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DESCRIPTION

Title of Invention

FILM-LIKE TRANSPARENT ADHESIVE AND INFRARED SENSOR MODULE

5

TECHNICAL FIELD

[0001]

The present invention relates to a film-like transparent adhesive and an infrared sensor module.

10 Priority is claimed on Japanese Patent Application No. 2017-163632, filed on August 28, 2017, the amount of which is incorporated herein by reference.

BACKGROUND ART

[0002]

15 As a cover member for an infrared sensor such as a human sensor, a cover glass member having high light transmittance in the infrared region has been proposed (Patent Document 1). In an infrared sensor, a cover glass member is provided with a concave portion and is fixed to a frame portion of the infrared sensor as in, for example, Patent Document 2.

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Citation List

Patent Literature

[0003]

[Patent Document 1] Japanese Unexamined Patent Application, First

25 Publication No. 2016-040220

DISCLOSURE OF INVENTION

5 Technical Problem

[0004]

When a glass wafer having infrared transmittance can be directly bonded to an infrared light receiving element using a film-like adhesive having light transmittance in a wide infrared wavelength region, an infrared sensor can be further miniaturized.

10 [0005]

Therefore, an object of the present invention is to provide a film-like transparent adhesive capable of directly bonding a glass wafer to an infrared light receiving element and having light transmittance in a wide infrared wavelength region, and an infrared sensor module using the film-like transparent adhesive.

15

Solution to Problem

[0006]

In order to achieve the object, the present invention provides a film-like transparent adhesive that is a thermosetting or energy ray curable film-like transparent adhesive and has a light transmittance of 80% or more at a wavelength of 800 nm after curing.

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In the film-like transparent adhesive according to the present invention, it is preferable that all light transmittances at wavelengths of 800 to 2,000 nm after curing are 80% or more.

25 In the film-like transparent adhesive according to the present invention, it is

preferable that a light transmittance at a wavelength of 850 nm after curing is 90% or more.

It is preferable that the film-like transparent adhesive according to the present invention contains a filler, and the filler has an average particle diameter of 450 nm or less.

[0007]

The present invention provides an infrared sensor module that is formed by bonding an infrared light receiving element having an infrared light receiving portion and a glass wafer by curing using the film-like transparent adhesive, and the infrared light receiving portion is provided to receive infrared light that has passed through the glass wafer and the film-like transparent adhesive after curing.

Advantageous Effects of Invention

[0008]

According to the present invention, it is possible to provide a film-like transparent adhesive capable of bonding a glass wafer to an infrared light receiving element and an infrared sensor module using the film-like transparent adhesive.

BEST MODE FOR CARRYING OUT THE INVENTION

[0009]

<Film-Like Transparent Adhesive>

A film-like transparent adhesive according to the present invention is a thermosetting or energy ray curable film-like transparent adhesive and has a light transmittance of 80% or more at a wavelength of 800 nm after curing. In the film-like transparent adhesive of the present invention, since a light transmittance of a transparent

resin film after curing at a wavelength of 800 nm is 80% or more, the transparent adhesive can exhibit light transmittance in a wide infrared wavelength region around a wavelength of 800 nm. In the film-like transparent adhesive of the present invention, it is preferable that all the light transmittances at wavelengths of 800 to 2,000 nm after curing are 80% or more and it is preferable that a light transmittance at a wavelength of 850 nm after curing is 90% or more. Due to a high infrared light transmittance of the film-like transparent adhesive of the present invention after curing, when the film-like transparent adhesive of the present invention is cured and the glass wafer is bonded to the infrared light receiving element, the infrared light receiving element can efficiently receive the infrared light that has passed through the glass wafer.

Although the upper limit of the light transmittance of the film-like transparent adhesive at a wavelength of 800 nm after curing is not limited, the upper limit may be 95% or 93%. Although the upper limit of the light transmittance of the film-like transparent adhesive at a wavelength of 800 to 2,000 nm after curing is not limited, the upper limit may be 95% or 93%. Although the upper limit of the light transmittance of the film-like transparent adhesive at a wavelength of 850 nm after curing is not limited, the upper limit may be 95% or 93%.

[0010]

The film-like transparent adhesive of the present invention has thermosetting properties or energy ray curability and may have both thermosetting properties and energy ray curability. Hereinafter, the film-like transparent adhesive having thermosetting properties is referred to as “thermosetting film-like transparent adhesive” and the film-like transparent adhesive having energy ray curability is referred to as “energy ray curable film-like transparent adhesive”.

[0011]

The film-like transparent adhesive preferably has pressure sensitive adhesiveness. The film-like transparent adhesive having both curability and pressure sensitive adhesiveness can be attached by being lightly pressed to various adherends in an uncured state. The film-like transparent adhesive can be attached to various adherends by heating and softening. The film-like transparent adhesive finally becomes a cured product with high impact resistance by curing and this cured product can retain sufficient bonding characteristics even under severe high temperature and high humidity conditions.

[0012]

Since the film-like transparent adhesive of the present invention has a film shape, there is no risk of liquid dripping in a case where the infrared light receiving element and the glass wafer are bonded by curing, and the thermosetting film-like transparent adhesive allows the infrared light receiving element and the glass wafer to be bonded simultaneously by a heat treatment in a case of preparing an infrared sensor module.

[0013]

The film-like transparent adhesive may be constituted of one layer (single layer) or a plurality of layers of two or more layers. In a case where the film-like transparent adhesive is constituted of a plurality of layers, the plurality of layers may be the same or different from each other, and a combination of the plurality of layers is not particularly limited as long as the effects of the present invention are not impaired.

In the present specification, although not limited to the case of the film-like transparent adhesive, “the plurality of layers may be the same or different from each other” means “all layers may be the same, all layers may be different from each other, or only some of the layers may be the same”, and further, “the plurality of layers may be

different from each other” means “at least one of the constituent materials and thickness of each layer is different from each other”.

[0014]

The thickness of the film-like transparent adhesive is not particularly limited,
5 but is preferably 1 to 50 μm and more preferably 3 to 40 μm . By setting the thickness of the film-like transparent adhesive to the lower limit value or more, a higher adhesive force with respect to the adherend (that is, the glass wafer and the infrared light receiving element) can be obtained.

Here, “the thickness of the film-like transparent adhesive” means the thickness
10 of the entire film-like transparent adhesive and for example, the thickness of the film-like transparent adhesive constituted of a plurality of layers means the total thickness of all the layers constituting the film-like transparent adhesive.

[0015]

In the present specification, “energy ray” means rays having an energy quantum
15 among electromagnetic waves and charged particles, which are, for example, ultraviolet rays, radiation rays, electron beams, and the like. Ultraviolet rays can be emitted by using, for example, a high pressure mercury lamp, a fusion H lamp, a xenon lamp, black light, or an LED lamp as an ultraviolet ray source. Electron beams can be generated by an electron beam accelerator or the like and then emitted.

20 In the present specification, “energy ray curable” means a property of being cured by irradiation with energy rays, and “non-energy ray curable” means a property of causing no curing by irradiation with energy rays.

[0016]

O Thermosetting Film-Like Transparent Adhesive

25 When the film-like transparent adhesive of the present invention has

thermosetting properties, as a preferable thermosetting film-like transparent adhesive, for example, an adhesive containing a polymer component and a thermosetting component may be adopted, and an adhesive containing a polymer component, a thermosetting component, and a filler is more preferable. The polymer component is a component that is formed by polymerization reaction of a polymerizable compound. The thermosetting component is a component that can be obtained by curing (that is, polymerization) reaction using heat as a reaction trigger. In the present invention, the polymerization reaction includes a polycondensation reaction.

[0017]

10 [Thermosetting Adhesive Composition]

The thermosetting film-like transparent adhesive can be formed using a thermosetting adhesive composition containing the constituent material. For example, a film-like transparent adhesive can be formed at a target site by applying a thermosetting adhesive composition to the surface on which the thermosetting film-like transparent adhesive is to be formed and drying the composition as necessary. In the thermosetting adhesive composition, the content ratio of components, which do not gasify at normal temperature, is generally the same as the content ratio of the components of the thermosetting film-like transparent adhesive. In the present specification, "normal temperature" means a temperature that is not particularly cooled or heated, that is, a temperature in an ordinary state, and examples thereof include a temperature of 15°C to 25°C.

[0018]

The thermosetting adhesive composition may be applied by using a known method and examples thereof include methods using various coaters such as an air knife coater, a blade coater, a bar coater, a gravure coater, a comma coater, a roll coater, a roll

knife coater, a curtain coater, a die coater, a knife coater, a screen coater, a Meyer bar coater, and a kiss coater.

[0019]

The drying conditions of the thermosetting adhesive composition are not particularly limited. However, in a case where the thermosetting adhesive composition contains a solvent described later, the thermosetting adhesive composition is preferably dried by heating, and in this case, drying is preferably performed under the conditions of, for example, a temperature of 70°C to 130°C for 10 seconds to 5 minutes.

[0020]

As a preferable thermosetting adhesive composition, for example, a thermosetting adhesive composition containing a polymer component (a) and an epoxy-based thermosetting resin (b) may be adopted. Each component will be described below.

[0021]

(Polymer Component (a))

The polymer component (a) is a component that is formed by polymerization reaction of a polymerizable compound and is a component for imparting film forming properties, flexibility, and the like to the film-like transparent adhesive and improving adhesiveness (adherence) to a bonding target such as the glass wafer. The polymer component (a) is a component that does not correspond to an epoxy resin (b1) and a thermal curing agent (b2) described later.

[0022]

The thermosetting adhesive composition and the thermosetting film-like transparent adhesive may contain only one type or two or more types of the polymer components (a). In a case where two or more polymer components are contained, the

combination and ratio thereof can be arbitrarily selected.

[0023]

Examples of the polymer component (a) include acrylic resins (resins having a (meth)acryloyl group), polyesters, urethane-based resins (that is, resins having a urethane
5 bond), acrylic urethane resins, silicone-based resins (that is, resins having a siloxane bond), rubber-based resins (that is, resins having a rubber structure), phenoxy resins, and thermosetting polyimides, and acrylic resins are preferable.

[0024]

Examples of the acrylic resin in the polymer component (a) include well-known
10 acrylic polymers.

The weight-average molecular weight (M_w) of the acrylic resin is preferably 10,000 to 2,000,000 and more preferably 100,000 to 1,500,000.

When the weight-average molecular weight of the acrylic resin is equal to or more than the lower limit value, the shape stability (aging stability during storage) of the
15 film-like transparent adhesive is improved. In addition, when the weight-average molecular weight of the acrylic resin is equal to or less than the upper limit value, it becomes easy for the film-like transparent adhesive to follow the uneven surface of an adherend, and the generation of voids and the like between an adherend and the film-like transparent adhesive is further suppressed.

