

DESCRIPTION

TITLE OF INVENTION: SURFACE-PROTECTING ADHESIVE TAPE FOR
PROCESSING SEMICONDUCTORS

5

TECHNICAL FIELD

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The present invention relates to a surface-protecting adhesive tape for
use in processing of semiconductor devices, and more specifically relates to a
10 surface-protecting adhesive tape for processing semiconductors, which is
preferably used when a backing face of a semiconductor wafer is ground.

BACKGROUND ART

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15 In a process for processing a semiconductor wafer (hereinafter referred to
as a wafer), after formation of a pattern on a wafer surface, a so-called backing
face grinding/polishing is performed, to grind/polish a backing face of the wafer to
a predetermined thickness. At that time, in order to protect a wafer surface, a
surface-protecting adhesive tape is applied onto the wafer surface, and the wafer
20 backing face is ground in this state. As the surface-protecting adhesive tape,
there is a proposal of one in which an adhesive layer mainly composed of an
acrylic polymer is provided, on a polyolefin base resin film, such as an
ethylene/vinyl acetate copolymer (hereinafter referred to as EVA) (for example,
see Patent Literature 1).

25 {0003}

In a pattern on the wafer surface, there are various types of electronic
circuits and electrodes, a protection film, such as polyimide, for protecting these
elements, and scribe lines which are grooves in which a blade is cut in a dicing

step for dicing the wafer into individual pieces of chips. According to the above structure, the wafer surface is not smooth, and steps and unevenness of several μm to several ten μm exist.

{0004}

- 5 Although the size and shape of the steps vary according to the kind of a wafer and a device, it is expected that a gap is filled, by applying the surface-protecting adhesive tape onto the wafer surface, to adhere tightly to the steps on the wafer surface. However, when the wafer has a large step, or when the tape is hard, a followability of the tape to the wafer surface is insufficient, resulting in
- 10 that there occurs a phenomenon called a seepage, in which a grinding water and/or a polishing liquid (slurry) are/is infiltrated or permeated into a gap between the wafer and the tape, upon the backing face grinding and the chemical machine polishing.

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- 15 When the seepage occurs, the tape is peeled off from the wafer, and this peeled portion becomes a starting point of occurrence of cracks at the wafer to lead to breakage, or when the seepage occurs, infiltration water contaminates the wafer surface or causes adhesion of an adhesive, and the seepage causes conspicuous lowering of yield.

20 {0006}

As measures against the seepage, there are known a method of enhancing adhesiveness to the wafer surface, by increasing the thickness of an adhesive, or by reducing an elasticity of the adhesive (for example, see Patent Literature 2). A similar effect is expected by increasing an adhesive force.

25 {0007}

The tack force of the tape is simultaneously increased, by employing the above method. The tack force is so-called a feeling of stickiness when touching a surface with a finger, and is a characteristics necessary to satisfy the most

basic conditions of an adhesive tape that the adhesive tape sticks to an adherend.
{0008}

On the other hand, there are some adverse effects due to a too strong tack force when the adhesive tape is used. In some cases, when a protecting
5 adhesive tape is applied onto a wafer, a device called a laminator is used. A tape set at a tape feeding-out position is supported by various rolls, and a releasing film is peeled off. The resultant tape is applied onto the wafer to be cut into a shape of the wafer, and a disused portion is finally wound and collected (for example, see Patent Literature 3).

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When the tape is wound after being applied onto the wafer, there is a portion where the adhesive and the support roll are in contact with each other. A tape having a large tack force is less likely to be peeled off from the roll, resulting in that the tape is wound around the roll while sticking to the roll.

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Thus, a tape has been required, which has both of the adhesive force enough to protect a wafer surface and the tack force hardly affecting workability.

CITATION LIST

20 PATENT LITERATURES

{0011}

Patent Literature 1: JP-A-2000-8010 ("JP-A" means unexamined published Japanese patent application)

Patent Literature 2: JP-A-2002-53819

25 Patent Literature 3: JP-A-2010-98132

SUMMARY OF INVENTION

{0012}

In order to solve the above problems, the present invention is contemplated for providing a surface-protecting adhesive tape for processing semiconductors, which has an adhesive force that prevents seepage from occurring in a wafer having large steps and unevenness, and which has a good workability, in processing of a semiconductor wafer, and more specifically in a backing-face grinding step for a silicon wafer or the like.

