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(54) Title: RESIN COMPOSITION, ADHESIVE, SEALANT, CURED PRODUCT AND SEMICONDUCTOR DEVICE

(57) Abstract: The object of the present invention is to provide a resin composition and an adhesive that can reduce odor derived from thiol curing agents and provide a cured product with reduced odor. The present invention provides a resin composition comprising (A) a thiol curing agent having two or more thiol groups, (B) a main agent having two or more groups (b) each of which is reactive with a thiol group, (C) an odor masking agent having one group (c) reactive with a thiol group, and (D) a heat latent curing catalyst, wherein the amount of the (A) thiol curing agent is 10 to 60% by weight of the total weight of the resin composition, and the component (C) is a monofunctional compound having one group containing an unsaturated double bond and an electron-withdrawing group adjacent thereto in its molecule.

Description

Title of Invention: RESIN COMPOSITION, ADHESIVE, SEALANT, CURED PRODUCT AND SEMICONDUCTOR DEVICE

Technical Field

[0001] The present invention relates to a resin composition, an adhesive or sealant containing the same, a cured product thereof, and a semiconductor device containing the cured product.

Background Art

[0002] Currently, in assembling and mounting parts, such as a semiconductor chip, used in a semiconductor device, an adhesive, a sealant and the like containing a curable resin composition are often used for such purposes as maintaining reliability. As such resin compositions, curable compositions containing epoxy resins or acrylic resins as a main agent and thiol curing agents as a curing agent are known (e.g., Patent Literatures 1 and 2).

[0003] When large amounts of thiol curing agents are added to the composition in adhesives, odor can be a problem. Especially in adhesives that require thermal curing, low molecular weight thiol compounds contained in thiol curing agents or generated as byproducts or decomposition products during the curing reaction tend to volatilize during heating, causing odor problems. The cured product after the curing reaction may also smell of low molecular weight thiol compound residue.

[0004] Some methods including a method for adsorbing the odor of thiol compounds using acrylic polymers, a method for trapping the odor of thiol compounds using aldehydes, and a method for masking the odor of thiol compounds using aromatic components such as eucalyptus are known. For example, Patent Literature 3 discloses a method of masking mercapto based odor by mixing mercaptosilane with one or more of the following deodorants: eucalyptus oil, 1,8-cineole, and propylene oxide in an epoxy resin composition for semiconductor sealing.

Citation List

Patent Literature

[0005] [PTL 1] Japanese Patent Application Laid-Open No. H06-211969

[PTL 2] Japanese Patent Application Laid-Open No. 2009-51954

[PTL 3] Japanese Patent Application Laid-Open No. 2003-268205

SUMMARY OF THE INVENTION

[0006] Aromatic components used in odor masking generally do not have reactive groups that can bind to the curable components of the adhesive or are too low molecular weight components, so they are not incorporated via bonding into the cured product when the adhesive cures, causing defects such as outgassing and bleed-out. Propylene oxide, which is described as an example of a deodorant in Patent Literature 3, has a reactive group, but is hazardous and a special flammable substance with a low boiling point (34°C) and flash point (-37°C). Therefore, a safer deodorant is desired.

[0007] The object of the present invention is to provide a resin composition capable of reducing odor derived from a curing agent in a thermosetting adhesive containing a thiol curing agent, and a cured product thereof with reduced odor.

[0008] After study, it was found that the problems can be solved by the following specific means.

The first embodiment of the present invention is the following resin composition.

(1) A resin composition comprising

(A) a thiol curing agent having two or more thiol groups,

(B) a main agent having two or more groups (b) each of which is reactive with a thiol group,

(C) an odor masking agent having one group (c) reactive with a thiol group, and

(D) a heat latent curing catalyst,

wherein

the amount of the thiol curing agent (A) is 10 to 60% by weight of the total weight of the resin composition, and

the component (C) is a monofunctional compound having one group containing an unsaturated double bond and an electron-withdrawing group adjacent thereto in its molecule.

(2) The resin composition as described in (1) above, wherein the component (C) is a monofunctional (meth)acrylate compound having a molecular weight of 100 to 400.

(3) The resin composition as described in (1) or (2) above, wherein the component (B) contains a polyfunctional epoxy compound, and an amount of the polyfunctional epoxy compound in a total weight of the component (B) is 51 to 100% by weight.

(4) The resin composition according to any one of (1) to (3) above, wherein a ratio of an equivalent number of the group (c) reactive with a thiol group of the component (C) to an equivalent number of the thiol group of the component (A) ([an equivalent number of the group (c) reactive with a thiol group of the component (C)]/[an equivalent number of the thiol group of the component (A)]) is 0.01 to 0.7.

(5) The resin composition according to any one of (1) to (4) above, wherein a ratio of a total of an equivalent number of the group (b) reactive with a thiol group of the component (B) and an equivalent number of the group (c) reactive with a thiol group of the component (C) to an equivalent number of the thiol group of the component (A)

(([an equivalent number of the group (b) reactive with a thiol group of the component (B)] + [an equivalent number of the group (c) reactive with a thiol group of the component (C)])/[an equivalent number of the thiol group of the component (A)]) is 0.5 to 1.5.

[0009] The second embodiment of the present invention is (6) an adhesive or sealant comprising the resin composition described in any one of (1) to (5) above.

The third embodiment of the present invention is (7) a cured product in which the resin composition described in any one of (1) to (5) above or the adhesive or sealant described in (6) above has been cured.

The fourth embodiment of the present invention is (8) a semiconductor device comprising the cured product described in (7) above.

One aspect of the resin composition or the adhesive or sealant as mentioned above is (9) the resin composition described in any one of (1) to (5) above or the adhesive or sealant described in (6) above for use in curing by heat alone.

Another embodiment of the present invention is (10) use of the resin composition described in any one of (1) to (5) above or the adhesive or sealant described in (6) above in curing by heat alone.

[0010] According to the first embodiment of the present invention, it is possible to provide a resin composition that is able to reduce odor derived from a thiol curing agent and that provides a cured product with reduced odor.. According to the second embodiment of the present invention, it is possible to provide an adhesive or sealant that is able to reduce odor derived from a thiol curing agent and that provides a cured product with reduced odor. Furthermore, according to the third embodiment of the present invention, it is provide a cured product with reduced odor. According to the fourth embodiment of the present invention, it is possible to provide a semiconductor device containing the cured product with reduced odor.

Embodiments to carry out the invention

[0011] In the present description, following conventions in the field of synthetic resins, names that include the term "resin" that usually refer to polymers (especially synthetic polymers) may be used for components of pre-cured curable resin compositions, even though the component is not a polymer.

[0012] <Resin composition>

A resin composition, which is the first embodiment of the present invention, contains

(A) a thiol curing agent having two or more thiol groups,

(B) a main agent having two or more groups (b) each of which is reactive with a thiol group,

(C) an odor masking agent having one group (c) reactive with a thiol group, and

(D) a heat latent curing catalyst,

wherein
the amount of the (A) thiol curing agent is 10 to 60% by weight of the total weight of the resin composition, and
the component (C) is a monofunctional compound having one group containing an unsaturated double bond and an electron-withdrawing group adjacent thereto in its molecule.
According to this embodiment, it is possible to provide a resin composition that is able to reduce odor derived from a thiol curing agent and that provides a cured product with reduced odor.

[0013] (A) Thiol curing agent having two or more thiol groups

The resin composition of this embodiment contains (A) a thiol curing agent having two or more thiol groups, (hereinafter also referred to as "(A) thiol curing agent" or "component (A)"). In this embodiment, the (A) thiol curing agent is a compound containing two or more thiol groups, each of which reacts with the group (b) reactive with a thiol group of the component (B) and the group (c) reactive with a thiol group of the component (C) as mentioned below. In this embodiment, the (A) thiol curing agent preferably has three or more thiol groups. It is more preferred that the (A) thiol curing agent contains a trifunctional and/or tetrafunctional thiol compound. Trifunctional and tetrafunctional thiol compounds are thiol compounds having three and four thiol groups, respectively. The thiol equivalent weight of the (A) thiol curing agent is preferably from 90 to 200 g/eq, more preferably from 90 to 150 g/eq, further preferably from 90 to 140 g/eq, and even more preferably from 90 to 130 g/eq.

[0014] The polyfunctional thiol compound is broadly classified into a thiol compound having a hydrolyzable substructure such as an ester bond in its molecule (i.e., a hydrolyzable thiol compound) and a thiol compound without such a substructure (i.e., a nonhydrolyzable thiol compound).

Examples of the hydrolyzable polyfunctional thiol compound include trimethylolpropane tris(3-mercaptopropionate),
tris[(3-mercaptopropionyloxy)-ethyl]-isocyanurate, pentaerythritol tetrakis(3-mercaptopropionate), tetraethyleneglycol bis(3-mercaptopropionate), dipentaerythritol hexakis(3-mercaptopropionate), pentaerythritol
tetrakis(3-mercaptobutyrate),
1,3,5-tris(3-mercaptobutyryloxyethyl)-1,3,5-triazine-2,4,6(1H,3H,5H)-trione, and the like. Any one of them may be used alone, or two or more may be used in combination.

