

[DESCRIPTION]

[TITLE OF INVENTION]

DICING DIE BONDING SHEET, METHOD FOR PRODUCING SEMICONDUCTOR

5 CHIP AND METHOD FOR MANUFACTURING SEMICONDUCTOR DEVICE

[Technical Field]

[0001]

The present invention relates to a dicing/die bonding sheet, a method for
10 producing a semiconductor chip, and a method for manufacturing a semiconductor
device.

Priority is claimed on Japanese Patent Application No. 2016-046904, filed
March 10, 2016, the content of which is incorporated herein by reference.

15 [Background Art]

[0002]

A dicing/die bonding sheet is constituted, for example, by including a pressure-
sensitive adhesive layer and a film adhesive in this order on a base material, and is used
by being adhered to a semiconductor wafer by the film adhesive. The semiconductor
20 wafer fixed on the dicing/die bonding sheet is divided into individual pieces of
semiconductor chips by dicing together with the pressure-sensitive adhesive layer and the
film adhesive. Thereafter, for example, in the case where the pressure-sensitive
adhesive layer is curable, the pressure-sensitive adhesive layer is cured to lower the
tackiness, and the semiconductor chip provided with the film adhesive after cutting is
25 separated and picked up from the cured pressure-sensitive adhesive layer. The picked-

up semiconductor chip is die-bonded to a circuit surface of a substrate by the film adhesive, and after one or more additional semiconductor chips are further stacked on this semiconductor chip and wire bonded, if necessary, the entire constitution is sealed with a resin. Using a semiconductor package obtained in this manner, an intended
5 semiconductor device is ultimately manufactured.

[0003]

Dicing is performed, for example, by using a dicing blade and cutting a semiconductor wafer while rotating the dicing blade. However, in this dicing method, since the semiconductor wafer and at least a part of the dicing/die bonding sheet are cut
10 by the dicing blade, cutting chips are generated. Although dicing is carried out while washing the cut portion with water, since it is not possible to completely wash away the cutting chips, if the amount of cutting chips is large, after the dicing, a portion thereof is likely to adhere to and remain on the obtained semiconductor chip and the cut film adhesive provided in the semiconductor chip. However, the semiconductor chip
15 provided with the film adhesive after cutting cannot be picked up properly in some cases if the cutting chips remain as described above. That is, if the amount of cutting chips generated during dicing is large, it will cause a pickup failure.

[0004]

Meanwhile, as one capable of suppressing adhesion of cutting chips to a
20 semiconductor chip during dicing of a semiconductor wafer using a dicing blade, an adhesive tape for fixing a semiconductor wafer has been disclosed, in which a radiation-curable acrylic pressure-sensitive adhesive layer constituted of a pressure-sensitive adhesive having a storage modulus at 60 to 100°C within a certain range is provided on a base material film (see Patent Document 1). This tape corresponds to a dicing sheet,
25 and a film adhesive (that is, a die bonding film) is further provided to the pressure-

sensitive adhesive layer and used for dicing.

[Citation List]

[Patent Document]

5 [0005]

[Patent Document 1] Japanese Unexamined Patent Application, First Publication
No. 2007-027215

[Summary of Invention]

10 [Technical Problem]

[0006]

However, although Patent Document 1 discloses that in the case of carrying out
dicing using a dicing blade, the generation of cutting chips can be suppressed by using a
dicing sheet (that is, the adhesive tape for fixing a semiconductor wafer) described in the
15 above-mentioned document, it does not disclose pick-up suitability of a semiconductor
chip provided with a film adhesive.

[0007]

Accordingly, the present invention has an object of providing a dicing/die
bonding sheet capable of reducing the amount of cutting chips generated during dicing of
20 a semiconductor wafer using a dicing blade, and capable of suppressing the occurrence of
poor pickup of a semiconductor chip provided with a film adhesive, and a method for
producing a semiconductor chip and a method for manufacturing a semiconductor device
using the same.

25 [Solution to Problem]

[0008]

In order to solve the above-mentioned problems, the present invention provides a dicing/die bonding sheet formed by including a pressure-sensitive adhesive layer on a base material and a film adhesive on the pressure-sensitive adhesive layer, wherein the pressure-sensitive adhesive layer has a thickness of 20 μm to 50 μm , and an elongation at break of the pressure-sensitive adhesive layer is from 5 to 50%.

In the dicing/die bonding sheet of the present invention, the pressure-sensitive adhesive layer is preferably non-energy ray-curable.

In the dicing/die bonding sheet of the present invention, an adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive is preferably from 35 to 300 mN / 25 mm.

[0009]

Further, the present invention provides a method for producing a semiconductor chip which is a method for producing a semiconductor chip using the aforementioned dicing/die bonding sheet, and includes: a step of forming an intermediate structure in which a semiconductor wafer is provided on a surface, of the aforementioned film adhesive in the aforementioned dicing/die bonding sheet, on a side opposite to a side where the aforementioned pressure-sensitive adhesive layer is provided; and a step of forming a notch that reaches the aforementioned pressure-sensitive adhesive layer from a surface of the aforementioned semiconductor wafer but does not reach the aforementioned base material in the aforementioned intermediate structure using a dicing blade, thereby dividing the aforementioned semiconductor wafer to form a semiconductor chip.

In addition, the present invention provides a method for manufacturing a semiconductor device that includes, after performing a step of forming the

aforementioned semiconductor chip by the aforementioned method for producing a semiconductor chip, a step of applying a force with respect to the dicing/die bonding sheet after forming the aforementioned notch from the base material side thereof, and separating the aforementioned semiconductor chip from the aforementioned pressure-sensitive adhesive layer together with the aforementioned film adhesive after cutting.

[Advantageous Effects of Invention]

[0010]

According to the present invention, there are provided a dicing/die bonding sheet capable of reducing the amount of cutting chips generated during dicing of a semiconductor wafer using a dicing blade, and capable of suppressing the occurrence of poor pickup of a semiconductor chip provided with a film adhesive, and a method for producing a semiconductor chip and a method for manufacturing a semiconductor device using the same.

15

[Brief Description of Drawings]

[0011]

FIG. 1 is a cross-sectional view schematically showing an embodiment of a dicing/die bonding sheet of the present invention.

20 FIG. 2 is a cross-sectional view schematically showing another embodiment of the dicing/die bonding sheet of the present invention.

FIG. 3 is a cross-sectional view schematically showing yet another embodiment of the dicing/die bonding sheet of the present invention.

25 FIG. 4 is a cross-sectional view for schematically illustrating an embodiment of a method for producing a semiconductor chip of the present invention.

FIG. 5 is an enlarged cross-sectional view schematically showing an embodiment of a semiconductor chip obtained by the production method of the present invention.

FIG. 6 is a cross-sectional view schematically showing an example of a state in which a notch is formed in an intermediate structure by using a dicing blade in a dicing step.

FIG. 7 is an enlarged cross-sectional view schematically showing an example of a semiconductor chip obtained by a conventional production method.

FIG. 8 is a cross-sectional view for schematically illustrating an embodiment of a method for manufacturing a semiconductor device of the present invention.

[Description of Embodiments]

[0012]

<< Dicing/die bonding sheet >>

A dicing/die bonding sheet of the present invention is obtained by including a pressure-sensitive adhesive layer on a base material and a film adhesive on the pressure-sensitive adhesive layer, wherein the pressure-sensitive adhesive layer has a thickness of 20 μm to 50 μm , and an elongation at break of the pressure-sensitive adhesive layer is from 5 to 50%.

The dicing/die bonding sheet of the present invention is suitable to be used when carrying out dicing of a semiconductor wafer using a dicing blade (that is, blade dicing) and a subsequent pickup of a semiconductor chip provided with a film adhesive after cutting (sometimes referred to as a “semiconductor chip with a film adhesive” in the present specification).

[0013]

In dicing using a dicing blade, a semiconductor wafer is cut by rotating the dicing blade. At this time, since the semiconductor wafer and at least a part of the dicing/die bonding sheet are cut by the dicing blade, cutting chips are generated. The cutting chips are generated from any one layer of the semiconductor wafer and the dicing/die bonding sheet, and they are suspended matter in a powdery state, a fibrous state or the like, or are not completely separated from any one of the above layers and remain in a whisker shape. If the amount of the generated cutting chips is large, a portion thereof tends to adhere to and remain on the semiconductor chip or the already cut film adhesive. Further, if the cutting chips remain in this manner, the semiconductor chip with a film adhesive cannot be picked up normally in some cases, which causes a pickup failure. Moreover, even if the pickup can be performed, a semiconductor device fabricated with the remaining cutting chips may not function normally in some cases.

[0014]

On the other hand, when the thickness and elongation at break of the pressure-sensitive adhesive layer are within the above ranges, the dicing/die bonding sheet of the present invention can reduce the amount of cutting chips generated at the time of dicing the semiconductor wafer using the dicing blade. Further, as a result, it is possible to suppress the occurrence of pickup failure of the semiconductor chip with a film adhesive.

Hereinafter, first, each layer constituting the dicing die bonding sheet of the present invention will be described.

[0015]

<Base material>

The material constituting the base material is preferably various resins, and specific examples thereof include polyethylenes (low density polyethylenes (sometimes abbreviated as LDPE), linear low density polyethylenes (sometimes abbreviated as

LLDPE), high density polyethylenes (sometimes abbreviated as HDPE) or the like), polypropylenes, polybutenes, polybutadienes, polymethylpentenes, styrene/ethylenebutylene/styrene block copolymers, polyvinyl chlorides, vinyl chloride copolymers, polyethylene terephthalates, polybutylene terephthalates, polyurethanes, polyurethane acrylates, polyimides, ethylene vinyl acetate copolymers, ionomer resins, ethylene/(meth)acrylic acid copolymers, ethylene/(meth)acrylate copolymers, polystyrenes, polycarbonates, fluororesins, and hydrogenated products, modified products, crosslinked products or copolymers of any of these resins.

[0016]

10 It should be noted that in the present specification, the term “(meth)acrylic acid” is a concept that includes both “acrylic acid” and “methacrylic acid”. The same also applies to the terms similar to (meth)acrylic acid, and for example, the term “(meth)acrylate” is a concept including both “acrylate” and “methacrylate”, and the term “(meth)acryloyl group” is a concept including both “acryloyl group” and “methacryloyl group”.

[0017]

The resin constituting the base material may be composed of only one type or may be composed of two or more types, and when it is composed of two or more types, the combination and ratio thereof can be arbitrarily selected.

[0018]

20 The base material may be composed of one layer (that is, a single layer), or it may be composed of two or more layers (a plurality of layers). When the base material is composed of a plurality of layers, these plurality of layers may be the same as or different from each other. That is, all of the layers may be the same, all of the layers may be different, or only some of the layers may be the same. Further, in the case

where the plurality of layers are different from each other, the combination of these plurality of layers is not particularly limited as long as the effects of the present invention are not impaired. Here, the expression “the plurality of layers are different” means that at least one of the material and the thickness of each layer is different from each other.

5 It should be noted that in the present specification, and this is not limited to the case of a base material, the expression “the plurality of layers may be the same as or different from each other” means that “all of the layers may be the same, all of the layers may be different, or only some of the layers may be the same”. Moreover, the expression “the plurality of layers are different from each other” means that “at least one
10 of the constituent material and the thickness of each layer is different from each other”.

[0019]

The thickness of the base material can be appropriately selected according to the purpose, but it is preferably from 50 μm to 300 μm , and more preferably from 60 μm to 100 μm .

