provided on the semiconductor chip 2 and the plurality of wires 5 in the rewiring layer 4 are electrically connected. One end of the wire 5 is connected to the terminal 2a, and the other end is connected to an external connection terminal 7. The wire 5 between the terminal 2a and the external connection terminal 7 is entirely covered by an interlayer insulating film 6.

In this manner, according to the Fan-Out type, an element sealing body can be formed by covering a semiconductor element (a semiconductor chip) with a sealing member so that the element sealing body is formed in a region larger than a size of a chip, and further, a rewiring layer that extends to the regions of the semiconductor chip and the sealing member can be formed. Since the rewiring layer is thin and even the region of the sealing member can be used as a region in which the rewiring layer is formed, the number of external connection terminals can be increased. Not only Fan-Out wafer level packaging (FOWLP) but also Fan-Out panel level packaging (FOPLP) is studied now.

In addition, it is expected that the demand for materials for such semiconductor chips and semiconductor packaging increases with the expansion of the demand in the communication field and the in-vehicle field.

[0003] In the manufacturing of such a semiconductor element, a photosensitive resin composition containing at least one precursor selected from the group consisting of a polyimide resin precursor (a polyimide precursor) and a polybenzoxazole resin precursor (a polybenzoxazole precursor) may be used. In a case where the photosensitive resin composition is used, merits such as simplification of the pattern forming step can be conceivable.

[0004] For example, WO2018/025738A discloses a photosensitive resin composition containing a heterocyclic ring-containing polymer precursor, a thermal base generator, and an organic compound containing a Group 4 element.

In addition, JP2010-039475A discloses a photosensitive resin composition for ultraviolet light laser exposure, containing (A) resin; (B) ethylenically unsaturated compound; (C) photopolymerization initiator; and (D) thiol compound.

SUMMARY

[0005a] In a first aspect of the present disclosure, there is provided a pattern forming method comprising:

an exposure step of exposing a photosensitive film to laser light; and

a development step of developing the photosensitive film after the exposure to obtain a pattern,

wherein the photosensitive film contains a polyimide precursor and an onium salt, and

wherein the photosensitive film before the exposure contains a compound having a plurality of carboxy groups and having a molecular weight of 1,000 or less.

[0005b] In another aspect of the present disclosure, there is provided a cured film producing method comprising:

a photosensitive film forming step of applying the photosensitive resin composition to obtain the photosensitive film of the pattern forming method disclosed herein, the exposure step of the pattern forming method, the development step of the pattern forming method, and a heating step of heating the pattern to obtain a cured pattern, after the development step.

[0005c] In yet another aspect of the present disclosure, there is provided a laminate producing method comprising:

repeating a laminating step, which comprise a photosensitive film forming step of applying the photosensitive resin composition to obtain the photosensitive film of the pattern forming method disclosed herein, the exposure step of the pattern forming method and the development step of the pattern forming method as a series of steps, a plurality of times.

[0005d] In a further aspect of the present disclosure, there is provided a device producing method comprising:

the cured film producing method disclosed herein or the laminate producing method disclosed herein.

[0005e] In another aspect of the present disclosure, there is provided a photosensitive resin composition comprising:

a polyimide precursor, a compound having a plurality of carboxy groups and having a molecular weight of 1,000 or less and an onium salt,

wherein the photosensitive resin composition is used for forming the photosensitive film in the pattern forming method disclosed herein.

[0005f] In yet another aspect of the present disclosure, there is provided a cured film formed from the photosensitive resin composition disclosed herein.

[0005g] In a further aspect of the present disclosure, there is provided a laminate comprising two or more layers of the cured films disclosed herein.

[0005h] In another aspect of the present disclosure, there is provided a device comprising the cured film disclosed herein or the laminate disclosed herein.

[0006] For the intended purpose of improving a surface smoothness (reducing surface roughness) of an obtained cured film, it is conceivable to carry out the exposure of a

photosensitive film containing a precursor such as a polyimide precursor by using laser light.

However, it has been found that in a case where the exposure is carried out using the laser light, damage such as decomposition of a polymer in the photosensitive film may occur

due to reasons such as the illumination intensity. As a result, it has been found that the chemical resistance of the obtained cured film by curing the photosensitive film may decrease.

[0007] An object of the present disclosure is to a pattern forming method with which a cured film excellent in surface smoothness and chemical resistance can be manufactured, a photosensitive resin composition that is used for forming a photosensitive film in the pattern forming method, a cured film that is formed from the photosensitive resin composition, a laminate containing the cured film, and a device having the cured film or the laminate.

[0008] Representative examples of the present disclosure are described below.

<1> A pattern forming method comprising an exposure step of exposing a photosensitive film to laser light; and

a development step of developing the photosensitive film after the exposure to obtain a pattern,

in which the photosensitive film contains at least one precursor selected from the group consisting of a polyimide precursor and a polybenzoxazole precursor, and an onium salt.

<2> The pattern forming method according to <1>, in which a wavelength of the laser light is 250 to 550 nm.

<3> The pattern forming method according to <1> or <2>, in which the photosensitive film further contains a compound having a plurality of carboxy groups and having a molecular weight of 1,000 or less.

<4> The pattern forming method according to any one of <1> to <3>, in which the photosensitive film further contains a compound having a sulfurous ester structure.

<5> The pattern forming method according to any one of <1> to <4>, further comprising a curing step of heating the pattern to obtain a cured pattern, after the development step.

<6> The pattern forming method according to any one of <1> to <5>, in which a cation in the onium salt includes at least one cation selected from the group consisting of a tetraalkylammonium cation, a sulfonium cation, and an iodonium cation.