{0013}

As a result of intensive studies to solve the above problems, the present inventors have found that a surface-protecting adhesive tape for processing semiconductors, in which a ratio of an adhesive force and a probe tack force is in a specific range, prevents seepage in a backing-face grinding step, and provides a good workability. The present invention has been attained based on this finding.

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That is, the present invention solves the above-mentioned problems, by the following means.

- (1) A surface-protecting adhesive tape for processing semiconductors, having an adhesive layer provided on a base material, wherein a probe tack force B of the adhesive tape is 0.08 to 0.20 (MPa), and a ratio C (A/B) of an adhesive force A (N/25mm) to the probe tack force B (MPa) of the adhesive tape is not less than 10 (N/25mm/MPa).
- (2) The surface-protecting adhesive tape for processing semiconductors described in item (1), wherein the adhesive force A is 0.9 to 2.0 (N/25mm).
- (3) The surface-protecting adhesive tape for processing semiconductors described in item (1) or (2), wherein a thickness of the adhesive layer is 15 to 55 μm .
- (4) The surface-protecting adhesive tape for processing semiconductors described in any one of items (1) to (3), wherein the base material is composed of

an ethylene/vinyl acetate copolymer.

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The present invention can provide a surface-protecting adhesive tape for processing semiconductors, which prevents seepage and improves workability, in processing of a semiconductor wafer, and more specifically in a backing-face grinding step for a silicon wafer or the like, even if the wafers have large steps and unevenness.

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Other and further features and advantages of the invention will appear more fully from the following description.

MODE FOR CARRYING OUT THE INVENTION

{0017}

The surface-protecting adhesive tape for processing semiconductors of the present invention, is constituted of the base material and the adhesive (adhesive layer) formed on the base material.

{0018}

A resin constituting the base material for use in the present invention is not limited particularly, and any of conventionally known resins may be used. Examples of the resin to be used in the base material according to the present invention include: polyolefins, such as high-density polyethylenes (HDPE), low-density polyethylenes (LDPE), polypropylenes (PP), ethylene/vinyl acetate copolymers (EVA), ethylene/(meth)acrylic acid copolymers, and metal-containing crosslinked products (ionomers) of any of these; and polyesters, such as polyethylene terephthalate (PET), polyethylene naphthalate (PEN), and polybutylene terephthalate (PBT). Those resins can be used singly or as a blend of two or more kinds thereof. The base material for use in the present invention may have a single layer structure, or a multilayer structure in a

combination of plural resins or blended resins. From a viewpoint of wafer warpage after grinding and the flexibility, more preferred is use of the base material using an ethylene/vinyl acetate copolymer (EVA). In the ethylene/vinyl acetate copolymer for use in the base material, the content of a vinyl acetate component is preferably 5 to 30% by mass, more preferably 10 to 20% by mass.

The base resin may contain an additive in a range where the physical properties are not affected, including a blend of a coloring dye or pigment for recognizing and distinguishing an adhesive tape in interest.

Although the thickness of the base material is not limited particularly, and may be suitably set, it is preferably 50 to 200 μm .
{0019}

A method of producing the base material is not limited particularly. Use may be made of any of conventional methods, such as injection, extrusion, and inflation.

{0020}

The adhesive for use in the present invention is not limited particularly as long as it satisfies such a condition that the ratio C (i.e. A/B) of the adhesive force A (N/25mm) to the probe tack force B (MPa) is not less than 10 (N/25mm/MPa), with respect to the adhesive tape formed by using the adhesive in interest.

Examples of the adhesive include homopolymers containing a (meth)acrylic ester as a constituting component, and copolymers containing two or more kinds of (meth)acrylic esters as constituting components. As the (meth)acrylic ester, preference is given to alkyl (meth)acrylates having a linear or branched alkyl group with the number of carbon atoms not more than 30 (such as methyl, ethyl, n-propyl, isopropyl, n-butyl, t-butyl, isobutyl, amyl, isoamyl, hexyl, heptyl, cyclohexyl, 2-ethylhexyl, octyl, isooctyl, nonyl, isononyl, decyl, isodecyl, undecyl, lauryl, tridecyl, tetradecyl, stearyl, octadecyl, and dodecyl), and more preference is given to alkyl (meth)acrylates having a linear or branched alkyl group with the

number of carbon atoms 4 to 18.

