

SHEET LAMINATE FOR FORMING RESIN FILM

TECHNICAL FIELD

[0001]

The present invention relates to a sheet laminate for forming resin film which enables easy adhesion of the sheet for forming resin film against an adherend.

DESCRIPTION OF THE RELATED ART

[0002]

Recently, the production of semiconductor device using the mounting method of so called “face down method” is carried out. For the face down method, the semiconductor chip comprising the electrodes such as a bump or so is used on the circuit face (hereinafter, it may be simply referred as “chip”), then said electrode is adhered to the base. Therefore, the opposite side (chip backside) of the circuit face of the chip may be exposed in some cases.

[0003]

This exposed backside of the chip may be protected by the organic film in some cases. Conventionally, this chip comprising the protective film made of organic film is obtained by coating the wafer backside with the liquid resin by a spin coat method, then drying and curing, and cutting the wafer together with the protective film. However, the thickness precision of the protective film formed as such is not good enough, thus in some cases the production yield decreased.

[0004]

In order to solve such problem, the sheet for forming protective film wherein a film for forming semiconductor backside protective layer laminated on the adhesive layer of the adhesive sheet comprising the adhesive layer may be used.

[0005]

Also, the semiconductor wafer produced in a larger diameter is cut and

separated (dicing step) into an element chip (the semiconductor chip), then it may be transferred to a bonding step which is the subsequent step. Here, the semiconductor wafer is subjected to steps of dicing, cleaning, drying, expanding and picking up while adhered to the adhesive sheet in advance, then it is transferred to the bonding step which is the subsequent step.

[0006]

Among these steps, in order to simplify the picking up step and the bonding step, various dicing-die bonding adhesive sheet which comprises both the wafer fixing function and die adhesive function are proposed. For example, by using said adhesive sheet, the semiconductor chip wherein the adhesive layer is adhered to the backside can be obtained, and allows direct bonding between organic base and chip, between lead frame and chip, and between chip and chip.

[0007]

The patent article 1 (JP Patent No.4677758) discloses a die bonding-dicing sheet comprising a release base, a base film, and an adhesive layer placed between said release base and said base film, wherein said release base is formed with the incision having a predetermined depth from the adhesive layer side along an outer peripheral of the adhesive layer.

[0008]

Also, the patent article 2 (JP Patent No.5546985) discloses a film for producing semiconductor device wherein a dicing tape with an adhesive layer which is the adhesive layer stacked on the dicing tape is stacked on a separator using the adhesive layer as the adhering face while predetermined space is taken between each dicing tape, and said separator has an incision having predetermined depth along the outer peripheral of the dicing tape.

PRIOR ART

[0009]

[Patent Article 1] JP Patent No. 4677758

[Patent Article 2] JP Patent No. 5546985

DISCLOSURE OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0010]

During the production step of the semiconductor device, the sheet for forming resin film comprising the resin film forming layer such as the adhesive layer or so is adhered to the adherend such as semiconductor wafer or so. However, at the step of adhering the sheet for forming resin film to the adherend, if the releasing of the resin film forming layer from the release base (separator) is not smoothly done, in some case the sheet for forming resin film was unable to use. That is, the resin film forming layer adhered to the release sheet, and the sheet for forming resin film could not be adhered to the adherend.

[0011]

The object of the present invention is to solve the above mentioned problems. That is, the object of the present invention is to provide the sheet laminate for forming resin film capable of easy release of the sheet for forming resin film from the release sheet, and stable adhering to the adherend.

MEANS FOR SOLVING THE OBJECTS

[0012]

The present inventors have carried out keen examination in order to attain the above mentioned objects, and as a result, they have found that the cutting to the release sheet at the outer peripheral part of the resin film forming layer, which is formed when producing the sheet laminate for forming resin film, interferes the releasing of the resin film forming layer from the release sheet. That is, during the production steps of the

sheet laminate for forming resin film, when an incision is made to the release sheet together with the cutting of the resin film forming layer, the resin film forming layer may intrude into incision of the release sheet, and the release sheet and the resin film forming layer could not be smoothly released at the boundary thereof in some cases. Based on such findings, the sheet laminate for forming resin film comprising a specific constitution was used, thereby the above mentioned object can be attained, and the present invention has been achieved.

[0013]

The present invention includes the following gist.

[1] A sheet laminate for forming resin film comprising a sheet for forming resin film including a support sheet and a resin film forming layer, and a release sheet laminated at the resin film forming layer side, wherein

said release sheet does not comprise an incision along an outer peripheral part of the resin film forming layer from the resin film forming layer side.

[0014]

[2] The sheet laminate for forming resin film as set forth in [1], wherein the support sheet comprises an incision along an outer peripheral part of the resin film forming layer from the resin film forming layer side, and

a depth of the incision is 0 μm or more and $2/3$ or less of the thickness of the support sheet.

[0015]

[3] The sheet laminate for forming resin film as set forth in [1] or [2], wherein a breaking elongation of the resin film forming layer is 1000% or less, and a breaking strength is 10 N/mm^2 or less.

[0016]

[4] A production method of a sheet laminate for forming resin film comprising

steps of,

cutting a first release sheet of a laminate including a support sheet and the first release sheet,

obtaining a first laminate comprising an opening by removing the first release sheet being cut,

leaving the resin film forming layer having a shape of the opening on the support sheet which is left on the support sheet by adhering the resin film forming layer to the opening side of the first laminate then by cleaving the resin film forming layer along the shape of the opening,

obtaining a second laminate by laminating a second release sheet to side of the resin film forming layer having the shape of the opening, and

cutting the second laminate from the support sheet side.

THE EFFECT OF THE INVENTION

[0017]

According to the sheet laminate for forming resin film of the present invention, when releasing the sheet for forming resin film from the release sheet, it can be released smoothly.

BRIEF DESCRIPTION OF DRAWINGS

[0018]

[Fig.1a] Fig.1a shows series of steps carrying out the process of adhering the sheet for forming resin film 10 comprising the support sheet 11 and the resin film forming layer 12a to the semiconductor wafer 32.

[Fig.1b] Fig.1b shows series of steps of carrying out the process of adhering the sheet for forming resin film 10 comprising the support sheet 11 and the resin film forming layer 12a to the semiconductor wafer 32.

[Fig.1c] Fig.1c shows series of steps of carrying out the process of adhering the

sheet for forming resin film 10 comprising the support sheet 11 and the resin film forming layer 12a to the semiconductor wafer 32.

[Fig.1d] Fig.1d shows series of steps of carrying out the process of adhering the sheet for forming resin film 10 comprising the support sheet 11 and the resin film forming layer 12a to the semiconductor wafer 32.

[Fig.2] Fig.2 is a planar view of the sheet laminate for forming resin film according to the present invention.

[Fig.3] Fig.3 shows the schematic cross section of cutting the sheet laminate for forming resin film shown in Fig.2 along A-A line (the sheet laminate for forming resin film according to the first embodiment).

