

DESCRIPTION

Title of Invention

ADHESIVE SHEET FOR SEMICONDUCTOR PROCESSING

Technical Field

[0001]

The present invention relates to a semiconductor processing pressure sensitive adhesive sheet. In particular, the present invention relates to a pressure sensitive adhesive sheet for semiconductor wafer surface protection, which is used for protecting the surface of a bump-provided semiconductor wafer.

Background Art

[0002]

Along with a rapid progress of thinning, downsizing, and multi-functionalizing of an information terminal instrument, thinning and densification of a semiconductor device to be mounted thereon are also required, and thinning of a semiconductor wafer is also demanded. In order to cope with such demands, thinning has hitherto been performed by grinding the back surface of the semiconductor wafer. In addition, in recent years, in a semiconductor wafer, there is a case where bumps made of solder or the like having a height of approximately several tens to several hundred μm are formed on the semiconductor wafer surface. In the case of grinding the back surface of such a bump-provided semiconductor wafer, in order to protect a bump portion, a surface protective sheet is attached on the wafer surface on which the bumps are formed.

[0003]

As disclosed in PTLs 1 and 2, it has hitherto been known to use, as the surface protective sheet, for example, a pressure sensitive adhesive sheet in which an intermediate layer and a pressure sensitive adhesive layer are provided in this order on a substrate. In PTLs 1 and 2, for the purpose of not only suppressing contamination of the wafer but also enhancing followability to irregularities of the surface of the wafer that is an adherend, in the intermediate layer, an elastic modulus or a gel fraction is regulated.

In addition, PTLs 1 and 2 disclose that in the pressure sensitive adhesive layer, an energy ray-curable oligomer is blended, or a carbon-carbon double bond is introduced into a polymer constituting the pressure sensitive adhesive, whereby the pressure sensitive adhesive may be made energy ray-curable. In the surface protective sheet, in view of the matter that the energy ray-curable pressure sensitive adhesive is used, an adhesive strength of the pressure sensitive adhesive layer is lowered upon irradiation with an energy ray, and therefore, after being used, the surface protective sheet becomes easy to be released from the semiconductor wafer.

Citation List

Patent Literature

[0004]

PTL 1: Japanese Patent No. 4367769

PTL 2: Japanese Patent No. 4369584

Summary of Invention

Technical Problem

[0005]

But, the pressure sensitive adhesive layer having been cured with an energy ray is occasionally insufficient in the adhesive strength to the intermediate layer. As a result, when after irradiation with an energy ray, the surface protective sheet is released from the semiconductor wafer, delamination is occasionally generated between the intermediate layer and the pressure sensitive adhesive layer. When the delamination is generated, for example, the pressure sensitive adhesive remains on the semiconductor wafer at the time of releasing the surface protective sheet, and contamination of the wafer is occasionally caused.

In view of the foregoing actual circumstances, the present invention has been made, and a problem of the present invention is to prevent the delamination generated from occurring between the intermediate layer and the pressure sensitive adhesive layer when the semiconductor processing pressure sensitive adhesive sheet is cured and then released from a work.

Solution to Problem

[0006]

The present inventors made extensive and intensive investigations. As a result, it has been found that the aforementioned problem can be solved by making both the intermediate layer and the pressure sensitive adhesive layer so as to have a predetermined blend having energy ray curability, respectively and controlling a difference in elastic modulus therebetween after energy ray curing, thereby leading to accomplishment of the present invention. The present invention provides the following (1) to (8).

(1) A semiconductor processing pressure sensitive adhesive sheet including a substrate, an intermediate layer, and a pressure sensitive adhesive layer in this order, wherein:

the intermediate layer is a layer formed of an intermediate layer forming composition containing a non-energy ray-curable acrylic polymer (A) and an energy ray-curable acrylic polymer (B) having a weight average molecular weight of 50,000 to 250,000,

the pressure sensitive adhesive layer is energy ray-curable, and

a difference in elastic modulus at 23°C between the intermediate layer and the pressure sensitive adhesive layer after energy ray curing is 20 MPa or less.

(2) The semiconductor processing pressure sensitive adhesive sheet as set forth in the above (1), wherein in the intermediate layer forming composition, the amount of the acrylic polymer (B) is less than 25 parts by mass based on 100 parts by mass of the acrylic polymer (A).

(3) The semiconductor processing pressure sensitive adhesive sheet as set forth in the above (1) or (2), wherein a weight average molecular weight of the acrylic polymer (A) is from 300,000 to 1,500,000.

(4) The semiconductor processing pressure sensitive adhesive sheet as set forth in any one of the above (1) to (3), wherein the pressure sensitive adhesive layer is formed of a pressure sensitive adhesive composition containing an energy ray-curable acrylic polymer (C).

(5) The semiconductor processing pressure sensitive adhesive sheet as set forth in the above (4), wherein the acrylic polymer (C) is an acrylic copolymer (C1) that is a reaction product obtained by allowing an acrylic copolymer (C0) having a structural unit derived from an alkyl (meth)acrylate (c1) in which the alkyl group has 1 to 18 carbon atoms and a structural unit derived from a

functional group-containing monomer (c2) to react with a polymerizable compound (Xc) having an energy ray-polymerizable group.

(6) The semiconductor processing pressure sensitive adhesive sheet as set forth in the above (4) or (5), wherein a weight average molecular weight of the acrylic polymer (C) is from 100,000 to 1,500,000.

(7) The semiconductor processing pressure sensitive adhesive sheet as set forth in any one of the above (4) to (6), wherein the intermediate layer forming composition contains a photopolymerization initiator in an amount of 0.3 to 15 parts by mass based on 100 parts by mass of the acrylic polymer (A), and the pressure sensitive adhesive composition contains a photopolymerization initiator in an amount of 0.5 to 15 parts by mass based on 100 parts by mass of the acrylic polymer (C).

(8) The semiconductor processing pressure sensitive adhesive sheet as set forth in any one of the above (1) to (7), wherein the acrylic polymer (B) is an acrylic copolymer (B1) that is a reaction product obtained by allowing an acrylic copolymer (B0) having a structural unit derived from an alkyl (meth)acrylate (b1) in which the alkyl group has 1 to 18 carbon atoms and a structural unit derived from a functional group-containing monomer (b2) to react with a polymerizable compound (Xb) having an energy ray-polymerizable group.

Advantageous Effects of Invention

[0007]

In the present invention, it is possible to prevent the delamination generated between the intermediate layer and the pressure sensitive adhesive layer from occurring when the semiconductor processing pressure sensitive adhesive sheet is cured with an energy ray and then released from a work.

Description of Embodiments

[0008]

In the following description, the term "weight average molecular weight (Mw)" is a value expressed in terms of polystyrene as measured by the gel permeation chromatography (GPC), and specifically, it is a value measured on a basis of the method as described in the section of Examples.

In addition, in the description of this specification, for example, the term "(meth)acrylate" is used as a term expressing both "acrylate" and

"methacrylate", and the same is also applicable to other analogous terms.

[0009]

The present invention is hereunder described in more detail by reference to embodiments.

The semiconductor processing pressure sensitive adhesive sheet of the present invention (hereinafter also referred to simply as "pressure sensitive adhesive sheet") includes a substrate, an intermediate layer provided on one surface of the substrate, and a pressure sensitive adhesive layer further provided on the intermediate layer. In addition, the pressure sensitive adhesive sheet may be further provided with a release material on the pressure sensitive adhesive layer. The release material protects the pressure sensitive adhesive layer, and when attaching the pressure sensitive adhesive sheet to a work, it is removed from the pressure sensitive adhesive layer.

The pressure sensitive adhesive sheet may have other layer than those mentioned above. For example, in order to enhance adhesion between the intermediate layer and the substrate, an easily adhesive layer formed of a curable resin of every sort or the like may be provided on one surface of the substrate. In addition, in order to prevent electrification of the pressure sensitive adhesive sheet from occurring, an antistatic layer containing a known antistatic agent may be provided on one surface of the substrate.

[0010]

The intermediate layer is a layer formed of an intermediate layer forming composition containing a non-energy ray-curable acrylic polymer (A) and an energy ray-curable acrylic polymer (B) having a weight average molecular weight of 50,000 to 250,000. In addition, the pressure sensitive adhesive layer is a layer formed of an energy ray-curable pressure sensitive adhesive composition. A difference in elastic modulus at 23°C between the intermediate layer after energy ray curing and the pressure sensitive adhesive layer after energy ray curing is 20 MPa or less. The elastic modulus at 23°C is a value of storage elastic modulus at 23°C when the storage elastic modulus is measured at -30 to 200°C at a temperature rise rate of 3°C/min by a viscoelasticity measuring apparatus (frequency: 1 Hz), and specifically, it is a value measured on a basis of the method described in the section of Examples.

In the present invention, all of the intermediate layer and the pressure sensitive adhesive layer are energy ray-curable. Accordingly, in the pressure

sensitive adhesive sheet attached to an adherend, when irradiated with an energy ray, the intermediate layer and the pressure sensitive adhesive layer are cured, whereby the adhesive strength to the adherend becomes low, and the pressure sensitive adhesive sheet is readily released from the adherend. In addition, the difference in elastic modulus between the intermediate layer and the pressure sensitive adhesive layer after energy ray curing is small, and therefore, on the occasion of releasing the pressure sensitive adhesive sheet, the generation of delamination between the intermediate layer and the pressure sensitive adhesive layer is prevented from occurring.