15 Here, the “thickness of the base material” means the thickness of the entire base material, and for example, the thickness of the base material composed of a plurality of layers means the total thickness of all the layers constituting the base material. It should be noted that as a method of measuring the thickness of the base material, for example, a method of measuring the thickness at five arbitrary places using a contact type thickness
20 meter and calculating the average of the measured values, and the like can be mentioned.

[0020]

In order to improve the adhesion to other layers such as a pressure-sensitive adhesive layer provided thereon, the surface of the base material may be subjected to a roughening treatment by a sandblasting treatment, a solvent treatment, an embossing
25 treatment or the like, or an oxidation treatment such as a corona discharge treatment, an

electron beam irradiation treatment, a plasma treatment, an ozone/ultraviolet irradiation treatment, a flame treatment, a chromic acid treatment, a hot air treatment or the like.

Further, the surface of the base material may be subjected to a primer treatment.

In addition, when an antistatic coating layer and the dicing/die bonding sheet are
5 superposed and stored, the base material may have a layer for preventing adhesion of the base material to other sheets and adhesion of the base material to the suction table, or the like.

[0021]

<Pressure-sensitive adhesive layer>

10 The pressure-sensitive adhesive layer satisfies the following conditions of thickness and elongation at break, and is preferably non-energy ray-curable.

In the present invention, the term “non-energy ray-curable” means a property of not being cured even when irradiated with an energy ray. On the contrary, a property of being cured by irradiation with an energy ray is referred to as “energy ray-curable”.

15 In the present invention, the term “energy ray” means an electromagnetic wave or a charged particle beam having an energy quantum, and examples thereof include ultraviolet rays and electron beams.

For example, ultraviolet rays can be irradiated by using a high pressure mercury lamp, a fusion H lamp, a xenon lamp or the like as an ultraviolet ray source. An
20 electron beam generated by an electron beam accelerator or the like can be irradiated.

[0022]

The pressure-sensitive adhesive layer may be composed of one layer (that is, a single layer), or it may be composed of two or more layers (a plurality of layers). When it is composed of a plurality of layers, the plurality of layers may be the same as or
25 different from each other, and the combination of the plurality of layers is not particularly

limited.

[0023]

The thickness of the pressure-sensitive adhesive layer is from 20 μm to 50 μm , preferably from 20 μm to 45 μm , more preferably from 20 μm to 40 μm , and particularly preferably from 20 μm to 35 μm . By ensuring that the thickness of the pressure-sensitive adhesive layer is equal to or more than the above-mentioned lower limit value, a higher adhesive force with respect to an adherend (that is, a film adhesive) can be obtained. On the other hand, by ensuring that the thickness of the pressure-sensitive adhesive layer is equal to or less than the above upper limit value, it is possible to separate and pick up the semiconductor chip with the film adhesive more easily in the separating step described later, and also the amount of cutting chips generated at the time of dicing the semiconductor wafer using the dicing blade can be further reduced. Furthermore, it is possible to avoid the thickness of the pressure-sensitive adhesive layer from becoming excessive, the production cost of the dicing/die bonding sheet can be reduced, the pressure-sensitive adhesive layer can be stably formed, and the production of the dicing/die bonding sheet can be further stabilized.

Here, the “thickness of the pressure-sensitive adhesive layer” means the thickness of the entire pressure-sensitive adhesive layer, and for example, the thickness of the pressure-sensitive adhesive layer composed of a plurality of layers means the total thickness of all the layers constituting the pressure-sensitive adhesive layer. It should be noted that as a method of measuring the thickness of the pressure-sensitive adhesive layer, for example, a method of measuring the thickness at five arbitrary places using a contact type thickness meter and calculating the average of the measured values, and the like can be mentioned.

[0024]

The elongation at break of the pressure-sensitive adhesive layer is from 5 to 50%, preferably from 6 to 46%, more preferably from 7 to 44%, and particularly preferably from 8 to 42%. By ensuring that the elongation at break of the pressure-sensitive adhesive layer is equal to or more than the above-mentioned lower limit value, when the pressure-sensitive adhesive layer is elongated (that is, expanded) in the process of separating and picking up the semiconductor chip with the film adhesive from the pressure-sensitive adhesive layer, cracking at an unintended portion of the pressure-sensitive adhesive layer is highly suppressed, and the dicing/die bonding sheet exhibits more excellent characteristics. On the other hand, by ensuring that the elongation at break of the pressure-sensitive adhesive layer is equal to or less than the above upper limit value, the amount of cutting chips generated during dicing of the semiconductor wafer using the dicing blade can be reduced, and the semiconductor chip with the film adhesive after dicing can be easily separated and picked up from the pressure-sensitive adhesive layer.

[0025]

It should be noted that in the present specification, unless otherwise stated, the “elongation at break of the pressure-sensitive adhesive layer” means the “elongation at break of the uncured pressure-sensitive adhesive layer” when the pressure-sensitive adhesive layer is curable. In addition, the above-mentioned elongation at break refers to an elongation at break of the pressure-sensitive adhesive layer at normal temperature, unless otherwise specified. Further, in the present specification, the term “normal temperature” means a temperature obtained without particular cooling or heating, in other words, ordinary temperature, and for example, a temperature of 15 to 25°C or the like can be mentioned.

[0026]

In the present invention, the elongation at break of the pressure-sensitive adhesive layer is determined by fixing the pressure-sensitive adhesive layer having a width of 10 mm and a thickness of 0.03 mm at two places so that the distance between the fixed places becomes 10 mm, pulling the pressure-sensitive adhesive layer between the fixed places with a tension speed of 1,000 mm/min, and measuring the elongation of the pressure-sensitive adhesive layer when the pressure-sensitive adhesive layer is ruptured.

It should be noted that in the present specification, the expression “the elongation at break is X% (in the formula, X is a positive number)” means that in the above measuring method, when the pressure-sensitive adhesive layer is pulled and the pressure-sensitive adhesive layer is extended in its tensile direction by a length of X% of the original length (that is, the length when no pulling is performed), in other words, when the total length of the pressure-sensitive adhesive layer in the tensile direction becomes $[1 + X/100]$ times the length before the pulling, the pressure-sensitive adhesive layer breaks.

[0027]

The elongation at break of the pressure-sensitive adhesive layer can be appropriately adjusted, for example, by adjusting the type and amount of the components contained in the pressure-sensitive adhesive layer, and the like. For example, it is possible to easily adjust the elongation at break of the pressure-sensitive adhesive layer by adjusting the type of the structural unit in the adhesive resin to be described later, which is a component contained in the pressure-sensitive adhesive layer, and its content ratio and the like. Further, by adjusting the content of the adhesive resin or the crosslinking agent in the pressure-sensitive adhesive layer, the elongation at break of the pressure-sensitive adhesive layer can be easily adjusted. However, these adjustment

methods are only examples.

[0028]

In the present invention, the adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive is not particularly limited as long as the effects of the present invention are not impaired, but it is preferably from 35 to 300 mN / 25 mm, and more preferably from 45 to 100 mN / 25 mm.

By ensuring that the adhesive force is equal to or more than 35 mN / 25 mm, the laminate structure of the pressure-sensitive adhesive layer and the film adhesive can be more stably maintained in the dicing/die bonding sheet. In addition, by ensuring that the adhesive force is equal to or more than 45 mN / 25 mm, the so-called chip flying in which the semiconductor chip is scattered by the force applied to the semiconductor chip during dicing of the semiconductor wafer is further suppressed.

On the other hand, by ensuring that the adhesive force is equal to or less than 300 mN / 25 mm, the adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive is moderately reduced, and as described later, it is possible to easily separate and pick up the semiconductor chip with the film adhesive after dicing from the pressure-sensitive adhesive layer without curing the pressure-sensitive adhesive layer by energy ray irradiation or the like. Furthermore, at this time, picking up of the semiconductor chip with the film adhesive, while a part of the pressure-sensitive adhesive layer remains adhered to the film adhesive, is suppressed. In addition, by ensuring that the adhesive force is equal to or less than 100 mN / 25 mm, when the semiconductor chip with the film adhesive is pushed up to be separated and picked up from the pressure-sensitive adhesive layer, it can be easily picked up with a small amount of push-up, and for example, the so-called chipping in which cracking or chipping occurs in the semiconductor chip is further suppressed.

[0029]

It should be noted that in the present specification, unless otherwise stated, the “adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive” means the “adhesive force of the uncured pressure-sensitive adhesive layer with respect to the film adhesive” when the pressure-sensitive adhesive layer is curable. In addition, the above-mentioned adhesive force means an adhesive force of the pressure-sensitive adhesive layer at normal temperature, unless otherwise specified.

[0030]

In the present invention, the adhesive force (mN / 25 mm) can be measured by the following method. That is, the dicing/die bonding sheet having a width of 25 mm and an arbitrary length is fabricated.

Then, this dicing/die bonding sheet is attached to a fixing base material through a film adhesive at normal temperature (for example, 23°C). Here, the “fixing base material” may be any material as long as it can firmly fix the film adhesive of the dicing/die bonding sheet, and its shape may be in the form of a sheet or in any other shape, and for example, an adhesive base material having an adhesive surface as a fixing surface of a film adhesive (in other words, a dicing/die bonding sheet) can be mentioned.

Then, at normal temperature (for example, 23°C), the so-called 180° peeling is performed in which the laminate of the base material and the pressure-sensitive adhesive layer is peeled from the film adhesive at a peeling rate of 300 mm/min, so that the planes of the film adhesive and the pressure-sensitive adhesive layer that have been brought into contact with each other form an angle of 180°. The peel force at this time is measured, and the measured value is defined as the adhesive force (mN / 25 mm).

The length of the dicing/die bonding sheet to be subjected to measurement is not particularly limited as long as it is within a range in which the peeling force can be stably

measured.

[0031]

The adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive can be appropriately adjusted, for example, by adjusting the type and amount of the components contained in the pressure-sensitive adhesive layer, the thickness of the pressure-sensitive adhesive layer, and the like. For example, it is possible to easily adjust the adhesive force by adjusting the type of the structural unit in the adhesive resin to be described later, which is a component contained in the pressure-sensitive adhesive layer, and its content ratio and the like. In addition, by adjusting the content of the adhesive resin or the crosslinking agent in the pressure-sensitive adhesive layer, the adhesive force can be easily adjusted. However, these adjustment methods are only examples.

[0032]

In the present invention, the elastic modulus of the pressure-sensitive adhesive layer is not particularly limited, but it is preferably from 30 to 140 MPa, more preferably from 35 to 130 MPa, and particularly preferably from 40 to 120 MPa. By ensuring that the elastic modulus of the pressure-sensitive adhesive layer is equal to or more than the above-mentioned lower limit value, since the pressure-sensitive adhesive layer is not excessively soft, the followability with respect to the film adhesive is suppressed from becoming excessive, and the semiconductor chip with the film adhesive tends to be picked up more easily when being separated and picked up from the pressure-sensitive adhesive layer. Further, by ensuring that the elastic modulus of the pressure-sensitive adhesive layer is equal to or less than the above upper limit value, since the pressure-sensitive adhesive layer is not excessively hard, when the semiconductor chip with the film adhesive is pushed up, and separated and picked up from the pressure-sensitive

adhesive layer, it can be picked up more easily because the pressure-sensitive adhesive layer is easily deformed.