[Fig.4] Fig.4 shows the schematic cross section of the sheet laminate for forming resin film of the second embodiment.

[Fig.5a] Fig.5a shows the production step of the sheet laminate for forming resin film of the first embodiment.

[Fig.5b] Fig.5b shows the production step of the sheet laminate for forming resin film of the first embodiment.

[Fig.5c] Fig.5c shows the production step of the sheet laminate for forming resin film of the first embodiment.

[Fig.5d] Fig.5d shows the production step of the sheet laminate for forming resin film of the first embodiment.

[Fig.5e] Fig.5e shows the production step of the sheet laminate for forming resin film of the first embodiment.

[Fig.5f] Fig.5f shows the production step of the sheet laminate for forming resin film of the first embodiment.

[Fig.5g] Fig.5g shows the production step of the sheet laminate for forming resin film of the first embodiment.

THE BEST MODE FOR CARRYING OUT THE INVENTION

[0019]

Hereinafter, the sheet laminate for forming resin film according to the present invention will be described in detail.

The sheet laminate for forming resin film according to the present invention is formed by laminating the release sheet to the resin film forming layer side of the sheet for forming resin film which comprises the support sheet and the resin film forming layer. Also, the release sheet does not comprise the incision from the resin film forming layer side along the outer peripheral part of the resin film forming layer. If the incision is formed from the resin film forming layer side along the outer peripheral part of the resin film forming layer, then during the production step of the sheet laminate for forming resin film, the resin film forming layer will intrude into the release sheet at the outer peripheral part thereof. As a result, during the step of adhering the sheet for forming resin film 10 of the sheet laminate for forming resin film 100 to the adherend 32 (herein after, this step may be referred as “the adherend adhering step”) which is shown in Fig.1a to Fig.1d, the sheet for forming resin film 10 may become difficult to release from the release sheet 13. This problem also occurs even in case of adhering the sheet for forming resin film of the sheet laminate for forming resin film to the adherend without the adherend adhering step shown in Fig.1a to Fig.1d (for example, in case of manually removing the release sheet of the sheet laminate for forming resin film, and adhering the sheet for forming resin film to the adherend).

[0020]

According to the sheet laminate for forming resin film of the present invention, during the production step of the sheet laminate for forming resin film, the incision is not formed to the release sheet from the resin film forming layer side along the outer peripheral part of the resin film forming layer, thus the resin film forming layer does not

intrude into the incision of the release sheet, and the sheet for forming resin film 10 can be easily released from the release sheet 13 even during the adherend adhering step shown in Fig.1a to Fig.1d, and also for example at the manual adhering step to the adherend. As a result, the adhesion of the resin film forming layer 12a to the adherend 32 can be carried out stably. Note that, the method for confirming that the release sheet does not comprise the incision is done by the method described in the following described examples.

[0021]

Also, as shown in Fig.2 to Fig.4, for the sheet laminate for forming resin film 100, the support sheet 11 comprises the incision D1 from the resin film forming layer side along the outer peripheral of the resin film forming layer. The depth of cut d1 of the incision D1 is preferably 0 μm or more and $2/3$ or less of the support sheet thickness; more preferably 0 μm or more and $1/2$ or less of the support sheet thickness; further preferably 0 μm or more and $1/3$ or less of the support sheet thickness; and particularly preferably 0 μm or more and $1/4$ or less of the support sheet thickness. Note that in case the depth of cut d1 of the incision D1 is 0 μm , this means that the support sheet 11 does not have the incision D1. Also, in Fig.2 to Fig.4, the adhesive sheet comprising the base 11a and the adhesive layer 11b is used as the support sheet 11.

By providing the incision D1 having a predetermined depth, in case of using the adhesive sheet as the support sheet 11, the base 11a and the adhesive layer 11b can be prevented from being released therebetween during the production step of the sheet laminate for forming resin film 100 and during the production step of the semiconductor device, which is caused by the adhesive layer 11b of the support sheet 11 intruding into the base 11a. Note that, the depth of cut of the incision of the present invention is obtained by carrying out the cross section observation of the incision by the optical microscope at 300x magnification, then measuring arbitrary 4 incision points and the

average value thereof is defined as the depth of the cut of the incision.

[0022]

Also, as shown in Fig.2 to Fig.4, in the sheet laminate for forming resin film 100, the release sheet 13 may comprise the incision D2 having the depth of cut d2 from the resin film forming side along the outer peripheral of the support sheet 11.

[0023]

In case of using the adhesive sheet as the support sheet 11, when the incision D2 is formed during the production step of the sheet laminate for forming resin film 100, the adhesive sheet 11b may intrude into the release sheet 13. As a result, during the adhering step to the adherend, the sheet for forming resin film 10 may become difficult to be released from the release sheet 13. However, in general, the adhesive layer 11b has weaker adhesive force compared to the resin film forming layer 12a, thus the adhesive layer 11b scarcely intrudes into the release sheet 13. Therefore, if the depth of cut d2 is 2/3 or less of the thickness of the release sheet 13, then the intrusion of the adhesive layer 11b to the release sheet 13 can be suppressed to minimum, thus there is no difficulty for releasing the sheet for forming resin film 10 from the release sheet 13. Note that, in case of using the support sheet only consisting of base, such intrusion is not a problem.

[0024]

Also, by providing the incision D2 having the depth of cut of 1/10 or more of the thickness of the release sheet 13, the initial release point can be easily formed at the boundary between the sheet for forming resin film 10 and the release sheet 13. As a result, the releasing of the sheet for forming resin film is enhanced.

[0025]

Also, since the incision D2 comprises a predetermined depth, the release sheet 13 is prevented from breaking by the stress applied to the release sheet 13 in the

longitudinal direction (the flow direction) during the adhering step to the adherend 32.

[0026]

Also, by forming the incision D2, the sheet for forming resin film 10 can be accurately cut into a predetermined shape during the production step of the sheet laminate for forming resin film 100.

[0027]

Also, during the adhering step to the adherend 32 shown in Fig.1a to Fig.1d, the stress is applied to the release sheet 13 in the longitudinal direction (the flow direction) thereof. If the incision D2 is not formed at the release sheet 13, the stress may be passed to the resin film forming layer 12a, and it may stretch in the longitudinal direction in some cases. The deformation (stretch) of the resin film forming layer 12a lowers the thickness precision thereof. As a result, the reliability of the semiconductor device obtained by using the resin film forming layer 12a may be lowered. By forming the incision D2 having the predetermined depth of cut to the release sheet 13, the stress applied to the resin film forming layer 12a is relieved, hence the deformation of the resin film forming layer 12a can be suppressed.

[0028]

According to such point of view, the depth of cut d2 of the incision D2 is preferably $1/10$ or more and $2/3$ or less of the thickness of the release sheet 13, more preferably $1/5$ or more and $3/5$ or less, further preferably $1/2$ or more and $3/5$ or less, and particularly preferably more than $1/2$ or more and $3/5$ or less.

