Summary Technical Problem

[0006]

However, cyclized polyimides having a flexibility group have a problem in that they reduce mechanical characteristics although they can achieve a lower stressfulness. In addition, polybenzoxazoles having a flexibility group that are synthesized from aliphatic dicarboxylic acids have a problem in that an increase in stress due to the cyclodehydration of the polybenzoxazole during curing is caused to a substrate wafer.

[0007]

In another respect, when a heat-resistant resin composition is used for applications for semiconductors and the like, the heat-cured film remains as a permanent film in a device, which means that the properties of the film cured after being heated are very important. In order to secure reliability in semiconductor packages, the adhesion to a material formed on the surface of a semiconductor chip is important, and in particular when a heat-resistant resin composition is used for applications such as for an insulating film between wiring layers of a wafer level package, the adhesion to a metal material used for electrodes and wiring is important. However, it is generally considered that, because of having a rigid main-chain structure, a heat-resistant resin has an adhesion strength that is not high to a metal material, and particularly in a cured resin film formed out of a resin composition with photosensitivity imparted thereto, the composition includes additives such as a photosensitizer, a sensitizer, an acid generator, and a solubility adjusting agent, which still remain in the cured film after heat-curing, resulting in the cured resin film having a lower adhesion strength than one which does not contain such additives. Accordingly, there is a problem in that resin compositions having an additive has a

low adhesion to metals used as wiring materials.

[0008]

The present disclosure has solved problems posed by the above-described conventional technologies and provides a high sensitivity photosensitive resin composition capable of affording a cured film having a lower stressfulness and a higher degree of elongation.

Solution to Problem

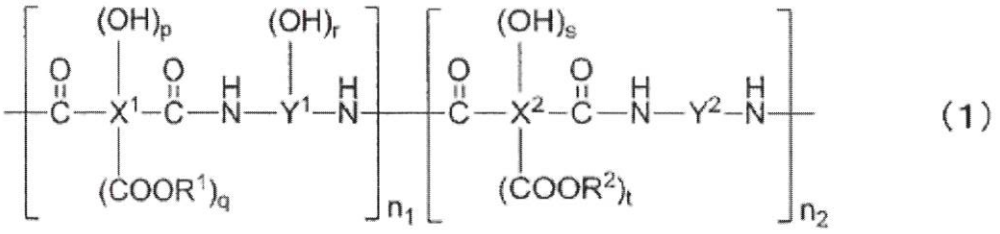
[0009]

In order to achieve the above object, the present disclosure relates to the following:

[0009a]

In an aspect, there is provided a photosensitive resin composition comprising an alkali-soluble resin having an organic group derived from an aliphatic diamine, wherein the alkali-soluble resin having an organic group derived from the aliphatic diamine is (A) an alkali-soluble polyamide represented by the general formula (1):

[Chem. 1]



(1)

wherein, in the general formula (1), X^1 and X^2 represent a bi- to deca-valent organic group;

Y^1 represents a bi- to tetravalent organic group;

Y^2 represents a bivalent organic group having a C_2 or more aliphatic structure;

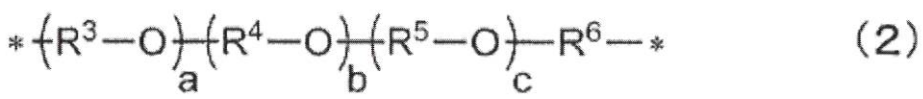
R^1 and R^2 represent hydrogen or a C_1-C_{20} organic group;

p, q, r, s, and t are integers satisfying $0 \leq p \leq 4$, $0 \leq q \leq 4$, $0 \leq r \leq 2$, $0 \leq s \leq 4$, and $0 \leq t \leq 4$;

when p, q, r, s, or t is 0, each group represents a hydrogen atom; and

n_1 and n_2 are integers satisfying $1 \leq n_1 \leq 500$, $1 \leq n_2 \leq 500$, and $0.05 \leq n_1 / (n_1 + n_2) < 1$, wherein Y^2 in the general formula (1) has a structural unit represented by the general formula (2):

[Chem. 2]



(2)

wherein, in the general formula (2), R^3 to R^6 each independently represent a C_2-C_{10} alkylene group;

a, b, and c each are integers satisfying $0 \leq a \leq 20$, $0 \leq b \leq 20$, and $0 \leq c \leq 20$;

the repeating units are arranged in blocks or randomly; and,

"*" in the general formula (2) represents a chemical bond, and

wherein Y^2 in the general formula (1) has a molecular weight of from not less than 900 to not more than 2,000.

[0009b]

In another aspect, there is provided a photosensitive sheet formed of the photosensitive resin composition as defined above.

[0009c]

In another aspect, there is provided a method for producing a photosensitive sheet, comprising the step of coating a base material with the photosensitive resin composition as defined above and drying the composition.