20 In the present specification, unless otherwise specified, “the weight-average molecular weight” is a value in terms of polystyrene measured by a gel permeation chromatography (GPC) method.

[0025]

The glass transition temperature (T_g) of the acrylic resin is preferably -60°C to
25 70°C and more preferably -30°C to 50°C . When the T_g of the acrylic resin is equal to

or higher than the lower limit value, the adhesive force between film-like transparent adhesive and a support sheet is suppressed and thus the glass wafer provided with the film-like transparent adhesive is more easily peeled off from the support sheet. When the Tg of the acrylic resin is equal to or lower than the upper limit value, the adhesive force of the film-like transparent adhesive and the glass wafer is improved.

[0026]

Examples of the (meth)acrylic acid esters constituting the acrylic resin include alkyl (meth)acrylic esters in which an alkyl group constituting the alkyl ester has 1 to 18 carbon atoms and has a chain-like structure, such as methyl (meth)acrylate, ethyl (meth)acrylate, n-propyl (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, sec-butyl (meth)acrylate, tert-butyl (meth)acrylate, pentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isooctyl (meth)acrylate, n-octyl (meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, decyl (meth)acrylate, undecyl (meth)acrylate, dodecyl (meth)acrylate (lauryl (meth)acrylate), tridecyl (meth)acrylate, tetradecyl (meth)acrylate (myristyl (meth)acrylate), pentadecyl (meth)acrylate, hexadecyl (meth)acrylate (palmityl (meth)acrylate), heptadecyl (meth)acrylate, and octadecyl (meth)acrylate (stearyl (meth)acrylate);

cycloalkyl (meth)acrylic acid esters such as isobornyl (meth)acrylate and dicyclopentanyl (meth)acrylate;

aralkyl (meth)acrylic acid esters such as benzyl (meth)acrylate;

cycloalkenyl (meth)acrylic acid esters such as dicyclopentenyl (meth)acrylate;

cycloalkenyloxy alkyl (meth)acrylic acid esters such as dicyclopentenylloxyethyl (meth)acrylate;

imide (meth)acrylate;

glycidyl group-containing (meth)acrylic acid esters such as glycidyl
(meth)acrylate;

hydroxyl group-containing (meth)acrylic acid esters such as hydroxymethyl
(meth)acrylate, 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-
5 hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxybutyl
(meth)acrylate, and 4-hydroxybutyl (meth)acrylate; and

substituted amino group-containing (meth)acrylic acid esters such as N-
methylaminoethyl (meth)acrylate. Here, “the substituted amino group” refers to a group
formed by substituting one or two hydrogen atoms in an amino group with a group other
10 than a hydrogen atom.

[0027]

In the present specification, “(meth)acrylic acid” refers to both “acrylic acid”
and “methacrylic acid”. What has been described above is also true for terminologies
similar to (meth)acrylic acid, for example, “(meth)acrylate” refers to both “acrylate” and
15 “methacrylate”, and “a (meth)acryloyl group” refers to both “an acryloyl group” and “a
methacryloyl group”.

[0028]

Examples of the acrylic resin include, in addition to the (meth)acrylic acid ester,
copolymers of one type or two or more types of monomers selected from (meth)acrylic
20 acid, itaconic acid, vinyl acetate, acrylonitrile, styrene, and N-methylol acrylamide.

[0029]

The acrylic resin may be constituted of only one or two or more types of
monomers, and, in a case where the acrylic resin is constituted of two or more types of
monomers, the combination and ratio thereof can be arbitrarily selected.

25 [0030]

The acrylic resin may also have a functional group capable of bonding to other compounds such as a vinyl group, a (meth)acryloyl group, an amino group, a hydroxyl group, a carboxy group, or an isocyanate group. These functional groups including a hydroxyl group in the acrylic resin may be bonded to other compounds through a crosslinking agent (f) described below or may be directly bonded to other compounds without the crosslinking agent (f). When the acrylic resin is bonded to other compounds through the functional group, there is a tendency that the reliability of packages obtained using the film-like transparent adhesive is improved.

[0031]

10 In the present invention, as the polymer component (a), a thermoplastic resin other than the acrylic resin (hereinafter, in some cases, simply abbreviated as “thermoplastic resin”) may be used singly without using the acrylic resin or may be used in combination with the acrylic resin. When the thermoplastic resin is used, the glass wafer provided with the film-like transparent adhesive is more easily peeled off from the support sheet, it becomes easy for the film-like transparent adhesive to follow the uneven surface of an adherend, and the generation of voids and the like between an adherend and the film-like transparent adhesive is further suppressed.

[0032]

The weight-average molecular weight of the thermoplastic resin is preferably 20 1,000 to 100,000 and more preferably 3,000 to 80,000.

[0033]

The glass transition temperature (T_g) of the thermoplastic resin is preferably -30°C to 150°C and more preferably -20°C to 120°C.

[0034]

25 Examples of the thermoplastic resin include polyesters, polyurethanes, phenoxy

resins, polybutene, polybutadienes, and polystyrenes.

[0035]

The thermosetting adhesive composition and the film-like transparent adhesive may contain only one type or two or more types of thermoplastic resins, and in a case
5 where two or more types of thermoplastic resins are contained, the combination and ratio thereof can be arbitrarily selected.

[0036]

In the thermosetting adhesive composition, the ratio of the amount of the polymer component (a) (that is, the amount of the polymer component (a) in the film-like
10 transparent adhesive) with respect to the total amount of all of the components other than the solvent is preferably 20% to 75% by mass and more preferably 30% to 65% by mass regardless of the type of the polymer component (a).

[0037]

(Epoxy-based Thermosetting Resin (b))

15 The epoxy-based thermosetting resin (b) is formed of an epoxy resin (b1) and a thermal curing agent (b2).

The thermosetting adhesive composition and the thermosetting film-like transparent adhesive may contain only one type or two or more types of the epoxy-based thermosetting resins (b) and in a case where two or more types of epoxy-based
20 thermosetting resins are contained, the combination and ratio thereof can be arbitrarily selected.

[0038]

· Epoxy Resin (b1)

As the epoxy resin (b1), well-known epoxy resins can be exemplified.

25 Examples thereof include polyfunctional epoxy resins, biphenyl compounds, bisphenol A

diglycidyl ethers and hydrogenated substances thereof, orthocresol novolac epoxy resins, dicyclopentadiene-type epoxy resins, biphenyl-type epoxy resins, bisphenol A-type epoxy resins, bisphenol F-type epoxy resins, and phenylene skeleton-type epoxy resins and the like, and di- or higher-functional epoxy compounds.

5 [0039]

As the epoxy resin (b1), an epoxy resin having an unsaturated hydrocarbon group may also be used. The epoxy resin having an unsaturated hydrocarbon group has higher compatibility with acrylic resins than epoxy resins not having an unsaturated hydrocarbon group. Therefore, when the epoxy resin having an unsaturated hydrocarbon group is used, the reliability of packages obtained using the film-like transparent adhesive is improved.

[0040]

Examples of the epoxy resin having an unsaturated hydrocarbon group include compounds formed by converting a part of epoxy groups in a polyfunctional epoxy resin to groups having an unsaturated hydrocarbon group. The above-described compound can be obtained by, for example, an addition reaction of (meth)acrylic acid or a derivative thereof to an epoxy group. In the present specification, unless particularly otherwise described, the “derivative” refers to a compound in which one or more groups of the original compound are substituted with other groups (substituents). Here, the “group” refers not only to an atomic group formed by bonding a plurality of atoms but also to one atom.

[0041]

Examples of the epoxy resin having an unsaturated hydrocarbon group include compounds in which a group having an unsaturated hydrocarbon group is directly bonded to an aromatic ring constituting the epoxy resin or the like.

The unsaturated hydrocarbon group is a polymerizable unsaturated group, and specific examples thereof include ethenyl groups (vinyl groups), 2-propenyl groups (allyl groups), (meth)acryloyl groups, and (meth)acrylamide groups, and acryloyl groups are preferable.

5 [0042]

The number average molecular weight of the epoxy resin (b1) is not particularly limited, but is preferably 300 to 30,000, more preferably 400 to 10,000, and particularly preferably 500 to 3,000 from the viewpoint of the curability of the film-like transparent adhesive and the strength and heat resistance of the film-like transparent adhesive after
10 thermal curing.

The epoxy equivalent of the epoxy resin (b1) is preferably 100 to 1,000 g/eq and more preferably 150 to 800 g/eq.

[0043]

The thermosetting adhesive composition and the thermosetting film-like
15 transparent adhesive may contain only one type or two or more types of the epoxy resins (b1) and in a case where two or more types of epoxy resins are contained, the combination and ratio thereof can be arbitrarily selected.

[0044]

· Thermal curing agent (b2)

20 The thermal curing agent (b2) functions as a curing agent of the epoxy resin (b1).

Examples of the thermal curing agent (b2) include compounds having two or more functional groups capable of reacting with an epoxy group in one molecule.

Examples of the functional group include phenolic hydroxyl groups, alcoholic hydroxyl
25 groups, an amino group, a carboxy group, groups in which an acid group is turned into an

anhydride, and the like, phenolic hydroxyl groups, amino groups, or groups in which an acid group is turned into an anhydride are preferable, and phenolic hydroxyl groups or amino groups are more preferable.

[0045]

5 As the thermal curing agent (b2), examples of phenolic curing agents having a phenolic hydroxyl group include polyfunctional phenolic resins, biphenol, novolac-type phenolic resins, dicyclopentadiene-based phenolic resins, and aralkylphenolic resin.

 As the thermal curing agent (b2), examples of amine-based curing agents having an amino group include dicyandiamide (DICY).

10 [0046]

 The thermal curing agent (b2) may also have an unsaturated hydrocarbon group.

 Examples of the thermal curing agent (b2) having an unsaturated hydrocarbon group include compounds formed by substituting a part of hydroxyl groups in a phenolic resin with groups having an unsaturated hydrocarbon group, and compounds formed by
15 directly bonding a group having an unsaturated hydrocarbon group to an aromatic ring of a phenolic resin.

 The unsaturated hydrocarbon group in the thermal curing agent (b2) is the same as the unsaturated hydrocarbon group in the above-described epoxy resin having an unsaturated hydrocarbon group.

20 [0047]

 In a case where a phenolic curing agent is used as the thermal curing agent (b2), the thermal curing agent (b2) preferably has a high softening point or glass transition temperature.