{0021}

In the copolymer, examples of the constituting component other than the alkyl (meth)acrylates include: a carboxyl group-containing monomer component, such as acrylic acid, methacrylic acid, carboxyethyl (meth)acrylate, carboxypentyl (meth)acrylate, itaconic acid, maleic acid, fumaric acid, and crotonic acid; an acid anhydride monomer component, such as maleic anhydride and itaconic anhydride; a hydroxyl group-containing monomer component, such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxydodecyl (meth)acrylate, and (4-hydroxymethyl cyclohexyl) methyl (meth)acrylate; a sulfonate group-containing monomer component, such as styrene sulfonate, allyl sulfonate, 2-(meth)acrylamide-2-methyl propane sulfonate, (meth)acrylamide propane sulfonate, sulfopropyl (meth)acrylate, and (meth)acryloyloxynaphthalene sulfonate; a phosphate group-containing monomer component, such as 2-hydroxyethylacryloyl phosphate; (meth)acrylamide, N-hydroxymethylamide (meth)acrylate, alkylaminoalkyl (meth)acrylate (e.g. dimethylaminoethyl methacrylate and t-butylaminoethyl methacrylate), N-vinylpyrrolidone, acryloyl morpholine, vinyl acetate, styrene, and acrylonitrile. One or two or more kinds of those monomer components may be contained in the copolymer.

{0022}

Further, the copolymer may contain the following multifunctional monomer component, as another constituting component. Examples of the multifunctional monomer component include hexanediol di(meth)acrylate, (poly)ethylene glycol di(meth)acrylate, (poly)propylene glycol di(meth)acrylate, neopentylglycol di(meth)acrylate, pentaerythritol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, tetramethylolmethane tetra(meth)acrylate,

pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, dipentaerythritol monohydroxy penta(meth)acrylate, dipentaerythritol hexa(meth)acrylate, epoxy(meth)acrylate, polyester (meth)acrylate, and urethane (meth)acrylate. One or two or more kinds of those multifunctional monomer components may be contained in the copolymer.

The copolymer may contain, as a (meth)acrylic ester component, for example, ethyl (meth)acrylate, butyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, glycidyl (meth)acrylate, and 2-hydroxyethyl (meth)acrylate.

{0023}

The adhesive for use in the present invention preferably contains a copolymer having both acrylate ester and methacrylic acid ester as constituents. The adhesive for use in the present invention more preferably contains a copolymer having as the constituents both of a (meth)acrylic ester having an unsubstituted alcohol moiety and a (meth)acrylic ester whose alcohol moiety has a substituent. Further, when the alcohol moiety has a substituent, the substituent is preferably an alkyl group, a hydroxyl group, or an epoxy group. As the (meth)acrylic ester whose alcohol moiety has a substituent, 2-hydroxyethyl (meth)acrylate or glycidyl (meth)acrylate is preferred.

{0024}

In the copolymer contained in the adhesive for use in the present invention, it is preferable that the content of a (meth)acrylic ester component having an unsubstituted alcohol moiety is 40 to 60% by mass. Further, in the copolymer, the content of an acrylic ester component having an unsubstituted alcohol moiety is preferably larger than the content of a methacrylic ester component having an unsubstituted alcohol moiety. The copolymer preferably contains 25 to 50% by mass of the acrylic ester component having an unsubstituted alcohol moiety.

In the copolymer, the content of a 2-ethylhexyl (meth)acrylate component,

which is a form in which the alcohol moiety has a substituent, is preferably 35 to 50% by mass, more preferably 40 to 50% by mass. The 2-ethylhexyl (meth)acrylate concerned is preferably 2-ethylhexyl acrylate.

Further, the copolymer preferably contains a glycidyl (meth)acrylate component. The copolymer preferably contains 1 to 5% by mass of the glycidyl (meth)acrylate concerned. The glycidyl (meth)acrylate component is preferably glycidyl methacrylate.

The copolymer preferably contains a (meth)acrylic acid component. The copolymer preferably contains 0.5 to 5% by mass of the (meth)acrylic acid component. The (meth)acrylic acid component is preferably methacrylic acid.

The copolymer that can be preferably used as the adhesive for use in the present invention, is preferably one obtained by emulsion polymerization using a surfactant. The surfactant is preferably an anionic surfactant, more preferably a sulfuric ester salt of polyoxyethylene alkyl phenyl ether, particularly preferably a sulfuric ester salt of polyoxyethylene alkyl phenyl ether in which an allyl group is added to a benzene ring. Polypropylene glycol and polyethylene glycol are preferably used together in the polymerization. Purified water subjected to deionization is preferably used as a reaction solvent. Any polymerization initiator may be used, but a persulfate is preferred.

In the present invention, the adhesive may contain a curing agent.