[0009d]

In another aspect, there is provided a cured film obtained by curing the photosensitive resin composition as defined above.

[0009e]

In another aspect, there is provided a cured film obtained by curing the photosensitive sheet as defined above.

[0009f]

In another aspect, there is provided an interlayer dielectric film or a semiconductor protective film comprising the cured film as defined above.

[0009g]

In another aspect, there is provided a method for producing a cured relief pattern, comprising the steps of:

coating a substrate with the photosensitive resin composition as defined above and drying the composition to form a photosensitive resin film;

exposing the photosensitive resin film to light through a mask;

developing the photosensitive resin film by dissolving or removing the exposed parts using an alkaline solution; and

heating the developed photosensitive resin film.

[0009h]

In another aspect, there is provided a method for producing a semiconductor electronic component or a semiconductor device, comprising the steps of:

laminating the photosensitive sheet as defined above or the photosensitive sheet produced by the method as defined above on a substrate;

then carrying out a UV-irradiation step and a developing step to form a pattern thereon; and

further heating the resultant to form a relief pattern layer of a cured film.

[0009i]

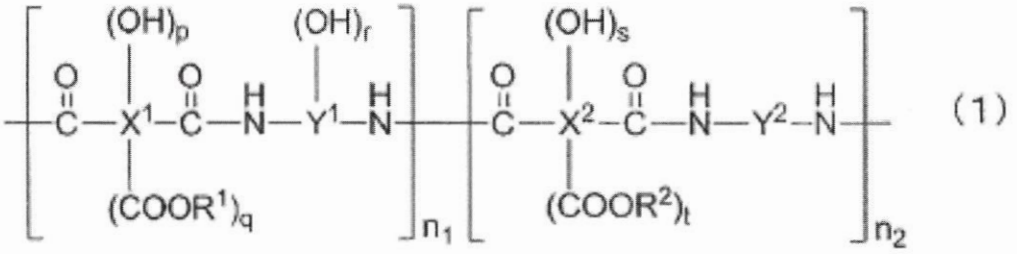
In another aspect, there is provided a semiconductor electronic component or a semiconductor device comprising the relief pattern layer of the cured film as defined above.

[1] A photosensitive resin composition including an alkali-soluble resin having an organic group derived from an aliphatic diamine.

[2] The photosensitive resin composition according to [1], in which the alkali-soluble resin having an organic group derived from the aliphatic diamine is (A) an alkali-soluble polyamide represented by the general formula (1):

[0010]

[Chem. 1]



(1)

[0011]

wherein, in the general formula (1), X^1 and X^2 represent a bivalent organic group; Y^1 represents a bi- to tetravalent organic group; Y^2 represents a bivalent organic group having a $C_{2\text{ or more}}$ aliphatic structure; R^1 and R^2 represent hydrogen or a C_1-C_{20} organic group; p, q, r, s, and t are integers satisfying $0 \leq p \leq 4$, $0 \leq q \leq 4$, $0 \leq$

semiconductor device, including the steps of: laminating the photosensitive sheet according to [7] or the photosensitive sheet produced by the method according to [8] on a substrate; then carrying out a UV-irradiation step and a developing step to form a pattern thereon; and further heating the resultant to form a relief pattern layer of a cured film.

[14] A semiconductor electronic component or a semiconductor device including the relief pattern layer of the cured film according to [9] or [10].

[15] The semiconductor electronic component or the semiconductor device, in which the cured film according to [9] or [10] is disposed as an interlayer dielectric film between rewiring layers.

[16] The semiconductor electronic component or the semiconductor device according to [15], in which layers each including the rewiring layer and interlayer dielectric film are disposed one on another two- to ten-fold.

[17] The semiconductor electronic component or the semiconductor device, in which the cured film according to [9] or [10] is disposed as an interlayer dielectric film covering two or more adjacent substrates made of different kinds of materials.

Advantageous Effects

[0016]

The photosensitive resin composition according to the present disclosure is highly sensitive and can afford a cured film having a low stressfulness, a high degree of elongation, and an excellent adhesion to a metal material, copper among others. In addition, the electronic components according to the present disclosure are highly reliable because of having a good shape and adhesion and a pattern having an excellent heat resistance.

