the viewpoints of the color developability and the UV printing durability of the planographic printing plate precursor to be obtained, the content of the electron-accepting polymerization initiator is preferably in a range of 0.1% by mass to 50% by mass, more preferably in a range of 0.5% by mass to 30% by mass, and still more preferably in a range of 0.8% by mass to 20% by mass with respect to the total mass of the image recording layer.

- Compound in which electron-donating polymerization initiator and electron-accepting polymerization initiator forming counter salt -

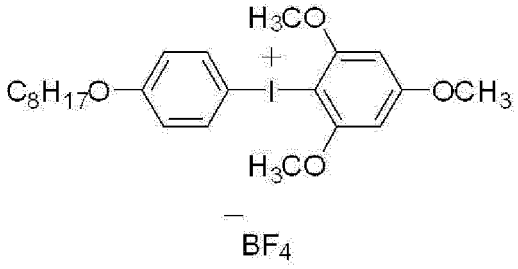
[0379] From the viewpoints of the color developability, the temporal color developability after exposure, the developability, and the UV printing durability of the planographic printing plate precursor to be obtained, it is preferable that the polymerization initiator includes a compound in which the electron-donating polymerization initiator and the electron-accepting polymerization initiator form a counter salt.

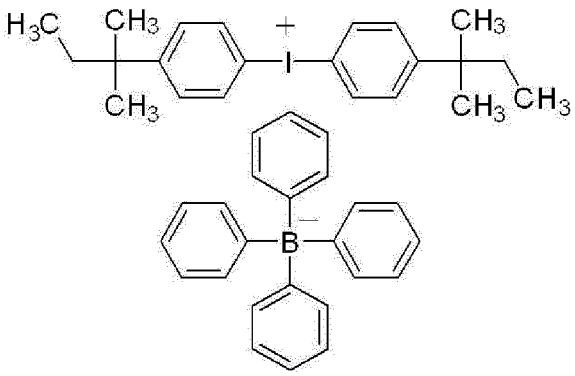
[0380] As the compound in which the electron-donating polymerization initiator and the electron-accepting polymerization initiator form a counter salt, from the viewpoints of the color developability and the UV printing durability of the planographic printing plate to be obtained, a compound in which an anion in the electron-donating polymerization initiator and a cation in the electron-accepting polymerization initiator form a counter salt is preferable, a compound in which an onium cation and a borate anion form a counter salt is more preferable, a compound in which an iodonium cation or a sulfonium cation and a borate anion form a counter salt is still more preferable, and a compound in which a diaryliodonium cation or a triarylsulfonium cation and a tetraaryl borate anion form a counter salt is particularly preferable.

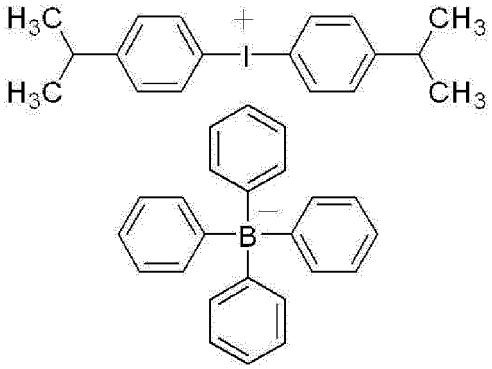
[0381] Preferred embodiments of the anion in the electron-donating polymerization initiator and the cation in the electron-accepting polymerization initiator are the same as the preferred embodiments of the anion in the electron-

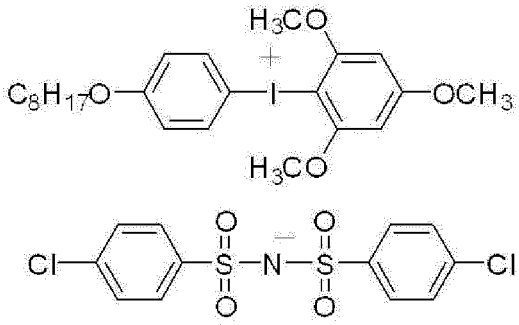
donating polymerization initiator and the cation in the electron-accepting polymerization initiator described above.

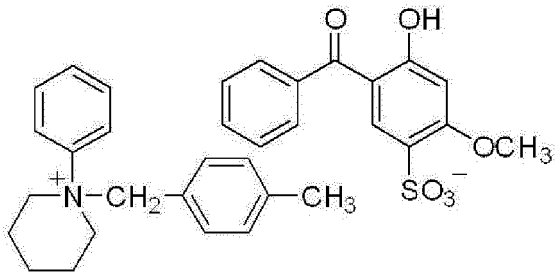
[0382] Specific examples of the embodiment in which the electron-accepting polymerization initiator and the electron-donating polymerization initiator form a salt are shown below, but the present disclosure is not limited thereto.











[0383] The compound in which the electron-donating polymerization initiator and the electron-accepting polymerization initiator form a counter salt may be used alone or in combination of two or more kinds thereof. Further, the compound may be used in combination with the electron-donating polymerization initiator or in combination with the electron-accepting polymerization initiator.

[0384] From the viewpoints of the color developability and the UV printing durability of the planographic printing plate to be obtained, the content of the compound in which the electron-donating polymerization initiator and the electron-accepting polymerization initiator form a counter salt is preferably in a range of 0.1% by mass to 50% by mass, more preferably in a range of 0.5% by mass to 30% by mass, and particularly preferably in a range of 0.8% by mass to 20% by mass with respect to the total mass of the image recording layer.

- Relationship between electron-donating polymerization initiator, electron-accepting polymerization initiator, and decomposable infrared absorbing agent -

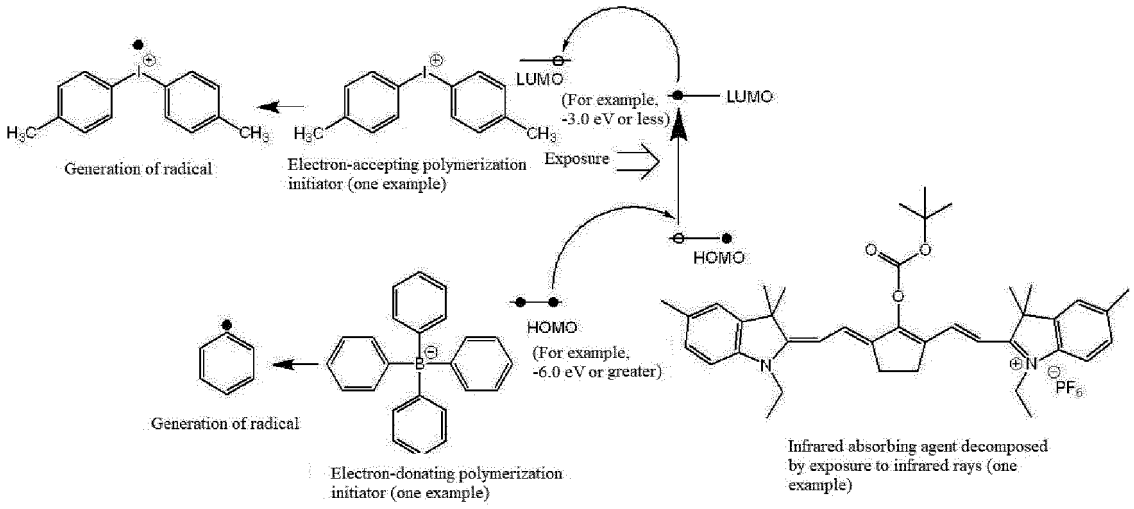
[0385] From the viewpoints of the color developability and the UV printing durability of the planographic printing plate to be obtained, the image recording layer contains the electron-donating polymerization initiator, the electron-accepting polymerization initiator, and the infrared absorbing agent decomposed by exposure to infrared rays, and the HOMO of the electron-donating polymerization initiator is preferably -6.0 eV or greater, and the LUMO of the electron-accepting polymerization initiator is preferably -3.0 eV or less.

[0386] More preferable embodiments of the HOMO of the electron-donating polymerization initiator and the LUMO electron-accepting polymerization initiator are the same as described above.

[0387] In the image recording layer of the present disclosure, it is assumed that the electron-donating polymerization initiator, the infrared absorbing agent, and the electron-accepting polymerization initiator perform energy delivery as described in the following chemical formula.

[0388] Therefore, it is considered that in a case where the HOMO of the electron-donating polymerization initiator is -6.0 eV or greater and the LUMO of the electron-accepting polymerization initiator is -3.0 eV or less, the radical generation efficiency is improved, and thus the chemical resistance and the UV printing durability are more excellent.

[0389] Further, it is assumed that decomposition of a part of the infrared absorbing agent decomposed by exposure to infrared rays may be promoted by exposure to infrared rays due to one electron donation from the electron-donating polymerization initiator.



[0390] From the viewpoints of the UV printing durability and the chemical resistance, a difference between the HOMO of the electron-donating polymerization initiator and the HOMO of the infrared absorbing agent is preferably in a range of 1.00 eV to -0.200 eV and more preferably in a range of 0.700 eV to -0.100 eV Further, the negative values indicate that the HOMO of the electron-donating polymerization initiator is greater than the HOMO of the infrared absorbing agent.

[0391] Further, from the viewpoint of the printing durability and the chemical resistance, a difference between the LUMO of the infrared absorbing agent and the LUMO of the electron-accepting polymerization initiator is preferably in a range of 1.00 eV to -0.200 eV and more preferably in a range of 0.700 eV to -0.100 eV Further, the negative values indicate that the LUMO of the infrared absorbing agent is greater than the LUMO of the electron-accepting polymerization initiator.

[Polymerizable compound]

[0392] The image recording layer in the present disclosure contains a polymerizable compound.

[0393] In the present disclosure, even in a case of a polymerizable compound, the compound corresponding to a polymer other than the above-described specific polymer and the specific polymer described below is considered not to correspond to a polymerizable compound.

[0394] From the viewpoints of the on-press developability and the UV printing durability of the planographic printing plate to be obtained, the molecular weight of the polymerizable compound (the weight-average molecular weight in a case where the compound has a molecular weight distribution) is preferably 50 or greater and less than 2500, more preferably 2000 or less, still more preferably 1500 or less, and particularly preferably in a range of 50 to 1500.

[0395] From the viewpoint of the UV printing durability of the planographic printing plate to be obtained, the mass of the ethylenically unsaturated bond (also referred to as an "ethylenically unsaturated bond equivalent") in the polymerizable compound per 1 mol is preferably 200 g/mol or less, more preferably in a range of 50 g/mol to 200 g/mol, still more preferably in a range of 80 g/mol to 180 g/mol, and particularly preferably in a range of 100 g/mol to 150 g/mol.

[0396] In the present disclosure, the ethylenically unsaturated bond equivalent of the polymerizable compound can be specifically determined, for example, in the following manner.

- Ethylenically unsaturated bond equivalent of dipentaerythritol hexaacrylate (DPHA, molecular weight of 578, six

ethylenically unsaturated bonds): 578 ÷ 6 = 96.3 (g/mol)

- Ethylenically unsaturated bond equivalent of styrene (molecular weight of 104, one ethylenically unsaturated bond): 104 ÷ 1 = 104 (g/mol)
- Ethylenically unsaturated bond equivalent of "mixture of 10 g of DPHA and 20 g of styrene": (10 + 20)/{10/96.3 + 20/104} = 101 (g/mol)

[0397] The ethylenically unsaturated bond equivalent in the present disclosure can be acquired by specifying the molecular weight of the polymerizable compound, the number of ethylenically unsaturated bonds, and the composition of the polymerizable compound in the image recording layer according to known methods and performing calculation according to the above-described calculation method.

[0398] From the viewpoints of the on-press developability and the UV printing durability of the planographic printing plate to be obtained, the ClogP value of the polymerizable compound is preferably 6 or less, more preferably in a range of 2 to 6, still more preferably in a range of 3 to 6, and particularly preferably in a range of 5 to 6.

[0399] The ClogP value in the present disclosure is a value acquired by calculating the common logarithm logP of a distribution coefficient P of 1-octanol and water and is also a value calculated by Chem Draw Ultra ver. 12.0.2.1076 (Cambridge Corporation).

[0400] The polymerizable compound used in the present disclosure may be, for example, a radically polymerizable compound or a cationically polymerizable compound, but it is preferable that the polymerizable compound is an addition polymerizable compound having at least one ethylenically unsaturated bond (ethylenically unsaturated compound). As the ethylenically unsaturated compound, a compound having at least one terminal ethylenically unsaturated bond is preferable, and a compound having two or more terminal ethylenically unsaturated bonds is more preferable. The polymerizable compound may have a chemical form such as a monomer, a pre-polymer, that is, a dimer, a trimer, or an oligomer, or a mixture thereof.

[0401] Among these, from the viewpoint of the UV printing durability of the planographic printing plate to be obtained, the polymerizable compound contains preferably a trifunctional or higher functional polymerizable compound, more preferably a trifunctional or higher functional ethylenically unsaturated compound, and still more preferably a trifunctional or higher functional (meth)acrylate compound.

[0402] Examples of the monomer include unsaturated carboxylic acids (for example, acrylic acid, methacrylic acid, itaconic acid, crotonic acid, isocrotonic acid, or maleic acid), esters thereof, and amides thereof. Among these, esters of unsaturated carboxylic acids and polyhydric alcohol compounds, and amides of unsaturated carboxylic acids and polyhydric amine compounds are preferably used. Further, an addition reaction product of unsaturated carboxylic acid esters having a nucleophilic substituent such as a hydroxy group, an amino group, or a mercapto group or amides with monofunctional or polyfunctional isocyanates or epoxies, and a dehydration condensation reaction product with a monofunctional or polyfunctional carboxylic acid are also suitably used. Further, an addition reaction product of unsaturated carboxylic acid esters having an electrophilic substituent such as an isocyanate group or an epoxy group or amides with monofunctional or polyfunctional alcohols, amines, and thiols, and a substitution reaction product of unsaturated carboxylic acid esters having a releasable substituent such as a halogen group or a tosyloxy group or amides with monofunctional or polyfunctional alcohols, amines, and thiols are also suitable. As another example, a compound group in which the unsaturated carboxylic acid is substituted with unsaturated phosphonic acid, styrene, vinyl ether, or the like can also be used. These compounds are described in JP2006-508380A, JP2002-287344A, JP2008-256850A, JP2001-342222A, JP1997-179296A (JP-H09-179296A), JP1997-179297A (JP-H09-179297A), JP1997-179298A (JP-H09-179298A), JP2004-294935A, JP2006-243493, JP2002-275129A, JP2003-064130A, JP2003-280187A, and JP1998-333321A (JP-H10-333321A).

[0403] Specific examples of the monomer of the ester of a polyhydric alcohol compound and an unsaturated carboxylic acid include acrylic acid ester such as ethylene glycol diacrylate, 1,3-butanediol diacrylate, tetramethylene glycol diacrylate, propylene glycol diacrylate, trimethylolpropane triacrylate, hexanediol diacrylate, tetraethylene glycol diacrylate, pentaerythritol tetraacrylate, sorbitol triacrylate, isocyanuric acid ethylene oxide (EO) modified triacrylate, and a polyester acrylate oligomer. Examples of the methacrylic acid ester include tetramethylene glycol dimethacrylate, neopentyl glycol dimethacrylate, trimethylolpropane trimethacrylate, ethylene glycol dimethacrylate, pentaerythritol trimethacrylate, bis[p-(3-methacryloxy-2-hydroxypropoxy)phenyl]dimethylmethane, and bis[p-(methacryloxyethoxy)phenyl]dimethylmethane. Further, specific examples of the monomer of the amide of a polyvalent amine compound and an unsaturated carboxylic acid include methylenebisacrylamide, methylenebismethacrylamide, 1,6-hexamethylenebisacrylamide, 1,6-hexamethylenebismethacrylamide, diethylenetriamine trisacrylamide, xylylene bisacrylamide, and xylylene bismethacrylamide.

[0404] Further, a urethane-based addition-polymerizable compound produced by the addition reaction of an isocyanate and a hydroxy group is also suitable, and specific examples thereof include a vinyl urethane compound containing two or more polymerizable vinyl groups in one molecule, which is obtained by adding a vinyl monomer containing a hydroxy group represented by Formula (M) to a polyisocyanate compound containing two or more isocyanate groups in one

molecule described in JP1973-041708B (JP-S48-041708B).

$$CH_2=C(R^{M4})COOCH_2CH(R^{M5})OH \quad (M)$$

[0405] In Formula (M), R^{M4} and R^{M5} each independently represent a hydrogen atom or a methyl group.

[0406] Further, suitable examples of the urethane compound include urethane acrylates described in JP1976-037193A (JP-S51-037193A), JP1990-032293B (JP-H02-032293B), JP1990-016765B (JP-H02-016765B), JP2003-344997A, and JP2006-065210A, urethane compounds having an ethylene oxide skeleton described in JP1983-049860B (JP-S58-049860B), JP1981-017654B (JP-S56-017654B), JP1987-039417B (JP-S62-039417B), JP1987-039418B (JP-S62-039418B), JP2000-250211A, and JP2007-094138A, and urethane compounds containing a hydrophilic group described in US7153632A, JP1996-505958A (JP-H08-505958A), JP2007-293221A, and JP2007-293223A.

[0407] The details of the method of using the polymerizable compound such as the structure of the polymerizable compound, whether the polymerizable compound is used alone or in combination, and the amount of addition can be optionally set.

[0408] From the viewpoint of the UV printing durability of the planographic printing plate to be obtained, it is preferable that the image recording layer contains two or more polymerizable compounds.

[0409] The content of the polymerizable compound is preferably in a range of 5% by mass to 75% by mass, more preferably in a range of 10% by mass to 70% by mass, and still more preferably in a range of 15% by mass to 60% by mass with respect to the total mass of the image recording layer.

[0410] Further, the content of the specific polymer in the image recording layer is preferably greater than 0% by mass and 400% by mass or less, more preferably in a range of 25% by mass to 300% by mass, and still more preferably in a range of 50% by mass to 200% by mass with respect to the total mass of the polymerizable compound.

[0411] In the image recording layer, it is preferable that the specific polymer and the polymerizable compound have a sea-island structure. For example, a structure in which the polymerizable compound is dispersed in an island shape (discontinuous layer) in the sea (continuous phase) of the specific polymer can be employed. It is considered that the sea-island structure is easily formed by setting the content of the specific polymer with respect to the total mass of the polymerizable compound to a value in the above-described range. Moreover, it is preferable that the specific polymer is a binder polymer.

[Acid color former]

[0412] From the viewpoints of the color developability and the visibility of the image area, it is preferable that the image recording layer contains an acid color former.

[0413] The "acid color former" used in the present disclosure indicates a compound that exhibits a color-developing property by being heated in a state of receiving an electron-accepting compound (for example, a proton such as an acid). As the acid color former, a colorless compound which has a partial skeleton such as a lactone, a lactam, a sultone, a spiropyran, an ester, or an amide and in which these partial skeletons are rapidly ring-opened or cleaved in a case of being brought into contact with an electron-accepting compound is preferable.