[0033]

It should be noted that in the present specification, unless otherwise stated, the
5 “elastic modulus of the pressure-sensitive adhesive layer” means the “elastic modulus of the uncured pressure-sensitive adhesive layer” when the pressure-sensitive adhesive layer is curable, like the case of the “elongation at break of the pressure-sensitive adhesive layer” described above. In addition, the above-mentioned elastic modulus means an elastic modulus of the pressure-sensitive adhesive layer at normal temperature, unless
10 otherwise specified.

[0034]

In the present invention, the elastic modulus of the pressure-sensitive adhesive layer can be measured at the same time when measuring the elongation at break of the pressure-sensitive adhesive layer described above.

15 [0035]

The elastic modulus of the pressure-sensitive adhesive layer can be appropriately adjusted, for example, by adjusting the type and amount of the components contained in the pressure-sensitive adhesive layer, and the like. For example, it is possible to easily adjust the elastic modulus of the pressure-sensitive adhesive layer by
20 adjusting the type of the structural unit in the adhesive resin to be described later, which is a component contained in the pressure-sensitive adhesive layer, and its content ratio and the like. Further, by adjusting the content of the adhesive resin or the crosslinking agent in the pressure-sensitive adhesive layer, the elastic modulus of the pressure-sensitive adhesive layer can be easily adjusted. However, these adjustment methods are
25 only examples.

[0036]

The pressure-sensitive adhesive layer can be formed from a pressure-sensitive adhesive composition containing a pressure-sensitive adhesive. For example, a pressure-sensitive adhesive layer can be formed at an intended portion by applying a pressure-sensitive adhesive composition onto the surface on which the pressure-sensitive adhesive layer is to be formed, followed by drying if necessary. A more specific method of forming the pressure-sensitive adhesive layer will be described in detail later, together with a method of forming other layers. The ratio of the contents of the components that do not vaporize at normal temperature to each other in the pressure-sensitive adhesive composition is usually the same as the ratio of the contents of the aforementioned components of the pressure-sensitive adhesive layer to each other.

[0037]

The pressure-sensitive adhesive composition may be applied by a known method, and examples thereof include a method using various coaters such as an air knife coater, a blade coater, a bar coater, a gravure coater, a roll coater, a roll knife coater, a curtain coater, a die coater, a knife coater, a screen coater, a Meyer bar coater and a kiss coater.

[0038]

Although the drying conditions of the pressure-sensitive adhesive composition are not particularly limited, in the case where the pressure-sensitive adhesive composition contains a solvent to be described later, it is preferable to dry the pressure-sensitive adhesive composition by heating, and in this case, for example, it is preferable to dry under conditions of 70 to 130°C for 10 seconds to 5 minutes.

[0039]

[Pressure-sensitive adhesive composition]

The pressure-sensitive adhesive composition is preferably non-energy ray-curable.

Examples of the non-energy ray-curable pressure-sensitive adhesive composition include those containing an adhesive resin (hereinafter referred to as “adhesive resin (i)”) such as an acrylic resin (that is, a resin having a (meth)acryloyl group), a urethane-based resin (that is, a resin having a urethane bond), a rubber-based resin (that is, a resin having a rubber structure), a silicone-based resin (that is, a resin having a siloxane bond), an epoxy-based resin (that is, a resin having an epoxy group), a polyvinyl ether or a polycarbonate.

10 [0040]

(Adhesive resin (i))

The adhesive resin (i) is preferably an acrylic resin.

As the acrylic resin in the adhesive resin (i), for example, an acrylic polymer having at least a structural unit derived from a (meth)acrylic acid alkyl ester can be mentioned.

The structural unit included in the acrylic resin may be composed of only one type or may be composed of two or more types, and when it is composed of two or more types, the combination and ratio thereof can be arbitrarily selected.

[0041]

20 Examples of the (meth)acrylic acid alkyl ester include those in which the alkyl group constituting the alkyl ester has 1 to 20 carbon atoms, and the alkyl group is preferably linear or branched.

More specific examples of the (meth)acrylic acid alkyl ester include methyl (meth)acrylate, ethyl (meth)acrylate, n-propyl (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, sec-butyl (meth)acrylate, tert-butyl

(meth)acrylate, pentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isooctyl (meth)acrylate, n-octyl (meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, decyl (meth)acrylate, undecyl (meth)acrylate, dodecyl (meth)acrylate (also referred to as lauryl (meth)acrylate), tridecyl (meth)acrylate, 5 tetradecyl (meth)acrylate (also referred to as myristyl (meth)acrylate), pentadecyl (meth)acrylate, hexadecyl (meth)acrylate (also referred to as palmityl (meth)acrylate), heptadecyl (meth)acrylate, octadecyl (meth)acrylate (also referred to as stearyl (meth)acrylate), nonadecyl (meth)acrylate and eicosyl (meth)acrylate.

[0042]

10 From the viewpoint of improving the adhesive force of the pressure-sensitive adhesive layer, it is preferable that the acrylic polymer has a structural unit derived from a (meth)acrylic acid alkyl ester in which the alkyl group has 4 or more carbon atoms. Further, from the viewpoint of further improving the adhesive force of the pressure-sensitive adhesive layer, the number of carbon atoms of the alkyl group is preferably 15 from 4 to 12, and more preferably from 4 to 8. In addition, the (meth)acrylic acid alkyl ester in which the alkyl group has 4 or more carbon atoms is preferably an acrylic acid alkyl ester.

[0043]

In addition to the structural unit derived from a (meth)acrylic acid alkyl ester, it 20 is preferable that the acrylic polymer further has a structural unit derived from a functional group-containing monomer.

As the functional group-containing monomer, for example, those in which the functional group reacts with a crosslinking agent to be described later to thereby become a starting point of crosslinking, and those in which the functional group reacts with an 25 unsaturated group in an unsaturated group-containing compound to thereby enable

introduction of an unsaturated group into the side chain of the acrylic polymer can be mentioned.

[0044]

Examples of the functional group in the functional group-containing monomer
5 include a hydroxyl group, a carboxy group, an amino group and an epoxy group.

That is, examples of the functional group-containing monomer include a hydroxyl group-containing monomer, a carboxy group-containing monomer, an amino group-containing monomer and an epoxy group-containing monomer.

[0045]

10 Examples of the hydroxyl group-containing monomer include hydroxyalkyl (meth)acrylates such as hydroxymethyl (meth)acrylate, 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxybutyl (meth)acrylate and 4-hydroxybutyl (meth)acrylate; non-
15 (meth)acrylic unsaturated alcohols (that is, unsaturated alcohols having no (meth)acryloyl skeleton) such as vinyl alcohol and allyl alcohol, and the like.

[0046]

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

[0047]

25 The functional group-containing monomer is preferably a hydroxyl group-

containing monomer or a carboxy group-containing monomer, and more preferably a hydroxyl group-containing monomer.

[0048]

The functional group-containing monomer constituting the acrylic polymer may
5 be composed of only one type or may be composed of two or more types, and when it is composed of two or more types, the combination and ratio thereof can be arbitrarily selected.

[0049]

In the acrylic polymer, the content of the structural unit derived from the
10 functional group-containing monomer is preferably from 1 to 35% by mass, more preferably from 3 to 32% by mass, and particularly preferably from 5 to 30% by mass with respect to the total amount of the structural unit.

[0050]

In addition to the structural unit derived from the (meth)acrylic acid alkyl ester
15 and the structural unit derived from the functional group-containing monomer, the acrylic polymer may further include a structural unit derived from another monomer.

The other monomer is not particularly limited as long as it is copolymerizable with a (meth)acrylic acid alkyl ester or the like.

Examples of the other monomer include styrene, α -methylstyrene, vinyltoluene,
20 vinyl formate, vinyl acetate, acrylonitrile and acrylamide.

[0051]

The other monomer constituting the acrylic polymer may be composed of only one type or may be composed of two or more types, and when it is composed of two or more types, the combination and ratio thereof can be arbitrarily selected.

25 [0052]

Like the acrylic polymer, the aforementioned adhesive resin (i) other than the acrylic polymer also preferably has a structural unit derived from a functional group-containing monomer.

[0053]

5 The adhesive resin (i) contained in the pressure-sensitive adhesive composition may be composed of only one type or may be composed of two or more types, and when it is composed of two or more types, the combination and ratio thereof can be arbitrarily selected.

[0054]

10 In the pressure-sensitive adhesive composition, the ratio of the content of the adhesive resin (i) (that is, the content of the adhesive resin (i) of the pressure-sensitive adhesive layer) with respect to the total content of components other than the solvent is preferably from 40 to 95% by mass, more preferably from 50 to 95% by mass, and particularly preferably from 60 to 90% by mass. By ensuring that the ratio of the
15 content of the adhesive resin (i) is within such a range, the tackiness of the pressure-sensitive adhesive layer is further improved.

[0055]

(Crosslinking agent (ii))

20 The pressure-sensitive adhesive composition preferably contains a crosslinking agent (ii).

For example, the crosslinking agent (ii) reacts with the functional group to crosslink the adhesive resins (i) with each other.

As the crosslinking agent (ii), for example, an isocyanate-based crosslinking agent (that is, a crosslinking agent having an isocyanate group) such as tolylene
25 diisocyanate, hexamethylene diisocyanate, xylylene diisocyanate and adduct forms of

these diisocyanates; an epoxy-based crosslinking agent (that is, a crosslinking agent having a glycidyl group) such as ethylene glycol glycidyl ethers; an aziridine-based crosslinking agent (that is, a crosslinking agent having an aziridinyl group) such as hexa[1-(2-methyl)-aziridinyl]triphosphatriazine; a metal chelate-based crosslinking agent
5 (that is, a crosslinking agent having a metal chelate structure) such as aluminum chelates; an isocyanurate-based crosslinking agent (that is, a crosslinking agent having an isocyanuric acid skeleton), and the like can be mentioned.

It is preferable that the crosslinking agent (ii) is an isocyanate-based crosslinking agent from the viewpoints of improving the cohesive force of the pressure-
10 sensitive adhesive to improve the adhesive force of the pressure-sensitive adhesive layer, easy availability, and the like.

[0056]

The crosslinking agent (ii) contained in the pressure-sensitive adhesive composition may be composed of only one type or may be composed of two or more
15 types, and when it is composed of two or more types, the combination and ratio thereof can be arbitrarily selected.

[0057]

When the pressure-sensitive adhesive composition contains the crosslinking agent (ii), the content of the crosslinking agent (ii) in the pressure-sensitive adhesive
20 composition is preferably from 5 to 100 parts by mass, more preferably from 10 to 80 parts by mass, and particularly preferably from 15 to 60 parts by mass, when the content of the adhesive resin (i) is 100 parts by mass. By ensuring that the content of the crosslinking agent (ii) is equal to or more than the above lower limit value, the effects of using the crosslinking agent (ii) can be obtained more remarkably. Further, by ensuring
25 that the content of the crosslinking agent (ii) is equal to or less than the above upper limit

value, it becomes easier to control the adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive.

[0058]

(Other additives)

5 The pressure-sensitive adhesive composition may contain other additives that do not correspond to any of the above-mentioned components within a range that does not impair the effects of the present invention.

Examples of the other additives include known additives such as an antistatic agent, an antioxidant, a softener (that is, a plasticizer), a filling material (that is, a filler),
10 a rust inhibitor, a colorant (that is, a pigment or a dye), a sensitizer, a tackifier, a reaction retarder and a crosslinking accelerator (that is, a catalyst).

