

DESCRIPTION

Title of Invention

DICING-DIE BONDING INTEGRATED FILM AND TACKIFIER
5 FILM USED FOR SAME

Technical Field

[0001] The present disclosure relates to a dicing/die bonding integrated film and a pressure-sensitive film used for the same.

Background Art

10 [0002] A semiconductor device is manufactured through the following steps. First, a dicing step is executed in a state where a pressure-sensitive adhesive film for dicing is pasted to a wafer. Thereafter, an expansion step, a pickup step, a mounting step, a die bonding step, and the like are executed.

15 [0003] In a manufacturing process of a semiconductor device, a film called a dicing/die bonding integrated film has been used. This film has a structure in which a base layer, a pressure-sensitive adhesive layer, and an adhesive layer are stacked in this order, and is used as follows, for example. First, a wafer is diced in a state where a surface of the
20 adhesive layer is pasted to the wafer and the wafer is fixed with a dicing ring. Thereby, the wafer is individuated into a plurality of chips. Subsequently, the adhesive force of the pressure-sensitive adhesive layer with respect to the adhesive layer is weakened by irradiating the pressure-sensitive adhesive layer with ultraviolet rays, and then
25 adhesive pieces obtained by individuating the adhesive layer and chips are picked up from the pressure-sensitive adhesive layer. Thereafter, a

semiconductor device is manufactured through a step of mounting the chips on a substrate or the like through the adhesive pieces. Incidentally, a laminate including the chip obtained through the dicing step and the adhesive piece attached thereto is referred to as a DAF (Die Attach Film).

[0004] As described above, a pressure-sensitive adhesive layer (a dicing film) whose adhesive force is weakened by irradiation of ultraviolet rays is referred to as a UV curable type. On the other hand, a pressure-sensitive adhesive layer which is not irradiated with ultraviolet rays in the manufacturing process of a semiconductor device and whose adhesive force is constant without any changes is referred to as a pressure-sensitive type.

[0005] Incidentally, the film used in the manufacturing process of a semiconductor device is required to have antistatic properties. Patent Literature 1 discloses a semiconductor processing sheet including a pressure-sensitive adhesive layer obtained by curing a pressure-sensitive adhesive composition by irradiation of energy rays, the pressure-sensitive adhesive composition containing a polymer having a quaternary ammonium salt (an antistatic agent) and an energy ray curable group and an energy ray curable pressure-sensitive adhesive component (excluding the above-described polymer). According to this semiconductor processing sheet, excellent antistatic properties can be exhibited and contamination of an adherend (a wafer or a chip) at the time of peeling can be suppressed (see Paragraph [0020] of Patent Literature 1).

Citation List

Patent Literature

[0006] Patent Literature 1: Japanese Unexamined Patent Publication No. 2015-115385

Summary of Invention

5 Technical Problem

[0007] The semiconductor processing sheet described in Patent Literature 1 is not assumed to be applied to a dicing/die bonding integrated film. That is, this semiconductor processing sheet is used as a back grinding sheet (a semiconductor wafer surface protective sheet),
10 a dicing sheet, or a sheet for transferring chips after pickup (see Paragraph [0101] of Patent Literature 1). That is, the adhesive layer of this semiconductor processing sheet uses a semiconductor wafer or a semiconductor chip as an adherend. On the other hand, the pressure-sensitive adhesive layer of the dicing/die bonding integrated
15 film uses an adhesive layer as an adherend. Since both the pressure-sensitive adhesive layer and the adhesive layer, which are disposed to be in contact with each other, contain a resin component, there is a tendency that the bleeding-out amount of a low-molecular-weight component is increased at an interface between
20 these layers. Thereby, a peeling strength between the adhesive layer and the pressure-sensitive adhesive layer is increased over time, and as a result, a pickup error is likely to occur. The pressure-sensitive adhesive layer in the dicing/die bonding integrated film is required to have properties that suppress a decrease in releasability caused by
25 bleeding-out of the component contained in the pressure-sensitive adhesive layer.

[0008] Furthermore, the pressure-sensitive adhesive layer of the dicing/die bond integrated film is required to have high adhesive force with respect to the adhesive layer and the dicing ring in the dicing step. When the adhesive force of the pressure-sensitive adhesive layer is not sufficient, a phenomenon that peeling occurs between the adhesive layer and the pressure-sensitive adhesive layer and thereby the chips fly together with the adhesive piece (hereinafter, this is referred to as "DAF flying") according to high-speed rotation of a dicing blade occurs, or a phenomenon that the dicing ring is peeled from the pressure-sensitive adhesive layer by water flow of cutting water (hereinafter, this phenomenon is referred to as "ring peeling") occurs. The pressure-sensitive adhesive layer of the semiconductor processing sheet described in Patent Literature 1 is preliminarily cured by irradiation of energy rays, and thus when this layer is used as a pressure-sensitive adhesive layer of a dicing/die bond integrated film, it is speculated that DAF flying and ring peeling occur at the time of dicing due to deficiency of adhesive force.

[0009] The present disclosure provides a pressure-sensitive adhesive film for a dicing/die bonding integrated film, the pressure-sensitive adhesive film being excellent in antistatic properties and adhesion with respect to a wafer in a dicing step and also excellent in releasability with respect to an adhesive layer in a pickup step. Furthermore, the present disclosure provides a dicing/die bonding integrated film including the above-described pressure-sensitive adhesive film.

Solution to Problem

[0010] An aspect of the present disclosure provides a pressure-sensitive

adhesive film for a dicing/die bonding integrated film. This pressure-sensitive adhesive film includes at least a base layer and a pressure-sensitive adhesive layer provided on the base layer, and the pressure-sensitive adhesive layer contains a photopolymerization component and a photopolymerization initiator (D) described below. That is, the photopolymerization component includes a structural unit derived from a polymer (A) having a group containing a quaternary ammonium salt and a hydroxyl group, an energy curable pressure-sensitive adhesive component (B) having a hydroxyl group, and a thermal cross-linking agent (C), and the structural unit is at least one of a structural unit in which the polymer (A) and the pressure-sensitive adhesive component (B) are linked with each other via the thermal cross-linking agent (C) and a structural unit in which the pressure-sensitive adhesive components (B) are linked with each other via the thermal cross-linking agent (C).

[0011] The pressure-sensitive adhesive component (B) is cross-linked with the polymer (A) via the thermal cross-linking agent (C) or the pressure-sensitive adhesive components (B) are cross-linked with each other via the thermal cross-linking agent (C), and thereby even when a low-molecular-weight component is used as the pressure-sensitive adhesive component (B), the bleeding-out thereof can be sufficiently suppressed. Furthermore, the photopolymerization component includes a structural unit derived from the polymer (A) having a group containing a quaternary ammonium salt, and thereby antistatic properties are exhibited.

[0012] In the above-described pressure-sensitive adhesive layer, by

irradiation of active energy rays (for example, ultraviolet rays), the above-described photopolymerization component reacts with the photopolymerization initiator (D), and thereby adhesion is reduced. In the manufacturing process of a semiconductor device, the pressure-sensitive adhesive layer is irradiated with active energy rays after the dicing step, and thereby the releasability of the DAF with respect to the pressure-sensitive adhesive layer can be improved and the pickup error in the subsequent pickup step can be sufficiently reduced. From the viewpoint of adhesion, the storage elastic modulus at 23°C of the adhesive layer is preferably sufficiently small, and this value is, for example, 10 MPa to 60 MPa.

[0013] From the viewpoint of further stably obtaining the above-described effect, it is preferable that the pressure-sensitive adhesive composition (B) includes a resin having a chain polymerizable functional group, and the functional group is at least one selected from an acryloyl group and a methacryloyl group. From the same viewpoint, it is preferable that a reaction product between a polyfunctional isocyanate having two or more isocyanate groups in one molecule and a polyhydric alcohol having three or more OH groups in one molecule is used as the thermal cross-linking agent (C). As an example of the photopolymerization initiator (D), a photoradical polymerization initiator is exemplified.

[0014] An aspect of the present disclosure provides a dicing/die bonding integrated film. This integrated film includes the above-described pressure-sensitive adhesive film and an adhesive layer provided on the pressure-sensitive adhesive layer provided in the

pressure-sensitive adhesive film. According to this integrated film, the pressure-sensitive adhesive layer has excellent adhesion with respect to a wafer in the dicing step, and the pressure-sensitive adhesive layer has excellent releasability with respect to the adhesive layer in the pickup step after irradiation of active energy rays. Contamination of the adhesive layer due to the component of the pressure-sensitive adhesive layer when the pressure-sensitive adhesive layer is peeled from the adhesive layer can be suppressed, and thus die bonding with excellent reliability (excellent die bonding properties) can be realized.

Advantageous Effects of Invention

[0015] According to the present disclosure, there is provided a pressure-sensitive adhesive film for a dicing/die bonding integrated film, the pressure-sensitive adhesive film being excellent in antistatic properties and adhesion with respect to a wafer in a dicing step and also excellent in releasability with respect to an adhesive layer in a pickup step. Furthermore, according to the present disclosure, there is provided a dicing/die bonding integrated film including the above-described pressure-sensitive adhesive film.