Brief Description of Drawings

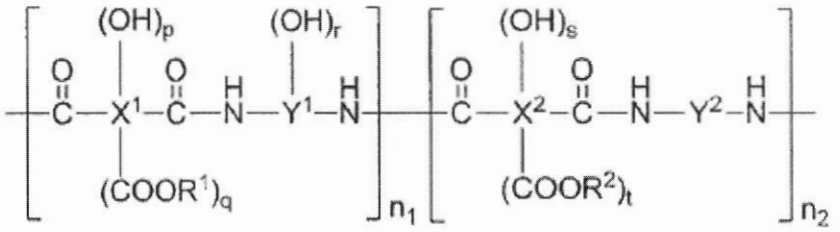
[0017]

CLAIMS

1. A photosensitive resin composition comprising an alkali-soluble resin having an organic group derived from an aliphatic diamine,

wherein the alkali-soluble resin having an organic group derived from the aliphatic diamine is (A) an alkali-soluble polyamide represented by the general formula (1):

[Chem. 1]



(1)

wherein, in the general formula (1), X^1 and X^2 represent a bi- to deca-valent organic group;

Y^1 represents a bi- to tetravalent organic group;

Y^2 represents a bivalent organic group having a C_2 or more aliphatic structure;

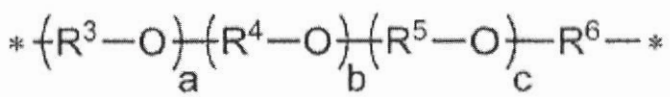
R^1 and R^2 represent hydrogen or a C_1-C_{20} organic group;

p, q, r, s, and t are integers satisfying $0 \leq p \leq 4$, $0 \leq q \leq 4$, $0 \leq r \leq 2$, $0 \leq s \leq 4$, and $0 \leq t \leq 4$;

when p, q, r, s, or t is 0, each group represents a hydrogen atom; and

n_1 and n_2 are integers satisfying $1 \leq n_1 \leq 500$, $1 \leq n_2 \leq 500$, and $0.05 \leq n_1 / (n_1 + n_2) < 1$, wherein Y^2 in the general formula (1) has a structural unit represented by the general formula (2):

[Chem. 2]



(2)

wherein, in the general formula (2), R^3 to R^6 each independently represent a C_2-C_{10} alkylene group;

a, b, and c each are integers satisfying $0 \leq a \leq 20$, $0 \leq b \leq 20$, and $0 \leq c \leq 20$;

the repeating units are arranged in blocks or randomly; and,

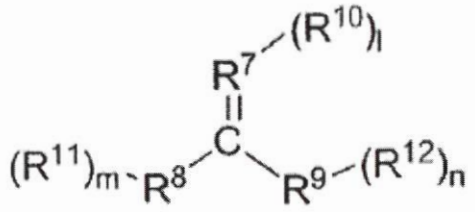
"*" in the general formula (2) represents a chemical bond, and

wherein Y^2 in the general formula (1) has a molecular weight of from not less than 900 to not more than 2,000.

2. The photosensitive resin composition according to claim 1, comprising (A) the alkali-soluble polyamide represented by the general formula (1), (B) a compound that generates an acid by light, and (C) a thermal crosslinking agent.

3. The photosensitive resin composition according to claim 1 or 2, further comprising (D) a compound represented by the general formula (3):

[Chem. 3]



(3)

wherein, in the general formula (3), R^7 to R^9 represent an O atom, a S atom, or a N atom;

at least one of R^7 to R^9 represents a S atom;

l is 0 or 1;

m and n represents an integer of 1 or 2; and

R^{10} to R^{12} each independently represent a hydrogen atom or a C_1-C_{20} organic group.

4. A photosensitive sheet formed of the photosensitive resin composition according to any of claims 1 to 3.

5. A method for producing a photosensitive sheet, comprising the step of coating a base material with the photosensitive resin composition according to any of claims 1 to 3 and drying the composition.

6. A cured film obtained by curing the photosensitive resin composition according to any of claims 1 to 3.

7. A cured film obtained by curing the photosensitive sheet according to claim 4.

8. An interlayer dielectric film or a semiconductor protective film comprising the cured film according to claim 6 or 7.

9. A method for producing a cured relief pattern, comprising the steps of:

coating a substrate with the photosensitive resin composition according to any of claims 1 to 3 and drying the composition to form a photosensitive resin film;

exposing the photosensitive resin film to light through a mask;

developing the photosensitive resin film by dissolving or removing the exposed parts using an alkaline solution; and

heating the developed photosensitive resin film.

10. A method for producing a semiconductor electronic component or a semiconductor device, comprising the steps of:

laminating the photosensitive sheet according to claim 4 or the photosensitive sheet produced by the method according to claim 5 on a substrate;

then carrying out a UV-irradiation step and a developing step to form a pattern thereon; and

further heating the resultant to form a relief pattern layer of a cured film.

11. A semiconductor electronic component or a semiconductor device comprising the relief pattern layer of the cured film according to claim 6 or 7.

12. The semiconductor electronic component or the semiconductor device according to claim 11, wherein the cured film according to claim 6 or 7 is disposed as an interlayer dielectric film between rewiring layers.

13. The semiconductor electronic component or the semiconductor device according to claim 12, wherein layers each including the rewiring layer and interlayer dielectric film are disposed one on another two- to ten-fold.

14. The semiconductor electronic component or the semiconductor device, wherein the cured film according to claim 6 or 7 is disposed as an interlayer dielectric film covering two or more adjacent substrates made of different kinds of materials.