As the curing agent, the curing agent described in JP-A-2007-146104 may be used. Examples of the curing agent include: epoxy compounds having two or more epoxy groups in the molecule, such as 1,3-bis(N,N-diglycidylaminomethyl)cyclohexane, 1,3-bis(N,N-diglycidylaminomethyl)toluene, 1,3-bis(N,N-diglycidylaminomethyl)benzene, and N,N,N,N'-tetraglycidyl-m-xylenediamine; isocyanate compounds having two or more isocyanate groups in

the molecule, such as 2,4-tolylenediisocyanate, 2,6-tolylenediisocyanate, 1,3-xylylenediisocyanate, 1,4-xylylenediisocyanate, and diphenylmethane-4,4'-diisocyanate; and aziridine compounds having two or more aziridinyl groups in the molecule, such as tetramethylol-tri- β -aziridinyl propionate, trimethylol-tri- β -aziridinyl propionate, trimethylolpropane-tri- β -aziridine propionate, and trimethylolpropane-tri- β -(2-methylaziridine) propionate. The content of the curing agent may be set according to a desired adhesive force, and is preferably 0.01 to 10 parts by mass, more preferably 0.1 to 5 parts by mass, to 100 parts by mass the copolymer.

10 {0027}

In the present invention, the adhesive layer may contain a photopolymerizable compound and a photopolymerization initiator. When the adhesive layer contains the photopolymerization initiator, the adhesive layer can be cured by irradiation with ultraviolet light, to lower the adhesive force of the adhesive layer. Examples of the photopolymerization compound that can be used include: low-molecular-weight compounds having at least two or more photopolymerizable carbon-carbon double bonds in the molecule that can form three-dimensional network structure upon irradiation with light, as disclosed in JP-A-60-196956 and JP-A-60-223139.

20 Specific examples that can be used include: trimethylolpropane triacrylate, pentaerythritol triacrylate, pentaerythritol tetraacrylate, dipentaerythritol monohydroxy pentaacrylate, dipentaerythritol hexaacrylate, 1,4-butylene glycol diacrylate, 1,6-hexanediol diacrylate, polyethylene glycol diacrylate, and commercially available oligoester acrylates.

25 {0028}

As the photopolymerization initiator, use can be made of the photopolymerization initiator described in JP-A-2007-146104 or JP-A-2004-186429. Furthermore, use can be made in combination, for example, of

isopropyl benzoin ether, isobutyl benzoin ether, benzophenone, a Michler's ketone, chlorothioxanthone, benzyl methyl ketal, α -hydroxycyclohexyl phenyl ketone, and 2-hydroxymethylphenylpropane.

{0029}

5 In the adhesive layer, use may be made of a photopolymerizable adhesive, which is obtained by using a resin composition, containing: a polymer having photopolymerizable carbon-carbon double bonds in the polymer; the photopolymerization initiator; and the curing agent. As the polymer having photopolymerizable carbon-carbon double bonds in the polymer, use may be
10 preferably made of a (meth)acrylic polymer, obtained by homopolymerizing or copolymerizing, via an arbitrary method, one or two or more kinds of a monomer or a copolymerizable modified monomer, such as a (meth)acrylic ester having an alkyl group with the number of carbon atoms of 4 to 12, more preferably 8, in the side chain thereof.

15 When the photopolymerizable adhesive layer formed as above is irradiated with radiation, preferably ultraviolet light, the adhesive force can be significantly lowered as compared to its initial one, to make it possible to readily peel the resultant adhesive tape off from the adherend.

{0030}

20 In the present invention, the thickness of the adhesive layer can be arbitrarily set depending on an adherend to be applied to. The thickness of the adhesive layer is not limited particularly, but it is preferably 15 to 55 μm , more preferably 20 to 50 μm . When the thickness of the adhesive layer is more than 55 μm , an adhesive residue or the like on a wafer highly likely occurs. When the
25 thickness of the adhesive layer is less than 15 μm , the adhesive layer cannot follow unevenness on a wafer surface, and this may cause seepage or the like.

{0031}

In the surface-protecting adhesive tape for processing semiconductors of

the present invention, the ratio C ($C=A/B$) of the adhesive force A (N/25mm) to the probe tack force B (MPa) is not less than 10 (N/25mm/MPa). When the ratio C is set in this range, the surface-protecting adhesive tape has an adhesive force that prevents occurrence of seepage with respect to a wafer having large steps and unevenness, and, at the same time, good workability can be maintained. The ratio C is preferably 10 to 60 (N/25mm/MPa), more preferably 10 to 40 (N/25mm/MPa).