[0029]

The support sheet 11 and the resin film forming layer 12a are cut into a desired planar shape, and partially stacked on the release sheet 13. Here, the desired planar shape of the support sheet 11 and the resin film forming layer 12a is not particularly limited as long as it is a shape wherein the support sheet 11 and the resin film forming

layer 12a are partially stacked on the release sheet 13.

[0030]

As the planar shape of the support sheet 11, it is a shape which is easy to adhere to the jig such as ring frame or so used during the production step of the semiconductor described in the following, and for example circular shape, approximate circular shape, square shape, pentagonal shape, hexagonal shape, octagonal shape, and wafer shape (the shape wherein a part of the outer peripheral of the circle is straight line) or so may be mentioned. Among these, circular shape and wafer shape are preferable in order to reduce the excess part other than the part which is adhered to the ring frame.

[0031]

Also, as the planar shape of the resin film forming layer 12a, the shape preferably matches with the planar shape of the adherend such as semiconductor wafer or so, and for example the shape allowing easy adhesion to the adherend such as circular shape, square shape, pentagonal shape, hexagonal shape, octagonal shape, and wafer shape (the shape wherein a part of the outer peripheral of the circle is straight line) or so may be mentioned. Among these, circular shape and wafer shape are preferable in order to reduce the excess part other than the part which is adhered to the ring frame.

[0032]

Hereinafter, the specific embodiment of the sheet laminate for forming resin film will be described.

[0033]

(First embodiment)

Fig.2 shows the first embodiment of the sheet laminate for forming resin film 100 according to the present invention, and Fig.3 is a schematic cross section of the sheet laminate for forming resin film 100 of Fig.2 being cut along A-A line.

[0034]

As shown in Fig.2 and Fig.3, the sheet laminate for forming resin film 100 according to the first embodiment has larger diameter of the support sheet 11 than diameter of the resin film forming layer 12a. Also, support sheet 11 is the adhesive sheet comprising the base 11a and the adhesive layer 11b. Note that, the base 11a alone may be used as the support sheet.

[0035]

(Second embodiment)

Fig.4 is the schematic cross section of the sheet laminate for forming resin film 100 according to the second embodiment. The sheet laminate for forming resin film 100 according to the second embodiment has larger diameter of the support sheet 11 than the diameter of the resin film forming layer 12a from the planar view. Also, the jig adhesion layer 14 having a ring form is provided at the outer peripheral part of the sheet for forming resin film 10 and between the release sheet 13 and the support sheet 11. Also, the release sheet 13 may comprise the incision D3 along the inner peripheral of the ring form jig adhesion layer 14.

[0036]

The depth of cut d3 of the incision D3 is not particularly limited, and it may be same as, or it may be larger or smaller than the depth of cut d2 of the incision D2. However, it is preferably $1/10$ or more and $2/3$ or less of the thickness of the release sheet, more preferably $1/10$ or more and $3/5$ or less of the thickness of the release sheet, and further preferably $1/10$ or more and $1/2$ or less of the thickness of the release sheet.

By providing the incision D3 having the predetermined depth, it becomes easy to suppress the deformation of the resin film forming layer 12a caused by the stress applied in the longitudinal direction (the flow direction) of the release sheet 13 during the adhering step to the adherend.

[0037]

Next, each layer constituting the sheet laminate for forming resin film 100 will be described.

[0038]

(Support sheet 11)

As the support sheet, for example polyethylene film, polypropylene film, polybutene film, polybutadiene film, polymethylpentene film, polyvinyl chloride film, vinylchloride copolymer film, polyethyleneterephthalate film, polyethylenenaphthalate film, polybutyleneterephthalate film, polyurethane film, ethylene vinylacetate copolymer film, ionomer resin film, ethylene-(meth)acrylic acid copolymer film, ethylene-(meth)acrylic ester copolymer film, polystyrene film, polycarbonate film, polyimide film, fluororesin film or so may be used. Also, the crosslinked film thereof may be used as well. Further, the multilayered film thereof may be used as well.

[0039]

The release treatment may be carried out by coating the release agent to the surface of the above mentioned film. As the release agent, alkyd based, silicone based, fluorine based, unsaturated polyester based, polyolefin based, waxes or so may be used; however the release agent of alkyd based, silicone based, and fluorine based are particularly preferable as these comprises the heat resistance. In order to carry out the release treatment to the surface of the film using the above mentioned release agent, the release agent is used as it is without solvent, by diluting with solvent or by emulsifying, and then coated using the gravure coater, mayer bar coater, air knife coater, roll coater or so; then cured under room temperature, or by heat applying or by electron beam, thereby the release agent layer may be formed.

[0040]

Also, an adhesive treatment may be carried out to the surface of the above mentioned film. As the adhesive treatment, it is not particularly limited, but for example

the corona discharge or so may be mentioned.

[0041]

The thickness of the above mentioned film is usually 30 to 300 μm , and preferably 50 to 200 μm or so.

[0042]

Also, as shown in Fig.2 to Fig.4, the adhesive sheet comprising the base 11a and the adhesive layer 11b can be used as the support sheet 11.

[0043]

In case of using the adhesive sheet as the support sheet 11, various processing such as dicing or so can be easily done to the adherend while on the sheet for forming resin film 10. In this embodiment, the resin film forming layer 12a is stacked on the adhesive layer 11b which is provided on the base 11a. As the base 11a, the above mentioned film exemplified as the support film may be mentioned.

[0044]

Also, as described in below, in case the adhesive layer 11b is formed by the ultraviolet ray curing adhesive agent, then the ultraviolet ray is used as the energy ray for curing the adhesive agent, the base 11a is preferably transparent against the ultraviolet ray. Note that, in case of using the electron beam as the energy ray, the base 11a does not necessarily have to be transparent. Other than the above mentioned film, the colored transparent film thereof, and non-transparent film or so can be used.

[0045]

The adhesive layer 11b is not particularly limited as long as the resin film forming layer 12a formed thereon is releasable, and it can be obtained by conventionally known various adhesive agents. As such adhesive agent, it is not particularly limited, and for example re-releasable adhesive agent such as rubber based, acrylic based, silicone based and polyvinylether or so may be used. Also, for the easy releasing at the

boundary between the adhesive layer 11b and the resin film forming layer 12a, the adhesive agent of energy ray curing type, heat foaming type, and water swelling type or so can be used. These adhesive agent decreases the adhesive force by predetermined procedures, thus the resin film forming layer 12a can be easily released from the adhesive layer 11b. As the energy ray curing (ultraviolet ray curing, electron beam curing or so) adhesive agent, the ultraviolet ray curing adhesive agent is particularly preferably used. The thickness of the adhesive layer 11b is usually 1 to 100 μm , and preferably 2 to 80 μm or so. In case of using the ultraviolet ray curing adhesive agent as the adhesive agent for forming the adhesive layer 11b, the ultraviolet ray may be irradiated to the adhesive layer 11b before stacking the resin film forming layer 12a on the adhesive layer 11b; or the ultraviolet ray may be irradiated to the adhesive layer 11b after stacking the resin film forming layer 12a on the adhesive layer 11b.

