

the present embodiment by using a metal oxide (component (M)) together with the compound (A) and the component (I). Further, a pattern having an excellent shape and high resolution can be formed.

[0145] Examples of the component (M) include oxides of metals such as silicon (metallic silicon), zirconium, and hafnium. Among these, an oxide of silicon is preferable. In addition, it is particularly preferable to use silica.

[0146] Further, it is preferable that the component (M) be a particulate.

[0147] Such a particulate component (M) preferably consist of particles having a volume average particle diameter of 5 to 40 nm, more preferably particles having a volume average particle diameter of 5 to 30 nm, and still more preferably particles having a volume average particle diameter of 10 to 20 nm.

[0148] In a case where the volume average particle diameter of the component (M) is greater than or equal to the lower limit of the above-described preferable range, the hardness of the cured film is likely to be increased. Further, in a case where the volume average particle diameter thereof is lower than or equal to the upper limit of the above-described preferable range, residues are unlikely to be generated during pattern formation, and a pattern with higher resolution is easily formed. In addition, the transparency of the resin film can be improved.

[0149] The particle diameter of the component (M) may be appropriately selected according to the exposure light source. Generally, a particle having a particle diameter of  $\frac{1}{10}$  or less of the wavelength of light is considered to be hardly affected by light scattering. Therefore, for example, in a case where a fine structure is formed using photolithography with an i-line (365 nm), it is preferable that particles having a primary particle diameter (volume average value) of 10 to 20 nm (particularly preferably the group of silica particles) be used as the component (M).

[0150] The component (M) may be used alone or in a combination of two or more kinds thereof.

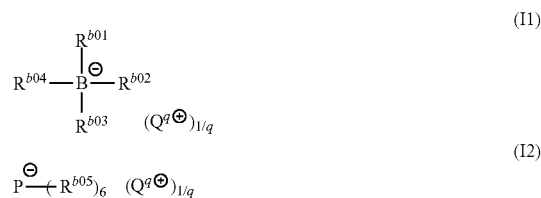
[0151] The content of the component (M) is preferably in a range of 10 to 30 parts by mass and more preferably in a range of 15 to 25 parts by mass with respect to 100 parts by mass of the component (A).

[0152] In a case where the content of the component (M) is greater than or equal to the lower limit of the above-described preferable range, the hardness of the cured film is likely to be increased. Further, in a case where the content thereof is lower than or equal to the upper limit of the above-described preferable range, the transparency of the resin film can be further improved. In addition, the fluidity of the photosensitive composition is likely to be maintained.

[0153] <Cationic Polymerization Initiator (I)>

[0154] As a cationic polymerization initiator (component (I)), a component containing one or more selected from the group consisting of a compound represented by Formula (11) (hereinafter, referred to as a "component (11)") and a compound represented by Formula (12) (hereinafter, referred to as a "component (12)") is used.

[0155] Since relatively strong acids are generated upon exposure from both of the component (11) and the component (12), in a case where a pattern is formed using a photosensitive composition that contains the component (I), sufficient sensitivity is obtained so that an excellent pattern is formed.



[0156] [In the formulae,  $\text{R}^{b01}$  to  $\text{R}^{b04}$  each independently represent an aryl group which may have a substituent or a fluorine atom.  $\text{R}^{b05}$  represents a fluorinated alkyl group which may have a substituent or a fluorine atom. A plurality of  $\text{R}^{b05}$ 's may be the same as or different from one another.  $q$  represents an integer of 1 or greater.  $\text{Q}^{q+}$ 's each independently represent a  $q$ -valent organic cation.]

[0157] In Formula (11),  $\text{R}^{b01}$  to  $\text{R}^{b04}$  each independently represent an aryl group which may have a substituent or a fluorine atom.

[0158] The aryl group as  $\text{R}^{b01}$  to  $\text{R}^{b04}$  preferably has 5 to 30 carbon atoms, more preferably 5 to 20 carbon atoms, still more preferably 6 to 15 carbon atoms, and particularly preferably 6 to 12 carbon atoms. Specific examples thereof include a naphthyl group, a phenyl group, and an anthracenyl group. Among these, a phenyl group is preferable from the viewpoint of availability.

[0159] The aryl group of  $\text{R}^{b01}$  to  $\text{R}^{b04}$  may have a substituent. The substituent is not particularly limited. As the substituent, a halogen atom, a hydroxyl group, an alkyl group (preferably a linear or branched alkyl group having 1 to 5 carbon atoms), or a halogenated alkyl group is preferable, a halogen atom or a halogenated alkyl group having 1 to 5 carbon atoms is more preferable, and a fluorine atom or a fluorinated alkyl group having 1 to 5 carbon atoms is particularly preferable. It is preferable that an aryl group have a fluorine atom because the polarity of the anion moiety is increased.

[0160] Among these,  $\text{R}^{b01}$  to  $\text{R}^{b04}$  in Formula (11) each preferably represent a fluorinated phenyl group and particularly preferably a perfluorophenyl group.

[0161] Specific preferred examples of the anion moiety of the compound represented by Formula (11) include tetrakis(pentafluorophenyl)borate ( $[\text{B}(\text{C}_6\text{F}_5)_4]^-$ ); tetrakis[(trifluoromethyl)phenyl]borate ( $[\text{B}(\text{C}_6\text{H}_4\text{CF}_3)_4]^-$ ); difluorobis(pentafluorophenyl)borate ( $[(\text{C}_6\text{F}_5)_2\text{BF}_2]^-$ ); trifluoro(pentafluorophenyl)borate ( $[(\text{C}_6\text{F}_5)\text{BF}_3]^-$ ); and tetrakis(difluorophenyl)borate ( $[\text{B}(\text{C}_6\text{H}_3\text{F}_2)_4]^-$ ).

[0162] Among these, tetrakis(pentafluorophenyl)borate ( $[\text{B}(\text{C}_6\text{F}_5)_4]^-$ ) is particularly preferable.

[0163] In Formula (12),  $\text{R}^{b05}$  represents a fluorinated alkyl group which may have a substituent or a fluorine atom. A plurality of  $\text{R}^{b05}$ 's may be the same as or different from one another.

[0164] The fluorinated alkyl group of  $\text{R}^{b05}$  preferably has 1 to 10 carbon atoms, more preferably 1 to 8 carbon atoms, and still more preferably 1 to 5 carbon atoms. Specific examples thereof include a group in which part or all of the hydrogen atoms in an alkyl group having 1 to 5 carbon atoms have been substituted with fluorine atoms.

[0165] Among the examples,  $\text{R}^{b05}$  preferably represents a fluorine atom or a fluorinated alkyl group having 1 to 5 carbon atoms, more preferably a fluorine atom or a perfluoro-