Herein, the adhesive force A is preferably 0.8 to 4.0 N/25 mm, more preferably 0.9 to 2.0 N/25mm. On the other hand, the probe tack force B is preferably not more than 0.20 MPa, more preferably 0.08 to 0.20 MPa, further preferably 0.10 to 0.20 MPa.

{0032}

The adhesive force A and the probe tack force B are measured by the following method according to JIS Z 0237, respectively.

<Adhesive force A>

In the test, use is made of a SUS 304 steel plate, which is uniformly water-polished by a water-resistant polishing paper #280, followed by washing and degreasing. The resultant SUS 304 steel plate is stood for 1 hour after being polished. Then, a rubber roll with a load of 2 kg is rolled back and forth three times against the surface of the surface-protecting adhesive tape with width 25 mm for processing semiconductors, to apply the adhesive tape onto the roll. After standing for 1 hour, a load at the time of peeling the tape off from the roll is measured, under the conditions of peeling angle 180 degrees, tension speed 300 mm/min, and measurement temperature 23°C, to determine the adhesive force A.

{0033}

<Probe tack force B>

By means of a tacking tester (for example, TAC II, manufactured by Rhesca Corporation), a columnar probe of 3 mmφ is pushed onto the backing

face side of the base material of the surface-protecting adhesive tape for processing semiconductors (on the opposite side of an adhesive coated face) at a speed of 30 mm/min, followed by holding for 1 sec with a stop load of 100 g at room temperature. Then, the load is measured when the columnar probe is
 5 drawn up at a speed of 600 mm/min, to determine the probe tack force B.
 {0034}

The adhesive force A and the probe tack force B can be adjusted by the kind of the polymer and/or the kind and amount of the additive in the adhesive layer, particularly the kind of the polymer used in the adhesive, and more
 10 particularly the kind and amount of the monomer component. In addition to those, the probe tack force can be adjusted by the kind of the base material. In order to adjust the ratio C to not less than 10 (N/25mm/MPa), it is preferable that the base material and the adhesive layer are in the above preferred range.
 {0035}

15 Further, the adhesive force A and the probe tack force B are changed by the elasticity, the molecular weight, and the glass transition temperature (T_g) of the polymer (the above-mentioned polymer) used in the adhesive layer, and/or the additive, such as the curing agent, a plasticizer, a releasing agent, and a filler, and significantly affected by T_g , a mass-average molecular weight, and the curing
 20 agent particularly. Thus, in order to adjust the ratio C to not less than 10 (N/25mm/MPa), the T_g after crosslinking is adjusted to generally -50 to -10°C , preferably -40 to -20°C , and/or the mass-average molecular weight is adjusted to generally not less than 800,000, preferably not less than 1,000,000, and/or the amount to be blended of the curing agent is set to generally 0.3 to 1.8 parts by
 25 mass, preferably 0.5 to 1.5 parts by mass, to 100 parts by mass of the polymer, whereby the target range can be achieved.

EXAMPLES

{0036}

The present invention will be described in more detail based on examples and comparative examples given below, but the invention is not meant to be limited by these.

5 {0037}

(Example 1)

Into purified water subjected to deionization, added were, as a surfactant, a polyoxyethylene alkyl phenyl ether compound in which an allyl group was added to a benzene ring, and a polypropylene glycol compound, followed by
10 adding thereto ammonium persulfate as a polymerization initiator, and being stirred under heating. Then, into the thus-stirred solution, added were, dropwise, 16 parts by mass of methyl methacrylate, 40 parts by mass of butyl acrylate, 40 parts by mass of 2-ethylhexyl acrylate, 2 parts by mass of glycidyl methacrylate, and 2 parts by mass of methacrylic acid, followed by further stirring to conduct
15 polymerization, to give an acrylic emulsion adhesive composition A.

Onto a base material composed of an ethylene/vinyl acetate copolymer (EVA) with thickness 165 μm film-formed by extrusion, a layer was formed with the adhesive composition A having the above-mentioned composition, so that the thickness after coating was 40 μm , to obtain a surface-protecting adhesive tape
20 for processing semiconductors. With respect to the resultant adhesive tape, the adhesive force and the probe tack force were measured by the methods described below, and the adhesive force was 1.18 N/25mm, and the probe tack force was 0.10 MPa.