It should be noted that the term “reaction retarder” means, for example, one that suppresses the unintended crosslinking reaction in the pressure-sensitive adhesive composition during storage by the action of the catalyst incorporated in the pressure-
15 sensitive adhesive composition. As the reaction retarder, for example, those that form a chelate complex by chelating to the catalyst can be mentioned, and more specifically, those having two or more carbonyl groups ($-C(=O)-$) in one molecule can be mentioned.

[0059]

The other additive contained in the pressure-sensitive adhesive composition may
20 be composed of only one type or may be composed of two or more types, and when it is composed of two or more types, the combination and ratio thereof can be arbitrarily selected.

[0060]

In the pressure-sensitive adhesive composition, the content of other additives is
25 not particularly limited, and may be appropriately selected depending on the types

thereof.

[0061]

(Solvent)

The pressure-sensitive adhesive composition may contain a solvent. Since the
5 pressure-sensitive adhesive composition contains a solvent, the coatability to the surface
to be coated is improved.

[0062]

The solvent is preferably an organic solvent, and examples of the organic
solvent include ketones such as methyl ethyl ketone and acetone; carboxylic acid esters
10 such as ethyl acetate; ethers such as tetrahydrofuran and dioxane; aliphatic hydrocarbons
such as cyclohexane and n-hexane; aromatic hydrocarbons such as toluene and xylene;
and alcohols such as 1-propanol and 2-propanol.

[0063]

As the solvent, for example, those used at the time of production of the adhesive
15 resin (i) may be used as they are in the pressure-sensitive adhesive composition without
being removed from the adhesive resin (i), or a solvent of the same type as or different
type from that used at the time of production of the adhesive resin (i) may be added
separately at the time of production of the pressure-sensitive adhesive composition.

[0064]

20 The solvent contained in the pressure-sensitive adhesive composition may be
composed of only one type or may be composed of two or more types, and when it is
composed of two or more types, the combination and ratio thereof can be arbitrarily
selected.

[0065]

25 In the pressure-sensitive adhesive composition, the content of the solvent is not

particularly limited and may be appropriately adjusted.

[0066]

[Method for producing pressure-sensitive adhesive composition]

The pressure-sensitive adhesive composition can be obtained by blending each
5 component for constituting the composition.

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

In the case of using a solvent, it may be used by mixing the solvent with any one of the blended components other than the solvent and diluting the blended component in
10 advance, or it may be used by mixing the solvent with these blended components without previously diluting any one of the blended components other than the solvent.

[0067]

The method of mixing the respective components at the time of blending is not particularly limited, and may be selected appropriately from known methods, such as a
15 method of mixing by rotating a stirrer, a stirring blade or the like; a method of mixing by using a mixer; and a method of mixing by applying ultrasonic waves.

The temperature and time at the time of adding and mixing each component are not particularly limited, as long as each blended component does not deteriorate, and may be adjusted appropriately, although the temperature is preferably from 15 to 30°C.

20 [0068]

<Film adhesive>

The film adhesive is not particularly limited as long as the effects of the present invention are not impaired, and known ones can be appropriately used.

[0069]

25 The film adhesive is curable, preferably has thermosetting properties, and

preferably has pressure-sensitive adhesive properties. A film adhesive having both thermosetting properties and pressure-sensitive adhesive properties can be adhered by lightly pressing it against various adherends in an uncured state. Further, the film adhesive may be one that can be adhered to various adherends by heating and softening.

- 5 The film adhesive finally becomes a cured product having high impact resistance through curing, and this cured product can retain sufficient adhesive properties even under severe high temperature and high humidity conditions.

[0070]

- The film adhesive may be composed of one layer (that is, a single layer), or it
10 may be composed of two or more layers (a plurality of layers). When the film adhesive is composed of a plurality of layers, these plurality of layers may be the same as or different from each other. That is, all of the layers may be the same, all of the layers may be different, or only some of the layers may be the same. Further, in the case where the plurality of layers are different from each other, the combination of these
15 plurality of layers is not particularly limited as long as the effects of the present invention are not impaired. Here, the expression “the plurality of layers are different” means that at least one of the material and the thickness of each layer is different from each other.

[0071]

- The thickness of the film adhesive is not particularly limited, but it is preferably
20 from 1 μm to 50 μm , and more preferably from 3 μm to 40 μm . By ensuring that the thickness of the film adhesive is equal to or more than the above-mentioned lower limit value, a higher adhesive force with respect to the adherend (that is, a semiconductor chip) can be obtained. On the other hand, by ensuring that the thickness of the film adhesive is equal to or less than the above upper limit value, the film adhesive can be more easily
25 cut in the dividing step to be described later, and also at the time of dicing a

semiconductor wafer using a dicing blade, it is possible to further reduce the amount of cutting chips generated.

Here, the “thickness of the film adhesive” means the thickness of the entire film adhesive, and for example, the thickness of the film adhesive composed of a plurality of layers means the total thickness of all the layers constituting the film adhesive. It should be noted that as a method of measuring the thickness of the film adhesive, for example, a method of measuring the thickness at five arbitrary places using a contact type thickness meter and calculating the average of the measured values, and the like can be mentioned.

10 [0072]

Preferable examples of the film adhesive include those containing a polymer component (a) and an epoxy-based thermosetting resin (b). Examples of the epoxy-based thermosetting resin (b) include those composed of an epoxy resin (b1) and a thermal curing agent (b2).

15 Further, in addition to the polymer component (a) and the epoxy-based thermosetting resin (b), the film adhesive may further contain other components that do not correspond to these, if necessary, in order to improve various physical properties thereof. Preferable examples of the other components include a curing accelerator (c), a filler (d), a coupling agent (e), a crosslinking agent (f), an energy ray-curable resin (g), a photopolymerization initiator (h), a general purpose additive (i), and the like. The general-purpose additive (i) may be a known additive, and can be arbitrarily selected according to the purpose and is not particularly limited, but preferred examples thereof include a plasticizer, an antistatic agent, an antioxidant, a colorant (that is, a dye or a pigment), a gettering agent and the like.

25 [0073]

[Adhesive composition]

The film adhesive can be formed from an adhesive composition containing the constituent material thereof. For example, a film adhesive can be formed at an intended portion by coating an adhesive composition on the surface on which the film adhesive is to be formed, followed by drying if necessary. A more specific method of forming the film adhesive will be described in detail later, together with a method of forming other layers. The ratio of the contents of the components that do not vaporize at normal temperature to each other in the adhesive composition is usually the same as the ratio of the contents of the aforementioned components of the film adhesive to each other.

10 [0074]

The coating of the adhesive composition can be carried out in the same manner as in the case of coating the above-described pressure-sensitive adhesive composition.

[0075]

Although the drying conditions of the adhesive composition are not particularly limited, in the case where the adhesive composition contains a solvent to be described later, it is preferable to dry the adhesive composition by heating, and in this case, for example, it is preferable to dry under conditions of 70 to 130°C for 10 seconds to 5 minutes.

[0076]

20 Preferred examples of the adhesive composition include those containing the above-mentioned polymer component (a), the epoxy-based thermosetting resin (b), and, if necessary, the aforementioned other components and solvent.

[0077]

Examples of the solvent contained in the adhesive composition include
25 hydrocarbons such as toluene and xylene; alcohols such as methanol, ethanol, 2-propanol,

isobutyl alcohol (that is, 2-methylpropan-1-ol) and 1-butanol; esters such as ethyl acetate; ketones such as acetone and methyl ethyl ketone; ethers such as tetrahydrofuran; and amides such as dimethylformamide and N-methylpyrrolidone (that is, compounds having an amide bond).

5 The solvent contained in the adhesive composition is preferably methyl ethyl ketone or the like from the viewpoint of more uniformly mixing the components contained in the adhesive composition.

[0078]

As the solvent contained in the adhesive composition, for example, those used at
10 the time of production of each component such as the polymer component (a) may be used as they are in the adhesive composition without being removed from each component, a solvent of the same type as or different type from that used at the time of production of each component such as the polymer component (a) may be added separately at the time of production of the adhesive composition.

15 [0079]

Each component such as the polymer component (a) contained in the adhesive composition and the film adhesive may be composed of only one type or two or more types, and in the case where it is composed of two or more types, the combination and ratio thereof can be arbitrarily selected.

20 The content of each component such as the polymer component (a) and the like in the adhesive composition and the film adhesive is not particularly limited and may be appropriately selected according to the purpose.

[0080]

[Method for producing adhesive composition]

25 The adhesive composition can be obtained by blending each component for

constituting the adhesive composition, and can be produced by the same method as the above-mentioned method for producing the pressure-sensitive adhesive composition, except that the blended components are different.

[0081]

5 Next, the dicing/die bonding sheet of the present invention will be described in more detail with reference to the drawings. It should be noted that the drawings used in the following description are showing the main part in an enlarged manner in some cases for the sake of convenience in order to make the features of the present invention easy to understand, and the dimensional ratios and the like of the respective constituents are not
10 necessarily the same as the actual ratios.

[0082]

FIG. 1 is a cross-sectional view schematically showing an embodiment of a dicing/die bonding sheet of the present invention.

A dicing/die bonding sheet 101 shown here is formed by including a pressure-
15 sensitive adhesive layer 12 on a base material 11 and a film adhesive 13 on the pressure-sensitive adhesive layer 12. In addition, the dicing/die bonding sheet 101 further includes a release film 15 on the film adhesive 13.

[0083]

In the dicing/die bonding sheet 101, the pressure-sensitive adhesive layer 12 is
20 laminated on one surface of the base material 11 (hereinafter may be referred to as a “first surface 11a”); the film adhesive 13 is laminated on the entire surface of the pressure-sensitive adhesive layer 12 on the side opposite to the side where the base material 11 is provided (hereinafter may be referred to as a “first surface 12a”); a jig
adhesive layer 14 is laminated on a part of the surface of the film adhesive 13 on the side
25 opposite to the side where the pressure-sensitive adhesive layer 12 is provided

(hereinafter may be referred to as a “first surface 13a”), that is, in a region in the vicinity of a peripheral edge portion; and the release film 15 is laminated, of the first surface 13a of the film adhesive 13, on the surface where the jig adhesive layer 14 is not laminated, and on the surface of the jig adhesive layer 14 which is not in contact with the film adhesive 13 (that is, a first surface 14a and a side surface 14c). Here, the first surface 14a of the jig adhesive layer 14 is a surface of the jig adhesive layer 14 on the side opposite to the side in contact with the film adhesive 13, and there are also cases where the boundary between the first surface 14a and the side surface 14c of the jig adhesive layer 14 cannot be distinguished clearly.

10 As described above, the pressure-sensitive adhesive layer 12 has a thickness of 20 μm to 50 μm and an elongation at break of 5 to 50%.

[0084]

For example, the jig adhesive layer 14 may have a single-layer structure containing an adhesive component, or may have a multiple-layer structure in which a layer containing an adhesive component is laminated on both surfaces of a sheet serving as a core material.

[0085]

The dicing/die bonding sheet 101 shown in FIG. 1 is used, in a state where the release film 15 is removed, while the first surface 13a of the film adhesive 13 is adhered to the surface (abbreviated as “back surface” in the present specification in some cases) of the semiconductor wafer (not shown) opposite to the surface where a circuit is formed (abbreviated as “circuit forming surface” in the present specification in some cases), and furthermore, the first surface 14a of the jig adhesive layer 14 is adhered to a jig such as a ring frame.