[0414] Examples of such an acid color former include phthalides such as 3,3-bis(4-dimethylaminophenyl)-6-dimethylaminophthalide (referred to as "crystal violet lactone"), 3,3-bis(4-dimethylaminophenyl)phthalide, 3-(4-dimethylaminophenyl)-3-(4-diethylamino-2-methylphenyl)-6-dimethylaminophthalide, 3-(4-dimethylaminophenyl)-3-(1,2-dimethylindol-3 -yl)phthalide, 3 -(4-dimethylaminophenyl)-3 -(2-methylindol-3 -yl)phthalide, 3,3-bis(1,2-dimethylindol-3-yl)-5-dimethylaminophthalide, 3,3-bis(1,2-dimethylindol-3-yl)-6-dimethylaminophthalide, 3,3-bis(9-ethylcarbazol-3-yl)-6-dimethylaminophthalide, 3,3-bis(2-phenylindol-3-yl)-6-dimethylaminophthalide, and 3-(4-dimethylaminophenyl)-3-(1-methylpyrrol-3-yl)-6-dimethylaminophthalide,

3,3-bis[1,1-bis(4-dimethylaminophenyl)ethylene-2-yl]-4,5,6,7-tetrachlorophthalide, 3,3-bis[1,1-bis(4-pyrrolidinophenyl)ethylene-2-yl]-4,5,6,7-tetrabromophthalide, 3,3-bis[1-(4-dimethylaminophenyl)-1-(4-methoxyphenyl)ethylene-2-yl]-4,5,6,7-tetrachlorophthalide, 3,3-bis[1-(4-pyrrolidinophenyl)-1-(4-methoxyphenyl)ethylene-2-yl]4,5,6,7-tetrachlorophthalide, 3-[1,1-di(1-ethyl-2-methylindol-3-yl)ethylene-2-yl]-3-(4-diethylaminophenyl)phthalide, 3-[1,1-di(1-ethyl-2-methylindol-3-yl)ethylene-2-yl]-3-(4-N-ethyl-N-phenylaminophenyl)phthalide, 3-(2-ethoxy-4-diethylaminophenyl)-3-(1-n-octyl-2-methylindol-3-yl)-phthalide, 3,3-bis(1-n-octyl-2-methylindol-3-yl)-phthalide, and 3-(2-methyl-4-diethylaminophenyl)-3-(1-n-octyl-2-methylindol-3-yl)-phthalide,

4,4-bis-dimethylaminobenzhydrinbenzylether, N-halophenyl-leucoauramine, N-2,4,5-trichlorophenyl leucoauramine, rhodamine-B-anilinolactam, rhodamine-(4-nitroanilino)lactam, rhodamine-B-(4-chloroanilino)lactam, 3,7-bis(diethylamino)-10-benzoylphenoxazine, benzoyl leucomethylene blue, and 4-nitrobenzoyl methylene blue,

fluorans such as 3,6-dimethoxyfluoran, 3-dimethylamino-7-methoxyfluoran, 3-diethylamino-6-methoxyfluoran, 3-diethylamino-7-methoxyfluoran, 3-diethylamino-7-chlorofluoran, 3-diethylamino-6-methyl-7-chlorofluoran, 3-di-

ethylamino-6,7-dimethylfluoran, 3-N-cyclohexyl-N-n-butylamino-7-methylfluoran, 3-diethylamino-7-dibenzylaminofluoran, 3-diethylamino-7-octylaminofluoran, 3-diethylamino-7-di-n-hexylaminofluoran, 3-diethylamino-7-anilinofluoran, 3-diethylamino-7-(2'-fluorophenylamino)fluoran, 3-diethylamino-7-(2'-chlorophenylamino)fluoran, 3-diethylamino-7-(3'-chlorophenylamino)fluoran, 3-diethylamino-7-(2',3'-dichlorophenylamino)fluoran, 3-diethylamino-7-(3'-trifluoromethylphenylamino)fluoran, 3-di-n-butylamino-7-(2'-fluorophenylamino)fluoran, 3-di-n-butylamino-7-(2'chlorophenylamino)fluoran, 3-N-isopentyl-N-ethylamino-7-(2'-chlorophenylamino)fluoran, 3-N-n-hexyl-N-ethylamino-7-(2'-chlorophenylamino)fluoran, 3-diethylamino-6-chloro-7-anilinofluoran, 3-di-n-butylamino-6-chloro-7-anilinofluoran, 3-diethylamino-6-methoxy-7-anilinofluoran, 3-di-n-butylamino-6-ethoxy-7-anilinofluoran, 3-pyrrolidino-6-methyl-7-anilinofluoran, 3-pyrrolidino-6-methyl-7-anilinofluoran, 3-morpholino-6-methyl-7-anilinofluran, 3-dimethylamino-6-methyl-7-anilinofluoran, 3-diethylamino-6-methyl-7-anilinofluoran, 3-di-n-butylamino-6-methyl-7-anilinofluoran, 3-di-n-pentylamino-6-methyl-7-anilinofluoran, 3-N-ethyl-N-methylamino-6-methyl-7-anilinofluoran, 3-N-n-propyl-N-methylamino-6-methyl-7-anilinofluoran, 3-N-n-propyl-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-n-butyl-N-methylamino-6-methyl-7-anilinofluoran, 3-N-n-butyl-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-isobutyl-N-methylamino-6-methyl-7-anilinofluoran, 3-N-isobutyl-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-isopentyl-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-n-hexyl-N-methylamino-6-methyl-7-anilinofluoran, 3-N-cyclohexyl-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-cyclohexyl-N-n-propylamino-6-methyl-7-anilinofluoran, 3-N-cyclohexyl-N-n-butylamino-6-methyl-7-anilinofluoran, 3-N-cyclohexyl-N-n-hexylamino-6-methyl-7-anilinofluoran, 3-N-cyclohexyl-N-n-octylamino-6-methyl-7-anilinofluoran, 3-N-(2'-methoxyethyl)-N-methylamino-6-methyl-7-anilinofluoran, 3-N-(2'-methoxyethyl)-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-(2'-methoxyethyl)-N-isobutylamino-6-methyl-7-anilinofluoran, 3-N-(2'-ethoxyethyl)-N-methylamino-6-methyl-7-anilinofluoran, 3-N-(2'-ethoxyethyl)-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-(3'-methoxypropyl)-N-methylamino-6-methyl-7-anilinofluoran, 3-N-(3'methoxypropyl)-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-(3'-ethoxypropyl)-N-methylamino-6-methyl-7-anilinofluoran, 3-N-(3'ethoxypropyl)-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-(2'-tetrahydrofurfuryl)-N-ethylamino-6-methyl-7-anilinofluoran, 3-N-(4'-methylphenyl)-N-ethylamino-6-methyl-7-anilinofluoran, 3-diethylamino-6-ethyl-7-anilinofluoran, 3-diethylamino-6-methyl-7-(3'-methylphenylamino)fluoran, 3-diethylamino-6-methyl-7-(2',6'-dimethylphenylamino)fluoran, 3-di-n-butylamino-6-methyl-7-(2',6'-dimethylphenylamino)fluoran, 3-di-n-butylamino-7-(2',6'-dimethylphenylamino)fluoran, 2,2-bis[4'-(3-N-cyclohexyl-N-methylamino-6-methylfluoran)-7-ylaminophenyl]propane, 3-[4'-(4-phenylaminophenyl)aminophenyl]amino-6-methyl-7-chlorofluoran, and 3-[4'(dimethylaminophenyl)]amino-5,7-dimethylfluoran,

phthalides such as 3-(2-methyl-4-diethylaminophenyl)-3-(1-ethyl-2-methylindol-3-yl)-4-azaphthalide, 3-(2-n-propoxycarbonylamino-4-di-n-propylaminophenyl)-3-(1-ethyl-2-methylindol-3-yl)-4-azaphthalide, 3-(2-methylamino-4-di-n-propylaminophenyl)-3-(1-ethyl-2-methylindol-3-yl)-4-azaphthalide, 3-(2-methyl-4-di-n-hexylaminophenyl)-3-(1-n-octyl-2-methylindol-3-yl)-4,7-diazaphthalide, 3,3-bis(2-ethoxy-4-diethylaminophenyl)-4-azaphthalide, 3,3-bis(1-n-octyl-2-methylindol-3-yl)-4-azaphthalide, 3-(2-ethoxy-4-diethylaminophenyl)-3-(1-ethyl-2-methylindol-3-yl)-4-azaphthalide, 3-(2-ethoxy-4-diethylaminophenyl)-3-(1-octyl-2-methylindol-3-yl)-4-azaphthalide, 3-(2-ethoxy-4-diethylaminophenyl)-3-(1-octyl-2-methylindol-3-yl)-7-azaphthalide, 3-(2-ethoxy-4-diethylaminophenyl)-3-(1-ethyl-2-methylindol-3-yl)-4-azaphthalide, 3-(2-ethoxy-4-diethylaminophenyl)-3-(1-ethyl-2-methylindol-3-yl)-7-azaphthalide, 3-(2-hexyloxy-4-diethylaminophenyl)-3-(1-ethyl-2-methylindol-3-yl)-4-azaphthalide, 3-(2-hexyloxy-4-diethylaminophenyl)-3-(1-ethyl-2-methylindol-3-yl)-7-azaphthalide, 3-(2-ethoxy-4-diethylaminophenyl)-3-(1-ethyl-2-phenylindol-3-yl)-4-azaphthalide, 3-(2-ethoxy-4-diethylaminophenyl)-3-(1-ethyl-2-phenylindol-3-yl)-7-azaphthalide, 3-(2-butoxy-4-diethylaminophenyl)-3-(1-ethyl-2-phenylindol-3-yl)-4-azaphthalide, 3-(2-butoxy-4-diethylaminophenyl)-3-(1-ethyl-2-phenylindol-3-yl)-7-azaphthalide, 3-methyl-spiro-dinaphthopyran, 3-ethyl-spiro-dinaphthopyran, 3-phenyl-spiro-dinaphthopyran, 3-benzyl-spiro-dinaphthopyran, 3-methyl-naphtho-(3-methoxybenzo)spiropyran, 3-propyl-spiro-dibenzopyran-3,6-bis(dimethylamino)fluorene-9-spiro-3'-(6'-dimethylamino)phthalide, and 3,6-bis(diethylamino)fluorene-9-spiro-3'-(6'-dimethylamino)phthalide.

[0415] Further, other examples thereof include 2-anilino-6'-(N-ethyl-N-isopentyl)amino-3'-methylspiro[isobenzofuran-1(3H),9'-(9H)xanthene]-3-one, 2'-anilino-6'-(N-ethyl-N-(4-methylphenyl))amino-3'-methylspiro[isobenzofuran-1(3H),9'-(9H)xanthene]-3-one, 3'-N,N-dibenzylamino-6'-N,N-diethylaminospiro[isobenzofuran-1(3H),9'-(9H)xanthene]-3-one, and 2'-(N-methyl-N-phenyl)amino-6'-(N-ethyl-N-(4-methylphenyl))aminospiro[isobenzofuran-1(3H),9'-(9H)xanthene]-3-one.

[0416] Among these, from the viewpoint of the color developability, it is preferable that the acid color former used in the present disclosure is at least one compound selected from the group consisting of a spiropyran compound, a spirooxazine compound, a spirolactone compound, and a spirolactam compound.

[0417] From the viewpoint of the visibility, it is preferable that the color tone of the dye after color development is green, blue, or black.

[0418] As the acid color former, a commercially available product can be used, and examples thereof include ETAC, RED500, RED520, CVL, S-205, BLACK305, BLACK400, BLACK100, BLACK500, H-7001, GREEN300, NIRBLACK78,

BLUE220, H-3035, BLUE203, ATP, H-1046, and H-2114 (all manufactured by Fukui Yamada Chemical Co., Ltd.), ORANGE-DCF, Vermilion-DCF, PINK-DCF, RED-DCF, BLMB, CVL, GREEN-DCF, and TH-107 (all manufactured by Hodogaya Chemical Co., Ltd.), ODB, ODB-2, ODB-4, ODB-250, ODB-BlackXV, Blue-63, Blue-502, GN-169, GN-2, Green-118, Red-40, and Red-8 (all manufactured by Yamamoto Chemicals Inc.), and Crystal Violet Lactone (manufactured by Tokyo Chemical Industry Co., Ltd.). Among these commercially available products, ETAC, S-205, BLACK305, BLACK400, BLACK100, BLACK500, H-7001, GREEN300, NIRBLACK78, H-3035, ATP, H-1046, H-2114, GREEN-DCF, Blue-63, GN-169, and Crystal Violet Lactone are preferable from the viewpoint that the visible light absorbance of a film to be formed is satisfactory.

[0419] These acid color formers may be used alone or in combination of two or more kinds thereof.

[0420] The content of the acid color former is preferably in a range of 0.5% by mass to 10% by mass and more preferably in a range of 1% by mass to 5% by mass with respect to the total mass of the image recording layer.

[Polymer other than specific polymer]

[0421] The image recording layer may contain polymers other than the specific polymer (hereinafter, also referred to as "other polymers").

[0422] Other polymers are polymers that do not have structural units formed of styrene compounds. Further, the other polymer may be polymer particles.

[0423] As other polymers, a (meth)acrylic resin, a polyvinyl acetal resin, and a polyurethane resin are preferable.

[0424] Among these, as the other polymers, known polymers used in the image recording layer of the planographic printing plate precursor can be suitably used. As an example, a polymer used in the on-press development type planographic printing plate precursor (hereinafter, also referred to as a polymer for on-press development) will be described in detail.

[0425] As the polymer for on-press development, a polymer having an alkylene oxide chain is preferable. The polymer having an alkylene oxide chain may have a poly(alkylene oxide) moiety in the main chain or in a side chain. Further, the binder polymer may be a graft polymer having poly(alkylene oxide) in a side chain or a block copolymer of a block formed of a poly(alkylene oxide)-containing repeating unit and a block formed of an (alkylene oxide)-free repeating unit.

[0426] A polyurethane resin is preferable in a case where the binder polymer has a poly(alkylene oxide) moiety in the main chain. Examples of the polymer of the main chain in a case of having a poly(alkylene oxide) moiety in a side chain include a (meth)acrylic resin, a polyvinyl acetal resin, a polyurethane resin, a polyurea resin, a polyimide resin, a polyamide resin, an epoxy resin, a polystyrene resin, a novolak type phenol resin, a polyester resin, synthetic rubber, and natural rubber. Among these, a (meth)acrylic resin is particularly preferable.

[0427] Other preferred examples of other polymers include a polymer compound (hereinafter, also referred to as a "star type polymer compound") which has a polymer chain bonded to a nucleus through a sulfide bond by using a hexa- to decafunctional polyfunctional thiol as the nucleus and in which the polymer chain contains a polymerizable group. As the star type polymer compound, for example, compounds described in JP2012-148555A can be preferably used.

[0428] Examples of the star type polymer compound include compounds having a polymerizable group such as an ethylenically unsaturated bond in the main chain or in a side chain and preferably in a side chain for improving coated-film hardness of an image area as described in JP2008-195018A. Crosslinking occurs between polymer molecules by a polymerizable group so that curing is promoted.

[0429] As the polymerizable group, an ethylenically unsaturated group such as a (meth)acryl group, a vinyl group, an allyl group, or a vinylphenyl group (styryl group) or an epoxy group is preferable, a (meth)acryl group, a vinyl group, or a vinylphenyl group (styryl group) is more preferable from the viewpoint of the polymerization reactivity, and a (meth)acryl group is particularly preferable. These groups can be introduced into a polymer by a polymer reaction or copolymerization. For example, a reaction between a polymer having a carboxy group in a side chain thereof and glycidyl methacrylate or a reaction between a polymer having an epoxy group and ethylenically unsaturated group-containing carboxylic acid such as methacrylic acid can be used. These groups may be used in combination.

[0430] In the molecular weight of other polymers, the weight-average molecular weight (Mw) thereof in terms of polystyrene that is measured according to the GPC method is preferably 2000 or greater, more preferably 5000 or greater, and still more preferably in a range of 10000 to 300000.

[0431] As necessary, hydrophilic polymers such as polyvinyl alcohol and polyacrylic acid described in JP2008-195018A can be used in combination. Further, a lipophilic polymer and a hydrophilic polymer can be used in combination.

[0432] In the image recording layer used in the present disclosure, other polymers may be used alone or in combination of two or more kinds thereof.

[0433] The image recording layer may contain an optional amount of other polymers, and the content of the polymers is preferably in a range of 1% by mass to 90% by mass and more preferably in a range of 5% by mass to 80% by mass with respect to the total mass of the image recording layer.

[0434] Further, in a case where the image recording layer of the present disclosure contains other polymers, the

content of other polymers is preferably greater than 0% by mass and 99% by mass or less, more preferably in a range of 20% by mass to 95% by mass, and still more preferably in a range of 40% by mass to 90% by mass with respect to the total mass of the specific polymer and other polymers.

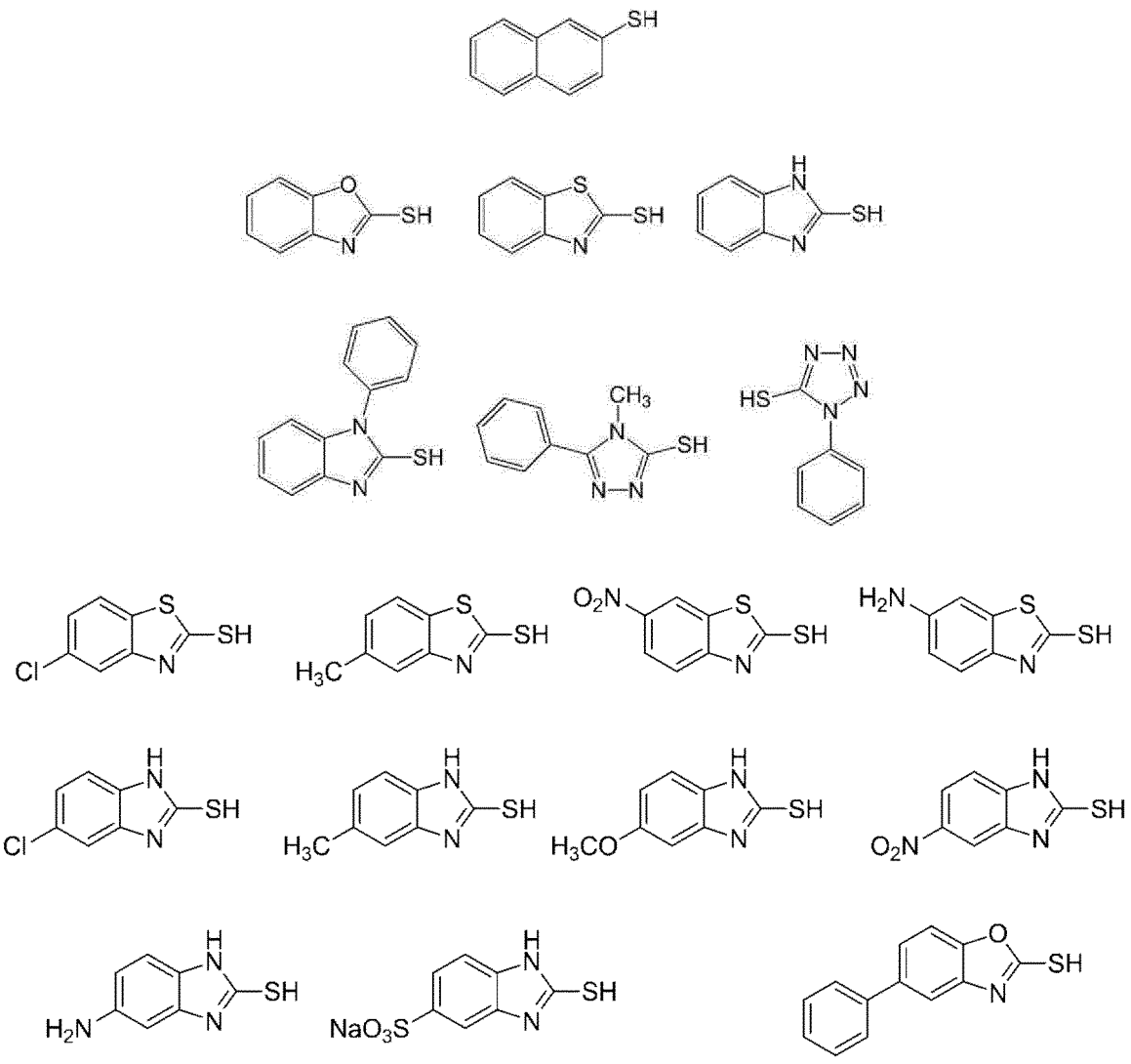
[0435] Further, it is preferable that the content of other polymers in the image recording layer is smaller than the content of the specific polymer.