Brief Description of Drawings

[0016] FIG. 1 is a cross-sectional view schematically illustrating an embodiment of a dicing/die bonding integrated film according to the present disclosure.

FIG. 2 is a cross-sectional view schematically illustrating an embodiment of a pressure-sensitive adhesive film according to the present disclosure.

Description of Embodiments

[0017] Hereinafter, embodiments of the present disclosure will be specifically described with reference to the drawings. In the following description, the same or similar portions are denoted with the same reference signs and repeated description is omitted. Incidentally, the present invention is not limited to the following embodiments. In the present specification, (meth)acryl means acryl or methacryl.

[0018] FIG. 1 is a cross-sectional view schematically illustrating a dicing/die bonding integrated film according to the present embodiment. A dicing/die bonding integrated film 10 (hereinafter, also simply referred to as the "film 10") illustrated in FIG. 1 includes a base layer 1, a pressure-sensitive adhesive layer 3 provided on the base layer 1, and an adhesive layer 5 provided on the pressure-sensitive adhesive layer 3. The pressure-sensitive adhesive layer 3 exhibits its effect in a dicing step of individuating a semiconductor wafer and a pickup step. The adhesive layer 5 exhibits its effect in a step of bonding semiconductor chips obtained through the pickup step to a substrate or the like. As illustrated in FIG. 1, the pressure-sensitive adhesive layer 3 has a larger diameter than the adhesive layer 5. A dicing ring for fixing a wafer at the time of dicing is pasted to a peripheral part, which is not covered with the adhesive layer 5, of the pressure-sensitive adhesive layer 3.

[0019] <Pressure-sensitive adhesive layer>

The pressure-sensitive adhesive layer 3 contains the following photopolymerization component and a photopolymerization initiator (D). That is, the photopolymerization component includes a structural unit derived from a polymer (A) having a group containing a quaternary ammonium salt and a hydroxyl group, an energy curable

pressure-sensitive adhesive component (B) having a hydroxyl group, and a thermal cross-linking agent (C), and the structural unit is at least one of a structural unit in which the polymer (A) and the pressure-sensitive adhesive component (B) are linked with each other via the thermal cross-linking agent (C) and a structural unit in which the pressure-sensitive adhesive components (B) are linked with each other via the thermal cross-linking agent (C).

[0020] (Photopolymerization component)

The above-described photopolymerization component can be obtained, for example, through a step of placing a composition containing the polymer (A), the pressure-sensitive adhesive component (B), and the thermal cross-linking agent (C) or a product obtained by molding the composition into a film shape in an environment at about 40°C over a predetermined period of time (for example, 3 to 4 days) (aging step) and by cross-linking the thermal cross-linking agent (C) with those components using the hydroxyl group of the polymer (A) and the hydroxyl group of the pressure-sensitive adhesive component (B) as cross-linking sites. The pressure-sensitive adhesive component (B) is cross-linked with the polymer (A) via the thermal cross-linking agent (C) or the pressure-sensitive adhesive components (B) are cross-linked with each other via the thermal cross-linking agent (C), and thereby even when a low-molecular-weight component (for example, having a molecular weight of about 200 to 10000) is used as the pressure-sensitive adhesive component (B), the bleeding-out thereof can be sufficiently suppressed. Furthermore, the photopolymerization component includes a structural unit derived from the polymer (A)

having a group containing a quaternary ammonium salt, and thereby antistatic properties are exhibited.

[0021] The storage elastic modulus at 23°C of the pressure-sensitive adhesive layer 3 is preferably sufficiently small, and for example, is in a range of 10 MPa to 60 MPa and may be 15 MPa to 50 MPa or 20 MPa to 40 MPa, from the viewpoint of adhesion, more specifically, from the viewpoint of suppressing DAF flying and ring peeling. This storage elastic modulus can be appropriately set, for example, by selection of the type of the polymer (A) or adjustment of the amount of the thermal cross-linking agent (C) when the photopolymerization component is prepared. Hereinafter, respective to be used in preparation of the pressure-sensitive adhesive layer 3 will be specifically described.

[0022] [Polymer (A)]

The polymer (A) is a polymer containing a group containing a quaternary ammonium salt and a hydroxyl group, and when the polymer (A) contains a group containing a quaternary ammonium salt, antistatic properties are exhibited. The polymer (A) may have a quaternary ammonium salt at the main chain or the side chain, and preferably has a quaternary ammonium salt at side chain from the viewpoint of polymerizability or the like. The quaternary ammonium salt is configured by a quaternary ammonium cation and a counterpart anion, and specifically, may be configured by a quaternary ammonium cation covalently bonded to the polymer (A) and a counterpart anion and may be configured by an anion covalently bonded to the polymer (A) and a counterpart quaternary ammonium salt.

[0023] As the polymer (A) has a hydroxyl group as a cross-linking site,

the polymer (A) can be linked with the pressure-sensitive adhesive component (B) or the polymers (A) can be linked with each other via the thermal cross-linking agent (C).

[0024] The weight average molecular weight of the polymer (A) is, for example, 10000 to 200000, and may be 10000 to 100000 or 10000 to 50000. When this molecular weight is less than 10000, the component of the polymer (A) is likely to be transferred to the adhesive layer; on the other hand, when the molecular weight exceeds 200000, tackiness of the pressure-sensitive adhesive layer is likely to become insufficient. Thereby, the sticking force of the pressure-sensitive adhesive layer is insufficient, and a problem such as DAF flying or ring peeling is likely to occur.

[0025] The polymer (A) can be obtained by performing synthesis according to a known method. Examples of the synthesis method include a solution polymerization method, a suspension polymerization method, an emulsion polymerization method, a bulk polymerization method, a precipitation polymerization method, a gas-phase polymerization method, a plasma polymerization method, and a supercritical polymerization method. Furthermore, as the type of polymerization reaction, methods such as ATRP (atom transfer radical polymerization) and RAFT (reversible addition-fragmentation chain transfer polymerization) are exemplified in addition to radical polymerization, cationic polymerization, anionic polymerization, living radical polymerization, living cationic polymerization, living anionic polymerization, coordination polymerization, immortal polymerization, and the like. Of these, synthesis by radical polymerization using a

solution polymerization method has advantages in that a resin solution obtained by polymerization can be used without any changes and then can be mixed, in addition to the merits of economic efficiency, a high reaction rate, ease of polymerization control, and the like.

[0026] Examples of an acrylic monomer having a hydroxy group (a hydroxy group-containing monomer) to be used in synthesis of the polymer (A) 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. Among these, in terms of reactivity with the pressure-sensitive adhesive component (B), 2-hydroxyethyl (meth)acrylate is preferred. These may be used alone or in combination of two or more kinds thereof.

[0027] [Pressure-sensitive adhesive component (B)]

The pressure-sensitive adhesive component (B) has a property that reacts the photopolymerization initiator (D) by irradiation of active energy rays (energy curability) and has a hydroxyl group as a cross-linking site. As the pressure-sensitive adhesive component (B) has a hydroxyl group as a cross-linking site, the pressure-sensitive adhesive component (B) is linked with the polymer (A) via the thermal cross-linking agent (C) or the pressure-sensitive adhesive components (B) are linked with each other via the thermal cross-linking agent (C). As described above, the pressure-sensitive adhesive component (B) is cross-linked via the thermal cross-linking agent (C), and thereby even when a low-molecular-weight component is used as the pressure-sensitive adhesive component (B), the bleeding-out thereof can

be sufficiently suppressed. The weight average molecular weight of the pressure-sensitive adhesive component (B) is, for example, 10000 to 2000000, and may be 100000 to 1500000 or 200000 to 1000000. When this molecular weight is less than 10000, there is a tendency that the shape of the film is difficult to maintain or the sticking force with the DAF becomes excessively strong. On the other hand, when this molecular weight exceeds 2000000, the adhesive force is likely to become insufficient. Hereinafter, a method of synthesizing the pressure-sensitive adhesive component (B) will be specifically described by using, as an example, a method of obtaining a (meth)acrylic resin by radical polymerization using a solution polymerization method.