[0011]

On the other hand, when the difference in elastic modulus is more than 20 MPa, when cured with an energy ray, an interlaminar strength between the intermediate layer and the pressure sensitive adhesive layer becomes low. In consequence, when the pressure sensitive adhesive sheet is released from the adherend after energy ray curing, the delamination is liable to be generated between the intermediate layer and the pressure sensitive adhesive layer. From the viewpoint of improving the interlaminar strength between the intermediate layer and the pressure sensitive adhesive layer to more effectively suppress the delamination, the difference in elastic modulus is preferably 15 MPa or less, and more preferably 8 MPa or less.

From the viewpoint of suppressing the delamination, though it would be better that the difference in elastic modulus is lower, in order to allow each of the intermediate layer and the pressure sensitive adhesive layer to bring about a desired function, the difference in elastic modulus is preferably 0.1 MPa or more, and more preferably 0.5 MPa or more.

[0012]

Each of the layers constituting the pressure sensitive adhesive sheet is hereunder described in more detail.

<Intermediate Layer>

In the pressure sensitive adhesive sheet, the intermediate layer is a layer to be provided between the pressure sensitive adhesive layer and the substrate. Although the intermediate layer may be formed directly on the substrate, as mentioned above, in the case where other layer, such as an easily adhesive layer and an antistatic layer, is provided on the substrate, the intermediate layer is formed on the foregoing other layer.

As mentioned above, the intermediate layer is a layer formed of an intermediate layer forming composition containing a non-energy ray-curable acrylic polymer (A) and an energy ray-curable acrylic polymer (B) having a weight average molecular weight of 50,000 to 250,000. The acrylic polymer (A) is hereinafter sometimes abbreviated and referred to simply as "component (A)". The same is also applicable to other components.

The intermediate layer not only exhibits a cohesion by the component (A) but also reveals stress relaxation by the component (B) having a low molecular weight. In the pressure sensitive adhesive sheet having such an intermediate layer, for example, a followability to the adherend having irregularities becomes favorable, and hence, a retention performance relative to the adherend becomes high. Accordingly, when undergoing grinding processing on a wafer having a pressure sensitive adhesive sheet attached thereto, or the like, it becomes possible to prevent damage of the wafer or invasion of a grinding chip or grinding water to the wafer surface.

[0013]

The elastic modulus of the intermediate layer at 23°C after energy ray curing is preferably 0.5 to 40 MPa, more preferably 1.0 to 30 MPa, and still more preferably 1.5 to 20 MPa. In view of the fact that the intermediate layer has such an elastic modulus, prior to irradiation with an energy ray, the aforementioned difference in elastic modulus is readily made small while thoroughly exhibiting a function as the intermediate layer. In addition, by allowing the elastic modulus to fall within the aforementioned range, it becomes easy to make the interlaminar strength higher.

[0014]

Although the elastic modulus of the intermediate layer at 23°C after energy ray curing may be lower than the elastic modulus of the pressure sensitive adhesive layer at 23°C after energy ray curing, it may also be higher.

It is possible to regulate the elastic modulus of the intermediate layer at 23°C after energy ray curing by, for example, a blending amount of the acrylic polymer (B), the amount of an energy ray-polymerizable group (a value of α as mentioned later) to be introduced into the acrylic polymer (B), or the like. For example, when the blending amount of the acrylic polymer (B) or the amount of the energy ray-polymerizable group is increased, the elastic modulus tends to become high. In addition, it is also possible to properly regulate the

foregoing elastic modulus by the kinds and amounts of monomers constituting the acrylic polymer (A); the amount of a crosslinking agent or the amount of a photopolymerization initiator, to be blended in the intermediate layer; and so on.

[0015]

[Acrylic Polymer (A)]

The acrylic polymer (A) is a non-energy ray-curable polymer having a structural unit derived from a (meth)acrylate. It is preferred that the acrylic polymer (A) contains an acrylic copolymer (A1) having a structural unit derived from an alkyl (meth)acrylate (a1) and a structural unit derived from a functional group-containing monomer (a2), and it is more preferred that the acrylic polymer (A) is composed of this acrylic copolymer (A1).

A mode of copolymerization of the acrylic copolymer (A1) is not particularly limited, and it may be a block copolymer or may be a random copolymer. In addition, the content of the acrylic copolymer (A1) is preferably 70 to 100% by mass, more preferably 80 to 100% by mass, still more preferably 90 to 100% by mass, and yet still more preferably 100% by mass relative to the whole amount (100% by mass) of the component (A) contained in the intermediate layer forming composition.

[0016]

As the alkyl (meth)acrylate (a1), an alkyl (meth)acrylate in which the alkyl group has 1 to 18 carbon atoms is used. Specifically, examples thereof include methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, n-butyl (meth)acrylate, n-pentyl (meth)acrylate, n-hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isooctyl (meth)acrylate, n-decyl (meth)acrylate, n-dodecyl (meth)acrylate, n-tridecyl (meth)acrylate, myristyl (meth)acrylate, palmityl (meth)acrylate, and stearyl (meth)acrylate. The alkyl (meth)acrylate (a1) may be used alone or may be used in combination of two or more thereof.

[0017]

The content of the structural unit derived from the alkyl (meth)acrylate (a1) in the acrylic copolymer (A1) is preferably 50 to 99.5% by mass, more preferably 60 to 99% by mass, still more preferably 70 to 97% by mass, and yet still more preferably 80 to 95% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (A1).

When this content is 50% by mass or more, the retention performance of

the pressure sensitive adhesive sheet is enhanced, whereby it becomes easy to make the followability to the adherend having a large difference in irregularities, and the like favorable. In addition, when the content is 99.5% by mass or less, it is possible to secure the structural unit derived from the component (a2) at a fixed amount or more.

[0018]

Among those mentioned above, in order to regulate the elastic modulus of the intermediate layer to an appropriate value, the alkyl (meth)acrylate (a1) is preferably an alkyl (meth)acrylate in which the alkyl group has 1 to 8 carbon atoms, and more preferably, it contains an alkyl (meth)acrylate in which the alkyl group has 4 to 8 carbon atoms (hereinafter sometimes referred to as "monomer (Y)"). Specifically, the monomer (Y) is preferably 2-ethylhexyl (meth)acrylate or n-butyl (meth)acrylate, and especially preferably n-butyl (meth)acrylate.

Here, all of the alkyl (meth)acrylates (a1) constituting the acrylic copolymer (A1) may be the monomer (Y), or a part thereof may be the monomer (Y). Specifically, a proportion of the monomer (Y) is preferably 75 to 100% by mass, more preferably 80 to 100% by mass, and still more preferably 90 to 100% by mass relative to the whole amount of the alkyl (meth)acrylate (a1).

[0019]

The functional group-containing monomer (a2) is a monomer having a functional group, such as a hydroxy group, a carboxy group, an epoxy group, an amino group, a cyano group, a nitrogen atom-containing cyclic group, and an alkoxysilyl group. Among those mentioned above, the functional group-containing monomer (a2) is preferably at least one selected from a hydroxy group-containing monomer, a carboxy group-containing monomer, and an epoxy group-containing monomer.

[0020]

Examples of the hydroxy group-containing monomer include hydroxyalkyl (meth)acrylates, such as 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 unsaturated alcohols, such as vinyl alcohol and allyl alcohol.

Examples of the carboxy group-containing monomer include

(meth)acrylic acid, maleic acid, fumaric acid, and itaconic acid.

[0021]

Examples of the epoxy group-containing monomer include an epoxy group-containing (meth)acrylic acid ester and a non-acrylic epoxy group-containing monomer. Examples of the epoxy group-containing (meth)acrylic acid ester include glycidyl (meth)acrylate, β -methylglycidyl (meth)acrylate, (3,4-epoxycyclohexyl)methyl (meth)acrylate, and 3-epoxycyclo-2-hydroxypropyl (meth)acrylate. In addition, examples of the non-acrylic epoxy group-containing monomer include glycidyl crotonate and allyl glycidyl ether.

The functional group-containing monomer (a2) may be used alone or may be used in combination of two or more thereof.

Among the functional group-containing monomers (a2), a carboxy group-containing monomer is more preferred, and above all, (meth)acrylic acid is still more preferred, and acrylic acid is most preferred. When a carboxy group-containing monomer is used as the functional group-containing monomer (a2), the cohesion of the intermediate layer is enhanced, and the retention performance, etc. of the intermediate layer is readily made much more favorable.

[0022]

The content of the structural unit derived from the functional group-containing monomer (a2) in the acrylic copolymer (A1) is preferably 0.5 to 40% by mass, more preferably 1 to 30% by mass, still more preferably 3 to 20% by mass, and yet still more preferably 5 to 15% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (A1).

When the content of the structural unit derived from the component (a2) is 0.5% by mass or more, the cohesion of the intermediate layer becomes high, and compatibility with the component (B) is readily made favorable, too. On the other hand, when the content is 40% by mass or less, it is possible to secure the structural unit derived from the component (a1) at a fixed amount or more.

[0023]

Although the acrylic copolymer (A1) may be a copolymer of the alkyl (meth)acrylate (a1) and the functional group-containing monomer (a2), it may also be a copolymer of the component (a1), the component (a2), and other

monomer (a3) than these components (a1) and (a2).

Examples of the other monomer (a3) include (meth)acrylates having a cyclic structure, such as cyclohexyl (meth)acrylate, benzyl (meth)acrylate, isobornyl (meth)acrylate, dicyclopentanyl (meth)acrylate, dicyclopentenyl (meth)acrylate, and dicyclopentenylloxyethyl (meth)acrylate, vinyl acetate, and styrene. The other monomer (a3) may be used alone or may be used in combination of two or more thereof.