[0015] Examples of the non-hydrolyzable polyfunctional thiol compound include
1,3,4,6-tetrakis(2-mercaptoethyl)glycoluril,
1,3,4,6-tetrakis(3-mercaptopropyl)glycoluril,
1,3,4,6-tetrakis(mercaptomethyl)glycoluril,

1,3,4,6-tetrakis(mercaptomethyl)-3a-methylglycoluril,
1,3,4,6-tetrakis(2-mercaptoethyl)-3a-methylglycoluril,
1,3,4,6-tetrakis(3-mercaptopropyl)-3a-methylglycoluril,
1,3,4,6-tetrakis(mercaptomethyl)-3a, 6a-dimethylglycoluril,
1,3,4,6-tetrakis(2-mercaptoethyl)-3a,6a-dimethylglycoluril,
1,3,4,6-tetrakis(3-mercaptopropyl)-3a,6a-dimethylglycoluril,
1,3,4,6-tetrakis(mercaptomethyl)-3a,6a-diphenylglycoluril,
1,3,4,6-tetrakis(2-mercaptoethyl)-3a,6a-diphenylglycoluril,
1,3,4,6-tetrakis(3-mercaptopropyl)-3a,6a-diphenylglycoluril,
tris(3-mercaptopropyl)isocyanurate, 1,3,5-tris[3-(2-mercaptoethylsulfanyl)propyl isocyanurate, 1,3,5-tris[2-(3-mercaptopropoxy)ethyl]isocyanurate, pentaerythritol tripropanethiol, 3-[2,3-bis(3-sulfanylpropoxy)propoxy]propan-1-thiol,
3-[2,2-bis[(3-mercaptopropoxy)methyl]butoxy]-1-propantiol, pentaerythritol tetrapropanethiol, 1,2,3-tris(mercaptomethylthio)propane,
1,2,3-tris(2-mercaptoethylthio)propane, 1,2,3-tris(3-mercaptopropylthio)propane,
4-mercaptomethyl-1,8-dimercapto-3,6-dithiaoctane,
5,7-dimercaptomethyl-1,11-dimercapto-3,6,9-trithiaundecane,
4,7-dimercaptomethyl-1,11-dimercapto-3,6,9-trithiaundecane,
4,8-dimercaptomethyl-1,11-dimercapto-3,6,9-trithiaundecane,
tetrakis(mercaptomethylthiomethyl)methane,
tetrakis(2-mercaptoethylthiomethyl)methane,
tetrakis(3-mercaptopropylthiomethyl)methane,
1,1,3,3-tetrakis(mercaptomethylthio)propane,
1,1,2,2-tetrakis(mercaptomethylthio)ethane,
1,1,5,5-tetrakis(mercaptomethylthio)-3-thiapentane,
1,1,6,6-tetrakis(mercaptomethylthio)-3,4-dithiahexane,
2,2-bis(mercaptomethylthio)ethanethiol,
3-mercaptomethylthio-1,7-dimercapto-2,6-dithiaheptane,
3,6-bis(mercaptomethylthio)-1,9-dimercapto-2,5,8-trithianonane,
3-mercaptomethylthio-1,6-dimercapto-2,5-dithiahexane,
1,1,9,9-tetrakis(mercaptomethylthio)-5-(3,3-bis(mercaptomethylthio)-1-thiapropyl) 3,7-dithianonane, tris(2,2-bis(mercaptomethylthio)ethyl)methane,
tris(4,4-bis(mercaptomethylthio)-2-thiabutyl)methane,
tetrakis(2,2-bis(mercaptomethylthio)ethyl)methane,
tetrakis(4,4-bis(mercaptomethylthio)-2-thiabutyl)methane,
3,5,9,11-tetrakis(mercaptomethylthio)-1,13-dimercapto-2,6,8,12-tetrathiatridecane,
3,5,9,11,15,17-hexakis(mercaptomethylthio)-1,19-dimercapto-2,6,8,12,14,18-hexathia nonadecane,

9-(2,2-bis(mercaptomethylthio)ethyl)-3,5,13,15-tetrakis(mercaptomethylthio)-1,17-dimercapto-2,6,8,10,12,16-hexathiaheptadecane,
3,4,8,9-tetrakis(mercaptomethylthio)-1,11-dimercapto-2,5,7,10-tetrathiaundecane,
3,4,8,9,13,14-hexakis(mercaptomethylthio)-1,16-dimercapto-2,5,7,10,12,15-hexathiahexadecane,
8-[bis(mercaptomethylthio)methyl]-3,4,12,13-tetrakis(mercaptomethylthio)-1,15-dimercapto-2,5,7,9,11,14-hexathiapentadecane,
4,6-bis[3,5-bis(mercaptomethylthio)-7-mercapto-2,6-dithiaheptylthio]-1,3-dithiane,
4-[3,5-bis(mercaptomethylthio)-7-mercapto-2,6-dithiaheptylthio]-6-mercaptomethylthio-1,3-dithiane,
1,1-bis[4-(6-mercaptomethylthio)-1,3-dithianylthio]-1,3-bis(mercaptomethylthio)propane,
1-[4-(6-mercaptomethylthio)-1,3-dithianylthio]-3-[2,2-bis(mercaptomethylthio)ethyl]-7,9-bis(mercaptomethylthio)-2,4,6,10-tetrathiaundecane,
3-[2-(1,3-dithietanyl)]methyl-7,9-bis(mercaptomethylthio)-1,11-dimercapto-2,4,6,10-tetrathiaundecane,
9-[2-(1,3-dithietanyl)]methyl-3,5,13,15-tetrakis(mercaptomethylthio)-1,17-dimercapto-2,6,8,10,12,16-hexathiaheptadecane,
3-[2-(1,3-dithietanyl)]methyl-7,9,13,15-tetrakis(mercaptomethylthio)-1,17-dimercapto-2,4,6,10,12,16-hexathiaheptadecane,
4,6-bis[4-(6-mercaptomethylthio)-1,3-dithianylthio]-6-[4-(6-mercaptomethylthio)-1,3-dithianylthio]-1,3-dithiane,
4-[3,4,8,9-tetrakis(mercaptomethylthio)-11-mercapto-2,5,7,10-tetrathiaundecyl]-5-mercaptomethylthio-1,3-dithiolane,
4,5-bis[3,4-bis(mercaptomethylthio)-6-mercapto-2,5-dithiahexylthio]-1,3-dithiolane,
4-[3,4-bis(mercaptomethylthio)-6-mercapto-2,5-dithiahexylthio]-5-mercaptomethylthio-1,3-dithiolane,
4-[3-bis(mercaptomethylthio)methyl-5,6-bis(mercaptomethylthio)-8-mercapto-2,4,7-trithiaoctyl]-5-mercaptomethylthio-1,3-dithiolane,
2-{bis[3,4-bis(mercaptomethylthio)-6-mercapto-2,5-dithiahexylthio]methyl}-1,3-dithietane,
2-[3,4-bis(mercaptomethylthio)-6-mercapto-2,5-dithiahexylthio]mercaptomethylthiomethyl-1,3-dithietane,
2-[3,4,8,9-tetrakis(mercaptomethylthio)-11-mercapto-2,5,7,10-tetrathiaundecylthio]mercaptomethylthiomethyl-1,3-dithietane,
2-[3-bis(mercaptomethylthio)methyl-5,6-bis(mercaptomethylthio)-8-mercapto-2,4,7-trithiaoctyl]mercaptomethylthiomethyl-1,3-dithietane,
4-{1-[2-(1,3-dithietanyl)]-3-mercapto-2-thiapropylthio}-5-[1,2-bis(mercaptomethylthio

)-4-mercapto-3-thiabutylthio]-1,3-dithiolane, and the like. Any one of them may be used alone, or two or more may be used in combination.

[0016] The amount of the (A) thiol curing agent is 10 to 60% by weight of the total weight of the resin composition. Because the (A) thiol curing agent is blended in a certain amount, it is usually prone to odor problems, but the constitution of the resin composition of this embodiment can reduce the odor. In one embodiment, the amount of the (A) thiol curing agent is 15 to 60% by weight of the total weight of the resin composition. In one embodiment, the amount of the (A) thiol curing agent is 15 to 60% by weight of the total weight of the resin composition excluding the (E) filler as described below.

[0017] (B) Main agent having two or more groups (b) each of which is reactive with a thiol group

The resin composition of this embodiment contains (B) a main agent having two or more groups (b) each of which is reactive with a thiol group (hereinafter also referred to as "(B) main agent" or "component (B)"). The component (B) is a polyfunctional compound that can be cured by reacting with thiol groups in the component (A) to form cross-linking networks by having two or more groups (b) each of which is reactive with a thiol group. Such a polyfunctional compound includes a polyfunctional epoxy compound having two or more epoxy groups and a polyfunctional (meth)acrylate compound having two or more (meth)acryloyloxy groups. In one embodiment, the component (B) is a polyfunctional epoxy compound. In one embodiment, the component (B) is a polyfunctional (meth)acrylate compound. In one embodiment, the component (B) contains a polyfunctional epoxy compound. In one embodiment, the component (B) contains both a polyfunctional epoxy compound and a polyfunctional (meth)acrylate compound. From the viewpoint of improving adhesive strength, it is preferable that the amount of the polyfunctional epoxy compound in the total weight of the component (B) is 50 to 100% by weight, preferably 51 to 100% by weight, more preferably 60 to 100% by weight, further preferably 80 to 100% by weight, and even further preferably 90 to 100% by weight. In the case of component (B) where the group (b) reactive with the thiol group of component (B) contains both an epoxy group and other reactive group in one molecule (for example, when component (B) is a (meth)acrylate compound having both epoxy group and (meth)acryloyloxy group), the numerical value obtained by dividing the weight of that compound (the charged amount) by the number of all reactive groups (b) in one molecule to obtain a numerical value, which is then multiplied by the number of epoxy groups in one molecule is estimated as the weight of the polyfunctional epoxy compound.