[0028] The monomer used when a (meth)acrylic resin is synthesized is not particularly limited as long as it has one acryloyl group and one methacryloyl group in one molecule. Specific examples thereof include aliphatic (meth)acrylates such as methyl (meth)acrylate, ethyl (meth)acrylate, butyl (meth)acrylate, isobutyl (meth)acrylate, tert-butyl (meth)acrylate, butoxyethyl (meth)acrylate, isoamyl (meth)acrylate, hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, heptyl (meth)acrylate, octylheptyl (meth)acrylate, nonyl (meth)acrylate, decyl (meth)acrylate, undecyl (meth)acrylate, lauryl (meth)acrylate, tridecyl (meth)acrylate, tetradecyl (meth)acrylate, pentadecyl (meth)acrylate, hexadecyl (meth)acrylate, stearyl (meth)acrylate, behenyl (meth)acrylate, methoxypolyethylene glycol (meth)acrylate, ethoxypolyethylene glycol (meth)acrylate, methoxypolypropylene glycol (meth)acrylate, ethoxypolypropylene glycol (meth)acrylate, and

mono(2-(meth)acryloyloxyethyl)succinate; alicyclic (meth)acrylates
 such as cyclopentyl (meth)acrylate, cyclohexyl (meth)acrylate,
 cyclopentyl (meth)acrylate, dicyclopentanylyl (meth)acrylate,
 dicyclopentenyl (meth)acrylate, isobornyl (meth)acrylate,
 5 mono(2-(meth)acryloyloxyethyl)tetrahydrophthalate, and
 mono(2-(meth)acryloyloxyethyl)hexahydrophthalate; aromatic
 (meth)acrylates such as benzyl (meth)acrylate, phenyl (meth)acrylate,
 o-biphenyl (meth)acrylate, 1-naphthyl (meth)acrylate, 2-naphthyl
 (meth)acrylate, phenoxyethyl (meth)acrylate, p-cumylphenoxyethyl
 10 (meth)acrylate, o-phenylphenoxyethyl (meth)acrylate, 1-naphthoxyethyl
 (meth)acrylate, 2-naphthoxyethyl (meth)acrylate, phenoxypolyethylene
 glycol (meth)acrylate, nonylphenoxypolyethylene glycol (meth)acrylate,
 phenoxypolypropylene glycol (meth)acrylate,
 2-hydroxy-3-phenoxypropyl (meth)acrylate,
 15 2-hydroxy-3-(o-phenylphenoxy)propyl (meth)acrylate,
 2-hydroxy-3-(1-naphthoxy)propyl (meth)acrylate, and
 2-hydroxy-3-(2-naphthoxy)propyl (meth)acrylate; heterocyclic
 (meth)acrylates such as 2-tetrahydrofurfuryl (meth)acrylate,
 N-(meth)acryloyloxyethylhexahydrophthalimide, and
 20 2-(meth)acryloyloxyethyl-N-carbazole, and caprolactone-modified
 products thereof; compounds having an ethylenically unsaturated group
 and an epoxy group such as ω -carboxy-polycaprolactone
 mono(meth)acrylate, glycidyl (meth)acrylate, α -ethylglycidyl
 (meth)acrylate, α -propylglycidyl (meth)acrylate, α -butylglycidyl
 25 (meth)acrylate, 2-methylglycidyl (meth)acrylate, 2-ethylglycidyl
 (meth)acrylate, 2-propylglycidyl (meth)acrylate, 3,4-epoxybutyl

(meth)acrylate, 3,4-epoxyheptyl (meth)acrylate, α -ethyl-6,7-epoxyheptyl (meth)acrylate, 3,4-epoxycyclohexylmethyl (meth)acrylate, o-vinylbenzylglycidyl ether, m-vinylbenzylglycidyl ether, and p-vinylbenzylglycidyl ether; compounds having an ethylenically unsaturated group and an oxetanyl group such as
 5 (2-ethyl-2-oxetanyl)methyl (meth)acrylate,
 (2-methyl-2-oxetanyl)methyl (meth)acrylate,
 2-(2-ethyl-2-oxetanyl)ethyl (meth)acrylate,
 2-(2-methyl-2-oxetanyl)ethyl (meth)acrylate,
 10 3-(2-ethyl-2-oxetanyl)propyl (meth)acrylate, and
 3-(2-methyl-2-oxetanyl)propyl (meth)acrylate; compounds having an ethylenically unsaturated group and an isocyanate group such as
 2-(meth)acryloyloxyethyl isocyanate; and compounds having an ethylenically unsaturated group and a hydroxyl group such as
 15 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate,
 4-hydroxybutyl (meth)acrylate, 3-chloro-2-hydroxypropyl (meth)acrylate, and 2-hydroxybutyl (meth)acrylate, and target (meth)acrylic resins can be obtained by appropriately combining these compounds.
 20 [0029] The (meth)acrylic resin preferably has one or a plurality of aromatic rings. In this case, as a monomer for synthesizing the (meth)acrylic resin, it is preferable that one selected from styrene, α -methylstyrene, α -ethylstyrene, α -propylstyrene, α -isopropylstyrene, α -butylstyrene, α -isobutylstyrene, α -tert-butylstyrene, 2-methylstyrene,
 25 4-methylstyrene, 2-ethylstyrene, 4-ethylstyrene, 2-propylstyrene, 4-propylstyrene, 2-isopropylstyrene, 4-isopropylstyrene, 2-butylstyrene,

4-butylstyrene, 2-isobutylstyrene, 4-isobutylstyrene, 2-tert-butylstyrene, 4-tert-butylstyrene, benzyl (meth)acrylate, phenyl (meth)acrylate, o-biphenyl (meth)acrylate, 1-naphthyl (meth)acrylate, 2-naphthyl (meth)acrylate, phenoxyethyl (meth)acrylate, p-cumyl phenoxyethyl (meth)acrylate, o-phenylphenoxyethyl (meth)acrylate, 1-naphthoxyethyl (meth)acrylate, 2-naphthoxyethyl (meth)acrylate, phenoxypropyl glycol (meth)acrylate, nonylphenoxypropyl glycol (meth)acrylate, phenoxypropyl glycol (meth)acrylate, 2-hydroxy-3-phenoxypropyl (meth)acrylate, 2-hydroxy-3-(o-phenylphenoxy)propyl (meth)acrylate, 2-hydroxy-3-(1-naphthoxy)propyl (meth)acrylate, and 2-hydroxy-3-(2-naphthoxy)propyl (meth)acrylate is used, or two or more kinds thereof are used in combination.

[0030] The (meth)acrylic resin preferably has at least one functional group selected from a hydroxyl group, a glycidyl group, an amino group, and the like, as a reactive site (cross-linking site) with a functional group-introduced compound or a cross-linking agent described below. Examples of a monomer for synthesizing a (meth)acrylic resin having a hydroxyl group include compounds having an ethylenically unsaturated group and a hydroxyl group such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 3-chloro-2-hydroxypropyl (meth)acrylate, and 2-hydroxybutyl (meth)acrylate, and these can be used alone or can be used in combination of two or more kinds thereof.

[0031] Examples of a monomer for synthesizing a (meth)acrylic resin having a glycidyl group include compounds having an ethylenically

unsaturated group and an epoxy group such as glycidyl (meth)acrylate, α -ethylglycidyl (meth)acrylate, α -propylglycidyl (meth)acrylate, α -butylglycidyl (meth)acrylate, 2-methylglycidyl (meth)acrylate, 2-ethylglycidyl (meth)acrylate, 2-propylglycidyl (meth)acrylate, 3,4-epoxybutyl (meth)acrylate, 3,4-epoxyheptyl (meth)acrylate, α -ethyl-6,7-epoxyheptyl (meth)acrylate, 3,4-epoxycyclohexylmethyl (meth)acrylate, o-vinylbenzylglycidyl ether, m-vinylbenzylglycidyl ether, and p-vinylbenzylglycidyl ether, and these can be used alone or can be used in combination of two or more kinds thereof.

[0032] The (meth)acrylic resins synthesized from these monomers preferably contain a chain polymerizable functional group. The chain polymerizable functional group is, for example, at least one selected from an acryloyl group and a methacryloyl group. The chain polymerizable functional group can be introduced into a (meth)acrylic resin, for example, by reacting the following compounds (functional group-introduced compounds) with the (meth)acrylic resin synthesized as described above. Specific examples of the functional group-introduced compounds include 2-methacryloyloxyethyl isocyanate, meta-isopropenyl- α,α -dimethylbenzyl isocyanate, methacryloyl isocyanate, allyl isocyanate, 1,1-(bisacryloyloxymethyl)ethyl isocyanate; an acryloyl monoisocyanate compound obtained by reacting a diisocyanate compound or a polyisocyanate compound with a hydroxyethyl (meth)acrylate or 4-hydroxybutyl ethyl (meth)acrylate; and an acryloyl monoisocyanate compound obtained by reacting a diisocyanate compound or a polyisocyanate compound, a polyol compound, and

hydroxyethyl (meth)acrylate. Of these, particularly, 2-methacryloyloxyethyl isocyanate is preferred. These compounds can be used alone or can also be used in combination of two or more kinds thereof.

5 [0033] [Thermal cross-linking agent (C)]

The thermal cross-linking agent (C) is used for controlling the elastic modulus and/or adhesion of the pressure-sensitive adhesive layer 3, for example. The thermal cross-linking agent (C) may be a compound having, in one molecule, two or more functional groups which can react with at least one functional group selected from a hydroxyl group, a glycidyl group, an amino group, and the like of the polymer (A) or the adhesive component (B). Examples of a bond to be formed by reaction between the thermal cross-linking agent (C) and the polymer (A) or the pressure-sensitive adhesive component (B) include an ester bond, an ether bond, an amide bond, an imide bond, a urethane bond, and a urea bond.

