

DESCRIPTION

TITLE OF INVENTION:

SURFACE PROTECTION ADHESIVE TAPE FOR SEMICONDUCTOR WAFER
5 BACKGRINDING, AND SEMICONDUCTOR WAFER GRINDING METHOD

TECHNICAL FIELD

{0001}

The present invention relates to a surface-protective adhesive tape for
10 back-grinding of a semiconductor wafer utilized in processing of a semiconductor
device, in particular to a surface-protective adhesive tape for back-grinding of the
semiconductor wafer suitable for use in back-grinding of the semiconductor wafer,
and to a processing method of the semiconductor wafer using the same.

15 BACKGROUND ART

{0002}

In the processing steps of the semiconductor wafer, the back-grinding
and/or polishing is carried out in order to set the semiconductor wafer backside
so as to have a predetermined thickness, after forming a pattern on the
20 semiconductor wafer surface. On this occasion, in order to protect the
semiconductor wafer surface against a stress and the like at the time of grinding
and to facilitate grinding, a surface-protective adhesive tape for back-grinding of
the semiconductor wafer is laminated on the semiconductor wafer. Then, in that
state, the semiconductor wafer backside is ground. As the surface-protective
25 adhesive tape for back-grinding of the semiconductor wafer, for example, there is
a surface-protective adhesive tape in which an adhesive layer consisting primarily
of an acrylic polymer has been provided on a substrate resin film of a polyolefin,
such as an ethylene/vinyl acetate copolymer (for example, please see Patent

Literature 1).

{0003}

The semiconductor wafer is thinned until a predetermined thickness by back-grinding. After that, a dicing-die-bond sheet in which a temporally
5 adhesive and an adhesion bond (an adhesion sheet for die-bonding) are stacked on a substrate in advance is laminated on the semiconductor wafer backside (ground side), which is fixed to a dicer chuck table with a ring flame, and then which is collectively cut together with the semiconductor wafer in a dicing step of cutting the semiconductor wafer with a dicing blade, so that the resultantly cut
10 semiconductor wafer is chipped. After that, a plurality of chips is stacked, and a substrate and the chips are each connected with a wire, and then sealed with a resin, and thereby becomes a product. A set of the foregoing processes is commonly practiced (for example, see Patent Literature 2). At the time of laminating the above-described dicing-die-bond sheet, the dicing-die-bond sheet
15 is in the state of being adsorbed on the chuck table while the surface-protective adhesive tape for back-grinding of the semiconductor wafer remains laminated on the semiconductor wafer surface. After lamination of the dicing-die-bond sheet, the surface-protective adhesive tape for back-grinding of the semiconductor wafer is peeled. Further, in order to make the above-described dicing-die-bond sheet to adhere to the semiconductor wafer, in recent years, the dicing-die-bond sheet
20 at the time of lamination thereof may be heated at higher temperature (about 80°C).

{0004}

Further, the surface-protective adhesive tape for back-grinding of the
25 semiconductor wafer to be laminated on the semiconductor wafer surface is commonly colored for discrimination of the lamination. As the coloring method, there are a method for coloring a substrate film and a method for coloring a temporally adhesive. However, from the point of surface contamination of the

semiconductor wafer, it is common to color the substrate film which does not directly get in contact with the semiconductor wafer.

{0005}

With the advance of high-density mount technology in recent years, a
 5 need to miniaturize a semiconductor chip is created, and a progress of thinning a semiconductor wafer is considerable. Depending on the kind of the semiconductor chip, it has been required to thin the chip until about 100 μm . Further, in order to increase the number of the semiconductor chips to be produced by a single processing, a diameter of the semiconductor wafer also
 10 tends to be increased. Until now, the semiconductor wafer having a diameter of 5 inches or 6 inches was the main stream. As against this wafer, in recent years, a semiconductor chip processed from a semiconductor wafer having a diameter of 8 to 12 inches has been the main stream. By increasing the diameter of the semiconductor wafer, a yield due to a single processing is increased, so that
 15 production costs are cut.

{0006}

With the foregoing increase in the diameter of the semiconductor wafer, the shape of the semiconductor wafer is also changing. In a case where the semiconductor wafer having a diameter of 5 inches or 6 inches was the main
 20 stream, a semiconductor wafer 8 had a large size of cutout 7 which is called orientation flat (see Fig. 3 shown below). Against this semiconductor wafer, in a semiconductor wafer 5 having a diameter of 8 inches or more for further improvement in yield, the semiconductor wafer having a small cutout 6 which is called notch (see Fig. 2 shown below) has been the main stream. However, with
 25 the foregoing change, the read of the position of the semiconductor wafer which was previously easy to do is becoming difficult. Further, in the semiconductor wafer having an orientation flat, the surface-protective adhesive tape for back-grinding of the semiconductor wafer is not laminated on the outside of the

orientation flat 7. Contrary to this semiconductor wafer, in the semiconductor wafer having a notch, the surface-protective adhesive tape for back-grinding of the semiconductor wafer is permitted to be laminated so as to cover the notch 6. For this reason, the color of the surface-protective adhesive tape for back-grinding of the semiconductor wafer became to make a major effect on sensor recognition.

{0007}

As mentioned above, improvement in the sensor recognition has been addressed by a color adjustment or the like. However, with the thinning of the semiconductor wafer, another problem was caused. With the thinning of the semiconductor wafer, the warpage of the semiconductor wafer became large, so that the notch sometimes became incapable of passing through a sensor portion due to the warpage, which resulted in failure of sensor recognition. Further, the thinning of the semiconductor wafer also has raised a problem that, for example, making the notch undetectable due to dust adherence to the substrate surface.

CITATION LIST

PATENT LITERATURES

{0008}

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

Patent Literature 2: JP-A-2007-53325

SUMMARY OF INVENTION

TECHNICAL PROBLEM

{0009}

The present invention is to address the problem which is special to the semiconductor wafer having a notch, as mentioned above.

Specifically, the present invention is contemplated for solving the above problems, for providing a surface-protective adhesive tape for back-grinding of the semiconductor wafer, which is excellent in operability in terms of combining visibility of lamination and heat resistance without raising a problem of the sensor recognition, even if applied to a semiconductor wafer for which a thinning grinding treatment is required in back-grinding of a silicon wafer or the like, and also for providing a method of grinding the semiconductor wafer using the same.

SOLUTION TO PROBLEM

10 {0010}

As a result of intensive studies on the above problems, the inventors of the present invention, have found that, by setting a roughness of the tape backside to a particular range, and further by setting a total light transmittance of the tape at the specific wavelength to a particular range, the above problems are solved, so that a visibility of lamination is effected and a sensor recognition error is not caused, whereby a working efficiency can be improved.

Herein, regarding the roughness of the tape backside, there is a variety of surface roughness (for example, center line average roughness Ra, and the like). Among these, the use of a surface roughness defined by Rz, allowed solution of the problems of the present invention.

20 {0011}

That is, the problems of the present invention were solved by the following means:

[1] A surface-protective adhesive tape for back-grinding of a semiconductor wafer, comprising: a substrate; and a temporally adhesive layer provided on one side of the substrate,

wherein a surface roughness Rz of the side of the substrate on which the temporally adhesive layer has not been formed is from 0.7 to 5.0 μm ,

wherein a total light transmittance of the surface-protective adhesive tape for back-grinding of the semiconductor wafer at an wavelength of 500 to 600 nm is from 40 to 80%,

5 wherein a difference ($\Delta ET - \Delta EM$) between a color difference (ΔEM) of a mirror wafer and a color difference (ΔET) under a condition that the surface-protective adhesive tape for back-grinding of the semiconductor wafer has been laminated on the mirror wafer is more than 6.5, and

10 wherein the surface-protective adhesive tape for back-grinding of the semiconductor wafer is laminated on a surface of the semiconductor wafer having a notch and is used in the step of back-grinding of the semiconductor wafer.

[2] The surface-protective adhesive tape for back-grinding of the semiconductor wafer as described in the item [1], wherein the surface roughness R_z is 0.7 μm or more and less than 5.0 μm .

15 [3] The surface-protective adhesive tape for back-grinding of the semiconductor wafer as described in the item [1] or [2], wherein the substrate comprises a pigment selected from a group consisting of a phthalocyanine pigment, a naphthalocyanine pigment, an indanthrone pigment, an indanthrene pigment, and a triarylcarbonium pigment.

20 [4] The surface-protective adhesive tape for back-grinding of the semiconductor wafer as described in any one of the items [1] to [3], wherein a thickness of the substrate is from 80 to 200 μm .