[0018] The polyfunctional epoxy compound is not limited as long as it is a compound

having at least two epoxy groups, and conventionally used epoxy resins can be used as the component (B). Epoxy resin is a generic term for thermosetting resins that can be cured by cross-linking networks with epoxy groups present in its molecule, including prepolymer compounds before curing. In consideration of ensuring heat resistance, a compound with 2 to 6 epoxy groups is more preferable as the component (B), and a compound with two epoxy groups is even more preferable. The polyfunctional epoxy compound may be liquid or solid at 25°C, and it is preferred to be liquid at 25°C. In one aspect, an amount of the polyfunctional epoxy compound that is liquid at 25°C is preferably 50 or more parts by weight, and for example, 60 or more parts by weight, and for example, 70 or more parts by weight, and for example, 80 or more parts by weight, and for example, 90 or more parts by weight, and for example 100 parts by weight, with respect to 100 parts by weight of the total of the polyfunctional epoxy compound. In one aspect, the polyfunctional epoxy compound contains a polyfunctional epoxy compound that is liquid at 25°C and a polyfunctional epoxy compound that is solid at 25°C, and an amount of the polyfunctional epoxy compound that is liquid at 25°C is preferably 50 or more parts by weight, and for example, 60 or more parts by weight, and for example, 70 or more parts by weight, and for example, 80 or more parts by weight, and for example, 90 or more parts by weight, with respect to 100 parts by weight of the total of the polyfunctional epoxy compound.
The polyfunctional epoxy compound is broadly classified into an aromatic polyfunctional epoxy compound and a polyfunctional epoxy compound without an aromatic ring.

[0019] The aromatic polyfunctional epoxy compound is a polyfunctional epoxy compound having a structure containing an aromatic ring such as a benzene ring. There are many epoxy resins of this type that have conventionally been used frequently, such as bisphenol A-type epoxy compounds. Examples of the aromatic polyfunctional epoxy compound include, but are not limited to:

- bisphenol A-type epoxy compounds;
- branched polyfunctional bisphenol A-type epoxy compounds such as p-glycidyloxyphenyldimethyl trisbisphenol A diglycidyl ether;
- bisphenol F-type epoxy compounds;
- novolac-type epoxy compounds;
- tetrabromobisphenol A-type epoxy compounds;
- fluorene-type epoxy compounds;
- biphenyl aralkyl epoxy compounds;
- diepoxy compounds such as 1,4-phenyldimethanol diglycidyl ether;
- biphenyl-type epoxy compounds such as 3,3',5,5'-tetramethyl-4,4'-diglycidyloxybiphenyl;

- glycidylamine-type epoxy compounds such as diglycidylaniline, diglycidyltoluidine, triglycidyl-p-aminophenol, tetraglycidyl-m-xylylenediamine; and
- naphthalene ring-containing epoxy compounds;

and the like. Any one of them may be used alone, or two or more may be used in combination. From the perspective of compatibility with the (A) polyfunctional thiol compound, it is preferable that the polyfunctional epoxy compound as the component (B) contains an aromatic polyfunctional epoxy compound. For the aromatic polyfunctional epoxy compound, bisphenol F-type epoxy compounds, bisphenol A-type epoxy compounds, and glycidylamine-type epoxy compounds are preferable, and among these, those having an epoxy equivalent weight of 90 to 500 g/eq are particularly preferable, and those having an epoxy equivalent weight of 90 to 400 g/eq are further preferable. The aromatic polyfunctional epoxy compound may be oxyalkylene modified, such as EO (ethylene oxide) modified or PO (propylene oxide) modified. The aromatic polyfunctional epoxy compound is preferably liquid at 25°C. The viscosity of the aromatic polyfunctional epoxy compound at 25°C is preferably from 0.1 to 100 Pa・s, more preferably 0.5 to 100 Pa・s, and further preferably 1 to 100 Pa・s.

[0020] In the present description, viscosity is expressed as a value measured according to the Japanese Industrial Standard JIS K6833, unless otherwise specified. Specifically, viscosity can be observed by measuring viscosity using an E-type viscometer at a rotational speed of 10 rpm. There are no limitations on instruments, rotors or measurement ranges used.

[0021] The polyfunctional epoxy compound without an aromatic ring includes, for example, an aliphatic polyfunctional epoxy compound and a polyfunctional epoxy compound with a heterocyclic ring.

[0022] Examples of the aliphatic polyfunctional epoxy compound include, but are not limited to:

- diepoxy compounds such as (poly)ethylene glycol diglycidyl ether, (poly)propylene glycol diglycidyl ether, butanediol diglycidyl ether, neopentyl glycol diglycidyl ether, 1,6-hexanediol diglycidyl ether, trimethylolpropane diglycidyl ether, polytetramethylene glycol diglycidyl ether, glycerin diglycidyl ether, neopentyl glycol diglycidyl ether, cyclohexane type diglycidyl ether, and dicyclopentadiene type diglycidyl ether;
- tri-poxy compounds such as trimethylolpropane triglycidyl ether, and glycerin triglycidyl ether;
- alicyclic epoxy compounds such as vinyl (3,4-cyclohexene) dioxide, and 2-(3,4-epoxycyclohexyl)-5,1-spiro-(3,4-epoxycyclohexyl)-m-dioxane;
- hydrogenated bisphenol A type diepoxy compounds such as hydrogenated bisphenol A diglycidyl ether;

- glycidylamine type epoxy compounds such as tetraglycidyl bis(aminomethyl)cyclohexane;
- hydantoin-type epoxy compounds such as 1,3-diglycidyl-5-methyl-5-ethylhydantoin;
- epoxy compounds with a silicone backbone, such as 1,3-bis(3-glycidoxypropyl)-1,1,3,3-tetramethyldisiloxane;

and the like.

The aliphatic polyfunctional epoxy compound preferably has an epoxy equivalent weight of 90 to 450 g/eq. The aliphatic polyfunctional epoxy compound is preferably liquid at 25°C. The viscosity of the aliphatic polyfunctional epoxy compound at 25°C is preferably from 5 to 10,000 mPa・s, and more preferably 10 to 5,000 mPa・s.

[0023] Examples of the polyfunctional epoxy compound having a heterocyclic ring include isocyanurate-type epoxy compounds (trade names: TEPIC-S, TEPIC-L, TEPIC-PAS TEPIC-VL TEPIC-VL, TEPIC-FL, and TEPIC-UC; available from Nissan Chemical Corporation) and glycoluril type epoxy compounds (trade name: TG-G available from Shikoku Chemicals Corporation).

The polyfunctional epoxy compound having a heterocyclic ring is preferably one having an epoxy equivalent weight of 80 to 450 g/eq. The polyfunctional epoxy compound having a heterocyclic ring is preferably liquid at 25°C from the viewpoint of workability. The polyfunctional epoxy compound having a heterocyclic ring is preferably one having the viscosity at 25°C of from 100 to 50,000 mPa・s, and more preferably 100 to 5,000 mPa・s. On the other hand, from the viewpoint of adhesion, the polyfunctional epoxy compound having a heterocyclic ring is preferably solid at 25°C.

[0024] The polyfunctional (meth)acrylate compound is not limited as long as it is a compound having at least two (meth)acryloyloxy groups. A compound with 2 to 6 (meth)acrylate groups is preferable, and a compound with two (meth)acrylate groups is more preferable.

[0025] Examples of the polyfunctional (meth)acrylate compound include, but are not limited to, diacrylate and/or dimethacrylate of tris(2-hydroxyethyl)isocyanurate;. triacrylate and/or trimethacrylate of tris(2-hydroxyethyl)isocyanurate; trimethylolpropane triacrylate and/or trimethacrylate, or oligomers thereof; pentaerythritol triacrylate and/or trimethacrylate, or oligomers thereof; polyacrylate and/or polymethacrylate of dipentaerythritol; tris(acryloxyethyl)isocyanurate; caprolactone-modified tris(acryloxyethyl)isocyanurate; caprolactone-modified tris(methacryloxyethyl)isocyanurate; polyacrylate and/or polymethacrylate of alkyl-modified dipentaerythritol; polyacrylate and/or polymethacrylate of caprolactone-modified dipentaerythritol; ethoxylated bisphenol A diacrylate and/or ethoxylated bisphenol A dimethacrylate; dihydrocyclopentadiethyl acrylate and/or dihydrocyclopentadiethyl methacrylate, and polyester acrylate and/or polyester methacrylate, dimethylol-tricyclodecanediacrylate, poly(meth)acrylate of ditrimethylolpropane, polyurethanes having two or more (meth)acryloyl groups per molecule, polyesters having two or more (meth)acryloyl groups per molecule, and the like. From the viewpoint of reactivity, it is preferable that the polyifunctional (meth)acrylate compound as component (B) is an acrylate compound, containing substantially no methacrylate compound.

Any one of the above mentioned polyfunctional (meth)acrylate compounds may be used alone, or two or more may be used in combination.

[0026] The polyfunctional (meth)acrylate compound preferably has a viscosity of 0.01 to 100 Pa・s from the viewpoint of preparation and dispensability of the resin composition.

[0027] Commercially available polyfunctional (meth)acrylate compounds include, for example, polyester acrylate from DAICEL-ALLNEX LTD. (trade name: EBECRYL810), ditrimethylolpropane tetraacrylate from DAICEL-ALLNEX LTD. (trade name: EBECRYL140), polyester acrylate from Toagosei Co., Ltd. (trade name: M7100), dimethylol tricyclodecane diacrylate from KYOEISHA CHEMICAL Co., LTD (trade name: Light Acrylate DCP-A), neopentylglycol modified trimethylolpropanediacrylate from Nippon Kayaku Co., Ltd. (trade name: Kayarad R-604). Any one of them may be used alone, or two or more may be used in combination as the polyfunctional (meth)acrylate compound.

[0028] The polyfunctional compound having two or more groups (b) each of which is reactive with a thiol group may include an episulfide compound. Episulfide compounds are compounds containing thiirane rings, in which all or part of the oxygen atoms of the oxirane rings of the epoxy compounds are replaced by sulfur atoms. Examples of the episulfide compounds include compounds containing two or more thiirane rings in the molecule and compounds containing one or more of both thiirane and oxirane rings in the molecule. In this regard, from the viewpoint of workability of the resin composition, the amount of the compound containing thiirane ring in the total weight of the component (B) is preferably 20% by weight or less, and for example, 15% by weight or less, and for example, 10% by weight or less, and for example, 5% by weight or less.