15 [0034] In the present embodiment, as the thermal cross-linking agent (C), a compound having two or more isocyanate groups in one molecule is preferably adopted. When such a compound is used, the thermal cross-linking agent (C) easily reacts with a hydroxyl group, a glycidyl group, an amino group, and the like of the polymer (A) or the pressure-sensitive adhesive component (B), and thereby a strong cross-linked structure can be formed.

20 [0035] Examples of the compound having two or more isocyanate groups in one molecule include isocyanate compounds such as 2,4-tolylene diisocyanate, 2,6-tolylene diisocyanate, 1,3-xylylene

diisocyanate, 1,4-xylene diisocyanate, diphenylmethane-4,4'-diisocyanate, diphenylmethane-2,4'-diisocyanate, 3-methyldiphenylmethane diisocyanate, hexamethylene diisocyanate, isophorone diisocyanate, dicyclohexylmethane-4,4'-diisocyanate, dicyclohexylmethane-2,4'-diisocyanate, and lysine isocyanate.

[0036] As the thermal cross-linking agent (C), a reaction product between the above-described isocyanate compound and a polyhydric alcohol having two or more OH groups in one molecule (an isocyanate group-containing oligomer) may be adopted. Examples of the polyhydric alcohol having two or more OH groups in one molecule include ethylene glycol, propylene glycol, butylene glycol, 1,6-hexanediol, 1,8-octanediol, 1,9-nonanediol, 1,10-decanediol, 1,11-undecanediol, 1,12-dodecanediol, glycerin, pentaerythritol, dipentaerythritol, 1,4-cyclohexanediol, and 1,3-cyclohexanediol.

[0037] Of these, the thermal cross-linking agent (C) is further desirably a reaction product between a polyfunctional isocyanate having two or more isocyanate groups in one molecule and a polyhydric alcohol having three or more OH groups in one molecule (an isocyanate group-containing oligomer). By using such an isocyanate group-containing oligomer as the thermal cross-linking agent (C), the pressure-sensitive adhesive layer 3 forms a dense cross-linked structure, and thereby adhesion of the pressure-sensitive adhesive to the adhesive layer 5 in the pickup step can be sufficiently suppressed.

[0038] (Synthesis of photopolymerization component)

The photopolymerization component is synthesized through a step of placing the pressure-sensitive adhesive composition containing

the polymer (A), the pressure-sensitive adhesive component (B), and the thermal cross-linking agent (C) or a product obtained by molding the pressure-sensitive adhesive composition into a film shape in an environment at about 40°C over a predetermined period of time (for example, 3 to 4 days) (aging step), as described above. The content of the polymer (A) in the pressure-sensitive adhesive composition is, for example, 1 to 50% by mass, and may be 5 to 40% by mass or 10 to 30% by mass, based on the total mass of the pressure-sensitive adhesive composition. The content of the pressure-sensitive adhesive component (B) in the pressure-sensitive adhesive composition is, for example, 30 to 98% by mass, and may be 50 to 90% by mass or 60 to 85% by mass, based on the total mass of the pressure-sensitive adhesive composition.

[0039] The content of the thermal cross-linking agent (C) in the pressure-sensitive adhesive composition may be appropriately set according to cohesion force and elongation rate at break required for the pressure-sensitive adhesive layer 3, adhesiveness with the adhesive layer 5, and the like. Specifically, the content of the thermal cross-linking agent (C) is, for example, 3 to 30 parts by mass, and is preferably 5 to 15 parts by mass and more preferably 7 to 10 parts by mass, with respect of 100 parts by mass of the total amount of the polymer (A) and the pressure-sensitive adhesive component (B). When the content of the thermal cross-linking agent is set in the above-described range, a property required for the pressure-sensitive adhesive layer 3 in the dicing step and a property required for the pressure-sensitive adhesive layer 3 in the die bonding step can be

achieved in a balanced manner, and excellent pickup property can be achieved.

[0040] When the content of the thermal cross-linking agent (C) is less than 3 parts by mass with respect to 100 parts by mass of the content of the total amount of the polymer (A) and the pressure-sensitive adhesive component (B), the formation of the cross-linked structure is likely to become insufficient, and thereby the sticking force of the interface with the adhesive layer 5 is not sufficiently lowered in the pickup step, and thus defects are likely to occur at the time of picking-up. On the other hand, when the content of the thermal cross-linking agent (C) exceeds 30 parts by mass with respect of 100 parts by mass of the total amount of the polymer (A) and the pressure-sensitive adhesive component (B), the pressure-sensitive adhesive layer 3 is likely to be excessively cured, and thereby a semiconductor chip is likely to be peeled in the expansion step.

[0041] The above-described pressure-sensitive adhesive composition is subjected to the above-described aging step, and thereby a cross-linking reaction proceeds to synthesize a photopolymerization component. Although the structure of the photopolymerization component that is a polymer is difficult to be specified, whether the photopolymerization component is synthesized can be figured out by measuring the amounts of the polymer (A) and the pressure-sensitive adhesive component (B) remaining alone in the pressure-sensitive adhesive composition after the aging step. It is sufficient that the amount of the pressure-sensitive adhesive component (B) remaining alone in the pressure-sensitive adhesive composition (the pressure-sensitive adhesive layer 3) after the

aging step is further reduced than the charged amount thereof (the amount before the aging step). It is sufficient that the amount of the polymer (A) remaining alone in the pressure-sensitive adhesive composition (the pressure-sensitive adhesive layer 3) after the aging step is further reduced than the charged amount thereof (the amount before the aging step).

[0042] (Photopolymerization initiator (D))

Next, the photopolymerization initiator (D) contained in the pressure-sensitive adhesive layer 3 along with the above-described photopolymerization component will be described. The photopolymerization initiator (D) is not particularly limited as long as it generates a chain polymerizable active species by irradiation of active energy rays (at least one selected from ultraviolet rays, electron beams, and visible rays), and for example, a photoradical polymerization initiator is exemplified. Herein, the chain polymerizable active species means one which reacts with a chain polymerizable functional group to start a polymerization reaction.

[0043] Examples of the photoradical polymerization initiator include benzoin ketals such as 2,2-dimethoxy-1,2-diphenylethane-1-one; α -hydroxyketones such as 1-hydroxycyclohexylphenylketone, 2-hydroxy-2-methyl-1-phenylpropan-1-one, and 1-[4-(2-hydroxyethoxy)phenyl]-2-hydroxy-2-methyl-1-propan-1-one; α -aminoketones such as 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butan-1-one, and 1,2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropan-1-one; oxime esters such as

1-[4-(phenylthio)phenyl]-1,2-octadione-2-(benzoyl)oxime; phosphine oxides such as bis(2,4,6-trimethylbenzoyl)phenylphosphine oxide, bis(2,6-dimethoxybenzoyl)-2,4,4-trimethylpentylphosphine oxide, and 2,4,6-trimethylbenzoyldiphenylphosphine oxide; 2,4,5-triarylimidazole dimers such as 2-(o-chlorophenyl)-4,5-diphenylimidazole dimer, 2-(o-chlorophenyl)-4,5-di(methoxyphenyl)imidazole dimer, 2-(o-fluorophenyl)-4,5-diphenylimidazole dimer, 2-(o-methoxyphenyl)-4,5-diphenylimidazole dimer, and 2-(p-methoxyphenyl)-4,5-diphenylimidazole dimer; benzophenone compounds such as benzophenone, N,N'-tetramethyl-4,4'-diaminobenzophenone, N,N'-tetraethyl-4,4'-diaminobenzophenone, and 4-methoxy-4'-dimethylaminobenzophenone; quinone compounds such as 2-ethylanthraquinone, phenanthrenequinone, 2-tert-butylanthraquinone, octamethylanthraquinone, 1,2-benzanthraquinone, 2,3-benzanthraquinone, 2-phenylanthraquinone, 2,3-diphenylanthraquinone, 1-chloroanthraquinone, 2-methylanthraquinone, 1,4-naphthoquinone, 9,10-phenanthraquinone, 2-methyl-1,4-naphthoquinone, and 2,3-dimethylanthraquinone; benzoin ethers such as benzoin methyl ether, benzoin ethyl ether, and benzoin phenyl ether; benzoin compounds such as benzoin, methyl benzoin, and ethyl benzoin; benzyl compounds such as benzyl dimethyl ketal; acridine compounds such as 9-phenylacridine and 1,7-bis(9,9'-acridinyl heptane); and N-phenylglycine and coumarin.

[0044] The content of the photopolymerization initiator (D) in the pressure-sensitive adhesive layer 3 is, for example, 0.1 to 30 parts by

mass, preferably 0.3 to 10 parts by mass, and more preferably 0.5 to 5 parts by mass, with respect to 100 parts by mass of the content of the photopolymerization component. When the content of the photopolymerization initiator (D) is less than 0.1 parts by mass, the pressure-sensitive adhesive layer 3 is not sufficiently cured after irradiation of active energy rays, and thus a pickup failure is likely to occur. When the content of the photopolymerization initiator (D) exceeds 30 parts by mass, contamination of the adhesive layer (transfer of the photopolymerization initiator to the adhesive layer) is likely to occur.