[5] The surface-protective adhesive tape for back-grinding of the semiconductor wafer as described in any one of the items [1] to [4], wherein the substrate is composed of resins one of which has the same copolymerizable component, the copolymerizable component comprising at least a vinyl acetate component.

25 [6] The surface-protective adhesive tape for back-grinding of the semiconductor wafer as described in the item [5], wherein a content of the vinyl

acetate component is from 1.9 to 10.5% by mass.

[7] The surface-protective adhesive tape for back-grinding of the semiconductor wafer as described in any one of the items [1] to [6], wherein the substrate is composed of a single layer or a plurality of layers, and wherein a melting point of a substrate-constituting resin in an outermost layer of the substrate at the side on which a temporally adhesive layer has not been formed is 85°C or more.

[8] A method of grinding a semiconductor wafer, comprising: laminating a surface-protective adhesive tape for back-grinding of a semiconductor wafer on a surface of the semiconductor wafer having a notch; and subjecting a semiconductor wafer backside to grinding,

wherein the surface-protective adhesive tape for back-grinding of the semiconductor wafer comprises: a substrate; and a temporally adhesive layer provided on one side of the substrate,

wherein a surface roughness R_z of the side of the substrate on which the temporally adhesive layer has not been formed is from 0.7 to 5.0 μm ,

wherein a total light transmittance of the surface-protective adhesive tape for back-grinding of the semiconductor wafer at a wavelength of 500 to 600 nm is from 40 to 80%,

wherein a difference ($\Delta\text{ET}-\Delta\text{EM}$) between a color difference (ΔEM) of a mirror wafer and a color difference (ΔET) under a condition that the surface-protective adhesive tape for back-grinding of the semiconductor wafer has been laminated on the mirror wafer is more than 6.5.

[9] The method of grinding the semiconductor wafer as described in the item [8], wherein the surface roughness R_z is 0.7 μm or more and less than 5.0 μm .

ADVANTAGEOUS EFFECTS OF INVENTION

{0012}

The surface-protective adhesive tape for back-grinding of the semiconductor wafer (hereinafter, also referred to simply as a surface-protective adhesive tape) of the present invention, has a visibility of lamination, also has a sensor recognition with respect to even a silicon wafer having a notch, and is
5 excellent in heat resistance, in the processing step of the semiconductor wafer, such as the back-grinding step of a silicon wafer.

Therefore, the use of the surface-protective adhesive tape for back-grinding of the semiconductor wafer of the present invention, allows enhancement in the efficiency of back-grinding of the semiconductor wafer,
10 whereby operability can be improved.

{0013}

Other and further features and advantages of the invention will appear more fully from the following description, appropriately referring to the accompanying drawings.

15

BRIEF DESCRIPTION OF DRAWINGS

{0014}

{Fig. 1}

Fig. 1 is a cross-sectional view showing an embodiment of the surface-protective adhesive tape for back-grinding of the semiconductor wafer of the
20 present invention.

{Fig. 2}

Fig. 2 is a plan view showing an example of the semiconductor wafer 5 having a notch 6 as a sensor recognition section.

25 {Fig. 3}

Fig. 3 is a plan view showing another example of the semiconductor wafer 8 having an orientation flat 7 as the sensor recognition section.

MODE FOR CARRYING OUT THE INVENTION

{0015}

Hereinafter, the surface-protective adhesive tape for back-grinding of the semiconductor wafer of the present invention will be described in detail with
5 reference to the drawings. However, the present invention is not limited to these.

{0016}

As shown in Fig. 1, the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer of the present invention is composed of: a substrate 1; and a temporally adhesive layer 2 provided on at least one side of
10 said substrate. Note that, in the substrate 1, the surface on the opposite side which has a contact with the adhesive layer 2 is a surface (backside) 11 of the substrate on which the temporally adhesive layer has not been formed, and also a surface which becomes an outermost surface under the condition that the temporally adhesive layer has been laminated on the semiconductor wafer 4.

15 The surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer is used under the condition that it has been laminated on the surface (the surface side) at the side on which an integrated circuit has been built or an electrode has been formed on the semiconductor wafer 5 having a notch 6 shown in Fig.2, and is used in the step of grinding of the surface
20 (backside) at the side on which the integrated circuit is not built or the electrode is not formed on the semiconductor wafer 5.

Herein, the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer of the present invention may be in a form in which the substrate 1 and the temporally adhesive layer 2 have been preliminarily cut (pre-cut) to a prescribed shape in accordance with the step or apparatus to be used,
25 or may be in a form in which an uncut-lengthy sheet has been re-wound in a roll state. Examples of the expression "a prescribed shape" include: a circular state, which has the same diameter as the semiconductor wafer 5 and also covers a

portion of the notch 6. There is no particular limitation to the prescribed shape, as long as the backside of the semiconductor wafer can be ground, while protecting an integrated circuit on the semiconductor wafer, and the advantageous effect of the present invention is not deteriorated.

5 Note that the numerical range represented by “to” includes the numerical values of the before and after “to”, unless otherwise specified.

{0017}

(Substrate)

10 A primary purpose of the substrate 1 (hereinafter, also referred to as a substrate film) to be used in the present invention is to protect a semiconductor wafer from an impact at the time of back-grinding of the semiconductor wafer. In particular, it is important that the substrate has a water-proof against a water cleaning or the like, and retention of the processed component. Examples of the foregoing substrate 1 include those described in JP-A-2004-186429.

15 In this regard, as the resin of the substrate 1 to be used in the present invention, ordinarily, those for use in an adhesive tape may be used. Examples of the resin include: α -olefin homopolymers or copolymers, such as polyethylene, polypropylene, ethylene/propylene copolymers, polybutene, ethylene/vinyl acetate copolymers, ethylene/acrylic acid ester copolymers, and ionomers;
20 engineering plastics, such as polyethylene terephthalate, polycarbonate, and polymethyl methacrylate; and thermoplastic elastomers, such as polyurethane and styrene/ethylene/butene-based or /pentene-based copolymers.

25 As the substrate 1, the resin selected from the group of those may be used in a single layer or a plurality of layers, or a mixture of at least 2 kinds of resins selected from the group of those may be used in a single layer or a plurality of layer.

{0018}

As to the substrate 1 to be used in the present invention, the surface

roughness Rz of the surface (backside) 11 on which the temporally adhesive layer 2 has not been formed is from 0.7 to 5.0 μm . If Rz becomes less than 0.7 μm , there is a problem that a blocking occurs at the time of coating of the temporally adhesive or at the time of film formation of the substrate 1, which results in the difficulty of production or the like. On the other hand, if Rz exceeds 5.0 μm , a grinding dust adheres to the backside 11 of the tape, which results in an inability of the sensor recognition. The roughness Rz of the substrate backside 11 is preferably 1.0 μm or more and less than 5.0 μm , more preferably from 1.0 to 4.9 μm , still more preferably from 1.0 to 4.5 μm , particularly preferably from 1.0 to 3.5 μm , and most preferably from 1.0 to 2.0 μm .

In this regard, the roughness of the substrate backside 11 can be adjusted to any given value, by controlling the roughness of a cooling roll at the time of film formation of the substrate 1. The resin which has obtained fluidity by heating is extruded and then is cooled with a cooling roll, to be shaped in the form of a film. In order to cool the resin, a metal roll or a rubber roll is often used. For example, in a case of using the rubber roll, silicon particles are blended in a rubber in order to give a peeling property thereto, so that the roughness of the substrate backside 11 can be adjusted, by arbitrarily controlling a particle size of said silicon particles.

As described above, if the roughness is controlled with a cooling roll, a surface roughness can be uniformly given to the entire surface of the substrate 1 on which the temporally adhesive layer 2 has not been formed.

{0019}

Further, the melting point of the substrate-constituting resin in the outermost layer of the substrate 1, on which the temporally adhesive layer 2 has not been formed, is preferably 85°C or more, more preferably 95°C or more, still more preferably 100°C or more, and particularly preferably 110°C or more, from the viewpoint of preventing fusion to a chuck table. Note that, although the

upper limit of the melting point is not limited in particular, it is practically 200°C or less, and more preferably 180°C or less.

Herein, the expression “the outermost layer of the substrate, on which the temporally adhesive layer 2 has not been formed” means a single layer in a case
5 where the substrate 1 is a single layer, and means a substrate layer, which is the most apart position from the temporally adhesive layer 2 in a case where the substrate 1 is a plurality of layers.