The content of the structural unit derived from the other monomer (a3) in the acrylic copolymer (A1) is preferably 0 to 30% by mass, more preferably 0 to 20% by mass, still more preferably 0 to 10% by mass, and yet still more preferably 0 to 5% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (A1).

[0024]

A weight average molecular weight (Mw) of the acrylic polymer (A) is preferably 300,000 to 1,500,000, more preferably 400,000 to 1,200,000, still more preferably 400,000 to 1,100,000, and yet still more preferably 450,000 to 900,000. By regulating the Mw to such an upper limit value, the acrylic polymer (A) becomes favorable in terms of compatibility with the acrylic polymer (B). In addition, by allowing the Mw to fall within the aforementioned range, the retention performance of the pressure sensitive adhesive sheet is readily enhanced.

The content of the acrylic polymer (A) in the intermediate layer forming composition is preferably 60 to 99% by mass, more preferably 70 to 97% by mass, and still more preferably 75 to 92% by mass relative to the whole amount (100% by mass) of the intermediate layer forming composition.

In the case where the intermediate layer forming composition is diluted with a diluent, such as an organic solvent, as mentioned later, the whole amount of the intermediate layer forming composition means the whole amount of solids excluding the diluent. The same is also applicable to a pressure sensitive adhesive composition as mentioned later.

[0025]

[Acrylic Polymer (B)]

The acrylic polymer (B) is an acrylic polymer having energy ray curability when an energy ray-polymerizable group is introduced thereinto. The acrylic polymer (B) is one having a weight average molecular weight (Mw)

of 50,000 to 250,000. In the present invention, by using the component (B) for the intermediate layer, on the occasion of irradiating an energy ray, it may be considered that the component (B) reacts with the energy ray-curable component in the pressure sensitive adhesive layer to undergo bonding. Accordingly, in cooperation with the matter that the difference in elastic modulus is small, the interlaminar strength between the intermediate layer and the pressure sensitive adhesive layer after energy ray curing is improved. [0026]

When the Mw of the acrylic polymer (B) is less than 50,000, on the occasion of keeping the pressure sensitive adhesive sheet over a long period of time, there is a concern that a part of the component (B) migrates into the pressure sensitive adhesive layer, whereby not only the adhesive strength of the pressure sensitive adhesive sheet becomes instable, but also the pressure sensitive adhesive layer is excessively cured after irradiation with an energy ray. As a result, for example, in the case of using the pressure sensitive adhesive sheet after keeping over a long period of time, or in the case of allowing the pressure sensitive adhesive sheet to stand in a state of being attached to the adherend over a long period of time, the interlaminar strength between the intermediate layer and the pressure sensitive adhesive layer after irradiation with an energy ray occasionally becomes insufficient. In addition, in the case where the Mw of the component (B) is more than 250,000, the interlaminar strength between the intermediate layer and the pressure sensitive adhesive layer after irradiation with an energy ray is also liable to be lowered.

From the foregoing viewpoints, the weight average molecular weight (Mw) of the acrylic polymer (B) is preferably 60,000 to 220,000, more preferably 70,000 to 200,000, still more preferably 80,000 to 180,000, and yet still more preferably 85,000 to 150,000. [0027]

The acrylic polymer (B) is an acrylic polymer into which an energy ray-polymerizable group is introduced and which has a structural unit derived from a (meth)acrylate. The energy ray-polymerizable group which the acrylic polymer (B) has is preferably introduced into a side chain of the acrylic polymer. The energy ray-polymerizable group may be a group containing an energy ray-polymerizable carbon-carbon double bond, and examples thereof include a

(meth)acryloyl group and a vinyl group. Above all, a (meth)acryloyl group is preferred.

[0028]

It is preferred that the acrylic polymer (B) contains an acrylic copolymer (B1) that is a reaction product obtained by allowing an acrylic copolymer (B0) having a structural unit derived from an alkyl (meth)acrylate (b1) and a structural unit derived from a functional group-containing monomer (b2) to react with a polymerizable compound (Xb) having an energy ray-polymerizable group, and it is more preferred that the acrylic polymer (B) is composed of this acrylic copolymer (B1).

A mode of copolymerization of the acrylic copolymer (B0) is not particularly limited, and it may be a block copolymer, a random copolymer, or the like. The content of the acrylic copolymer (B1) is preferably 70 to 100% by mass, more preferably 80 to 100% by mass, still more preferably 90 to 100% by mass, and yet still more preferably 100% by mass relative to the whole amount (100% by mass) of the component (B) contained in the intermediate layer forming composition.

[0029]

As the alkyl (meth)acrylate (b1), an alkyl (meth)acrylate in which the alkyl group has 1 to 18 carbon atoms is used, and specific examples thereof include those exemplified as the component (a1). These may be used alone or may be used in combination of two or more thereof.

The content of the structural unit derived from the alkyl (meth)acrylate (b1) in the acrylic copolymer (B0) is preferably 50 to 95% by mass, more preferably 55 to 90% by mass, still more preferably 60 to 85% by mass, and yet still more preferably 65 to 80% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (B0). When this content is 50% by mass or more, a shape of the intermediate layer to be formed can be thoroughly kept. In addition, when the content is 95% by mass or less, it is possible to secure the structural unit derived from the component (b2) serving as a reactive site with the polymerizable compound (Xb) at a fixed amount.

[0030]

Similar to the component (a1), the alkyl (meth)acrylate (b1) is preferably an alkyl (meth)acrylate in which the alkyl group has 1 to 8 carbon atoms, and more preferably, it contains the monomer (Y) (namely, an alkyl

(meth)acrylate in which the alkyl group has 4 to 8 carbon atoms). Suitable compounds as the monomer (Y) are the same as those in the aforementioned (a1), and n-butyl (meth)acrylate is especially preferred.

Here, though all of the alkyl (meth)acrylates (b1) to be contained in the acrylic copolymer (B0) may be the monomer (Y), it is preferred that a part thereof is the monomer (Y). A proportion of the monomer (Y) is preferably 65 to 100% by mass, more preferably 70 to 100% by mass, and still more preferably 80 to 95% by mass relative to the whole amount of the alkyl (meth)acrylate (b1).

[0031]

Examples of the functional group-containing monomer (b2) include the monomers having a functional group exemplified for the aforementioned functional group-containing monomer (a2), and at least one selected from a hydroxy group-containing monomer, a carboxy group-containing monomer, and an epoxy group-containing monomer is preferred. As specific compounds thereof, the same compounds as those exemplified for the component (a2) can be exemplified.

As the functional group-containing monomer (b2), a hydroxy group-containing monomer is preferred, and above all, various hydroxyalkyl (meth)acrylates, such as 2-hydroxyethyl (meth)acrylate, are more preferred. By using a hydroxyalkyl (meth)acrylate, it becomes possible to allow the acrylic copolymer (B0) to react relatively easily with the polymerizable compound (Xb).

[0032]

Although the functional groups in the functional group-containing monomer (a2) to be used for the acrylic polymer (A) and the functional group-containing monomer (b2) to be used for the acrylic polymer (B) may be the same as or different from each other, they are preferably different from each other. That is, for example, when the functional group-containing monomer (a2) is a carboxy group-containing monomer, the functional group-containing monomer (b2) is preferably a hydroxy group-containing monomer. In this way, when the functional groups are different from each other, it becomes possible to preferentially crosslink the acrylic polymer (B) with a crosslinking agent as mentioned later, and it becomes easy to make the aforementioned retention performance, etc. of the pressure sensitive adhesive

sheet more favorable.

[0033]

The content of the structural unit derived from the functional group-containing monomer (b2) in the acrylic copolymer (B0) is preferably 5 to 50% by mass, more preferably 10 to 45% by mass, still more preferably 15 to 40% by mass, and yet still more preferably 20 to 35% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (B0). When the foregoing content is 5% by mass or more, a relatively large proportion of reactive sites with the polymerizable compound (Xb) can be secured, and it becomes easy to introduce an energy ray-polymerizable group into a side chain thereof. In addition, when the content is 50% or less, a shape of the formed intermediate layer can be thoroughly kept.

[0034]

Although the acrylic copolymer (B0) may be a copolymer of the alkyl (meth)acrylate (b1) and the functional group-containing monomer (b2), it may also be a copolymer of the component (b1), the component (b2), and other monomer (b3) than these components (b1) and (b2).

Examples of the other monomer (b3) include those exemplified above for the monomer (a3).

The content of the structural unit derived from the other monomer (b3) in the acrylic copolymer (B0) is preferably 0 to 30% by mass, more preferably 0 to 20% by mass, still more preferably 0 to 10% by mass, and yet still more preferably 0 to 5% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (B0).

[0035]

The polymerizable compound (Xb) is a compound having an energy ray-polymerizable group and a substituent capable of reacting with the functional group in the structural unit derived from the component (b2) of the acrylic copolymer (B0) (hereinafter also referred to simply as "reactive substituent").

As mentioned above, examples of the energy ray-polymerizable group include a (meth)acryloyl group and a vinyl group, with a (meth)acryloyl group being preferred. In addition, the polymerizable compound (Xb) is preferably a compound having 1 to 5 energy ray-polymerizable groups per molecule.

Although the reactive substituent in the polymerizable compound (Xb)

may be properly changed according to the functional group which the functional group-containing monomer (b2) has, examples thereof include an isocyanate group, a carboxy group, and an epoxy group, with an isocyanate group being preferred from the viewpoint of reactivity, etc. When the polymerizable compound (Xb) has an isocyanate group, for example, in the case where the functional group of the functional group-containing monomer (b2) is a hydroxy group, it becomes possible to allow it to easily react with the acrylic copolymer (B0).