[0046]

Also, in case of using the adhesive sheet as the support sheet, from the point ensuring the effect of the above mentioned incision D1, the ratio between the thickness of the base and the adhesive layer is preferably (the base thickness) : (the adhesive layer thickness) of 1:1 to 200:1, and more preferably 2:1 to 150:1.

[0047]

(Resin film forming layer 12a)

The resin film forming layer 12a is stacked on the support sheet 11 in a releasable manner. The breaking elongation of the resin film forming layer is preferably 1000% or less, and the breaking strength of the resin film forming layer is preferably 10 N/mm^2 or less. By setting the breaking elongation and the breaking strength of the resin film forming layer within the above mentioned range, the resin film forming layer can be easily cleaved during the production step of the sheet laminate for forming resin film which will be described in below. According to such point of view, the breaking

elongation of the resin film forming layer is preferably 0.5 to 1000%, more preferably 0.5 to 800%; and the breaking strength is more preferably 0.1 to 10 N/mm² and even more preferably 0.1 to 5 N/mm². The breaking elongation and the breaking strength of the resin film forming layer can be controlled for example by the content and the weight average molecular weight of the polymer component (A), and the weight average molecular weight of the curable component (B) (specifically, the weight average molecular weight of the epoxy compound (B11) and the weight average molecular weight of the heat curing agent (B12) or so). Note that, the breaking elongation and the breaking strength of the resin film forming layer can be measured by the method described in the following examples.

[0048]

The functions at least required for the resin film forming layer are (1) the sheet form maintaining property, (2) the initial adhesiveness and (3) the curable property.

[0049]

By adding the binder component, (1) the sheet form maintaining property and (3) the curable property can be provided to the resin film forming layer. As the binder component, a first binder component comprising the polymer component (A) and the curable component (B), or a second binder component comprising curable polymer component (AB) which comprises both properties of component (A) and component (B) can be used.

Note that, until the resin film forming layer is cured, (2) the initial adhesiveness which is the function for temporarily adhering the resin film forming layer to the adherend may be pressure sensitive adhesiveness or may be adhesiveness by softening by heat. The initial adhesiveness (2) can be controlled by various characteristics of the binder component, or by regulating the amount of the inorganic filler (C).

[0050]

(First binder component)

The first binder component comprises the polymer component (A) and the curable component (B), thereby provides the sheet form maintaining property and the curable property to the resin film forming layer. Note that, the first binder component does not comprise the curable polymer component (AB) in order to differentiate from the second binder component.

[0051]

Binder component (A)

The binder component (A) is added to the resin film forming layer mainly for providing the sheet form maintaining property to the resin film form layer.

In order to achieve the above mentioned purpose, the weight average molecular weight (Mw) of the polymer component (A) is usually 20,000 or more, and preferably 20,000 to 3,000,000. The value of the weight average molecular weight (Mw) is the value measured by a gel permeation chromatography (GPC) method (polystyrene standard). The measurement by such method is carried out for example, by connecting the high speed GPC device “HLC-8120GPC” made by TOSOH CORPORATION with the high speed GPC column “TSK gurd column H_{XL}-H”, “TSK Gel GMH_{XL}”, “TSK Gel G2000 H_{XL}” (all made by TOSOH CORPORATION) in this order, and under the condition of the column temperature: 40°C, the liquid sending speed: 1.0 mL/min, and using the differential refractometer as the detector (hereinafter, the same applies).

Note that, in order to differentiate from the following described curable polymer component (AB), the polymer component (A) does not comprise the curable functional group.

[0052]

As the polymer component (A), acrylic polymer, polyester, phenoxy resin (however it is limited to those without epoxy group in order to differentiate from the

curable polymer component (AB)), polycarbonate, polyether, polyurethane, polysiloxane, rubber based polymer or so can be used. Also, two or more thereof can be bonded as well, for example, it may be acrylic urethane resin or so obtained by acrylic polyol which is the acrylic polymer comprising hydroxyl group reacting with urethane prepolymer comprising isocyanate group at the molecular terminal end. Furthermore, including the polymer bonded with two or more types, the combination of two or more types may be used as well.

[0053]

Acrylic polymer (A1)

As the acrylic polymer (A), the acrylic polymer (A1) is preferably used. The glass transition temperature (T_g) of the acrylic polymer (A1) is preferably -60 to 50°C , more preferably -50 to 40°C and further preferably -40 to 30°C . If the glass transition temperature of the acrylic polymer (A1) is high, the adhesiveness of the resin film forming layer decreases, then transferring to the adherend may not be possible, and the resin film forming layer after the transferring to the adherend may be released or the resin film obtained by curing the resin film forming layer may be released. Also, if the glass transition temperature of the acrylic polymer (A1) is too low, the release force between the resin film forming layer and the support sheet may increase and the transfer malfunction of the resin film forming layer may occur.

[0054]

The weight average molecular weight of the acrylic polymer (A1) is preferably 100,000 to 2,000,000, and more preferably 300,000 to 1,500,000. If the weight average molecular weight of the acrylic polymer (A1) is high, the adhesiveness of the resin film forming layer decreases, then the transferring to the adherend may not be possible, and the resin film forming layer after transferring to the adherend may be released, or the resin film obtained by curing the resin film forming layer may be released. Also, if the

weight average molecular weight of the acrylic polymer (A1) is too low, the adhesiveness between the resin film forming layer and the support sheet may increase and the transfer malfunction of the resin film forming layer may occur. By making the weight average molecular weight of the acrylic polymer (A1) within the above mentioned range, the breaking elongation and the breaking strength of the resin film forming layer can be easily regulated within the predetermined range.

[0055]

The acrylic polymer (A1) includes (meth)acrylate at least in the constituting monomer. As (meth)acrylate, alkyl (meth)acrylate having alkyl group of carbon atoms of 1 to 18, specifically such as methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, butyl (meth)acrylate, 2-ethylhexyl (meth)acrylate or so; (meth)acrylate having cyclic back bone such as cycloalkyl (meth)acrylate, benzyl (meth)acrylate, isobornyl (meth)acrylate, dicyclopentanyl (meth)acrylate, dicyclopentenyl (meth)acrylate, dicyclopentenylloxy (meth)acrylate, imide (meth)acrylate or so may be mentioned. Also, among examples of the monomer comprising the hydroxyl group, the monomer comprising the carboxyl group and the monomer comprising the amino group, those which are (meth)acrylate can be mentioned as example as well.

[0056]

Note that, in the present specification, (meth)acryl refers both acryl and methacryl.