{0020}

For the substrate 1 to be used in the present invention, a resin in which at
10 least vinyl acetate is contained as a copolymerizable component is preferably used. Further, the content of said vinyl acetate component is preferably from 1.9 to 10.5% by mass. Examples of the copolymerizable component to be combined with vinyl acetate include: an olefin, such as ethylene. In this regard, the copolymer may be a binary copolymer, or may be a ternary or multinary
15 copolymer.

Further, in the present invention, the resin composed of the copolymer may be composed of any of a random copolymer, a block copolymer, an alternating copolymer, and a graft copolymer.

Further, in the present invention, in particular, an ethylene/vinyl acetate
20 copolymer (also referred to as EVA) is preferable.

{0021}

The resin of the substrate 1 may be composed of resins of the same copolymerizable component, or may be stacked with a plurality of resins of different copolymerizable components. Alternatively, a plurality of resins may be
25 used in a mixture thereof. In the present invention, in view of the impact on warpage, the substrate 1 composed of the resins of the same copolymerizable component is preferable.

{0022}

In order to recognize and discriminate a surface-protective adhesive tape for back-grinding of the semiconductor wafer, a coloring pigment (also referred to simply as a pigment) or the like is blended in the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer. The coloration may be carried out by adding a pigment or a dye in a temporally adhesive. However, it is preferable to color the substrate 1 by adding a pigment thereto.

As a pigment, a blue pigment is preferable, and examples thereof include: a phthalocyanine pigment, a naphthalocyanine pigment, an indanthrone pigment, an indanthrene pigment, and a triarylcarbonium pigment. Among these pigments, a phthalocyanine pigment and a naphthalocyanine pigment are preferable, and a phthalocyanine pigment is more preferable. Especially, a copper phthalocyanine blue is preferable.

The blend amount of the coloring pigment is preferably from 0.005 to 1.0 part by mass, and more preferably from 0.01 to 0.5 parts by mass, with respect to 100 parts by mass of the resin which forms the substrate 1. Further, it is more preferable to extrude a plurality of layers which may be composed of the same resin, so as to form a plurality of films, and to blend a pigment with the resin only at the side of the film on which a temporally adhesive layer is formed. By blending the pigment only at the side of the film on which the temporally adhesive layer is formed, change in color of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer can be prevented. This is because even if the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer is immersed in an etching liquid, such as an acid, the pigment is not exposed to the acid.

{0023}

In a case where the substrate 1 is a laminate of a plurality of the resins which are composed of different kinds of copolymerizable components, use may be made of resins other than the resins containing at least vinyl acetate as said

copolymerizable component. Examples of the other resins include: polyolefin resins, e.g. a polyethylene and a polypropylene, such as a high-density polyethylene (hereinafter, also referred to as HDPE), and a low-density polyethylene (hereinafter, also referred to as LDPE); and a polyolefin, such as
 5 ethylene/acrylic acid copolymer, ethylene/methacrylic acid copolymer, and their metal-crosslinked polymers (ionomers).

In the present invention, among these polymers, a high-density polyethylene, a low-density polyethylene, and a polypropylene are preferable.

In a case of the substrate 1 in which two or more resins are stacked, in
 10 the present invention, it is preferable that a layer containing a resin in which vinyl acetate is contained is arranged at the side on which the temporally adhesive layer is formed.

{0024}

As the substrate 1 to be used in the surface-protective adhesive tape for
 15 back-grinding of the semiconductor wafer of the present invention, the melt flow rate (MFR) thereof, which is measured in accordance with JIS K 7210, is preferably from 1.0 to 2.9 g/10min, more preferably from 1.5 to 2.5 g/10min, and still more preferably from 1.8 to 2.3 g/10min.

If the MFR of the substrate 1 is in the above range, in the process of:
 20 setting a rolled surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer to a laminator; and drawing the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer out of the laminator, thus the surface-protective adhesive tape 3 can be laminated on the surface of the semiconductor wafer 5. Further, by rotating a cutting blade heated at about
 25 150°C along the outer periphery of the semiconductor wafer 5 and by a heat generated at the time of cutting the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer in the shape of the semiconductor wafer, a fusion bonding can be carried out, so that the substrate 1 of the surface-

protective adhesive tape 3 for back-grinding of the semiconductor wafer covers the sides of the semiconductor wafer 5. As a result, an interface between the temporally adhesive layer 2 and the semiconductor wafer 5 turns out to be covered with the substrate 1, so that seepage can be prevented.

5 {0025}

Specifically, if MFR exceeds 2.9 g/10min, the flow property of the substrate 1 may become too high. For this reason, at the time of cutting a melted substrate 1, a time for the cutting blade to get into touch with a certain point on the outer periphery of the semiconductor wafer 5 becomes short.

10 Therefore, there is a possibility that a resin which constitutes the substrate 1 is sharply cut at once, and a fusion bonding may not be performed so as to cover the sides of the semiconductor wafer 5. On the contrary, if MFR is less than 1.0 g/10min, the flow property of the substrate 1 may become too low, which results in a possibility that the interface of the semiconductor wafer 5 cannot be covered
15 with the tape.

{0026}

Adjustment of MFR of the substrate 1 to the above range can be achieved, for example, by adjustments of other copolymerizable components of the resin, a content of vinyl acetate, a molecular weight and its distribution, a
20 mixture of different resins in terms of MFR, and a combination of these methods.

{0027}

In the resin of the substrate 1 to be used in the present invention, if needed, use may be to contain a stabilizer, a sliding agent, an antioxidant, an anti-blocking agent, a plasticizer, a tackifier, a softener, or the like.

25 {0028}

The thickness of the substrate 1 is not particularly limited and may be set properly. However, the thickness is preferably from 80 to 200 μm , and more preferably from 100 to 180 μm .

Adjustment of the thickness to the above range leads to: an excellent property needed for keeping the form of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer; and also improvement in the operability in the time of handling. Note that, if the thickness is made
 5 excessively thick, there is a possibility that productivity of the substrate 1 is adversely affected, which results in increase of production costs.

{0029}

The production method of the substrate 1 is not particularly limited, and the substrate may be produced by a conventional injection or extrusion technique,
 10 such as a calender method, a T-die extrusion method, an inflation method, a casting method, and the like. These methods may be properly selected, in view of productivity, thickness accuracy of the substrate 1 to be obtained, and the like.

{0030}

(Temporally adhesive layer)

15 The materials of the temporally adhesive to be used in the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer of the present invention is not particularly limited, and any of conventional materials may be used. For example, the materials may be any of those having such a property that their temporally adhesion property is lowered due to curing by
 20 exposure to a radiation, so that the temporally adhesive can be easily peeled from the semiconductor wafer 5. Specifically, examples thereof include a homopolymer having a (meth)acrylic acid ester as a constituting component, a copolymer having a (meth)acrylic acid ester as a constituting component, a (meth)acrylic resin, and a (meth)acrylic acid ester.

25 {0031}

The mass-average molecular weight of these resins is preferably from 200 thousands to 200 ten thousands, more preferably from 300 thousands to 150 ten thousands, and still more preferably from 400 thousands to 120 ten

thousands.

Note that the mass-average molecular weight is a value calculated as the polystyrene-equivalent mass-average molecular weight from a value measured by gel permeation chromatography (trade name: 150-C ALC/GPC, manufactured
 5 by Waters Corporation), using a 1% solution obtained by dissolving a resin in tetrahydrofuran.

{0032}

Examples of the monomer component of the polymer containing a (meth)acrylic acid ester as a constituting component include: an alkyl
 10 (meth)acrylate or an alkyl (meth)acrylate each having a straight or branched alkyl group having 30 or less carbon atoms, and preferably having 4 to 18 carbon atoms, such as methyl, ethyl, n-propyl, isopropyl, n-butyl, t-butyl, isobutyl, amyl, iso-amyl, hexyl, heptyl, cyclohexyl, 2-ethylhexyl, octyl, iso-octyl, nonyl, iso-nonyl, decyl, iso-decyl, undecyl, lauryl, tridecyl, tetradecyl, stearyl, octadecyl, and
 15 dodecyl. These monomer components may be used singly or in combination of 2 or more kinds.