25 [0086]

FIG. 2 is a cross-sectional view schematically showing another embodiment of the dicing/die bonding sheet of the present invention. It should be noted that in FIG. 2 and in the subsequent figures, the same components as those shown in FIG. 1 are denoted by the same reference numerals as in FIG. 1, and a detailed description thereof will be omitted.

[0087]

A dicing/die bonding sheet 102 shown here is the same as the dicing/die bonding sheet 101 shown in FIG. 1 except that the jig adhesive layer 14 is not included.

That is, in the dicing/die bonding sheet 102, the pressure-sensitive adhesive layer 12 is laminated on the first surface 11a of the base material 11, the film adhesive 13 is laminated on the entire surface of the first surface 12a of the pressure-sensitive adhesive layer 12, and the release film 15 is laminated on the entire surface of the first surface 13a of the film adhesive 13.

[0088]

The dicing/die bonding sheet 102 shown in FIG. 2 is used, in a state where the release film 15 is removed, while a part of a region on the center side of the first surface 13a of the film adhesive 13 is adhered to the back surface of a semiconductor wafer (not shown), and furthermore a region in the vicinity of the peripheral edge portion of the first surface 13a of the film adhesive 13 is adhered to a jig such as a ring frame.

[0089]

FIG. 3 is a cross-sectional view schematically showing yet another embodiment of the dicing/die bonding sheet of the present invention.

A dicing/die bonding sheet 103 shown here is the same as the dicing/die bonding sheet 101 shown in FIG. 1 except that the shape of the film adhesive is different.

That is, the dicing/die bonding sheet 103 is formed by including the pressure-

sensitive adhesive layer 12 on the base material 11 and a film adhesive 23 on the pressure-sensitive adhesive layer 12. In addition, the dicing/die bonding sheet 103 further includes the release film 15 on the film adhesive 23.

[0090]

5 In the dicing/die bonding sheet 103, the pressure-sensitive adhesive layer 12 is laminated on the first surface 11a of the base material 11, and the film adhesive 23 is laminated on a part of the first surface 12a of the pressure-sensitive adhesive layer 12, that is, a region on the center side. Further, the release film 15 is laminated, of the first surface 12a of the pressure-sensitive adhesive layer 12, on the surface where the film
10 adhesive 23 is not laminated and the surface of the film adhesive 23 which is not in contact with the pressure-sensitive adhesive layer 12 (that is, a first surface 23a and a side surface 23c). It should be noted that there are also cases where the boundary between the first surface 23a and the side surface 23c of the film adhesive 23 cannot be distinguished clearly.

15 [0091]

When the dicing/die bonding sheet 103 is viewed from the upper side of the film adhesive 23 in a plan view, the film adhesive 23 has a smaller surface area than that of the pressure-sensitive adhesive layer 12 and has a shape such as a circular shape, for example.

20 [0092]

The dicing/die bonding sheet 103 shown in FIG. 3 is used, in a state where the release film 15 is removed, while the first surface 23a of the film adhesive 23 is adhered to the back surface of a semiconductor wafer (not shown), and furthermore, a surface of the first surface 12a of the pressure-sensitive adhesive layer 12 where the film adhesive
25 23 is not laminated is adhered to a jig such as a ring frame.

[0093]

It should be noted that in the dicing/die bonding sheet 103 shown in FIG. 3, on the surface of the first surface 12a of the pressure-sensitive adhesive layer 12 where the film adhesive 23 is not laminated, a jig adhesive layer similar to the one shown in FIG. 1 may be laminated (not shown). Like the dicing/die bonding sheet 101 shown in FIG. 1, the dicing/die bonding sheet 103 having such a jig adhesive layer is used, while a first surface of the jig adhesive layer is adhered to a jig such as a ring frame.

[0094]

The dicing/die bonding sheet of the present invention is not limited to those shown in FIGS. 1 to 3, but may be those shown in FIGS. 1 to 3 in which a part of the configurations is modified, deleted or added within a range that does not impair the effects of the present invention.

[0095]

<< Manufacturing method of dicing/die bonding sheet >>

The dicing/die bonding sheet can be manufactured by sequentially laminating each of the above-described layers so as to establish the corresponding positional relationships. The method of forming each layer is as described above.

[0096]

For example, a pressure-sensitive adhesive layer can be laminated on a base material by coating the above-described pressure-sensitive adhesive composition on the base material, followed by drying if necessary.

[0097]

On the other hand, for example, when a film adhesive is further laminated on the pressure-sensitive adhesive layer already laminated on the base material, it is possible to directly form the film adhesive by applying the above-described adhesive composition

onto the pressure-sensitive adhesive layer, followed by drying, if necessary. As described above, in the case of forming a laminate structure of two successive layers by using any of the compositions, it is possible to newly form a layer, onto the layer formed from the aforementioned composition, by further applying a composition. However, it is preferable to form a laminate structure of two successive layers by: forming in advance, the layer to be laminated later, of these two layers, on another release film using the aforementioned composition; and bonding the exposed surface of the already formed layer on the side opposite to the side in contact with the release film to the exposed surface of the remaining layer that has been already formed. At this time, it is preferable that the composition is applied to the release-treated surface of the release film. After the formation of the laminate structure, the release film may be removed as necessary.

[0098]

That is, the aforementioned dicing/die bonding sheet can be obtained by the following manner: a pressure-sensitive adhesive composition is applied onto a base material and dried as necessary, to thereby laminate a pressure-sensitive adhesive layer on the base material in advance; an adhesive composition is separately applied onto a release film and dried as necessary to thereby form a film adhesive on the release film in advance; and the exposed surface of the film adhesive is bonded to the exposed surface of the pressure-sensitive adhesive layer already laminated on the base material to laminate the film adhesive on the pressure-sensitive adhesive layer.

[0099]

It should be noted that in the case of laminating the pressure-sensitive adhesive layer on the base material, as described above, instead of the method of applying the pressure-sensitive adhesive composition on the base material, a pressure-sensitive

adhesive layer may be formed on a release film in advance by applying a pressure-sensitive adhesive composition on the release film, followed by drying if necessary, and the exposed surface of the pressure-sensitive adhesive layer may be bonded to one surface of the base material for lamination.

5 In either method, the release film may be removed at an arbitrary timing after formation of the intended laminate structure.

[0100]

As described above, since any layer constituting the dicing/die bonding sheet other than the base material can be laminated by a method of forming the layer in advance on a release film and bonding it on the surface of the target layer, the dicing/die bonding sheet may be manufactured by appropriately selecting the layer for adopting such a process, if necessary.

[0101]

It should be noted that the dicing/die bonding sheet is usually stored in a state where a release film is bonded to the surface of the outermost layer (for example, the film adhesive) on the side where the film adhesive is provided. Therefore, the dicing/die bonding sheet can also be obtained by: forming a layer constituting the outermost layer in advance on the release film by applying a composition for forming the layer constituting the outermost layer, such as an adhesive composition, onto the release film (preferably the release-treated surface thereof), followed by drying as necessary, and laminating each of the remaining layers on the exposed surface of this layer on the side opposite to the side in contact with the release film by any of the above-mentioned methods, while leaving the release film in a bonded state without removal.

[0102]

25 <<Method for producing semiconductor chip>>

A method for producing a semiconductor chip of the present invention is a method for producing a semiconductor chip using the above-described dicing/die bonding sheet of the present invention, and includes: a step of forming an intermediate structure (hereinafter, abbreviated as “intermediate structure formation step” in some cases) in which a semiconductor wafer is provided on a surface (that is, the
5 aforementioned first surface) of the aforementioned film adhesive on a side opposite to the side where the aforementioned pressure-sensitive adhesive layer is provided in the aforementioned dicing/die bonding sheet; and a step of forming a notch, by using a dicing blade, that reaches the aforementioned pressure-sensitive adhesive layer from the
10 surface of the aforementioned semiconductor wafer in the aforementioned intermediate structure, but does not reach the aforementioned base material, thereby dividing the aforementioned semiconductor wafer to form a semiconductor chip (hereinafter abbreviated as “dicing step” in some cases).

[0103]

15 By using the dicing/die bonding sheet of the present invention, in the dicing step, at the time of dicing a semiconductor wafer using a dicing blade, the amount of cutting chips generated can be considerably reduced compared with conventional cases. Here, the term “cutting chip” is as described above.

[0104]

20 Hereinafter, the method for producing a semiconductor chip will be described with reference to FIG. 4. FIG. 4 is a cross-sectional view for schematically illustrating an embodiment of the method for producing a semiconductor chip of the present invention.

Here, a production method in the case of using the dicing/die bonding sheet
25 shown in FIG. 1 will be described.

[0105]

<Intermediate structure formation step>

In the intermediate structure formation step, as shown in FIG. 4(a), on the first surface 13a of the film adhesive 13 in the dicing/die bonding sheet 101, an intermediate structure 201 in which a semiconductor wafer 9' is provided is formed.

Although the thickness of the semiconductor wafer 9' in the intermediate structure 201 is not particularly limited, it is preferably from 10 μm to 100 μm , and more preferably from 30 μm to 90 μm .

[0106]

10 <Dicing step>

Then, in the dicing step, as shown in FIG. 4 (b), by using a dicing blade, a notch 10 that reaches the pressure-sensitive adhesive layer 12 from a surface (that is, a circuit forming surface) 9a' of the semiconductor wafer 9' in the intermediate structure 201, and at the same time does not reach the base material 11 is formed, whereby the semiconductor wafer 9' is divided to form semiconductor chips 9.

The thickness of the semiconductor chip 9 is the same as the thickness of the above-mentioned semiconductor wafer 9'.

[0107]

FIG. 5 is an enlarged cross-sectional view schematically showing the obtained semiconductor chip 9 together with the dicing/die bonding sheet 101 in which the notches 10 are formed.

As shown in FIG. 5, in this step, the notches 10 are formed so that a thickness T_1 of the pressure-sensitive adhesive layer 12 and a depth T_2 of the notches 10 from the first surface 12a of the pressure-sensitive adhesive layer 12 satisfy a relationship of $T_1 > T_2$. It should be noted that when a bottom surface 120a of the notch portion in the pressure-

sensitive adhesive layer 12 is not a flat surface, a portion of the bottom surface 120a that is closest to the base material 11 (that is, a portion in which the depth of the notch 10 is deepest in the pressure-sensitive adhesive layer 12) may be taken as one criterion when calculating the value of T_2 .

5 [0108]

As described above, by forming the notches 10 so as to remain in the pressure-sensitive adhesive layer 12 without reaching the first surface 11a of the base material 11, the amount of cutting chips generated can be reduced, and it is possible to suppress the occurrence of poor pickup of the semiconductor chip 9 with the film adhesive.

10 Reduction in the amount of cutting chips generated in the dicing step can be confirmed, for example, by the fact that the amount of cutting chips remaining on the dicing line is reduced, when the pressure-sensitive adhesive layer and the base material are observed using a SEM after picking up the semiconductor chip 9 with a film adhesive.