[0048]

25 The number average molecular weight of the resin component such as a

polyfunctional phenolic resin, a novolac-type phenolic resin, a dicyclopentadiene-based phenolic resin, or an aralkylphenolic resin in the thermal curing agent (b2) is preferably 300 to 30,000, more preferably 400 to 10,000, and particularly preferably 500 to 3,000.

The molecular weight of a non-resin component such as biphenol or
5 dicyandiamide in the thermal curing agent (b2) is not particularly limited, and is preferably, for example, 60 to 500.

[0049]

The thermosetting adhesive composition and the thermosetting film-like transparent adhesive may contain only one type or two or more types of the thermal
10 curing agents (b2), and in a case where two or more types of thermal curing agents are contained, the combination and ratio thereof can be arbitrarily selected.

[0050]

In the thermosetting adhesive composition and thermosetting film-like transparent adhesive, the amount of the thermal curing agent (b2) is preferably 0.1 to 500
15 parts by mass and more preferably 1 to 200 parts by mass with respect to the content (100 parts by mass) of the epoxy resin (b1). When the amount of the thermal curing agent (b2) is equal to or more than the lower limit value, the curing of the film-like transparent adhesive more easily proceeds. When the amount of the thermal curing agent (b2) is equal to or less than the upper limit value, the moisture absorptivity of the film-like
20 transparent adhesive is decreased and thus the reliability of packages obtained using the film-like transparent adhesive is further improved.

[0051]

In the thermosetting adhesive composition and the thermosetting film-like transparent adhesive, the amount of the epoxy-based thermosetting resin (b) (for
25 example, the total amount of the epoxy resin (b1) and the thermal curing agent (b2)) is

preferably 5 to 100 parts by mass, more preferably 6 to 90 parts by mass, and particularly preferably 7 to 80 parts by mass with respect to the content (100 parts by mass) of the polymer component (a).

[0052]

5 In order to improve various physical properties, in addition to the polymer component (a) and the epoxy-based thermosetting resin (b), the thermosetting film-like transparent adhesive may further contain other components, which do not correspond to these components, as necessary.

Examples of preferable other components contained in the thermosetting film-
10 like transparent adhesive include a curing accelerator (c), a filler (d), a coupling agent (e), a crosslinking agent (f), an energy ray curable resin (g), photopolymerization initiator (h), and a versatile additive (i).

[0053]

(Curing Accelerator (c))

15 The curing accelerator (c) is a component for adjusting the curing speed of the thermosetting adhesive composition.

Examples of preferable curing accelerators (c) include tertiary amines such as triethylene diamine, benzyldimethylamine, triethanolamine, dimethylaminoethanol, and tris(dimethylaminomethyl)phenol; imidazoles (imidazoles in which one or more
20 hydrogen atoms are substituted with groups other than a hydrogen atom) such as 2-methylimidazole, 2-phenyl imidazole, 2-phenyl-4-methylimidazole, 2-phenyl-4,5-dihydroxymethylimidazole, and 2-phenyl-4-methyl-5-hydroxymethylimidazole; organic phosphines (phosphines in which one or more hydrogen atoms are substituted with organic groups) such as tributyl phosphine, diphenyl phosphine, and triphenyl phosphine;
25 and tetraphenyl boron salts such as tetraphenyl phosphonium tetraphenyl borate and

triphenyl phosphine tetraphenyl borate.

[0054]

The curing accelerator thermosetting adhesive composition and the thermosetting film-like transparent adhesive may contain only one type or two or more
5 types of the curing accelerators (c), and in a case where two or more types of curing accelerators are contained, the combination and ratio thereof can be arbitrarily selected.

[0055]

In a case where the curing accelerator (c) is used, in the thermosetting adhesive composition and the thermosetting film-like transparent adhesive, the amount of the
10 curing accelerator (c) is preferably 0.01 to 10 parts by mass and more preferably 0.1 to 5 parts by mass with respect to the content (100 parts by mass) of the epoxy-based thermosetting resin (b). When the amount of the curing accelerator (c) is equal to or more than the lower limit value, the effects of the use of the curing accelerator (c) can be more significantly obtained. When the amount of the curing accelerator (c) is equal to
15 or less than the upper limit value, for example, the effect of suppressing a highly polar curing accelerator (c) moving toward the bonding interface with an adherend in the film-like transparent adhesive under high temperature and high humidity conditions and segregating becomes significant, and the reliability of an infrared sensor module obtained using the film-like transparent adhesive is further improved.

20 [0056]

(Filler (d))

When the thermosetting film-like transparent adhesive contains the filler (d), the thermal expansion coefficient of the film-like transparent adhesive can be easily adjusted. Further, when the thermal expansion coefficient is optimized for an object to which the
25 thermosetting film-like transparent adhesive is to be attached, the reliability of packages

obtained using the thermosetting film-like transparent adhesive is further improved.

When the thermosetting film-like transparent adhesive contains the filler (d), it is also possible to decrease the moisture absorptivity of the film-like transparent adhesive after curing or improve the heat dissipation.

5 [0057]

The filler (d) may be any one of an organic filler and an inorganic filler.

Examples of preferable organic fillers include acrylic particles and silicone particles. Among these, acrylic particles are preferable from the viewpoint of light transmittance and compatibility with other materials.

10 Examples of preferable inorganic fillers include powder of silica, alumina, talc, calcium carbonate, titanium white, colcothar, silicon carbide, boron nitride, and the like; beads obtained by spherodizing these inorganic fillers; surface-modified products of these inorganic fillers; single crystal fibers of these inorganic fillers; and glass fibers. Among these, the inorganic filler is preferably silica or alumina and more preferably
15 spherical silica.

[0058]

The thermosetting adhesive composition and the thermosetting film-like transparent adhesive may contain only one type or two or more types of the fillers (d), and in a case where two or more types of fillers are contained, the combination and ratio
20 thereof can be arbitrarily selected.

[0059]

In a case where acrylic fine particles are used as the filler (d), the average particle diameter of the acrylic fine particles is preferably 1 to 450 nm and more preferably 1 to 400 nm.

25 [0060]

In a case where spherical silica is used as the filler (d), the average particle diameter of the spherical silica is preferably 1 to 250 nm and more preferably 5 to 200 nm.

[0061]

5 In a case where the filler (d) is used, in the thermosetting adhesive composition, the ratio of the amount of the filler (d) (that is, the amount of the filler (d) in the film-like transparent adhesive) with respect to the total amount of all of the components other than the solvent is preferably 5% to 80% by mass and more preferably 7% to 60% by mass. When the amount of the filler (d) is in the above-described range, the adjustment of the
10 thermal expansion coefficient becomes easier.

[0062]

(Coupling Agent (e))

When the film-like transparent adhesive contains the coupling agent (e), it is possible to improve the adhesiveness and adhesion of the film-like transparent adhesive
15 to an adherend. When the film-like transparent adhesive contains the coupling agent (e), without impairing the heat resistance of the cured product thereof, the water resistance is improved. The coupling agent (e) is a compound having a functional group capable of reacting with an inorganic compound or an organic compound.

[0063]

20 The coupling agent (e) is preferably a compound having a functional group capable of reacting with the functional group of the polymer component (a), the epoxy-based thermosetting resin (b), or the like and more preferably a silane coupling agent.

Examples of preferable silane coupling agents include 3-glycidyloxypropyltrimethoxysilane, 3-glycidyloxypropylmethyldiethoxysilane, 3-glycidyloxypropyltriethoxysilane, 3-glycidyloxymethyldiethoxysilane, 2-(3,4-
25 glycidyloxypropyltriethoxysilane, 3-glycidyloxymethyldiethoxysilane, 2-(3,4-

epoxycyclohexyl)ethyltrimethoxysilane, 3-methacryloyloxypropyltrimethoxysilane, 3-aminopropyltrimethoxysilane, 3-(2-aminoethylamino)propyltrimethoxysilane, 3-(2-aminoethylamino)propylmethyldiethoxysilane, 3-(phenylamino)propyltrimethoxysilane, 3-anilinopropyltrimethoxysilane, 3-ureidopropyltrimethoxysilane, 3-mercaptopropyltrimethoxysilane, 3-mercaptopropylmethyldimethoxysilane, bis(3-triethoxysilylpropyl)tetrasulfane, methyltrimethoxysilane, methyltriethoxysilane, vinyltrimethoxysilane, vinyltriacetoxysilane, and imidazolesilane.

[0064]

The thermosetting adhesive composition and the thermosetting film-like transparent adhesive may contain only one type or two or more types of the coupling agents (e), and in a case where two or more types of coupling agents are contained, the combination and ratio thereof can be arbitrarily selected.

[0065]

In a case where the coupling agent (e) is used, in the thermosetting adhesive composition and the thermosetting film-like transparent adhesive, the amount of the coupling agent (e) is preferably 0.03 to 20 parts by mass, more preferably 0.05 to 10 parts by mass, and particularly preferably 0.1 to 5 parts by mass with respect to the total amount of the polymer component (a) and the epoxy-based thermosetting resin (b).

When the amount of the coupling agent (e) is equal to or more than the lower limit value, the effects of the use of the coupling agent (e) such as the improvement of the dispersibility of the filler (d) in resins and the improvement of the adhesiveness of the thermosetting film-like transparent adhesive to an adherend can be more significantly obtained. When the amount of the coupling agent (e) is equal to or less than the upper limit value, the generation of outgas is further suppressed.

[0066]

(Crosslinking Agent (f))

In a case where a polymer component having a functional group such as a vinyl group, a (meth)acryloyl group, an amino group, a hydroxyl group, a carboxy group, or an isocyanate group which are capable of bonding to other compounds such as the above-described acrylic resin is used as the polymer component (a), the thermosetting adhesive composition and the thermosetting film-like transparent adhesive may also contain a crosslinking agent (f) for crosslinking the functional group by bonding with the other compounds. By performing crosslinking using the crosslinking agent (f), the initial adhesive force and the agglomerative force of the film-like transparent adhesive can be adjusted.

[0067]

Examples of the crosslinking agent (f) include organic polyvalent isocyanate compounds, organic polyvalent imine compounds, metal chelate-based crosslinking agents (crosslinking agents having a metal chelate structure), and aziridine-based crosslinking agents (crosslinking agents having an aziridinyll group).

[0068]

Examples of the organic polyvalent isocyanate compounds include aromatic polyvalent isocyanate compounds, aliphatic polyvalent isocyanate compounds, and alicyclic polyvalent isocyanate compounds (hereinafter, in some cases, these compounds are collectively abbreviated as “aromatic polyvalent isocyanate compounds and the like”); trimers, isocyanurate bodies, and adduct bodies of the aromatic polyvalent isocyanate compounds and the like; terminal isocyanate urethane prepolymers obtained by reacting the aromatic polyvalent isocyanate compounds and the like and a polyol compound. The “adduct body” means a reactant of the aromatic polyvalent isocyanate compound, the aliphatic polyvalent isocyanate compound, or the alicyclic polyvalent

isocyanate compound and a low molecular weight active hydrogen-containing compound such as ethylene glycol, propylene glycol, neopentyl glycol, trimethylolpropane, or castor oil. Examples of the adduct body include xylylene diisocyanate adducts of trimethylolpropane as described below. In addition, the “terminal isocyanate urethane prepolymer” is as described above.