[0029] (C) Odor masking agent having one group (c) reactive with a thiol group

The resin composition of this embodiment contains (C) an odor masking agent (hereinafter referred to simply as "component (C)") having one group (c) reactive with a thiol group (hereinafter referred to simply as "group (c)"). In the present description, "odor masking agent" means a compound that reacts with a thiol group derived from the component (A) to mask the odor derived from the component (A). The component

(C) is not limited so long as it is an odor masking agent as mentioned above, which is a monofunctional compound having one group containing an unsaturated double bond and an electron-withdrawing group adjacent thereto in its molecule. The group containing an unsaturated double bond and an electron-withdrawing group adjacent thereto corresponds to the group (c) reactive with a thiol group. Examples of the electron-withdrawing group include a carbonyl group and a cyano group, with a carbonyl group being preferred. Carbonyl groups also include carbonyloxy groups.

[0030] Examples of the component (C) include a monofunctional maleimide compound, a monofunctional (meth)acrylate compound, and a monofunctional acrylamide compound. Group (c) includes a maleimide group, a (meth)acryloyl group and a (meth)acryloyloxy group. In this embodiment, the component (C) is preferably selected from a monofunctional maleimide compound and a monofunctional (meth)acrylate compound, with monofunctional (meth)acrylate compound being more preferred.

[0031] The monofunctional maleimide compound is a compound having one maleimide group as the group (c), examples of which include: maleimide; maleimides containing aliphatic hydrocarbon groups such as methyl maleimide, ethyl maleimide, propyl maleimide, butyl maleimide, hexyl maleimide, octyl maleimide, dodecyl maleimide, stearyl maleimide, cyclohexyl maleimide; maleimides containing aromatic rings such as phenyl maleimide; and the like. They may be used alone or in combination of two or more kinds.

[0032] The monofunctional (meth)acrylate compound is a compound with one (meth)acryloyloxy group as the group (c). Examples of the monofunctional (meth)acrylate compound include:

- esters of monovalent alcohols and (meth)acrylic acids such as ethyl (meth)acrylate, trifluoroethyl (meth)acrylate, diethylaminoethyl (meth)acrylate, dimethylaminoethyl (meth)acrylate, glycidyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, tert-butyl (meth)acrylate, isoamyl (meth)acrylate, cyclohexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isodecyl (meth)acrylate, isobornyl (meth)acrylate, stearyl (meth)acrylate, lauryl (meth)acrylate, phenoxyethyl (meth)acrylate, benzyl (meth)acrylate, tetrahydrofurfuryl (meth)acrylate, ethoxydiethylene glycol (meth)acrylate, phenoxydiethylene glycol (meth)acrylate, phenoxypolyethylene glycol (meth)acrylate, butoxydiethylene glycol (meth)acrylate, methoxydipropylene glycol (meth)acrylate, methoxypolyethylene glycol (meth)acrylate, methoxytriethylene glycol (meth)acrylate, methoxypolyethylene glycol (meth)acrylate, 2-ethylhexyl diethylene glycol (meth)acrylate, 4-tert-butylcyclohexyl (meth)acrylate, and 3-phenoxybenzyl(meth)acrylate; mono(meth)acrylates of polyhydric alcohols or esters of monovalent alcohols and (meth)acrylic acids such as

2-hydroxyethyl(meth)acrylate, 2-hydroxypropyl(meth)acrylate, 2-hydroxybutyl(meth)acrylate, 2-hydroxy-3-phenoxypropyl(meth)acrylate, octyl acrylate, nonyl acrylate, isononyl acrylate, 3,3,5-trimethylcyclohexyl acrylate, cyclic trimethylolpropane formal acrylate, 1-naphthalene methyl(meth)acrylate, 1-ethylcyclohexyl (meth)acrylate, 1-methylcyclohexyl (meth)acrylate, 1-ethylcyclopentyl (meth)acrylate, 1-methylcyclopentyl(meth)acrylate, dicyclopentenyl(meth)acrylate, dicyclopentenyloxyethyl(meth)acrylate, dicyclopentanyl(meth)acrylate, nonylphenoxy polyethylene glycol(meth)acrylate, tetrahydrodicyclopentadienyl(meth)acrylate, 2-(o-phenylphenoxy)ethyl(meth)acrylate, isobornylcyclohexyl(meth)acrylate, (2-methyl-2-ethyl-1,3-dioxolan-4-yl)methyl(meth)acrylate, 1-adamantyl(meth)acrylate, 3-hydroxy-1-adamantyl(meth)acrylate, 2-methyl-2-adamantanyl(meth)acrylate, 2-ethyl-2-adamantanyl(meth)acrylate, 2-isopropyladamantan-2-yl(meth)acrylate, 3-hydroxy-1-adamantyl(meth)acrylate, (adamantan-1-yloxy)methyl(meth)acrylate, 2-isopropyl-2-adamantyl(meth)acrylate, 1-methyl-1-ethyl-1-adamantylmethanol(meth)acrylate, 1,1-diethyl-1-adamantylmethanol(meth)acrylate, 2-cyclohexylpropan-2-yl(meth)acrylate, 1-isopropylcyclohexyl(meth)acrylate, 1-methylcyclohexyl(meth)acrylate, 1-ethylcyclopentyl(meth)acrylate, 1-methylcyclohexyl(meth)acrylate, tetrahydropyranyl(meth)acrylate, tetrahydro-2-furanyl(meth)acrylate, 2-oxotetrahydrofuran-3-yl(meth)acrylate, (5-oxotetrahydrofuran-2-yl)methyl(meth)acrylate, (2-oxo-1,3-dioxolan-4-yl)methyl(meth)acrylate, N-acryloyloxyethyl hexahydrophthalimide, α-acryloyl-ω-methoxypoly(oxyethylene), 1-ethoxyethyl(meth)acrylate; and the like. Any one of them may be used alone, or two or more may be used in combination.

[0033] Component (C) is preferred to have a molecular weight of 400 or less, more preferably of 350 or less, and even more preferably 300 or less in terms of its odor masking effect. In order to prevent adverse effects on the human body and contamination of the thermosetting furnace due to volatilization, the component (C) is preferably low volatile, and its molecular weight is preferably 100 or higher, and more preferably 130 or higher. In some aspects, the molecular weight of the component (C) is preferably from 100 to 400, more preferably from 100 to 350, and even more preferably from 130 to 300.

[0034] The inclusion of the component (C) masks the odor derived from the component (A). The reasons for this are, without limitation, considered to be the following.

Low molecular weight thiol compounds contained in the component (A) or generated as byproducts or decomposition products during the curing reaction are easily volatilized and can cause odor problems. It should be noted that most substances involved in the sense of smell are said to have a molecular weight of about 20 to 400. In one aspect, the component (C) reacts with a low molecular weight thiol compound via group (c), resulting in a larger molecular weight of the resulting sulfur-containing compound, which is considered to be low volatile and odor suppressed. In particular, when the component (C) is a monofunctional (meth)acrylate compound or a monofunctional maleimide compound, the reactivity of the (meth)acryloyl group, (meth)acryloyloxy group, and maleimide group is high and the ability to trap low molecular thiol compounds is high.

The above monofunctional (meth)acrylate compound also contains a carbonyloxy group and has somewhat small molecular weight, thereby having a unique ester odor . The odor derived from the component (A) can be masked by the ester odor.

Since the component (C) is incorporated via group (c) in the cured product of the resin composition, outgassing and bleed-out from the cured product after heat treatment are suppressed compared to aromatic components generally used in odor masking.

[0035] In this embodiment, from the viewpoint of odor reduction and curability, a ratio of an equivalent number of the group (c) reactive with a thiol group of the component (C) to an equivalent number of the thiol group of the component (A) ([an equivalent number of the group (c) reactive with a thiol group of the component (C)]/[an equivalent number of the thiol group of the component (A)]) is preferably 0.01 to 0.7, more preferably 0.05 to 0.65, further preferably 0.1 to 0.6, and particularly preferably 0.15 to 0.55.

From the viewpoint of cured product properties, a ratio of an equivalent number of the group (b) reactive with a thiol group of the component (B) to an equivalent number of the thiol group of the component (A) ([an equivalent number of the group (b) reactive with a thiol group of the component (B)]/[an equivalent number of the thiol group of the component (A)]) is preferably 0.5 to 0.99, and more preferably 0.55 to 0.95, further preferably 0.60 to 0.90, and particularly preferably 0.60 to 0.85. In the case of component (B) having both an epoxy group and other reactive group in one molecule as the group (b) reactive with the thiol group (for example, when component (B) is a (meth)acrylate compound having both epoxy group and (meth)acryloyloxy group), it is preferable to calculate both the epoxy group and other reactive group as group (b) to satisfy the above equation for the equivalent numbers.

In this embodiment, a ratio of a total of an equivalent number of the group (b) reactive with a thiol group of the component (B) and an equivalent number of the group (c) reactive with a thiol group of the component (C) to an equivalent number of the thiol group of the component (A) (([an equivalent number of the group (b) reactive with a thiol group of the component (B)] + [an equivalent number of the group (c) reactive with a thiol group of the component (C)])/[an equivalent number of the thiol group of the component (A)]) is preferably 0.5 to 1.5, and more preferably 0.7 to 1.3, further preferably 0.8 to 1.1.

[0036] In the present description, a functional group equivalent weight such as thiol equivalent weight, epoxy equivalent weight, (meth)acryloyloxy equivalent weight, and the like, refers to the molecular weight of the compound per functional group. The equivalent number of functional group, such as equivalent number of thiol group, equivalent number of epoxy group, and equivalent number of (meth)acryloyloxy group, represents the number (equivalent number) of functional groups per weight (charged amount) of the compound.