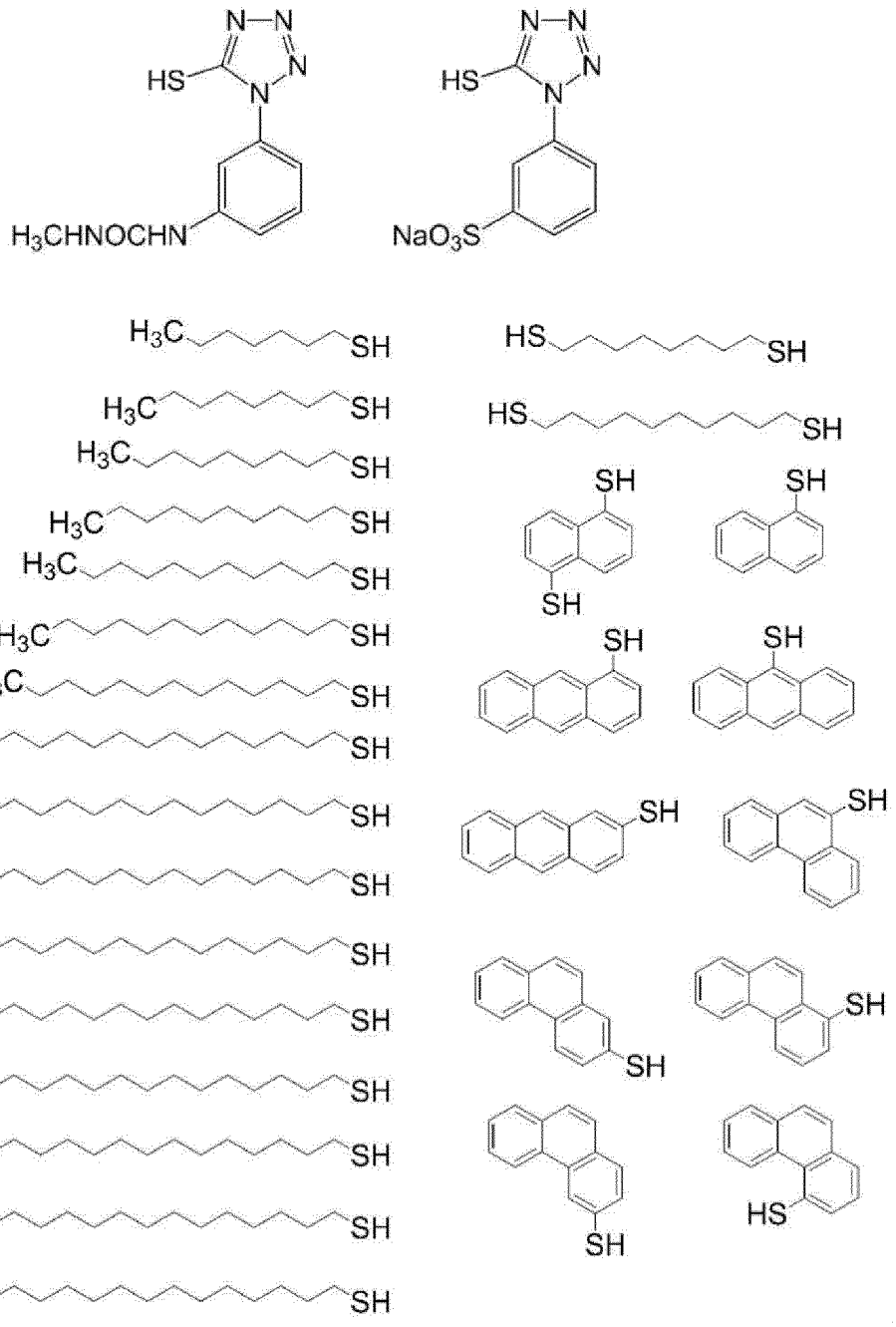
[Chain transfer agent]

[0436] The image recording layer may contain a chain transfer agent. The chain transfer agent contributes to improvement of the printing durability of the planographic printing plate.

[0437] As the chain transfer agent, a thiol compound is preferable, a thiol group having 7 or more carbon atoms is more preferable from the viewpoint of the boiling point (difficulty in volatilization), and a compound containing a mercapto group on an aromatic ring (aromatic thiol compound) is still more preferable. It is preferable that the thiol compound is a monofunctional thiol compound.

[0438] Specific examples of the chain transfer agent include the following compounds.





[0439] The chain transfer agent may be used alone or in combination of two or more kinds thereof.

[0440] The content of the chain transfer agent is preferably in a range of 0.01% by mass to 50% by mass, more preferably in a range of 0.05% by mass to 40% by mass, and still more preferably in a range of 0.1% by mass to 30% by mass with respect to total mass of the image recording layer.

[Sensitizing agent]

[0441] In order to improve the impressing property, the image recording layer may contain a sensitizing agent such as a phosphonium compound, a nitrogen-containing low-molecular-weight compound, or an ammonium group-containing polymer. Particularly, in a case where an overcoat layer contains an inorganic layered compound, these compounds function as a surface coating agent of the inorganic layered compound and suppress degradation of the impressing property due to the inorganic layered compound during the printing.

[0442] As the sensitizing agent, it is preferable that a phosphonium compound, a nitrogen-containing low-molecular-weight compound, and an ammonium group-containing polymer are used in combination and more preferable that a

phosphonium compound, quaternary ammonium salts, and an ammonium group-containing polymer are used in combination.

- Phosphonium compound -

[0443] Examples of the phosphonium compound include phosphonium compounds described in JP2006-297907A and JP2007-050660A. Specific examples thereof include tetrabutyl phosphonium iodide, butyl triphenyl phosphonium bromide, tetraphenyl phosphonium bromide, 1,4-bis(triphenylphosphonio)butane=di(hexafluorophosphate), 1,7-bis(triphenylphosphonio)heptane=sulfate, and 1,9-bis(triphenylphosphonio)nonane=naphthalene-2,7-disulfonate.

- Nitrogen-containing low-molecular-weight compound-

[0444] Examples of the nitrogen-containing low-molecular-weight compound include amine salts and quaternary ammonium salts. Further, examples thereof include imidazolinium salts, benzimidazolinium salts, pyridinium salts, and quinolinium salts. Among these, quaternary ammonium salts and pyridinium salts are preferable. Specific examples thereof include tetramethyl ammonium=hexafluorophosphate, tetrabutylammonium=hexafluorophosphate, dodecyltrimethylammonium=p-toluene sulfonate, benzyltriethylammonium=hexafluorophosphate, benzyldimethyloctylammonium=hexafluorophosphate, benzyldimethyldodecylammonium=hexafluorophosphate, and compounds described in paragraphs 0021 to 0037 of JP2008-284858A and paragraphs 0030 to 0057 of JP2009-090645A.

- Ammonium group-containing polymer -

[0445] The ammonium group-containing polymer may contain an ammonium group in the structure thereof, and a polymer that contains, as a copolymerization component, 5% by mole to 80% by mole of (meth)acrylate containing an ammonium group in a side chain is preferable. Specific examples thereof include polymers described in paragraphs 0089 to 0105 of JP2009-208458A.

[0446] The reduced specific viscosity (unit: ml/g) of the ammonium salt-containing polymer which is acquired by the measuring method described in JP2009-208458A is preferably in a range of 5 to 120, more preferably in a range of 10 to 110, and particularly preferably in a range of 15 to 100. In a case where the reduced specific viscosity is converted to the weight-average molecular weight (Mw), the value thereof is preferably in a range of 10,000 to 150,0000, more preferably in a range of 17,000 to 140,000, and particularly preferably in a range of 20,000 to 130,000.

[0447] Hereinafter, specific examples of the ammonium group-containing polymer will be described.

(1) A 2-(trimethylammonio)ethylmethacrylate=p-toluenesulfonate/3,6-dioxaheptylmethacrylate copolymer (molar ratio of 10/90, Mw of 45000);
(2) A 2-(trimethylammonio)ethylmethacrylate=hexafluorophosphate/3,6-dioxaheptylmethacrylate copolymer (molar ratio of 20/80, Mw of 60000);
(3) A 2-(ethyldimethylammonio)ethylmethacrylate=p-toluenesulfonate/hexylmethacrylate copolymer (molar ratio of 30/70, Mw of 45000);
(4) A 2-(trimethylammonio)ethylmethacrylate=hexafluorophosphate/2-ethylhexylmethacrylate copolymer (molar ratio of 20/80, Mw of 60000);
(5) A 2-(trimethylammonio)ethylmethacrylate=methylsulfate/hexylmethacrylate copolymer (molar ratio of 40/60, Mw of 70000);
(6) A 2-(butyldimethylammonio)ethylmethacrylate=hexafluorophosphate/3,6-dioxaheptylmethacrylate copolymer (molar ratio of 25/75, Mw of 65000);
(7) A 2-(butyldimethylammonio)ethylacrylate=hexafluorophosphate/3,6-dioxaheptylmethacrylate copolymer (molar ratio of 20/80, Mw of 65000); and
(8) A 2-(butyldimethylammonio)ethylmethacrylate=13-ethyl-5,8,11-trioxa-1-heptadecanesulfonate/3,6-dioxaheptylmethacrylate copolymer (molar ratio of 20/80, Mw of 75000)

[0448] The sensitizing agent may be used alone or in combination of two or more kinds thereof.

[0449] The content of the sensitizing agent is preferably in a range of 1% by mass to 40.0% by mass, more preferably in a range of 2% by mass to 25.0% by mass, and still more preferably in a range of 3% by mass to 20% by mass with respect to the total mass of the image recording layer.

[Development accelerator]

[0450] The image recording layer may contain a development accelerator.

[0451] As the development accelerator, a hydrophilic macromolecular compound or a hydrophilic low-molecular-weight compound is preferable.

[0452] In the present disclosure, the hydrophilic macromolecular compound indicates a compound having a molecular weight (the weight-average molecular weight in a case of having a molecular weight distribution) of 3000 or greater, and the hydrophilic low-molecular-weight compound indicates a compound having a molecular weight (the weight-average molecular weight in a case of having a molecular weight distribution) of less than 3000.

- Hydrophilic macromolecular compound -

[0453] Examples of the hydrophilic macromolecular compound include a cellulose compound and polyvinyl alcohol. Among these, a cellulose compound is preferable.

[0454] Examples of the cellulose compound include cellulose and a compound in which at least a part of cellulose is modified (modified cellulose compound). Among these, a modified cellulose compound is preferable.

[0455] Preferred examples of the modified cellulose compound include a compound in which at least a part of the hydroxy group of cellulose is substituted with at least one selected from the group consisting of an alkyl group and a hydroxyalkyl group.

[0456] As the modified cellulose compound, an alkyl cellulose compound or a hydroxyalkyl cellulose compound is preferable, and a hydroxyalkyl cellulose compound is more preferable.

[0457] Preferred examples of the alkyl cellulose compound include methyl cellulose.

[0458] Preferred examples of the hydroxyalkyl cellulose compound include hydroxypropyl cellulose.

[0459] The molecular weight (the weight-average molecular weight in a case of having a molecular weight distribution) of the hydrophilic macromolecular compound is preferably in a range of 3000 to 300000 and more preferably in a range of 10000 to 150000.

- Hydrophilic low-molecular-weight compound -

[0460] Examples of the hydrophilic low-molecular-weight compound include a glycol compound, a polyol compound, an organic amine compound, an organic sulfonic acid compound, an organic sulfamine compound, an organic sulfuric acid compound, an organic phosphonic acid compound, an organic carboxylic acid compound, and a betaine compound. Among these, a polyol compound, an organic sulfonic acid compound, or a betaine compound is preferable.

[0461] Examples of the glycol compound include glycols such as ethylene glycol, diethylene glycol, triethylene glycol, propylene glycol, dipropylene glycol, and tripropylene glycol, and ether or ester derivatives of these compounds.

[0462] Examples of the polyol compound include glycerin, pentaerythritol, and tris(2-hydroxy ethyl)i socyanurate.

[0463] Examples of the organic amine compound include triethanolamine, diethanolamine, monoethanolamine, and salts thereof.

[0464] Examples of the organic sulfonic acid compound include alkyl sulfonic acid, toluene sulfonic acid, benzene sulfonic acid, and salts thereof, and preferred examples thereof include alkyl sulfonic acid having an alkyl group with 8 to 20 carbon atoms.

[0465] Examples of the organic sulfamine compound include alkyl sulfamic acid and salts thereof.

[0466] Examples of the organic sulfuric acid compound include alkyl sulfuric acid, alkyl ether sulfuric acid, and salts thereof.

[0467] Examples of the organic phosphonic acid compound include phenyl phosphonic acid and salts thereof.

[0468] Examples of the organic carboxylic acid compound include tartaric acid, oxalic acid, citric acid, malic acid, lactic acid, gluconic acid, and salts thereof.

[0469] Examples of the betaine compound include a phosphobetaine compound, a sulfobetaine compound, and a carboxybetaine compound, and preferred examples thereof include trimethylglycine.

[0470] The molecular weight (the weight-average molecular weight in a case of having a molecular weight distribution) of the hydrophilic low-molecular-weight compound is preferably 50 or greater and less than 3000 and more preferably in a range of 100 to 1000.

[0471] The development accelerator may be used alone or in combination of two or more kinds thereof.

[0472] The content of the development accelerator is preferably in a range of 0.1% by mass to 20% by mass, more preferably in a range of 0.5% by mass to 15% by mass, and still more preferably in a range of 1% by mass to 10% by mass with respect to the total mass of the image recording layer.

[Other components]

[0473] The image recording layer may contain, as other components, a surfactant, a polymerization inhibitor, a higher fatty acid derivative, a plasticizer, inorganic particles, an inorganic layered compound, and the like. Specifically, the

description in paragraphs 0114 to 0159 of JP2008-284817A can be referred to.

[Formation of image recording layer]

[0474] The image recording layer of the planographic printing plate precursor according to the embodiment of the present disclosure can be formed by dispersing or dissolving each of the above-described required components in a known solvent to prepare a coating solution, coating a support with the coating solution using a known method such as a bar coater coating method, and drying the coating solution, as described in paragraphs 0142 and 0143 of JP2008-195018A. The coating amount (solid content) of the image recording layer after the coating and the drying varies depending on the applications thereof, but is preferably in a range of 0.3 g/m^2 to 3.0 g/m^2. In a case where the coating amount thereof is in the above-described range, excellent sensitivity and excellent film-coating characteristics of the image recording layer are obtained.

[0475] As the solvent, a known solvent can be used. Specific examples thereof include water, acetone, methyl ethyl ketone (2-butanone), cyclohexane, ethyl acetate, ethylene dichloride, tetrahydrofuran, toluene, ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol dimethyl ether, propylene glycol monomethyl ether, propylene glycol monoethyl ether, acetylacetone, cyclohexanone, diacetone alcohol, ethylene glycol monomethyl ether acetate, ethylene glycol ethyl ether acetate, ethylene glycol monoisopropyl ether, ethylene glycol monobutyl ether acetate, 1-methoxy-2-propanol, 3- methoxy-1-propanol, methoxy methoxy ethanol, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, propylene glycol monomethyl ether acetate, propylene glycol monoethyl ether acetate, 3-methoxypropyl acetate, N,N-dimethylformamide, dimethylsulfoxide, γ-butyrolactone, methyl lactate, and ethyl lactate. The solvent may be used alone or in combination of two or more kinds thereof. The concentration of solid contents in the developer is preferably in a range of 1% by mass to 50% by mass.

[0476] The coating amount (solid content) of the image recording layer after the coating and the drying varies depending on the applications thereof, but from the viewpoints of satisfactory sensitivity and satisfactory film characteristics of the image recording layer, the coating amount thereof is preferably in a range of 0.3 g/m^2 to 3.0 g/m^2.

[0477] Further, the film thickness of the image recording layer in the planographic printing plate precursor according to the embodiment of the present disclosure is preferably in a range of 0.1 μm to 3.0 μm and more preferably in a range of 0.3 μm to 2.0 μm.

[0478] In the present disclosure, the film thickness of each layer in the planographic printing plate precursor is confirmed by preparing a section cut in a direction perpendicular to the surface of the planographic printing plate precursor and observing the cross section of the section with a scanning electron microscope (SEM).

<Overcoat layer>

[0479] The planographic printing plate precursor according to the embodiment of the present disclosure has preferably an overcoat layer (also referred to as a "protective layer") on the image recording layer and more preferably an overcoat layer on a surface of the image recording layer opposite to the side of the support.

[0480] It is preferable that the film thickness of the overcoat layer is larger than the film thickness of the image recording layer.

[0481] The overcoat layer has a function of suppressing a reaction of inhibiting image formation through oxygen blocking, a function of preventing generation of damage to the image recording layer, and a function of preventing ablation in a case of exposure to a high illuminance laser.

[0482] Such an overcoat layer having the above-described characteristics is described in US3458311A and JP1980-049729B (JP-S55-049729B). As a polymer with low oxygen permeability which is used for the overcoat layer, any of a water-soluble polymer or a water-insoluble polymer can be appropriately selected and used, and two or more kinds thereof can be mixed and used as necessary. Further, from the viewpoint of the on-press developability, it is preferable that the overcoat layer contains a water-soluble polymer.

[0483] In the present disclosure, the water-soluble polymer indicates a polymer in which 1 g or greater of the polymer is dissolved in 100 g of pure water at 70°C and is not deposited even in a case where the solution obtained by dissolving 1 g of the polymer in 100 g of pure water at 70°C is cooled to 25°C.

[0484] Examples of the water-soluble polymer used in the overcoat layer include polyvinyl alcohol, modified polyvinyl alcohol, polyvinylpyrrolidone, a water-soluble cellulose derivative, polyethylene glycol, and poly(meth)acrylonitrile.

[0485] As the modified polyvinyl alcohol, acid-modified polyvinyl alcohol containing a carboxy group or a sulfo group is preferably used. Specific examples thereof include modified polyvinyl alcohol described in JP2005-250216A and JP2006-259137A.

[0486] Among the examples of the water-soluble polymer, it is preferable that the overcoat layer contains polyvinyl alcohol and more preferably polyvinyl alcohol having a saponification degree of 50% or greater.

[0487] The saponification degree of polyvinyl alcohol is preferably 60% or greater, more preferably 70% or greater, and still more preferably 85% or greater. The upper limit of the saponification degree is not particularly limited and may be 100% or less.

[0488] The saponification degree can be measured according to the method described in JIS K 6726:1994.

[0489] Further, as an embodiment of the overcoat layer, an embodiment in which the overcoat layer contains polyvinyl alcohol and polyethylene glycol is also preferable.

[0490] In a case where the overcoat layer of the present disclosure contains a water-soluble polymer, the content of the water-soluble polymer is preferably in a range of 1% by mass to 99% by mass, more preferably in a range of 3% by mass to 97% by mass, and still more preferably in a range of 5% by mass to 95% by mass with respect to the total mass of the overcoat layer.

[0491] The overcoat layer may contain an inorganic layered compound in order to enhance the oxygen-blocking property. The inorganic layered compound indicates a particle having a thin tabular shape, and examples thereof include a mica group such as natural mica and synthetic mica, talc represented by Formula: $3MgO \cdot 4SiO \cdot H_2O$, teniolite, montmorillonite, saponite, hectorite, and zirconium phosphate.

[0492] An inorganic layered compound which has been preferably used is a mica compound. Examples of the mica compound include a mica group such as synthetic mica and natural mica represented by Formula: $A(B,C)_{2\text{-}5}D_4O_{10}(OH,F,O)_2$ [here, A represents any of K, Na, or Ca, B and C represent any of Fe (II), Fe (III), Mn, Al, Mg, or V, and D represents Si or Al].

[0493] In the mica group, examples of the natural mica include muscovite, soda mica, phlogopite, biotite, and lepidolite. Examples of the synthetic mica include non-swellable mica such as fluorophogopite $KMg_3(AlSi_3O_{10})F_2$ or potassium tetrasilicic mica $KMg_{2.5}Si_4O_{10})F_2$; and swellable mica such as Na tetrasilicic mica $NaMg_{2.5}(Si_4O_{10})F_2$, Na or Li teniolite $(Na,Li)Mg_2Li(Si_4O_{10})F_2$, or montmorillonite-based Na or Li hectorite $(Na,Li)_{1/8}Mg_{2/5}Li_{1/8}(Si_4O_{10})F_2$. Further, synthetic smectite is also useful.

[0494] Among the above-described mica compounds, fluorine-based swellable mica is particularly useful. In other words, swellable synthetic mica has a laminated structure formed of unit crystal lattice layers having a thickness of 10 Å to 15 Å (1 Å = 0.1 nm), and substitution of metal atoms in the lattice is significantly larger than that in other clay minerals. As the result, the lattice layers causes shortage of a positive charge. In order to compensate for this, cations such as Li^+, Na^+, Ca^{2+}, and Mg^{2+} are adsorbed between layers. Cations interposed between layers are referred to as exchangeable cations and can be exchanged for various cations. Particularly, in a case where interlayer cations are Li^+ and Na^+, since the ion radii thereof is small, bonds between layered crystal lattices are weak and largely swollen due to water. In a case where shearing is applied in this state, cleavage easily occurs so that a sol stabilized in water is formed. The swellable synthetic mica has such a strong tendency and is particularly preferably used.

[0495] As the shape of the mica compound, from the viewpoint of controlling diffusion, it is preferable that the thickness thereof is as small as possible and the plane size thereof is as large as possible within a range where the smoothness of the coating surface or the permeability of actinic rays is not inhibited. Therefore, the aspect ratio thereof is preferably 20 or greater, more preferably 100 or greater, and particularly preferably 200 or greater. The aspect ratio is a ratio of the major diameter to the thickness of a particle and can be measured using, for example, a projection drawing obtained from a microphotograph of particles. The effects to be obtained increase as the aspect ratio increases.

[0496] In the particle diameter of the mica compound, the average major diameter thereof is preferably in a range of 0.3 μm to 20 μm, more preferably in a range of 0.5 μm to 10 μm, and particularly preferably in a range of 1 μm to 5 μm. The average thickness of the particles is preferably 0.1 μm or less, more preferably 0.05 μm or less, and particularly preferably 0.01 μm or less. Specifically, for example, as a preferable embodiment of swellable synthetic mica which is a representative compound, the thickness thereof is in a range of 1 nm to 50 nm and the surface size (major diameter) is in a range of 1 μm to 20 μm.