[0069]

More specific examples of the organic polyvalent isocyanate compound include 2,4-tolylene diisocyanate; 2,6-tolylene diisocyanate; 1,3-xylylene diisocyanate; 1,4-xylylene diisocyanate; diphenylmethane-4,4'-diisocyanate; diphenylmethane-2,4'-diisocyanate; 3-methyldiphenylmethane diisocyanate; hexamethylene diisocyanate; isophorone diisocyanate; dicyclohexylmethane-4,4'-diisocyanate; dicyclohexylmethane-2,4'-diisocyanate; compounds obtained by adding any one or two or more types of tolylene diisocyanate, hexamethylene diisocyanate, and xylylene diisocyanate to all or some of hydroxyl groups in a polyol such as trimethylolpropane; and lysine diisocyanate.

[0070]

Examples of the organic polyvalent imine compounds include N,N'-diphenylmethane-4,4'-bis(1-aziridinecarboxamide), trimethylolpropane tri- β -aziridinylpropionate, tetramethylolmethane-tri- β -aziridinylpropionate, and N,N'-toluene-2,4-bis(1-aziridinecarboxamide) triethylene melamine.

[0071]

In a case where the organic polyvalent isocyanate compound is used as the crosslinking agent (f), as the polymer component (a), a hydroxyl group-containing polymer is preferably used. In a case where the crosslinking agent (f) has an isocyanate group and the polymer component (a) has a hydroxyl group, it is possible to simply introduce a crosslinking structure into the film-like transparent adhesive by a reaction

between the crosslinking agent (f) and the polymer component (a).

[0072]

The thermosetting adhesive composition and the thermosetting film-like transparent adhesive may contain only one type or two or more types of the crosslinking agents (f), and in a case where two or more types of crosslinking agents are contained, the combination and ratio thereof can be arbitrarily selected.

[0073]

In a case where the crosslinking agent (f) was used, in the thermosetting adhesive composition, the amount of the crosslinking agent (f) is preferably 0.01 to 20 parts by mass, more preferably 0.1 to 10 parts by mass, and particularly preferably 0.3 to 5 parts by mass with respect to the content (100 parts by mass) of the polymer component (a). When the amount of the crosslinking agent (f) is equal to or more than the lower limit value, the effects of the use of the crosslinking agent (f) can be more significantly obtained. When the amount of the crosslinking agent (f) is equal to or less than the upper limit value, the excess use of the crosslinking agent (f) is suppressed.

[0074]

(Energy Ray Curable Resin (g))

When the film-like transparent adhesive contains the energy ray curable resin (g), it is possible to change the characteristics by being irradiated with energy rays.

[0075]

The energy ray curable resin (g) is obtained by polymerizing (curing) an energy ray curable compound.

Examples of the energy ray curable compound include compounds having at least one polymerizable double bond in the molecule, and acrylate-based compounds having a (meth)acryloyl group are preferable.

[0076]

Examples of the acrylate-based compounds include chain-like aliphatic skeleton-containing (meth)acrylates such as trimethylolpropane tri(meth)acrylate, tetramethylolmethane tetra(meth)acrylate, pentaerythritol tri(meth)acrylate, 5 pentaerythritol tetra(meth)acrylate, dipentaerythritol monohydroxy penta(meth)acrylate, dipentaerythritol hexa(meth)acrylate, 1,4-butylene glycol di(meth)acrylate, and 1,6-hexanediol di(meth)acrylate; cyclic aliphatic skeleton-containing (meth)acrylates such as dicyclopentanyl di(meth)acrylate; polyalkylene glycol (meth)acrylates such as polyethylene glycol di(meth)acrylate; oligo ester (meth)acrylates; urethane 10 (meth)acrylate oligomers; epoxy-modified (meth)acrylates; polyether (meth)acrylates other than the above-described polyalkylene glycol (meth)acrylates; and itaconic acid oligomers.

[0077]

The weight-average molecular weight of the energy ray curable resin (g) is 15 preferably 100 to 30,000 and more preferably 300 to 10,000.

[0078]

The thermosetting adhesive composition may contain only one type or two or more types of the energy ray curable resins (g), and in a case where two or more types of energy ray curable resins are contained, the combination and ratio thereof can be 20 arbitrarily selected.

[0079]

In a case where the energy ray curable resin (g) is used, in the thermosetting adhesive composition, the amount of the energy ray curable resin (g) is preferably 1% to 95% by mass, more preferably 1.5% to 90% by mass, and particularly preferably 2% to 25 85% by mass.

[0080]

(Photopolymerization Initiator (h))

In a case where the thermosetting adhesive composition contains the energy ray curable resin (g), in order to cause the polymerization reaction of the energy ray curable resin (g) to more efficiently proceed, the thermosetting adhesive composition may also contain a photopolymerization initiator (h).

[0081]

Examples of the photopolymerization initiator (h) in the thermosetting adhesive composition include benzoin compounds such as benzoin, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzoin isobutyl ether, benzoin benzoate, methyl benzoin benzoate, and benzoin dimethyl ketal; acetophenone compounds such as acetophenone, 2-hydroxy-2-methyl-1-phenyl-propane-1-one, and 2,2-dimethoxy-1,2-diphenylethane-1-one; acylphosphine oxide compounds such as bis(2,4,6-trimethylbenzoyl)phenylphosphine oxide and 2,4,6-trimethylbenzoyldiphenylphosphine oxide; sulfide compounds such as benzylphenyl sulfide and tetramethylthiuram monosulfide; α -ketol compounds such as 1-hydroxycyclohexyl phenyl ketone; azo compounds such as azobisisobutyronitrile; titanocene compounds such as titanocene; thioxanthone compounds such as thioxanthone; peroxide compounds; diketone compounds such as diacetyl; benzyl; dibenzyl; benzophenone; 2,4-diethylthioxanthone; 1,2-diphenylmethane; 2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl]propanone; and quinone compounds such as 1-chloroanthraquinone, and 2-chloroanthraquinone.

Examples of the photopolymerization initiator (h) include photosensitizers such as amine.

[0082]

The thermosetting adhesive composition may contain only one type or two or

more types of the photopolymerization initiators (h), and in a case where two or more types of photopolymerization initiators are contained, the combination and ratio thereof can be arbitrarily selected.

[0083]

5 In a case where the photopolymerization initiator (h) is used, in the thermosetting adhesive composition, the amount of the photopolymerization initiator (h) is preferably 0.1 to 20 parts by mass, more preferably 1 to 10 parts by mass, and particularly preferably 2 to 5 parts by mass with respect to the content (100 parts by mass) of the energy ray curable resin (g).

10 [0084]

(Versatile Additive (i))

The versatile additive (I) may be a well-known versatile additive, can be arbitrarily selected depending on the purpose, and is not particularly limited, and examples of preferable versatile additives include a plasticizer, an antistatic agent, an
15 antioxidant, a colorant (a pigment or a dye), and a gettering agent.

[0085]

The thermosetting adhesive composition and the thermosetting film-like transparent adhesive may contain only one type or two or more types of the versatile additives (i), and in a case where two or more types of the versatile additives are
20 contained, the combination and ratio thereof can be arbitrarily selected.

The amount of the thermosetting adhesive composition and the thermosetting film-like transparent adhesive is not particularly limited and may be appropriately selected depending on the purpose.

[0086]

25 In the thermosetting adhesive composition and the thermosetting film-like

transparent adhesive, from the viewpoint of improving film forming properties such as the improvement of the surface condition of the film-like transparent adhesive, the amount of the polymer component (a) is 30 parts by mass or more and more preferably 38 parts by mass or more with respect to the total content (100 parts by mass) of the polymer component (a), the epoxy-based thermosetting resin (b), and the filler (d) (the total amount of the polymer component (a), the epoxy resin (b1), the thermal curing agent (b2), and the filler (d)). From the above viewpoint, the upper limit value of the amount of the polymer component (a) is not particularly limited and is preferably 65 parts by mass.

10 [0087]

On the other hand, in the thermosetting adhesive composition and the thermosetting film-like transparent adhesive, from the viewpoint of improving the reliability of the film-like transparent adhesive, the amount of the polymer component (a) is preferably 45 parts by mass or more with respect to the total content (100 parts by mass) of the polymer component (a), the epoxy-based thermosetting resin (b), and the filler (d) (that is, the total amount of the polymer component (a), the epoxy resin (b1), the thermal curing agent (b2), and the filler (d)). From the above viewpoint, the upper limit value of the amount of the polymer component (a) is not particularly limited and is preferably 65 parts by mass.

20 [0088]

(Solvent)

The thermosetting adhesive composition preferably further contains a solvent. When the thermosetting adhesive composition contains a solvent, the handleability is improved.

25 The solvent is not particularly limited and examples of preferable solvents

include hydrocarbons such as toluene and xylene; alcohols such as methanol, ethanol, 2-propanol, isobutyl alcohol (2-methyl propane-1-ol), and 1-butanol; esters such as ethyl acetate; ketones such as acetone and methyl ethyl ketone; ethers such as tetrahydrofuran; amides (compounds having an amide bond) such as dimethyl formamide and N-methyl pyrrolidone, and the like.

The adhesive composition may contain only one type or two or more types of solvents, and in a case where two or more types of solvents are contained, the combination and ratio thereof can be arbitrarily selected.

[0089]

The solvent contained in the thermosetting adhesive composition is preferably methyl ethyl ketone or the like since it is possible to more uniformly mix the components contained in the thermosetting adhesive composition.

[0090]

[Method of Producing Thermosetting Adhesive Composition]

The thermosetting adhesive composition can be obtained by blending respective components for constituting the thermosetting adhesive composition.

The addition order during the blending of the respective components is not particularly limited, and two or more types of components may be added at the same time.

In a case where the solvent is used, the solvent may be used by mixing the solvent with all of the blending components other than the solvent so as to dilute these blending components in advance or may be used by mixing the solvent with the blending components without diluting all of the blending components other than the solvent in advance.

[0091]

A method of mixing the respective components during blending is not particularly limited and may be appropriately selected from well-known methods such as a method in which the components are mixed together by rotating a stirring stick, a stirring blade, or the like; a method in which the components are mixed together using a mixer, and a method in which the components are mixed together by applying ultrasonic waves thereto.

