a hydrophobic resin.

(9) A resist film, which is formed from the actinic ray-sensitive or radiation-sensitive resin composition as described in any one of (1) to (8) above.

(10) A pattern forming method, comprising:

forming a resist film by using the actinic ray-sensitive or radiation-sensitive resin composition as described in any one of (1) to (8) above; and

exposing and developing the resist film.

(11) The pattern forming method as described in (10) above,

wherein exposure in the exposing is immersion exposure.

The present invention preferably further includes the following configurations.

(12) The actinic ray-sensitive or radiation-sensitive resin composition as described in any one of (1) to (8) above,

wherein the molar extinction coefficient ε of the compound (PA) at a wavelength of 193 nm as measured in acetonitrile solvent is from 6,500 to 55,000.

(13) The actinic ray-sensitive or radiation-sensitive resin composition as described in any one of (1) to (8) and (12) above, which is used for ArF excimer laser exposure.

(14) The actinic ray-sensitive or radiation-sensitive resin composition as described in any one of (1) to (8), (12) and (13) above, which is used for immersion exposure.

In one aspect, there is provided an actinic ray-sensitive or radiation-sensitive resin composition, comprising:

(PA) a compound having a proton acceptor functional group and undergoing decomposition upon irradiation with an actinic ray or radiation to generate a compound reduced in or deprived of proton acceptor property or changed to be acidic from being proton acceptor-functioning, wherein a molar extinction coefficient ε of the compound (PA) at a wavelength of 193 nm as measured in acetonitrile solvent is 55,000 or less;

(B1) a resin capable of increasing a solubility of the resin (B1) in an alkali developer by an action of an acid, wherein the resin (B1) contains a resin having a repeating unit represented by the following formula (V), and the compound (PA) is a compound capable of decomposing upon irradiation with an actinic ray or radiation to generate a compound represented by the following formula (PA-1):

$$Q\text{-}A_{PA1}\text{-}(X)_n\text{-}R \qquad \text{(PA-1)}$$

wherein Q represents $-SO_3H$, $-CO_2H$ or $-W_1\text{-}NH\text{-}W_2\text{-}Rf$;

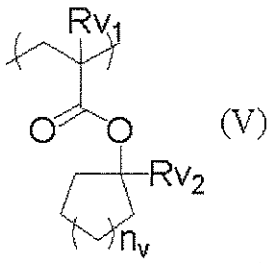
each of X, W_1 and W_2 independently represents $-SO_2-$ or $-CO-$;

Rf represents an alkyl group which may be substituted with a halogen atom, a cycloalkyl group which may be substituted with a halogen atom, or an aryl group which may be substituted with a halogen atom;

A_{PA1} represents a single bond or a divalent linking group;

n represents 0 or 1;

R represents a monovalent organic group having a proton acceptor functional group;

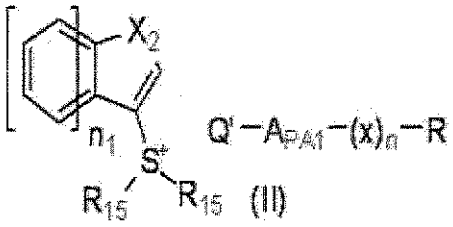


(V)

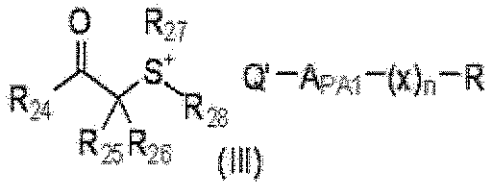
wherein each of Rv_1 and Rv_2 independently represents an alkyl group having a carbon number of 1 to 10;

n_v represents an integer of 1 to 6,

wherein the compound (PA) is represented by the following formula (II) or (III):



(II)



(III)

wherein each R_{15} independently represents an alkyl group or a cycloalkyl group, two R_{15}'s may combine with each other to form a ring;