{0038}

25 (Example 2)

A surface-protecting adhesive tape for processing semiconductors was obtained in the same manner as in Example 1, except that the adhesive composition A was changed to an adhesive composition B, in which the addition

amounts of methyl methacrylate was changed to 10 parts by mass, and 2-ethylhexyl acrylate to 46 parts by mass, to result in the adhesive force 1.24 N/25mm and the probe tack force 0.11 MPa.

{0039}

5 (Example 3)

Into purified water subjected to deionization, added were, as a surfactant, an ammonium salt compound of polyoxyethylene nonyl phenyl ether sulfate in which an allyl group was added to a benzene ring, and a polypropylene glycol compound, followed by adding thereto ammonium persulfate as a polymerization
10 initiator, and being stirred under heating. Then, into the thus-stirred solution, added were, dropwise, 15 parts by mass of methyl methacrylate, 30 parts by mass of butyl acrylate, 43 parts by mass of 2-ethylhexyl acrylate, and 2 parts by mass of glycidyl methacrylate, followed by further stirring to conduct polymerization, to give an acrylic emulsion adhesive composition C.

15 A base material composed of an ethylene/vinyl acetate copolymer (EVA) with thickness 70 μm film-formed by extrusion, and a biaxially-stretched polypropylene film (PP) with thickness 40 μm , were laminated, to give a base material with a multilayer structure with the total thickness of 110 μm . Onto the resultant base material, a layer was formed with the adhesive composition C
20 having the above composition, so that the thickness after coating was 20 μm , to obtain a surface-protecting adhesive tape for processing semiconductors. With respect to the resultant adhesive tape, the adhesive force was 3.20 N/25mm, and the tack force was 0.16 MPa.

{0040}

25 (Example 4)

Into purified water subjected to deionization, added were, as a surfactant, a polyoxyethylene alkyl phenyl ether compound in which an allyl group was added to a benzene ring, and a polypropylene glycol compound, followed by

adding thereto ammonium persulfate as a polymerization initiator, and being stirred under heating. Then, into the thus-stirred solution, added were, dropwise, 15 parts by mass of methyl methacrylate, 35 parts by mass of butyl acrylate, 45 parts by mass of 2-ethylhexyl acrylate, 2 parts by mass of glycidyl methacrylate, and 1 part by mass of methacrylic acid, followed by further stirring to conduct polymerization, to give an acrylic emulsion adhesive composition D.

Onto a base material composed of an ethylene/vinyl acetate copolymer (EVA) with thickness 120 μm film-formed by extrusion, a layer was formed with the adhesive composition D mainly composed of the (meth)acrylic acid copolymer and having the above-mentioned composition, so that the thickness after coating was 50 μm , to obtain a surface-protecting adhesive tape for processing semiconductors. With respect to the resultant adhesive tape, the adhesive force was 1.38 N/25mm, and the tack force was 0.11 MPa.

{0041}

(Example 5)

A surface-protecting adhesive tape for processing semiconductors was obtained in the same manner as in Example 4, except that the adhesive composition D was changed to an adhesive composition E, in which the addition amount of methacrylic acid was changed to 5 parts by mass, to result in the adhesive force 3.75 N/25mm and the probe tack force 0.10 MPa.

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(Comparative example 1)

In an ethyl acetate solution, 5 parts by mass of methyl acrylate, 60 parts by mass of 2-ethylhexyl acrylate, and 5 parts by mass of methyl methacrylate were polymerized, to give an acrylic copolymer. To the thus-polymerized acrylic copolymer, blended were 0.5 parts by mass of an adduct-based isocyanate crosslinking agent Coronate L (trade name, manufactured by Nippon Polyurethane Co., Ltd.) and 2 parts by mass of an epoxy-based curing agent E-

5XM (trade name, manufactured by Soken Chemical and Engineering Co., Ltd.), followed by adding ethyl acetate thereto to adjust to a viscosity for readily coating, to obtain an adhesive composition F.

Onto a base material composed of an ethylene/vinyl acetate copolymer (EVA) with thickness 165 μm film-formed by extrusion, a layer was formed with the adhesive composition F mainly composed of the (meth)acrylic acid copolymer and having the above-mentioned composition, so that the thickness after coating was 40 μm , to obtain a surface-protecting adhesive tape for processing semiconductors. The adhesive force was 0.31 N/25mm, and the probe tack force was 0.11 MPa.