[0037] The thiol equivalent weight of component (A) is theoretically the number obtained by dividing the molecular weight of component (A) by the number of thiol groups in one molecule. The actual thiol equivalent weight can be determined, for example, by determining the thiol value by potentiometry. This method is widely known and is disclosed, for example, in paragraph 0079 of JP 2012-153794 A. The equivalent number of thiol group of component (A) is the number of thiol groups (equivalent number) per weight (charged amount) of component (A), and it is the quotient of the weight (g) of the thiol compound as component (A) divided by the thiol equivalent weight of that thiol compound (the sum of such quotients for each thiol compound, if more than one thiol compound is included.).

[0038] When the component (B) is a polyfunctional epoxy compound, the epoxy equivalent weight of component (B) is theoretically the number obtained by dividing the molecular weight of component (B) by the number of epoxy groups in one molecule. The actual epoxy equivalent weight can be determined by the method described in JIS K7236. The equivalent number of epoxy group of component (B) is the number (equivalent number) of epoxy groups per weight (charged amount) of component (B), and it is the quotient of the weight (g) of the epoxy compound as component (B) divided by the epoxy equivalent weight of that epoxy compound (the sum of such quotients for each epoxy compound, if more than one epoxy compound is included.).

[0039] When the component (B) is a polyfunctional (meth)acrylate compound and/or the component (C) is a monofunctional (meth)acrylate compound, the (meth)acryloyloxy equivalent weight of component (B) and/or component (C) is theoretically equal to the number obtained by dividing the molecular weight of the (meth)acrylate compound by the number of acryloyloxy groups (or methacryloyloxy groups) in one molecule. The actual (meth)acryloyloxy equivalent weight can be measured, for example, by NMR. The equivalent number of (meth)acryloyloxy group of component (B) and/or component (C) is the number of (meth)acryloyloxy groups (equivalent number) per weight (charged amount) of component (B) and/or component (C), and it is the quotient of the weight (g) of the (meth)acrylate compound as component (B) and/or component (C) divided by the (meth)acryloyloxy equivalent weight of that (meth)acrylate compound (the sum of such quotients for each (meth)acrylate compound, if more than one (meth)acrylate compound is included.).

[0040] When component (C) is a monofunctional maleimide compound, the maleimide equivalent weight of component (C) is theoretically equal to the number obtained by dividing the molecular weight of the maleimide compound by the number of maleimide groups in one molecule. The actual maleimide equivalent weight can be measured, for example, by NMR. The equivalent number of maleimide group of component (C) is the number of maleimide groups (equivalent number) per weight (charged amount) of component (C), and it is the quotient of the weight (g) of the maleimide compound as component (C) divided by the maleimide equivalent weightof that maleimide compound (the sum of such quotients for each maleimide compound, if more than one maleimide compound is included.).

[0041] (D) Heat latent curing catalyst

The resin composition of this embodiment contains (D) a heat latent curing catalyst (hereinafter also referred to as "component (D)"). By using component (D), the resin composition of this embodiment can be made a one-component resin composition and can be cured in a short time even under a low temperature condition.

[0042] A latent curing catalyst is a compound that is inactive at room temperature and is activated by heating to function as a curing catalyst. Examples of the latent curing catalyst include imidazole compounds that are solid at room temperature; solid dispersion type amine adduct latent curing catalysts such as reaction products of amine compounds and epoxy compounds (amine-epoxy adduct type latent curing catalysts); reaction products of amine compounds and isocyanate compounds or urea compounds (urea type adduct type latent curing catalysts). As component (D), the solid-dispersion amine adduct-type latent curing catalysts are preferred from the viewpoint of pot life and curing performance.

[0043] Examples of the imidazole compounds that are solid at room temperature include, but are not limited to, 2-heptadecylimidazole, 2-phenyl-4,5-dihydroxymethylimidazole, 2-undecylimidazole, 2-phenyl-4-methyl-5-hydroxymethylimidazole, 2-phenyl-4-benzyl-5-hydroxymethylimidazole, 2,4-diamino-6-(2-methylimidazolyl-(1))-ethyl-S-triazine, 2,4-diamino-6-(2'-methylimidazolyl-(1)')-ethyl-S-triazine-isocyanuric acid adduct, 2-methylimidazole, 2-phenylimidazole, 2-phenyl-4-methylimidazole, 1-cyanoethyl-2-phenylimidazole, 1-cyanoethyl-2-methylimidazole-trimellitate, 1-cyanoethyl-2-phenylimidazole-trimellitate, N-(2-methylimidazolyl-1-ethyl)-urea, N,N'-(2-methylimidazolyl-(1)-ethyl)-azivoyldiamide, and the like.

[0044] Examples of the epoxy compounds used as one of the raw materials for making solid dispersion type amine adduct latent curing catalysts (amine-epoxy adduct type latent curing catalysts) include, but are not limited to, polyvalent phenols such as bisphenol A, bisphenol F, catechol and resorcinol, or polyglycidyl ether obtained by reacting polyhydric alcohols such as glycerin or polyethylene glycol with epichlorohydrin; glycidyl ether esters obtained by reacting hydroxycarboxylic acids such as p-hydroxybenzoic acid and β-hydroxynaphthoic acid with epichlorohydrin; polyglycidyl esters obtained by reacting polycarboxylic acids such as phthalic acid and terephthalic acid with epichlorohydrin; glycidylamine compounds obtained by reacting 4,4'-diaminodiphenylmethane or m-aminophenol with epichlorohydrin; and, poly-functional epoxy compounds such as epoxidized phenolic novolac resin, epoxidized cresol novolac resin, epoxidized polyolefin, and monofunctional epoxy compounds such as butyl glycidyl ether, phenyl glycidyl ether, glycidyl methacrylate; and the like.

[0045] Amine compounds used as another production raw material for solid-dispersion type amine adduct latent curing catalysts can be any as long as it has at least one active hydrogen in its molecule that can additionally react with epoxy groups, and at least one functional group selected from primary, secondary and tertiary amino groups in its molecule. Examples of such amine compounds include, but are not limited to, the following. Examples of such amine compounds include, but are not limited to, aliphatic amines such as diethylenetriamine, triethylenetetramine, n-propylamine, 2-hydroxyethylaminopropylamine, cyclohexylamine, 4,4'-diamino-dicyclohexylmethane; aromatic amine compounds such as 4,4'-diaminodiphenylmethane and 2-methylaniline; heterocyclic compounds containing a nitrogen atom(s) such as 2-ethyl-4-methylimidazole, 2-ethyl-4-methylimidazoline, 2,4-dimethylimidazoline, piperidine and piperazine; and the like.

[0046] Among these, compounds with intramolecular tertiary amino group(s) are raw materials that provide latent curing catalysts with excellent curing accelerating ability. Examples of such compounds include, but are not limited to, amine compounds such as dimethylaminopropylamine, diethylaminopropylamine, di-n-propylaminopropylamine, dibutylaminopropylamine, dimethylaminoethylamine, di-ethylaminoethylamine and N-methylpiperazine, and primary or secondary amines with intramolecular tertiary amino group(s), such as 2-methylimidazole, 2-ethylimidazole, 2-ethyl-4-methylimidazole, 2-phenylimidazole and other imidazole compounds; alcohols, phenols, thiols, carboxylic acids, and hydrazides with tertiary amino group(s) in its molecule such as 2-dimethylaminoethanol, 1-methyl-2-dimethylaminoethanol, 1-phenoxymethyl-2-dimethylaminoethanol, 2-diethylaminoethanol, 1-butoxymethyl-2-dimethylaminoethanol, 1-(2-hydroxy-3-phenoxypropyl)-2-methylimidazole, 1-(2-hydroxy-3-phenoxypropyl)-2-ethyl-4-methylimidazole, 1-(2-hydroxy-3-butoxypropyl)-2-methylimidazole, 1-(2-hydroxy-3-butoxypropyl)-2-ethyl-4-methylimidazole, 1-(2-hydroxy-3-phenoxypropyl)-2-phenylimidazoline, 1-(2-hydroxy-3-butoxypropyl)-2-methylimidazoline, 2-(dimethylaminomethyl)phenol, 2,4,6-tris(dimethylaminomethyl)phenol, N-β-hydroxyethylmorpholine, 2-dimethylaminoethanethiol, 2-mercaptopyridine, 2-benzoimidazole, 2-mercaptobenzoimidazole, 2-mercaptobenzothiazole, 4-mercaptopyridine, N,N-dimethylaminobenzoic acid, N,N-dimethylglycine, nicotinic acid, isonicotinic acid, picolinic acid, N,N-dimethylglycine hydrazide, N,N-dimethylpropionic acid hydrazide, nicotinic acid hydrazide, isonicotinic acid hydrazide; and the like.

[0047] Examples of the isocyanate compounds used as yet another production raw material for the solid-dispersion type amine adduct latent curing catalysts include, but are not limited to, monofunctional isocyanate compounds such as n-butyl isocyanate, isopropyl isocyanate, phenyl isocyanate, and benzyl isocyanate; polyfunctional isocyanate compounds such as hexamethylene diisocyanate, toluene diisocyanate, 1,5-naphthalene diisocyanate, diphenylmethane-4,4'-diisocyanate, isophorone diisocyanate, xylylene diisocyanate, para-phenylene diisocyanate, 1,3,6-hexamethylene triisocyanate, and bicycloheptane triisocyanate; compounds containing a terminal isocyanate group obtained by the reaction of the above-mentioned polyfunctional isocyanate compounds with active hydrogen compounds; and the like. Examples of the compounds containing a terminal isocyanate group include, but are not limited to, addition compounds with a terminal isocyanate group obtained by the reaction of toluylene diisocyanate with trimethylolpropane, addition compounds with a terminal isocyanate group obtained by the reaction of toluylene diisocyanate with pentaerythritol, and the like.

[0048] Examples of the urea compounds include, but are not limited to, urea, thiourea, and the like.