[0045] The thickness of the pressure-sensitive adhesive layer 3 may be appropriately set according to conditions (such as a temperature and a tension) of the expansion step, and is, for example, 1 to 200 μm , preferably 5 to 50 μm , and more preferably 10 to 20 μm . When the thickness of the pressure-sensitive adhesive layer 3 is less than 1 μm , adhesion is likely to become insufficient; on the other hand, when the thickness thereof exceeds 200 μm , separation property at the time of cool expansion is likely to become insufficient.

[0046] The pressure-sensitive adhesive layer 3 is formed on the base layer 1. As a method of forming the pressure-sensitive adhesive layer 3, a known method can be adopted. For example, a laminate of the base layer 1 and the pressure-sensitive adhesive layer 3 may be formed by a two layer extrusion method, and a varnish for forming the pressure-sensitive adhesive layer 3 may be prepared and applied to the surface of the base layer 1 or the pressure-sensitive adhesive layer 3 may be formed on a film subjected to a mold release treatment and

transferred to the base layer 1.

[0047] The varnish for forming the pressure-sensitive adhesive layer 3 is preferably prepared by using an organic solvent that can dissolve the photopolymerization component and the photopolymerization initiator (D) and volatilizes by heating. Specific examples of the organic solvent include aromatic hydrocarbons such as toluene, xylene, mesitylene, cumene, and p-cymene; cyclic ethers such as tetrahydrofuran and 1,4-dioxane; alcohols such as methanol, ethanol, isopropanol, butanol, ethylene glycol, and propylene glycol; ketones such as acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone, and 4-hydroxy-4-methyl-2-pentanone; esters such as methyl acetate, ethyl acetate, butyl acetate, methyl lactate, ethyl lactate, and γ -butyrolactone; carbonic esters such as ethylene carbonate and propylene carbonate; polyhydric alcohol alkyl ethers such as ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monobutyl ether, ethylene glycol dimethyl ether, ethylene glycol diethyl ether, propylene glycol monomethyl ether, propylene glycol monoethyl ether, propylene glycol dimethyl ether, propylene glycol diethyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, diethylene glycol dimethyl ether, and diethylene glycol diethyl ether; polyhydric alcohol alkyl ether acetates such as ethylene glycol monomethyl ether acetate, ethylene glycol monoethyl ether acetate, ethylene glycol monobutyl ether acetate, propylene glycol monomethyl ether acetate, propylene glycol monoethyl ether acetate, diethylene glycol monomethyl ether acetate, and diethylene glycol monoethyl ether acetate; and amides such

as N,N-dimethylformamide, N,N-dimethylacetamide, and N-methylpyrrolidone.

[0048] Of these, from the viewpoint of solubility and a boiling point, for example, toluene, methanol, ethanol, isopropanol, acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone, methyl acetate, ethyl acetate, butyl acetate, ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, propylene glycol monomethyl ether, propylene glycol monoethyl ether, diethylene glycol dimethyl ether, ethylene glycol monomethyl ether acetate, propylene glycol monomethyl ether acetate, and N,N-dimethylacetamide are preferred. These organic solvents may be used alone or may be used in combination of two or more kinds thereof. The solid content concentration of the varnish is generally preferably 10 to 60% by mass.

[0049] <Base layer>

As the base layer 1, a known polymer can be used. Specifically, examples of the base layer 1 include polyolefins such as crystalline polypropylene, amorphous polypropylene, high-density polyethylene, intermediate-density polyethylene, low-density polyethylene, very low-density polyethylene, low-density linear polyethylene, polybutene, and polymethylpentene; an ethylene-vinylacetate copolymer; an ionomer resin; an ethylene-(meth)acrylic acid copolymer; an ethylene-(meth)acrylic acid ester (random or alternating) copolymer; an ethylene-butene copolymer; an ethylene-hexene copolymer; polyurethane; polyesters such as polyethylene terephthalate and polyethylene naphthalate; polycarbonate; polyimide; polyetheretherketone; polyimide; polyetherimide;

polyamide; whole aromatic polyamides; polyphenylsulfide; aramid (paper); glass; glass cloth; a fluorine resin; polyvinyl chloride; polyvinylidene chloride; a cellulose-based resin; a silicone resin; or mixtures obtained by mixing a plasticizer with these components or cured products subjected to cross-linkage by electron beam irradiation.

[0050] It is preferable that the base layer 1 has a surface having, as a main component, at least one resin selected from polyethylene, polypropylene, a polyethylene-polypropylene random copolymer, and a polyethylene-polypropylene block copolymer, and this surface is in contact with the adhesive layer 3. These resins are favorable base materials also from the viewpoints of characteristics such as a Young's modulus, stress alleviation property, and a melting point, costs, waste material recycle after use, and the like. The base layer 1 may be a single layer, but may have a multi-layered structure in which layers formed by different materials are stacked, as necessary. In order to control adhesiveness with the pressure-sensitive adhesive layer 3, a surface roughening treatment such as a matting treatment or a corona treatment may be performed with respect to the surface of the base layer 1.

[0051] <Adhesive layer>

A known adhesive composition constituting a die bonding film can be applied to the adhesive layer 5. Specifically, an adhesive composition constituting the adhesive layer 5 preferably contains an epoxy group-containing acrylic copolymer, an epoxy resin, and an epoxy resin curing agent. According to the adhesive layer 5 containing these components, there are characteristics that adhesiveness between a

chip and a substrate and between chips is excellent, electrode
embeddability, wire embeddability, and the like can also be imparted,
adhesion can be performed at a low temperature in the die bonding step,
excellent curing is obtainable in a short time, excellent reliability is
5 obtained after molding with a sealing agent, and the like, which are
preferable.

[0052] Examples of the epoxy resin include a bisphenol A type epoxy
resin, a bisphenol F type epoxy resin, a bisphenol S type epoxy resin, an
alicyclic epoxy resin, an linear aliphatic epoxy resin, a phenol novolak
10 type epoxy resin, a cresol novolak type epoxy resin, a bisphenol A
novolak type epoxy resin, a diglicidyletherified product of biphenol, a
diglicidyletherified product of naphthalenediol, a diglicidyletherified
product of phenols, a diglycidyletherified product of alcohols, and a
bifunctional epoxy resin of an alkyl-substitution product, halide,
15 hydrogen additive, or the like of these materials, and a novolak type
epoxy resin. Furthermore, generally known other epoxy resins such as
a polyfunctional epoxy resin and a heterocyclic ring-containing epoxy
resin may be applied. These can be used alone or can be used in
combination of two or more kinds thereof. Incidentally, components
20 other than the epoxy resins may be contained as impurities in a range
that does not impair properties.

[0053] As the epoxy resin curing agent, for example, those like a
phenolic resin that can be obtained by reacting a phenolic compound
with a xylylene compound, which is a bivalent linking group, in the
25 absence of a catalyst or in the presence of an acid catalyst are
exemplified. Examples of the phenolic compound used in the

production of the phenolic resin include phenol, o-cresol, m-cresol, p-cresol, o-ethylphenol, p-ethylphenol, o-n-propylphenol, m-n-propylphenol, p-n-propylphenol, o-isopropylphenol, m-isopropylphenol, p-isopropylphenol, o-n-butylphenol, m-n-butylphenol, p-n-butylphenol, o-isobutylphenol, m-isobutylphenol, p-isobutylphenol, octylphenol, nonylphenol, 2,4-xyleneol, 2,6-xyleneol, 3,5-xyleneol, 2,4,6-trimethylphenol, resorcin, catechol, hydroquinone, 4-methoxyphenol, o-phenylphenol, m-phenylphenol, p-phenylphenol, p-cyclohexylphenol, o-allylphenol, p-allylphenol, o-benzylphenol, p-benzylphenol, o-chlorophenol, p-chlorophenol, o-bromophenol, p-bromophenol, o-iodophenol, p-iodophenol, o-fluorophenol, m-fluorophenol, and p-fluorophenol. These phenolic compounds may be used alone or may be used as a mixture of two or more kinds thereof. As the xylylene compound, which is a bivalent linking group, used in the production of the phenolic resin, xylylene dihalide, xylylene diglycol, and a derivative thereof listed below can be used. That is, examples thereof include α,α' -dichloro-p-xylene, α,α' -dichloro-m-xylene, α,α' -dichloro-o-xylene, α,α' -dibromo-p-xylene, α,α' -dibromo-m-xylene, α,α' -dibromo-o-xylene, α,α' -diiodo-p-xylene, α,α' -diiodo-m-xylene, α,α' -diiodo-o-xylene, α,α' -dihydroxy-p-xylene, α,α' -dihydroxy-m-xylene, α,α' -dihydroxy-o-xylene, α,α' -dimethoxy-p-xylene, α,α' -dimethoxy-m-xylene, α,α' -dimethoxy-o-xylene, α,α' -diethoxy-p-xylene, α,α' -diethoxy-m-xylene, α,α' -diethoxy-o-xylene, α,α' -di-n-propoxy-p-xylene, and α,α' -di-n-propoxy-m-xylene.

