

mixing rubber particles for the purpose of relaxing stress exerted on a cured underfill material (refer to Patent Document 2), there have been concerns that dispersion of the inorganic particles in forming a film is insufficient or a coefficient of linear expansion of the underfill material increases due to mixing of rubber particles. That is, as with the above description, these technologies have had a possibility that connection reliability becomes insufficient in connecting between the chips.

[0010]

10 In order to solve the above-mentioned problem, the present invention provides a semiconductor resin composition and a semiconductor resin film which impart heat resistance and in which a coefficient of linear expansion of a cured product is adequately small while relaxing stress and a distribution of the inorganic particles is uniform in the film thickness direction of a semi-cured film formed; and a semiconductor device using these.

SOLUTIONS TO THE PROBLEMS

[0011]

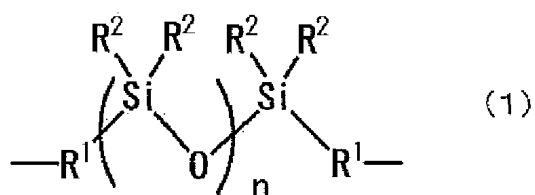
20 There is provided a semiconductor resin composition which contains (a) an epoxy compound, (b) inorganic particles, (c) a polyimide, and (d) a solvent, wherein the semiconductor resin composition further contains (e) rubber

particles and a ratio of the (b) inorganic particles in the weight of the total solid fraction resulting from subtracting the weight of the (d) solvent from the total weight of the semiconductor resin composition is 60 wt% or more and 92 wt%
5 or less.

[0011a]

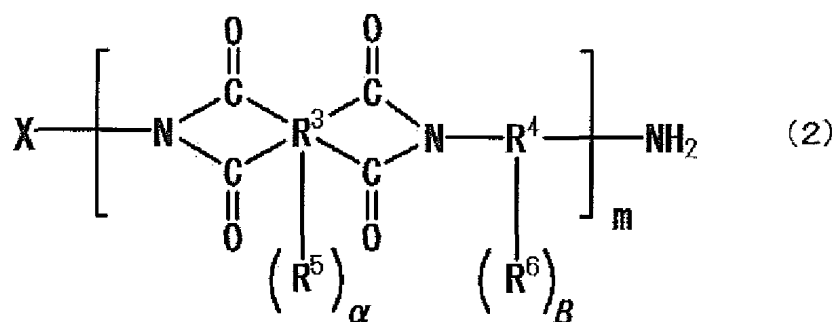
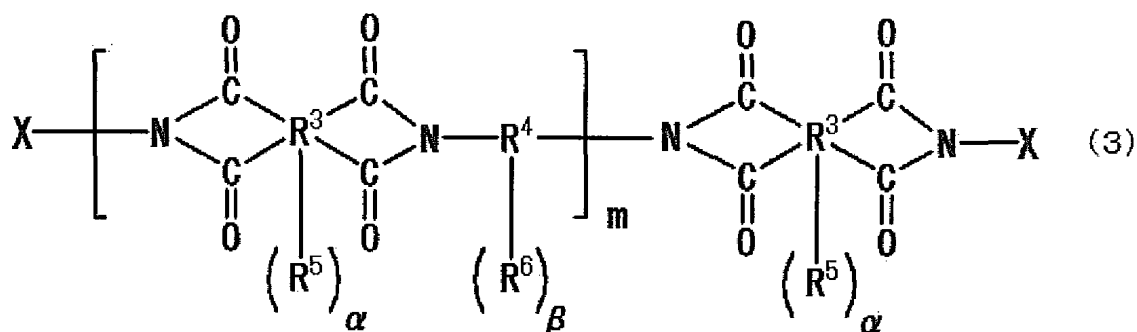
In an aspect, there is provided a semiconductor resin composition which contains (a) an epoxy compound, (b) inorganic particles, (c) a polyimide, and (d) a solvent, wherein the
10 semiconductor resin composition further contains (e) rubber particles and a ratio of the (b) inorganic particles in the weight of the total solid fraction resulting from subtracting the weight of the (d) solvent from the total weight of the semiconductor resin composition is 60 wt% or more and 92 wt%
15 or less, wherein the average particle diameter of the (e) rubber particles is smaller than or equal to the average particle diameter of the (b) inorganic particles, wherein the (c) polyimide has a structure represented by a general formula (2) or a general formula (3), has at least one functional group
20 reactive with an epoxy group on its side chain, and has a structure represented by a general formula (1) as R^4 in the general formula (2) and the general formula (3), and the amount of the structure represented by the general formula (1) is 5 wt% or more and 15 wt% or less with respect to the total amount
25 of the (c) polyimide:

[Chem. 1]



in which R^1 is a divalent hydrocarbon group, R^2 is a monovalent hydrocarbon group, and n represents an integer of 1 to 2,

5 [Chem. 2]



in which R^3 is a tetra- to 14-valent organic group, R^4 is a di- to 12-valent organic group, at least one of R^3 and R^4 contains at least one group selected from the group consisting of a 1,1,1,3,3,3-hexafluoropropyl group, an isopropyl group, an ether group, a thioether group and a SO_2 group, R^5 and R^6 each represent an organic group having at least one group selected from the group consisting of a phenolic hydroxyl group, a

sulfonic acid group and a thiol group, X represents a monovalent organic group, m is 8 to 200, α and β each represent an integer of 0 to 10 and $\alpha + \beta$ is an integer of 0 to 10, and a ratio of the structural units in which $\alpha + \beta$ is an integer of 1 to 10 in the structural units whose repeating number is m, is 20 to 90 mol%.

[0012]

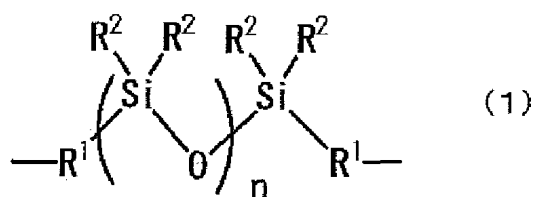
There is provided a semiconductor resin film having, on a support, a semiconductor resin layer containing (a) an epoxy compound, (b) inorganic particles, (c) a polyimide and (e) rubber particles, wherein a ratio of the (b) inorganic particles in the weight of the semiconductor resin layer is 60 wt% or more and 92 wt% or less.

[0012a]

In another aspect, there is provided a semiconductor resin film having, on a support, a semiconductor resin layer containing (a) an epoxy compound, (b) inorganic particles, and (c) a polyimide, wherein a ratio of the (b) inorganic particles in the weight of the semiconductor resin layer is 60 wt% or more and 92 wt% or less, and the semiconductor resin layer further contains (e) rubber particles, wherein the average particle diameter of the (e) rubber particles is smaller than or equal to the average particle diameter of the (b) inorganic particles, wherein the (c) polyimide has a structure represented by a general formula (2) or a general formula (3), has at least one

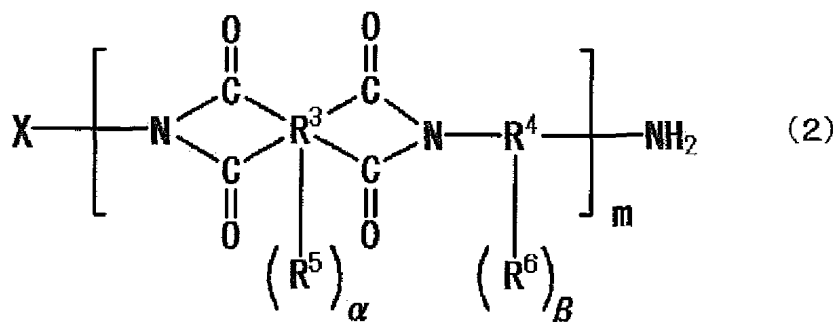
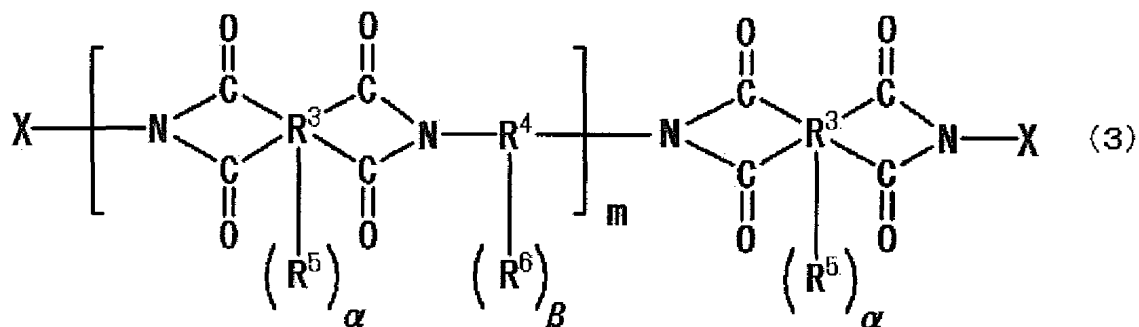
functional group reactive with an epoxy group on its side chain,
 and has a structure represented by a general formula (1) as R^4
 in the general formula (2) and the general formula (3), and the
 amount of the structure represented by the general formula (1)
 5 is 5 wt% or more and 15 wt% or less with respect to the total
 amount of the (c) polyimide:

[Chem. 3]



in which R^1 is a divalent hydrocarbon group, R^2 is a monovalent
 10 hydrocarbon group, and n represents an integer of 1 to 2,

[Chem. 4]



in which R^3 is a tetra- to 14-valent organic group, R^4 is a di-

to 12-valent organic group, at least one of R^3 and R^4 contains at least one group selected from the group consisting of a 1,1,1,3,3,3-hexafluoropropyl group, an isopropyl group, an ether group, a thioether group and a SO_2 group, R^5 and R^6 each
5 represent an organic group having at least one group selected from the group consisting of a phenolic hydroxyl group, a sulfonic acid group and a thiol group, X represents a monovalent organic group, m is 8 to 200, α and β each represent an integer of 0 to 10 and $\alpha + \beta$ is an integer of 0 to 10, and
10 a ratio of the structural units in which $\alpha + \beta$ is an integer of 1 to 10 in the structural units whose repeating number is m, is 20 to 90 mol%.

[0012b]

In another aspect, there is provided a semiconductor device
15 having a cured product of the composition resulting from removing the (d) solvent from the semiconductor resin composition as defined above, or a cured product of the semiconductor resin layer as defined above.

EFFECTS

20 [0013]

In accordance with the present disclosure, it is possible to attain a semiconductor resin composition and a semiconductor resin film which impart heat resistance and in which a coefficient of linear expansion of a cured product is

adequately small while relaxing stress and a distribution of the inorganic particles is uniform in the film thickness direction of a semi-cured film formed; and a semiconductor device using these.

5

BRIEF DESCRIPTION OF THE DRAWINGS

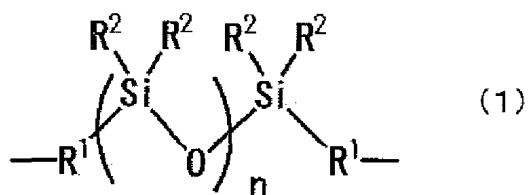
[0014]

Fig. 1 shows an example of a SEM image of a semiconductor

CLAIMS

1. A semiconductor resin composition which contains (a) an epoxy compound, (b) inorganic particles, (c) a polyimide, and
 5 (d) a solvent, wherein the semiconductor resin composition further contains (e) rubber particles and a ratio of the (b) inorganic particles in the weight of the total solid fraction resulting from subtracting the weight of the (d) solvent from the total weight of the semiconductor resin composition is 60
 10 wt% or more and 92 wt% or less, wherein the average particle diameter of the (e) rubber particles is smaller than or equal to the average particle diameter of the (b) inorganic particles, wherein the (c) polyimide has a structure represented by a general formula (2) or a general formula (3), has at least one
 15 functional group reactive with an epoxy group on its side chain, and has a structure represented by a general formula (1) as R^4 in the general formula (2) and the general formula (3), and the amount of the structure represented by the general formula (1) is 5 wt% or more and 15 wt% or less with respect to the total
 20 amount of the (c) polyimide:

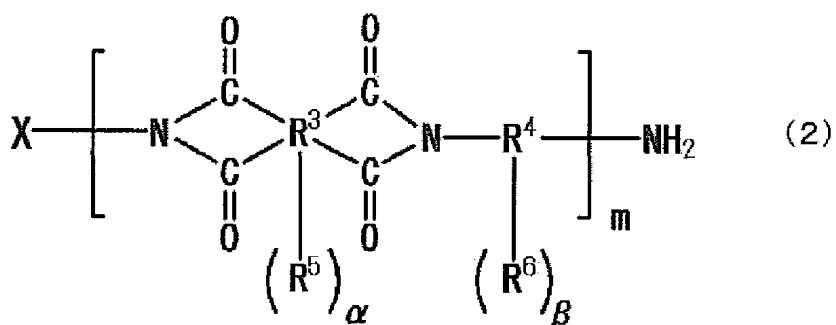
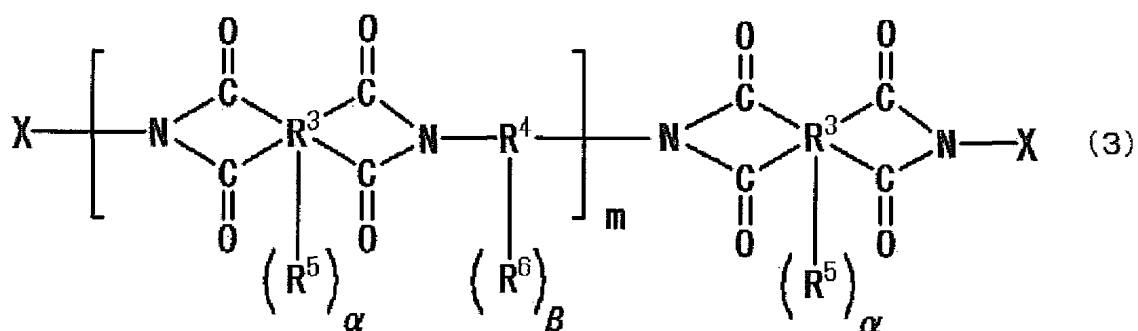
[Chem. 1]



in which R^1 is a divalent hydrocarbon group, R^2 is a monovalent

hydrocarbon group, and n represents an integer of 1 to 2,

[Chem. 2]



in which R^3 is a tetra- to 14-valent organic group, R^4 is a di- to
 5 12-valent organic group, at least one of R^3 and R^4 contains at least
 one group selected from the group consisting of a
 1,1,1,3,3,3-hexafluoropropyl group, an isopropyl group, an ether
 group, a thioether group and a SO_2 group, R^5 and R^6 each represent
 an organic group having at least one group selected from the group
 10 consisting of a phenolic hydroxyl group, a sulfonic acid group and
 a thiol group, X represents a monovalent organic group, m is 8
 to 200, α and β each represent an integer of 0 to 10 and $\alpha + \beta$ is
 an integer of 0 to 10, and a ratio of the structural units in which
 $\alpha + \beta$ is an integer of 1 to 10 in the structural units whose repeating
 15 number is m, is 20 to 90 mol%.

2. The semiconductor resin composition according to claim 1, wherein the (c) polyimide is organic solvent-soluble.

5 3. The semiconductor resin composition according to claim 1 or 2, wherein the average particle diameter of the (b) inorganic particles is 10 nm or more and 5 μm or less.

4. The semiconductor resin composition according to any one
10 of claims 1 to 3, wherein the (a) epoxy compound contains a liquid epoxy compound and a solid epoxy compound, and a weight ratio of the liquid epoxy compound in the (a) epoxy compound is 10 to 50 wt%.

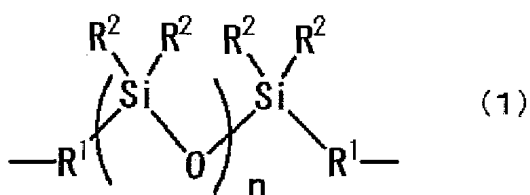
15 5. The semiconductor resin composition according to claim 4, wherein the amount of the (e) rubber particles is 2 to 100 parts by weight with respect to 100 parts by weight of the liquid epoxy compound.

20 6. The semiconductor resin composition according to any one

of claims 1 to 5, wherein the (e) rubber particle is a core-shell rubber particle.

7. A semiconductor resin film having, on a support, a
 5 semiconductor resin layer containing (a) an epoxy compound, (b) inorganic particles, and (c) a polyimide, wherein a ratio of the (b) inorganic particles in the weight of the semiconductor resin layer is 60 wt% or more and 92 wt% or less, and the semiconductor resin layer further contains (e) rubber particles,
 10 wherein the average particle diameter of the (e) rubber particles is smaller than or equal to the average particle diameter of the (b) inorganic particles, wherein the (c) polyimide has a structure represented by a general formula (2) or a general formula (3), has at least one functional group
 15 reactive with an epoxy group on its side chain, and has a structure represented by a general formula (1) as R^4 in the general formula (2) and the general formula (3), and the amount of the structure represented by the general formula (1) is 5 wt% or more and 15 wt% or less with respect to the total amount
 20 of the (c) polyimide:

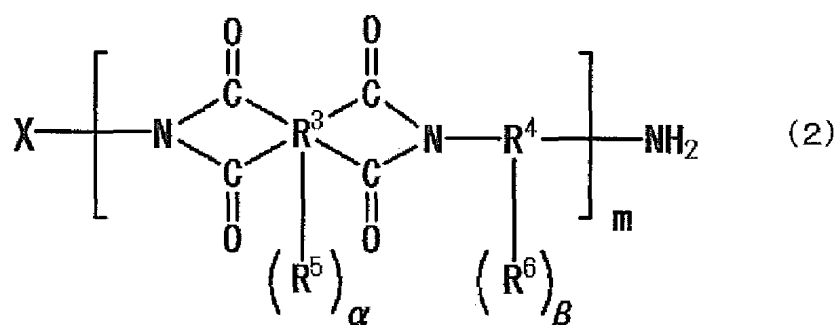
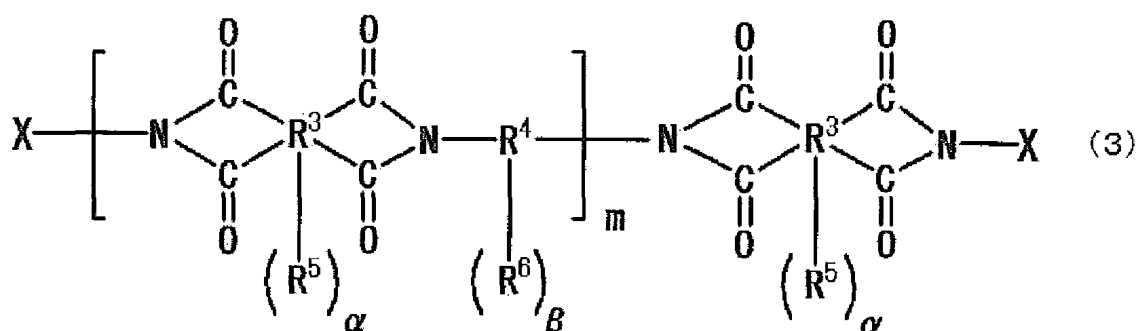
[Chem. 3]



in which R^1 is a divalent hydrocarbon group, R^2 is a monovalent

hydrocarbon group, and n represents an integer of 1 to 2,

[Chem. 4]



in which R^3 is a tetra- to 14-valent organic group, R^4 is a di-
 5 to 12-valent organic group, at least one of R^3 and R^4 contains
 at least one group selected from the group consisting of a
 1,1,1,3,3,3-hexafluoropropyl group, an isopropyl group, an ether
 group, a thioether group and a SO_2 group, R^5 and R^6 each represent
 an organic group having at least one group selected from the group
 10 consisting of a phenolic hydroxyl group, a sulfonic acid group
 and a thiol group, X represents a monovalent organic group, m
 is 8 to 200, α and β each represent an integer of 0 to 10 and
 $\alpha + \beta$ is an integer of 0 to 10, and a ratio of the structural units
 in which $\alpha + \beta$ is an integer of 1 to 10 in the structural units
 15 whose repeating number is m, is 20 to 90 mol%.

8. The semiconductor resin film according to claim 7,
wherein the (c) polyimide is organic solvent-soluble.

9. The semiconductor resin film according to claim 7 or 8,
5 wherein the average particle diameter of the (b) inorganic
particles is 10 nm or more and 5 μm or less.

10. The semiconductor resin film according to claim 7 to 9,
wherein the (a) epoxy compound contains a liquid epoxy compound
10 and a solid epoxy compound, and a weight ratio of the liquid
epoxy compound in the (a) epoxy compound is 10 to 50 wt%.

11. The semiconductor resin film according to claim 10,
wherein the amount of the (e) rubber particles is 2 to 100 parts
15 by weight with respect to 100 parts by weight of the liquid epoxy
compound.

12. The semiconductor resin film according to any one of

claims 7 to 11, wherein the (e) rubber particle is a core-shell rubber particle.

13. A semiconductor device having a cured product of the
5 composition resulting from removing the (d) solvent from the semiconductor resin composition according to any one of claims 1 to 6, or a cured product of the semiconductor resin layer according to any one of claims 7 to 12.