[0049] Solid-dispersion type latent curing catalysts that can be used in this embodiment are, for example, combinations of (a) two components of the amine compound and the epoxy compound as mentioned above, (b) three components of these two components and the active hydrogen compound, or (c) two or three components of the amine compound and the isocyanate compound and/or the urea compound. They can be easily prepared by taking each component, mixing them, reacting them at temperatures from room temperature to 200°C, cooling and solidifying the reaction product, and then pulverizing it, or reacting the components in a solvent such as methyl ethyl ketone, dioxane, or tetrahydrofuran, desolventing the reaction product, and then pulverizing the solid content thereof.

[0050] Typical examples of commercially available latent curing catalyst products include, but are not limited to, amine-epoxy adduct-type products (amine adducts) such as Ajicure PN-23 (trade name; Ajinomoto Fine-Techno Co., Inc.), Ajicure PN-40 (trade name; Ajinomoto Fine-Techno Co., Inc.), Ajicure PN-50 (trade name; Ajinomoto Fine-Techno Co., Inc.), Hardner X-3661S (trade name; A.C.R. (K.K.)), Hardner X-3670S (trade name; A.C.R (K.K.)), Novacure HX-3742 (trade name; Asahi Kasei Corp.), Novacure HX-3721 (trade name; Asahi Kasei Corp.), Novacure HXA9322HP (trade name; Asahi Kasei Corp.), Novacure HXA3922HP (trade name; Asahi Kasei Corp.), Novacure HXA3932HP (trade name; Asahi Kasei Corp.), Novacure HXA5945HP (trade name; Asahi Kasei Corp.), Novacure HXA5911HP (trade name; Asahi Kasei Corp.), Novacure HXA9382HP (trade name; Asahi Kasei Corp.), and the like; and urea adduct products such as Fujicure FXE-1000 (trade name; T & K TOKA Co., Ltd.), Fujicure FXR-1020 (trade name; T & K TOKA Co., Ltd.), Fujicure FXR-1030 (trade name; T & K TOKA Co., Ltd.), Fujicure FXR1121 (trade name; T & K TOKA Co., Ltd.), Fujicure FXR1081 (trade name; T & K TOKA Co., Ltd.), Fujicure FXR1061 (trade name; T & K TOKA Co., Ltd.), Fujicure FXR1171 (trade name; T & K TOKA Co., Ltd.), and the like. Any one component (D) may be used alone, or two or more may be used in combination.

[0051] Component (D) is preferably contained in 0.1 to 30% by weight, more preferably in 0.5 to 20% by weight relative to the total weight of the resin composition.

[0052] Component (D) may be provided in the form of a dispersion dispersed in a polyfunctional epoxy compound. It should be noted that, when component (D) is used in such form, the amount of the polyfunctional epoxy compound in which component (D) is dispersed is also included in the amount of component (B) above present in the resin composition of the present embodiment.

[0053] The resin composition of this embodiment may, if desired, contain optional components other than the above components (A) through (D), such as those described below, as needed.

[0054] (E) Filler

The resin composition of this embodiment may contain a (E) filler (hereinafter also referred to as "component (E)") to the extent that the effect of the present invention is not impaired. Inclusion of the (E) filler in the resin composition lowers the linear expansion coefficient of the cured product obtained by curing the resin composition, thereby improving thermal cycle resistance. In addition, a filler with a low modulus of elasticity can relieve stresses in the cured product, improving long-term reliability. The (E) filler is broadly classified into inorganic and organic fillers.

[0055] The inorganic filler is not limited as long as it consists of a granular material formed by an inorganic material and has the effect of lowering the coefficient of linear expansion when added. Silica, talc, alumina, aluminum nitride, calcium carbonate, aluminum silicate, magnesium silicate, magnesium carbonate, barium sulfate, barium carbonate, lime sulfate, aluminum hydroxide, calcium silicate, potassium titanate, titanium oxide, zinc oxide, silicon carbide, silicon nitride, boron nitride, and the like can be used as the inorganic material. Any one of the inorganic filler may be used alone, or two or more may be used in combination. Silica filler is preferred as the inorganic filler because of its high filling capacity. Amorphous silica is preferred for silica. The inorganic filler may be surface treated with a coupling agent such as a silane coupling agent.

[0056] Examples of organic fillers include polytetrafluoroethylene (PTFE) filler, silicone filler, acrylic filler, filler with urethane skeleton, filler with butadiene skeleton, styrene filler, and the like. Organic fillers may be surface treated.

[0057] The shape of the filler is not limited and can be any of spherical, phosphor, needle, irregularly shaped, and the like.

[0058] The average particle diameter of the filler is preferably 6.0 μm or less, more preferably 5.0 μm or less, and even more preferably 4.0 μm or less. In the present description, the average particle diameter refers to the volume-based median diameter (d50) measured by the laser diffraction method in accordance with ISO-13320 (2009), unless otherwise noted. By keeping the average particle diameter of the filler below the upper limit, sedimentation of the filler can be suppressed. It also inhibits the formation of coarse grains, wear of the nozzle of the jet dispenser, and scattering of the resin composition ejected from the nozzle of the jet dispenser outside the desired area. The lower limit of the average particle diameter of the filler is not particularly limited, and from the viewpoint of the viscosity of the resin composition, it is preferable to be 0.005 μm or larger, and more preferable to be 0.1 μm or larger. In a certain aspect of this embodiment, the average particle diameter of the (F) filler is preferably from 0.01 μm to 5.0 μm, and more preferably from 0.1 μm to 3.0 μm. Fillers with different average particle diameters may be used in combination. For example, a filler with an average particle diameter of from 0.005 μm to less than 0.1 μm and a filler with an average particle diameter from 0.1 μm to 6.0 μm may be used in combination.

[0059] The filler content in the resin composition of this embodiment is preferably 15 to 50% by weight, more preferably 20 to 45% by weight, and even more preferably 20 to 40% by weight with respect to the total weight of the resin composition. By setting the filler content in the above range, the thermal cycle resistance is improved, and the viscosity of the resin composition is set in an appropriate range, improving its applicability for dispensing.

[0060] (F) Stabilizer

The resin composition of this embodiment may, if desired, contain (F) a stabilizer (hereinafter also referred to as "component (F)") to the extent that the effect of the invention is not impaired. The stabilizer can improve the storage stability and lengthen the pot life of the resin composition of this embodiment. Various known stabilizers can be used as the stabilizer, and at least one selected from the group consisting of liquid boric acid ester compounds, aluminum chelates, and organic acids is preferred due to its effectiveness in improving storage stability.

[0061] Examples of the liquid boric acid ester compounds include 2,2'-oxybis(5,5'-dimethyl-1,3,2-oxaborinane), trimethylborate, triethylborate, tri-n-propylborate, triisopropylborate, tri-n-butylborate, tripentylborate, triallylborate, trihexylborate, tricyclohexylborate, trioctylborate, trinonylborate, tridecylborate, tridodecylborate, trihexadecylborate, trioctadecylborate, tris(2-ethylhexyloxy)borane, bis(1,4,7,10-tetraoxaundecyl)(1,4,7,10,13-pentaoxatetradecyl)(1,4,7-trioxaundecyl)borane, tribenzylborate, triphenylborate, tri-o-tolylborate, tri-m-tolylborate, triethanolamineborate, and the like. Liquid boric acid ester compounds are preferred because they are liquid at room temperature (25°C), which keeps the composition viscosity low. For example, Aluminum Chelate A (from Kawaken Fine Chemicals Co., Ltd.) can be used as aluminum chelate. Barbituric acid, for example, may be used as an organic acid.

Any one of the stabilizers may be used alone, or two or more may be used in combination.

[0062] When a stabilizer is added, the amount of the stabilizer added is preferably from 0.01 to 30% by weight, more preferably from 0.05 to 25% by weight, and even more preferably from 0.1 to 20% by weight of the total resin composition.

[0063] (G) Other additives

The resin composition of this embodiment may, if desired, further contain other additives, such as a photo-radical initiator, a coupling agent, carbon black, titanium black, an ion trap agent, a leveling agent, an antioxidant, a defoaming agent, a viscosity adjuster, a flame retardant, a colorant, a solvent, and the like, to the extent that the purpose of this embodiment is not compromised. The type and amount of each additive is as usual.

[0064] The method of producing the resin composition of this embodiment is not limited. For example, components (A) to (D), components (E), (F), and (G) other additives, and the like, if necessary, can be introduced simultaneously or separately into an appropriate mixing machine and mixed by stirring while melting by heating if necessary, to obtain a uniform composition as the resin composition of this embodiment. The mixing machine is not limited, and can be a ricer, Henschel mixer, 3-roll mill, ball mill, planetary mixer, bead mill, and the like, equipped with an agitator and heating device. A combination of these devices may also be used as appropriate.

[0065] The resin composition thus obtained is thermosetting, and under a temperature of 80°C, it preferably cures within 5 hours, more preferably within 3 hours, and even more preferably within 1 hour. When the curable composition of this embodiment is used in the manufacture of a semiconductor module containing components that deteriorate under a high temperature condition, it is preferred that the composition be thermally cured at a temperature of 50 to 90°C for 30 to120 minutes. The resin composition of this embodiment can, in particular, reduce odor derived from the component (A), which tends to occur during thermal curing, and can also provide a cured product with reduced odor. In one aspect, the resin composition of this embodiment is the resin composition as mentioned above for use in curing by heat alone. Use of the resin composition as mentioned above in curing by heat alone is also one embodiment of the present invention.

[0066] When the resin composition of this embodiment contains the polyfunctional (meth)acrylate compound and the photo-radical initiator, the resin composition can also be cured by light (UV). For example, the resin composition can be cured preliminarily by light (UV) curing, and then cured mainly by heat curing.

[0067] The resin composition of this embodiment can be used, for example, as an adhesive or sealant for fixing, bonding, or protecting parts comprising a semiconductor device or an electronic component, or as a raw material thereof.