[0497] The content of the inorganic layered compound is preferably in a range of 0% by mass to 60% by mass and more preferably in a range of 3% by mass to 50% by mass with respect to the total solid content of the overcoat layer. In a case where a plurality of kinds of inorganic layered compounds are used in combination, it is preferable that the total amount of the inorganic layered compounds is the content described above. In a case where the content thereof is in the above-described range, the oxygen-blocking property is improved and satisfactory sensitivity is obtained. Further, degradation of the impressing property can be prevented.

[0498] The overcoat layer may contain known additives such as a plasticizer for imparting flexibility, a surfactant for improving the coating properties, and inorganic particles for controlling the slipperiness of the surface. Further, the overcoat layer may contain a sensitizing agent described in the section of the image recording layer.

[0499] The overcoat layer is applied by a known method. The coating amount (solid content) of the overcoat layer is preferably in a range of 0.01 g/m^2 to 10 g/m^2, more preferably in a range of 0.02 g/m^2 to 3 g/m^2, and particularly preferably in a range of 0.02 g/m^2 to 1 g/m^2.

[0500] The film thickness of the overcoat layer in the planographic printing plate precursor according to the embodiment of the present disclosure is preferably in a range of 0.1 μm to 5.0 μm and more preferably in a range of 0.3 μm to 4.0 μm.

[0501] The film thickness of the overcoat layer in the planographic printing plate precursor according to the embodiment of the present disclosure is preferably in a range of 1.1 times to 5.0 times and more preferably in a range of 1.5 times to 3.0 times with respect to the film thickness of the image recording layer.

<Undercoat layer>

[0502] It is preferable that the planographic printing plate precursor according to the embodiment of the present disclosure includes an undercoat layer (also referred to as an interlayer) between the image recording layer and the support. Since the undercoat layer strengthens adhesion between the support and the image recording layer in the exposed portion and allows the image recording layer to be easily peeled off from the support in the unexposed portion, the undercoat layer contributes to improvement of the developability while suppressing degradation of the printing durability. Further, in a case of infrared laser exposure, since the undercoat layer functions as a heat insulating layer, the undercoat layer also has an effect of preventing heat generated by exposure from being diffused in the support, and thus the sensitivity is not degraded.

[0503] Examples of the compound used for the undercoat layer include a polymer containing an adsorptive group which can be adsorbed on the surface of the support and a hydrophilic group. A polymer which contains an adsorptive group and a hydrophilic group for the purpose of improving the adhesiveness to the image recording layer and further contains a crosslinkable group is preferable. The compound used for the undercoat layer may be a low-molecular-weight compound or a polymer. The compound used for the undercoat layer may be used in the form of a mixture of two or more kinds thereof as necessary.

[0504] In a case where the compound used for the undercoat layer is a polymer, a copolymer of a monomer containing an adsorptive group, a monomer containing a hydrophilic group, and a monomer containing a crosslinkable group is preferable.

[0505] Preferred examples of the adsorptive group that can be adsorbed on the surface of the support include a phenolic hydroxy group, a carboxy group, $-PO_3H_2$, $-OPO_3H_2$, $-CONHSO_2-$, $-SO_2NHSO_2-$, and $-COCH_2COCH_3$. As the hydrophilic group, a sulfo group or a salt thereof, or a salt of a carboxy group is preferable. As the crosslinkable group, an acrylic group, a methacrylic group, an acrylamide group, a methacrylamide group, or an allyl group is preferable.

[0506] The polymer may contain a crosslinkable group introduced by forming salts between a polar substituent of the polymer and a compound that has a substituent having the opposite charge to the polar substituent and an ethylenically unsaturated bond or may be formed by further copolymerization of monomers other than the monomers described above and preferably hydrophilic monomers.

[0507] Specifically, a silane coupling agent having an ethylenic double bond reactive group, which can be addition-polymerized, described in JP1998-282679A (JP-H10-282679A); and a phosphorous compound having an ethylenic double bond reactive group described in JP1990-304441A (JP-H02-304441A) are suitably exemplified. Further, crosslinkable groups (preferably ethylenically unsaturated bond groups) described in JP2005-238816A, JP2005-125749A, JP2006-239867A, and JP2006-215263A, and low-molecular-weight or high-molecular-weight compounds containing functional groups and hydrophilic groups that interact with the surface of a support are preferably used.

[0508] More preferred examples thereof include high-molecular-weight polymers containing adsorptive groups which can be adsorbed on the surface of a support, hydrophilic groups, and crosslinkable groups described in JP2005-125749A and JP2006-188038A.

[0509] The content of the ethylenically unsaturated bond group in the polymer used for the undercoat layer is preferably in a range of 0.1 mmol to 10.0 mmol and more preferably in a range of 0.2 mmol to 5.5 mmol with respect to 1 g of the polymer.

[0510] The weight-average molecular weight (Mw) of the polymer used for the undercoat layer is preferably 5000 or greater and more preferably in a range of 10000 to 300000.

[0511] For the purpose of preventing stain over time, the undercoat layer may contain a chelating agent, a secondary or tertiary amine, a polymerization inhibitor, a compound that includes an amino group or a functional group having polymerization inhibiting ability and a group interacting with the surface of a support (for example, 1,4-diazabicyclo[2.2.2]octane (DABCO), 2,3,5,6-tetrahydroxy-p-quinone, chloranil, sulfophthalic acid, hydroxyethyl ethylene diamine triacetic acid, dihydroxyethyl ethylene diamine diacetic acid, or hydroxyethyl imino diacetic acid) in addition to the compounds for an undercoat layer described above.

[0512] The undercoat layer is applied according to a known method. The coating amount (solid content) of the undercoat layer is preferably in a range of 0.1 mg/m^2 to 100 mg/m^2 and more preferably in a range of 1 mg/m^2 to 30 mg/m^2.

(Method of preparing planographic printing plate and planographic printing method)

[0513] A planographic printing plate can be prepared by image-exposing the planographic printing plate precursor according to the embodiment of the present disclosure and performing a development treatment thereon.

[0514] It is preferable that the method of preparing a planographic printing plate according to the embodiment of the present disclosure includes a step of imagewise-exposing the planographic printing plate precursor according to the embodiment of the present disclosure (hereinafter, also referred to as an "exposure step"), and a step of supplying at least one selected from the group consisting of printing ink and dampening water to remove the image recording layer of the non-image area on the printing press (hereinafter, also referred to as an "on-press development step").

[0515] It is preferable that the planographic printing method according to the embodiment of the present disclosure includes a step of imagewise-exposing the planographic printing plate precursor according to the embodiment of the present disclosure (an exposure step), a step of supplying at least one selected from the group consisting of printing ink and dampening water to remove the image recording layer of the non-image area on the printing press and preparing a planographic printing plate (an on-press development step), and a step of performing printing using the obtained planographic printing plate (a printing step).

[0516] Hereinafter, preferred embodiments of each step of the method of preparing a planographic printing plate according to embodiment of the present disclosure and each step of the planographic printing method according to the embodiment of the present disclosure will be sequentially described. Further, the planographic printing plate precursor according to the embodiment of the present disclosure can also be developed with a developer.

[0517] Hereinafter, the exposure step and the on-press development step in the method of preparing a planographic printing plate will be described, and the exposure step in the method of preparing a planographic printing plate according to the embodiment of the present disclosure is the same as the exposure step in the planographic printing method according to the embodiment of the present disclosure, and the on-press development step in the method of preparing a planographic printing plate according to the embodiment of the present disclosure is the same as the on-press development step in the planographic printing method according to the embodiment of the present disclosure.

<Exposure step>

[0518] It is preferable that the method of preparing a planographic printing plate according to the embodiment of the present disclosure includes an exposure step of imagewise-exposing the planographic printing plate precursor according to the embodiment of the present disclosure to form an exposed portion and an unexposed portion. It is preferable that the planographic printing plate precursor according to the embodiment of the present disclosure is exposed to a laser through a transparent original picture having a line image, a halftone image, and the like or imagewise-exposed by laser beam scanning using digital data.

[0519] A light source having a wavelength of 750 nm to 1400 nm is preferably used. As the light source having a wavelength of 750 nm to 1400 nm, a solid-state laser or a semiconductor laser that radiates infrared rays is suitable. The output of the infrared laser is preferably 100 mW or greater, the exposure time per one pixel is preferably shorter than 20 microseconds, and the irradiation energy quantity is preferably in a range of 10 mJ/cm^2 to 300 mJ/cm^2. For the purpose of reducing the exposure time, it is preferable to use a multi-beam laser device. The exposure mechanism may be any of an internal drum system, an external drum system, or a flat bed system.

[0520] The image exposure can be performed using a plate setter according to a usual method. In a case of the on-press development, the planographic printing plate precursor may be mounted on the printing press and then imagewise-exposed on the printing press.

<On-press development step>

[0521] It is preferable that the method of preparing a planographic printing plate according to the embodiment of the present disclosure includes an on-press development step of supplying at least one selected from the group consisting of printing ink and dampening water to remove the image recording layer of the non-image area on the printing press.

[0522] Hereinafter, the on-press development method will be described.

[On-press development method]

[0523] According to the on-press development method, it is preferable that the planographic printing plate is prepared from the image-exposed planographic printing plate precursor by supplying oil-based ink and an aqueous component on the printing press to remove the image recording layer of the non-image area.

[0524] That is, in a case where the planographic printing plate precursor is image-exposed and then mounted on the printing press without performing any development treatment thereon or the planographic printing plate precursor is mounted on the printing press, image-exposed on the printing press, and oil-based ink and an aqueous component are supplied to perform printing, the uncured image recording layer is removed by being dissolved or dispersed by any or both the supplied oil-based ink and aqueous component in the non-image area at an initial state of the printing so that the hydrophilic surface is exposed to the portion thereof. Meanwhile, the image recording layer cured by exposure forms

an oil-based ink receiving unit having a lipophilic surface in the exposed portion. The oil-based ink or the aqueous component may be initially supplied to the plate surface, but it is preferable that the oil-based ink is initially supplied from the viewpoint of preventing contamination of the aqueous component due to the component of the removed image recording layer. In this manner, the planographic printing plate precursor is on-press developed on the printing press and used as it is for printing a plurality of sheets. As the oil-based ink and the aqueous component, printing ink and dampening water for typical planographic printing are suitably used.

[0525] As the laser for image-exposing the planographic printing plate precursor according to the embodiment of the present disclosure, a light source having a wavelength of 300 nm to 450 nm or 750 nm to 1400 nm is preferably used. A planographic printing plate precursor containing, in the image recording layer, a sensitizing dye that has an absorption maximum in this wavelength range is preferably used as the light source having a wavelength of 300 nm to 450 nm, and those described above are preferably used as the light source having a wavelength of 750 nm to 1400 nm. A semiconductor laser is suitable as the light source having a wavelength of 300 nm to 450 nm.

<Developer development step>

[0526] The method of preparing a planographic printing plate according to the embodiment of the present disclosure may be a method including a step of imagewise-exposing the planographic printing plate precursor according to the embodiment of the present disclosure, and a step of removing the image recording layer of the non-image area with a developer to prepare a planographic printing plate (also referred to as a "developer development step").

[0527] Further, the planographic printing method according to the embodiment of the present disclosure may be a method including a step of imagewise-exposing the planographic printing plate precursor according to the embodiment of the present disclosure, a step of removing the image recording layer of the non-image area with a developer to prepare a planographic printing plate, and a step of performing printing using the obtained planographic printing plate.

[0528] As the developer, a known developer can be used.

[0529] The pH of the developer is not particularly limited and a strong alkaline developer may be used, but a developer having a pH of 2 to 11 is preferable. Preferred examples of the developer having a pH of 2 to 11 include a developer containing at least one of a surfactant or a water-soluble polymer compound.

[0530] As the method for the development treatment using a strong alkaline developer, a method of removing a protective layer by carrying out the pre-water washing step, performing alkali development, removing the alkali with water by carrying out the post-water washing step, performing a gum liquid treatment, and performing drying by carrying out a drying step may be employed.

[0531] Further, in a case where the developer containing a surfactant or a water-soluble polymer compound is used, the development and the gum liquid treatment can be performed at the same time. Accordingly, the post-water washing step is not particularly necessary, and the drying step can be performed after the development and the gum liquid treatment carried out using one liquid. Further, since the removal of the protective layer can be carried out simultaneously with the development and the gum liquid treatment, the pre-water washing step is not particularly necessary. After the development treatment, it is preferable that the drying is performed after the excessive developer is removed using a squeeze roller.

<Printing step>

[0532] The planographic printing method according to the embodiment of the present disclosure includes a printing step of supplying printing ink to the planographic printing plate and performing printing with a recording medium.

[0533] The printing ink is not particularly limited, and various known inks can be used as desired. Further, preferred examples of the printing ink include oil-based ink and ultraviolet curable ink (UV ink).

[0534] In the printing step, dampening water may be supplied as necessary.

[0535] Further, the printing step may be performed continuously with the on-press development step or the developer development step without stopping the printing press.

[0536] The recording medium is not particularly limited, and a known recording medium can be used as desired.

[0537] In the method of preparing a planographic printing plate from the planographic printing plate precursor according to the embodiment of the present disclosure and the planographic printing method according to the embodiment of the present disclosure, the entire surface of the planographic printing plate precursor may be heated before the exposure, during the exposure, and between the exposure and the development as necessary. In a case where the surface is heated in the above-described manner, there is an advantage that the image forming reaction in the image recording layer is promoted, the sensitivity and the printing durability are improved, and the sensitivity is stabilized. In a case where the surface is heated before the development, it is preferable that the heating is performed under a mild temperature condition of 150°C or lower. In this manner, problems of curing the non-image area and the like can be prevented. In a case where the surface is heated after the development, it is preferable that the heating is performed under an extremely

high temperature condition of 100°C to 500°C. In a case where the temperature is in the above-described range, a sufficient image strengthening effect can be obtained, and problems such as deterioration of the support and thermal decomposition of the image area can be suppressed.

Examples

[0538] Hereinafter, the present disclosure will be described in detail with reference to examples, but the present disclosure is not limited thereto. In the present examples, "%" and "part" respectively indicate "% by mass" and "part by mass" unless otherwise specified. Further, in a polymer compound, the molecular weight indicates the weight-average molecular weight (Mw) and the proportion of repeating structural units indicates mole percentage unless otherwise specified. Further, the weight-average molecular weight (Mw) is a value in terms of polystyrene obtained by performing measurement using gel permeation chromatography (GPC).

(Example 1 to 41 and Comparative Examples 1 to 3)

<Preparation of support A>

[0539] In order to remove rolling oil on a surface of an aluminum plate (Material JIS A 1050) having a thickness of 0.3 mm, a degreasing treatment was performed using a 10 mass% sodium aluminate aqueous solution at 50°C for 30 seconds, the surface of the aluminum plate was grained using three bundled nylon brushes having a diameter of 0.3 mm and a pumice water suspension (specific gravity of 1.1 g/cm^3) having a median diameter of 25 μm and then sufficiently washed with water. The aluminum plate was etched by being immersed in a 25 mass% sodium hydroxide aqueous solution at 45°C for 9 seconds, washed with water, further immersed in a 20 mass% nitric acid aqueous solution at 60°C for 20 seconds, and washed with water. The etching amount of the grained surface was approximately 3 g/m^2.

[0540] Next, an electrochemical roughening treatment was continuously performed using an AC voltage of 60 Hz. An aqueous solution (containing 0.5% by mass of aluminum ions) having a nitric acid concentration of 1% by mass was used as the electrolytic solution, and the liquid temperature was 50°C. Using a trapezoidal rectangular waveform AC having a time TP, until the current value reached a peak from zero, of 0.8 msec and the duty ratio of 1:1 as the AC power source waveform, the electrochemical roughening treatment was performed using a carbon electrode as a counter electrode. As an auxiliary anode, ferrite was used. The current density was 30 A/dm^2 in terms of the peak current value, and 5% of the current from the power source was separately flowed to the auxiliary anode. The electric quantity in the nitric acid electrolysis was 175 C/dm^2 which is an electric quantity in a case where the aluminum plate was an anode. Thereafter, the aluminum plate was washed with water using a spray.

[0541] Next, an electrochemical roughening treatment was performed according to the same method as the method for nitric acid electrolysis under the condition of an electric quantity of 50 C/dm^2 in a case where an aluminum plate is an anode in a 0.5 mass% hydrochloric acid aqueous solution (including 0.5% by mass of aluminum ions) and an electrolytic solution at a liquid temperature of 50°C. Subsequently, washing with water was performed using a spray.

[0542] Next, 2.5 g/m^2 of a DC anodized film was formed on the aluminum plate at a current density of 15 A/dm^2 using a 15 mass% sulfuric acid aqueous solution (including 0.5% by mass of aluminum ions) as an electrolytic solution, washed with water, and then dried, thereby preparing a support A. The average pore diameter (surface average pore diameter) in the surface layer of the anodized film was 10 nm.

[0543] The pore diameter in the surface layer of the anodized film was measured by observing the surface at a magnification of 150000 times using an ultra-high resolution type SEM (S-900, scanning electron microscope, manufactured by Hitachi, Ltd.) without performing a vapor deposition treatment and the like to impart the conductivity at a relatively low acceleration voltage of 12 V, randomly extracting 50 pores, and acquiring the average value. The standard deviation was less than or equal to $\pm$ 10% of the average value.

[0544] The obtained support A was used as the support in Examples 1 to 36 and Comparative Examples 1 to 3.

<Preparation of supports S1 to S3>

«Surface treatment A»

[Support having large-diameter pores and small-diameter pores]

(A-a) Alkali etching treatment

[0545] The aluminum plate was subjected to an etching treatment by spraying a caustic soda (sodium hydroxide) aqueous solution having a caustic soda concentration of 26% by mass and an aluminum ion concentration of 6.5% by

mass using a spray tube at a temperature of 70°C. Thereafter, the aluminum plate was washed with water using a spray. The amount of aluminum dissolved in the surface to be subsequently subjected to an electrochemical roughening treatment was 1.0 g/m^2.

(A-b) Desmutting treatment in acidic aqueous solution (first desmutting treatment)

[0546] Next, a desmutting treatment was performed in an acidic aqueous solution. As the acidic aqueous solution used for the desmutting treatment, an aqueous solution containing 150 g/L of sulfuric acid was used. The liquid temperature was 30°C. The desmutting treatment was performed for 3 seconds by spraying the desmutting liquid using a spray. Thereafter, a washing treatment was performed.

(A-c) Electrochemical roughening treatment in hydrochloric acid aqueous solution

[0547] Next, an electrolytic roughening treatment was performed using the AC current and an electrolytic solution having a hydrochloric acid concentration of 14 g/L, an aluminum ion concentration of 13 g/L, and a sulfuric acid concentration of 3 g/L. The liquid temperature of the electrolytic solution was 30°C. The aluminum ion concentration was adjusted by adding aluminum chloride. The waveform of the AC current was a sine wave in which the positive and negative waveforms were symmetrical, the frequency was 50 Hz, the ratio between the anodic reaction time and the cathodic reaction time in one cycle of the AC current was 1:1, and the current density was 75 A/dm^2 in terms of the peak current value of the AC current waveform. Further, the total electric quantity of the aluminum plate used for the anodic reaction was 450 C/dm^2, and the electrolytic treatment was performed four times at energization intervals of 4 seconds for each of the electric quantity of 125 C/dm^2. A carbon electrode was used as a counter electrode of the aluminum plate. Thereafter, a washing treatment was performed.

(A-d) Alkali etching treatment

[0548] The aluminum plate after being subjected to the electrochemical roughening treatment was subjected to an etching treatment by spraying a caustic soda aqueous solution having a caustic soda concentration of 5% by mass and an aluminum ion concentration of 0.5% by mass using a spray tube at a temperature of 45°C. The amount of aluminum dissolved in the surface after being subjected to an electrochemical roughening treatment was 0.2 g/m^2. Thereafter, a washing treatment was performed.

(A-e) Desmutting treatment in acidic aqueous solution

[0549] Next, a desmutting treatment was performed in an acidic aqueous solution. As the acidic aqueous solution used for the desmutting treatment, a waste liquid (5.0 g/L of aluminum ions were dissolved in an aqueous solution containing 170 g/L of sulfuric acid) generated in the anodization treatment step was used. The liquid temperature was 30°C. The desmutting treatment was performed for 3 seconds by spraying the desmutting liquid using a spray.