The temperature and the time during the addition and mixing of the respective components are not particularly limited as long as the respective blending components do not deteriorate and may be appropriately adjusted, but the temperature is preferably 15°C to 30°C.

[0092]

O Energy Ray Curable Film-like Transparent Adhesive

When the film-like transparent adhesive of the present invention has energy ray curability, as the energy ray curable film-like transparent adhesive, a film-like transparent adhesive containing an energy ray curable component (a) may be adopted and a film-like transparent adhesive containing an energy ray curable component (a) and a filler is preferable.

In the energy ray curable film-like transparent adhesive, it is preferable that the energy ray curable component (a) is uncured and has pressure sensitive adhesiveness, and it is more preferable that the energy ray curable component (a) is uncured and has pressure sensitive adhesiveness. Here, the “energy ray” and “energy ray curable” are as described above.

[0093]

The curing conditions when the energy ray curable film-like transparent adhesive is attached to the glass wafer, is further bonded to the infrared light receiving

element, and then is cured are not particularly limited as long as the cured product has a sufficient hardness so as to exert its function, and may be appropriately selected according to the type of the energy ray curable film-like transparent adhesive.

For example, the illuminance of the energy ray during the curing of the energy ray curable film-like transparent adhesive is preferably 120 to 280 mW/cm². Then, the light amount of the energy ray during the curing is preferably 100 to 1,000 mJ/cm².

[0094]

[Energy Ray Curable adhesive Composition]

The energy ray curable film-like transparent adhesive can be formed using an energy ray curable adhesive composition containing a constituent material thereof. For example, the energy ray curable film-like transparent adhesive can be formed at an intended portion by applying the energy ray curable adhesive composition to the formation target surface of the energy ray curable film-like transparent adhesive and drying the energy ray curable adhesive composition as necessary.

[0095]

For example, the energy ray curable adhesive composition can be applied by the same method as in a case of the application of the above-described thermosetting adhesive composition.

[0096]

The drying conditions of the energy ray curable adhesive composition are not particularly limited but in a case where the energy ray curable adhesive composition contains a solvent described later, drying by heating is preferable. Then, the energy ray curable adhesive composition containing a solvent is preferably dried under the conditions, for example, 70°C to 130°C for 10 seconds to 5 minutes. However, in the present invention, the energy ray curable adhesive composition is preferably dried so as

not to cure the formed energy ray curable film-like transparent adhesive.

[0097]

<Energy Ray Curable adhesive Composition (IV-1)>

5 Examples of a preferable energy ray curable adhesive composition include an energy ray curable adhesive composition (IV-1) containing the energy ray curable component (a) and the filler (in the present specification, in some cases, simply abbreviated as “composition (IV-1)”).

[0098]

[Energy Ray Curable Component (a)]

10 The energy ray curable component (a) is a component that is cured by irradiation with an energy ray and is a component for imparting film forming properties flexibility, and the like to the energy ray curable film-like transparent adhesive to form a hard transparent resin film after curing.

15 Examples of the energy ray curable component (a) include a polymer (a1) having an energy ray curable group and a weight-average molecular weight of 80,000 to 2,000,000, and a compound (a2) having an energy ray curable group and a weight-average molecular weight of 100 to 80,000. The polymer (a1) may be a polymer at least a part of which is crosslinked with a crosslinking agent or a polymer which is not crosslinked.

20 [0099]

(Polymer (a1) Having Energy Ray Curable Group and Weight-Average Molecular Weight of 80,000 to 2,000,000)

25 Examples of the polymer (a1) which has an energy ray curable group and a weight-average molecular weight of 80,000 to 2,000,000 include an acrylic resin (a1-1) formed by performing addition reaction on an acrylic polymer (a11) having a functional

group capable of reacting with groups in other compounds and an energy ray curable compound (a12) having a group that reacts with the functional group and an energy ray curable group such as an energy ray curable double bond.

[0100]

5 Examples of the functional group capable of reacting with groups in other compounds include a hydroxyl group, a carboxy group, an amino group, a substituted amino group (a group formed by substituting one or two hydrogen atoms in an amino group with a group other than a hydrogen atom), and an epoxy group. Here, the functional group is preferably a group other than a carboxy group from the viewpoint of
10 preventing the corrosion of circuits of semiconductor wafers, semiconductor chips, or the like.

Among these, the functional group is preferably a hydroxyl group.

[0101]

· Acrylic Polymer Having Functional Group (a11)

15 Examples of the acrylic polymer (a11) having a functional group include acrylic polymers formed by copolymerizing an acrylic monomer having the above-described functional group and an acrylic monomer not having the above-described functional group, and the acrylic polymer may be an acrylic polymer formed by copolymerizing the above-described monomers and, furthermore, a monomer other than acrylic monomers
20 (non-acrylic monomer).

The acrylic polymer (a11) may be a random copolymer or a block copolymer and regarding the polymerization method, a known method can be adopted.

[0102]

Examples of the acrylic monomer having a functional group include hydroxyl
25 group-containing monomers, carboxy group-containing monomers, amino group-

containing monomers, substituted amino group-containing monomers, and epoxy group-containing monomers.

[0103]

Examples of the hydroxyl group-containing monomers include hydroxyalkyl
5 (meth)acrylates such as hydroxymethyl (meth)acrylate, 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxybutyl (meth)acrylate, and 4-hydroxybutyl (meth)acrylate; and non-(meth)acrylic unsaturated alcohols such as vinyl alcohol and allyl alcohol (unsaturated alcohols not having a (meth)acryloyl skeleton).

10 [0104]

Examples of the carboxy group-containing monomers include ethylenically unsaturated monocarboxylic acids such as (meth)acrylic acid and crotonic acid (that is, monocarboxylic acids having an ethylenically unsaturated bond); ethylenically unsaturated dicarboxylic acids such as fumaric acid, itaconic acid, maleic acid, and
15 citraconic acid (dicarboxylic acids having an ethylenically unsaturated bond); anhydrides of the ethylenically unsaturated dicarboxylic acid; and carboxyalkyl (meth)acrylates such as 2-carboxyethyl methacrylate.

[0105]

The acrylic monomer having a functional group is preferably the hydroxyl
20 group-containing monomer.

[0106]

The acrylic polymer (all) may be constituted of only one type or two or more types of the acrylic monomers having a functional group, and, in a case where the acrylic polymer is constituted of two or more types of the acrylic monomers having a functional
25 group, the combination and ratio thereof can be arbitrarily selected.

[0107]

Examples of the acrylic monomer not having a functional group include alkyl (meth)acrylates in which an alkyl group constituting the alkyl ester has 1 to 18 carbon atoms and has a chain-like structure such as methyl (meth)acrylate, ethyl (meth)acrylate, n-propyl (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, sec-butyl (meth)acrylate, tert-butyl (meth)acrylate, pentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isooctyl (meth)acrylate, n-octyl (meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, decyl (meth)acrylate, undecyl (meth)acrylate, dodecyl (meth)acrylate (lauryl (meth)acrylate), tridecyl (meth)acrylate, tetradecyl (meth)acrylate (myristyl (meth)acrylate), pentadecyl (meth)acrylate, hexadecyl (meth)acrylate (that is, palmityl (meth)acrylate), heptadecyl (meth)acrylate, and octadecyl (meth)acrylate (that is, stearyl (meth)acrylate).

[0108]

Examples of the acrylic monomer not having a functional group also include alkoxyalkyl group-containing (meth)acrylic acid esters such as methoxymethyl (meth)acrylate, methoxyethyl (meth)acrylate, ethoxymethyl (meth)acrylate, and ethoxyethyl (meth)acrylate; (meth)acrylic acid esters having an aromatic group which includes (meth)acrylic acid aryl ester such as phenyl (meth)acrylate; non-crosslinkable (meth)acrylamides and derivatives thereof; and (meth)acrylic acid esters having a non-crosslinkable tertiary amino group such as N,N-dimethyl aminoethyl (meth)acrylate and N,N-dimethyl aminopropyl (meth)acrylate.

[0109]

The acrylic polymer (a11) may be constituted of only one type or two or more types of the acrylic monomers not having a functional group, and, in a case where the

acrylic polymer is constituted of two or more types of the acrylic monomers not having a functional group, the combination and ratio thereof can be arbitrarily selected.

[0110]

5 Examples of the non-acrylic monomer include olefins such as ethylene and norbornene; vinyl acetate; and styrene.

The acrylic polymer (a11) may be constituted of only one type or two or more types of the non-acrylic monomers, and, in a case where the acrylic polymer is constituted of two or more types of the non-acrylic monomers, the combination and ratio thereof can be arbitrarily selected.

10 [0111]

The ratio (content) of a constituent unit derived from the acrylic monomer having a functional group with respect to the total amount of constituent units constituting the acrylic polymer (a11) is preferably 0.1% to 50% by mass, more preferably 1% to 40% by mass, and particularly preferably 3% to 30% by mass. When
15 the ratio is in the above-described range, in the acrylic resin (a1-1) obtained by polymerization between the acrylic polymer (a11) and the energy ray curable compound (a12), it becomes possible to easily adjust the degree of curing of the transparent resin film to a p range by satisfying the amount of the energy ray curable group.

[0112]

20 The acrylic polymer (a11) may be constituted of only one type or two or more types of the acrylic resins (a1-1), and, in a case where the acrylic polymer is constituted of two or more types of the acrylic resins, the combination and ratio thereof can be arbitrarily selected.

[0113]

25 In the composition (IV-1), the ratio of the amount of the acrylic resin (a1-1) with

respect to the total amount of components other than the solvent (that is, the amount of the acrylic resin (a1-1) of the energy ray curable film-like transparent adhesive) is preferably 1% to 70% by mass, more preferably 5% to 60% by mass, and particularly preferably 10% to 50% by mass.

5 [0114]

· Energy Ray Curable Compound (a12)

The energy ray curable compound (a12) is preferably an energy ray curable compound having one or two or more types of groups selected from the group consisting of an isocyanate group, an epoxy group, and a carboxy group as the group capable of
 10 reacting with the functional group in the acrylic polymer (a11) and more preferably an energy ray curable compound having an isocyanate group as the above-described group. For example, in a case where the energy ray curable compound (a12) has an isocyanate group as the above-described group, this isocyanate group easily reacts with a hydroxyl group in the acrylic polymer (a11) having a hydroxyl group as the functional group.

15 [0115]

The number of energy ray curable groups in one molecule of the energy ray curable compound (a12) is preferably 1 to 5 and more preferably 1 to 3.