[0068] <Adhesive or sealant>

An adhesive or sealant, which is the second embodiment of the invention, contains the resin composition of the first embodiment described above. The adhesive or sealant enables good fixation, bonding, or protection for engineering plastics (e.g., LCP (liquid crystal polymer), polyamide, polycarbonate, etc.), ceramics, and metals (e.g., copper, nickel, etc.) and can be used to fix, bond, or protect parts comprising a semiconductor device or an electronic component. Examples of the semiconductor device include, but are not limited to, HDDs, semiconductor elements, sensor modules such as image sensor modules, camera modules, semiconductor modules, integrated circuits, and the like.

The adhesive or sealant of this embodiment can, in particular, reduce odor derived from the component (A), which tends to occur during thermal curing, and can also provide a cured product with reduced odor. In one aspect, the adhesive or sealant of this embodiment is the adhesive or sealant as mentioned above for use in curing by heat alone. Use of the adhesive or sealant as mentioned above in curing by heat alone is also one embodiment of the present invention.

[0069] <Cured product of the resin composition or adhesive or sealant>

The cured product of the third embodiment of the present invention is a cured product in which the resin composition of the first embodiment or the adhesive or sealant of the second embodiment described above has been cured. The cured product has a reduced odor derived from the component (A).

[0070] <Semiconductor device>

The semiconductor device of the fourth embodiment of the present invention contains the cured product of the third embodiment as mentioned above. The term "semiconductor device" refers to all devices that can function by utilizing semiconductor characteristics and includes electronic components, semiconductor circuits, modules incorporating these components, and electronic equipment. Examples of the semiconductor device include, but are not limited to, HDDs, semiconductor elements, sensor modules such as image sensor modules, camera modules, semiconductor modules, integrated circuits, and the like.

Examples

[0071] Hereinafter, the present invention will be described by way of examples and comparative examples, but the present invention is not limited thereto. In the following examples, parts and percentages (%), unless otherwise specified, represent parts by weight and percentages (%) by weight.

[0072] <Examples 1 to 21 and Comparative Examples 1 to 5>

Each of resin compositions was prepared by mixing each of the components in the amounts according to the formulations shown in Table 1 using a three-roll mill. In Table 1, the amount of each component is expressed in parts by weight (unit: g). The ingredients used in the examples and comparative examples are as follows.

[0073] (A) Thiol curing agent having two or more thiol groups (Component (A))

(A-1) Thiol curing agent containing 1,3,4,6-tetrakis(2-mercaptoethyl)glycoluryl as a main component

(A-2) Thiol curing agent containing pentaerythritol tetrakis(3-mercaptobutyrate) as a main component

(A-3) Thiol curing agent containing pentaerythritol tetrakis(3-mercaptopropionate) as a main component

(A-4) Thiol curing agent containing pentaerythritol tripropanethiol as a main component

(A-5) Thiol curing agent containing 1,3,5-tris(3-mercaptobutyryloxyethyl)-1,3,5-triazine-2,4,6(1H,3H,5H)-trione as a main component

[0074] (B) Main agent having two or more groups (b) each of which is reactive with a thiol group (Component (B))

(B-1): Bisphenol F epoxy resin and bisphenol A epoxy resin mixture (trade name: EXA-835LV, available from DIC Corporation, epoxy equivalent weight: 165 g/eq)

(B-2): Epoxy resin in component (D-1) (mixture of bisphenol A epoxy resin and bisphenol F epoxy resin, epoxy equivalent weight: 180 g/eq)

[0075] (C) Odor masking agent having one group (c) reactive with a thiol group (Component (C))

(C-1): Butyl acrylate (available from Tokyo Chemical Industry Co., Ltd., (meth)acryloyloxy equivalent weight: 128 g/eq)

(C-2): n-Octyl acrylate (trade names: NOAA, available from Osaka Organic Chemical Industry Ltd., (meth)acryloyloxy equivalent weight: 184 g/eq))

(C-3): Cyclic trimethylolpropane formal acrylate (trade name: Viscote #200, available from Osaka Organic Chemical Industry Ltd., (meth)acryloyloxy equivalent weight: 200 g/eq)

(C-4): Dicyclopentanyl acrylate (trade name: FA513AS, available from Showa Denko Materials Co., Ltd., (meth)acryloyloxy equivalent weight: 206 g/eq)

(C-5): Isobornyl acrylate (trade name: IBXA, available from Kyoeisha Chemical Co., Ltd., (meth)acryloyloxy equivalent weight: 208 g/eq)

(C-6): N-acryloyloxyethyl hexahydrophthalimide (trade name: Aronix M-140, available from Toagosei Co., Ltd., (meth)acryloyloxy equivalent weight: 251 g/eq)

(C-7): m-Phenoxybenzyl acrylate (trade name: light acrylate POB-A, available from Kyoeisha Chemical Co., Ltd., (meth)acryloyloxy equivalent weight: 254 g/eq)

(C-8): 2-(o-phenylphenoxy)ethyl acrylate (trade name: HRD-01, available from Nisshoku Techno Fine Chemical Co., Ltd., (meth)acryloyloxy equivalent weight: 268 g/eq)

(C-9): Isostearyl acrylate (trade name: ISTA, available from Osaka Organic Chemical Industry Ltd., (meth)acryloyloxy equivalent weight: 325 g/eq)

(C-10): Methoxyethylene oxide modified acrylate (trade name: Light Acrylate 130A, available from Kyoeisha Chemical Co., Ltd., (meth)acryloyloxy equivalent weight: 428 g/eq)

[0076] (D) Heat latent curing catalyst (Component (D))

(D-1): Amine-epoxy adduct-type latent curing catalyst (trade name: Novacure HXA9322HP, available from Asahi Kasei Corporation)

[0077] In Table 1, the symbols in the "Equivalent number calculation" column have the following meanings.

The "((B)+(C)) /(A)" represents a ratio of a total of an equivalent number of the group (b) reactive with thiol group of the component (B) and an equivalent number of the group (c) reactive with thiol group of the component (C) to an equivalent number of the thiol group of the component (A) (([an equivalent number of the group (b) reactive with thiol group of the component (B)] + [an equivalent number of the group (c) reactive with thiol group of the component (C)])/[an equivalent number of the thiol group of the component (A)]).

The "(B)/(A)" represents a ratio of an equivalent number of the group (b) reactive with thiol group of the component (B) to an equivalent number of the thiol group of the component (A) ([an equivalent number of the group (b) reactive with thiol group of the component (B)] /[an equivalent number of the thiol group of the component (A)]).

The "(C)/(A)" represents a ratio of an equivalent number of the group (c) reactive with thiol group of the component (C) to an equivalent number of the thiol group of the component (A) ([an equivalent number of the group (c) reactive with thiol group of the component (C)] /[an equivalent number of the thiol group of the component (A)]).

[0078] In Examples and Comparative Examples, the properties of the resin compositions and the cured products thereof were measured as follows.

[0079] <Panel selection test>

Selection tests were conducted in accordance with the Environment Agency Public Notice "Methods for Calculating Odor Index and Odor Emission Intensity" to determine the panel (i.e., those who determine the presence or absence of odor using the sense of smell). People who could sniff out the five standard odors were selected as the panel using the panel selection standard concentration set (available from Daiichi Yakuhin Sangyo Co., Ltd.).

Panel 1: Male in his 30s
Panel 2: Female in her 20s
Panel 3: Female in her 20s
Panel 4: Male in his 40s
Panel 5: Female in her 20s
Panel 6: Female in her 40s
Panel 7: Male in his 40s
Panel 8: Female in her 30s
Panel 9: Male in his 20s
Panel 10: Male in his 30s

<Odor evaluation>

1 g of each resin composition was placed in a container made of SUS with a diameter of 5 cm and a depth of 6 mm, and the entire bottom of the container was filled so that the surface area was uniform. A 100-mL disposable cup (Azwan) was prepared, a hole of 5 mm diameter was made in the center of the side, and the hole was covered with polyimide tape. The disposable cups were placed over the SUS container containing the resin composition so that the openings overlapped each other, and the perimeters were taped together using heat-resistant tape to create a sealed state. The resin composition was then heat-treated by heating this sealed container in an air dryer at 80°C/60 min. Then, 50 mL of air inside the container was taken out through a hole

previously drilled in the container and filled into an odor bag containing 3 L of odor-free air. Odor was determined by each panel member smelling the odor in the odor bag with diluted air inside the container.

The reference odor consisted only of the (A) thiol curing agent, the (B) main agent, and the (D) heat latent curing catalyst, as in Comparative Examples 1 to 5. It was then observed whether the (C) odor masking agent in the resin compositions of Examples 1 to 21 masked the odor derived from the thiol curing agent in the corresponding comparative example. The criteria for determining the masking effect were the following five grades. The average score for each resin composition was calculated by excluding one upper limit and one lower limit in the grade judged by each panel (△ and ▲ in Table 1) and then calculating the average. The results are shown in Table 1.

5: Thiol odor is strong, and the odor is the same or stronger than in the comparative example.

4: The thiol odor is slightly diminished and the masking effect is perceived.

3: The thiol odor and the odor of the masking agent are present to the same degree, and the masking effect is perceived.

2: The thiol odor becomes almost negligible and the masking effect is perceived.

1: The thiol odor is not perceptible and the masking effect is very strong.

It can be seen that in each resin composition, a strong odor of thiol was identified in Comparative Examples 1 to 5, while the odor was determined to be reduced in Examples 1 to 21 compared to the Comparative Examples. The average score in the odor determination is preferably 4.5 points or less, more preferably 4.0 points or less, and further preferably 3.5 points or less.