(A-f) First stage anodization treatment

[0550] A first stage anodization treatment was performed by an anodization device having a structure illustrated in Fig. 3 using DC electrolysis. An anodized film having a predetermined film thickness was formed by performing an anodization treatment under conditions listed in Table 1.

[0551] Further, an aluminum plate 616 in an anodization treatment device 610 is transported as indicated by the arrow in Fig. 5. The aluminum plate 616 is positively (+) charged by a power supply electrode 620 in a power supply tank 612 in which an electrolytic solution 618 is stored. Further, the aluminum plate 616 is transported upward by a roller 622 in the power supply tank 612, redirected downward by a nip roller 624, transported toward an electrolytic treatment tank 614 in which an electrolytic solution 626 was stored, and redirected to the horizontal direction by a roller 628. Next, the aluminum plate 616 is negatively (-) charged by an electrolytic electrode 630 so that an anodized film is formed on the surface thereof, and the aluminum plate 616 coming out of the electrolytic treatment tank 614 is transported to the next step. In the anodization treatment device 610, direction changing means is formed of the roller 622, the nip roller 624, and the roller 628. The aluminum plate 616 is transported in a mountain shape and an inverted U shape by the roller 622, the nip roller 624, and the roller 628 in an inter-tank portion between the power supply tank 612 and the electrolytic treatment tank 614. The power supply electrode 620 and the electrolytic electrode 630 are connected to a DC power source 634.

(A-g) Pore widening treatment

[0552] The aluminum plate after being subjected to the anodization treatment was subjected to a pore widening treatment by being immersed in a caustic soda aqueous solution having a caustic soda concentration of 5% by mass and an aluminum ion concentration of 0.5% by mass at a temperature of 35°C under the conditions listed in Table 1. Thereafter, the aluminum plate was washed with water using a spray.

(A-h) Second stage anodization treatment

[0553] A second stage anodization treatment was performed by an anodization device having a structure illustrated in Fig. 3 using DC electrolysis. An anodized film having a predetermined film thickness was formed by performing an anodization treatment under conditions listed in Table 1.

[0554] The support S1 of the examples was obtained by performing the above-described surface treatment A.

[0555] The average diameter (nm) of the large-diameter pores in the anodized film having micropores after the second anodization treatment step, which had been obtained in the above-described manner, in the surface of the anodized film, the average diameter (nm) of the small-diameter pores at the communication position, the depths (nm) of the large-diameter pores and the small-diameter pores, the pit density (the density of micropores, unit; piece/μm^2), and the thickness (nm) of the anodized film from the bottom portions of the small-diameter pores to the surface of the aluminum plate are collectively listed in Table 2.

[0556] Further, the average diameter of micropores (the average diameter of the large-diameter pores and the small-diameter pores) is a value obtained by observing 4 sheets (N = 4) of the surfaces of the large-diameter pores and the surfaces of the small-diameter pores using a FE-SEM at a magnification of 150000, measuring the diameters of micropores (the large-diameter pores and the small-diameter pores) present in a range of 400 $nm^2 \times 600$ nm^2 in the obtained four sheets of images, and averaging the values. Further, in a case where the depth of the large-diameter pores is deep and the diameter of the small-diameter pores is unlikely to be measured and in a case where expanded-diameter pores in the small-diameter pores are measured, the upper portion of the anodized film is cut and then various kinds of diameters are acquired.

[0557] Further, the depth of the micropores (the depth of the large-diameter pores and the small-diameter pores) is a value obtained by observing the cross section of the support (anodized film) using a FE-SEM (at a magnification of 150000 in observation of the depth of the large-diameter pores and at a magnification of 50000 in observation of the depth of the small-diameter pores), measuring 25 cases of depths of optional micropores in the obtained image, and averaging the values.

[0558] In Table 1, the coating film amount (AD) in the columns of the first anodization treatment and the coating film amount (AD) in the columns of the second anodization treatment indicate the coating film amounts obtained in each treatment. Further, the electrolytic solution used is an aqueous solution containing the components in Table 1.

«Surface treatment B»

[Support having large-diameter pores]

(B-a) Alkali etching treatment

[0559] The aluminum plate was subjected to an etching treatment by spraying a caustic soda aqueous solution having a caustic soda concentration of 26% by mass and an aluminum ion concentration of 6.5% by mass, to the aluminum plate using a spray tube at a temperature of 70°C. Thereafter, the aluminum plate was washed with water using a spray. The amount of aluminum dissolved in the surface to be subsequently subjected to an electrochemical roughening treatment was 1.0 g/m^2.

(B-b) Desmutting treatment in acidic aqueous solution (first desmutting treatment)

[0560] Next, a desmutting treatment was performed in an acidic aqueous solution. As the acidic aqueous solution used for the desmutting treatment, an aqueous solution containing 150 g/L of sulfuric acid was used. The liquid temperature was 30°C. The desmutting treatment was performed for 3 seconds by spraying the desmutting liquid using a spray. Thereafter, a washing treatment was performed.

(B-c) Electrochemical roughening treatment in hydrochloric acid aqueous solution.

[0561] Next, an electrolytic roughening treatment was performed using the AC current and an electrolytic solution

having a hydrochloric acid concentration of 14 g/L, an aluminum ion concentration of 13 g/L, and a sulfuric acid concentration of 3 g/L. The liquid temperature of the electrolytic solution was 30°C. The aluminum ion concentration was adjusted by adding aluminum chloride.

[0562] The waveform of the AC current was a sine wave in which the positive and negative waveforms were symmetrical, the frequency was 50 Hz, the ratio between the anodic reaction time and the cathodic reaction time in one cycle of the AC current was 1:1, and the current density was 75 A/dm^2 in terms of the peak current value of the AC current waveform. Further, the total electric quantity of the aluminum plate used for the anodic reaction was 450 C/dm^2, and the electrolytic treatment was performed four times at energization intervals of 4 seconds for each of the electric quantity of 125 C/dm^2. A carbon electrode was used as a counter electrode of the aluminum plate. Thereafter, a washing treatment was performed.

(B-d) Alkali etching treatment

[0563] The aluminum plate after being subjected to the electrochemical roughening treatment was subjected to an etching treatment by spraying a caustic soda aqueous solution having a caustic soda concentration of 5% by mass and an aluminum ion concentration of 0.5% by mass using a spray tube at a temperature of 45°C. The amount of aluminum dissolved in the surface after being subjected to an electrochemical roughening treatment was 0.2 g/m^2. Thereafter, a washing treatment was performed.

(B-e) Desmutting treatment in acidic aqueous solution

[0564] Next, a desmutting treatment was performed in an acidic aqueous solution. As the acidic aqueous solution used for the desmutting treatment, a waste liquid (5.0 g/L of aluminum ions were dissolved in an aqueous solution containing 170 g/L of sulfuric acid) generated in the anodization treatment step was used. The liquid temperature was 30°C. The desmutting treatment was performed for 3 seconds by spraying the desmutting liquid using a spray.

(B-f) First anodization treatment

[0565] A first stage anodization treatment was performed by an anodization device having a structure illustrated in Fig. 3 using DC electrolysis. An anodized film having a predetermined film thickness was formed by performing an anodization treatment under conditions listed in Table 1.

(B-g) Pore widening treatment

[0566] The aluminum plate after being subjected to the anodization treatment was subjected to a pore widening treatment by being immersed in a caustic soda aqueous solution having a caustic soda concentration of 5% by mass and an aluminum ion concentration of 0.5% by mass at a temperature of 35°C under the conditions listed in Table 1. Thereafter, the aluminum plate was washed with water using a spray.

[0567] The support S2 of the examples was obtained by performing the above-described surface treatment B. The details of the obtained support S2 are collectively listed in Table 2.

<<Surface treatment C>>

[Support having large-diameter pores]

(C-a) Alkali etching treatment

[0568] The aluminum plate was subjected to an etching treatment by spraying a caustic soda aqueous solution having a caustic soda concentration of 26% by mass and an aluminum ion concentration of 6.5% by mass, to the aluminum plate using a spray tube at a temperature of 70°C. Thereafter, the aluminum plate was washed with water using a spray. The amount of aluminum dissolved in the surface to be subsequently subjected to an electrochemical roughening treatment was 1.0 g/m^2.

(C-b) Desmutting treatment in acidic aqueous solution (first desmutting treatment)

[0569] Next, a desmutting treatment was performed in an acidic aqueous solution. As the acidic aqueous solution used for the desmutting treatment, an aqueous solution containing 150 g/L of sulfuric acid was used. The liquid temperature was 30°C. The desmutting treatment was performed for 3 seconds by spraying the desmutting liquid using a spray.

Thereafter, a washing treatment was performed.

(C-c) Electrochemical roughening treatment in hydrochloric acid aqueous solution

[0570] Next, an electrolytic roughening treatment was performed using the AC current and an electrolytic solution having a hydrochloric acid concentration of 14 g/L, an aluminum ion concentration of 13 g/L, and a sulfuric acid concentration of 3 g/L. The liquid temperature of the electrolytic solution was 30°C. The aluminum ion concentration was adjusted by adding aluminum chloride.

[0571] The waveform of the AC current was a sine wave in which the positive and negative waveforms were symmetrical, the frequency was 50 Hz, the ratio between the anodic reaction time and the cathodic reaction time in one cycle of the AC current was 1:1, and the current density was 75 A/dm^2 in terms of the peak current value of the AC current waveform. Further, the total electric quantity of the aluminum plate used for the anodic reaction was 450 C/dm^2, and the electrolytic treatment was performed four times at energization intervals of 4 seconds for each of the electric quantity of 125 C/dm^2. A carbon electrode was used as a counter electrode of the aluminum plate. Thereafter, a washing treatment was performed.

(C-d) Desmutting treatment in acidic aqueous solution

[0572] Next, a desmutting treatment was performed in an acidic aqueous solution without performing an alkali etching treatment. As the acidic aqueous solution used for the desmutting treatment, a waste liquid (5.0 g/L of aluminum ions were dissolved in an aqueous solution containing 170 g/L of sulfuric acid) generated in the anodization treatment step was used. The liquid temperature was 30°C. The desmutting treatment was performed for 3 seconds by spraying the desmutting liquid using a spray.

(C-e) First anodization treatment

[0573] A first stage anodization treatment was performed by an anodization device having a structure illustrated in Fig. 3 using DC electrolysis. An anodized film having a predetermined film thickness was formed by performing an anodization treatment under conditions listed in Table 1.

(C-f) Pore widening treatment

[0574] The aluminum plate after being subjected to the anodization treatment was subjected to a pore widening treatment by being immersed in a caustic soda aqueous solution having a caustic soda concentration of 5% by mass and an aluminum ion concentration of 0.5% by mass at a temperature of 30°C under the conditions listed in Table 1. Thereafter, the aluminum plate was washed with water using a spray.

[0575] The supports S-1 to S-3 of the examples were obtained by performing the above-described surface treatment C. The details of the obtained supports S-1 to S-3 are collectively listed in Table 1.

(C-g) First anodization treatment

[0576] A second stage anodization treatment was performed by an anodization device having a structure illustrated in Fig. 3 using DC electrolysis. An anodized film having a predetermined film thickness was formed by performing an anodization treatment under conditions listed in Table 1.

[Table 1]

	Support	Surface treatment	First anodization treatment							Pore widening treatment		
			Type of liquid	Liquid component	Component concentration (g/L)	Temperature (°C)	Current density (Å/dm²)	Time (s)	Coating film amount (g/m²)	Liquid component	Temperature (°C)	Time (s)
Example	Support S1	A	Phosphoric acid	H_3PO_4	15	35	4.5	12	1.0	NaOH5% /Al0.5%	40	3
Example	Support S2	B	Sulfuric acid	H_2SO_4/Al	170/5	50	30	18	2.4	NaOH5% /Al0.5%	40	3
Example	Support S3	C	Sulfuric acid	H_2SO_4/Al	170/5	43	8	5	0.3	NaOH5% /Al0.5%	30	5

	Support	Surface treatment	Second anodization treatment						
			Type of liquid	Liquid component	Component concentration (g/L)	Temperature (°C)	Current density (Å/dm2)	Time (s)	Coating film amount (g/m²)
Example	Support S1	A	Sulfuric acid	H_2SO_4/Al	170/5	50	15	10.5	1.4
Example	Support S2	B	-	-	-	-	-	-	-
Example	Support S3	C	Sulfuric acid	H_2SO_4/Al	170/5	50	13	25	3.5

	Support	Surface treatment	Large-diameter pores				Small-diameter pores			Density of micropores (pieces/μm)	Film thickness (nm)
			Average diameter (nm)	Average diameter of bottom portions (nm)	Shape	Depth (nm)	Pore diameter at communication position (nm)	Shape	Depth (nm)		
Example	Support S1	A	35	35	Straight tubular shape	100	10	Straight tubular shape	570	320	1,000
Example	Support S2	B	25	25	Straight tubular shape	100	-	-	980	500	1,000
Example	Support S3	C	26	26	Straight tubular shape	100	10	Straight tubular shape	1,350	1,080	1,450

<Formation of planographic printing plate precursor>

[0577] The support A or each of the supports S1 to S3 listed in Tables 2 to 4 was coated with an undercoat liquid (1) having the following composition such that the dry coating amount reached 20 mg/m^2, and dried in an oven at 100°C for 30 seconds, thereby preparing a support having an undercoat layer.

[0578] The undercoat layer was bar-coated with the following image recording layer coating solution (1) and dried in an oven at 100° for 60 seconds to form an image recording layer having a dry coating amount of 0.60 g/m^2 (a film thickness of approximately 0.60 μm), thereby obtaining a planographic printing plate precursor.

[0579] Thereafter, the image recording layer was coated with the overcoat layer coating solution (1) having the following composition and dried in an oven at 100°C for 60 seconds to form an overcoat layer (including a hydrophobic portion) having a dry coating amount of 1.0 g/m^2 (a film thickness of approximately 1.0 μm), thereby obtaining a planographic printing plate precursor.

[Undercoat liquid (1)]

[0580]

- Undercoat compound 1 shown below: 0.18 parts
- Methanol: 55.24 parts
- Distilled water: 6.15 parts

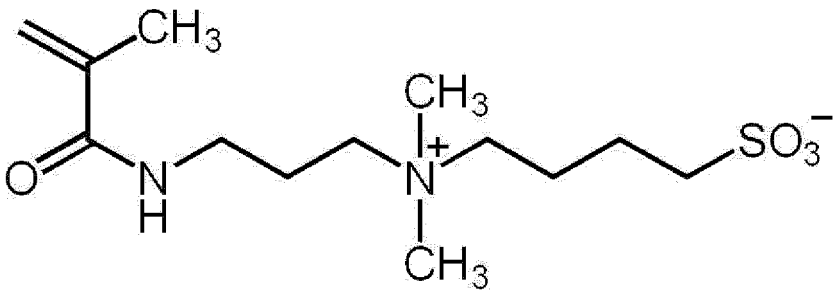
- Synthesis of undercoat compound 1 -

<<Purification of monomer m-1>>

[0581] 420 parts of light ester P-1M (2-methacryloyloxyethyl acid phosphate, manufactured by Kyoeisha Chemical Co., Ltd.), 1050 parts of diethylene glycol dibutyl ether, and 1050 parts of distilled water were added to a separatory funnel, violently stirred, and allowed to stand still. After the upper layer was disposed of, 1050 parts of diethylene glycol dibutyl ether was added thereto, and the mixture was violently stirred and allowed to stand still. The upper layer was disposed of, thereby obtaining 1300 parts of an aqueous solution of the monomer m-1 (10.5% by mass in terms of solid content).

«Synthesis of undercoat compound 1»

[0582] 53.73 parts of distilled water and 3.66 parts of a monomer m-2 shown below were added to a three-neck flask and heated to 55°C in a nitrogen atmosphere. Next, a dripping liquid 1 described below was added dropwise thereto for 2 hours, the solution was stirred for 30 minutes, 0.386 parts of VA-046B (manufactured by Wako Pure Chemical Industries, Ltd.) was added thereto, and the resulting solution was heated to 80°C and stirred for 1.5 hours. After the reaction solution was cooled to room temperature (25°C), a 30 mass% sodium hydroxide aqueous solution was added thereto to adjust the pH thereto to 8.0, and 0.005 parts of 4-hydroxy-2,2,6,6-tetramethylpiperidin-1-oxyl (4-OH-TEMPO) was added thereto. 180 parts of an aqueous solution of the undercoat compound 1 was obtained by performing the above-described operation. Further, the weight-average molecular weight (Mw) in terms of polyethylene glycol according to a gel permeation chromatography (GPC) method was 170000.



m - 2

<<Dripping liquid 1>>

[0583]

- Monomer m-1 aqueous solution shown above: 87.59 parts
- Monomer m-2 shown above: 14.63 parts
- VA-046B (2,2'-azobis[2-(2-imidazolin-2-yl)propane]disulfate dihydrate, manufactured by Wako Pure Chemical Industries, Ltd.): 0.386 parts
- Distilled water: 20.95 parts

<Image recording layer coating solution (1)>

[0584]

- Infrared absorbing agents listed in Tables 2 to 4: amounts listed in Tables 2 to 4.
- Polymerizable compounds listed in Tables 2 to 4: amounts listed in Tables 2 to 4.
- Polymers listed in Tables 2 to 4: amounts listed in Tables 2 to 4
- Electron-accepting polymerization initiators listed in Tables 2 to 4: amounts listed in Tables 2 to 4
- Electron-donating polymerization initiators listed in Tables 2 to 4: amounts listed in Tables 2 to 4
- Acid color formers listed in Tables 2 to 4: amounts listed in Tables 2 to 4
- BYK 306 (manufactured by BYK Chemie GmbH): 0.008 parts
- 1-Methoxy-2-propanol: 8.609 parts
- Methyl ethyl ketone: 1.091 parts

<Overcoat layer coating solution>

[0585]

- POVAL PVA105 (manufactured by Kuraray Co., Ltd., saponification degree of 80% or greater): 0.6 parts by mass
- PEG4000 (manufactured by Tokyo Chemical Industry Co., Ltd.): 0.39 parts by mass
- Surfactant (RAPISOL A-80, manufactured by NOF Corporation): 0.01 parts by mass
- Water: amount set such that total amount reached 10 parts by mass

<Evaluation>

[Color developability and temporal color developability after exposure (ΔL)]

[0586] Each of the obtained planographic printing plate precursors was exposed by Trendsetter 3244VX equipped with a water-cooled 40W infrared semiconductor laser (manufactured by Creo Co., Ltd.) under conditions of an output of 11.7 W, an external drum rotation speed of 250 rpm, and a resolution of 2400 dpi (dot per inch, 1 inch = 2.54 cm). The exposure was performed in an environment of 25°C and 50% RH.

[0587] The color development of the planographic printing plate precursor was measured immediately after the exposure (color developability) and after storage in a dark place (25°C) for 2 hours after the exposure (temporal color developability after exposure). The measurement was performed by a specular reflection light removal (SCE) method using a spectrophotometer CM2600d (manufactured by Konica Minolta Inc.) and operation software CM-S100W. The color developability is evaluated based on a difference ΔL between the L* value of the exposed portion and the L* value of the unexposed portion using the L* value (brightness) of the L*a*b* color system. The color developability and the temporal color developability after exposure are excellent as the value of ΔL increases.

[UV printing durability]

[0588] Each of the obtained planographic printing plate precursors was exposed by Luxel PLATESETTER T-6000III (manufactured by Fujifilm Corporation) equipped with an infrared semiconductor laser under conditions of an external drum rotation speed of 1000 rpm (revolutions per minute), a laser output of 70%, and a resolution of 2400 dpi (dot per inch, 1 inch = 2.54 cm). The exposed image had a solid image, a 50% halftone dot chart of a 20 μm dot FM screen, and a non-image area.

[0589] The obtained exposed planographic printing plate precursor was attached to the plate cylinder of a printing press LITHRONE26 (manufactured by KOMORI Corporation) without performing a development treatment. The water supply roller was decelerated by 5% with respect to the plate cylinder, dampening water and ink were supplied to perform on-press development using dampening water of ECOLITY-2 (manufactured by Fujifilm Corporation) and tap water at a volume ratio of 2/98 and UV ink (T & K UV OFS K-HS ink GE-M (manufactured by T&K TOKA Co., Ltd.) according to a standard automatic printing start method of LITHRONE26, and printing was performed on 50000 sheets of Tokubishi Art (manufactured by Mitsubishi Paper Mills Ltd., ream weight of 76.5 kg) paper at a printing speed of 10000 sheets per hour.