[0116]

Examples of the energy ray curable compound (a12) include 2-
 20 methacryloyloxyethyl isocyanate, methaisopropenyl- α,α -dimethylbenzyl isocyanate, methacryloyl isocyanate, allyl isocyanate, 1,1-(bisacryloyloxymethyl)ethyl isocyanate; acryloyl monoisocyanate compounds obtained by a reaction between a diisocyanate compound or a polyisocyanate compound and hydroxyethyl (meth)acrylate; and

25 acryloyl monoisocyanate compounds obtained from a reaction among a

diisocyanate compound or a polyisocyanate compound, a polyol compound, and hydroxyethyl (meth)acrylate.

Among these, the energy ray curable compound (a12) is preferably 2-methacryloyloxyethyl isocyanate.

5 [0117]

The energy ray curable compound (a12) may be constituted of only one type or two or more types of the acrylic resins (a1-1), and, in a case in which the energy ray curable compound is constituted of two or more types of the acrylic resins, the combination and ratio thereof can be arbitrarily selected.

10 [0118]

The ratio of the amount of an energy ray curable group derived from the energy ray curable compound (a12) with respect to the amount of the functional group derived from the acrylic polymer (a11) in the acrylic resin (a1-1) is preferably 20 to 120 mol %, more preferably 35 to 100 mol %, and particularly preferably 50 to 100 mol %. When
15 the ratio of the content thereof is in the above-described range, the adhesive force of the first protective film after curing becomes stronger. Meanwhile, in a case in which the energy ray curable compound (a12) is a monofunctional compound (having one group in one molecule), the upper limit value of the ratio of the content thereof becomes 100 mol %; however, in a case in which the energy ray curable compound (a12) is a
20 polyfunctional compound (having two or more groups in one molecule), the upper limit value of the ratio of the content thereof exceeds 100 mol % in some cases.

[0119]

The weight-average molecular weight (M_w) of the polymer (a1) is preferably 100,000 to 2,000,000 and more preferably 300,000 to 1,500,000.

25 Here, the “weight-average molecular weight” is as described above.

[0120]

In a case where at least a part of the polymer (a1) is crosslinked with a crosslinking agent, the polymer (a1) may be a polymer that is formed by polymerizing monomers which do not correspond to any of the monomers described above as the monomers constituting the acrylic polymer (a11) and have a group that reacts with the crosslinking agent and is crosslinked in the group that reacts with the crosslinking agent or may be a polymer crosslinked in a group which is derived from the energy ray curable compound (a12) and reacts with the functional group.

[0121]

The composition (IV-1) and the energy ray curable film-like transparent adhesive may contain only one type or two or more types of the polymers (a1), and, in a case in which the composition and the energy ray curable film-like transparent adhesive contain two or more types of the polymers, the combination and ratio thereof can be arbitrarily selected.

[0122]

(Compound Having Energy Ray Curable Group and Molecular Weight of 100 to 80,000 (a2))

Examples of the energy ray curable group in the compound (a2) which has an energy ray curable group and a molecular weight of 100 to 80,000 include groups having an energy ray curable double bond, and preferable examples thereof include a (meth)acryloyl group, a vinyl group, and the like.

[0123]

The compound (a2) is not particularly limited as long as the compound satisfies the above-described conditions, and examples thereof include low molecular weight compounds having an energy ray curable group, epoxy resins having an energy ray

curable group, and phenolic resins having an energy ray curable group.

[0124]

Among the compounds (a2), examples of the low molecular weight compounds having an energy ray curable group include polyfunctional monomers, and oligomers,
5 and acrylate-based compounds having a (meth)acryloyl group are preferable.

Examples of the acrylate-based compounds include difunctional (meth)acrylates such as 2-hydroxy-3-(meth)acryloyloxypropoyl methacrylate, polyethylene glycol di(meth)acrylate, propoxylated ethoxylated bisphenol A di(meth)acrylate, 2,2-bis[4-
((meth)acryloxypolyethoxy)phenyl]propane, ethoxylated bisphenol A di(meth)acrylate,
10 2,2-bis[4-((meth)acryloxydiethoxy)phenyl]propane, 9,9-bis[4-(2-(meth)acryloyloxyethoxy)phenyl]fluorene, 2,2-bis[4-
((meth)acryloxypolypropoxy)phenyl]propane, tricyclodecanedimethanol di(meth)acrylate, 1,10-decanediol di(meth)acrylate, 1,6-hexanediol di(meth)acrylate, 1,9-nonanediol di(meth)acrylate, dipropylene glycol di(meth)acrylate, tripropylene glycol
15 di(meth)acrylate, polypropylene glycol di(meth)acrylate, polytetramethylene glycol di(meth)acrylate, ethylene glycol di(meth)acrylate, diethylene glycol di(meth)acrylate, triethylene glycol di(meth)acrylate, 2,2-bis[4-((meth)acryloylethoxy)phenyl]propane, neopentyl glycol di(meth)acrylate, ethoxylated polypropylene glycol di(meth)acrylate, and 2-hydroxy-1,3-di(meth)acryloxypropane;
20 polyfunctional (meth)acrylates such as tris(2-(meth)acryloxyethyl) isocyanurate, ε-caprolactone-modified tris-(2-(meth)acryloxyethyl) isocyanurate, ethoxylated glycerin tri(meth)acrylate, pentaerythritol tri(meth)acrylate, trimethylolpropane tri(meth)acrylate, ditrimethylolpropane tetra(meth)acrylate, ethoxylated pentaerythritol tetra(meth)acrylate, pentaerythritol tetra(meth)acrylate, dipentaerythritol poly(meth)acrylate, and
25 dipentaerythritol hexa(meth)acrylate; and

polyfunctional (meth)acrylate oligomers such as urethane (meth)acrylate oligomers.

[0125]

Among the compound (a2), as the epoxy resins having an energy ray curable group and the phenolic resins having an energy ray curable group, for example, the epoxy resins and the phenolic resins described in Paragraph 0043 and the like of “Japanese Unexamined Patent Application, First Publication No. 2013-194102” can be used. These resins also correspond to resins constituting a thermosetting component described below, but in the present invention, the resins will be handled as the compound (a2).

[0126]

The weight-average molecular weight of the compound (a2) is preferably 100 to 30,000 and more preferably 300 to 10,000.

[0127]

The composition (IV-1) and the energy ray curable film-like transparent adhesive may contain only one type or two or more types of the compounds (a2), and, in a case in which the composition and the energy ray curable film-like transparent adhesive contain two or more types of the polymers, the combination and ratio thereof can be arbitrarily selected.

[0128]

[Polymer not Having Energy Ray Curable Group (b)]

In the case of containing the compound (a2) as the energy ray curable component (a), the composition (IV-1) and the energy ray curable film-like transparent adhesive preferably further contain a polymer (b) not having an energy ray curable group.

The polymer (b) may be a polymer at least a part of which is crosslinked with a crosslinking agent or a polymer which is not crosslinked.

[0129]

Examples of the polymer (b) not having an energy ray curable group include
5 acrylic polymers, phenoxy resins, urethane resins, polyesters, rubber-based resins, acrylic urethane resins, and the like.

Among these, the polymer (b) is preferably an acrylic polymer (hereinafter, in some cases, abbreviated as “the acrylic polymer (b-1)”).

[0130]

10 The acrylic polymer (b-1) may be a well-known acrylic polymer, and, for example, the acrylic polymer may be a homopolymer of one type of acrylic monomer, a copolymer of two or more types of acrylic monomers, or a copolymer of one or more types of acrylic monomers and one or more types of monomers other than acrylic monomers (non-acrylic monomers).

15 [0131]

Examples of the acrylic monomer constituting the acrylic polymer (b-1) include alkyl (meth)acrylates, (meth)acrylic acid ester having a cyclic skeleton, glycidyl group-containing (meth)acrylic acid ester, hydroxyl group-containing (meth)acrylic acid esters, and substituted amino group-containing (meth)acrylic acid esters. Here, the
20 “substituted amino group” is as described above.

[0132]

Examples of the alkyl (meth)acrylic acid esters include alkyl (meth)acrylic acid esters in which an alkyl group constituting the alkyl ester has 1 to 18 carbon atoms and has a chain-like structure such as methyl (meth)acrylate, ethyl (meth)acrylate, n-propyl
25 (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate,

sec-butyl (meth)acrylate, tert-butyl (meth)acrylate, pentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isooctyl (meth)acrylate, n-octyl (meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, decyl (meth)acrylate, undecyl (meth)acrylate, dodecyl (meth)acrylate (lauryl (meth)acrylate), tridecyl (meth)acrylate, tetradecyl (meth)acrylate (myristyl (meth)acrylate), pentadecyl (meth)acrylate, hexadecyl (meth)acrylate (palmityl (meth)acrylate), heptadecyl (meth)acrylate, and octadecyl (meth)acrylate (stearyl (meth)acrylate).

[0133]

10 Examples of the (meth)acrylic acid esters having a cyclic skeleton include cycloalkyl (meth)acrylic acid esters such as isobornyl (meth)acrylate and dicyclopentanyl (meth)acrylate;

aralkyl (meth)acrylic acid esters such as benzyl (meth)acrylate;

cycloalkenyl (meth)acrylic acid esters such as dicyclopentenyl (meth)acrylate;

15 and

cycloalkenyloxy alkyl (meth)acrylic acid esters such as dicyclopentenylloxyethyl (meth)acrylate.

[0134]

20 Examples of the glycidyl group-containing (meth)acrylic acid esters include glycidyl (meth)acrylate.

Examples of the hydroxyl group-containing (meth)acrylic acid esters include hydroxymethyl (meth)acrylate, 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxybutyl (meth)acrylate, and 4-hydroxybutyl (meth)acrylate.

25 Examples of the substituted amino group-containing (meth)acrylic acid esters

include N-methylaminoethyl (meth)acrylate.

[0135]

Examples of the non-acrylic monomer constituting the acrylic polymer (b-1) include olefins such as ethylene and norbornene; vinyl acetate; and styrene.

5 [0136]

Examples of the polymer (b) at least a part of which is crosslinked with a crosslinking agent and which does not have the energy ray curable group include polymers in which a reactive functional group in the polymer (b) reacts with a crosslinking agent.

10 The reactive functional group may be appropriately selected depending on the type and the like of the crosslinking agent and is not particularly limited. For example, in a case in which the crosslinking agent is a polyisocyanate compound, examples of the reactive functional group include a hydroxyl group, a carboxy group, and an amino group, and, among these, the hydroxyl group that is highly reactive with isocyanate groups is preferable. In addition, in a case in which the crosslinking agent is an epoxy-based compound, examples of the reactive functional group include a carboxy group, an amino group, and an amide group, and, among these, the carboxy group that is highly reactive with epoxy groups is preferable. Here, the reactive functional group is preferably a group other than a carboxy group from the viewpoint of preventing the corrosion of circuits of semiconductor wafers or semiconductor chips.

