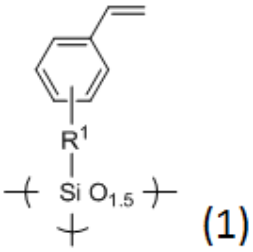
An object of the embodiments disclosed herein is to provide a resin composition that exhibits excellent coating properties on rugged surface and has excellent planarization properties even if the resin composition is in a form of thin film.

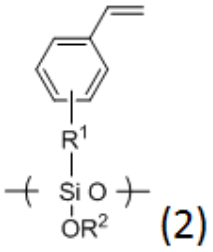
Means for Solving the Problem

[0009]

There is provided a resin composition comprising a polysiloxane (A), wherein the polysiloxane (A) contains at least one partial structure represented by any of the general formulae (1) to (3), and the molar content of styryl groups contained in the polysiloxane (A) is in the range of not less than 40% by mole to not more than 99% by mole relative to 100% by mole of the Si atoms:

[0010]


(1)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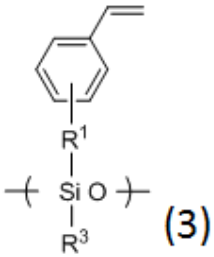
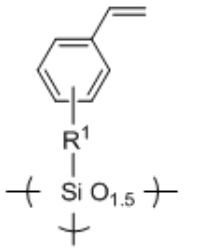

(3)

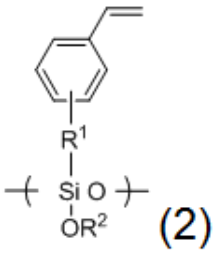
[0011]

(wherein R^1 represents a single bond or a C_{1-4} alkyl group; R^2 represents a hydrogen atom or a C_{1-4} alkyl group; and R^3 represents an organic group).

[0011a]

In an aspect, there is provided a resin composition comprising a polysiloxane (A), wherein the polysiloxane (A) contains at least one partial structure represented by any of the general formulae (1) to (3), and the molar content of styryl groups contained in the polysiloxane (A) is in the range of not less than 40% by mole to not more than 99% by mole relative to 100% by mole of the Si atoms:


(1)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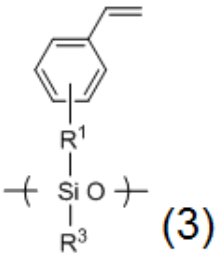
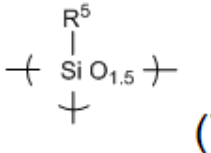
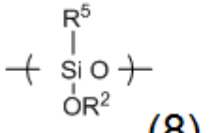
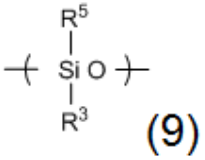

(3)

wherein R^1 represents a single bond or a C_{1-4} alkylene group; R^2 represents a hydrogen atom or a C_{1-4} alkyl group; and R^3 represents an organic group, wherein the polysiloxane (A) further contains at least one partial structure represented by any of the following general formulae (7) to (9):


(7)


(8)


(9)

wherein R^5 represents a hydrocarbon group having an epoxy group, urea group, urethane group, amide group, hydroxyl group, carboxyl group, or carboxylic anhydride; R^2 represents a hydrogen atom or a C_{1-4} alkyl group; and R^3 represents an organic group, and

the polysiloxane (A) contains a styryl group (a-1), (meth)acryloyl group (a-2) and a hydrophilic group (a-3), and the resin composition further comprises a compound having a radical polymerizable group and an aromatic ring (B).

[0011b]

In another aspect, there is provided a method of manufacturing a cured film, the method comprising the steps of:

(I) applying the resin composition as defined above on a substrate to prepare a coated film;

(II) exposing the coated film to light and developing the exposed film;

(IV) further applying the resin composition as defined above on the developed coated film to prepare a second coated film;

(V) exposing the second coated film to light and developing the exposed film; and

(VI) heating the developed coated film and the developed second coated film.

[0011c]

In another aspect, there is provided a method of manufacturing a cured film, the method comprising the steps of:

(I) applying the resin composition as defined above on a substrate to prepare a coated film;

(II) exposing the coated film to light and developing the exposed film;

(III) heating the developed coated film;

(IV') further applying the resin composition as defined above on the heated coated film to prepare a second coated film;

(V') exposing the second coated film to light and developing the exposed film; and

(VI') heating the developed second coated film.

[0011d]

In another aspect, there is provided a cured film of the resin composition as defined above.

[0011e]

In another aspect, there is provided a solid-state image sensor comprising the cured film as defined above.

Advantageous Effect

[0012]

The resin composition according to the present invention exhibits excellent coating properties on rugged surface and has excellent planarization properties even if the resin composition is in a form of thin film.

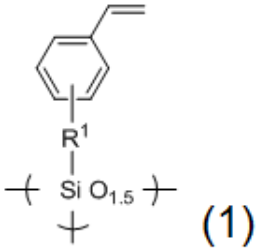
Brief Description of the Drawings

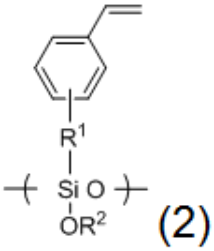
[0013]

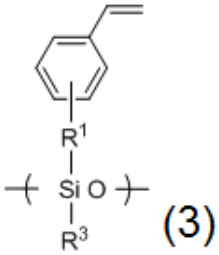
FIG. 1 is a top view of a substrate which has a concave-convex structure