{0033}

As a constituting component other than the constituting components in the (meth)acrylic acid ester resin, the following monomers may be contained.
 20 Examples thereof include: a carboxy group-containing monomer, 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, such as maleic anhydride, and itaconic anhydride; a hydroxy group-containing monomer, such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl
 25 (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxylauryl (meth)acrylate, and (4-hydroxymethylcyclohexyl)methyl (meth)acrylate; a sulfonic acid group-containing monomer, such as styrene sulfonic acid, allyl sulfonic acid,

2-(meth)acrylamide-2-methylpropane sulfonic acid, (meth)acrylamide propane sulfonic acid, sulfopropyl (meth)acrylate, and (meth)acryloyloxynaphthalene sulfonic acid; a phosphoric acid group-containing monomer, such as 2-hydroxyethylacryloyl phosphate; (meth)acrylamide, (meth)acrylic acid N-hydroxymethylamide, (meth)acrylic acid alkylaminoalkyl esters (for example, dimethylaminoethyl methacrylate, t-butylaminoethyl methacrylate, and the like), N-vinylpyrrolidone, acryloylmorpholine, vinyl acetate, styrene, and acrylonitrile. These monomer components may be used singly, or in combination of 2 or more kinds thereof.

10 {0034}

Further, in the (meth)acrylic acid ester resin, the following multifunctional monomers may be contained as a constituting component. Examples thereof include: hexanediol di(meth)acrylate, (poly)ethyleneglycol di(meth)acrylate, (poly)propyleneglycol di(meth)acrylate, neopentylglycol di(meth)acrylate, 15 pentaerythritol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, tetramethylolmethane tetra(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, dipentaerythritol monohydroxypenta(meth)acrylate, dipentaerythritol hexa(meth)acrylate, epoxy (meth)acrylate, polyester (meth)acrylate, and urethane (meth)acrylate. These 20 monomer components may be used singly, or in combination of 2 or more kinds thereof.

{0035}

The acrylic acid esters include: ethyl acrylate, butyl acrylate, 2-ethylhexyl acrylate, glycidyl acrylate, 2-hydroxyethyl acrylate, and the like. Further, a 25 combination may be also used: of a methacrylic polymer, in which the acrylic acid ester has been replaced with, for example, a methacrylic acid ester, or the like, and a curing agent.

{0036}

As the curing agent, use may be made of: those described in JP-A-2007-146104. Examples thereof include: an epoxy compound having 2 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-

5 diglycidylaminomethyl)benzene, and N,N,N',N'-tetraglycidyl-m-xylenediamine; an isocyanate-based compound having 2 or more isocyanate groups in the molecule, such as tolylene diisocyanates (TDI), for example, 2,4-tolylene diisocyanate, and 2,6-tolylene diisocyanate, xylyrene diisocyanate (XDI), for example, 1,3-xylyrene diisocyanate and 1,4-xylyrene diisocyanate, diphenylmethane diisocyanate (MDI),

10 for example, diphenylmethane-4,4'-diisocyanate; or a pre-polymer of these isocyanate-based compounds, such as a trimethylol propane adduct of TDI; and an aziridine-based compound having 2 or more aziridinyl groups in the molecule, such as tetramethylol-tri- β -aziridinyl propionate, trimethylol-tri- β -aziridinyl propionate, trimethylolpropane-tri- β -aziridinyl propionate, and trimethylolpropane-

15 tri- β -(2-methylaziridinyl) propionate.

{0037}

The content of the curing agent has only to be adjusted depending on a desired temporally adhesive force, and is preferably from 0.01 to 10 parts by mass and more preferably from 0.1 to 5 parts by mass, with respect to 100 parts

20 by mass of the resin component.

{0038}

Further, by incorporating a photo-polymerizable compound and a photo-polymerization initiator in the temporally adhesive layer 2, the temporally adhesive force of the temporally adhesive layer can be reduced due to curing

25 upon exposure to an ultraviolet light. As the foregoing photo-polymerizable compound, a widespread use can be made of a low molecular compound having, in the molecule, at least 2 photo-polymerizable carbon-carbon double bonds which are able to be 3-dimensionally netted by exposure to light, as described, for

example, in JP-A-S60-196956 and JP-A-S60-223139.

{0039}

Specifically, a use can be made of: trimethylolpropane triacrylate, pentaerythritol triacrylate, pentaerythritol tetraacrylate, dipentaerythritol
5 monohydroxypentaacrylate, dipentaerythritol hexaacrylate, or 1,4-butyleneglycol diacrylate, 1,6-hexanediol diacrylate, polyethyleneglycol diacrylate, a commercially available oligo ester acrylate, and the like.

{0040}

As a photo-polymerization initiator, use may be made of: those described
10 in JP-A-2007-146104 and JP-A-2004-186429. Specifically, a use can be made of: benzoin isopropyl ether, benzoin isobutyl ether, benzophenone, Michler's ketone, chlorothioxanthone, benzylmethylketal, α -hydroxycyclohexylphenylketone, 2-hydroxymethylphenylpropane, and the like. One kind or two or more kinds of these compounds may be used. The addition amount of the photo-
15 polymerization initiator is preferably from 0.1 to 15 parts by mass and more preferably from 5 to 10 parts by mass, with respect to 100 parts by mass of the resin component.

{0041}

Further, as the temporally adhesive layer 2, a use can be made of: a
20 photo-polymerizable temporally adhesive layer formed by using a resin composition containing a polymer having a photo-polymerizable carbon-carbon double bond therein, a photo-polymerization initiator, and a curing agent. As the polymer having a photo-polymerizable carbon-carbon double bond therein, preferably use may be made of: a (meth)acrylic polymer obtained by subjecting a
25 monomer, such as a (meth)acrylic acid ester having an alkyl group with carbon atoms of from 4 to 12 and more preferably 8 carbon atoms at the side chain thereof, and 1 kind or 2 or more kinds of copolymerizable modified monomers, to homopolymerization or copolymerization in accordance with an arbitrary method.

{0042}

In the thus-formed photo-polymerizable temporally adhesive layer, when compared to the initial temporally adhesive force, the temporally adhesive force thereof is substantially lowered by irradiating, from the substrate 1 side, a radiation, preferably an ultraviolet light, which is capable of lowering the temporally adhesive force of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer with respect to a surface of the semiconductor wafer 5, before peeling the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer from the surface of the semiconductor wafer 5. As a result, the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer can be easily peeled from the adherend.

{0043}

Further, into the temporally adhesive, use may be blended of: a tackifier, the temporally adhesive modifier, a surfactant, any of inorganic compound fillers, or other modifiers, if necessary.

{0044}

In the present invention, the thickness of the temporally adhesive layer 2 may be set adequately depending on the adherend to be applied and is not particularly limited, but preferably from 10 to 60 μm , and more preferably from 20 to 50 μm . In this regard, the temporally adhesive layer 2 may have a structure in which a plurality of layers is stacked.

{0045}

Adjustment of the thickness of the temporally adhesive layer 2 to the above range allows excellent productivity leading to reduction in production costs. Further, because the temporally adhesive force of the temporally adhesive layer 2 never increases more than necessary, when the temporally adhesive layer 2 is peeled after back-grinding, a damage of the semiconductor wafer 5 due to increase of the peel temporally adhesive is never occurred and a contamination

resulting from the temporally adhesive layer 2 is never caused on the surface of the semiconductor wafer 5. Further, the temporally adhesive layer excels in adhesion to the asperity of the semiconductor wafer 5 surface, and when the backside of the semiconductor wafer 5 is subjected to grinding or a chemical treatment, even if water or a chemical liquid is entered thereto, a damage of the semiconductor wafer 5 does not occur and a contamination of the semiconductor wafer 5 due to a grinding dust or a chemical liquid also does not occur, and reduction of the temporally adhesive force in post-radiation irradiation is enough, and when the temporally adhesive layer 2 is peeled from the semiconductor wafer 5, the semiconductor wafer 5 is never damaged.

{0046}

In the present invention, when the temporally adhesive layer 2 is provided on one side of the substrate 1, use can be made of: a method of forming the temporally adhesive layer 2 by coating and drying the temporally adhesive in accordance with a known method, such as a roll coater, a comma coater, a die coater, a Meyer bar coater, a reverse roll coater, and a gravure coater. At this time, in order to protect the coated temporally adhesive layer 2 from, for example, contamination caused by an environment, it is preferable to laminate a peeling liner 4 (also referred to as a peeling film) on the surface of the coated temporally adhesive layer 2.

{0047}

Examples of the peeling film to be used in the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer of the present invention includes: a synthetic resin, such as polypropylene, polyethylene terephthalate, and the like. If needed, it is preferable to use a peeling film the surface of which has been subjected to a silicone treatment or the like. The thickness of the peeling film is ordinarily from 10 to 100 μm and preferably from 20 to 50 μm .