{0043}

(Comparative example 2)

A surface-protecting adhesive tape for processing semiconductors was obtained in the same manner as in Comparative example 1, except that the adhesive composition F was changed to an adhesive composition G, in which the addition amount of the epoxy-based curing agent was changed to 0.5 parts by mass, to result in the adhesive force 1.88 N/25mm and the probe tack force 0.30 MPa.

{0044}

(Comparative example 3)

An ethylene/vinyl acetate copolymer (EVA) and a high-density polyethylene (HDPE) were laminated by extrusion, to give an EVA (70 μm)/HDPE (30 μm) base material with a multilayer structure with thickness 100 μm . Further, in an ethyl acetate solution, 85 parts by mass of butyl acrylate, and 15 parts by mass of 2-hydroxyethyl acrylate were polymerized, to give an acrylic copolymer. To the thus-polymerized acrylic copolymer, blended was 0.5 parts by mass of an adduct-based isocyanate crosslinking agent Coronate L (trade name, manufactured by Nippon Polyurethane Co., Ltd.), followed by adding ethyl

acetate thereto to adjust to a viscosity for readily coating, to obtain an adhesive composition H. Onto the base material, a layer was formed with the adhesive composition H, so that the thickness after coating was 30 μm , to obtain a surface-protecting adhesive tape for processing semiconductors. With respect to the resultant adhesive tape, the adhesive force was 0.88 N/25mm, and the probe tack force was 0.26 MPa.

{0045}

(Comparative example 4)

To 100 parts by mass of an acrylic copolymer, which was a copolymer of 60 parts by mass of 2-ethylhexyl acrylate, 38 parts by mass of 2-hydroxyethyl acrylate, and 2 parts by mass of methacrylic acid, blended were 4 parts by mass of an adduct-based isocyanate crosslinking agent Coronate L (trade name, manufactured by Nippon Polyurethane Co., Ltd.), 150 parts by mass of tetramethylolmethane tetraacrylate having photopolymerizable carbon-carbon double bonds, which was used as an oligomer, and 5 parts by mass of Irgacure 184 (trade name, manufactured by Ciba Japan K.K.) as a photopolymerization initiator, followed by adding ethyl acetate thereto to adjust to a viscosity for readily coating, to obtain an adhesive composition I.

Onto an EVA (70 μm)/HDPE (30 μm) base material with a multilayer structure with thickness 100 μm film-formed by extrusion, a layer was formed with the adhesive composition I, so that the thickness after coating was 30 μm , to obtain a surface-protecting adhesive tape for processing semiconductors. With respect to the resultant adhesive tape, the adhesive force was 1.30 N/25mm, and the probe tack force was 0.24 MPa.

{0046}

(Evaluation of performance of surface-protecting adhesive tapes)

The surface-protecting adhesive tapes for processing semiconductors obtained in the above Examples and Comparative examples were tested as

follows, and the performance of those was evaluated, to obtain the results shown in Tables 1 and 2.

{0047}

(Adhesive force)

- 5 Use was made of a SUS 304 steel plate, which was uniformly water-polished by a water-resistant polishing paper #280, followed by washing and degreasing. The resultant SUS 304 steel plate was stood for 1 hour after being polished. Then, a rubber roll with a load of 2 kg was rolled back and forth three times against the surface of a test piece of the adhesive tape with width 25 mm, 10 to apply the test piece onto the roll. After standing for 1 hour, a load at the time of peeling the tape off from the roll was measured, to determine the adhesive force A. The peeling angle was 180 degrees, the tension speed was 300 mm/min, and the measurement temperature was 23°C.

{0048}

- 15 (Probe tack force)

By means of a tacking tester (TAC II, trade name, manufactured by Rhesca Corporation), a columnar probe of 3 mmφ was pushed onto the backing face side of the base material of a test piece of the adhesive tape (on the opposite side of an adhesive coated face) at a speed of 30 mm/min, followed by 20 holding for 1 sec with a stop load of 100 g. Then, the load was measured when the columnar probe was drawn up at a speed of 600 mm/min, to determine the probe tack force B.

{0049}

(Seepage)

- 25 A test piece of the surface-protecting adhesive tape for processing semiconductors was laminated onto a surface formed with grooves, of a silicon wafer with diameter 8 inches, on which grooves with width 50 μm and depth 30 μm were formed over the entire surface at intervals 5 mm, by means of a

laminator (DR-8500 II, trade name, manufactured by NITTO DENKO Corporation).