[0109]

15 The ratio (T_2/T_1) of the depth T_2 of the notch 10 in the pressure-sensitive adhesive layer 12 with respect to the thickness T_1 of the pressure-sensitive adhesive layer 12 is greater than 0 and less than 1, preferably from 0.1 to 0.9, more preferably from 0.2 to 0.8, and particularly preferably from 0.3 to 0.7. By ensuring that the above ratio is equal to or more than the above lower limit value, it is possible to reduce the size of the protruding portion of the pressure-sensitive adhesive layer, that is, the amount of protrusion, in a portion of the pressure-sensitive adhesive layer where the notches 10 are formed. By reducing the protrusion amount of the pressure-sensitive adhesive layer, it is possible to highly suppress the occurrence of poor pickup of the semiconductor chip 9 with the film adhesive even further. On the other hand, by ensuring that the above ratio
20
25 is equal to or less than the above upper limit value, the amount of cutting chips generated

can be further reduced.

[0110]

FIG. 6 is a cross-sectional view schematically showing an example of a state in which the notch 10 is formed in the intermediate structure 201 by using a dicing blade in the dicing step. Here, a state is shown in which a tip portion 8a of the dicing blade 8 in the radial direction is located in the pressure-sensitive adhesive layer 12 and does not reach the base material 11. It should be noted that in FIG. 6, only the configuration related to the dicing/die bonding sheet is shown in cross section. In addition, although a state is shown in which a void portion is present as the notch 10 between the dicing blade 8 and the pressure-sensitive adhesive layer 12, there are also cases where the pressure-sensitive adhesive layer 12 protrudes and remains on the dicing blade 8 side, and, as described above, a protruding portion is present while the void portion is further narrowed or does not exist.

[0111]

In the present invention, a width W of the dicing blade 8 is preferably from 20 μm to 50 μm , and more preferably from 30 μm to 35 μm . By using the dicing blade 8 having such a width W, more excellent effects of the present invention can be obtained. It should be noted that in the case where a semiconductor chip is formed by dividing a semiconductor wafer using a dicing blade having the width W, the distance (that is, the kerf width) between adjacent semiconductor chips is usually the same as W or become an approximate value of W.

[0112]

In the present invention, in a region in the vicinity of the tip portion 8a of the dicing blade 8, a length L in the radial direction in a region in which the width W becomes narrower toward the outside of the radial direction of the dicing blade 8 (that is,

toward the tip portion 8a) is preferably less than the thickness T_1 of the pressure-sensitive adhesive layer 12 ($L < T_1$), for example, preferably less than 50 μm , more preferably less than 45 μm , still more preferably less than 40 μm , and particularly preferably less than 35 μm . By using the dicing blade 8 having the length L as described above, more excellent effects of the present invention can be obtained.

On the other hand, the lower limit value of the length L is not particularly limited as long as it is larger than 0 μm , but it is usually preferably 10 μm , and more preferably 15 μm . The length L is expressed by the formula: $L = (W \times \tan\theta) / 2$, using an angle θ to be described later.

[0113]

In the present invention, it is possible to use those in which an angle θ formed by the tip portion 8a of the dicing blade 8 with the surface on which the notch is to be formed (such an angle is sometimes referred to as "tip angle of the dicing blade" in the present specification) is greater than 0° and less than 90° . In such a dicing blade 8, the angle θ may be, for example, larger than 0° and equal to or smaller than 80° , but it is preferably larger than 0° and equal to or smaller than 70° . By using the dicing blade 8 having such a tip angle θ , more excellent effects of the present invention can be obtained.

[0114]

It should be noted that although the case of using those mentioned above in which the tip angle θ is greater than 0° and less than 90° as the dicing blade has been described, the dicing blade used in the dicing step is not limited to this type of dicing blade. For example, in the dicing blade 8 shown in FIG. 6, the dicing blade 8 whose tip angle θ is 0° , that is, a dicing blade in which there is no region where the width W becomes narrower toward the outside in the radial direction of the dicing blade 8 (that is, toward the tip portion 8a), in a region in the vicinity of the tip portion 8a of the dicing

blade 8, may be used in the dicing step.

[0115]

On the other hand, as shown in FIG. 7, in the case where the notches 10 are formed so as to satisfy a relationship of $T_1 = T_2$, that is, to penetrate through the pressure-sensitive adhesive layer 12 from the surface 9a' of the semiconductor wafer 9' and to reach the base material 11, in the intermediate structure 201 according to the conventional manufacturing method, the above-described effects of the present invention cannot be obtained. It should be noted that in FIG. 7, T_3 ($T_3 > 0$) means a depth of the notch 10 from the first surface 11a of the base material 11. In addition, a portion denoted by a reference numeral 110a indicates a bottom surface at the notch portion of the base material 11.

[0116]

In the dicing step, the rotational speed of the dicing blade is preferably from 10,000 to 60,000 rpm, and more preferably from 20,000 to 50,000 rpm.

In addition, the moving speed of the dicing blade is preferably from 20 to 80 mm/sec, and more preferably from 40 to 60 mm/sec.

Further, when operating the dicing blade, it is preferable to feed the cutting water in an amount of about 0.5 to 1.5 L/min, for example, to a place where the dicing is carried out.

[0117]

<<Method for manufacturing semiconductor device>>

The method for manufacturing a semiconductor device of the present invention includes, after carrying out the step of forming the semiconductor chip (that is, the dicing step) by the above-described method for producing a semiconductor chip of the present invention, a step of applying a force with respect to the dicing/die bonding sheet from the

base material side thereof after forming the notch, and separating the semiconductor chip from the pressure-sensitive adhesive layer together with the film adhesive after cutting (hereinafter may be abbreviated as “separating step”).

[0118]

5 In the method for manufacturing a semiconductor device of the present invention, the amount of cutting chips generated in the dicing step can be considerably reduced by utilizing the above-described method for producing a semiconductor chip of the present invention.

As a result, in the separating step, the occurrence of poor pickup of the
10 semiconductor chip having the film adhesive (that is, the semiconductor chip with the film adhesive) is suppressed.

[0119]

Hereinafter, the method for manufacturing a semiconductor device will be described with reference to FIG. 8. FIG. 8 is a cross-sectional view for schematically
15 illustrating an embodiment of a method for manufacturing a semiconductor device of the present invention. Here, a manufacturing method in the case of using the dicing/die bonding sheet shown in FIG. 1 will be described. It should be noted that in FIG. 8, only the configuration related to the dicing/die bonding sheet and the semiconductor chip is shown in cross section.

20 [0120]

<Separating step>

In the separating step, as shown in FIG. 8, a force is applied to the dicing/die bonding sheet 101 after the formation of the notches 10 from the side of the base material 11 thereof, and the semiconductor chip 9 is separated (that is, picked up) from the
25 pressure-sensitive adhesive layer 12 together with the film adhesive 13 after cutting.

[0121]

Here, an example is shown in which a protrusion (that is, a pin) 70 is protruded from a push-up portion (not shown) in the manufacturing apparatus of the semiconductor device, and a tip portion of the protrusion 70 pushes up the dicing/die bonding sheet 101 from the base material 11 side thereof, whereby a force is applied in the protruding direction of the protrusion 70 with respect to the intermediate structure 201 in which the notch 10 and the semiconductor chip 9 are formed. At this time, it is possible to appropriately adjust the thrusting conditions such as the protrusion amount (that is, the push-up amount) of the protrusion 70, the protrusion rate (that is, the push-up rate) and the retention time of the protrusion state (that is, the lifting latency). The number of the protrusions 70 is not particularly limited, and may be appropriately selected.

[0122]

In the separating step, the method of pushing up the dicing/die bonding sheet 101 may be a known method, and for example, in addition to the method of pushing up by the protrusions as described above, a method of pushing up the dicing/die bonding sheet 101 by moving a slider along the dicing/die bonding sheet 101 can be mentioned.

[0123]

Further, here, an example is shown in which the semiconductor chip 9 is peeled off from the pressure-sensitive adhesive layer 12 together with the film adhesive 13 by pulling up the semiconductor chip 9 by a lifting portion 71 of the manufacturing apparatus of a semiconductor device. Here, the pulling direction of the semiconductor chip 9 is indicated by an arrow I.

A method for pulling up the semiconductor chip 9 may be a known method, and for example, a method of sucking and pulling up the surface of the semiconductor chip 9 with a vacuum collet, or the like can be mentioned.

[0124]

In the separating step, by using the dicing/die bonding sheet 101 of the present invention and utilizing the method for producing a semiconductor chip of the present invention, the occurrence of poor pickup of the semiconductor chip 9 with the film
5 adhesive is suppressed.

[0125]

In the method for manufacturing a semiconductor device according to the present invention, as described above, by using a dicing/die bonding sheet in which an adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive
10 is equal to or less than a specific value in the separating step, it is possible to easily separate and pick up the semiconductor chip with the film adhesive from the pressure-sensitive adhesive layer without curing the pressure-sensitive adhesive layer through energy ray irradiation or the like. Further, since the semiconductor chip with the film adhesive can be picked up without curing the pressure-sensitive adhesive layer, the
15 manufacturing process of the semiconductor device can be simplified.

[0126]

In the method for manufacturing a semiconductor device of the present invention, a semiconductor device can be manufactured by using the semiconductor chip separated (that is, picked up) together with the film adhesive (that is, the semiconductor
20 chip with the film adhesive), followed by the same method as the conventional method, in other words, through a step of die bonding the semiconductor chip to the circuit surface of the substrate with the film adhesive. For example, the semiconductor chip is die bonded to the circuit surface of a substrate with the film adhesive and, if necessary, on this semiconductor chip, one or more semiconductor chips are further laminated, and
25 after carrying out wire bonding, the entire configuration is sealed by a resin, thereby

forming a semiconductor package. Then, by using this semiconductor package, a desired semiconductor device may be fabricated.

[Examples]

5 [0127]

Hereinafter, the present invention will be described in more detail with reference to specific examples. However, the present invention is not limited in any way by the following examples.

It should be noted that in the following description, “msec” means
10 “milliseconds” which is a unit of time.

[0128]

[Example 1]

<Production of dicing/die bonding sheet>

To a non-energy ray-curable pressure-sensitive adhesive layer of a dicing sheet
15 formed by including the pressure-sensitive adhesive layer on a base material (thickness of base material: 80 μm , thickness of pressure-sensitive adhesive layer: 30 μm), a film adhesive (“ADWILL LE 61-25*” manufactured by Lintec Corporation, thickness: 25 μm) was adhered under normal temperature. As described above, a dicing/die bonding sheet formed by including a pressure-sensitive adhesive layer on the base material and a
20 film adhesive on the pressure-sensitive adhesive layer was obtained.

[0129]

It should be noted that the pressure-sensitive adhesive layer of the dicing sheet used here contains: an acrylic polymer (weight average molecular weight: 450,000, glass transition temperature: -31°C) (100 parts by mass) obtained by copolymerizing 2-
25 ethylhexyl acrylate (hereinafter abbreviated as “2-EHA”) (60 parts by mass), methyl

methacrylate (hereinafter abbreviated as “MMA”) (30 parts by mass) and 2-hydroxyethyl acrylate (hereinafter abbreviated as “HEA”) (10 parts by mass) as an adhesive resin; and a tolylene diisocyanate trimer adduct of trimethylolpropane (“BHS 8515” manufactured by Toyo Ink Co., Ltd.) (18.85 parts by mass) as a crosslinking agent.

5 [0130]

Table 1 shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive as measured by the following methods.

[0131]

10 (Measurement of elongation at break and elastic modulus of pressure-sensitive adhesive layer)

A test piece was prepared by cutting out the pressure-sensitive adhesive layer so as to have a length of 30 mm, a width of 10 mm, and a thickness of 0.03 mm.