{0048}

Adaption of the foregoing constitution enables the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer to retain an excellent adhesion to the semiconductor wafer surface and an excellent easy peeling property, and also to combine these properties and a low contamination. Specifically, by forming the temporally adhesive layer 2 on one side of the substrate 1, a good adhesion to the semiconductor wafer surface can be obtained, even if an asperity exists on the semiconductor wafer surface. Further, when the backside of the semiconductor wafer 5 is subjected to grinding or a chemical treatment, a grinding-water or a chemical liquid is kept from entering, and both damage and contamination of the semiconductor wafer due to these liquids can be prevented.

Further, when the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer is peeled from the semiconductor wafer surface, the temporally adhesive layer 2 is cured and contracted by irradiating a radiation, and thereby the temporally adhesive force of the entire temporally adhesive layer is fully reduced, so that the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer can be peeled with a good operability and no damage to the semiconductor wafer surface. Therefore, by the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer of the present invention, a low contamination can be achieved at the same time with retention of an excellent adhesion to the asperity and an easy peeling property at the time of peeling.

{0049}

A total light transmittance of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer of the present invention at the wavelength of 500 to 600 nm is from 40 to 80%. The lower limit of the total light transmittance is preferably 50% or more, more preferably more than 50%, still

more preferably 51% or more, and particularly preferably 53% or more. On the other hand, the upper limit of the total light transmittance is preferably 70% or less.

5 If the total light transmittance at the wavelength of 500 to 600 nm gets to less than 40%, detection of the notch becomes difficult, so that sensor recognition error occurs. On the other hand, if the total light transmittance at the wavelength of 500 to 600 nm exceeds 80%, such high transparency makes it difficult to recognize whether lamination has been completed or not.

{0050}

10 In the present invention, a difference ($\Delta ET - \Delta EM$) between a color difference (ΔEM) of a mirror wafer and a color difference (ΔET) of a tape-laminated wafer in which the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer of the present invention has been laminated on the mirror wafer, is more than 6.5 ($\Delta ET - \Delta EM > 6.5$). The difference $\Delta ET - \Delta EM$ is
 15 preferably more than 7.0 and more preferably more than 7.8. If the difference $\Delta ET - \Delta EM$ is 6.5 or less, it is difficult to recognize at a glance whether the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer has been laminated on the mirror wafer, and therefore this becomes a factor that causes an error, such as a double lamination of the surface-protective adhesive tape 3 for
 20 back-grinding of the semiconductor wafer. Note that the upper limit of the difference $\Delta ET - \Delta EM$ is not limited in particular, but the difference $\Delta ET - \Delta EM$ is preferably less than 30, more preferably less than 25, and still more preferably less than 20.

{0051}

25 The temporally adhesive force at ordinary temperature (25°C) of the surface-protective adhesive tape for back-grinding of the semiconductor wafer of the present invention with respect to a SUS plate polished with an abrasive paper of #280 is preferably from 0.3 to 5.0 N/25mm in a case of a pressure-sensitive

temporally adhesive. On the other hand, in a case of an ultraviolet curable temporally adhesive, the temporally adhesive force before ultraviolet curing is preferably from 1.0 to 20 N/25mm, and the temporally adhesive force after ultraviolet curing is preferably from 0.01 to 1.0 N/25mm. In a case of a pressure-sensitive temporally adhesive, a major adjustment of the temporally adhesive force is difficult in contrast to the ultraviolet curable temporally adhesive, and therefore if the temporally adhesive force gets to more than 5.0 N/25mm, problems of peeling failure and adhesive deposit are caused. On the other hand, if the temporally adhesive force gets to less than 0.3 N/25mm, problems of dust penetration and tape peeling are caused, so that a wafer cracking is raised. In a case of an ultraviolet curable temporally adhesive, the temporally adhesive force at the time of peeling can be arbitrarily controlled by ultraviolet irradiation, and a preferable range of the temporally adhesive force is different between before ultraviolet curing and after ultraviolet curing.

15 {0052}

By adjusting the temporally adhesive force to the above range, the surface-protective adhesive tape for back-grinding of the semiconductor wafer is never peeled from the semiconductor wafer upon the grinding, whereby the seepage and the semiconductor wafer cracking are improved. Further, the peeling after grinding gets easy, whereby a damage of the semiconductor wafer and an adhesive deposit are improved.

Note that, with respect to articles which are capable of lowering the temporally adhesive force in order to peel, such as a radiation curable tape, the temporally adhesive force is referred to the temporally adhesive force measured before the grinding, specifically measured under the conditions of before and after performance of a treatment for lowering the temporally adhesive force.

It can be accomplished by the preferable constitution of the temporally adhesive layer to give the foregoing temporally adhesive force thereto. In

particular, adjustment of the blending amount of the curing agent allows a setting of the range.

Further, in addition to this, the temporally adhesive force can be also adjusted by the thickness of the temporally adhesive layer or the kind of the substrate, albeit the same temporally adhesive.

{0053}

Examples of the notch size which can be recognized by the present invention include: a size consisting of a notch depth of 1.00 mm (allowable tolerance +0.25 mm, -0.00 mm) and a notch angle of 90° (allowable tolerance +5°, -1°), defined by the SEMI standards and the JEITA standards. By using the surface-protective adhesive tape for back-grinding of the semiconductor wafer of the present invention, a good sensor recognition effect is achieved, even with respect to a semiconductor wafer having a notch which has more sensor recognition difficulty than an orientation flat.

The semiconductor wafer having a notch which can be recognized by the present invention includes: a large-diameter semiconductor wafer having a diameter of as large as 8 inches or 12 inches.

{0054}

(Grinding method of semiconductor wafer)

The grinding method of the semiconductor wafer of the present invention includes: a process of laminating the surface-protective adhesive tape for back-grinding of the semiconductor wafer of the present invention, on the surface of the semiconductor wafer having a notch.

The surface-protective adhesive tape for back-grinding of the semiconductor wafer has: a substrate; and a temporally adhesive layer provided on one side of said substrate, wherein the surface roughness Rz of the side of said substrate on which the temporally adhesive layer has not been formed, is from 0.7 to 5.0 μm , wherein a total light transmittance of said surface-protective

adhesive tape for back-grinding of the semiconductor wafer at the wavelength of 500 to 600 nm, is from 40 to 80%, and wherein a difference ($\Delta ET - \Delta EM$) between a color difference (ΔEM) of a mirror wafer and a color difference (ΔET) under the condition that said surface-protective adhesive tape for back-grinding of the semiconductor wafer has been laminated on the mirror wafer, is more than 6.5.

As the surface-protective adhesive tape for back-grinding of the semiconductor wafer for use in the grinding method of the semiconductor wafer, such preferable surface-protective adhesive tapes for back-grinding of the semiconductor wafer as explained earlier are preferably applied.

Hereinafter, the grinding method of the semiconductor wafer of the present invention will be described in more detail. However, the present invention is not limited thereto.

{0055}

At first, after peeling a peeling liner 4 from the temporally adhesive layer 2 of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer, to expose the surface of the temporally adhesive layer 2, through the temporally adhesive layer 2, the surface-protective adhesive tape is laminated by fusion on the face (surface) at the side of the built-in integrated circuit of the semiconductor wafer having a notch or at the side of the electrode formed on the semiconductor wafer. Next, after fixing the semiconductor wafer on a chuck table or the like of the grinder through the substrate 1 of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer, the face (backside) at the side of the semiconductor wafer on which the integrated circuit has not been built-in or at the side of the semiconductor wafer on which the electrode has not been formed is subjected to grinding, a chemical treatment, or the like. After completion of the grinding, the chemical treatment, or the like, said surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer is peeled.

{0056}

Herein, for operation of the adhesion to the semiconductor wafer of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer, for example, use may be made of: an automatic taping machine of LAMINATOR DR8500III (trade name, manufactured by NITTO SEIKI Co., Ltd.).

- 5 For operation of the back-grinding at the backside of the semiconductor wafer, for example, use may be made of: a grinding apparatus of DGP8760 (trade name, manufactured by DISCO Corporation).
{0057}

- 10 Further, the peeling of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer is carried out, after thinning by the back-grinding at the backside of the semiconductor wafer, and also after wafer-mounting by laminating the backside of the thinned semiconductor wafer on the adhesion surface of a dicing-die-bond sheet (dicing tape) in which the temporally adhesive and the adhesion bond are stacked on the substrate.