[0036]

Specifically, examples of the polymerizable compound (Xb) include (meth)acryloyloxyethyl isocyanate, m-isopropenyl- α,α -dimethylbenzyl isocyanate, (meth)acryloyl isocyanate, allyl isocyanate, glycidyl (meth)acrylate, and (meth)acrylic acid. These polymerizable compounds (Xb) may be used either alone or in combination of two or more thereof.

Of these, (meth)acryloyloxyethyl isocyanate is preferred from the viewpoint that it is a compound which has an isocyanate group suitable as the reactive substituent and in which a distance between the main chain and the energy ray-polymerizable group is appropriate.

The polymerizable compound (Xb) reacts with the functional group in a proportion of preferably 40 to 98 equivalents, more preferably 50 to 95 equivalents, still more preferably 60 to 90 equivalents, and yet still more preferably 70 to 85 equivalents relative to the whole amount (100 equivalents) of functional groups derived from the functional group-containing monomer (b2) in the acrylic copolymer (B1).

[0037]

A value of α as calculated according to the following equation (1) is an index expressing the number of energy ray-polymerizable groups which the acrylic copolymer (B1) has. In the acrylic copolymer (B1), the value of α is preferably 5 to 40, more preferably 10 to 35, and still more preferably 15 to 30.

By using the acrylic copolymer (B1) having such a value of α in a blending amount as mentioned later, the elastic modulus of the intermediate layer is readily regulated to a desired range.

$$\text{Equation (1): } \alpha = [P_b] \times [Q_b] \times [R_b]/100$$

In the equation (1), $[P_b]$ represents the content of the structural unit derived from the functional group-containing monomer (b2) based on 100 parts by mass of the whole of structural units of the acrylic copolymer (B0); $[Q_b]$ represents an equivalent of the polymerizable compound (Xb) based on 100 equivalents of the functional group derived from the functional group-containing monomer (b2) which the acrylic copolymer (B0) has; and $[R_b]$ represents the number of energy ray-polymerizable groups which the polymerizable compound (Xb) has.

[0038]

In the intermediate forming composition, the content of the acrylic polymer (B) is preferably less than 25 parts by mass, more preferably 1 to 24 parts by mass, and still more preferably 8 to 23 parts by mass based on 100 parts by mass of the acrylic polymer (A). By making the content of the component (B) relatively small in this way, stress relaxation of the intermediate layer is improved, and an intermediate layer having high followability to irregularities is provided.

When the content of the acrylic polymer (B) is made small, the elastic modulus of the intermediate layer after energy ray curing does not increase so much, and therefore, it becomes possible to make the aforementioned difference in elastic modulus small, and the delamination is readily prevented from occurring.

[0039]

[Crosslinking Agent]

It is preferred that the intermediate layer forming composition further contains a crosslinking agent. Examples of the crosslinking agent include an isocyanate-based crosslinking agent, an epoxy-based crosslinking agent, an aziridine-based crosslinking agent, and a metal chelate-based crosslinking agent, and of these, an isocyanate-based crosslinking agent is preferred. When an isocyanate-based crosslinking agent is used, for example, in the case where the component (B) has a hydroxy group, the crosslinking agent preferentially crosslinks the acrylic polymer (B).

For example, when the intermediate layer forming composition is heated after coating, it is crosslinked by the crosslinking agent. When the intermediate layer is crosslinked with an acrylic polymer, especially the acrylic polymer (B) having a low molecular weight, etc., a coating film is appropriately

formed, whereby the function as the intermediate layer is readily exhibited.

The content of the crosslinking agent is preferably 0.1 to 10 parts by mass, more preferably 0.5 to 7 parts by mass, and still more preferably 1 to 5 parts by mass based on 100 parts by mass of the acrylic polymer (A).

[0040]

Examples of the isocyanate-based crosslinking agent include polyisocyanate compounds. Specific examples of the polyisocyanate compound include aromatic polyisocyanates, such as tolylene diisocyanate, diphenylmethane diisocyanate, and xylylene diisocyanate; aliphatic polyisocyanates, such as hexamethylene diisocyanate; and alicyclic polyisocyanates, such as isophorone diisocyanate and hydrogenated diphenylmethane diisocyanate. In addition, examples thereof further include biurets and isocyanurates thereof as well as adducts thereof that are a reaction product with a low molecular weight active hydrogen-containing compound, such as ethylene glycol, propylene glycol, neopentyl glycol, trimethylolpropane, and castor oil.

These may be used alone or may be used alone or may be used in combination of two or more thereof. In addition, among those mentioned above, adducts of a polyhydric alcohol (for example, trimethylolpropane) of an aromatic polyisocyanate, such as tolylene diisocyanate, are preferred.

[0041]

Examples of the epoxy-based crosslinking agent include 1,3-bis(N,N'-diglycidylaminomethyl)cyclohexane, N,N,N',N'-tetraglycidyl-m-xylylenediamine, ethylene glycol diglycidyl ether, 1,6-hexanediol diglycidyl ether, trimethylolpropane diglycidyl ether, diglycidylaniline, and diglycidylamine. These may be used alone or may be used in combination of two or more thereof.

Examples of the metal chelate-based crosslinking agent include compounds in which acetylacetone, ethyl acetoacetate, tris(2,4-pentanedionate), etc. coordinates to a polyvalent metal, such as aluminum, iron, copper, zinc, tin, titanium, nickel, antimony, magnesium, vanadium, chromium, and zirconium. These may be used alone or may be used in combination of two or more thereof.

Examples of the aziridine-based crosslinking agent include diphenylmethane-4,4'-bis(1-aziridinecarboxamide), trimethylolpropane

tri- β -aziridinyl propionate, tetramethylolmethane tri- β -aziridinyl propionate, toluene-2,4-bis(1-aziridinecarboxymide), triethylene melamine, bisisophthaloyl-1-(2-methylaziridine), tris-1-(2-methylaziridine)phosphine, trimethylolpropane tri- β -(2-methylaziridine) propionate, and hexa[1-(2-methyl)-aziridinyl]triphosphatriazine.

[0042]

[Photopolymerization Initiator]

It is preferred that the intermediate layer forming composition further contains a photopolymerization initiator. When the intermediate forming composition contains a photopolymerization initiator, energy ray curing of the intermediate forming composition with an ultraviolet ray, etc. is readily advanced.

Examples of the photopolymerization initiator include low molecular weight polymerization initiators, such as acetophenone, 2,2-diethoxybenzophenone, 4-methylbenzophenone, 2,4,6-trimethylbenzophenone, Michler's ketone, benzoin, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzoin isobutyl ether, benzyl diphenyl sulfide, tetramethylthiuram monosulfide, benzyl dimethyl ketal, dibenzyl, diacetyl, 1-chloroanthraquinone, 2-chloroanthraquinone, 2-ethylantraquinone, 2,2-dimethoxy-1,2-diphenylethan-1-one, 1-hydroxycyclohexyl phenyl ketone, 2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropanone-1, 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butanone-1, 2-hydroxy-2-methyl-1-phenyl-propan-1-one, diethyl thioxanthone, isopropyl thioxanthone, and 2,4,6-trimethylbenzoyldiphenyl phosphine oxide; and oligomerized polymerization initiators, such as oligo{2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl]propanone}. These may be used alone or may be used in combination of two or more thereof. In addition, of these, 1-hydroxycyclohexyl phenyl ketone is preferred.

Although the content of the photopolymerization initiator is typically 0.3 to 15 parts by mass based on 100 parts by mass of the acrylic polymer (A), in order that even when the content of the acrylic polymer (B) is small, not only the curing may thoroughly proceed, but also the elastic modulus of the intermediate layer after curing may be readily made high, it would be better that the content of the photopolymerization initiator is made relatively high,

and it is preferably 1 to 10 parts by mass, and more preferably 3 to 8 parts by mass.

[0043]

The intermediate layer forming composition may contain other additives within a range where the effects of the present invention are not impaired. Examples of the other additives include an antioxidant, a softener (plasticizer), a filler, a rust inhibitor, a pigment, a dye, and a tackifier. In the case of containing such an additive, the content of each of the additives is preferably 0.01 to 6 parts by mass, and more preferably 0.01 to 2 parts by mass based on 100 parts by mass of the acrylic polymer (A).

Although a thickness of the intermediate layer may be properly selected according to, for example, a height of a bump to be formed on the semiconductor wafer serving as the adherend, it is preferably 10 to 800 μm , more preferably 15 to 600 μm , and still more preferably 20 to 500 μm .

[0044]

<Pressure Sensitive Adhesive Layer>

In the pressure sensitive adhesive sheet, the pressure sensitive adhesive layer is a layer to be formed on the intermediate layer, and the pressure sensitive adhesive sheet is attached to the adherend by the pressure sensitive adhesive layer. The pressure sensitive adhesive layer is in general formed directly on the intermediate layer. The pressure sensitive adhesive layer is an energy ray-curable layer as mentioned above. The pressure sensitive adhesive sheet has a high adhesive strength such that the work may be thorough held before irradiation with an energy ray; however, after irradiation with an energy ray, the adhesive strength is lowered upon curing of the pressure sensitive adhesive layer, and it is possible to easily release the pressure sensitive adhesive sheet from the wafer that is the adherend, etc.