Subsequently, this test piece was set in a measuring apparatus (“Autograph”
15 manufactured by Shimadzu Corporation). At this time, portions having a length of 10 mm from the both ends in the length direction of the test piece were sandwiched between the chucks so that the length of the test piece to be measured was 10 mm.

Subsequently, the test piece was pulled in the longitudinal direction thereof under an environment of a temperature of 23°C and a relative humidity of 50% at a
20 tension speed of 1,000 mm/min to measure the elongation at break and elastic modulus of the pressure-sensitive adhesive layer.

[0132]

(Measurement of adhesive force of pressure-sensitive adhesive layer with respect to film adhesive)

25 A test piece was prepared by cutting out the dicing/die bonding sheet so as to

have a width of 25 mm and a length of 200 mm.

Subsequently, at normal temperature (23°C), this test piece was adhered to an adhesive surface of a pressure-sensitive adhesive sheet with the film adhesive.

Then, at normal temperature (23°C), 180° peeling was carried out in which a
5 laminate of the base material and the pressure-sensitive adhesive layer was peeled off from the film adhesive at a peeling rate of 300 mm/min, so that the planes of the film adhesive and the pressure-sensitive adhesive layer that had been brought into contact with each other formed an angle of 180°, and the peel force at this time was measured and taken as the adhesive force (mN / 25 mm) of the pressure-sensitive adhesive layer
10 with respect to the film adhesive.

[0133]

<Production and evaluation of semiconductor chip>

(Intermediate structure formation step)

The dicing/die bonding sheet obtained as described above was adhered to a
15 polished surface of a 12-inch silicon wafer (thickness: 75 μm) finished by dry polishing with the film adhesive, using a fully automatic multifunction wafer mounter ("ADWILL RAD-2700" manufactured by Lintec Corporation) to obtain an intermediate structure.

[0134]

(Dicing step)

20 Then, the obtained intermediate structure was adhered and fixed to a ring frame for dicing through the exposed surface of the pressure-sensitive adhesive layer thereof.

Subsequently, using a dicing apparatus ("DFD 6361" manufactured by Disco Corporation), a notch was formed in the intermediate structure obtained as described above. The conditions at that time are as follows. A notch was formed by cutting,
25 using a dicing blade, from the surface of the silicon wafer, penetrating through the film

adhesive, and down to a depth of 20 μm from the surface of the pressure-sensitive adhesive layer on the side provided with the film adhesive. In other words, the above notch was formed so as not to reach the base material in the intermediate structure, and a ratio (T_2/T_1) of a depth T_2 of the notch in the pressure-sensitive adhesive layer with respect to a thickness T_1 of the pressure-sensitive adhesive layer was set to 0.67. As the dicing blade, one having the width W of 30 μm to 35 μm , the angle θ of the tip portion of 30°, and the length L in the radial direction of 9 μm to 10 μm was used, and the rotational speed and the moving speed of the dicing blade were set to 40,000 rpm and 50 mm/sec, respectively. Further, dicing was performed while causing the cutting water to flow in an amount of 1 L/min with respect to a place where the dicing was carried out.

As described above, when the surface of the silicon wafer was viewed from the upper side, dicing was performed at intervals of 8 mm in two orthogonal directions, that is, so that the size of the silicon chip was 8 mm $\times$ 8 mm.

[0135]

(Evaluation of pick-up suitability of semiconductor chip)

Subsequently, an intermediate structure after forming a notch and forming a silicon chip was set in a pickup/ die bonding device ("BESTEM-D02" manufactured by Canon Machinery Inc.). Then, under normal temperature, with respect to the dicing/die bonding sheet after formation of the notch, a force was applied from the base material side thereof to push up the intermediate structure after formation of the notch and the silicon chip through a 5 pin push-up system by setting the push-up rate to 20 mm/sec, the retention time to 300 msec and the push-up amount to a certain value, and at the same time, an attempt was made to separate (that is, pickup) the obtained semiconductor chip with the film adhesive from the pressure-sensitive adhesive layer using a collet in which a portion for separating the semiconductor chip had a size of 8 mm $\times$ 8 mm. The push-

up of the intermediate structure and the separation of the semiconductor chip with the film adhesive were continuously performed while changing the push-up amount, and the minimum value of the push-up amount in the case where it was possible to carry out the process successively 30 times without causing defects was determined and used as an indicator for evaluating pick-up suitability of the semiconductor chip with the film adhesive. Further, the surface of the base material and the pressure-sensitive adhesive layer after the pickup was observed using a scanning electron microscope (SEM) ("VE-9800" manufactured by KEYENCE CORPORATION), and the amount of cutting chips on a dicing line was confirmed. The results are shown in Table 1.

10 [0136]

<Production of dicing/die bonding sheet, production and evaluation of semiconductor chip>

[Example 2]

A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the minimum value of the push-up amount was determined and the amount of cutting chips on the dicing line was confirmed. The results are shown in Table 1. Further, Table 1 also shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive.

(Pressure-sensitive adhesive layer)

A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 700,000, glass transition temperature: -63°C) (100 parts by mass) obtained by copolymerizing 2EHA (85 parts by mass) and HEA (15 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane

("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (28.28 parts by mass) as a crosslinking agent.

[0137]

[Example 3]

5 A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the minimum value of the push-up amount was determined and the amount of cutting chips on the dicing line was confirmed. The results are shown in Table 1. Further, Table 1
10 also shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive.

(Pressure-sensitive adhesive layer)

 A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 850,000, glass transition temperature: -61°C) (100 parts by
15 mass) obtained by copolymerizing 2EHA (80 parts by mass) and HEA (20 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (37.70 parts by mass) as a crosslinking agent.

[0138]

20 [Example 4]

 A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the minimum value of the push-up amount was determined and the amount of cutting chips
25 on the dicing line was confirmed. The results are shown in Table 1. Further, Table 1

also shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive.

(Pressure-sensitive adhesive layer)

A pressure-sensitive adhesive layer containing an acrylic polymer (weight
5 average molecular weight: 450,000, glass transition temperature: -31°C) (100 parts by mass) obtained by copolymerizing 2EHA (60 parts by mass), MMA (30 parts by mass) and HEA (10 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (56.55 parts by mass) as a crosslinking agent.

10 [0139]

[Example 5]

A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the
15 minimum value of the push-up amount was determined and the amount of cutting chips on the dicing line was confirmed. The results are shown in Table 1. Further, Table 1 also shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive.

(Pressure-sensitive adhesive layer)

20 A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 300,000, glass transition temperature: -30°C) (100 parts by mass) obtained by copolymerizing 2EHA (60 parts by mass), MMA (30 parts by mass) and 4-hydroxybutyl acrylate (hereinafter abbreviated as "4HBA") (10 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS
25 8515" manufactured by Toyo Ink Co., Ltd.) (15.19 parts by mass) as a crosslinking agent.

[0140]

[Comparative Example 1]

<Production of dicing/die bonding sheet>

A dicing/die bonding sheet was produced in the same manner as in Example 1.

5 [0141]

<Production and evaluation of semiconductor chip>

(Intermediate structure formation step)

An intermediate structure was obtained in the same manner as in Example 1.

[0142]

10 (Dicing step)

Then, the obtained intermediate structure was adhered and fixed to a ring frame for dicing through the exposed surface of the pressure-sensitive adhesive layer thereof.

Subsequently, using a dicing apparatus ("DFD 6361" manufactured by Disco Corporation), a notch was formed in the intermediate structure obtained as described
15 above. The conditions at that time are as follows. A notch was formed by cutting, using a dicing blade, from the surface of the silicon wafer, penetrating through the film adhesive and the pressure-sensitive adhesive layer, and down to a depth of 20 μm from the surface of the base material on the side provided with the pressure-sensitive adhesive layer. In other words, the above notch was formed over the entire region in the
20 thickness direction of the pressure-sensitive adhesive layer in the intermediate structure, and a ratio (T_2/T_1) of a depth T_2 of the notch in the pressure-sensitive adhesive layer with respect to a thickness T_1 of the pressure-sensitive adhesive layer was set to 1, and moreover, a notch was also formed in the base material, and a depth T_3 of the notch in the base material was set to 20 μm . The dicing blade and the rotational speed and moving
25 speed of the dicing blade were the same as those in Example 1.

As described above, when the surface of the silicon wafer was viewed from the upper side, dicing was performed at intervals of 8 mm in two orthogonal directions, that is, so that the size of the silicon chip was 8 mm × 8 mm.

[0143]

5 (Evaluation of pick-up suitability of semiconductor chip)

An attempt was made to separate (that is, pickup) the semiconductor chip with the film adhesive from the pressure-sensitive adhesive layer in the same manner as in Example 1, the minimum value of the push-up amount was determined, and the amount of cutting chips on the dicing line was confirmed. The results are shown in Table 2.

10 [0144]

[Comparative Example 2]

A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the
15 minimum value of the push-up amount was determined and the amount of cutting chips on the dicing line was confirmed. The results are shown in Table 2. Further, Table 2 also shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive.

(Pressure-sensitive adhesive layer)

20 A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 510,000, glass transition temperature: -44°C) (100 parts by mass) obtained by copolymerizing 2EHA (70 parts by mass), MMA (20 parts by mass) and HEA (10 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (18.85
25 parts by mass) as a crosslinking agent.

[0145]

[Comparative Example 3]

A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the minimum value of the push-up amount was determined and the amount of cutting chips on the dicing line was confirmed. The results are shown in Table 2. Further, Table 2 also shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive.

10 (Pressure-sensitive adhesive layer)

A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 700,000, glass transition temperature: -66°C) (100 parts by mass) obtained by copolymerizing 2EHA (90 parts by mass) and HEA (10 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane (“BHS 8515” manufactured by Toyo Ink Co., Ltd.) (18.85 parts by mass) as a crosslinking agent.

[0146]

[Comparative Example 4]

A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the minimum value of the push-up amount was determined and the amount of cutting chips on the dicing line was confirmed. The results are shown in Table 2. Further, Table 2 also shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive.

(Pressure-sensitive adhesive layer)

A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 700,000, glass transition temperature: -63°C) (100 parts by mass) obtained by copolymerizing 2EHA (85 parts by mass) and HEA (15 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (28.28 parts by mass) as a crosslinking agent.

[0147]

[Comparative Example 5]

A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the minimum value of the push-up amount was determined and the amount of cutting chips on the dicing line was confirmed. The results are shown in Table 2. Further, Table 2 also shows the elongation at break of the pressure-sensitive adhesive layer and the adhesive force with respect to the film adhesive. It should be noted that the elastic modulus of the pressure-sensitive adhesive layer could not be measured.

(Pressure-sensitive adhesive layer)

A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 850,000, glass transition temperature: -61°C) (100 parts by mass) obtained by copolymerizing 2EHA (80 parts by mass) and HEA (20 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (113.10 parts by mass) as a crosslinking agent.

[0148]

[Comparative Example 6]

Although an attempt was made to manufacture a dicing die bonding sheet in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, the film adhesive
5 could not be adhered to the pressure-sensitive adhesive layer, and the dicing/die bonding sheet could not be produced.

(Pressure-sensitive adhesive layer)

A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 850,000, glass transition temperature: -61°C) (100 parts by
10 mass) obtained by copolymerizing 2EHA (80 parts by mass) and HEA (20 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (188.50 parts by mass) as a crosslinking agent.