X_2 represents any one of $-CR_{21}=CR_{22}-$, $-NR_{23}-$, -S- and -O-;

each of R_{21} to R_{23} independently represents a hydrogen atom, an alkyl group, a cycloalkyl group, an alkoxy group or an aryl group;

R_{24} represents an aryl group;

each of R_{25} and R_{26} independently represents a hydrogen atom, an alkyl group or a cycloalkyl group, R_{25} and R_{26} may combine with each other to form a ring;

each of R_{27} and R_{28} independently represents a hydrogen atom, an alkyl group, a cycloalkyl group, an allyl group or a vinyl group, R_{27} and R_{28} may combine with each other to form a ring;

n_1 represents an integer of 0 to 3;

Q' represents $-SO_3^-$, $-CO_2^-$ or $-W_1-N^--W_2-Rf$; and

X, W_1, W_2, Rf, A_{PA1}, R and n have the same meanings as X, W_1, W_2, Rf, A_{PA1}, R and n in formula (PA-1).

In another aspect, there is provided a resist film, which is formed from the actinic ray-sensitive or radiation-sensitive resin composition as defined above.

In another aspect, there is provided a pattern forming method, comprising:

forming a resist film by using the actinic ray-sensitive or radiation-sensitive resin composition as defined above; and

exposing and developing the resist film.

Description of Embodiments

The present invention is described in detail below.

In the present invention, when a group (atomic group) is denoted without specifying whether substituted or unsubstituted, the group includes both a group having no substituent and a group having a substituent. For example, "an alkyl group" includes not only an alkyl group having no substituent (unsubstituted alkyl group) but also an alkyl group having a substituent (substituted alkyl group).

In the present invention, the term "actinic ray" or "radiation" indicates, for example, a bright line spectrum of mercury lamp, a far ultraviolet ray typified by excimer laser, an extreme-ultraviolet ray (EUV light), an X-ray or an electron beam. Also, in the present invention, the "light" means an actinic ray or radiation.

Furthermore, in the present invention, unless otherwise indicated, the "exposure" includes not only exposure with a mercury lamp, a far ultraviolet ray typified by excimer laser, an X-ray, EUV light or the like but also lithography with a particle beam such as electron beam and ion beam.

CLAIMS

1. An actinic ray-sensitive or radiation-sensitive resin composition, comprising:

(PA) a compound having a proton acceptor functional group and undergoing decomposition upon irradiation with an actinic ray or radiation to generate a compound reduced in or deprived of proton acceptor property or changed to be acidic from being proton acceptor-functioning, wherein a molar extinction coefficient ε of the compound (PA) at a wavelength of 193 nm as measured in acetonitrile solvent is 55,000 or less;

(B1) a resin capable of increasing a solubility of the resin (B1) in an alkali developer by an action of an acid, wherein the resin (B1) contains a resin having a repeating unit represented by the following formula (V), and the compound (PA) is a compound capable of decomposing upon irradiation with an actinic ray or radiation to generate a compound represented by the following formula (PA-1):

$$Q\text{-}A_{PA1}\text{-}(X)_n\text{-}R \qquad (PA\text{-}1)$$

wherein Q represents $-SO_3H$, $-CO_2H$ or $-W_1\text{-}NH\text{-}W_2\text{-}Rf$;

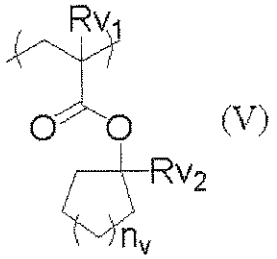
each of X, W_1 and W_2 independently represents $-SO_2-$ or -CO-;

Rf represents an alkyl group which may be substituted with a halogen atom, a cycloalkyl group which may be substituted with a halogen atom, or an aryl group which may be substituted with a halogen atom;

A_{PA1} represents a single bond or a divalent linking group;

n represents 0 or 1;

R represents a monovalent organic group having a proton acceptor functional group;