A backing face of the resultant wafer laminated with the adhesive tape was ground to 50 μm , by a grinder (DGP8760, trade name, manufactured by DISCO Corporation), to observe infiltration of cutting water into the grooves from the outer periphery of the wafer after being ground. Then, seepage thus-observed or not with the naked eyes was evaluated, according to the following ranks.

{0050}

Evaluation rank

A: No infiltration was observed.

10 B: Slight infiltration was observed.

C: Apparent infiltration was observed.

{0051}

(Workability in laminating)

After the lamination by the laminator, when the tape was taken by winding, the degree of detachability (peelability) that the tape was caught to a support roll in contact with the adhesive was evaluated, according to the following ranks.

{0052}

Evaluation rank

20 A: The tape was not caught to any support roll existing in a path line, and the tape was possible to be wound without any problem.

B: Although the tape was caught to a support roll, the tape was possible to be wound, without being rolled by the support roll.

C: The tape was caught to a support roll not to be peeled off from the support roll, and the tape was rolled by the support roll.

25 {0053}

(Warpage)

In the above-mentioned grinding, when a silicon bare wafer with diameter 8 inches was ground to a thickness of 50 μm , the side of a convex occurred via

warpage of the wafer laminated with the surface-protecting adhesive tape for processing semiconductors was directed downward, and the wafer with the adhesive tape was left to stand on a horizontal stage. The warpage at each end of the wafer was measured, to determine an average value, which was regarded as the warpage of the wafer. Then, the warpage was evaluated according to the following ranks.

{0054}

Evaluation rank

- A: Warpage was less than 25 mm.
- 10 B: Warpage was 25 mm or more and less than 30 mm.
- C: Warpage was 30 mm or more.

{0055}

Table 1

	Example 1	Example 2	Example 3	Example 4	Example 5
Base material	EVA	EVA	EVA+PP	EVA	EVA
Vinyl acetate content (mass%)	10	10	10	20	20
Adhesive	A	B	C	D	E
Adhesive layer thickness (μm)	40	40	20	50	50
Adhesive force A (N/25mm)	1.18	1.24	3.20	1.38	3.75
Probe tack force B (MPa)	0.10	0.11	0.16	0.11	0.10
Ratio C (N/25mm/MPa)	11.8	11.3	20.0	12.5	37.5
Seepage	A	A	A	A	A
Workability	A	A	A	A	A
Warpage	A	A	B	A	A

{0056}

Table 2

	Comparative example 1	Comparative example 2	Comparative example 3	Comparative example 4
Base material	EVA	EVA	EVA+HDPE	EVA+HDPE
Vinyl acetate content (mass%)	10	10	10	10
Adhesive	F	G	H	I
Adhesive layer thickness (μm)	40	40	30	30
Adhesive force A (N/25mm)	0.31	1.88	0.88	1.30
Probe tack force B (MPa)	0.11	0.30	0.26	0.24
Ratio C (N/25mm/MPa)	2.8	6.3	3.4	5.4
Seepage	C	A	C	C
Workability	A	C	B	B
Warpage	A	A	B	B

{0057}

From the results shown in Tables 1 and 2, it is understood that Comparative examples 1 to 4 in which the ratio C of the adhesive force to the probe tack force was less than 10, each had a problem in the seepage or the workability at the time of laminating; but that the surface-protecting adhesive tapes of the present invention each prevented occurrence of the seepage and had favorable workability.

{0058}

Having described our invention as related to the present embodiments, it is our intention that the invention not be limited by any of the details of the description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

{0059}

This application claims priority on Patent Application No. 2012-118040 filed in Japan on May 23, 2012, which is entirely herein incorporated by reference.

CLAIMS

{Claim 1}

- 5 A surface-protecting adhesive tape for processing semiconductors,
having an adhesive layer provided on a base material,
wherein a probe tack force B of the adhesive tape is 0.08 to 0.20 (MPa),
and a ratio C (A/B) of an adhesive force A (N/25mm) to the probe tack force B
(MPa) of the adhesive tape is not less than 10 (N/25mm/MPa).

10 {Claim 2}

The surface-protecting adhesive tape for processing semiconductors
according to claim 1, wherein the adhesive force A is 0.9 to 2.0 (N/25mm).

{Claim 3}

- 15 The surface-protecting adhesive tape for processing semiconductors
according to claim 1 or 2, wherein a thickness of the adhesive layer is 15 to 55
μm.

{Claim 4}

- 20 The surface-protecting adhesive tape for processing semiconductors
according to any one of claims 1 to 3, wherein the base material is composed of
an ethylene/vinyl acetate copolymer.