- 15 For the process of the wafer-mounting to the dicing tape and the peeling of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer, for example, use may be made of: an apparatus of RAD-2700F (trade name, manufactured by Lintec Corporation).
{0058}

- 20 At the time of laminating on a dicing-die-bond sheet, the dicing-die-bond sheet may be closely adhered to the semiconductor wafer by heating it at a high temperature (about 80°C). The surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer of the present invention excels in heat resistance, and therefore is able to act as the surface-protective adhesive tape
25 without causing any of problems, such as melting and a change of shape even at the time of heating.
{0059}

By using the surface-protective adhesive tape 3 for back-grinding of the

semiconductor wafer of the present invention which excels in sensor recognition, and also excels in both lamination visibility and heat resistance, the grinding method of the semiconductor wafer of the present invention achieves both enhancement in operation efficiency and further enhancement in operability, 5 when compared to a conventional grinding method.

EXAMPLES

{0060}

The present invention will be described in more detail based on examples 10 given below, but the invention is not meant to be limited by these.

{0061}

(Example 1)

0.6 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and 15 6.0% by mass at a content of a vinyl acetate component was dry-blended into 100 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin A containing 6.0% by mass at a content of a vinyl acetate component. By extrude-molding the blend with an extruder, a substrate film A was obtained, which had a thickness of 165 μm and a surface roughness R_z of the backside of 1.2 μm ($R_z =$ 20 1.2 μm).

2 mol% of methacrylic acid, 50 mol% of 2-ethylhexyl acrylate, 30 mol% of 2-hydroxyethyl acrylate, and 18 mol% of methyl acrylate were blended in this proportion. With respect to 100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-isobutyronitrile was added, and this mixture was 25 subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted with nitrogen gas, to obtain a solution of a polymer having a mass-average molecular weight of 800,000. Into this polymer solution, 2.0 parts by mass of CORONATE L (trade name, manufactured by

Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was blended, to obtain the temporally adhesive composition.

As shown in Fig. 1, the thus-obtained temporally adhesive composition
 5 was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 30 μm , and then the temporally adhesive layer was laminated on a substrate film 1 (the substrate film A in Example 1), to obtain a surface-protective adhesive tape 3 for back-grinding having a thickness of 195 μm .

10 {0062}
 (Example 2)

0.3 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and 6.0% by mass at a content of a vinyl acetate component was dry-blended into
 15 100 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin A containing 6.0% by mass at a content of a vinyl acetate component. By extrude-molding the blend with an extruder, a substrate film B was obtained, which had a thickness of 165 μm and a surface roughness R_z of the backside of 0.7 μm ($R_z = 0.7 \mu\text{m}$).

20 1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77 mol% of butyl acrylate were blended in this proportion. With respect to 100 parts by mass of a total of these monomers, 0.3 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted with nitrogen
 25 gas, to obtain a solution of a polymer having a mass-average molecular weight of 300,000. Into this polymer solution, 1.5 parts by mass of CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was blended, to obtain

the temporally adhesive composition.

As shown in Fig. 1, the thus-obtained temporally adhesive composition was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 40 μm , and then the temporally adhesive layer was

5 laminated on a substrate film 1 (the substrate film B in Example 2), to obtain a surface-protective adhesive tape 3 for back-grinding having a thickness of 205 μm .

{0063}

(Example 3)

10 0.6 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and 6.0% by mass at a content of a vinyl acetate component was dry-blended into 100 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin C containing 10.0% by mass at a content of a vinyl acetate component. By extrude-molding
15 the blend with an extruder, a substrate film C was obtained, which had a thickness of 100 μm and a surface roughness R_z of the backside of 3.7 μm ($R_z = 3.7 \mu\text{m}$).

2 mol% of methacrylic acid, 29 mol% of 2-hydroxyethyl acrylate, and 69 mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to
20 100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted with nitrogen gas, to obtain a solution of a polymer having a mass-average molecular weight of 230,000. Into this polymer solution, 1.5 parts by mass of
25 CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was blended, to obtain the temporally adhesive composition.

As shown in Fig. 1, the thus-obtained temporally adhesive composition

was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 30 μm , and then the temporally adhesive layer was laminated on a substrate film 1 (the substrate film C in Example 3), to obtain a surface-protective adhesive tape 3 for back-grinding having a thickness of 130 μm .

{0064}

(Example 4)

0.8 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and 6.0% by mass at a content of a vinyl acetate component was dry-blended into 100 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin C containing 10.0% by mass at a content of a vinyl acetate component. By extrude-molding the blend with an extruder, a substrate film D was obtained, which had a thickness of 100 μm and a surface roughness R_z of the backside of 4.9 μm ($R_z = 4.9 \mu\text{m}$).

1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77 mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to 100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted with nitrogen gas, to obtain a solution of a polymer having a mass-average molecular weight of 700,000. Into this polymer solution, 1.5 parts by mass of CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was blended, to obtain the temporally adhesive composition.

As shown in Fig. 1, the thus-obtained temporally adhesive composition was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 30 μm , and then the temporally adhesive layer was

laminated on a substrate film 1 (the substrate film D in Example 4), to obtain a surface-protective adhesive tape 3 for back-grinding having a thickness of 130 μm .

{0065}

5 (Example 5)

3.0 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and 6.0% by mass at a content of a vinyl acetate component was dry-blended into 100 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin C containing
10 10.0% by mass at a content of a vinyl acetate component. By extrude-molding the above EVA resin dry-blended with a low-density polyethylene (LDPE) by using an extruder, a substrate film E was obtained, which had a thickness ratio of LDPE:EVA = 1:1, a thickness of 80 μm , and a surface roughness Rz of the backside of 2.1 μm ($R_z = 2.1 \mu\text{m}$).

15 1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77 mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to 100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted
20 with nitrogen gas, to obtain a solution of a polymer having a mass-average molecular weight of 700,000. Into this polymer solution, 1.5 parts by mass of CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was blended, to obtain the temporally adhesive composition.

25 As shown in Fig. 1, the thus-obtained temporally adhesive composition was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 40 μm , and then the temporally adhesive layer was laminated on the EVA side of a substrate film 1 (the substrate film E in Example

5), to obtain a surface-protective adhesive tape 3 for back-grinding having a thickness of 120 μm .

{0066}

(Example 6)

5 5.0 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and 6.0% by mass at a content of a vinyl acetate component was dry-blended into 100 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin C containing 10.0% by mass at a content of a vinyl acetate component. By extrude-molding
10 the above EVA resin dry-blended with a high-density polyethylene (HDPE) by using an extruder, a substrate film F was obtained, which had a thickness ratio of HDPE:EVA = 3:7, a thickness of 200 μm , and a surface roughness Rz of the backside of 3.2 μm ($R_z = 3.2 \mu\text{m}$).

 1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77
15 mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to 100 parts by mass of a total of these monomers, 0.3 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted with nitrogen gas, to obtain a solution of a polymer having a mass-average
20 molecular weight of 700,000. Into this polymer solution, 1.5 parts by mass of CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was blended, to obtain the temporally adhesive composition.

 As shown in Fig. 1, the thus-obtained temporally adhesive composition
25 was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 40 μm , and then the temporally adhesive layer was laminated on the EVA side of a substrate film 1 (the substrate film F in Example 6), to obtain a surface-protective adhesive tape 3 for back-grinding having a

thickness of 240 μm .

{0067}

(Comparative Example 1)

1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77
5 mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to
100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-
isobutyronitrile was added, and this mixture was subjected to copolymerization at
a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted
with nitrogen gas, to obtain a solution of a polymer having a mass-average
10 molecular weight of 700,000. Into this polymer solution, 1.5 parts by mass of
CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co.,
Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was
blended, to obtain the temporally adhesive composition.

As shown in Fig. 1, the thus-obtained temporally adhesive composition
15 was coated on a peeling liner 4 so that the thickness of the temporally adhesive
layer 2 would get to 42 μm , and then the temporally adhesive layer 2 was
laminated on a substrate film 1 (in Comparative Example 1, TEIJIN TETORON
film G2C, having a thickness of 38 μm and a surface roughness Rz of the
backside of 0.1 μm (Rz = 0.1 μm) (trade name, manufactured by Teijin DuPont
20 Films Japan Limited)), to obtain a surface-protective adhesive tape 3 for back-
grinding having a thickness of 80 μm .

{0068}

(Comparative Example 2)

By extrude-molding a low-density polyethylene (LDPE) resin using an
25 extruder, a substrate film G was obtained, which had a thickness of 150 μm and a
surface roughness Rz of the backside of 5.8 μm (Rz = 5.8 μm).