[0045]

The elastic modulus of the pressure sensitive adhesive layer at 23°C after energy ray curing is preferably 1 to 60 MPa, more preferably 1.5 to 30 MPa, and still more preferably 1.8 to 12 MPa. In the pressure sensitive adhesive layer, by allowing the elastic modulus after energy ray curing to fall within the foregoing range, the aforementioned difference in elastic modulus is readily made small. In addition, before irradiation with an energy ray, an appropriate pressure sensitive adhesiveness as the pressure sensitive adhesive

layer is readily revealed. Furthermore, by allowing the elastic modulus to fall within the foregoing range, the interlaminar strength is readily made higher.

[0046]

The pressure sensitive adhesive composition which forms the pressure sensitive adhesive layer contains, for example, an acrylic polymer, a polyurethane, a rubber-based polymer, a polyolefin, a silicone, etc., as a pressure sensitive adhesive component (pressure sensitive adhesive resin) capable of revealing a pressure sensitive adhesiveness on the pressure sensitive adhesive layer.

Although the pressure sensitive adhesive composition which forms the pressure sensitive adhesive layer may have energy ray curability when blended with an energy ray-curable compound separately from the pressure sensitive adhesive resin, it is preferred that the aforementioned pressure sensitive adhesive resin per se has energy ray curability. In the case where the pressure sensitive adhesive resin per se has energy ray curability, though an energy ray-polymerizable group is introduced into the pressure sensitive adhesive resin, it is preferred that the energy ray-polymerizable group is introduced into a main chain or a side chain.

[0047]

In the case where the energy ray-curable compound is blended separately from the pressure sensitive adhesive resin, a monomer or oligomer having an energy ray-polymerizable group is used as the energy ray-curable compound. The oligomer is an oligomer having a weight average molecular weight (Mw) of less than 10,000, and examples thereof include a urethane (meth)acrylate. Even in the case where the pressure sensitive adhesive resin per se has energy ray curability, the pressure sensitive adhesive composition may be blended with the energy ray-curable compound in addition to the pressure sensitive adhesive resin.

[0048]

The case where the energy ray-curable pressure sensitive adhesive resin which is contained in the pressure sensitive adhesive composition is an acrylic polymer (hereinafter also referred to as "acrylic polymer (C)") is hereunder described in more detail.

[Acrylic Polymer (C)]

The acrylic polymer (C) is an acrylic polymer into which an energy

ray-polymerizable group is introduced and which has a structural unit derived from a (meth)acrylate. The energy ray-polymerizable group is preferably introduced into a side chain of the acrylic polymer.

It is preferred that the acrylic polymer (C) contains an acrylic copolymer (C1) that is a reaction product obtained by allowing an acrylic copolymer (C0) having a structural unit derived from an alkyl (meth)acrylate (c1) and a structural unit derived from a functional group-containing monomer (c2) to react with a polymerizable compound (Xc) having an energy ray-polymerizable group, and it is more preferred that the acrylic polymer (C) is composed of this acrylic copolymer (C1).

A mode of copolymerization of the acrylic copolymer (C0) is not particularly limited, and it may be a block copolymer, a random copolymer, or the like. The content of the acrylic copolymer (C1) is preferably 70 to 100% by mass, more preferably 80 to 100% by mass, still more preferably 90 to 100% by mass, and yet still more preferably 100% by mass relative to the whole amount (100% by mass) of the component (C) contained in the pressure sensitive adhesive composition.

[0049]

As the alkyl (meth)acrylate (c1), an alkyl (meth)acrylate in which the alkyl group has 1 to 18 carbon atoms is used, and specific examples thereof include those exemplified for the component (a1). These may be used alone or may be used in combination of two or more thereof.

The content of the structural unit derived from the alkyl (meth)acrylate (c1) in the acrylic copolymer (C0) is preferably 50 to 99% by mass, more preferably 60 to 98% by mass, still more preferably 70 to 97% by mass, and yet still more preferably 80 to 96% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (C0) from the viewpoint of improving the adhesive strength of the pressure sensitive adhesive layer to be formed.

[0050]

Similar to the components (a1) and (b1), the alkyl (meth)acrylate (c1) is preferably an alkyl (meth)acrylate in which the alkyl group has 1 to 8 carbon atoms, and more preferably, it contains an alkyl (meth)acrylate in which the alkyl group has 4 to 8 carbon atoms (namely, the monomer (Y)). Suitable compounds which are used as the monomer (Y) are the same as those in the aforementioned (a1) and (b1), and n-butyl (meth)acrylate is especially

preferred.

Here, though all of the alkyl (meth)acrylates (c1) may be the monomer (Y), for the purpose of appropriately regulating the pressure sensitive adhesive performance or elastic modulus of the pressure sensitive adhesive layer, it is preferred that a part thereof is the monomer (Y). Specifically, a proportion of the monomer (Y) is preferably 65 to 98% by mass, more preferably 70 to 95% by mass, and still more preferably 75 to 90% by mass relative to the whole amount of the alkyl (meth)acrylate (c1).

[0051]

For example, the alkyl (meth)acrylate (c1) may contain, in addition to the aforementioned monomer (Y), ethyl (meth)acrylate. When ethyl (meth)acrylate is used, even after energy ray curing, the elastic modulus of the pressure sensitive adhesive layer is readily made low, and the difference in elastic modulus from the intermediate layer is readily made small. In addition, the pressure sensitive adhesive performance of the pressure sensitive adhesive layer is readily regulated to a desired one.

Furthermore, the alkyl (meth)acrylate (c1) may contain, in addition to the aforementioned monomer (Y), or the monomer (Y) and ethyl (meth)acrylate, methyl (meth)acrylate. By containing methyl (meth)acrylate, the pressure sensitive adhesive performance of the pressure sensitive adhesive layer is readily regulated to a desired one.

[0052]

A total content of ethyl (meth)acrylate and methyl (meth)acrylate is preferably 2 to 35% by mass, more preferably 5 to 30% by mass, and still more preferably 10 to 25% by mass relative to the whole amount of the alkyl (meth)acrylate (c1).

The content of ethyl (meth)acrylate is preferably 2 to 30% by mass, more preferably 5 to 25% by mass, and still more preferably 10 to 20% by mass relative to the whole amount of the alkyl (meth)acrylate (c1).

[0053]

Examples of the functional group-containing monomer (c2) include monomers having a functional group exemplified for the aforementioned functional group-containing monomer (a2), and specifically, at least one selected from a hydroxy group-containing monomer, a carboxy group-containing monomer, and an epoxy group-containing monomer is

preferred. As specific compounds thereof, the same compounds as those exemplified for the component (a2) can be exemplified.

[0054]

As the functional group-containing monomer (c2), among those as mentioned above, a hydroxy group-containing monomer is more preferred. Above all, a hydroxyalkyl (meth)acrylate is more preferred, 2-hydroxyethyl (meth)acrylate and 4-hydroxybutyl (meth)acrylate are still more preferred, and 4-hydroxybutyl (meth)acrylate is especially preferred.

By using a hydroxyalkyl (meth)acrylate as the component (c2), it becomes possible to allow the acrylic copolymer (C0) to react relatively easily with the polymerizable compound (Xc). In addition, by using 4-hydroxybutyl (meth)acrylate, a tensile strength of the intermediate layer becomes high, and the generation of an adhesive residue is readily prevented from occurring.

[0055]

The content of the structural unit derived from the functional group-containing monomer (c2) in the acrylic copolymer (C0) is preferably 1 to 40% by mass, more preferably 2 to 30% by mass, still more preferably 3 to 25% by mass, and yet still more preferably 4 to 15% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (C0).

When the foregoing content is 1% by mass or more, a fixed amount of reactive sites with the polymerizable compound (Xc) can be secured. Accordingly, the pressure sensitive adhesive layer can be appropriately cured upon irradiation with an energy ray, and therefore, it becomes possible to make the adhesive strength after irradiation with an energy ray low. Furthermore, the interlaminar strength between the pressure sensitive adhesive layer and the intermediate layer after irradiation with an energy ray is readily improved. In addition, when the foregoing content is 40% by mass or less, on the occasion of coating a solution of the pressure sensitive adhesive composition to form a pressure sensitive adhesive layer, a sufficient pot life can be secured.

[0056]

Although the acrylic copolymer (C0) may be a copolymer of the alkyl (meth)acrylate (c1) and the functional group-containing monomer (c2), it may also be a copolymer of the component (c1), the component (c2), and other monomer (c3) than these components (c1) and (c2).

Examples of the other monomer (c3) include those exemplified above for

the monomer (a3).

The content of the structural unit derived from the other monomer (c3) in the acrylic copolymer (C0) is preferably 0 to 30% by mass, more preferably 0 to 20% by mass, still more preferably 0 to 10% by mass, and yet still more preferably 0 to 5% by mass relative to the whole of structural units (100% by mass) of the acrylic copolymer (C0).

[0057]

Similar to the aforementioned polymerizable compound (Xb), the polymerizable compound (Xc) is a compound having an energy ray-polymerizable group and a substituent (reactive substituent) capable of reacting with the functional group in the structural unit derived from the component (c2) of the acrylic copolymer (C0) and is preferably a compound having 1 to 5 energy ray-polymerizable groups per molecule.

Specific examples of the reactive substituent and the energy ray-polymerizable group are the same as those in the polymerizable compound (Xb). In consequence, the reactive substituent is preferably an isocyanate group, and the energy ray-polymerizable group is preferably a (meth)acryloyl group.

Specifically, examples of the polymerizable compound (Xc) include those exemplified for the component (a1), and the polymerizable compound (Xc) is preferably (meth)acryloyloxyethyl isocyanate. The polymerizable compound (Xc) may be used either alone or in combination of two or more thereof.