α,α' -di-n-propoxy-o-xylene, α,α' -di-isopropoxy-p-xylene,
 α,α' -diisopropoxy-m-xylene, α,α' -diisopropoxy-o-xylene,
 α,α' -di-n-butoxy-p-xylene, α,α' -di-n-butoxy-m-xylene,
 α,α' -di-n-butoxy-o-xylene, α,α' -diisobutoxy-p-xylene,
5 α,α' -diisobutoxy-m-xylene, α,α' -diisobutoxy-o-xylene,
 α,α' -di-tert-butoxy-p-xylene, α,α' -di-tert-butoxy-m-xylene, and
 α,α' -di-tert-butoxy-o-xylene. These can be used alone or can be used
in combination of two or more kinds thereof.

[0054] When the phenolic compound and the xylylene compound
10 described above are reacted with each other, the reaction can be
performed by using an acidic catalyst such as mineral acids such as
hydrochloric acid, sulfuric acid, phosphoric acid, and polyphosphoric
acid; organic carboxylic acids such as dimethyl sulphate, diethyl
sulphate, p-toluenesulfonic acid, methanesulfonic acid, and
15 ethanesulfonic acid; superacids such as trifluoromethanesulfonic acid;
strong acid ion-exchange resins such as an alkanesulfonic acid type
ion-exchange resin; superacid type ion-exchange resins such as a
perfluoroalkanesulfonic acid type ion-exchange resin (trade name:
Nafion manufactured by Du Pont, "Nafion" is the registered trademark);
20 natural and synthetic zeolites; and activated clay (acid clay), until the
xylylene compound serving as a raw material substantially disappears at
50°C to 250°C and the reaction composition becomes constant.
Although depending on a raw material and a reaction temperature, a
reaction time is approximately 1 to 15 hours, and in practice, may be
25 decided while following a reaction composition by GPC (gel
permeation chromatography) or the like.

[0055] The epoxy group-containing acrylic copolymer is preferably a copolymer obtained by using glycidyl acrylate or glycidyl methacrylate as a raw material in an amount of 0.5 to 6% by mass with respect to a copolymer to be obtained. When this amount is 0.5% by mass or more, high adhesive force is easily obtained; on the other hand, when this amount is 6% by mass or less, gelation can be suppressed. For the remaining part, alkyl acrylates having an alkyl group having 1 to 8 carbon atoms, such as methyl acrylate or methyl methacrylate, and a mixture of alkyl methacrylate, styrene, acrylonitrile, and the like can be used. Of these, ethyl (meth)acrylate and/or butyl (meth)acrylate are particularly preferable. The mixing ratio is preferably adjusted in consideration of Tg of the copolymer. When Tg is lower than -10°C, the tackiness of the adhesive layer 5 in the B-stage state tends to increase, and handleability tends to deteriorate. Incidentally, the upper limit value of the glass transition temperature (Tg) of the epoxy group-containing acrylic copolymer is, for example, 30°C. The polymerization method is not particularly limited, and for example, pearl polymerization and solution polymerization are exemplified. As a commercially available epoxy group-containing acrylic copolymer, for example, HTR-860P-3 (trade name, manufactured by Nagase ChemteX Corporation) is exemplified.

[0056] The weight average molecular weight of the epoxy group-containing acrylic copolymer is 100000 or more, when the weight average molecular weight is in this range, adhesiveness and heat resistance are high, and the weight average molecular weight is preferably 300000 to 3000000 and more preferably 500000 to 2000000.

When the weight average molecular weight is 3000000 or less, a decrease in fillability between a semiconductor chip and a substrate supporting the semiconductor chip can be suppressed. The weight average molecular weight is a value in terms of polystyrene using a calibration curve of standard polystyrene by gel permeation chromatography (GPC).

[0057] The adhesive layer 5 may further contain, as necessary, curing accelerators such as tertiary amine, imidazoles, and quaternary ammonium salts. Specific examples of the curing accelerator include 2-methylimidazole, 2-ethyl-4-methylimidazole, 1-cyanoethyl-2-phenylimidazole, and 1-cyanoethyl-2-phenylimidazolium trimellitate. These may be used alone or may be used in combination of two or more kinds thereof.

[0058] The adhesive layer 5 may further contain, as necessary, an inorganic filler. Specific examples of the inorganic filler include aluminum hydroxide, magnesium hydroxide, calcium carbonate, magnesium carbonate, calcium silicate, magnesium silicate, calcium oxide, magnesium oxide, aluminum oxide, aluminum nitride, aluminum borate whisker, boron nitride, crystalline silica, and amorphous silica. These may be used alone or may be used in combination of two or more kinds thereof.

[0059] The thickness of the adhesive layer 5 is, for example, 1 to 300 μm , preferably 5 to 150 μm , more preferably 10 to 100 μm . When the thickness of the adhesive layer 5 is less than 1 μm , adhesiveness is likely to become insufficient; on the other hand, when the thickness thereof exceeds 300 μm , separation property at the time of expansion

and pickup property are likely to become insufficient.

[0060] Hereinbefore, embodiments of the present disclosure have been described in detail, but the present invention is not limited to the above embodiments. For example, in the above-described embodiment, the dicing/die bonding integrated film 10 including the base layer 1, the pressure-sensitive adhesive layer 3, and the adhesive layer 5 in this order has been exemplified, but an embodiment not including the adhesive layer 5 may be employed. FIG. 2 is a cross-sectional view schematically illustrating an embodiment of a pressure-sensitive adhesive film for dicing according to the present disclosure. A pressure-sensitive adhesive film 20 for dicing illustrated in FIG. 2 includes the base layer 1 and the pressure-sensitive adhesive layer 3 provided on the base layer 1. Furthermore, the films 10 and 20 may further include a cover film (not illustrated) covering the outermost layer opposite to the base layer 1. That is, the film 10 may further include a cover film covering the adhesive layer 5, and the film 20 may further include a cover film covering the pressure-sensitive adhesive layer 3.

Examples

[0061] Hereinafter, the present disclosure will be described in more detail on the basis of Examples; however, the present invention is not limited to these Examples. Incidentally, unless otherwise specified, chemicals used were all reagents.

[0062] <Production of polymer (A)>

(Production Example A1)

A polymer (A) according to Production Example 1 was obtained

by copolymerizing the following plurality of monomers (see Production Example 1 of Table 1).

· Quaternary ammonium salt monomer:
[2-(Methacryloyloxy)ethyl]trimethylammonium
5 bis(trifluoromethylsulfonyl)imide 50 parts by mass

· Polymerizable monomer: 2-Ethylhexyl acrylate 40 parts by mass

· 2-Hydroxyethyl acrylate 10 parts by mass

[0063] The acid value and the hydroxyl value of this resin were
10 measured according to JIS K0070, and as a result, the acid value was 0.0 mgKOH/g, and the hydroxyl value was 48.4 mgKOH/g.

[0064] The obtained polymer (A) was vacuum-dried at 60°C overnight, the obtained solid content was subjected to elemental analysis with a full automatic elemental analysis apparatus varioEL manufactured by
15 Elementar, and the content of the introduced 2-methacryloxyethyl isocyanate (the amount of the chain polymerizable functional group) was calculated from the content of nitrogen.

[0065] GPC measurement was performed by using SD-8022/DP-8020/RI-8020 manufactured by Tosoh Corporation, using
20 Gelpack GL-A150-S/GL-A160-S manufactured by Hitachi Chemical Company, Ltd. as a column, and using tetrahydrofuran as an eluent, and as a result, the weight average molecular weight in terms of polystyrene was 20000. The results are shown in Table 1.

[0066] (Production Examples A2 and A3)

25 Polymers (A) according to Production Examples A2 and A3 were obtained in the same manner as in Production Example A1, except

that monomers described in Production Examples A2 and A3 of Table 1 were used, and the weight average molecular weight and the like were measured. The results are shown in Table 1.

[0067] [Table 1]

	Polymer (A)	Production Example A1	Production Example A2	Production Example A3
Mixing amount (parts by mass)	[2-(Methacryloyloxy)ethyl]trimethylammonium bis(trifluoromethylsulfonyl)imide	50	50	50
	2-Ethylhexyl acrylate	40	35	45
	2-Hydroxyethyl acrylate	10	10	-
	Methacrylic acid	-	5	5
	Glycidyl methacrylate	-	-	-
	Weight average molecular weight	20000	50000	30000
Result	Hydroxyl value (mgKOH/g)	48.4	48.4	0.0
	Acid value (mgKOH/g)	48.4	32.6	32.6
	Amount (mmol/g) of chain functional group	0.0	0.0	0.0

[0068] <Synthesis of pressure-sensitive adhesive component (B)>

(Production Example B1)

A polymer was obtained by copolymerizing the following components.