1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77
mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to

100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted with nitrogen gas, to obtain a solution of a polymer having a mass-average
 5 molecular weight of 700,000. Into this polymer solution, 1.5 parts by mass of CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was blended, to obtain the temporally adhesive composition.

As shown in Fig. 1, the thus-obtained temporally adhesive composition
 10 was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 30 μm , and then the temporally adhesive layer 2 was laminated on a substrate film 1 (in Comparative Example 2, the substrate film G), to obtain a surface-protective adhesive tape 3 for back-grinding having a thickness of 180 μm .

15 {0069}

(Comparative Example 3)

30 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and 6.0% by mass at a content of a vinyl acetate component was dry-blended into
 20 100 parts by mass of a low-density polyethylene (LDPE) resin. By extrude-molding the dry-blended resins with an extruder, a substrate film H was obtained, which had a thickness of 300 μm and a surface roughness R_z of the backside of 2.5 μm ($R_z = 2.5 \mu\text{m}$).

1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77
 25 mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to 100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted

with nitrogen gas, to obtain a solution of a polymer having a mass-average molecular weight of 700,000. Into this polymer solution, 1.5 parts by mass of CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was
 5 blended, to obtain the temporally adhesive composition.

As shown in Fig. 1, the thus-obtained temporally adhesive composition was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 30 μm , and then the temporally adhesive layer 2 was laminated on a substrate film 1 (in Comparative Example 3, the substrate film H),
 10 to obtain a surface-protective adhesive tape 3 for back-grinding having a thickness of 330 μm .

{0070}

(Comparative Example 4)

4.0 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B
 15 containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and 6.0% by mass at a content of a vinyl acetate component was dry-blended into 100 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin C containing 10.0% by mass at a content of a vinyl acetate component. By extrude-molding the above EVA resin dry-blended with a low-density polyethylene (LDPE) by
 20 using an extruder, a substrate film I was obtained, which had a thickness ratio of LDPE:EVA = 3:7, a thickness of 100 μm , and a surface roughness R_z of the backside of 7.1 μm ($R_z = 7.1 \mu\text{m}$).

1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77 mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to
 25 100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted with nitrogen gas, to obtain a solution of a polymer having a mass-average

molecular weight of 700,000. Into this polymer solution, 1.5 parts by mass of CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was blended, to obtain the temporally adhesive composition.

- 5 As shown in Fig. 1, the thus-obtained temporally adhesive composition was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 30 μm , and then the temporally adhesive layer 2 was laminated on the EVA side of a substrate film 1 (in Comparative Example 4, the substrate film I), to obtain a surface-protective adhesive tape 3 for back-grinding
- 10 having a thickness of 130 μm .

{0071}

(Comparative Example 5)

- 0.3 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin B containing 5.0% by mass of a blue pigment of copper phthalocyanine blue and
- 15 6.0% by mass at a content of a vinyl acetate component was dry-blended into 100 parts by mass of ethylene/vinyl acetate copolymer (EVA) resin D containing 20.0% by mass at a content of a vinyl acetate component. By extrude-molding the blend with an extruder, a substrate film J was obtained, which had a thickness of 165 μm and a surface roughness R_z of the backside of 6.8 μm ($R_z = 6.8 \mu\text{m}$).

- 20 1 mol% of methacrylic acid, 22 mol% of 2-hydroxyethyl acrylate, and 77 mol% of 2-ethylhexyl acrylate were blended in this proportion. With respect to 100 parts by mass of a total of these monomers, 0.2 parts by mass of azobis-isobutyronitrile was added, and this mixture was subjected to copolymerization at a temperature of 70°C in an ethyl acetate solution in a reaction vessel substituted
- 25 with nitrogen gas, to obtain a solution of a polymer having a mass-average molecular weight of 700,000. Into this polymer solution, 1.5 parts by mass of CORONATE L (trade name, manufactured by Nippon Polyurethane Industry Co., Ltd.) as a curing agent with respect to 100 parts by mass of the polymer was

blended, to obtain the temporally adhesive composition.

As shown in Fig. 1, the thus-obtained temporally adhesive composition was coated on a peeling liner 4 so that the thickness of the temporally adhesive layer 2 would get to 30 μm , and then the temporally adhesive layer 2 was laminated on a substrate film 1 (in Comparative Example 5, the substrate film J), to obtain a surface-protective adhesive tape 3 for back-grinding having a thickness of 195 μm .

{0072}

Note that the mass-average molecular weight of a resin is a value calculated as the polystyrene-equivalent mass-average molecular weight from a value measured by gel permeation chromatography (trade name: 150-C ALC/GPC, manufactured by Waters Corporation), using a 1% solution obtained by dissolving the resin in tetrahydrofuran.

{0073}

(Performance evaluation of surface-protective adhesive tape for back-grinding of the semiconductor wafer)

The following tests were conducted, with respect to each surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer, which was obtained by any of Examples 1 to 6 and Comparative Examples 1 to 5, and their performances were evaluated. The results shown in Tables 1 and 2 were obtained.

{0074}

(Measurement of surface roughness of substrate film backside)

The surface roughness R_z of the substrate film backside was a value of a ten-point average roughness R_z , which was obtained by the measurement in accordance with JIS B0601, in a total 3 points of the center and right- or left-position at 80 mm distance from the center when viewed from the transverse direction of the substrate film 1 of width 230mm, with respect to 5 mm of

measurement length in 2 directions of the longitudinal direction and the transverse direction, using "HANDY SURF E-30A" (trade name, manufactured by Tokyo Seimitsu Co., Ltd).

{0075}

5 (Measurement of total light transmittance)

After peeling the peeling liner 4 from each of surface-protective adhesive tapes 3 for back-grinding of the semiconductor wafer of any of Examples and Comparative Examples, the total light transmittance at the wavelength of 500 to 600 nm from the side of the substrate film 1 was measured at N=3, using a spectrophotometer UV3101PC & MPC-3100 (trade name, manufactured by Shimadzu Corporation), to obtain an average value.

{0076}

(Visibility evaluation)

After peeling the peeling liner 4 from each of surface-protective adhesive tapes 3 for back-grinding of the semiconductor wafer of any of Examples and Comparative Examples, a measurement of color difference was carried out, by using a chromatic color-difference meter CR-400 (trade name, manufactured by Konica Minolta, Inc.). A color difference (ΔEM) of the mirror wafer was measured, by using a white calibration plate, and this white color as a standard.

On the measured mirror wafer, each of surface-protective adhesive tapes 3 for back-grinding of the semiconductor wafer of any of Examples and Comparative Examples, from which the peeling liner 4 had been peeled, was laminated so that the air was not entered, and the color difference (ΔET) of the tape-laminated wafer was measured. A difference ($\Delta ET - \Delta EM$) between the color difference (ΔET) of the tape-laminated wafer and the color difference (ΔEM) of the mirror wafer was calculated. Evaluation was conducted by the following criteria.

A: Achievement of the difference $\Delta ET - \Delta EM > 6.5$

C: Achievement of the difference $\Delta ET - \Delta EM \leq 6.5$

{0077}

(Evaluation of sensor recognition)

Each of surface-protective adhesive tapes 3 for back-grinding of the semiconductor wafer of any of Examples and Comparative Examples, from which the peeling liner 4 had been peeled, was laminated on an 8-inch silicon mirror wafer having a notch 6 (semiconductor wafer having a notch depth of 1.00 mm (allowable tolerance +0.25 mm, -0.00 mm) and a notch angle of 90° (allowable tolerance +5°, -1°), manufactured by Shin-Etsu Semiconductor Industry), as shown in Fig. 2, by using a laminator DR8500III (trade name, manufactured by NITTO SEIKI Co., Ltd.).

After that, the side of the semiconductor wafer, on which the surface-protective adhesive tapes 3 for back-grinding of the semiconductor wafer had not been laminated, was ground until the thickness of 100 μm, by using DGP8760 (trade name, manufactured by DISCO Corporation). The semiconductor wafer after grinding was subjected to wafer mounting to the dicing tape and the peeling of the surface-protective adhesive tape 3 for back-grinding of the semiconductor wafer were carried out, by using RAD-2700F (trade name, manufactured by Lintec Corporation). Evaluation was conducted by the following criteria.

- A: The peeling was performed with no problem.
- C: Detection error of the notch occurred at the time of the tape mounting.