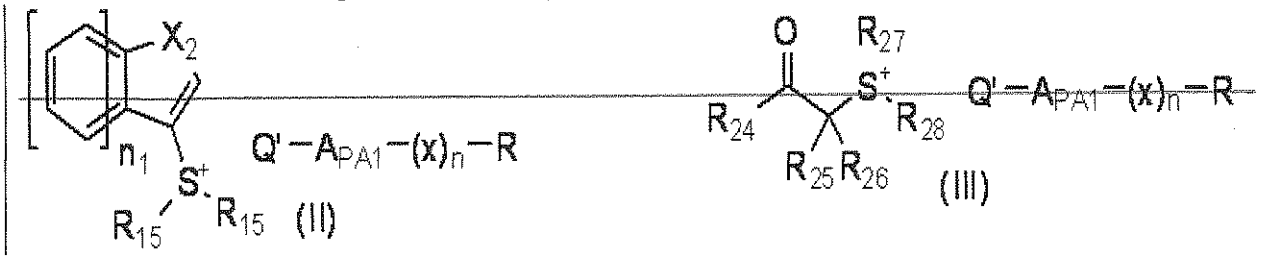


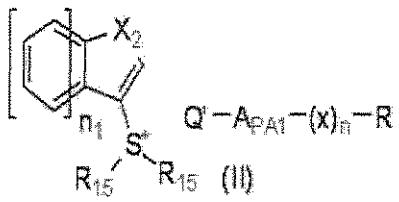
(V)

wherein each of Rv_1 and Rv_2 independently represents an alkyl group having a carbon number of 1 to 10;

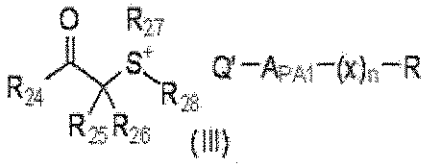
n_v represents an integer of 1 to 6,

wherein the compound (PA) is represented by the following formula (II) or (III):



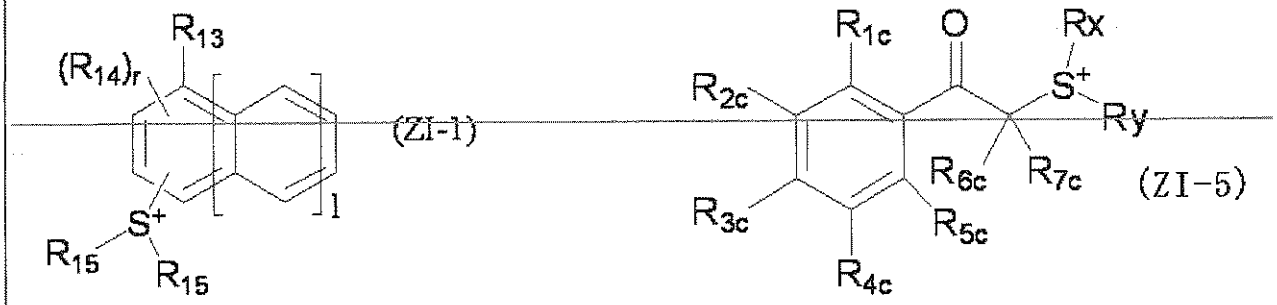


(II)



(III)

~~11. The actinic ray-sensitive or radiation-sensitive resin composition according to claim 1, wherein a cationic structure represented by formula (II) and (III) is a cation represented by the formula (ZI-1) or (ZI-5):~~



~~wherein in formula (ZI-1):~~

~~R_{13} represents a hydrogen atom, a fluorine atom, a hydroxyl group, an alkyl group, a cycloalkyl group, an alkoxy group, an alkoxycarbonyl group, or a group having a cycloalkyl group;~~