[0057]

As the monomer constituting the acrylic polymer (A1), the monomer comprising the hydroxyl group may be used. By using such monomer, the hydroxyl group is introduced into the acrylic polymer (A1), and in case the resin film forming layer further comprises the energy ray curable component (B2), the compatibility between the acrylic polymer (A1) and the energy ray curable component is enhanced. As the

monomer comprising the hydroxyl group, (meth)acrylate comprising the hydroxyl group such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate or so; N-methylol (meth)acryl amide or so may be mentioned.

[0058]

As the monomer constituting the acrylic polymer (A1), the monomer comprising the carboxyl group may be used. By using such monomer, carboxyl group is introduced into the acrylic polymer (A1), and in case the resin film forming layer further comprises the energy ray curable component (B2), the compatibility between the acrylic polymer (A1) and the energy ray curable component is enhanced. As the monomer comprising the carboxyl group, (meth)acrylate comprising the carboxyl group such as 2-(meth)acryloyloxyethyl phthalate, 2-(meth)acryloyloxypropyl phthalate or so; (meth)acrylic acid, maleic acid, fumaric acid, itaconic acid or so may be mentioned. In case of using epoxy based heat curable component as the curable component (B) which will be described in below, the carboxyl group and the epoxy group in the epoxy based heat curable component reacts, thus the used amount of the monomer comprising the carboxyl group is preferably set low.

[0059]

As the monomer constituting the acrylic polymer (A1), the monomer comprising the amino group may be used. As such monomer, (meth)acrylate comprising the amino group such as monoethylamino (meth)acrylate or so may be mentioned.

[0060]

As the monomer constituting the acrylic polymer (A1), other than these, vinyl acetate, styrene, ethylene, α -olefin or so may be used.

[0061]

The resin film forming layer comprises preferably 1 to 95 parts by weight, more preferably 5 to 80 parts by weight, further preferably 10 to 60 parts by weight and

particularly preferably 10 to 50 parts by weight of the acrylic polymer (A1) with respect to 100 parts by weight of entire solid portion constituting the resin film forming layer. By setting the content of the acrylic polymer (A1) within the above mentioned range, the breaking elongation and the breaking strength of the resin film forming layer can be easily regulated within the predetermined range.

[0062]

The acrylic polymer (A1) may be crosslinked. The acrylic polymer (A1) prior to the crosslinking comprises the crosslinkable functional group such as hydroxyl group or so, and by adding the crosslinking agent into the composition for forming the resin film forming layer, the crosslinkable functional group and the functional group of the crosslinking agent reacts, thereby the crosslinking can be carried out. By crosslinking the acrylic polymer (A1), the cohesive force of the resin film forming layer can be regulated.

[0063]

As the crosslinking agent, organic polyvalent isocyanate compound, organic polyvalent imine compound or so may be mentioned.

[0064]

As the organic polyvalent isocyanate compound, an aromatic polyvalent isocyanate compound, an aliphatic polyvalent isocyanate compound, an alicyclic polyvalent compound, and the trimer of these organic polyvalent isocyanates; and the terminal isocyanate urethane prepolymer or so may be mentioned which is obtained by reacting these organic polyvalent isocyanate and polyol compound.

[0065]

As the organic polyvalent isocyanate compound, for example, 2,4-tolylene diisocyanate, 2,6-tolylene diisocyanate, 1,3-xylylene diisocyanate, 1,4-xylylene diisocyanate, diphenylmethane-4,4'-diisocyanate, diphenylmethane-2,4'-diisocyanate,

3-methyldiphenylmethane diisocyanate, hexamethylene diisocyanate, isophorone diisocyanate, dicyclohexylmethane-4,4'-diisocyanate, dicyclohexyl-2,4'-diisocyanate, lysine isocyanate, and the polyvalent alcohol adduct of these may be mentioned.

[0066]

As for the above mentioned organic polyvalent imine compound, N,N'-diphenylmethane-4,4'-bis(1-aziridinecarboxamide), trimethylolpropane- β -aziridinypropionate, tetramethylolmethane-tri- β -aziridinypropionate, and N,N'-toluene-2,4-bis(1-aziridinecarboxamide) triethylene melamine or so may be mentioned.

[0067]

The crosslinking agent is usually used in the ratio of 0.01 to 20 parts by weight, preferably 0.1 to 10 parts by weight, and more preferably 0.5 to 5 parts by weight with respect to 100 parts by weight of acrylic polymer (A1) of before the crosslinking.

[0068]

In the present invention, when determining the content of component constituting the resin film forming layer using the content of the polymer component (A) as the standard, in case the polymer component (A) is the crosslinked acrylic polymer, the content as the standard is the content of the acrylic polymer before the crosslinking.

[0069]

Non-acrylic resin (A2)

Also, as the polymer component (A), the non-acrylic resin (A2) selected from the group consisting of polyester, phenoxy resin (it is limited to those without the epoxy resin in order to differentiate from the following curable polymer component (AB)), polycarbonate, polyether, polyurethane, polysiloxane, rubber based polymer and the

combination of two or more thereof may be mentioned, and these may be used alone or by combining two or more thereof. As such resin, the weight average molecular weight is preferably 20,000 to 100,000, and more preferably 20,000 to 80,000.

[0070]

The glass transition temperature of the non-acrylic resin (A2) is preferably -30 to 150°C and more preferably -20 to 120°C.

[0071]

In case the non-acrylic resin (A2) is used together with the above mentioned acrylic polymer (A1), when the resin film forming layer is transferred to the adherend using the sheet for forming resin film, the support sheet and the resin forming layer can be easily released, and the resin film forming layer follows the transfer face thus the void or so can be suppressed from occurring.

[0072]

In case of using the non-acrylic resin (A2) together with the above mentioned acrylic polymer (A1), the content of the non-acrylic resin (A2) satisfies the mass ratio (A2:A1) between the non-acrylic resin (A2) and the acrylic polymer (A1) of 1:99 to 80:20, preferably 1:99 to 60:40, and preferably 1:99 to 55:45. When the content of the non-acrylic resin (A2) is within this range, the above mentioned effect can be obtained.

[0073]

Curable component (B)

The curable component (B) is added to the resin film forming layer mainly for providing the curable property to the resin film forming layer. As the curable component (B), the heat curable component (B1) or the energy ray curable component (B2) can be used. Also, these may be combined to be used. The heat curable component (B1) comprises the compound having the functional group which reacts at least to the heat application. Also, the energy ray curable component (B2) comprises the compound

comprising the functional group (B21) which reacts by energy ray irradiation, and it polymerize cures by energy ray irradiation such as ultraviolet ray and electron beam or so. The functional groups comprised by these curable components reacts against each other and forms three dimensional mesh structure thereby the curing is carried out. The curable component (B) is used together with the polymer component (A), hence from the point of suppressing the viscosity of the coating composition for forming the resin film forming layer, and from the point of improving the handling property, usually the weight average molecular weight (Mw) thereof is 10,000 or less and preferably 100 to 10,000.

[0074]

Heat curable component (B1)

As the heat curable component, for example epoxy based curable component is preferable. The epoxy based heat curable component comprises the compound comprising the epoxy group (B11), and preferably those combined with the compound comprising epoxy group (B11) and the heat curing agent (B12) is used.