[0590] As the number of printed sheets increased, the image recording layer was gradually worn and the ink receiving property was degraded, and thus the ink density on the printing paper decreased. The number of printed sheets in a case where the value obtained by measuring the halftone dot area ratio of FM screen 3% halftone dots using x-lite (manufactured by x-lite Inc.) in the printed material was decreased by 5% than the measured value of the 100th printed sheet was defined as the number of completely printed sheets, and the UV printing durability was evaluated.

[On-press developability]

[0591] Each of the obtained planographic printing plate precursors was exposed by Luxel PLATESETTER T-6000III (manufactured by Fujifilm Corporation) equipped with an infrared semiconductor laser under conditions of an external drum rotation speed of 1000 rpm, a laser output of 70%, and a resolution of 2400 dpi. The exposed image had a solid image, a 50% halftone dot chart of a 20 μm dot FM screen, and a non-image area.

[0592] The obtained exposed precursor was attached to the plate cylinder of a printing press LITHRONE26 (manufactured by KOMORI Corporation) without performing a development treatment. Further, dampening water and ink were supplied to perform on-press development using dampening water of ECOLITY-2 (manufactured by Fujifilm Corporation) and tap water at a volume ratio of 2/98 and Space Color Fusion G Yellow Ink (manufactured by DIC Graphics Corporation) according to a standard automatic printing start method of a printing press LITHRONE26 (manufactured by KOMORI Corporation), and printing was performed on 500 sheets of Tokubishi Art (manufactured by Mitsubishi Paper Mills Ltd., ream weight of 76.5 kg) paper at a printing speed of 10000 sheets per hour.

[0593] The on-press development performed on the unexposed portion of the image recording layer on the printing press was completed, and the number of sheets of printing paper required until the ink was not transferred to the non-image area was measured as the on-press developability. It can be said that the on-press developability is more excellent as the number of sheets decreases.

[Table 2]

	Infrared absorbing agent		Polymerizable compound		Binder polymer (specific polymer)		Electron-accepting polymerization initiator			Electron-donating polymerization initiator		Acid color former		Evaluation of color developability (ΔL)		Evaluation of UV printing durability	Evaluation of on-press developability
	Type	Content	Type	Content	Type	Content	Type	Content	LUMO (eV)	Type	Content	Type	Content	Immediately after exposure	After 2 hours from exposure	Number of sheets	Number of sheets
Example 1	IR-1	0.030	M-1	0.100	P-1	0.825	IA-1	0.100	-3.0	D-1	0.020	None	-	8	8	7,000	35
Example 2	1R-2	0.040	M-2	0.150	P-2	0.500	IA-1	0.100	-3.0	D-2	0.020	None	-	7	7	8,000	30
Example 3	IR-3	0.060	M-3	0.200	P-3	0.250	IA-1	0.100	-3.0	None	-	None	-	8	8	8,500	25
Example 4	IR-4	0.030	M-1	0.100	P-4	0.600	IA-1	0.100	-3.0	D-3	0.030	None	-	7	7	7,500	30
Example 5	IR-5	0.080	M-1	0.300	P-5	0.750	IA-1	0.100	-3.0	D-4	0.015	None	-	9	9	9,000	25
Example 6	IR-6	0.100	M-3	0.050	P-6	0.300	IA-1	0.100	-3.0	D-2	0.040	None	-	8	8	8,000	25
Example 7	IR-7	0.030	M-3	0.120	P-7	0.500	IA-1	0.100	-3.0	D-5	0.030	None	-	9	9	8,500	20
Example 8	IR-8	0.060	M-2	0.300	P-8	0.400	IA-1	0.100	-3.0	D-2	0.020	None	-	10	10	9,000	15
Example 9	IR-9	0.150	M-2	0.400	P-9	0.900	IA-1	0.100	-3.0	D-6	0.050	None	-	8	8	11,000	20
Example 10	IR-10	0.020	M-2	0.100	P-10	1.000	IA-1	0.100	-3.0	D-2	0.025	None	-	8	8	10,000	20
Example 11	IR-10	0.030	M-1 M-3	0.050 0.100	P-10	1.000	IA-1	0.100	-3.0	D-2	0.025	None	-	8	8	11,000	15
Example 12	IR-1	0.030	M-4	0.100	P-1	0.825	IA-1	0.100	-3.0	D-1	0.020	None	-	8	8	6,000	35
Example 13	IR-1	0.030	M-1	0.100	P-1	0.825	IS-1	0.100	-3.2	D-1	0.020	None	-	8	8	8,000	35
Example 14	IR-1	0.030	M-1	0.100	P-1	0.825	IS-2	0.100	-3.2	D-1	0.020	None	-	8	8	8,000	35
Example 15	IR-1	0.030	M-1	0.100	P-1	0.825	IS-3	0.100	-3.3	D-1	0.020	None	-	8	8	8,000	35
Example 16	IR-1	0.030	M-1	0.100	P-1	0.825	IS-4	0.100	-3.2	D-1	0.020	None	-	8	8	8,000	35
Example 17	IR-1	0.030	M-1	0.100	P-1	0.825	IS-5	0.100	-3.5	D-1	0.020	None	-	8	8	9,000	35
Example 18	IR-1	0.030	M-1	0.100	P-1	0.825	IS-6	0.100	-3.3	D-1	0.020	None	-	8	8	8,000	35
Example 19	IR-1	0.030	M-1	0.100	P-1	0.825	IA-2	0.100	-2.4	D-1	0.020	None	-	7	7	6,000	35

(continued)

	Infrared absorbing agent		Polymerizable compound		Binder polymer (specific polymer)		Electron-accepting polymerization initiator			Electron-donating polymerization initiator		Acid color former		Evaluation of color developability (ΔL)		Evaluation of UV printing durability	Evaluation of on-press developability
	Type	Content	Type	Content	Type	Content	Type	Content	LUMO (eV)	Type	Content	Type	Content	Immediately after exposure	After 2 hours from exposure	Number of sheets	Number of sheets
Comparative Example 1	IR-2	0.030	None	-	P-2	0.800	IS-2	0.100	-3.2	D-2	0.030	None	-	6	6	2,500	50
Comparative Example 2	IR-11	0.030	M-3	0.100	Acrylic resin	0.825	IS-2	0.100	-3.2	None	-	None	-	6	6	6,000	60
Comparative Example 3	IR-12	0.080	M-3	0.200	P-2	0.800	IS-2	0.100	-3.2	None	-	None	-	1	0	6,000	70

[Table 3]

	Infrared absorbing agent		Polymerizable compound		Binder polymer (specific polymer)		Electron-Accepting polymerization initiator			Electron-donating polymerization initiator		Acid color former		Evaluation of color developability (ΔL)		Evaluation of UV printing durability	Evaluation of on-press developability
	Type	Content	Type	Content	Type	Content	Type	Content	LUMO (eV)	Type	Content	Type	Content	Immediately after exposure	After 2 hours from exposure	Number of sheets	Number of sheets
Example 20	IR-1	0.030	M-1	0.100	P-1	0.825	IA-1	0.100	-3.0	D-1	0.020	CA-1	0.050	10	10	6,000	30
Example 21	IR-2	0.040	M-2	0.150	P-2	0.500	IA-1	0.100	-3.0	D-2	0.020	CA-1	0.050	9	9	7,000	25
Example 22	IR-3	0.060	M-3	0.200	P-3	0.250	IA-1	0.100	-3.0	None	-	CA-1	0.050	10	10	7,500	20
Example 23	IR-4	0.030	M-1	0.100	P-4	0.600	IA-1	0.100	-3.0	D-3	0.030	CA-1	0.050	9	9	6,500	25
Example 24	IR-5	0.080	M-1	0.300	P-5	0.750	IA-1	0.100	-3.0	D-4	0.015	CA-1	0.050	11	11	8,000	20
Example 25	IR-6	0.100	M-3	0.050	P-6	0.300	IA-1	0.100	-3.0	D-2	0.040	CA-1	0.050	10	10	7,000	20
Example 26	IR-7	0.030	M-3	0.120	P-7	0.500	IA-1	0.100	-3.0	D-5	0.030	CA-1	0.050	11	11	7,500	15
Example 27	IR-8	0.060	M-2	0.300	P-8	0.400	IA-1	0.100	-3.0	D-2	0.020	CA-1	0.050	12	12	8,000	10
Example 28	IR-9	0.150	M-2	0.400	P-9	0.900	IA-1	0.100	-3.0	D-6	0.050	CA-1	0.050	10	10	10,000	15
Example 29	IR-10	0.020	M-2	0.100	P-10	1.000	IA-1	0.100	-3.0	D-2	0.025	CA-1	0.050	10	10	9,000	15
Example 30	IR-1	0.030	M-1	0.100	P-1	0.825	IS-1	0.100	-3.2	D-1	0.020	CA-1	0.050	10	10	6,000	30
Example 31	IR-1	0.030	M-1	0.100	P-1	0.825	IS-2	0.100	-3.2	D-1	0.020	CA-1	0.050	10	10	6,000	30

(continued)

	Infrared absorbing agent		Polymerizable compound		Binder polymer (specific polymer)		Electron-Accepting polymerization initiator			Electron-donating polymerization initiator		Acid color former		Evaluation of color development (ΔL)		Evaluation of UV printing durability	Evaluation of on-press developability
	Type	Content	Type	Content	Type	Content	Type	Content	LUMO (eV)	Type	Content	Type	Content	Immediately after exposure	After 2 hours from exposure	Number of sheets	Number of sheets
Example 32	IR-1	0.030	M-1	0.100	P-1	0.825	IS-3	0.100	-3.3	D-1	0.020	CA-1	0.050	10	10	6,000	30
Example 33	IR-1	0.030	M-1	0.100	P-1	0.825	IS-4	0.100	-3.2	D-1	0.020	CA-1	0.050	10	10	6,000	30
Example 34	IR-1	0.030	M-1	0.100	P-1	0.825	IS-5	0.100	-3.5	D-1	0.020	CA-1	0.050	10	10	7,000	30
Example 35	IR-1	0.030	M-1	0.100	P-1	0.825	IS-6	0.100	-3.3	D-1	0.020	CA-1	0.050	10	10	6,000	30
Example 36	IR-10	0.030	M-1 M-3	0.050 0.100	P-10	1.000	IA-1	0.100	-3.0	D-2	0.025	None	-	8	8	11,000	15

[Table 4]

	Support	Infrared absorbing agent		Polymerizable compound		Binder polymer (specific polymer)		Polymer particle (specific polymer)		Electron-Accepting polymerization initiator			Electron-donating polymerization initiator		Acid color former		Evaluation of color developability (ΔL)		Evaluation of UV printing durability	Evaluation of on-press developability
	Type	Type	Content	Type	Content	Type	Content	Type	Content	Type	Content	LUMO (eV)	Type	Content	Type	Content	Immediately after exposure	After 2 hours from exposure	Number of sheets	Number of sheets
Example 37	S1	IR-2	0.060	M-3	0.100	P-11	0.500	-	-	IA-1	0.100	-3.0	D-2	0.02	CA-1	0.05	9	8	9,000	25
Example 38	S2	IR-9	0.060	M-5	0.150	P-12	0.500	-	-	IA-1	0.100	-3.0	D-2	0.02	CA-1	0.05	8	7	10,000	25
Example 39	S3	IR-8	0.060	M-5	0.200	P-13	0.500	-	-	IA-1	0.100	-3.0	D-2	0.03	CA-1	0.05	9	8	10,500	25
Example 40	S1	IR-2	0.060	M-3	0.100	-	-	Polymer particle 1	0.500	IA-1	0.100	-3.0	D-2	0.02	CA-1	0.05	9	8	9,000	15
Example 41	S1	IR-2	0.060	M-3	0.100	P-11	0.250	Polymer particle 1	0.250	IA-1	0.100	-3.0	D-2	0.02	CA-1	0.05	9	8	10,000	15

[0594] The unit of the content of each component in Tables 2 to 4 is parts by mass.

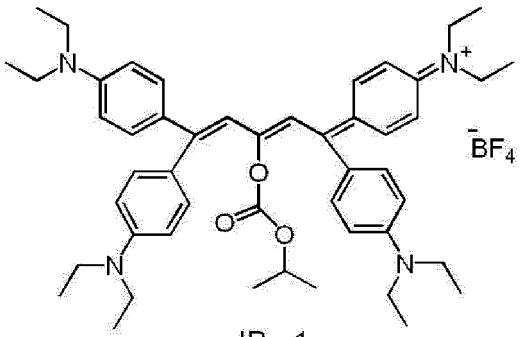
[0595] Further, the details of the compounds listed in Tables 2 to 4 are as follows.

<Infrared absorbing agent>

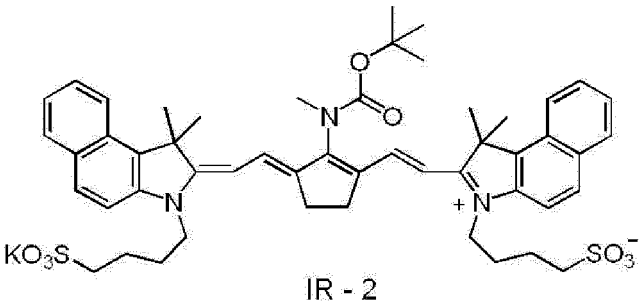
[0596]

IR-1 to IR-11: infrared absorbing agents decomposed by exposure to infrared rays, the following compounds
IR-12: infrared absorbing agent that is not decomposed by exposure to infrared rays, the following compound

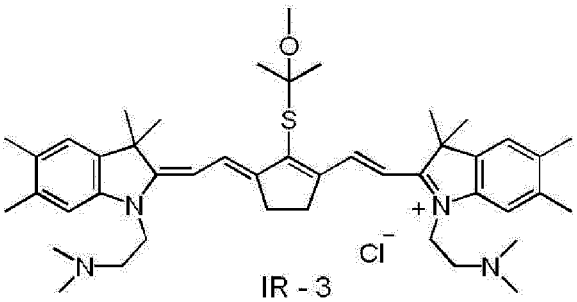
[0597] In the following compounds, TsO^- represents a tosylate anion and Ph represents a phenyl group.



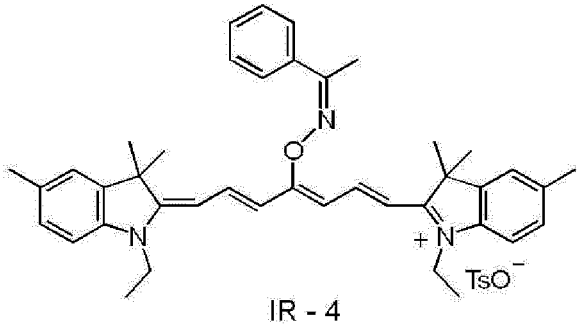
IR - 1



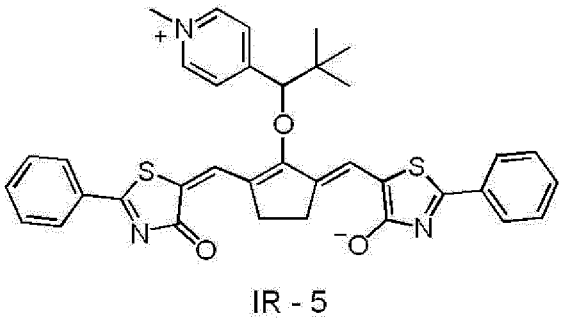
IR - 2



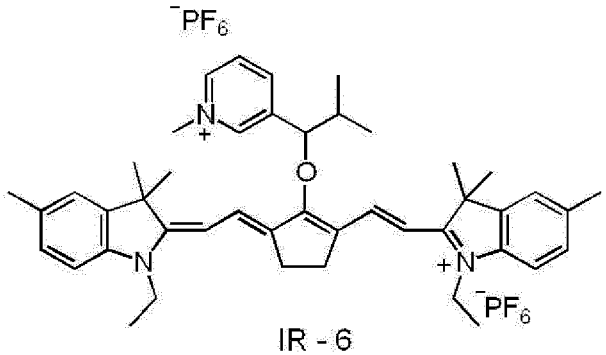
IR - 3



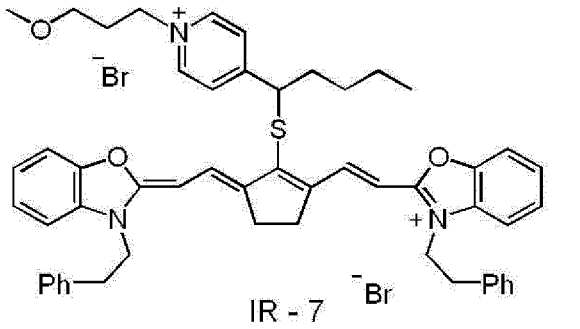
IR - 4



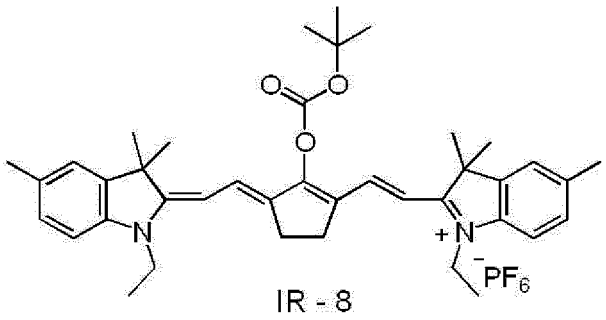
IR - 5



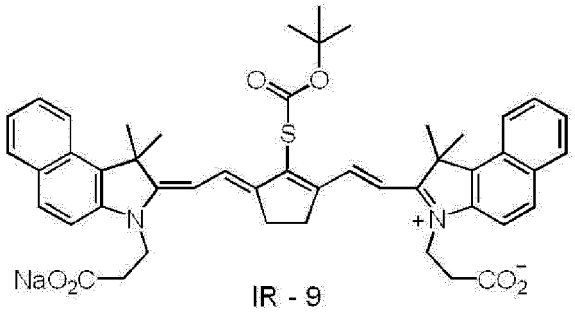
IR - 6



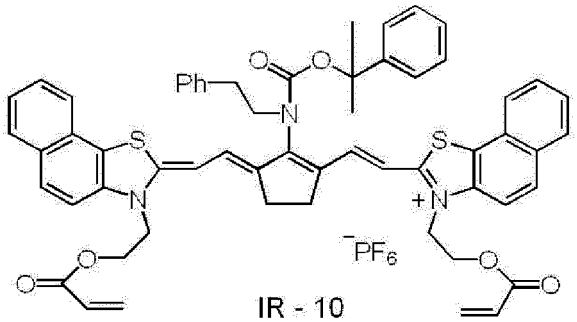
IR - 7



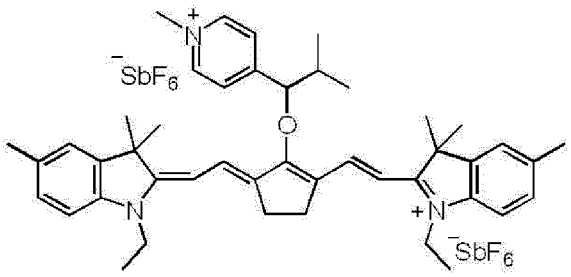
IR - 8



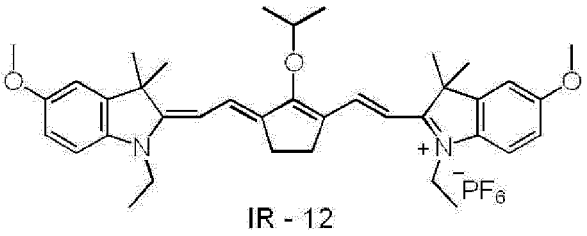
IR - 9



IR - 10



IR - 11



IR - 12

<Polymerizable compound>

[0598]

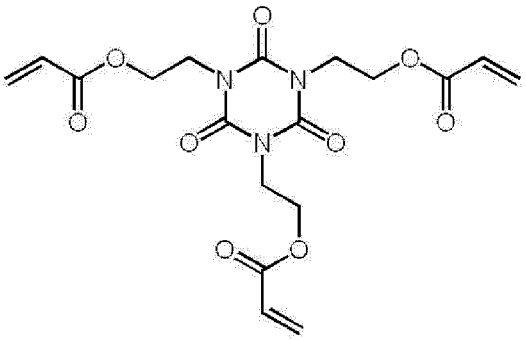
M-1: the following compound, molecular weight of 423.58, ethylenically unsaturated bond equivalent of 141.13, ClogP value of 2.59

M-2: the following compound, molecular weight of 1217.23, ethylenically unsaturated bond equivalent of 121.72, ClogP value of 5.92