~~R_{14} represents, when a plurality of R_{14}'s are present, each independently represents a hydroxyl group, an alkyl group, a cycloalkyl group, an alkoxy group, an alkoxycarbonyl group, an alkylcarbonyl group, an alkylsulfonyl group, a cycloalkylsulfonyl group, or a group having a cycloalkyl group;~~

~~each R_{15} independently represents an alkyl group or a cycloalkyl group, wherein two R_{15}'s may combine with each other to form a ring;~~

~~l represents an integer of 0 to 2;~~

~~r represents an integer of 0 to 10;~~

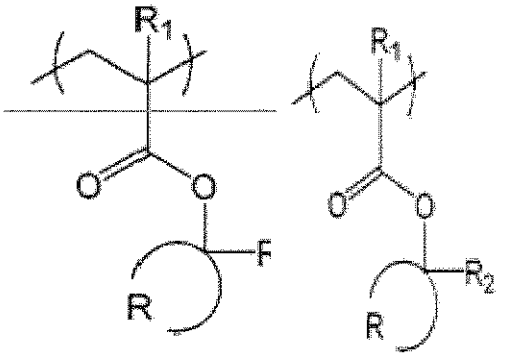
~~wherein in formula (ZI-5):~~

~~each of R_{1c} to R_{5c} independently represents a hydrogen atom, an alkyl group, a cycloalkyl group, an alkoxy group, an aryloxy group, an alkylthio group, an arylthio group or a halogen atom, wherein any two or more members out of R_{1c} to R_{5c} may combine to form a ring structure, and provided that at least one of R_{1C} to R_{5C} represents a linear or branched alkyl group, a cycloalkyl group, or a branched or cyclic alkoxy group;~~

~~each of R_{6c} and R_{7c} independently represents a hydrogen atom, an alkyl group or a cycloalkyl group wherein R_{6c} and R_{7c} may combine to form a ring structure; and~~

~~each of R_x and R_y independently represents an alkyl group, a cycloalkyl group, an allyl group or a vinyl group wherein R_x and R_y may combine with each other to form a ring.~~

112. The actinic ray-sensitive or radiation-sensitive resin composition according to claim 1, wherein the resin (B1) further contains a repeating unit represented by formula (I), in addition to the repeating unit represented by formula (V),



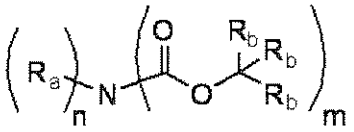
(I) (I)

wherein R_1 independently represents a hydrogen atom, a methyl group which may have a substituent, or a group represented by $-CH_2-R_9$;

R_2, independently represents an alkyl group or a cycloalkyl group; and

R represents an atomic group necessary for forming an alicyclic structure together with the carbon atom.

~~13~~12. The actinic ray-sensitive or radiation-sensitive resin composition according to claim 1, wherein the resin composition further contains a compound represented by formula (A),



(A)

wherein each Ra independently represents a hydrogen atom, an alkyl group, a cycloalkyl group, an aryl group or an aralkyl group;

each Rb independently represents a hydrogen atom, an alkyl group, a cycloalkyl group, an aryl group or an aralkyl group, provided that in -C(Rb)(Rb)(Rb), when one or more Rb's are a hydrogen atom, at least one of remaining Rb's is a cyclopropyl group or a 1-alkoxyalkyl group;

each of the alkyl group, cycloalkyl group, aryl group and aralkyl group of Ra and Rb is optionally substituted with a functional group selected from the group consisting of: hydroxyl group, cyano group, amino group, pyrrolidino group, piperidino group, morpholino group and oxo group, an alkoxy group or a halogen atom;

n represents an integer of 0 to 2;

m represents an integer of 1 to 3;

wherein n+m=3;

wherein n=2, two Ra's may be the same or different, and two Ra's may combine with each other to form a divalent heterocyclic hydrocarbon group or a derivative thereof; and

wherein at least two Rb's may combine to form an alicyclic hydrocarbon group, an aromatic hydrocarbon group, a heterocyclic hydrocarbon group or a derivative thereof.