[0075]

Compound comprising the epoxy group (B11)

As the compound comprising the epoxy group (B11) (hereinafter, it may be referred as “the epoxy group compound (B11)”), conventionally known ones can be used. Specifically, the epoxy compound comprising two or more functional groups in the molecule such as polyfunctional epoxy resin, bisphenol A diglycidyl ether or the hydrogenates thereof, orthocresol novolac epoxy resin, dicyclopentadiene type epoxy resin, biphenyl type epoxy resin, bisphenol A type epoxy resin, bisphenol F type epoxy resin, phenylene backbone type epoxy resin or so may be mentioned. These may be used alone or by combining two or more thereof.

[0076]

In case of using the epoxy compound (B11), the resin film forming layer preferably comprises 1 to 1500 parts by weight, more preferably 3 to 1200 parts by weight of the epoxy compound (B11) with respect to 100 parts by weight of the polymer component (A). If the epoxy compound (B11) is too little, the adhesiveness after the curing of the resin film forming layer tends to decrease. Also, if the epoxy compound (B11) is too much, the release force between the resin film forming layer and the support sheet becomes too large, hence the transfer malfunction of the resin film forming layer may occur.

[0077]

Also, the weight average molecular weight (Mw) of the epoxy compound (B11) is preferably 100 to 2,000 and more preferably 200 to 1,500. By setting the weight average molecular weight of the epoxy compound (B11) within the above mentioned range, the breaking elongation and the breaking strength of the resin film forming layer can be easily regulated within the predetermined range.

[0078]

Heat curing agent (B12)

The heat curing agent (B12) functions as the curing agent against the epoxy compound (B12). As the preferable heat curing agent, the compound comprising two or more functional groups capable of reacting with the epoxy group in one molecule may be mentioned. As such functional group, phenolic hydroxyl group, alcoholic hydroxyl group, amino group, carboxyl group and acid anhydride or so may be mentioned. Among these, preferably phenolic hydroxyl group, amino group and acid anhydride or so may be mentioned, and further preferably phenolic hydroxyl group and amino group may be mentioned.

[0079]

As the specific example of the phenol based curing agent, polyfunctional phenol

resin, biphenol, biphenyl phenol resin, novolac type phenol resin, dicyclopentadiene based phenol resin, XYLOK type phenol resin, aralkyl phenol resin or so may be mentioned. As the specific examples of the amine based curing agent, DICY (dicyandiamide) may be mentioned. These may be used alone or two or more may be combined.

[0080]

The weight average molecular weight (Mw) of the heat curing agent (B12) is not particularly limited, but preferably it is 100 to 20,000, and more preferably 200 to 20,000. Also, the heat curing agent (B12) is preferably liquid state at 180°C or less, and more preferably liquid state at 160°C or less, and particularly preferably liquid state around normal temperature (23°C). By setting the weight average molecular weight (Mw) of the heat curing agent (B12) within the above mentioned range, and by using the heat curing agent (B12) having above mentioned property (softening point), the breaking elongation and the breaking strength of the resin film forming layer can be easily regulated within the predetermined range. Note that, the softening point is measured by the method of the ring and ball method according to JIS K7234:1986.

[0081]

The content of the heat curing agent (B12) is preferably 0.1 to 500 parts by weight, and more preferably 1 to 200 parts by weight with respect to 100 parts by weight of the epoxy compound (B11). If the content of the heat curing agent is low, the adhesiveness after the curing tends to decrease.

[0082]

Curing catalyst (B13)

The curing catalyst (B13) may be used in order to regulate the speed of the heat curing of the resin film forming layer. The curing catalyst (B13) is particularly preferably used when epoxy based heat curable component is used as the heat curable

component (B1).

[0083]

As the preferable curing catalyst, tertiary amines such as triethylene diamine, benzyldimethyl amine, triethanol amine, dimethylamino ethanol, tris(dimethylaminomethyl) phenol or so; imidazols such as 2-methylimidazol, 2-phenylimidazol, 2-phenyl-4-methylimidazol, 2-phenyl-4,5-dihydroxymethylimidazol, 2-phenyl-4-methyl-5-hydroxymethylimidazol or so; organic phosphines such as tributylphosphine, diphenylphosphine, triphenylphosphine or so; tetraphenyl boron salt such as tetraphenylphosphoniumtetraphenyl borate, triphenylphosphinetetraphenyl borate or so may be mentioned. These may be used alone or by mixing two or more thereof.

[0084]

The curing catalyst (B13) is comprised in the amount of 0.01 to 10 parts by weight, and more preferably 0.1 to 1 parts by weight with respect to 100 parts by weight of total amount of the epoxy compound (B11) and the heat curing agent (B12). By comprising the curing catalyst (B13) within the above mentioned range, excellent adhesiveness can be obtained even when exposed to high temperature high humidity condition, and high reliability can be attained even when exposed to harsh reflow condition. By adding the curing catalyst (B13), the adhesiveness after the curing of the resin film forming layer can be improved. Such effect is enhanced as the content of the curing catalyst (B13) increases.

[0085]

Energy ray curable component (B2)

By comprising the energy ray curable component in the resin film forming layer, the resin film forming layer can be cured without the heat curing step which requires large amount of energy and takes long time. Thereby, the production cost can be

reduced. As the energy ray curable component, the compound comprising the functional group which reacts by the energy ray irradiation (B21) may be used alone, but preferably those combining the compound comprising the functional group which reacts by the energy ray irradiation (B21) and the photopolymerization initiator (B22) is used.

[0086]

Compound comprising the functional group which reacts by energy ray irradiation (B21)

As the compound comprising the functional group which reacts by the energy ray irradiation (B21) (hereinafter, it may be referred as “the energy ray reactable compound (B21)”), specifically acrylate based compounds such as trimethylolpropanetriacrylate, pentaerythritoltriacylate, pentaerythritoltetraacylate, dipentaerythritolmonohydroxypentaacylate, dipentaerythritolhexaacylate or 1,4-butyleneglycoldiacrylate, 1,6-hexanedioldiacrylate may be mentioned; and also the acrylate compounds comprising polymeric structure of the acrylate based compounds having relatively low molecular weight such as oligoester acrylate, urethane acrylate based oligomer, epoxy acrylate, polyether acrylate and itaconic oligomer or so may be mentioned.

[0087]

In case of using the energy ray reactable compound (B21), the resin film forming layer comprises 1 to 1500 parts by weight, and more preferable 3 to 1200 parts by weight of energy ray reactable compound (B21) with respect to 100 parts by weight of the polymer component (A).

[0088]

Photopolymerization initiator (B22)

By combining the photopolymerization initiator (B22) with the energy ray reactable compound (B21), the time for polymerization curing can be shortened, and the

energy ray irradiation amount can be decreased.