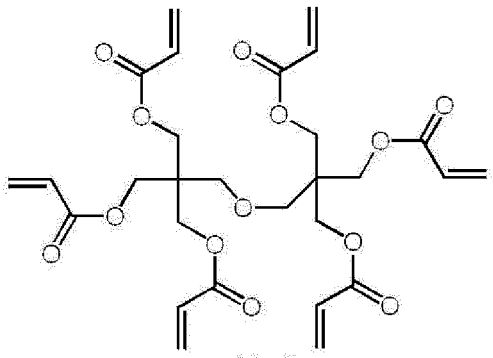
M-3: the following compound, molecular weight of 578.57, ethylenically unsaturated bond equivalent of 96.43, ClogP value of 5.08

M-4: the following compound, m + n = 4, molecular weight of 424.29, ethylenically unsaturated bond equivalent of 212.15, ClogP value of 5.85

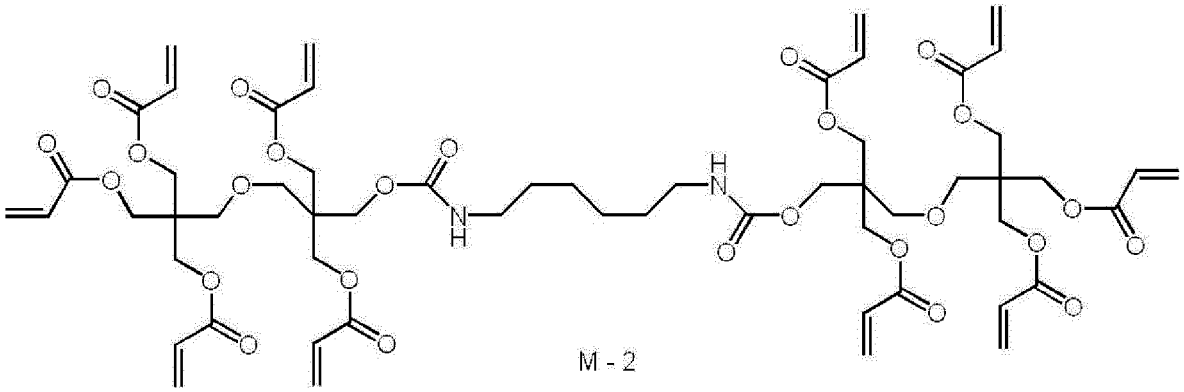
M-5: the following compound, molecular weight of 2078.15, ethylenically unsaturated bond equivalent of 138.54, ClogP value of 8.34



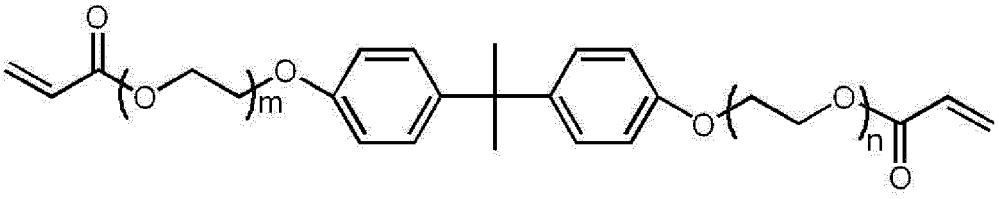
M - 1



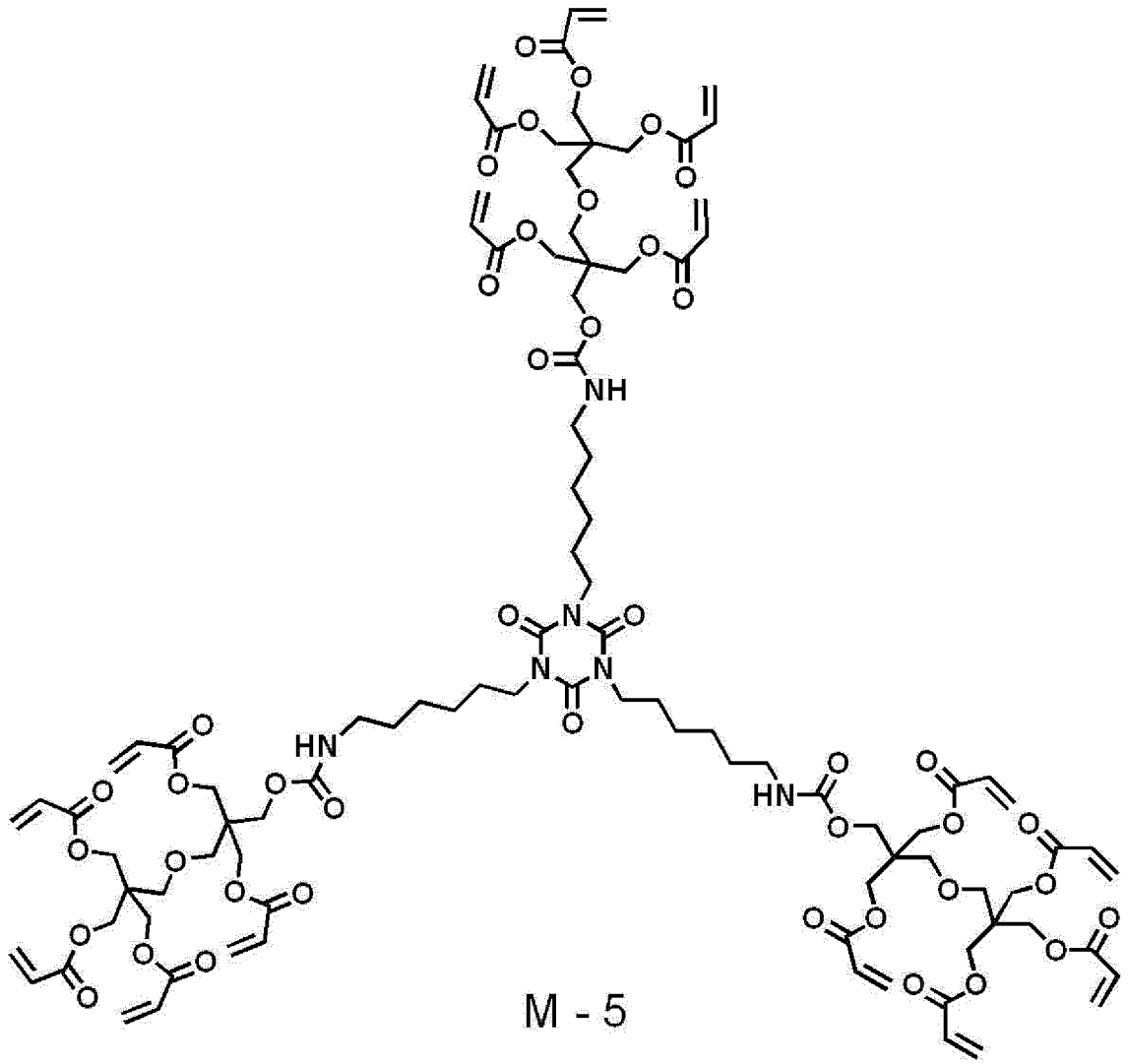
M - 3



M - 2



M - 4



M - 5

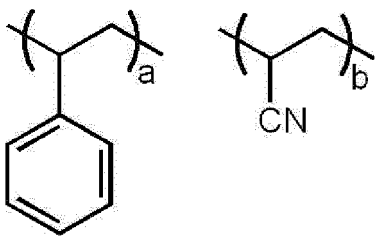
<Polymer>

[0599] P-1 to P-10: specific polymers shown below

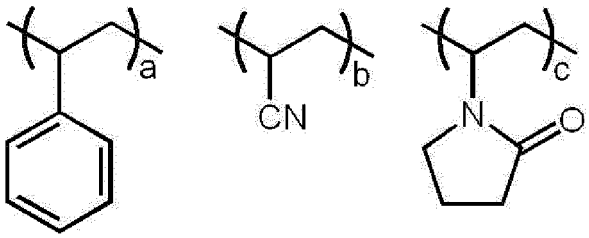
Acrylic resin: polymethyl methacrylate (PMMA), manufactured by Sigma-Aldrich Co., LLC, Mw of approximately 120000

[0600] Further, a to d in the following compounds P-1 to P-10 represent the mass ratio.

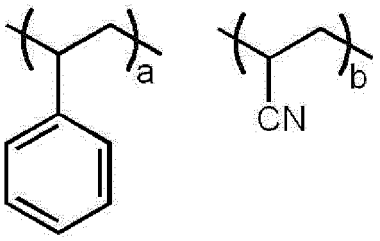
[0601] The weight-average molecular weights (Mw) of the compounds P-1 to P-10 were in a range of 3000 to 300000.



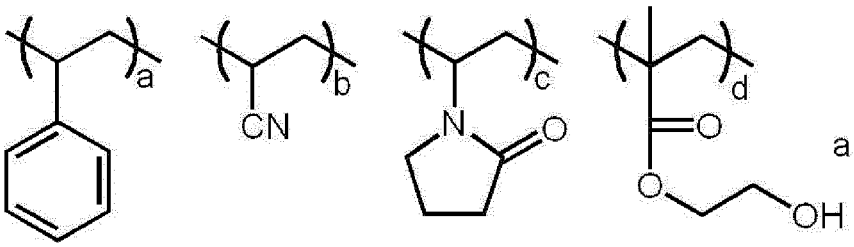
P - 1
a : b = 5 : 1



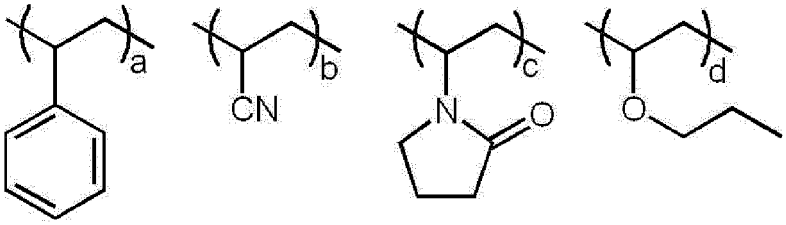
P - 2
a : b : c = 1 : 1 : 1



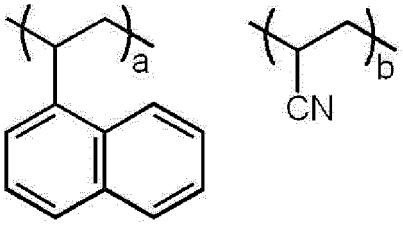
P - 3
a : b = 10 : 1



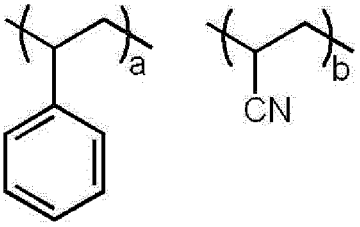
P - 4
a : b : c : d = 1 : 1 : 1 : 1



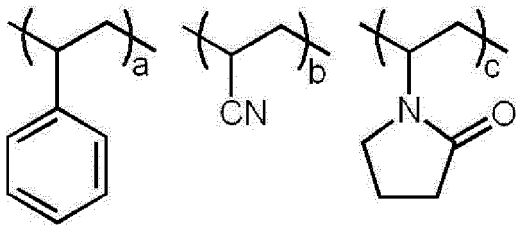
P - 5
a : b : c : d = 2 : 1 : 1 : 1



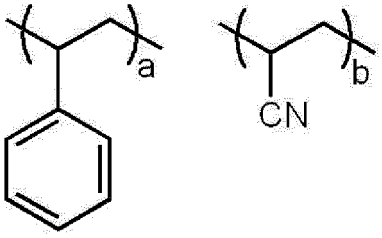
P - 6
a : b = 5 : 6



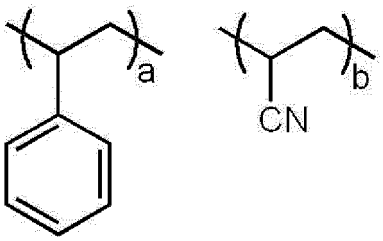
P - 7
a : b = 2 : 1



P - 8
a : b : c = 1 : 1 : 2

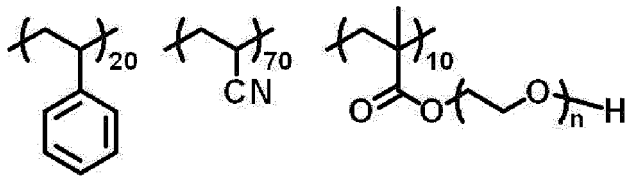


P - 9
a : b = 1 : 1

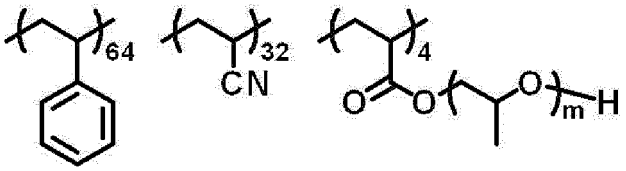


P - 10
a : b = 3 : 1

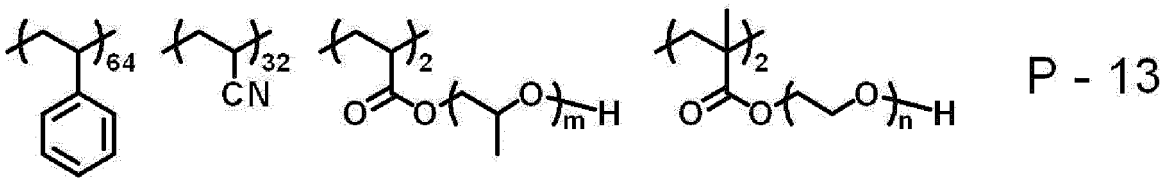
· P-11 [structure shown below]: 7.14 parts by mass, n = 40 to 50, weight-average molecular weight = 50000
· P-12 [structure shown below]: 7.14 parts by mass, m = 9, n = 45, weight-average molecular weight = 50000
· P-13 [structure shown below]: 7.14 parts by mass, m = 9, n = 45, weight-average molecular weight = 50000



P - 11



P - 12



P - 13

[Synthesis of polymer]

- Synthesis of P-1 -

[0602] 300 parts of methyl ethyl ketone was poured into a three-neck flask and heated to 80°C in a nitrogen stream. A mixed solution consisting of 83.3 parts of styrene, 16.7 parts of acrylonitrile, 0.7 parts of AIBN (azobisisobutyronitrile),

and 100 parts of methyl ethyl ketone was added dropwise to the reaction container for 30 minutes. After the completion of the dropwise addition, the reaction was allowed to further continue for 7.5 hours. Thereafter, 0.3 g of AIBN was added thereto, and the reaction was allowed to further continue for 12 hours. After the completion of the reaction, the reaction solution was cooled to room temperature. The composition ratio between the structural unit formed of styrene and the structural unit formed of acrylonitrile in the obtained compound P-1 was 5: 1 (mass ratio).

- Synthesis of P-2 to P-10 -

[0603] The compounds P-2 to P-10 were respectively prepared in the same manner as in the synthesis of the compound P-1 except that the kind of the monomer used and the amount of the monomer used were changed.

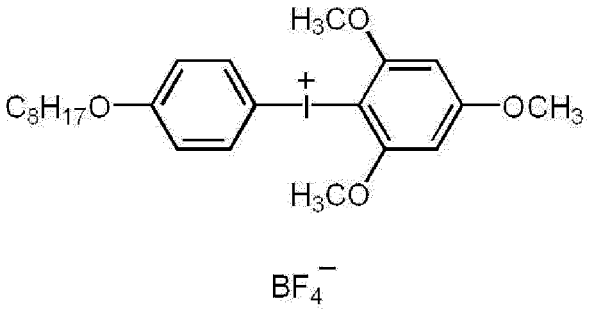
- Synthesis of polymer particles 1 -

[0604] A solution of 20 parts of polyethylene glycol methyl ether methacrylate (PEGMA) dissolved in a mixture of 50.5 parts of deionized water and 242.2 parts of n-propanol was put into a four-neck flask and slowly heated in a N_2 atmosphere until the solution was slightly refluxed (to 73°C). A premixture of styrene (9 parts), acrylonitrile (81 parts), and VAZO-64 (2,2'-azobis(isobutyronitrile), 0.7 parts) was added thereto for 2 hours. After 6 hours, 0.5 part of VAZO-64 was further added thereto. The temperature was increased to 80°C. Subsequently, 0.7 part of VAZO-64 was added thereto for 12 hours. After a total of 20 hours of the reaction, the conversion rate to a graft copolymer was greater than 98%, based on the measurement of the percentage of the non-volatile content. The mass ratio of PEGMA/styrene/acrylonitrile was 10: 9: 81, and the ratio of n-propanol/water was 80:20. The number average particle diameter of the polymer particles was 200 nm.

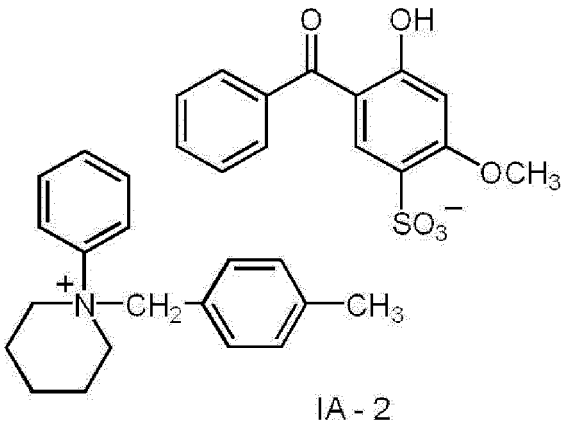
[0605] Here,the number average particle diameter is an average value obtained by capturing an electron micrograph of the polymer particles and measuring the equivalent circle diameters of a total of 5000 particles on the photograph, and calculating the average value thereof. The equivalent circle diameter is a diameter of a circle having the same area as the projected area of each particle on the photograph.

<Electron-accepting polymerization initiator>

[0606] IA-1 and IA-2: the following compounds

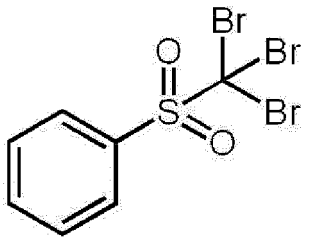


IA - 1

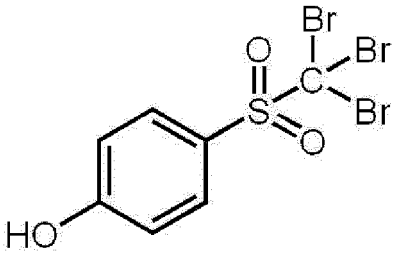


IA - 2

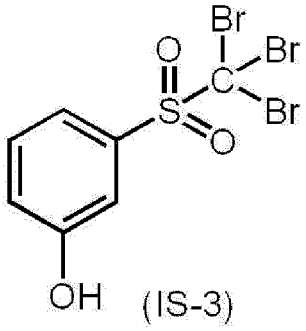
[0607] IS-1 to IS-6: the following compounds



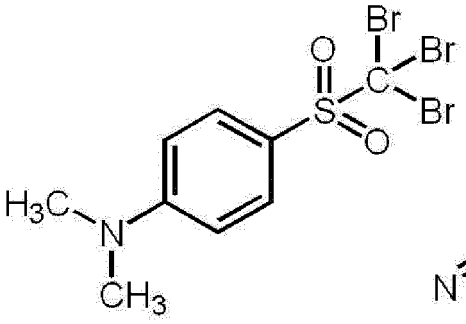
(IS-1)



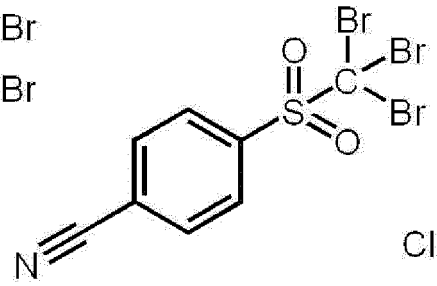
(IS-2)



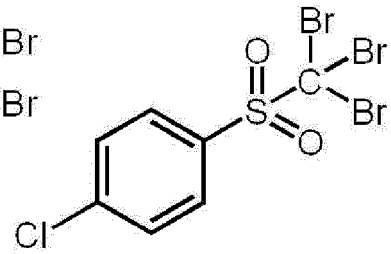
(IS-3)



(IS-4)



(IS-5)

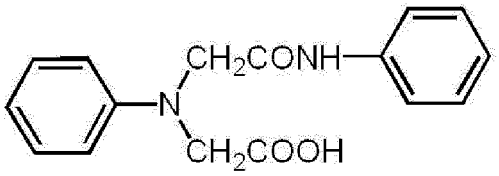


(IS-6)

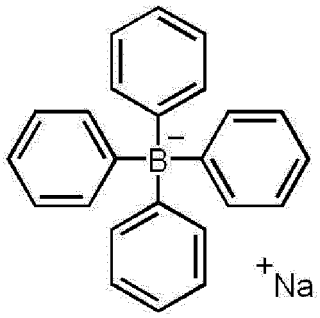
[Electron-donating polymerization initiator]

[0608] D-1 to D-6: the following compounds
Further, Bu in the following compounds represents an n-butyl group.