- 20 parts by mass of 2-hydroxyethyl acrylate (a copolymerization component having a hydroxyl group),
- 79 parts by mass of 2-ethylhexyl acrylate, and
- 1 part by mass of methacrylic acid were copolymerized.

Methoquinone as a polymerization inhibitor and dioctyltin dilaurate as a urethane-forming catalyst were added to the obtained polymer, 16.2 parts by mass of 2-methacryloxyethyl isocyanate (Karencz MOI manufactured by Showa Denko K.K.) was then added, and thereby an acrylic resin solution having a chain polymerizable functional group (a solution containing the pressure-sensitive adhesive component (B)) was obtained.

[0069] The acid value and the hydroxyl value were measured, and as a result, the acid value was 6.5 mgKOH/g, and the hydroxyl value was 32.8 mgKOH/g. Furthermore, the obtained acrylic resin was vacuum-dried at 60°C overnight, the obtained solid content was subjected to elemental analysis with a full automatic elemental analysis apparatus varioEL manufactured by Elementar, the content of the introduced 2-methacryloxyethyl isocyanate (the amount of the chain polymerizable functional group) was calculated from the content of nitrogen, and as a result, the content thereof was 0.9 mmol/g.

[0070] GPC measurement was performed by using SD-8022/DP-8020/RI-8020 manufactured by Tosoh Corporation, using

Gelpack GL-A150-S/GL-A160-S manufactured by Hitachi Chemical Company, Ltd. as a column, and using tetrahydrofuran as an eluent, and as a result, the weight average molecular weight in terms of polystyrene was 300000. The results are shown in Table 2.

5 [0071] (Production Example B2)

An acrylic resin solution (a solution containing the adhesive component (B)) according to Production Example B2 was obtained in the same manner as in Production Example B1, except that monomers described in Production Example B2 of Table 2 were used, and the weight average molecular weight and the like were measured. The results are shown in Table 2.

10

[0072] [Table 2]

Adhesive component (B)		Production Example B1	Production Example B2
Mixing amount (parts by mass)	2-Ethylhexyl acrylate	79	80
	2-Hydroxyethyl acrylate	20	20
	Methacrylic acid	1	-
Result	Weight average molecular weight	300000	400000
	Hydroxyl value (mgKOH/g)	32.8	60.8
	Acid value (mgKOH/g)	6.5	0.0
	Amount (mmol/g) of chain polymerizable functional group	0.9	0.5

[0073] <Production of dicing film>

(Example 1)

A mixture of the following components (A) to (D) and ethyl acetate added so as to have the total solid content of these components of 25% by mass was stirred for 10 minutes, and thereby a varnish for a dicing film (for an adhesive layer) was obtained.

15

(A) Polymer according to Production Example A1 10 g (solid

content)

(B) Acrylic resin according to Production Example B1 100 g
(solid content)

(C) Thermal cross-linking agent: Polyfunctional isocyanate
(Coronate L manufactured by Nippon Polyurethane Industry Co., Ltd.,
solid content: 75%) 8.0 g (solid content)

(D) Photopolymerization initiator: 1-Hydroxy cyclohexyl phenyl
ketone (IRGACURE 184 manufactured by Ciba Specialty Chemicals
Co., Ltd., "IRGACURE" is the registered trademark) 1.0 g

[0074] The varnish for a pressure-sensitive adhesive was coated on a
polyethylene terephthalate film having a width of 450 mm, a length of
500 mm, and a thickness of 38 μm in which one surface was subjected
to a release treatment by using an applicator while adjusting a gap so
that the thickness became 10 μm , and then the varnish was dried at
80°C for 5 minutes. Separately, a polyolefin film having a width of
450 mm, a length of 500 mm, and a thickness of 100 μm in which one
surface was subjected to a corona treatment was used, the
corona-treated surface of the polyolefin film and the pressure-sensitive
adhesive layer surface of the aforementioned pressure-sensitive
adhesive layer-attached polyethylene terephthalate film were pasted at
room temperature and stuck by a rubber roll, and thereby the adhesive
layer was transferred to the polyolefin film. Thereafter, through the
step of leaving the resultant product to stand at room temperature for 3
days (aging step), a cover film-attached dicing film was obtained.

[0075] <Production of pressure-sensitive adhesive single layer film>

A varnish for a pressure-sensitive adhesive layer for a dicing

film was produced in the same manner as described above, the varnish for a pressure-sensitive adhesive was coated on a polyethylene terephthalate film having a width of 450 mm, a length of 500 mm, and a thickness of 38 μm in which one surface was subjected to a release treatment by using an applicator while adjusting a gap so that the thickness of the pressure-sensitive adhesive layer became 10 μm , and then the varnish was dried at 80°C for 5 minutes. Separately, a polyethylene terephthalate film having a width of 450 mm, a length of 500 mm, and a thickness of 25 μm in which one surface was subjected to a release treatment was used, the release-treated surface of the polyethylene terephthalate film and the pressure-sensitive adhesive layer surface of the aforementioned pressure-sensitive adhesive layer-attached polyethylene terephthalate film were pasted at room temperature, and thereby a pressure-sensitive adhesive layer single layer film was produced.

[0076] <Production of die bonding film>

Cyclohexanone was added to a composition containing the following components, and the resultant product was stirred and mixed and further kneaded for 90 minutes by using a bead mill.

- Epoxy resin: YDCN-703 (manufactured by TOHTO Chemical Industry Co., Ltd., trade name, cresol novolak type epoxy resin, epoxy equivalent: 210, molecular weight: 1200, softening point: 80°C) 55 parts by mass

- Phenolic resin: MILEX XLC-LL (manufactured by Mitsui Chemicals, Inc., trade name, phenolic resin, hydroxyl equivalent: 175, water absorption percentage: 1.8%, heating mass decrease rate at

350°C: 4%) 45 parts by mass

· Silane coupling agent: NUC A-189 (manufactured by NUC Corporation, trade name, γ -mercaptopropyl trimethoxysilane) 1.7 parts by mass, and NUC A-1160 (manufactured by NUC Corporation, trade name, γ -ureidopropyl triethoxysilane) 3.2 parts by mass

· Filler : AEROSIL R972 (a filler having an organic group such as a methyl group on the surface in which dimethyldichlorosilane is coated on the silica surface and is hydrolyzed in a reactor set at 400°C, manufactured by Nippon Aerosil Co., Ltd., trade name, silica, average particle diameter: 0.016 μ m) 32 parts by mass

[0077] 280 parts by mass of acrylic rubber HTR-860P-3 (manufactured by Nagase ChemteX Corporation, trade name, weight average molecular weight: 800000) containing 3% by mass of glycidyl acrylate or glycidyl methacrylate and 0.5 parts by mass of CUREZOL 2PZ-CN (manufactured by SHIKOKU CHEMICALS CORPORATION, trade name, 1-cyanoethyl-2-phenylimidazole, "CUREZOL" is the registered trademark) as a curing accelerator were added to the mixture obtained as described above, stirred and mixed, and subjected to vacuum deaeration, and thereby a varnish was obtained.

[0078] The varnish was applied onto the polyethylene terephthalate film having a thickness of 35 μ m which has been subjected to the release treatment, and then dried by heating at 140°C for 5 minutes to form a coating film in a B-stage state having a film thickness of 10 μ m, and thereby a die bonding film provided with a carrier film was produced.

[0079] <Production of dicing/die bonding integrated film>

The aforementioned die bonding film was cut into a circle having a diameter of 318 mm for each carrier film. The dicing film from which the cover film was peeled was pasted thereto at room temperature and left to stand at room temperature for one day. Thereafter, the dicing film was cut into a circle having a diameter of 370 mm, and thereby a dicing/die bonding integrated film according to Example 1 was obtained. Incidentally, a plurality of dicing/die bonding integrated films were produced for the following evaluation.

[0080] (Measurement of storage elastic modulus at 23°C of pressure-sensitive adhesive layer)

The storage elastic modulus at 23°C of the pressure-sensitive adhesive layer was measured by using a dynamic viscoelasticity measuring apparatus Autograph (registered trademark) manufactured by UBM. The aforementioned pressure-sensitive adhesive single layer film was used as a measurement sample. Both the polyethylene terephthalate films of the pressure-sensitive adhesive layer cut into a width of 50 mm and a length of 30 mm were peeled and the pressure-sensitive adhesive single layer was closely gathered. The elastic modulus at 23°C of the pressure-sensitive adhesive layer (non-UV irradiation) was measured at an inter-chuck distance of 20 mm and a frequency of 1 Hz.