[0089]

As the specific example of the photopolymerization initiator (B22), benzophenone, acetophenone, benzoin, benzoin methylether, benzoin ethylether, benzoin isopropylether, benzoin isobutylether, benzoin benzoate, benzoin methyl benzoate, benzoin dimethylketal, 2,4-diethylthioxanthone, α -hydroxycyclohexylphenylketone, benzyldiphenylsulphide, tetramethylthiuram monosulphide, azobisbutyronitrile, benzyl, dibenzyl, diacetyl, 1,2-diphenylmethane, 2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl] propanone, 2,4,6-trimethylbenzoyldiphenylphosphineoxide, and β -chloroanthraquinone or so may be mentioned. The photopolymerization initiator (B22) may be used alone or by combining two or more thereof.

[0090]

The blending ratio of the photopolymerization initiator is preferably 0.1 to 10 parts by weight and more preferably 1 to 5 parts by weight with respect to 100 parts by weight of the energy ray reactable compound (B21). If the blending ratio of the photopolymerization initiator (B22) is less than 0.1 parts by weight, sufficient curability may not be able to obtain due to the insufficient photopolymerization; and if it exceeds 10 parts by weight, then the residual products which does not contribute to the photopolymerization is generated which may cause malfunction.

[0091]

(Second binder component)

The second binder component comprises the curable polymer component (AB), thereby provides the sheet form maintaining property and curable property to the resin film forming layer.

[0092]

Curable polymer component (AB)

The curable polymer component is the polymer comprising the curable functional group. The curable functional group is the functional group capable of constituting the three dimensional structure by reacting with each other. The functional group reacting by the heat application, and the functional group reacting by energy ray irradiation may be mentioned. The curable functional group may be added to the repeating structure unit which forms the backbone of the curable polymer component (AB), or it may be added to the terminal. In case the curable functional group is added to the repeating structure unit which forms the backbone of the curable polymer component (AB), the curable functional group may be added to the side chain, or it may be directly added to the main chain. The weight average molecular weight (Mw) of the curable polymer component (AB) is usually 20,000 or more from the point of providing the sheet form maintaining property to the resin film forming layer.

[0093]

As the functional group reacting by applying the heat, the epoxy group may be mentioned. As the curable polymer component (AB) comprising the epoxy group, the epoxy group containing compound having large molecular weight, and phenoxy resin comprising the epoxy group may be mentioned. The epoxy group containing compound having large molecular weight is for example disclosed in JP Patent Application Laid Open No.2001-261789.

Also, it may be the same polymer as the above mentioned acrylic polymer (A1) which is polymerized using the monomer comprising the epoxy group as the monomer (the epoxy group containing acrylic polymer). As the monomer comprising the epoxy group, for example (meth)acrylate comprising glycidyl group such as glycidyl (meth)acrylate or so may be mentioned.

In case of using the epoxy group containing acrylic polymer, the preferable

embodiment is same as the acrylic polymer (A1) except for the epoxy group.

[0094]

In case of using the curable polymer component (AB) comprising the epoxy group, as similar to the case of using the epoxy based heat curable component as the curable component (B), the heat curing agent (B12) and the curing catalyst (B13) may be used together.

[0095]

As the functional group reacting by the energy ray irradiation, (meth)acryloyl group may be mentioned. As the curable polymer component (AB) comprising the functional group reacting by the energy ray, the acrylate compounds comprising the polymeric structure such as polyether acrylate or so and also having large molecular weight can be used.

Also, the polymer produced by reacting the source material polymer comprising the functional group X such as hydroxyl group or so at the side chain with the low molecular weight compound comprising the functional group Y capable of reacting with the functional group X (for example if the functional group is hydroxyl group, the functional group Y is isocyanate or so) and also the functional group reacting by energy ray irradiation may be used as well.

In such case, when the acrylic polymer (A1) is the source material polymer mentioned in above, then the preferable embodiment of the source material polymer thereof is same as the acrylic polymer (A1).

[0096]

In case of using the curable polymer component (AB) comprising the functional group reacting by the energy ray, the photopolymerization initiator (B22) may be used together similar to the case of using the energy ray curable component (B2).

[0097]

The second binder component (B22) may comprise the above mentioned polymer component (A) and the curable component (B) together with the curable polymer component (AB).

[0098]

In the resin film forming layer, following components may be comprised besides the binder component.

[0099]

Inorganic filler (C)

The resin film forming layer may comprise the inorganic filler (C). By blending the inorganic filler (C) to the resin film forming layer, the heat expansion coefficient of the resin film after the curing can be regulated, and by optimizing the heat expansion coefficient of the resin film after the curing with respect to the adherend, the reliability of the semiconductor device can be improved. Also, the moisture absorption property of the resin film after the curing can be reduced as well.

Also, when the resin film obtained by curing the resin film forming layer of the present invention is used as the protective film of the chip which is the separated adherend, by carrying out the laser marking to the protective film, the inorganic filler (C) is exposed at the part which is ground off by the laser beam, and the reflection light is scattered which show a color close to white. Therefore, if the resin film forming layer comprises the coloring agent (D), the contrast between the laser marking part and other part is generated thereby the printing becomes clearer.

[0100]

As the preferable inorganic filler, powders such as silica, alumina, talc, calcium carbonate, titanium oxide, iron oxide, silicon carbide, boron nitride or so, a beads of which these has been made into spherical form, a single crystal fiber and glass fiber or so may be mentioned. Among these, silica filler and alumina filler are preferable. Also,

the surface of these inorganic fillers can be modified by functional group such as epoxy group and (meth)acryloyl group or so. The above mentioned inorganic filler (C) may be used alone or by mixing two or more thereof.

In order to ensure the above effect, as the range of the content of the inorganic filler (C), it is preferably 1 to 80 parts by weight, more preferably 5 to 75 parts by weight and particularly preferably 10 to 70 parts by weight with respect to 100 parts by weight of entire solid portion constituting resin film forming layer.

[0101]

Coloring agent (D)

The coloring agent (D) can be blended in the resin film forming layer. By blending the coloring agent, when the semiconductor devices are incorporated to the machines, the infrared ray or so generated by the surrounding devices can be blocked, thus the malfunction of the semiconductor device caused thereby can be prevented. Also, if the resin film is marked by means of laser marking or so, there is an effect which makes the marks such as the letters and symbols or so more recognizable. That is, for the semiconductor device or the semiconductor chip formed with the resin film, usually the product number is printed on the surface of the resin film by laser marking method (the method of printing by grinding off the surface of the protective film by the laser light), the sufficient contrast between the area of the resin film which is ground off by the laser, and those not ground off can be generated, hence the visibility is improved by comprising the coloring agent (D) in the resin film.

[0102]

As the coloring agent, the organic or inorganic pigment and dye are used. Among these, a black pigment is preferable from the point of the blocking of the electromagnetic wave or the infrared ray. As for the black pigment, carbon black, iron oxide, manganese dioxide, aniline black, and activated carbon or so may be used, but it

is not limited thereto. The carbon black is particularly preferable from the point of improving the reliability of the semiconductor device. The coloring agent (D) may be used alone, or by combining two or more thereof.