CLAIMS

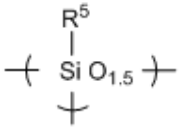
1. A resin composition comprising a polysiloxane (A), wherein the polysiloxane (A) contains at least one partial structure represented by any of the general formulae (1) to (3), and the molar content of styryl groups contained in the polysiloxane (A) is in the range of not less than 40% by mole to not more than 99% by mole relative to 100% by mole of the Si atoms:

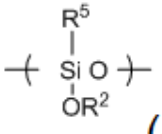

(1)


(2)


(3)

wherein R^1 represents a single bond or a C_{1-4} alkylene group; R^2 represents a hydrogen atom or a C_{1-4} alkyl group; and R^3 represents an organic group, wherein the polysiloxane (A) further contains at least one partial structure represented by any of the following general formulae (7) to (9):


(7)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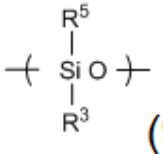
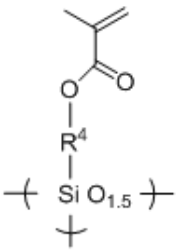

(9)

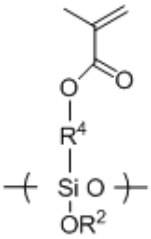
wherein R^5 represents a hydrocarbon group having an epoxy group, urea group, urethane group, amide group, hydroxyl group, carboxyl group, or carboxylic anhydride; R^2 represents a hydrogen atom or a C_{1-4} alkyl group; and R^3 represents an organic group, and

the polysiloxane (A) contains a styryl group (a-1), (meth)acryloyl group (a-2) and a hydrophilic group (a-3), and the resin composition further comprises a compound having a radical polymerizable group and an aromatic ring (B).

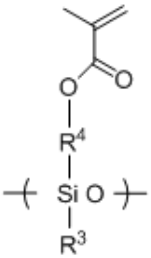
2. The resin composition according to claim 1, wherein the polysiloxane (A) further contains at least one partial structure represented by any of the following general formulae (4) to (6):



(4)



(5)

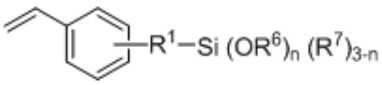


(6)

wherein R^4 each independently represents a single bond or a C_{1-4} alkylene group; R^2 represents a hydrogen atom or a C_{1-4} alkyl group; and R^3 represents an organic group.

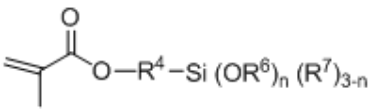
3. The resin composition according to claim 1 or 2, wherein the rate of film thickness change in the resin composition before and after heating at 230°C for 5 minutes is not more than 5%.

4. The resin composition according to claim 1, comprising polysiloxane (A), wherein the polysiloxane (A) is a polysiloxane that is obtainable by hydrolysis and polycondensation of plural alkoxysilane compounds, the alkoxysilane compounds represented by the following general formulae (10) and/or (11):



(10)

wherein R^1 represents a single bond or a C_{1-4} alkyl group; R^7 represents a C_{1-4} alkyl group; R^6 represents an organic group, and n is 2 or 3;



(11)

wherein R^4 represents an epoxy group, urea group, urethane group, amido group, hydroxyl group, carboxyl group, or hydrocarbon group having a structure based on a carboxylic anhydride; R^7 represents a C_{1-4} alkyl group; R^6 represents an organic group, and n is 2 or 3.

5. The resin composition according to any one of claims 1 to 4, which comprises

metal compound particles (D).

6. The resin composition according to any one of claims 1 to 5, wherein the molar contents of styryl groups (a-1) and (meth)acryloyl groups (a-2) in the polysiloxane (A) are, respectively, in the range of not less than 45% by mole to not more than 70% by mole and not less than 15% by mole to not more than 40% by mole relative to 100% by mole of the Si atoms.

7. The resin composition according to any one of claims 1 to 6, wherein the hydrophilic group (a-3) is a hydrocarbon group having a structure based on succinic acid or succinic anhydride and the molar content of the hydrophilic groups (a-3) in the polysiloxane (A) is in the range of not less than 10% by mole to not more than 20% by mole relative to 100% by mole of the Si atoms.

8. The resin composition according to any one of claims 1 to 7, which contains:
the polysiloxane (A) in a content of not less than 20% by weight and not more than 50% by weight,
the compound having a radical polymerizable group and an aromatic ring (B) in a content of not less than 5% by weight and not more than 35% by weight,
a photosensitizer (C) in a content of not less than 1% by weight and not more than 10% by weight, and
the metal compound particles (D) in a content of not less than 30% by weight and not more than 60% by weight.

9. A method of manufacturing a cured film, the method comprising the steps of:
(I) applying the resin composition according to any one of claims 1 to 8 on a substrate to prepare a coated film;

(II) exposing the coated film to light and developing the exposed film;

(IV) further applying the resin composition according to any one of claims 1 to 8 on the developed coated film to prepare a second coated film;

(V) exposing the second coated film to light and developing the exposed film; and

(VI) heating the developed coated film and the developed second coated film.

10. A method of manufacturing a cured film, the method comprising the steps of:

(I) applying the resin composition according to any one of claims 1 to 8 on a substrate to prepare a coated film;

(II) exposing the coated film to light and developing the exposed film;

(III) heating the developed coated film;

(IV') further applying the resin composition according to any one of claims 1 to 8 on the heated coated film to prepare a second coated film;

(V') exposing the second coated film to light and developing the exposed film; and

(VI') heating the developed second coated film.

11. A cured film of the resin composition according to any one of claims 1 to 8.

12. A solid-state image sensor comprising the cured film according to claim 11.

13. The solid-state image sensor according to claim 12, wherein the cured film is an optical waveguide.