The polymerizable compound (Xc) reacts with the functional group in a proportion of preferably 30 to 98 equivalents, more preferably 40 to 95 equivalents, still more preferably 50 to 92 equivalents, and yet still more preferably 80 to 92 equivalents relative to the whole amount (100 equivalents) of functional groups derived from the functional group-containing monomer (c2) in the acrylic copolymer (C0).

[0058]

A weight average molecular weight (Mw) of the acrylic polymer (C) is preferably 100,000 to 1,500,000, more preferably 250,000 to 1,000,000, still more preferably 300,000 to 900,000, and yet still more preferably 350,000 to 800,000. When the acrylic polymer (C) has such an Mw, it becomes possible to impart an appropriate pressure sensitive adhesiveness to the pressure sensitive adhesive layer.

The content of the acrylic polymer (C) in the pressure sensitive adhesive composition is preferably 70 to 99% by mass, more preferably 75 to 98% by mass, and still more preferably 80 to 96% by mass relative to the whole amount (100% by mass) of the pressure sensitive adhesive composition.

[0059]

A value of β as calculated according to the following equation (2) is an index expressing the number of energy ray-polymerizable groups which the acrylic copolymer (C1) has. In the acrylic copolymer (C1), the value of β as calculated according to the following equation (2) is preferably 0.5 to 30, more preferably 1.0 to 20, still more preferably 1.2 to 15, and yet still more preferably 2 to 12.

In view of the fact that the pressure sensitive adhesive layer contains the acrylic copolymer (C1) having such a value of β , the elastic modulus of the pressure sensitive adhesive layer is readily regulated to a desired range.

$$\text{Equation (2): } \beta = [P_c] \times [Q_c] \times [R_c]/100$$

In the equation (2), $[P_c]$ represents the content of the structural unit derived from the functional group-containing monomer (c2) based on 100 parts by mass of the whole of structural units of the acrylic copolymer (C0); $[Q_c]$ represents an equivalent of the polymerizable compound (Xc) based on 100 equivalents of the functional group derived from the functional group-containing monomer (c2) which the acrylic copolymer (C0) has; and $[R_c]$ represents the number of energy ray-polymerizable groups which the polymerizable compound (Xc) has.

[0060]

[Crosslinking Agent]

It is preferred that the pressure sensitive adhesive composition further contains a crosslinking agent. For example, when the pressure sensitive adhesive composition is heated after coating, it is crosslinked by the crosslinking agent. When the pressure sensitive adhesive layer is crosslinked with the acrylic polymer (C), a coating film is appropriately formed, whereby the function as the pressure sensitive adhesive layer is readily exhibited.

Examples of the crosslinking agent include an isocyanate-based crosslinking agent, an epoxy-based crosslinking agent, an aziridine-based

crosslinking agent, and a chelate-based crosslinking agent, and of these, an isocyanate-based crosslinking agent is preferred. The crosslinking agent may be used either alone or in combination of two or more thereof. Specific examples of the isocyanate-based crosslinking agent include those exemplified as the crosslinking agent which may be used for the intermediate layer forming composition, and preferred compounds thereof are also the same.

The content of the crosslinking agent is preferably 0.01 to 10 parts by mass, more preferably 0.1 to 7 parts by mass, and still more preferably 0.3 to 4 parts by mass based on 100 parts by mass of the acrylic polymer (C).

[0061]

[Photopolymerization Initiator]

It is preferred that the pressure sensitive adhesive composition further contains a photopolymerization initiator. Examples of the photopolymerization initiator include those exemplified as the photopolymerization initiator which is used for the aforementioned intermediate layer forming composition. The photopolymerization initiator may be used either alone or in combination of two or more thereof. In addition, among those as described above, 2,2-dimethoxy-1,2-diphenylethan-1-one and 1-hydroxycyclohexyl phenyl ketone are preferred.

Although the content of the photopolymerization initiator is typically 0.5 to 15 parts by mass based on 100 parts by mass of the acrylic polymer (C), it is more preferably 1 to 12 parts by mass, and still more preferably 4.5 to 10 parts by mass. When the content of the photopolymerization initiator is made relatively high in this way, the elastic modulus of the pressure sensitive adhesive layer after curing is readily made high.

[0062]

The pressure sensitive adhesive composition may contain other additives within a range where the effects of the present invention are not impaired. Examples of the other additives include a tackifier, an antioxidant, a softener (plasticizer), a filler, a rust inhibitor, a pigment, and a dye. In the case of containing such an additive, the content of each of the additives is preferably 0.01 to 6 parts by mass, and more preferably 0.01 to 2 parts by mass based on 100 parts by mass of the acrylic polymer (C).

A thickness of the pressure sensitive adhesive layer is preferably 1 to 100 μm , more preferably 1 to 75 μm , and still more preferably 3 to 50 μm .

[0063]

For example, in the case of using acrylic polymer (C), it is possible to regulate the elastic modulus of the pressure sensitive adhesive layer by the kinds and amounts of monomers constituting the acrylic polymer (C), the amount (value of β) of the energy ray-polymerizable group to be introduced into the acrylic polymer (C), and the like. For example, when the amount (value of β) of the energy ray-polymerizable group is increased, the elastic modulus tends to become high. Furthermore, it is also possible to properly regulate the elastic modulus by the amount of the crosslinking agent or the amount of the photopolymerization initiator, which is blended in the pressure sensitive adhesive layer, and so on.

[0064]

On the occasion of forming an intermediate layer or a pressure sensitive adhesive layer on the surface of the substrate, the release material, or the like, from the viewpoint of improving coatability, each of the intermediate layer forming composition and the pressure sensitive adhesive composition may be further diluted with an organic solvent to convert in a solution form of the intermediate layer forming composition or the pressure sensitive adhesive composition.

Examples of the organic solvent include methyl ethyl ketone, acetone, ethyl acetate, tetrahydrofuran, dioxane, cyclohexane, n-hexane, toluene, xylene, n-propanol, and isopropanol. As the organic solvent to be used, the organic solvent which is used at the time of synthesizing the components (A) to (C) may be used as it is, or at least one organic solvent other than the organic solvent which is used at the time of synthesis may be added, too.

In the case of converting in a solution form as mentioned above, a solid content concentration of the solution is preferably 5 to 70% by mass, more preferably 10 to 60% by mass, and still more preferably 15 to 50% by mass.

[0065]

<Substrate>

From the viewpoint that the retention performance against the work can be made favorable, or the like, the substrate which is used for the pressure sensitive adhesive sheet is preferably a resin film. Examples of the resin film include a polyethylene film, a polypropylene film, a polybutene film, a polybutadiene film, a polymethylpentene film, a polyvinyl chloride film, a vinyl

chloride copolymer film, an ethylene-vinyl acetate copolymer (EVA) film, a polyethylene terephthalate film, a polyethylene naphthalate film, a polybutylene terephthalate film, an ethylene-(meth)acrylic acid copolymer film, an ethylene-(meth)acrylic acid ester copolymer film, a polycarbonate-based film, a polystyrene-based film, a polyphenylene sulfide-based film, a cycloolefin polymer-based film, a polyurethane-based film, an ionomer resin film, a polyimide-based film, and a fluorine resin film.

[0066]

The substrate may be a resin film having only one kind of the aforementioned resins or may be one having two or more thereof. For example, the substrate may be a single-layer film composed of a single resin film, or may be a multilayer film obtained by laminating plural resin films. In addition, the resin film may also be a crosslinked film thereof.

Among the aforementioned resin films, in order to more enhance the retention performance of the work, a polyethylene film, a polypropylene film, an ethylene-vinyl acetate copolymer (EVA) film, and a polyethylene terephthalate film are preferred.

The resin film may contain a known filler, a colorant, an antistatic agent, an antioxidant, an organic lubricant, a catalyst, or the like. In addition, though the resin film may be transparent or may be colored, if desired,

A thickness of the substrate is preferably 10 to 500 μm , more preferably 15 to 300 μm , and still more preferably 20 to 200 μm .

[0067]

<Release Material>

The wafer protecting pressure sensitive adhesive sheet of the present invention may further have a release material on the pressure sensitive adhesive layer.

Examples of the release material include a release sheet having been subjected to a double-sided release treatment and a release sheet having been subjected to a single-sided release treatment. Examples of such a release sheet include those obtained by coating a release agent on a substrate for release material.

Examples of the substrate for release material include the resin films which are used as the aforementioned substrate, and polyester-based films of polyethylene terephthalate, polybutylene terephthalate, polyethylene

naphthalate, or the like, and polyolefin-based films of polypropylene, polyethylene, or the like are preferred.

Examples of the release material include a silicone-based resin, an olefin-based resin, an isoprene-based resin, a rubber-based elastomer, such as a butadiene-based resin, a long-chain alkyl-based resin, an alkyd-based resin, and a fluorine-based resin.

Although a thickness of the release material is not particularly limited, it is preferably 10 to 200 μm , and more preferably 20 to 150 μm .

[0068]

[Production Method of Pressure Sensitive Adhesive Sheet]

The wafer protecting pressure sensitive adhesive sheet of the present invention is not particularly limited with respect to its production method and can be produced by a known method.

For example, the pressure sensitive adhesive sheet can be produced by preparing an intermediate layer-provided substrate in which an intermediate layer is provided on one surface of a substrate, and further laminating a pressure sensitive adhesive layer on the intermediate layer of the intermediate layer-provided substrate.

The intermediate layer-provided substrate can be, for example, produced by coating the intermediate layer forming composition or its solution on one surface of a substrate and then heating for drying to form an intermediate layer. Alternatively, the intermediate layer-provided substrate may be obtained by coating the intermediate layer forming composition or its solution on the release treated surface of a release material and then heating for drying to form an intermediate layer on the release material, followed by attaching this intermediate layer on a substrate. The release material may be released before laminating the pressure sensitive adhesive layer on the intermediate layer.