[0149]

15 [Comparative Example 7]

A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and moreover, the minimum value of the push-up amount was determined and the amount of cutting chips
20 on the dicing line was confirmed. The results are shown in Table 3. Further, Table 3 also shows the elongation at break and elastic modulus of the pressure-sensitive adhesive layer, and the adhesive force with respect to the film adhesive.

(Pressure-sensitive adhesive layer)

A pressure-sensitive adhesive layer containing an acrylic polymer (weight
25 average molecular weight: 450,000, glass transition temperature: -31°C) (100 parts by

mass) obtained by copolymerizing 2EHA (60 parts by mass), MMA (30 parts by mass) and HEA (10 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (94.25 parts by mass) as a crosslinking agent.

5 [0150]

[Comparative Example 8]

A dicing/die bonding sheet and a semiconductor chip were manufactured in the same manner as in Example 1 except that a dicing sheet having the following layer (thickness: 30 μm) as the pressure-sensitive adhesive layer was used, and the amount of
10 cutting chips on the dicing line was confirmed. The results are shown in Table 3. Further, Table 3 also shows the elongation at break of the pressure-sensitive adhesive layer and the adhesive force with respect to the film adhesive. It should be noted that in this Comparative Example, it was not possible to separate (that is, pick up) the semiconductor chip with the film adhesive from the pressure-sensitive adhesive layer,
15 and the minimum value of the push-up amount could not be obtained. In addition, the elastic modulus of the pressure-sensitive adhesive layer could not be measured.
(Pressure-sensitive adhesive layer)

A pressure-sensitive adhesive layer containing an acrylic polymer (weight average molecular weight: 720,000, glass transition temperature: -27°C) (100 parts by
20 mass) obtained by copolymerizing lauryl acrylate (hereinafter abbreviated as "LA") (80 parts by mass) and HEA (20 parts by mass) as an adhesive resin, and a tolylene diisocyanate trimer adduct of trimethylolpropane ("BHS 8515" manufactured by Toyo Ink Co., Ltd.) (137.70 parts by mass) as a crosslinking agent.

[0151]

25 [Table 1]

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5
Notch position during dicing	Depth of 20 μm from surface of pressure-sensitive adhesive layer				
Thickness T_1 of pressure-sensitive adhesive layer (μm)	30				
Depth T_2 of notch in pressure-sensitive adhesive layer (μm)	20				
T_2 / T_1	0.67				
Elongation at break of pressure-sensitive adhesive layer (%)	33.7	8.7	24.6	9.2	40.2
Elastic modulus of pressure-sensitive adhesive layer (MPa)	98.5	45.2	97.3	112.8	50.9
Adhesive force of pressure-sensitive adhesive layer with respect to film adhesive (mN / 25 mm)	98	69	62	67	78
Minimum value of push-up amount (μm)	200	175	150	150	200
Amount of cutting chips on dicing line	Small	Extremely small	Extremely small	Extremely small	Small

[0152]

[Table 2]

	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4	Comp. Ex. 5
Notch position during dicing	Depth of 20 μm from surface of base material	Depth of 20 μm from surface of pressure-sensitive adhesive layer			
Thickness T_1 of pressure-sensitive adhesive layer (μm)	30	30			
Depth T_2 of notch in pressure-sensitive adhesive layer (μm)	30	20			
T_2 / T_1	1	0.67			
Elongation at break of pressure-sensitive adhesive layer (%)	33.7	59.4	80.3	53.6	0
Elastic modulus of pressure-sensitive adhesive layer (MPa)	98.5	38.6	8.2	32.3	-
Adhesive force of pressure-sensitive adhesive layer with respect to film adhesive (mN / 25 mm)	98	221	260	132	37
Minimum value of push-up amount (μm)	300	275	275	250	75
Amount of cutting chips on dicing line	Extremely large	Large	Extremely large	Large	Extremely small

[Table 3]

	Comp. Ex. 6	Comp. Ex. 7	Comp. Ex. 8
Notch position during dicing	-	Depth of 20 μm from surface of pressure-sensitive adhesive layer	
Thickness T_1 of pressure-sensitive adhesive layer (μm)	30	30	
Depth T_2 of notch in pressure-sensitive adhesive layer (μm)	-	20	
T_2 / T_1	-	0.67	
Elongation at break of pressure-sensitive adhesive layer (%)	0	3.2	109.2
Elastic modulus of pressure-sensitive adhesive layer (MPa)	-	121.5	0.9
Adhesive force of pressure-sensitive adhesive layer with respect to film adhesive (mN / 25 mm)	-	42	1210
Minimum value of push-up amount (μm)	-	75	-
Amount of cutting chips on dicing line	-	Extremely small	Extremely large

[0154]

In Examples 1 to 5, using a dicing/die bonding sheet in which the thickness of the pressure-sensitive adhesive layer was in the range of 20 μm to 50 μm and the elongation at break of the pressure-sensitive adhesive layer was within the range of 8.7% to 40.2%, in an intermediate structure in the dicing step, a notch that reached the pressure-sensitive adhesive layer from the surface of the semiconductor wafer but did not reach the base material was formed. As a result, as is clear from the above results, the minimum value of the push-up amount was equal to or less than 200 μm , and the pick-up suitability of the semiconductor chip with the film adhesive was favorable. In particular, in Examples 2 to 4 in which the adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive was smaller, the minimum value of the push-up amount was smaller and the pick-up suitability of the semiconductor chip with the film adhesive was extremely excellent. Further, in Examples 1 to 5, there were few cutting chips on the dicing line, and in particular, the amount thereof was extremely reduced in Examples 2 to 4.

As described above, the amount of cutting chips on the dicing line was correlated with the pick-up suitability of the semiconductor chip with the film adhesive.

It should be noted that in Examples 1 to 5, the so-called chip flying in which the semiconductor chip is scattered during dicing of the semiconductor wafer was also not
5 observed.

[0155]

On the other hand, in Comparative Example 1, as a result of forming a notch reaching the base material from the surface of the semiconductor wafer in the intermediate structure in the dicing step, although the pressure-sensitive adhesive layer
10 was the same as in Example 1, the minimum value of the push-up amount was 300 μm , and the pick-up suitability of the semiconductor chip with the film adhesive was inferior.

Further, in Comparative Examples 2 to 3, the elongation at break of the pressure-sensitive adhesive layer was too large, and accordingly, the minimum value of the push-up amount was large, and the pick-up suitability of the semiconductor chip with
15 the film adhesive was inferior.

[0156]

Moreover, in Comparative Example 4, the elongation at break of the pressure-sensitive adhesive layer was too large, and accordingly, as will be described later, a large amount of cutting chips remained on the dicing line, and the minimum value of the push-
20 up amount was also relatively large.

[0157]

In addition, in Comparative Examples 5 and 7, the elongation at break of the pressure-sensitive adhesive layer was too small, cracking was observed at an unintended portion of the pressure-sensitive adhesive layer, and the characteristics of the pressure-
25 sensitive adhesive layer were inferior. The dicing/die bonding sheets of these

Comparative Examples were unsuitable for practical use.

Further, in Comparative Example 6, since the content of the crosslinking agent in the pressure-sensitive adhesive layer was too large and there was a problem with the composition of the pressure-sensitive adhesive layer, as described above, it was impossible to adhere the film adhesive to the pressure-sensitive adhesive layer, and the dicing/die bonding sheet could not be produced.

Furthermore, in Comparative Example 8, the type of the adhesive resin in the pressure-sensitive adhesive layer was inappropriate, the elongation at break of the pressure-sensitive adhesive layer was too large, the adhesive force of the pressure-sensitive adhesive layer with respect to the film adhesive was too large, and as described above, it was impossible to pick up the semiconductor chip with the film adhesive.

[0158]

In Comparative Examples 1 to 4 and 8, there were many cutting chips on the dicing line, and the minimum value of the push-up amount was equal to or more than 250 μm in Comparative Examples 1 to 4 and unmeasurable in Comparative Example 8, whereas in Comparative Examples 5 and 7, there were few cutting chips on the dicing line and the minimum value of the push-up amount was as small as 75 μm . As described above, also in these Comparative Examples, the amount of cutting chips on the dicing line was correlated with the pick-up suitability of the semiconductor chip with the film adhesive.

Further, in Comparative Examples 1 to 5 and 7, as a result of observing the semiconductor chip with the film adhesive failed in the pickup process and the pressure-sensitive adhesive layer and the base material at the positions corresponding thereto using a SEM, the cutting chips on the dicing line were in close contact with the film adhesive, and it was confirmed that the cutting chips remaining on the dicing line was

one cause of poor pickup. In addition, in Comparative Examples 1, 3 and 8, the amount of cutting chips remaining on the dicing line was extremely large.

It should be noted that in Comparative Examples 5 and 7, the chip flying was observed, but in Comparative Examples 1 to 4 and 8, the chip flying was not observed.

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[Industrial Applicability]

[0159]

The present invention can be used for manufacturing a semiconductor device.

10 [Reference Signs List]

[0160]

101, 102, 103: Dicing/die bonding sheet; 11: Base material; 11a: First surface of base material; 12: Pressure-sensitive adhesive layer; 12a: First surface of pressure-sensitive adhesive layer; 13, 23: Film adhesive; 13a, 23a: First surface of film adhesive;

15 201: Intermediate structure; 8: Dicing blade; 9: Semiconductor chip; 9': Semiconductor wafer; 9a': Surface of semiconductor wafer; 10: Notch; T₁: Thickness of pressure-sensitive adhesive layer

[CLAIMS]

[Claim 1]

A dicing/die bonding sheet comprising:

a pressure-sensitive adhesive layer on a base material; and

a film adhesive on said pressure-sensitive adhesive layer,

wherein said pressure-sensitive adhesive layer has a thickness of 20 μm to 50 μm , and

an elongation at break of said pressure-sensitive adhesive layer is from 5 to 50%, in which the elongation at break of the pressure-sensitive adhesive layer is determined by fixing the pressure-sensitive adhesive layer having a width of 10 mm at two places so that the distance between the fixed places becomes 10 mm, pulling the pressure-sensitive adhesive layer between the fixed places with a tension speed of 1,000 mm/min, and measuring the elongation of the pressure-sensitive adhesive layer when the pressure-sensitive adhesive layer is ruptured.

[Claim 2]

The dicing/die bonding sheet according to Claim 1, wherein said pressure-sensitive adhesive layer is non-energy ray-curable.

[Claim 3]

The dicing/die bonding sheet according to Claim 1 or 2,

wherein an adhesive force of said pressure-sensitive adhesive layer with respect to said film adhesive is from 35 to 300 mN / 25 mm.

[Claim 4]

A method for producing a semiconductor chip which is a method for producing a semiconductor chip using the dicing/die bonding sheet according to any one of Claims 1 to 3, the method comprising:

a step of forming an intermediate structure in which a semiconductor wafer is provided on a surface, of said film adhesive in said dicing/die bonding sheet, on a side opposite to a side where said pressure-sensitive adhesive layer is provided; and

a step of forming a notch that reaches said pressure-sensitive adhesive layer from a surface of said semiconductor wafer but does not reach said base material in said intermediate structure using a dicing blade, thereby dividing said semiconductor wafer to form a semiconductor chip.

[Claim 5]

A method for manufacturing a semiconductor device comprising, after performing a step of forming said semiconductor chip by the method for producing a semiconductor chip according to Claim 4,

a step of applying a force with respect to the dicing/die bonding sheet after forming said notch from the base material side thereof, and separating said semiconductor chip from said pressure-sensitive adhesive layer together with said film adhesive after cutting.