[0081] (Measurement of surface resistivity of pressure-sensitive adhesive layer)

The dicing/die bonding integrated film according to Example 1 was cut into a size of 150 mm × 150 mm and this cut film was used as a measurement sample. The release sheet was peeled from the

measurement sample in an environment of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $50 \pm 2\%$ RH, and the surface resistivity of the exposed surface of the pressure-sensitive adhesive layer was measured according to JIS K6911 by using a high resistivity meter (manufactured by Mitsubishi Chemical Corporation, HIRESTA-UP MCP-HT450). A value after 30 seconds from the start of measurement was read, and this value was regarded as the surface resistivity ($\Omega/\square$) of the pressure-sensitive adhesive layer (before UV irradiation). The dicing/die bonding integrated film according to Example 1 was irradiated with ultraviolet rays under conditions of 70 mW and $200 \text{ mJ}/\text{cm}^2$, and then the surface resistivity ($\Omega/\square$) was measured in the same manner as described above. This surface resistivity was regarded as the surface resistivity ($\Omega/\square$) of the pressure-sensitive adhesive layer (after UV irradiation).

[0082] (30° peeling after UV curing)

The dicing/die bonding integrated film according to Example 1 was irradiated with ultraviolet rays under conditions of 70 mW and $200 \text{ mJ}/\text{cm}^2$. After irradiation of ultraviolet rays, the film was cut into a width of 25 mm. This film was used as a measurement sample. This measurement sample was pasted to a silicon mirror wafer mounted on a hot plate set at 40°C . After the measurement sample was left to stand for about 30 minutes, the peeling adhesive force was measured by using a tensile tester. The measurement conditions were set to a peeling angle of 30° and a tension rate of 60 mm/min. Incidentally, the storage of the measurement sample and the measurement of the peeling adhesive force were performed in an environment of a temperature of 23°C and a relative humidity of 50%.

[0083] (Pickup property)

The dicing/die bonding integrated film according to Example 1 was pasted to an 8-inch wafer (thickness: 50 μm) at 80°C over 10 seconds, and then was diced into 10 mm $\times$ 10 mm. The pickup property of the semiconductor chip obtained by the above-described step was evaluated by using a flexible die holder "DB-730" manufactured by Renesas Eastern Japan Semiconductor, Inc. "RUBBER TIP13-087E-33 (size: 10 $\times$ 10 mm)" manufactured by Micromechanics, Inc. was used as a collet for pickup. "EJECTOR NEEDLE SEN2-83-05 (diameter: 0.7 mm, tip end shape: hemisphere having a diameter of 350 μm)" manufactured by Micromechanics, Inc. was used as a thrust-up pin. Nine thrust-up pins were disposed with a pin center distance of 4.2 mm. The pickup property was evaluated under conditions of a thrust-up rate of the pin of 10 mm/s and a thrust-up height of 200 μm at the time of pickup. In a case where 100 chips were continuously picked up and errors such as chip cracks or pickup errors did not occur was determined as "A", a case where errors occurred even one chip was determined as "B", a case where errors occurred in two to five chips was determined as "C", and a case where errors occurred at a higher rate as compared with other cases was determined as "D".

[0084] (Die shear strength)

The chip compression-bonded to a lead frame was placed on a stage, the chip was pulled while being caught by Multipurpose Bondtester Series 4000 (manufactured by Nordson DAGE), and thereby the interface adhesive force between the chip and the lead frame (before

UV irradiation) was measured. As the measurement condition, the measurement was performed at a stage temperature of room temperature.

[0085] (Examples 2 to 7 and Comparative Examples 1 and 2)

- 5 Dicing/die bonding integrated films and the like were produced by using the pressure-sensitive adhesive composition prepared in the same manner as in Example 1, except that compositions of the pressure-sensitive adhesive layer composition shown in Table 3 and Table 4 were used, and the above-described evaluation was performed.

[0086] [Table 3]

		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7
Pressure-sensitive adhesive layer composition (parts by mass)	Polymer (A)	Production Example A1	10	20	-	-	5	-
		Production Example A2	-	-	10	5	-	5
		Production Example A3	-	-	-	-	-	-
	Pressure-sensitive adhesive component (B)	Production Example B1	100	100	100	100	-	-
		Production Example B2	-	-	-	-	100	100
	Thermal cross-linking agent (C)	8	8	8	8	8	7	7
Properties of pressure-sensitive adhesive layer	Photopolymerization initiator (D)	1	1	1	1	1	1	1
	Storage elastic modulus (MPa) at 23°C	35	39	33	34	36	22	23
	Surface resistance	3.5×10^{10}	7.6×10^{11}	1.4×10^{10}	3.5×10^{10}	8.2×10^{11}	5.4×10^{11}	7.9×10^{11}
	Surface value ($\Omega/\square$)	1.9×10^{11}	3.3×10^{12}	9.7×10^{10}	4.5×10^{11}	4.0×10^{12}	2.3×10^{12}	4.4×10^{12}
Die bonding properties	30° peeling strength (N/25 mm)	0.71	0.73	0.79	0.76	0.74	1.1	1.0
	Pickup property	A	A	B	A	A	A	A
	Die shear strength (MPa)	4.1	4.2	3.4	4.2	4.1	3.9	4.0

[0087] [Table 4]

			Comparative Example 1	Comparative Example 2
Pressure-sensitive adhesive layer composition (parts by mass)	Polymer (A)	Production Example A1	-	-
		Production Example A2	-	-
		Production Example A3	-	10
	Adhesive component (B)	Production Example B1	100	100
		Production Example B2	-	-
	Thermal cross-linking agent (C)		8	8
Properties of pressure-sensitive adhesive layer	Photopolymerization initiator (D)		1	1
	Storage elastic modulus (MPa) at 23°C		41	32
	Surface resistance value (Ω)	Before UV irradiation	2.5×10^{14}	4.9×10^{10}
		After UV irradiation	8.8×10^{14}	4.5×10^{11}
	30° peeling strength (N/25 mm)		0.67	1.2
Die bonding properties	Pickup property		A	D
	Die shear strength (MPa)		4.0	1.9

[0088] As shown in Table 3, since the dicing/die bonding integrated films according to Examples 1 to 7 had excellent antistatic properties because of a low surface resistivity, and in the die bonding step, even in the case of a low thrust-up height, picking-up was possible and the adhesive layer also had excellent die bonding properties.

[0089] On the other hand, in Comparative Example 1 shown in Table 4, the surface resistivity is high. In Comparative Example 2, although the surface resistivity was decreased, the peeling strength between the adhesive layer and the pressure-sensitive adhesive layer was increased to lower the pickup property, and the die shear strength was decreased, and thus contamination due to the antistatic agent was confirmed.

Industrial Applicability

[0090] The dicing/die bonding integrated film according to an aspect of the present disclosure has excellent antistatic properties, suppresses contamination to the adhesive layer at the time of peeling and an increase in peeling strength, and can exhibit excellent picking-up properties and die bonding properties, and thus excellent productivity can be obtained by utilizing this dicing/die bonding integrated film in the semiconductor manufacturing process.

Reference Signs List

[0091] 1: base layer, 3: pressure-sensitive adhesive layer, 5: adhesive layer, 10: dicing/die bonding integrated film, 20: pressure-sensitive adhesive film for dicing/die bonding integrated film.

CLAIMS

1. A pressure-sensitive adhesive film for a dicing/die bonding integrated film, the pressure-sensitive adhesive film comprising at least:

a base layer; and

5 a pressure-sensitive adhesive layer provided on the base layer, wherein

the pressure-sensitive adhesive layer contains:

a photopolymerization component which includes a structural unit derived from a polymer (A) having a group containing a quaternary ammonium salt and a hydroxyl group, an energy curable pressure-sensitive adhesive component (B) having a hydroxyl group, and a thermal cross-linking agent (C); and

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a photopolymerization initiator (D), and

the structural unit is at least one of a structural unit in which the polymer (A) and the pressure-sensitive adhesive component (B) are linked with each other via the thermal cross-linking agent (C) and a structural unit in which the pressure-sensitive adhesive components (B) are linked with each other via the thermal cross-linking agent (C).

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2. The pressure-sensitive adhesive film according to claim 1, wherein a storage elastic modulus at 23°C of the pressure-sensitive adhesive layer is 10 MPa to 60 MPa.

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3. The pressure-sensitive adhesive film according to claim 1 or 2, wherein a weight average molecular weight of the polymer (A) is 10000 to 200000.

4. The pressure-sensitive adhesive film according to any one of claims 1 to 3, wherein the pressure-sensitive adhesive component (B)

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includes a resin having a chain polymerizable functional group, and
the functional group is at least one selected from an acryloyl
group and a methacryloyl group.

5. The pressure-sensitive adhesive film according to any one of
5 claims 1 to 4, wherein the thermal cross-linking agent (C) is a reaction
product between a polyfunctional isocyanate having two or more
isocyanate groups in one molecule and a polyhydric alcohol having
three or more OH groups in one molecule.

6. The pressure-sensitive adhesive film according to any one of
10 claims 1 to 5, wherein the photopolymerization initiator (D) is a
photoradical polymerization initiator.

7. A dicing/die bonding integrated film comprising:
the pressure-sensitive adhesive film according to any one of
claims 1 to 6; and

15 an adhesive layer provided on the pressure-sensitive adhesive
layer of the pressure-sensitive adhesive film.