[0069]

As for the pressure sensitive adhesive layer, the pressure sensitive adhesive composition or its solution is coated on the release treated surface of a release material separately from the release material used at the time of production of the intermediate layer, and then heated for drying to form a pressure sensitive adhesive layer, and the release material-provided pressure sensitive adhesive layer may be attached on the intermediated layer. The

release material may be released from the pressure sensitive adhesive layer, or may be used as it is as the release material provided on the pressure sensitive adhesive layer.

The pressure sensitive adhesive layer may also be formed by coating the pressure sensitive adhesive composition directly on the intermediate layer of the intermediate layer-provided substrate, followed by heating for drying. In this case, the release material may be further attached on the pressure sensitive adhesive layer.

[0070]

Examples of a method of coating the intermediate layer forming composition, the pressure sensitive adhesive composition, or the solution thereof on the substrate or the release material include a spin coating method, a spray coating method, a bar coating method, a knife coating method, a roll coating method, a blade coating method, a die coating method, and a gravure coating method.

On the occasion of forming a relatively thick intermediate layer, the intermediate layer may be formed by coating a solution of the intermediate layer forming composition on the release treated surface of the release material and drying to form two or more intermediate layers, followed by mutually attaching the intermediate layers, or successively laminating the plural intermediate layers on the substrate. The same is also applicable to the pressure sensitive adhesive layer.

[0071]

[Use Method of Pressure Sensitive Adhesive Sheet]

The pressure sensitive adhesive sheet of the present invention is one to be used when attached on a work of every sort, such as a semiconductor wafer, to process a work and is preferably used upon attachment on the work surface with irregularities, protrusions, or the like.

The pressure sensitive adhesive sheet of the present invention is more preferably used as a pressure sensitive adhesive sheet for semiconductor wafer surface protection upon attachment on the semiconductor wafer surface, particularly the wafer surface having bumps formed thereon. In addition, the pressure sensitive adhesive sheet is still more preferably used as a back grinding tape which is attached on the semiconductor wafer surface to protect a circuit formed on the wafer surface at the time of subsequent grinding of the

wafer back surface. In the case where the pressure sensitive adhesive sheet of the present invention has an intermediate layer, even when a difference in height to be caused due to, for example, bumps, is present on the wafer surface, its embedding properties are favorable, and therefore, the protective performance of the wafer surface becomes favorable.

[0072]

In the present invention, the pressure sensitive adhesive layer and the intermediate layer are of an energy ray curing type. Accordingly, the pressure sensitive adhesive sheet attached on the work surface, such as a semiconductor wafer, is energy ray-cured upon irradiation with an energy ray and then released from the work surface. According to this, the pressure sensitive adhesive sheet is released after the adhesive strength has been lowered, and therefore, its release properties become favorable. In addition, as mentioned above, on the occasion of releasing the cured pressure sensitive adhesive sheet, as mentioned above, the delamination generated between the pressure sensitive adhesive layer and the intermediate layer is prevented from occurring, and the adhesive residue is hardly generated.

The application of the pressure sensitive adhesive sheet is not limited to a back grinding sheet, but the pressure sensitive adhesive sheet is also usable for other applications. For example, the pressure sensitive adhesive sheet may also be used as a dicing sheet which is attached on the wafer back surface to hold the wafer on dicing the wafer. In this case, the wafer may be one having through-electrodes formed thereon or one having protrusions, such as bumps, or irregularities, formed on the wafer back surface.

Examples

[0073]

The present invention is hereunder described in more detail by reference to Examples, but it should be construed that the present invention is by no means limited by these Examples.

[0074]

The measurement methods and evaluation methods in the present invention are as follows.

[Weight Average Molecular Weight (Mw)]

The measurement was performed under the following condition by

using a gel permeation chromatograph (a product name: "HLC-8220", manufactured by Tosoh Corporation), and values as expressed in terms of standard polystyrene were adopted.

(Measurement Condition)

Column: "TSK guard column HXL-H", "TSK gel GMHXL-L ($\times 2$)", and "TSK gel G2000HXL" (all of which are manufactured by Tosoh Corporation)

Column temperature: 40°C

Eluent: Tetrahydrofuran

Flow rate: 1.0 mL/min

[0075]

[Measurement of Elastic Modulus]

Using an intermediate layer forming composition and a pressure sensitive adhesive composition used in each of the Examples and Comparative Examples, an intermediate layer and a pressure sensitive adhesive layer, each having a thickness of 200 μm and having a polyethylene terephthalate (PET)-based release film (a trade name: "SP-PET381031", manufactured by Lintec Corporation, thickness: 38 μm) attached on the both surfaces thereof, were prepared. The intermediate layer having a thickness of 200 μm is one obtained by preparing a plurality of 50 μm -thick intermediate layers formed on the release film and successively laminating by the same method as in the Examples and Comparative Examples. The same is also applicable to the pressure sensitive adhesive layer.

Thereafter, the intermediate layer and the pressure sensitive adhesive layer were each irradiated with an ultraviolet ray at an illuminance of 230 mW/cm^2 and an integral of light of 500 mJ/cm^2 by using an ultraviolet ray irradiating device (a product name: "RAD-2000m/12", manufactured by Lintec Corporation). Subsequently, the intermediate layer and the pressure sensitive adhesive layer, each having been cured with an ultraviolet ray, were each cut in a size of 4 mm $\times$ 50 mm, thereby preparing a sample for measuring viscoelasticity. Using this sample, a storage elastic modulus at -30 to 200°C at a temperature rise rate of 3°C/min was measured by a viscoelasticity measuring apparatus (a trade name: "Rheovibron", manufactured by Orientec Co., Ltd.) (frequency: 1 Hz), and a value of the storage elastic modulus at 23°C was defined as an elastic modulus of each layer after energy ray curing.

[0076]

[Measurement of Interlaminar Strength]

On an SUS plate, a double-sided tape (a trade name: "TackLiner", manufactured by Lintec Corporation) was attached; a substrate surface of a dicing tape (a product name: "ADWILL D-510T", manufactured by Lintec Corporation) was attached thereon; and a pressure sensitive adhesive sheet (length: 200 mm, width: 25 mm) produced in each of the Examples and Comparative Examples, from which a release film had been released, was attached on the pressure sensitive adhesive surface of the dicing tape such that the surface of the pressure sensitive adhesive sheet on the pressure sensitive adhesive layer side adhered to the pressure sensitive adhesive surface of the dicing tape. Thereafter, the produced sample was irradiated with UV by using RAD-2000m/12, manufactured by Lintec Corporation (illuminance: 230 mW/cm, luminous energy: 500 mJ/cm²), and the pressure sensitive adhesive sheet was released in an environment at 23°C and a relative humidity of 50% under a condition at a release rate of 600 mm/min and a release angle of 180° by "Autograph AG-IS 1kN", manufactured by Shimadzu Corporation, thereby measuring an interlaminar strength between the intermediate layer and the pressure sensitive adhesive layer.

[0077]

[Example 1]

(Production of Intermediate Layer-provided Substrate A)

An acrylic copolymer (weight average molecular weight: 600,000) obtained through copolymerization of 91 parts by mass of n-butyl acrylate (BA) and 9 parts by weight of acrylic acid (AA) was prepared as an acrylic polymer (A). In addition, an acrylic copolymer (weight average molecular weight: 100,000) was obtained by adding methacryloyloxyethyl isocyanate (a product name: "KARENZ MOI", manufactured by Showa Denko K.K.) to an acrylic copolymer obtained through copolymerization of 62 parts by mass of n-butyl acrylate (BA), 10 parts by mass of methyl methacrylate (MMA), and 28 parts by mass of 2-hydroxyethyl acrylate (2HEA) in an addition ratio of 80 equivalents relative to the hydroxy group of 2HEA (100 equivalents), and was designated as an acrylic polymer (B).

To 100 parts by mass of the acrylic polymer (A), 13 parts by mass of the acrylic polymer (B), 2.2 parts by mass of trimethylolpropane adduct tolylene diisocyanate (a product name: "CORONATE L", manufactured by Tosoh

Corporation) as a crosslinking agent, and 3.71 parts by mass of 1-hydroxycyclohexyl phenyl ketone (a product name: "IRGACURE 184", manufactured by BASF SE) as a photopolymerization initiator were added, and the mixture was regulated with toluene to provide a solid content concentration of 37% by mass and stirred for 30 minutes, thereby preparing a solution of an intermediate forming composition.

[0078]

Subsequently, the solution of an intermediate forming composition was coated on a PET-based release film (a product name: "SP-PET381031", manufactured by Lintec Corporation, thickness: 38 μm) and heated for drying at 100°C for 2 minutes, thereby forming a release film-provided intermediate layer. A thickness of the intermediate layer was 50 μm . Two sheets of this release film-provided intermediate layer were prepared. Subsequently, one of the release film-provided intermediate layers on the intermediate layer side was attached on an ethylene-vinyl acetate film (a product name: "FUNCRARE LEB", manufactured by Gunze Limited, thickness: 120 μm) as a substrate, and the release film on the intermediate layer was released. Thereafter, the other release film-provided intermediate layer was further attached on the intermediate layer laminated on the substrate, thereby obtaining an intermediate layer-provided substrate A having a thickness of the intermediate layer of 100 μm and composed of release material/intermediate layer/substrate.