[0137]

Examples of the polymer (b) which has the reactive functional group but does not have any energy ray curable groups include polymers obtained by polymerizing monomers having at least the reactive functional group. In the case of the acrylic polymer (b-1), as any one or both of the acrylic monomer and the non-acrylic monomer

25

that are exemplified as the monomers constituting the acrylic polymer, monomers having a reactive functional group may be used. Examples of the polymer (b) having a hydroxyl group as the reactive functional group include polymers obtained by polymerizing hydroxyl group-containing (meth)acrylic acid ester and also include
5 polymers obtained by polymerizing monomers formed by substituting one or more hydrogen atoms in the previously exemplified acrylic monomer or non-acrylic monomer with the reactive functional group.

[0138]

In the polymer (b) having a reactive functional group, the ratio (content) of the
10 amount of a constituent unit derived from a monomer having a reactive functional group is preferably 1% to 20% by mass and more preferably 2% to 10% by mass with respect to the total amount of constituent units constituting the polymer. When the ratio is in the above-described range, in the polymer (b), the degree of crosslinking is in a more preferable range.

15 [0139]

The weight-average molecular weight (M_w) of the polymer (b) not having an energy ray curable group is preferably 10,000 to 2,000,000 and more preferably 100,000 to 1,500,000 since the film forming property of the composition (IV-1) is further improved. Here, the “weight-average molecular weight” is as described above.

20 [0140]

The composition (IV-1) and the energy ray curable film-like transparent adhesive may contain only one type or two or more types of the polymers (b) not having an energy ray curable group, and in a case where two or more types of the polymers are contained, the combination and ratio thereof can be arbitrarily selected.

25 [0141]

Examples of the composition (IV-1) include compositions containing any one or both of the polymer (a1) and the compound (a2). In the case in which the composition (IV-1) contains the compound (a2), the composition preferably further contains a polymer (b) not having an energy ray curable group, and in this case, the polymer (a1) is further preferably contained. In addition, the composition (IV-1) may contain the polymer (a1) and the polymer (b) not having any energy ray curable group without containing the compound (a2).

[0142]

In a case where the composition (IV-1) contains the polymer (a1), the compound (a2), and the polymer (b) not having an energy ray curable group, in the composition (IV-1), the amount of the compound (a2) is preferably 10 to 400 parts by mass, and more preferably 30 to 350 parts by mass with respect to the total content (100 parts by mass) of the polymer (a1) and the polymer (b) not having an energy ray curable group.

[0143]

In the composition (IV-1), the ratio of the total amount of the energy ray curable component (a) and the polymer (b) not having an energy ray curable group (that is, the total amount of the energy ray curable component (a) and the polymer (b) not having an energy ray curable group in the energy ray curable film-like transparent adhesive) with respect to the total amount of the components other than the solvent is preferably 5% to 90% by mass, more preferably 10% to 80% by mass, and particularly preferably 20% to 70% by mass. When the ratio of the amount of the energy ray curable component is in the above-described range, the energy ray curability of the energy ray curable film-like transparent adhesive is further improved.

[0144]

[Filler]

The energy ray curable film-like transparent adhesive containing a filler exhibits the same effects as the thermosetting film-like transparent adhesive containing the filler (d).

[0145]

5 Examples of the filler contained in the composition (IV-1) and the energy ray curable film-like transparent adhesive include those the same as the examples of the filler (d) contained in the thermosetting adhesive composition and the thermosetting film-like transparent adhesive.

[0146]

10 The composition (IV-1) and the energy ray curable film-like transparent adhesive may contain only one type or two or more types of the fillers, and in a case where two or more types of the fillers are contained, the combination and ratio thereof can be arbitrarily selected.

[0147]

15 In the composition (IV-1), the ratio of the amount of the filler with respect to the total amount of all of the components other than the solvent (that is, the amount of the filler of the energy ray curable film-like transparent adhesive) is preferably 25% to 75% by mass and more preferably 28% to 72% by mass.

20 Since the filler is much less likely to absorb water than other components, by setting the ratio to the lower limit value or more, the moisture absorptivity is more easily set to 0.55% or less, and when a small glass wafer with a transparent resin film is peeled off from the support sheet, the effect of suppressing the remaining of the transparent resin film on the support sheet becomes higher. When the ratio is set to the upper limit or less, the strength of the film-like transparent adhesive and the transparent resin film that
25 is a cured product thereof is further improved.

[0148]

The composition (IV-1) may also contain, in addition to the energy ray curable component and the filler, one or more types of elements selected from the group consisting of a thermosetting component, a coupling agent, a crosslinking agent, a
5 photopolymerization initiator, and a versatile additive depending on the purpose.

[0149]

Examples of each of the thermosetting component, the coupling agent, the crosslinking agent, the photopolymerization initiator, and the versatile additive in the composition (IV-1) include those which are the same as the examples of the epoxy-based
10 thermosetting resin (b), the coupling agent (e), the crosslinking agent (f), the photopolymerization initiator (h), and the versatile additive (i) in the thermosetting adhesive composition.

[0150]

For example, by using the composition (IV-1) containing the energy ray curable
15 component and the thermosetting component, the adhesive force of the energy ray curable film-like transparent adhesive to be formed to an adherend by heating is improved and the strength of the transparent resin film formed of the energy ray curable film-like transparent adhesive is also improved.

[0151]

20 In the composition (IV-1), one type of each of the thermosetting component, the coupling agent, the crosslinking agent, the photopolymerization initiator, and the versatile additive may be used singly or two or more types thereof may be used in combination, and in a case where two or more types thereof are used in combination, the combination and ratio thereof can be arbitrarily selected.

25

[0152]

The contents of the thermosetting component, the coupling agent, the crosslinking agent, the photopolymerization initiator, and the versatile additive in the composition (IV-1) may be appropriately adjusted depending on the purpose and are not particularly limited.

5 [0153]

From the view point of improving the handleability by dilution, it is preferable that the composition (IV-1) further contains a solvent.

Examples of the solvent contained in the composition (IV-1) include the same solvents as in the thermosetting adhesive composition.

10 The composition (IV-1) may contain only one type or two or more types of the solvents.

[0154]

<<Method of Producing Energy Ray Curable Adhesive Composition>>

The energy ray curable adhesive composition such as the composition (IV-1)
15 can be obtained by blending respective components constituting the energy ray curable adhesive composition.

The addition order during the blending of the respective components is not particularly limited, and two or more types of components may be added at the same time.

20 In a case where the solvent is used, the solvent may be used by mixing the solvent with all of the blending components other than the solvent so as to dilute these blending components in advance or may be used by mixing the solvent with the blending components without diluting all of the blending components other than the solvent in advance.

25 A method of mixing the respective components during blending is not

particularly limited and may be appropriately selected from well-known methods such as a method in which the components are mixed together by rotating a stirring stick, a stirring blade, or the like; a method in which the components are mixed together using a mixer, and a method in which the components are mixed together by applying ultrasonic waves thereto.

The temperature and the time during the addition and mixing of the respective components are not particularly limited as long as the respective blending components do not deteriorate and may be appropriately adjusted, but the temperature is preferably 15°C to 30°C.

10 [0155]

<<Infrared Sensor Module>>

An infrared sensor module according to the present invention is formed by bonding an infrared light receiving element and a glass wafer by curing using the film-like transparent adhesive of the present invention. Since the glass wafer with a high infrared transmittance and the film-like transparent adhesive after curing have a high infrared transmittance, the infrared light receiving element can efficiently receive the infrared light that has passed through the glass wafer and the film-like transparent adhesive after curing. Since the glass wafer is firmly bonded to the infrared light receiving element by the film-like transparent adhesive, the infrared light receiving element is protected and a highly reliable infrared sensor module can be obtained.

[0156]

The infrared sensor module of the present invention can be produced by bonding the infrared light receiving element and the glass wafer by curing using the film-like transparent adhesive of the present invention.

52
EXAMPLES

[0157]

Hereinafter, the present invention will be more specifically described using specific examples. However, the present invention is not limited to examples described
5 below.

[0158]

<Production of Acrylic Resin>

Acrylic resin (1): acrylic resin (weight-average molecular weight (Mw) 600,000) obtained by copolymerizing methyl acrylate (hereinafter, abbreviated as “MA”) (85 parts
10 by mass) and 2-hydroxyethyl acrylate (hereinafter, abbreviated as “HEA”) (15 parts by mass).

[0159]

Acrylic resin (2): acrylic resin (weight-average molecular weight (Mw) 700,000) obtained by copolymerizing methyl acrylate (hereinafter, abbreviated as “MA”) (85 parts
15 by mass) and 2-hydroxyethyl acrylate (hereinafter, abbreviated as “HEA”) (15 parts by mass).

[0160]

Acrylic resin (3): acrylic resin (weight-average molecular weight (Mw) 800,000) obtained by copolymerizing butyl acrylate (hereinafter abbreviated as “BA”) (55 parts by
20 mass), methyl acrylate (hereinafter abbreviated as “MA”) (15 parts by mass), glycidyl methacrylate (hereinafter abbreviated as “GMA”) (20 parts by mass), and 2-hydroxyethyl acrylate (hereinafter abbreviated as “HEA”) (10 parts by mass).

[0161]

<Production of Film-like Transparent Adhesive>

25 [Example 1]

With respect to 100 parts by mass of the acrylic resin (1) (MA/HEA = 85/15), 15 parts by mass of an epoxy resin (product name “CNA-147” manufactured by Nippon Kayaku Co., Ltd.), 12 parts by mass of a phenolic resin (product name “MILEX XLC-4L” manufactured by Mitsui Chemicals, Inc.), 90 parts by mass of spherical silica (average particle diameter 0.05 μm , product name “YA050C-SV2” manufactured by Admatechs), and 1 part by mass of a crosslinking agent (product name “BHS8515” manufactured by Toyochem Co., Ltd.) were dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to obtain an adhesive composition having a solid content concentration of 20% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 10 μm .

[0162]

[Example 2]

With respect to 100 parts by mass of the acrylic resin (1) (MA/HEA = 85/15), 15 parts by mass of an epoxy resin (product name “CNA-147” manufactured by Nippon Kayaku Co., Ltd.), 12 parts by mass of a phenolic resin (product name “MILEX XLC-4L” manufactured by Mitsui Chemicals, Inc.), 90 parts by mass of spherical silica (average particle diameter 0.05 μm , product name “YA050C-SV2” manufactured by Admatechs), and 1 part by mass of a crosslinking agent (product name “BHS8515” manufactured by Toyochem Co., Ltd.) were dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to obtain an adhesive composition having a solid content

concentration of 20% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 20 μm .