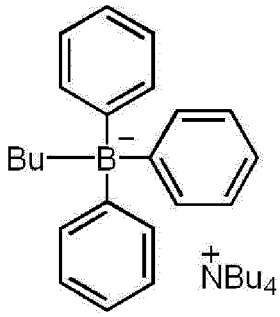
[0609] Further, the HOMO of D-6 is -5.905 eV, and the LUMO thereof is -3.250 eV.



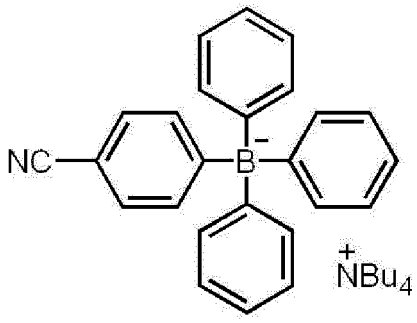
D - 1



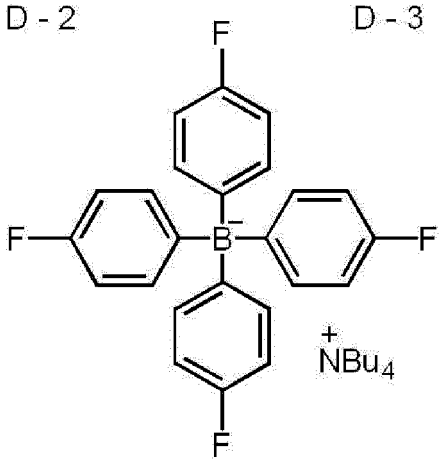
D - 2



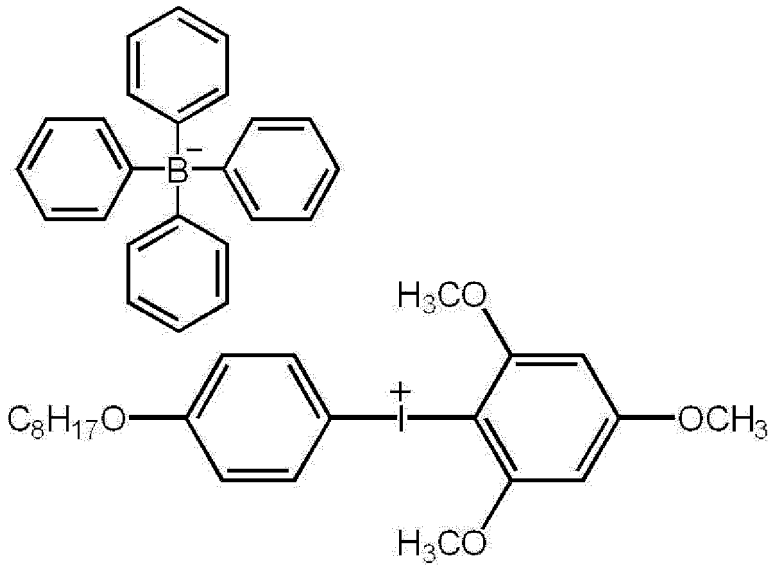
D - 3



D - 4



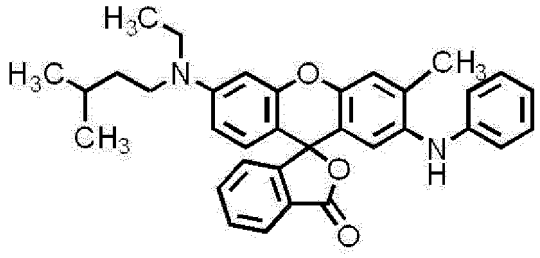
D - 5



D - 6

<Acid color former>

[0610] CA-1: the following compound



CA - 1

[0611] In each of the planographic printing plate precursors of Examples 1 to 41 which was the planographic printing plate precursor according to the embodiment of the present disclosure, it was found that a planographic printing plate having excellent color developability and excellent printing durability was obtained even in a case where UV ink was used as compared to the planographic printing plate precursors of Comparative Examples 1 to 3.

[0612] Further, it found that each of the planographic printing plate precursors of Examples 1 to 41 which was the planographic printing plate precursor according to the embodiment of the present disclosure had excellent temporal color developability after exposure and excellent on-press developability.

[0613] The disclosure of JP2018-205751 filed on October 31, 2018 and the disclosure of JP2019-122430 filed on June 28, 2019 are incorporated in the present specification by reference.

[0614] All documents, patent applications, and technical standards described in the present specification are incorporated herein by reference to the same extent as in a case of being specifically and individually noted that individual documents, patent applications, and technical standards are incorporated by reference.

Explanation of References

[0615]

12a, 12b:	aluminum support
18:	aluminum plate
20a, 20b:	anodized film
22a, 22b:	micropore
24:	large-diameter pore
26:	small-diameter pore
D:	depth of large-diameter pore
610:	anodization treatment device
612:	power supply tank
614:	electrolytic treatment tank
616:	aluminum plate
618, 26:	electrolytic solution
620:	power supply electrode
622, 628:	roller
624:	nip roller
630:	electrolytic electrode
632:	tank wall
634:	DC power source

Claims

1. A planographic printing plate precursor comprising:

a support; and
an image recording layer on the support,
wherein the image recording layer comprises an infrared absorbing agent that is capable of being decomposed by exposure to infrared rays, a polymer having a structural unit formed of an aromatic vinyl compound, a polymerization initiator, and a polymerizable compound.

2. The planographic printing plate precursor according to claim 1, wherein the polymer comprises polymer particles.

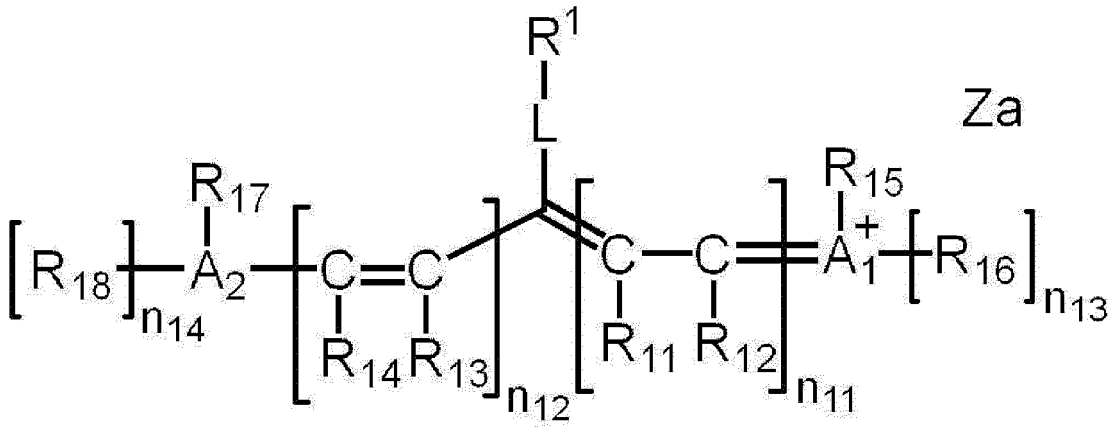
3. The planographic printing plate precursor according to claim 1 or 2, wherein the polymer has a hydrophilic group.

4. The planographic printing plate precursor according to claim 3, wherein the hydrophilic group has a polyalkyleneoxy structure.

5. The planographic printing plate precursor according to any one of claims 1 to 4, wherein the infrared absorbing agent is an infrared absorbing agent that is decomposed due to heat, electron transfer, or both thereof caused by exposure to infrared rays.

6. The planographic printing plate precursor according to any one of claims 1 to 5, wherein the infrared absorbing agent is a cyanine coloring agent.

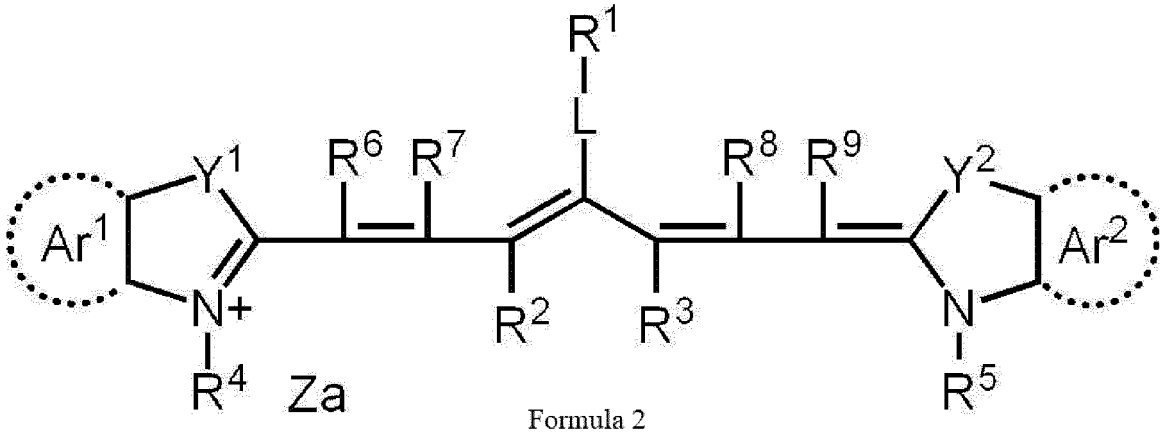
7. The planographic printing plate precursor according to claim 6, wherein the cyanine coloring agent is a cyanine coloring agent represented by Formula 1,



Formula 1

in Formula 1, R^1 represents a group having an R^1-L bond that is capable of being cleaved by exposure to infrared rays, R_{11} to R_{18} each independently represent a hydrogen atom, a halogen atom, -Ra, -ORb, -SRc, or -NRdRe, Ra to Re each independently represent a hydrocarbon group, A_1, A_2, and a plurality of R_{11}'s to R_{18}'s may be linked to each other to form a monocycle or a polycycle, A_1 and A_2 each independently represent an oxygen atom, a sulfur atom, or a nitrogen atom, n_{11} and n_{12} each independently represent an integer of 0 to 5, where a total of n_{11} and n_{12} is 2 or greater, n_{13} and n_{14} each independently represent 0 or 1, L represents an oxygen atom, a sulfur atom, or $-NR^{10}-$, R^{10} represents a hydrogen atom, an alkyl group, or an aryl group, and Za represents a counter ion that neutralizes an electric charge.

8. The planographic printing plate precursor according to claims 6 or 7, wherein the cyanine coloring agent is a cyanine coloring agent represented by Formula 2,



Formula 2

in Formula 2, R^1 represents a group having an R^1-L bond that is capable of being cleaved by exposure to infrared rays, R^2 and R^3 each independently represent a hydrogen atom or an alkyl group, R^2 and R^3 may be linked to each other to form a ring, Ar^1 and Ar^2 each independently represent a group forming a benzene ring or a naphthalene ring, Y^1 and Y^2 each independently represent an oxygen atom, a sulfur atom, $-NR^0-$, or a dialkylmethylene group, R^0 represents a hydrogen atom, an alkyl group, or an aryl group, R^4 and R^5 each independently represent an alkyl group, a $-CO_2M$ group, or a $-PO_3M_2$ group, M represents a hydrogen atom, a Na atom, a K atom, or an onium group, R^6 to R^9 each independently represent a hydrogen atom or an alkyl group, L represents an oxygen atom, a sulfur atom, or $-NR^{10}-$, R^{10} represents a hydrogen atom, an alkyl group, or an aryl group, and Za represents a counter ion that neutralizes an electric charge.

9. The planographic printing plate precursor according to any one of claims 1 to 8, wherein an ethylenically unsaturated bond equivalent of the polymerizable compound is 200 g/mol or less.

10. The planographic printing plate precursor according to any one of claims 1 to 9, wherein a weight-average molecular weight of the polymerizable compound is 1500 or less.

11. The planographic printing plate precursor according to any one of claims 1 to 10, wherein the polymerizable compound contains a trifunctional or higher functional polymerizable compound.

12. The planographic printing plate precursor according to any one of claims 1 to 11, wherein the polymerizable compound contains a heptafunctional or higher functional polymerizable compound.

13. The planographic printing plate precursor according to any one of claims 1 to 12, wherein the polymerizable compound contains a decafunctional or higher functional polymerizable compound.

14. The planographic printing plate precursor according to any one of claims 1 to 13, wherein a CLogP value of the polymerizable compound is 6 or less.

15. The planographic printing plate precursor according to any one of claims 1 to 14, wherein the image recording layer contains two or more kinds of polymerizable compounds.

16. The planographic printing plate precursor according to any one of claims 1 to 15, wherein the polymerization initiator comprises an electron-donating polymerization initiator and an electron-accepting polymerization initiator.

17. The planographic printing plate precursor according to claim 16, wherein the polymerization initiator includes an onium salt compound as the electron-accepting polymerization initiator.

18. The planographic printing plate precursor according to claim 16 or 17, wherein the polymerization initiator comprises a borate compound as the electron-donating polymerization initiator.

19. The planographic printing plate precursor according to any one of claims 16 to 18,

wherein a HOMO of the electron-donating polymerization initiator is -6.0 eV or greater.

20. The planographic printing plate precursor according to any one of claims 16 to 19, wherein a LUMO of the electron-accepting polymerization initiator is -3.0 eV or less.

21. The planographic printing plate precursor according to any one of claims 1 to 20, wherein the polymerization initiator comprises a compound in which an electron-donating polymerization initiator and an electron-accepting polymerization initiator form a counter salt.

22. The planographic printing plate precursor according to any one of claims 1 to 21, wherein the image recording layer further comprises an acid color former.

23. The planographic printing plate precursor according to any one of claims 1 to 22, further comprising: an overcoat layer on the image recording layer.

24. The planographic printing plate precursor according to any one of claims 1 to 23,

wherein the aluminum support comprises an aluminum plate and an anodized aluminum film disposed on the aluminum plate,
the anodized film is positioned closer to a side of the image recording layer than a side of the aluminum plate,
the anodized film has micropores extending from a surface on the side of the image recording layer in a depth direction, and
an average diameter of the micropores in the surface of the anodized film is greater than 10 nm and 100 nm or less.

25. The planographic printing plate precursor according to claim 24,

wherein the micropores are formed of large-diameter pores extending to a position at a depth of 10 nm to 1000 nm from the surface of the anodized film and small-diameter pores communicating with bottom portions of the large-diameter pores and extending to a position at a depth of 20 nm to 2000 nm from the communication positions,
the average diameter of the large-diameter pores in the surface of the anodized film is in a range of 15 nm to 100 nm, and
the average diameter of the small-diameter pores at the communication position is 13 nm or less.

26. A method of preparing a planographic printing plate, comprising:

a step of imagewise-exposing the planographic printing plate precursor according to any one of claims 1 to 25; and
a step of supplying at least one selected from the group consisting of printing ink and dampening water to remove an image recording layer of a non-image area on a printing press.

27. A planographic printing method comprising:

a step of imagewise-exposing the planographic printing plate precursor according to any one of claims 1 to 25;
a step of supplying at least one selected from the group consisting of printing ink and dampening water to remove an image recording layer of a non-image area on a printing press and preparing a planographic printing plate; and
a step of performing printing using the obtained planographic printing plate.

FIG. 1

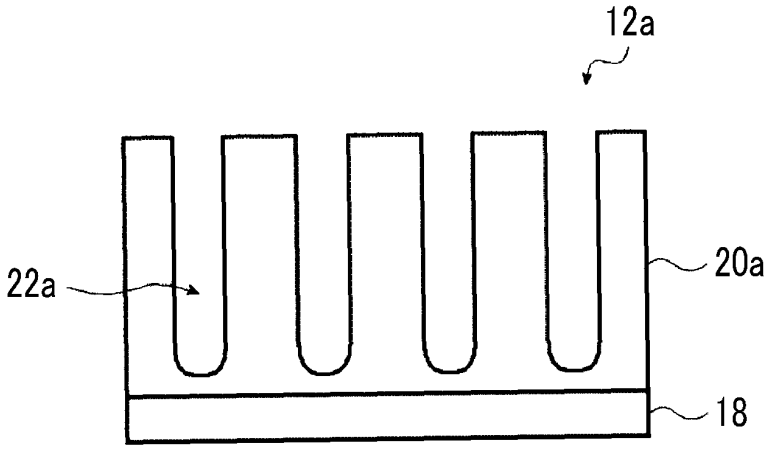


FIG. 2

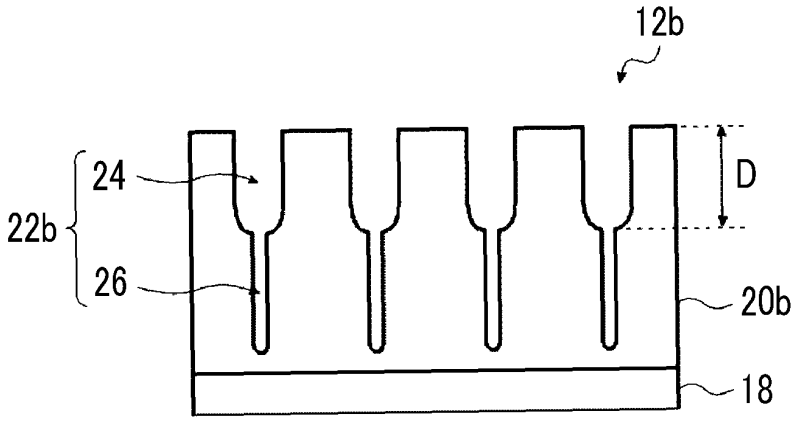
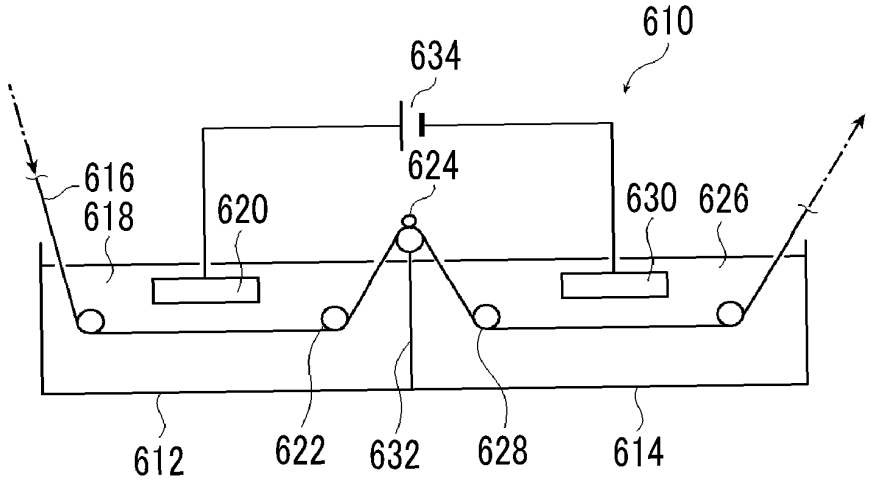


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/042871

A. CLASSIFICATION OF SUBJECT MATTER
B41N 1/14(2006.01)i; G03F 7/00(2006.01)i; G03F 7/004(2006.01)i; G03F 7/027(2006.01)i; G03F 7/029(2006.01)i; G03F 7/033(2006.01)i; G03F 7/11(2006.01)i
FI: B41N1/14; G03F7/00 503; G03F7/004 505; G03F7/033; G03F7/027 502; G03F7/029; G03F7/11 501

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)
B41N1/14; G03F7/00; G03F7/004; G03F7/027; G03F7/029; G03F7/033; G03F7/11

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2018/159710 A1 (FUJIFILM CORPORATION) 07.09.2018 (2018-09-07) claims 1-15, paragraphs [0016], [0034]-[0036], [0037], [0047], [0075], [0081], [0092]-[0110]	1-15,22-24,26-27 12-13,16-21,23,25
X Y	WO 2018/043259 A1 (FUJIFILM CORPORATION) 08.03.2018 (2018-03-08) claims 1-12, paragraphs [0026], [0071]-[0079], [0116], [0168], [0196]-[0201], [0226]-[0227], [0243]-[0246], [0250]-[0262]	1-11,14-20,23-24,26-27 12-13,21-22,25

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

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Date of the actual completion of the international search	Date of mailing of the international search report
08 January 2020 (08.01.2020)	28 January 2020 (28.01.2020)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2019/042871

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Form PCT/ISA/210 (patent family annex) (January 2015)

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