[0079]

(Production of Pressure Sensitive Adhesive Sheet)

An acrylic copolymer (weight average molecular weight: 600,000) was obtained by adding methacryloyloxyethyl isocyanate (a product name: "KARENZ MOI", manufactured by Showa Denko K.K.) to an acrylic copolymer obtained through copolymerization of 70 parts by mass of n-butyl acrylate (BA), 15 parts by mass of ethyl acrylate (EA), 5 parts by mass of methyl methacrylate (MMA), and 10 parts by mass of 4-hydroxybutyl acrylate (4HBA) in an addition ratio of 90 equivalents relative to the hydroxy group of 4HBA (100 equivalents), and was designated as an acrylic polymer (C).

To 100 parts by mass of the acrylic polymer (C), 1.5 parts by mass of trimethylolpropane adduct tolylene diisocyanate (a product name: "CORONATE L", manufactured by Tosoh Corporation) as a crosslinking agent and 7.3 parts by mass of 2,2-dimethoxy-1,2-diphenylethan-1-one ("IRGACURE

651", manufactured by BASF SE) as a photopolymerization initiator were added, and the mixture was regulated with toluene to provide a solid content concentration of 20% by mass and stirred for 30 minutes, thereby preparing a solution of a pressure sensitive adhesive composition.

Subsequently, the solution of a pressure sensitive adhesive composition was coated on a PET-based release film (a product name: "SP-PET381031", manufactured by Lintec Corporation, thickness: 38 μm) and heated for drying at 90°C for 1 minute, thereby forming a pressure sensitive adhesive layer having a thickness of 10 μm . The release film on the previously produced intermediate layer-provided substrate A was removed, and the exposed intermediate layer was attached on the pressure sensitive adhesive layer, thereby producing a pressure sensitive adhesive sheet composed of release material/pressure sensitive adhesive layer/intermediate layer/substrate.

[0080]

[Example 2]

(Production of Intermediate Layer-provided Substrate B)

An intermediate layer-provided substrate B was produced by carrying out the same method as in Example 1, except for changing the addition amount of the acrylic polymer (B) to 23 parts by mass.

(Production of Pressure Sensitive Adhesive Sheet)

An acrylic copolymer (weight average molecular weight: 600,000) was obtained by adding methacryloyloxyethyl isocyanate (a product name: "KARENZ MOI", manufactured by Showa Denko K.K.) to an acrylic copolymer obtained through copolymerization of 74 parts by mass of n-butyl acrylate (BA), 20 parts by mass of methyl methacrylate (MMA), and 6 parts by mass of 2-hydroxyethyl acrylate (2HEA) in an addition ratio of 50 equivalents relative to the hydroxy group of 2HEA (100 equivalents), and was designated as an acrylic polymer (C).

To 100 parts by mass of the acrylic polymer (C), 0.5 parts by mass of trimethylolpropane adduct tolylene diisocyanate (a product name: "CORONATE L", manufactured by Tosoh Corporation) as a crosslinking agent and 6.0 parts by mass of 1-hydroxycyclohexyl phenyl ketone ("IRGACURE 184", manufactured by BASF SE) as a photopolymerization initiator were added, and the mixture was regulated with toluene to provide a solid content concentration of 20% by mass and stirred for 30 minutes, thereby preparing a

solution of a pressure sensitive adhesive composition.

Subsequently, a pressure sensitive adhesive sheet was produced in the same manner as in Example 1, except for not only using this solution of a pressure sensitive adhesive composition but also using the intermediate layer-provided substrate B in place of the intermediate layer-provided substrate A.

[0081]

[Comparative Example 1]

(Production of Pressure Sensitive Adhesive Sheet)

An acrylic copolymer (weight average molecular weight: 600,000) in which to an acrylic copolymer obtained through copolymerization of 52 parts by mass of n-butyl acrylate (BA), 20 parts by mass of methyl methacrylate (MMA), and 28 parts by mass of 2-hydroxyethyl acrylate (2HEA), methacryloyloxyethyl isocyanate (a product name: "KARENZ MOI", manufactured by Showa Denko K.K.) was added in an addition ratio of 90 equivalents relative to the hydroxy group of 2HEA (100 equivalents) was prepared as an acrylic polymer (C).

To 100 parts by mass of the acrylic polymer (C), 0.5 parts by mass of trimethylolpropane adduct tolylene diisocyanate (a product name: "CORONATE L", manufactured by Tosoh Corporation) as a crosslinking agent and 1.4 parts by mass of 1-hydroxycyclohexyl phenyl ketone ("IRGACURE 184", manufactured by BASF SE) as a photopolymerization initiator were added, and the mixture was regulated with toluene to provide a solid content concentration of 20% by mass and stirred for 30 minutes, thereby preparing a solution of a pressure sensitive adhesive composition. Using the resulting pressure sensitive adhesive composition, a pressure sensitive adhesive sheet was produced according to the same method as in Example 1.

[0082]

[Comparative Example 2]

An intermediate layer-provided substrate C was obtained according to the same method as in the intermediate layer-provided substrate A (Example 1), except for changing the addition amount of the acrylic polymer (B) to 67 parts by mass. A surface protective sheet was produced according to the same method as in Example 2, except for using the intermediate layer-provided substrate C.

[0083]

[Comparative Example 3]

An intermediate layer-provided substrate D was obtained according to the same method as in the intermediate layer-provided substrate A (Example 1), except for changing the addition amount of the acrylic polymer (B) to 107 parts by mass. A surface protective sheet was produced according to the same method as in Example 2, except for using the intermediate layer-provided substrate D.

[0084]

Table 1

	Elastic modulus (MPa)		Difference in elastic modulus between intermediate layer and pressure sensitive adhesive layer (MPa)	Interlaminar strength (N/25 mm)
	Intermediate layer	Pressure sensitive adhesive layer		
Example 1	2.0	7.2	5.2	15
Example 2	10	2.6	7.4	13
Comparative Example 1	2.0	1120	1118	3
Comparative Example 2	48	2.6	45.4	5
Comparative Example 3	88	2.6	85.4	5

[0085]

As is clear from Examples 1 and 2, by making the difference in elastic modulus small as 20 MPa or less, the interlaminar strength became high; and therefore, at the time of curing the semiconductor processing pressure sensitive adhesive sheet and then releasing from the work, it becomes possible to prevent the delamination generated between the intermediate layer and the pressure sensitive adhesive layer from occurring.

In contrast, in Comparative Examples 1 to 3, in view of the matter that the difference in elastic modulus became large, the interlaminar strength became low; and therefore, at the time of curing the semiconductor processing pressure sensitive adhesive sheet and then releasing from the work, the delamination generated between the intermediate layer and the pressure sensitive adhesive layer cannot be thoroughly prevented from occurring.

CLAIMS

[Claim 1]

A semiconductor processing pressure sensitive adhesive sheet comprising a substrate, an intermediate layer, and a pressure sensitive adhesive layer in this order, wherein:

the intermediate layer is a layer formed of an intermediate layer forming composition containing a non-energy ray-curable acrylic polymer (A) and an energy ray-curable acrylic polymer (B) having a weight average molecular weight of 50,000 to 250,000,

the pressure sensitive adhesive layer is energy ray-curable, and

a difference in elastic modulus at 23°C between the intermediate layer and the pressure sensitive adhesive layer after energy ray curing is 20 MPa or less.

[Claim 2]

The semiconductor processing pressure sensitive adhesive sheet according to claim 1, wherein in the intermediate layer forming composition, the amount of the acrylic polymer (B) is less than 25 parts by mass based on 100 parts by mass of the acrylic polymer (A).

[Claim 3]

The semiconductor processing pressure sensitive adhesive sheet according to claim 1 or 2, wherein a weight average molecular weight of the acrylic polymer (A) is from 300,000 to 1,500,000.

[Claim 4]

The semiconductor processing pressure sensitive adhesive sheet according to any one of claims 1 to 3, wherein the pressure sensitive adhesive layer is formed of a pressure sensitive adhesive composition containing an energy ray-curable acrylic polymer (C).

[Claim 5]

The semiconductor processing pressure sensitive adhesive sheet according to claim 4, wherein the acrylic polymer (C) is an acrylic copolymer (C1) that is a reaction product obtained by allowing an acrylic copolymer (C0) having a structural unit derived from an alkyl (meth)acrylate (c1) in which the alkyl group has 1 to 18 carbon atoms and a structural unit derived from a functional group-containing monomer (c2) to react with a polymerizable

compound (Xc) having an energy ray-polymerizable group.

[Claim 6]

The semiconductor processing pressure sensitive adhesive sheet according to claim 4 or 5, wherein a weight average molecular weight of the acrylic polymer (C) is from 100,000 to 1,500,000.

[Claim 7]

The semiconductor processing pressure sensitive adhesive sheet according to any one of claims 4 to 6, wherein the intermediate layer forming composition contains a photopolymerization initiator in an amount of 0.3 to 15 parts by mass based on 100 parts by mass of the acrylic polymer (A), and the pressure sensitive adhesive composition contains a photopolymerization initiator in an amount of 0.5 to 15 parts by mass based on 100 parts by mass of the acrylic polymer (C).

[Claim 8]

The semiconductor processing pressure sensitive adhesive sheet according to any one of claims 1 to 7, wherein the acrylic polymer (B) is an acrylic copolymer (B1) that is a reaction product obtained by allowing an acrylic copolymer (B0) having a structural unit derived from an alkyl (meth)acrylate (b1) in which the alkyl group has 1 to 18 carbon atoms and a structural unit derived from a functional group-containing monomer (b2) to react with a polymerizable compound (Xb) having an energy ray-polymerizable group.