[0163]

[Example 3]

With respect to 100 parts by mass of the acrylic resin (2) (MA/HEA = 85/15), 29 parts by mass of an epoxy resin (product name “CNA-147” manufactured by Nippon Kayaku Co., Ltd.), 14 parts by mass of a phenolic resin (product name “MILEX XLC-4L” manufactured by Mitsui Chemicals, Inc.), 4 parts by mass of an energy ray curable resin (product name “SEIKA SEVEN SS02-165” manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.), and 1 part by mass of a crosslinking agent (product name “BHS8515” manufactured by Toyochem Co., Ltd.) were dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to prepare an adhesive composition having a solid content concentration of 30% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 20 μm .

[0164]

[Example 4]

With respect to 100 parts by mass of the acrylic resin (1) (MA/HEA = 85/15), 15 parts by mass of an epoxy resin (product name “CNA-147” manufactured by Nippon Kayaku Co., Ltd.), 12 parts by mass of a phenolic resin (product name “MILEX XLC-4L” manufactured by Mitsui Chemicals, Inc.), 90 parts by mass of spherical silica (average particle diameter 0.01 μm , product name “YA010C-SV1” manufactured by Admatechs), and 1 part by mass of a crosslinking agent (product name “BHS8515” manufactured by Toyochem Co., Ltd.) were dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to obtain an adhesive composition having a solid content concentration of 20% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 20 μm .

[0165]

[Example 5]

With respect to 100 parts by mass of the acrylic resin (1) (MA/HEA = 85/15), 15 parts by mass of an epoxy resin (product name “CNA-147” manufactured by Nippon Kayaku Co., Ltd.), 12 parts by mass of a phenolic resin (product name “MILEX XLC-4L” manufactured by Mitsui Chemicals, Inc.), 90 parts by mass of spherical silica (average particle diameter 0.1 μm , product name “YA100C-SV2” manufactured by Admatechs), and 1 part by mass of a crosslinking agent (product name “BHS8515” manufactured by Toyochem Co., Ltd.) were dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to obtain an adhesive composition having a solid content

concentration of 20% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 20 μm .

[0166]

[Example 6]

With respect to 100 parts by mass of the acrylic resin (3) (BA/MA/GMA/HEA = 55/15/20/10), 850 parts by mass of a thermosetting resin containing acrylic particles (product name “SEIKA SEVEN SS02-135” (6 parts by mass of acrylic particles (average particle diameter 0.4 μm) with respect to 100 parts by mass of a resin solid content) manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.), 150 parts by mass of an energy ray curable resin (product name “SEIKA SEVEN SS02-242” manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.), and 1 part by mass of a crosslinking agent (product name “BHS8515” manufactured by Toyochem Co., Ltd.) were dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to prepare an adhesive composition having a solid content concentration of 40% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 20 μm .

[0167]

[Comparative Example 1]

With respect to 100 parts by mass of the acrylic resin (3) (BA/MA/GMA/HEA = 55/15/20/10), 1,000 parts by mass of a thermosetting resin containing a silica filler (product name "SEIKA SEVEN SS02-193" (which is a thermosetting resin containing 13 parts by mass of spherical silica (average particle diameter 500 μm) with respect to 100 parts by mass of a resin solid content) manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.) was dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to prepare an adhesive composition having a solid content concentration of 60% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 20 μm .

[0168]

15 [Comparative Example 2]

With respect to 100 parts by mass of the acrylic resin (3) (BA/MA/GMA/HEA = 55/15/20/10), 850 parts by mass of a thermosetting resin containing acrylic particles (product name "SEIKA SEVEN SS02-135" (6 parts by mass of acrylic particles (average particle diameter 0.4 μm) with respect to 100 parts by mass of a resin solid content) manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.), 1,200 parts by mass of an energy ray curable resin (product name "SEIKA SEVEN SS02-242" manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.), and 1 part by mass of a crosslinking agent (product name "BHS8515" manufactured by Toyochem Co., Ltd.) were dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to prepare an adhesive composition having a solid content concentration of 40% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 20 μm .

[0169]

[Comparative Example 3]

With respect to 100 parts by mass of the acrylic resin (1) (MA/HEA = 85/15), 15 parts by mass of an epoxy resin (product name “CNA-147” manufactured by Nippon Kayaku Co., Ltd.), 12 parts by mass of a phenolic resin (product name “MILEX XLC-4L” manufactured by Mitsui Chemicals, Inc.), 90 parts by mass of spherical silica (average particle diameter 500 nm, product name “SC2050-MA” manufactured by Admatechs), and 1 part by mass of a crosslinking agent (product name “BHS8515” manufactured by Toyochem Co., Ltd.) were dissolved and dispersed in methyl ethyl ketone, and stirred at 23°C to obtain an adhesive composition having a solid content concentration of 20% by mass.

The above-obtained adhesive composition was applied onto a peeling-treated surface of a peeling film obtained by performing a peeling treatment on one surface of a polyethylene terephthalate film (thickness 38 μm) with a silicone treatment and dried at 100°C for 2 minutes to obtain a film-like transparent adhesive having a thickness of 20 μm .

[0170]

The compositions of the film-like transparent adhesives of Examples 1 to 6 and Comparative Examples 1 to 3 are shown in Table 1.

[Table 1]

[illegible]

[0172]

The film-like transparent adhesive with a peeling film obtained above was laminated on the glass wafer having a thickness of 100 μm (D263 T eco manufactured by SCHOTT AG) at 70°C and the peeling film was removed to prepare a laminate of the glass wafer and the film-like transparent adhesive. Then, the film-like transparent adhesive was cured in an oven at 175°C for 5 h.

However, since the film-like transparent adhesives in Examples 3 and 6 and Comparative Example 2 contained the energy ray curable resin, while the laminate of the glass wafer and the film-like transparent adhesive was being subjected to ultraviolet irradiation (illuminance 220 mW/cm^2 , light amount 120 mJ/cm^2) using an ultraviolet irradiator (RAD-2,000m/12 manufactured by Lintec Corporation, dominant wavelength 365 nm), the film-like transparent adhesive was cured in an oven at 175°C for 5 h.

The following items were evaluated for each laminate of the glass wafer and the film-like transparent adhesive after thermal curing.

[0173]

(Light Transmittance)

A spectrophotometer (UV-VIS-NIR SPECTROPHOTOMETER UV-3600 manufactured by SHIMADZU Corporation) was used, and when setting the glass wafer having a thickness of 150 μm as a reference, the light transmittance (%) of the laminate after thermal curing at a wavelength of 800 to 2,000 nm was measured using a direct light receiving unit without using an integrating sphere to obtain a light transmittance at a wavelength of 850 nm.

Regarding the light transmittance in a wavelength range of 800 to 2,000 nm, 80% or more was evaluated as O and others were evaluated as X.

[0174]

(Shear Strength)

The film-like transparent adhesive side of a tape in which the film-like transparent adhesive was laminated on a low density polypropylene base material (thickness 100 μm) was attached to on a polished surface (dry polish) of a silicon wafer (diameter 200 mm, thickness 350 μm) at 60°C and was fixed to a ring frame. Next, the wafer was diced into chips with a size of 5 mm $\times$ 5 mm using a dicing apparatus (DFD 6361 manufactured by DISCO Corporation). The amount of cutting into the base material at the time of dicing was 20 μm .

10 Dicing blade: 27HECC

Dicing speed: 50 mm/s

Number of revolutions of dicing: 30,000 rpm

[0175]

Thereafter, bonding was performed on the chip diced into a side of 10 mm $\times$ 10 mm at 150°C with 300 gf for 1 second and heating was further performed at 175°C for 5 hours to cure the resin. Then, in a state in which heat was applied to the laminate of the chips on a plate heated to 250°C using a Nordson DAGE 4000HS bond tester (manufactured by Nordson Advanced Technology K. K.), under the condition of a shear speed of 0.2 mm/s, the shear strength (N/5mm $\square$) was measured.

20 [0176]

The evaluation results of the film-like transparent adhesives of Examples 1 to 6 and Comparative Examples 1 to 3 are collectively shown in Table 2.

[0177]

[Table 2]

	Unit	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comparative Example 1	Comparative Example 2	Comparative Example 3
Thickness of film-like transparent adhesive	μm	10	20	20	20	20	20	20	20	20
Average particle diameter of filler	μm	0.05	0.05	-	0.01	0.1	0.4	500	0.4	500
Content of filler	%by mass	41	41	0	41	41	5	12	2	41
Shear strength	N/5mm□	48	75	42	110	68	125	330	250	71
Light transmittance at wavelength of 800 nm	%	92	92	91	92	90	91	5	6	42
Light transmittance at wavelength of 800 to 2,000nm	-	O	O	O	O	O	O	X	X	X

[0178]

As clearly seen from the above results, in Examples 1 to 6, the film-like adhesive after thermal curing had a good light transmittance of 90% or more at a wavelength of 850 nm and had a good light transmittance of 80% or more at a
5 wavelength of 800 to 2,000 nm.

[0179]

In contrast, In Comparative Examples 1 to 3, the film-like adhesive after thermal curing had an infrared transmittance of 5% to 42% at a wavelength of 850 nm and had an infrared transmittance of less than 80% at a wavelength of 800 to 2,000 nm in some
10 cases, and due to a low infrared transmittance, the adhesive could not be used for bonding the infrared light receiving element and the glass wafer.

Industrial Applicability

[0180]

15 The film-like transparent adhesive of the present invention can be suitably used for bonding the infrared light receiving element having an infrared light receiving portion and the glass wafer in the infrared sensor module.

64
CLAIMS

What is claimed is:

1. A film-like transparent adhesive that is a thermosetting or energy ray curable film-like transparent adhesive and has a light transmittance of 80% or more at a wavelength of 800 nm after curing.
2. The film-like transparent adhesive according to claim 1, wherein all light transmittances at wavelengths of 800 to 2,000 nm after curing are 80% or more.
3. The film-like transparent adhesive according to claim 1 or 2, wherein a light transmittance at a wavelength of 850 nm after curing is 90% or more.
4. The film-like transparent adhesive according to any one of claims 1 to 3 comprising:
a filler,
wherein the filler has an average particle diameter of 450 nm or less.
5. An infrared sensor module that is formed by bonding an infrared light receiving element having an infrared light receiving portion and a glass wafer by curing using the film-like transparent adhesive according to any one of claims 1 to 4,
wherein the infrared light receiving portion is provided to receive infrared light that has passed through the glass wafer and the film-like transparent adhesive after curing