<7> The pattern forming method according to any one of <1> to <6>, in which the onium salt contains an ammonium cation as a cation, and the onium salt contains an anion of which a conjugate acid has a pKa of 1.8 or less, as an anion.

<8> The pattern forming method according to any one of <1> to <7>, in which a Group 4 element-containing compound is further contained.

<9> The pattern forming method according to <8>, in which the Group 4

element-containing compound is a photoradical generator.

<10> The pattern forming method according to <8> or <9>, in which the Group 4 element-containing compound is an organic compound containing at least one selected from the group consisting of a titanium atom, a zirconium atom, and a hafnium atom.

<11> The pattern forming method according to any one of <8> to <10>, in which the Group 4 element-containing compound includes at least one selected from the group consisting of metallocene and a metallocene derivative.

<12> The pattern forming method according to any one of <1> to <11>, in which the photosensitive film is a photosensitive film formed by slit coating.

<13> The pattern forming method according to any one of <1> to <12>, in which the photosensitive film is formed on a rectangular base material.

<14> A photosensitive resin composition comprising: at least one precursor selected from the group consisting of a polyimide precursor and a polybenzoxazole precursor; and an onium salt,

in which the photosensitive resin composition is used for forming the photosensitive film in the pattern forming method according to any one of <1> to <13>.

<15> A cured film formed from the photosensitive resin composition according to <14>.

<16> The cured film according to <15>, in which the cured film is used as an interlayer insulating film for a rewiring layer.

<17> A laminate comprising two or more layers of the cured films according to <15> or <16>.

<18> The laminate according to <17>, further comprising a metal layer between the cured films.

<19> A device comprising the cured film according to <15> or <16> or the laminate according to <17> or <18>.

[0009] An object of the present disclosure is to provide a pattern forming method with which a cured film excellent in surface smoothness and chemical resistance can be manufactured, a photosensitive resin composition that is used for forming a photosensitive film in the pattern forming method, and a cured film that is formed from the photosensitive resin composition, a laminate containing the cured film, and a device having the cured film or the laminate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a schematic cross-sectional view illustrating one example of a Fan-Out type

WHAT IS CLAIMED IS:

1. A pattern forming method comprising:

an exposure step of exposing a photosensitive film to laser light; and

a development step of developing the photosensitive film after the exposure to obtain a pattern,

wherein the photosensitive film contains a polyimide precursor and an onium salt, and

wherein the photosensitive film before the exposure contains a compound having a plurality of carboxy groups and having a molecular weight of 1,000 or less.

2. The pattern forming method according to claim 1,

wherein a wavelength of the laser light is 250 to 550 nm.

3. The pattern forming method according to claim 1 or 2,

wherein the photosensitive film further contains a compound having a sulfurous ester structure.

4. The pattern forming method according to any one of claims 1 to 3, further comprising a curing step of heating the pattern to obtain a cured pattern, after the development step.

5. The pattern forming method according to any one of claims 1 to 4,

wherein a cation in the onium salt includes at least one cation selected from the group consisting of a tetraalkylammonium cation, a sulfonium cation, and an iodonium cation.

6. The pattern forming method according to any one of claims 1 to 5,

wherein the onium salt contains an ammonium cation as a cation, and the onium salt contains an anion of which a conjugate acid has a pKa of 1.8 or less, as an anion.

7. The pattern forming method according to any one of claims 1 to 6,

wherein a Group 4 element-containing compound is further contained.

8. The pattern forming method according to claim 7,

wherein the Group 4 element-containing compound is a photoradical generator.

9. The pattern forming method according to claim 7 or 8,

wherein the Group 4 element-containing compound is an organic compound containing at least one selected from the group consisting of a titanium atom, a zirconium atom, and a hafnium atom.

10. The pattern forming method according to any one of claims 7 to 9,

wherein the Group 4 element-containing compound includes at least one selected from the group consisting of metallocene and a metallocene derivative.

11. The pattern forming method according to any one of claims 1 to 10,

wherein the photosensitive film is a photosensitive film formed by slit coating.

12. The pattern forming method according to any one of claims 1 to 11,

wherein the photosensitive film is formed on a rectangular base material.

13. A cured film producing method comprising:

a photosensitive film forming step of applying the photosensitive resin composition to obtain the photosensitive film of the pattern forming method according to any one of claims 1 to 12, the exposure step of the pattern forming method, the development step of the pattern forming method, and a heating step of heating the pattern to obtain a cured pattern, after the development step.

14. A laminate producing method comprising:

repeating a laminating step, which comprise a photosensitive film forming step of applying the photosensitive resin composition to obtain the photosensitive film of the pattern forming method according to any one of claims 1 to 12, the exposure step of the pattern forming method and the development step of the pattern forming method as a series of steps, a plurality of times.

15. A device producing method comprising:

the cured film producing method according to claim 13 or the laminate producing method according to claim 14.

16. A photosensitive resin composition comprising:

a polyimide precursor, a compound having a plurality of carboxy groups and having a molecular weight of 1,000 or less and an onium salt,

wherein the photosensitive resin composition is used for forming the photosensitive film in the pattern forming method according to any one of claims 1 to 12.

17. A cured film formed from the photosensitive resin composition according to claim 16.

18. The cured film according to claim 17,

wherein the cured film is used as an interlayer insulating film for a rewiring layer.

19. A laminate comprising two or more layers of the cured films according to claim 17 or 18.

20. The laminate according to claim 19, further comprising a metal layer between the cured films.

21. A device comprising the cured film according to claim 17 or 18 or the laminate according to claim 19 or 20.