[0080]

[Table 1-1]

		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8
(A)Thiol curing agent having two or more thiol groups	(A-1)	38.14	35.62	34.64	34.28	34.16	31.85	31.69	33.01
	(A-2)								
	(A-3)								
	(A-4)								
	(A-5)								
(B)Main agent	(B-1)	44.05	26.58	25.75	25.45	25.35	23.37	23.25	34.46
(C)Odor masking agent having one group (c) reactive with a thiol group	(C-1)	11.80							
	(C-2)		31.80						
	(C-3)			33.62					
	(C-4)				34.27				
	(C-5)					34.49			
	(C-6)						38.78		
	(C-7)							39.06	
	(C-8)								26.54
	(C-9)								
	(C-10)								
(D)Heat latent curing catalyst	(D-1)	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Equivalent number calculation	((B)+(C))/(A)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	(B)/(A)	0.76	0.51	0.51	0.51	0.51	0.51	0.51	0.70
	(C)/(A)	0.24	0.49	0.49	0.49	0.49	0.49	0.49	0.30
Odor evaluation	Panel 1	1	△1	3	1	▲3	▲3	1	4
	Panel 2	1	1	2	1	1	1	1	▲4
	Panel 3	1	1	2	1	1	2	1	4
	Panel 4	1	1	1	▲1	1	2	1	4
	Panel 5	1	1	1	1	1	1	1	4
	Panel 6	1	2	1	△1	1	1	1	4
	Panel 7	1	1	1	1	3	1	1	△1
	Panel 8	△1	2	△1	1	△1	△1	△1	4
	Panel 9	1	1	▲5	1	2	2	▲2	1
	Panel 10	▲2	▲2	2	1	1	1	1	2
	Average	1.0	1.3	1.6	1.0	1.4	1.4	1.0	3.4
	SD	0.0	0.5	0.7	0.0	0.7	0.5	0.0	1.2

[0081]

[Table 1-2]

		Example 9	Example 10	Example 11	Example 12	Example 13	Example 14	Example 15	Example 16	Example 17
(A)Thiol curing agent having two or more thiol groups	(A-1)									
	(A-2)	39.81	40.11	38.18	34.96					
	(A-3)					40.11	38.36			40.91
	(A-4)							38.14		
	(A-5)								50.39	
(B)Main agent	(B-1)	34.02	30.18	28.54	26.03	33.70	36.32	34.98	27.13	46.12
(C)Odor masking agent having one group (c) reactive with a thiol group	(C-1)									
	(C-2)									
	(C-3)									
	(C-4)	20.17							16.48	
	(C-5)					20.19		20.88		6.97
	(C-6)									
	(C-7)		23.71							
	(C-8)						19.32			
	(C-9)			27.28						
	(C-10)				33.01					
(D)Heat latent curing catalyst	(D-1)	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Equivalent number calculation	((B)-(C))/(A)	1.11	1.01	0.99	1.00	0.98	1.00	1.09	1.00	1.00
	(B)/(A)	0.78	0.70	0.70	0.70	0.69	0.77	0.76	0.70	0.90
	(C)/(A)	0.33	0.32	0.30	0.30	0.30	0.23	0.33	0.30	0.10
Odor evaluation	Panel 1	2	▲5	3	4	2	▲3	3	2	3
	Panel 2	3	5	▲4	3	4	1	5	3	3
	Panel 3	2	2	1	5	▲4	△1	2	2	3
	Panel 4	2	△2	1	4	△2	1	1	2	△1
	Panel 5	△1	2	△1	△1	2	1	△2	△1	3
	Panel 6	2	2	3	3	2	1	4	2	3
	Panel 7	2	3	1	▲5	3	3	3	2	2
	Panel 8	2	2	2	4	2	1	4	5	3
	Panel 9	▲5	2	4	5	4	2	▲5	▲5	3
	Panel 10	2	3	2	5	4	1	3	2	▲4
	Average	2.1	2.6	2.1	4.1	2.9	1.4	3.1	2.5	2.9
	SD	0.4	1.1	1.1	0.8	1.0	0.7	1.2	1.1	0.4

[0082]

[Table 1-3]

		Example 18	Example 19	Example 20	Example 21	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
(A)Thiol curing agent having two or more thiol groups	(A-1)					36.86				
	(A-2)						44.13			
	(A-3)	41.21	41.46	44.64	22.62			41.52		
	(A-4)				11.31				41.91	
	(A-5)									52.14
(B)Main agent	(B-1)	49.28	51.90	26.52	38.85	57.14	49.87	52.48	52.09	41.86
(C)Odor masking agent having one group (c) reactive with a thiol group	(C-1)									
	(C-2)									
	(C-3)									
	(C-4)									
	(C-5)	3.51	0.64	22.83	21.21					
	(C-6)									
	(C-7)									
	(C-8)									
	(C-9)									
	(C-10)									
(D)Heat latent curing catalyst	(D-1)	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Equivalent number calculation	((B)+(C))/(A)	1.00	1.00	0.80	1.30	1.00	1.00	1.00	1.00	1.0
	(B)/(A)	0.95	0.99	0.50	0.93	1.00	1.00	1.00	1.00	1.0
	(C)/(A)	0.05	0.01	0.30	0.37	0.00	0.00	0.00	0.00	0.0
Odor evaluation	Panel 1	3	4	3	2	5	5	5	5	5
	Panel 2	3	4	3	3	5	5	5	5	5
	Panel 3	3	4	2	△1	5	5	5	5	5
	Panel 4	△2	4	△1	1	5	5	5	5	5
	Panel 5	4	▲5	▲3	2	5	5	5	5	5
	Panel 6	3	△4	2	3	5	5	5	5	5
	Panel 7	3	4	2	1	5	5	5	5	5
	Panel 8	▲4	4	3	2	5	5	5	5	5
	Panel 9	3	4	2	▲3	5	5	5	5	5
	Panel 10	4	5	2	2	5	5	5	5	5
	Average	3.3	4.1	2.4	2.0	5.0	5.0	5.0	5.0	5.0
	SD	0.5	0.4	0.5	0.8	0.0	0.0	0.0	0.0	0.0

Industrial Applicability

[0083] The present invention is a resin composition that can reduce the odor derived from thiol curing agents and gives a cured product with reduced odor. The resin composition is very useful as an adhesive or sealant suitable for use in the manufacture of a semiconductor device.

[0084] The disclosure of Japanese patent application No. 2022-173404 (filing date: Oct. 28, 2022) is incorporated herein by reference in its entirety.

All references, patent applications, and technical standards described herein are incorporated by reference herein to the same extent that individual references, patent applications, and technical standards are specifically and individually noted as being incorporated by reference.

Claims

[Claim 1] A resin composition comprising
(A) a thiol curing agent having two or more thiol groups,
(B) a main agent having two or more groups (b) each of which is reactive with a thiol group,
(C) an odor masking agent having one group (c) reactive with a thiol group, and
(D) a heat latent curing catalyst,
wherein
the amount of the (A) thiol curing agent is 10 to 60% by weight of the total weight of the resin composition, and
the component (C) is a monofunctional compound having one group containing an unsaturated double bond and an electron-withdrawing group adjacent thereto in its molecule.

[Claim 2] The resin composition according to claim 1, wherein the component (C) is a monofunctional (meth)acrylate compound having a molecular weight of 100 to 400.

[Claim 3] The resin composition according to claim 1 or 2, wherein the component (B) contains a polyfunctional epoxy compound, and an amount of the polyfunctional epoxy compound in a total weight of the component (B) is 51 to 100% by weight.

[Claim 4] The resin composition according to any one of claims 1 to 3, wherein a ratio of an equivalent number of the group (c) reactive with a thiol group of the component (C) to an equivalent number of the thiol group of the component (A) ([an equivalent number of the group (c) reactive with a thiol group of the component (C)]/[an equivalent number of the thiol group of the component (A)]) is 0.01 to 0.7.

[Claim 5] The resin composition according to any one of claims 1 to 4, wherein a ratio of a total of an equivalent number of the group (b) reactive with a thiol group of the component (B) and an equivalent number of the group (c) reactive with a thiol group of the component (C) to an equivalent number of the thiol group of the component (A) (([an equivalent number of the group (b) reactive with a thiol group of the component (B)] + [an equivalent number of the group (c) reactive with a thiol group of the component (C)])/[an equivalent number of the thiol group of the component (A)]) is 0.5 to 1.5.

[Claim 6] An adhesive or sealant comprising the resin composition described in any one of claims 1 to 5.

[Claim 7] A cured product in which the resin composition described in any one of claims 1 to 5 or the adhesive or sealant described in claim 6 has been cured.

[Claim 8] A semiconductor device comprising the cured product described in claim 7.

[Claim 9] The resin composition described in any one of claims 1 to 5 or the adhesive or sealant described in claim 6 for use in curing by heat alone.

[Claim 10] Use of the resin composition described in any one of claims 1 to 5 or the adhesive or sealant described in claim 6 in curing by heat alone.

INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2022/047360

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L23/29 C08G59/18 C08G59/66 C08G59/68 C08G75/045
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C08G H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, CHEM ABS Data, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2008 001867 A (THREE BOND CO LTD) 10 January 2008 (2008-01-10) claims 1,2 examples 1-8; table 1 Comparative example 1; table 2 paragraph [0040] -----	1-10
A	KR 102 271 763 B1 (UNIV KOREA IND UNIV COOP FOUND [KR]; EG CHEM [KR]) 1 July 2021 (2021-07-01) examples 1-5 table 1 -----	1-8
A	KR 2015 0034488 A (SINKWANG CHEMISTRY INDUSTRY) 3 April 2015 (2015-04-03) claim 1 examples 1-3; table 1 ----- -/--	1-8

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2023	20/07/2023

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O'Sullivan, Timothy

2

Form PCT/ISA/210 (second sheet) (April 2005)

International application No

PCT/JP2022/047360

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2021 075698 A (AJINOMOTO KK) 20 May 2021 (2021-05-20) claim 1 examples 1-6; table 1 -----	1-8
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A	CN 110 016 311 A (UNIV XIANGTAN) 16 July 2019 (2019-07-16) claim 1 examples 1-8 -----	1-8
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