{0078}

(Warpage evaluation)

Similar to the evaluation of the above sensor recognition, each of surface-protective adhesive tapes 3 for back-grinding of the semiconductor wafer of any of Examples and Comparative Examples, from which the peeling liner 4 had been peeled, was laminated on an 8-inch silicon mirror wafer (semiconductor wafer) having the same notch 6 as described above. The side of each of 25 sheets of the semiconductor wafer, on which the surface-protective adhesive tape 3 for

back-grinding of the semiconductor wafer had not been laminated on the respective semiconductor wafer after lamination, was ground until the thickness of 50 μm , by using a grinder DGP8760 (trade name, manufactured by DISCO Corporation) having an inline system. Evaluation was conducted by the

5 following criteria.

A: The warpage in all of 25 sheets of the semiconductor wafer was less than 10 mm.

B: At least one sheet of the semiconductor wafer was 10 mm or more and less than 20 mm in the warpage.

10 C: At least one sheet of the semiconductor wafer was 20 mm or more in the warpage.

{0079}

(Heat resistance evaluation)

Similar to the evaluation of the above sensor recognition, each of surface-
 15 protective adhesive tapes 3 for back-grinding of the semiconductor wafer of any of Examples and Comparative Examples, from which the peeling liner 4 had been peeled, was laminated on an 8-inch silicon mirror wafer (semiconductor wafer) having the same notch 6 as described above. Each of semiconductor wafers after lamination, was placed on a hot plate of 80°C so that the sides of the
 20 surface-protective adhesive tapes 3 for back-grinding of the semiconductor wafer would get to contact with the hot plate, and was left for 3 minutes. After that, the backside of any of the surface-protective adhesive tapes 3 for back-grinding of the semiconductor wafer (substrate film side) was observed with the naked eye. Evaluation was conducted by the following criteria.

25 A: A melting or the like was not observed and there was no change before and after heating.

C: A change, such as melting at the backside due to heating or the like, was observed.

{0080}

Table 1

	Ex 1	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6
Roughness of the substrate backside, Rz [μm]	1.2	0.7	3.7	4.9	2.1	3.2
Total light transmittance [%]	58	60	58	53	78	42
Melting point of the substrate backside [$^{\circ}\text{C}$]	103	103	96	96	113	136
Substrate structure	EVA	EVA	EVA	EVA	LDPE/EVA	HDPE/EVA
Substrate thickness [μm]	165	165	100	100	80	200
$\Delta\text{ET}-\Delta\text{EM}$	15.1	11.4	13.1	16.0	7.9	12.7
Sensor recognition	A	A	A	A	A	A
Visibility	A	A	A	A	A	A
Warpage	A	A	A	A	B	B
Heat resistance	A	A	A	A	A	A

Note: "Ex" means Example.

{0081}

Table 2

	C Ex 1	C Ex 2	C Ex 3	C Ex 4	C Ex 5
Roughness of the substrate backside, Rz [μm]	0.1	5.8	2.5	7.1	6.8
Total light transmittance [%]	80	61	20	54	61
Melting point of the substrate backside [$^{\circ}\text{C}$]	258	113	113	113	83
Substrate structure	PET	LDPE	EVA+LDPE	LDPE/EVA	EVA
Substrate thickness [μm]	38	150	300	100	165
$\Delta\text{ET}-\Delta\text{EM}$	6.3	9.2	19.9	12.1	11.6
Sensor recognition	A	C	C	C	C
Visibility	C	A	A	A	A
Warpage	A	B	C	B	A
Heat resistance	A	A	A	A	C

Note: "C Ex" means Comparative Example.

{0082}

As shown in Table 1 and Table 2, in Examples 1 to 6, each of surface-protective adhesive tapes for back-grinding of the semiconductor wafer had no problem with the visibility (lamination recognition), and the semiconductor wafer ground into a thin film was mounted on a dicing tape without any error of the sensor recognition, and the surface-protective adhesive tape for back-grinding of the semiconductor wafer was able to be peeled, and further was excellent in heat resistance. In contrast, in Comparative Example 1, it was hard to know at a glance whether the surface-protective adhesive tape for back-grinding of the semiconductor wafer was laminated or not, and therefore the surface-protective adhesive tape had a problem with the visibility. Further, in Comparative Examples 2, 4, and 5, the surface roughness (Rz) of the substrate backside was rough, and therefore a large amount of silicon dust adhered thereto at the time of grinding into a thin film of the semiconductor wafer, which resulted in occurrence of a non-detectable error of the notch. Further, in Comparative Example 3, the total light transmittance was poor because of a dense color, which resulted in occurrence of an undetectable error of the notch.

REFERENCE SIGNS LIST

{0083}

- 1 Substrate (Substrate film)
- 11 The side of the substrate on which the temporally adhesive layer has not been formed (Backside)
- 2 Temporally adhesive layer
- 3 Surface-protective adhesive tape for back-grinding of the semiconductor wafer
- 4 Peeling liner
- 5 Semiconductor wafer (Silicon mirror wafer)

- 6 Notch
- 7 Orientation flat
- 8 Semiconductor wafer (Silicon mirror wafer)

CLAIMS

{Claim 1}

5 A surface-protective adhesive tape for back-grinding of a semiconductor wafer, comprising: a substrate; and a temporally adhesive layer provided on one side of the substrate,

wherein a surface roughness R_z of the side of the substrate on which the temporally adhesive layer has not been formed is from 0.7 to 5.0 μm ,

10 wherein a total light transmittance of the surface-protective adhesive tape for back-grinding of the semiconductor wafer at an wavelength of 500 to 600 nm is from 40 to 80%,

wherein a difference ($\Delta ET - \Delta EM$) between a color difference (ΔEM) of a mirror wafer and a color difference (ΔET) under a condition that the surface-protective adhesive tape for back-grinding of the semiconductor wafer has been
15 laminated on the mirror wafer is more than 6.5, and

wherein the surface-protective adhesive tape for back-grinding of the semiconductor wafer is laminated on a surface of the semiconductor wafer having a notch and is used in the step of back-grinding of the semiconductor wafer.

20 {Claim 2}

The surface-protective adhesive tape for back-grinding of the semiconductor wafer according to claim 1, wherein the surface roughness R_z is 0.7 μm or more and less than 5.0 μm .

25 {Claim 3}

The surface-protective adhesive tape for back-grinding of the semiconductor wafer according to claim 1 or 2, wherein the substrate comprises a pigment selected from a group consisting of a phthalocyanine pigment, a

naphthalocyanine pigment, an indanthrone pigment, an indanthrene pigment, and a triarylcarbonium pigment.

{Claim 4}

- 5 The surface-protective adhesive tape for back-grinding of the semiconductor wafer according to any one of claims 1 to 3, wherein a thickness of the substrate is from 80 to 200 μm .

{Claim 5}

- 10 The surface-protective adhesive tape for back-grinding of the semiconductor wafer according to any one of claims 1 to 4, wherein the substrate is composed of resins one of which has the same copolymerizable component, the copolymerizable component comprising at least a vinyl acetate component.

15 {Claim 6}

 The surface-protective adhesive tape for back-grinding of the semiconductor wafer according to claim 5, wherein a content of the vinyl acetate component is from 1.9 to 10.5% by mass.

20 {Claim 7}

- The surface-protective adhesive tape for back-grinding of the semiconductor wafer according to any one of claims 1 to 6, wherein the substrate is composed of a single layer or a plurality of layers, and wherein a melting point of a substrate-constituting resin in an outermost layer of the substrate at the side
25 on which a temporally adhesive layer has not been formed is 85°C or more.

{Claim 8}

 A method of grinding a semiconductor wafer, comprising: laminating a

surface-protective adhesive tape for back-grinding of a semiconductor wafer on a surface of the semiconductor wafer having a notch; and subjecting a semiconductor wafer backside to grinding,

5 wherein the surface-protective adhesive tape for back-grinding of the semiconductor wafer comprises: a substrate; and a temporally adhesive layer provided on one side of the substrate,

wherein a surface roughness R_z of the side of the substrate on which the temporally adhesive layer has not been formed is from 0.7 to 5.0 μm ,

10 wherein a total light transmittance of the surface-protective adhesive tape for back-grinding of the semiconductor wafer at an wavelength of 500 to 600 nm is from 40 to 80%,

wherein a difference ($\Delta ET - \Delta EM$) between a color difference (ΔEM) of a mirror wafer and a color difference (ΔET) under a condition that the surface-protective adhesive tape for back-grinding of the semiconductor wafer has been
15 laminated on the mirror wafer is more than 6.5.

{Claim 9}

The method of grinding the semiconductor wafer according to claim 8, wherein the surface roughness R_z is 0.7 μm or more and less than 5.0 μm .