The blending amount of the coloring agent (D) is preferably 0.1 to 35 parts by weight, more preferably 0.5 to 25 parts by weight and particularly preferably 1 to 15 parts by weight with respect to 100 parts by weight of the entire solid portion constituting the resin film forming layer.

[0103]

Coupling agent (E)

The coupling agent (E) comprising the functional group reacting with the inorganic compound and the functional group reacting with the organic functional group may be used to improve the adhesiveness against the adherend of the resin film forming layer and/or to improve the cohesiveness of the resin film. Also, by using the coupling agent (E), without compromising the heat resistance of the resin film obtained by curing the resin film forming layer, the water resistance thereof can be improved. As such coupling agent, a titanate based coupling agent, an aluminate based coupling agent, and a silane coupling agent or so may be mentioned. Among these, the silane coupling agent is preferable.

[0104]

As the silane coupling agent, the silane coupling agent wherein the functional group which reacts with the organic functional group thereof is the group which reacts with the functional group comprised in the polymer component (A), the heat curable component (B) or the heat curable polymer component (AB) is preferably used. As such silane coupling agent, γ -glycidoxypyltrimethoxy silane, γ -glycidoxypylmethyldiethoxy silane, β -(3,4-epoxycyclohexyl)ethyltrimethoxy silane, γ -(methacryloxypropyl)trimethoxy silane, γ -aminopropyltrimethoxy silane,

N-6-(aminoethyl)- γ -aminopropyltrimethoxy silane, N-6-(aminoethyl)- γ -aminopropylmethyldiethoxy silane, N-phenyl- γ -aminopropyltrimethoxy silane, γ -ureidopropyltriethoxy silane, γ -melcaptopropyltrimethoxy silane, γ -melcaptopropylmethyldimethoxy silane, bis(3-triethoxysilylpropyl)tetrasulphone, methyltrimethoxy silane, methyltriethoxy silane, vinyltrimethoxy silane, vinyltriacetoxysilane, imidazole silane or so may be mentioned. These may be used alone or by mixing two or more thereof.

[0105]

The silane coupling agent is included in the ratio usually of 0.1 to 20 parts by weight, more preferably 0.2 to 10 parts by weight and further preferably 0.3 to 5 parts by weight with respect to 100 parts by weight of total of the polymer component (A), the curable component (B) and the curable polymer component (AB). If the content of the coupling agent is less than 0.1 parts by weight, there is a possibility that the above mentioned effect cannot be obtained, and if it exceeds 20 parts by weight, it may cause the outgas.

[0106]

General additives (F)

If needed, various additives may be blended in the resin film forming layer besides the above mentioned components. As for the various additives, a leveling agent, a plasticizer, an antistatic agent, an antioxidant, an ion scavenger, a gettering agent, a chain transfer agent, a release agent or so may be mentioned.

[0107]

The resin film forming layer is obtained for example by using the composition (the resin film forming composition) obtained by mixing the above mentioned each component in appropriate ratio. The resin film forming composition may be diluted with the solvent in advance, or the solvent may be added during the mixing. Also, when

using the resin film forming composition, it may be diluted with the solvent. As such solvent, ethyl acetate, methyl acetate, diethyl ether, dimethyl ether, acetone, methylethyl ketone, acetonitrile, hexane, cyclohexane, toluene, heptane or so may be mentioned.

[0108]

The resin film forming layer comprises the initial adhesiveness and the curability, and when it is non-cured state, it can be easily adhered to the adherend by pressing at room temperature or under heat application. Also, when pressing, heat may be applied to the resin film forming layer. By going through the curing, the resin film having high impact resistance can be provided, and excellent adhesive strength and sufficient reliability can be obtained even under the harsh condition of high temperature and high humidity. Note that, the resin film forming layer may be single layer structure, or it may be multilayer structure.

[0109]

The thickness of the resin film forming layer is preferably 1 to 100 μm , more preferably 2 to 90 μm , and particularly preferably 3 to 80 μm . By setting the thickness of the resin film forming layer within the above mentioned range, the resin film forming layer will be excellent as the adhesive agent for adhering the adherend with the base and other chip or so, or as the protective film protecting the backside of the adherend.

[0110]

(Release sheet 13)

The release sheet 13 is laminated on the resin film forming layer 12a side. The release sheet 13 functions as the carrier film when using the sheet for forming resin film 10, and the above film mentioned as example of the support sheet 11 can be used.

[0111]

The surface tension of the face of the release sheet contacting the resin film forming layer is preferably 40 mN/m or less, more preferably 37 mN/m or less and

particularly preferably 35 mN/m or less. The lower limit is usually 25 mN/m or so. Such release sheet having relatively low surface tension can be obtained by appropriately selecting the material, or by carrying out the release treatment by coating the release agent to the surface of the release sheet.

[0112]

As the release agent used for the release treatment, the release agent of an alkyd based, a silicone based, a fluorine based, an unsaturated polyester based, a polyolefin based, a waxed based or so may be used; and the alkyd based, the silicone based, and the fluorine based release agent are preferable since these have heat resistance.

[0113]

In order to carry out the release treatment to the surface of the film or so which becomes the base of the release sheet using the above mentioned release agent, the release agent may be used without the solvent, or by diluting with the solvent or by emulsifying, then coating by a gravure coater, a Meyer bar coater, an air knife coater, a roll coater or so; then the release layer may be formed by curing by placing the release sheet coated with the release agent under the ambient temperature or under a heat application, or applying the electron beam.

[0114]

Also, the surface tension of the release sheet may be regulated by stacking the films using a wet lamination or dry lamination, a thermofusion lamination, a melt extrusion lamination, and a coextrusion processing or so. That is, the film wherein the surface tension of at least one face satisfies the preferable range as the face of the above mentioned release sheet contacting the resin film forming layer, is stacked with other film to produce the multilayer body, thereby the release sheet may be used.

[0115]

The thickness of the release sheet is not particularly limited, but it is preferably

10 to 200 μm , and more preferably 30 to 150 μm .

[0116]

(Jig adhesion layer)

As the jig adhesion layer, the adhesive member made of adhesive layer alone, the adhesive member constituted by base and adhesive layer, the double-sided adhesive member comprising the core material or so can be employed. The jig adhesion layer is for example a ring form and comprises a hollow part (a donut form), and has the size capable of fixing the jig such as the ring frame or so. Specifically, the inner diameter of the ring frame is smaller than the outer diameter of the jig adhesion layer. Also, the inner diameter of the ring frame is slightly larger than the inner diameter of the jig adhesion layer. Note that, the ring frame is usually a molded article of the metal or plastic.

[0117]

In case of using the adhesive member made of single adhesive layer as the jig adhesion layer, the adhesive agent forming the adhesive layer is not particularly limited, but for example it is preferably made of the acrylic based adhesive agent, rubber based adhesive agent and silicone based adhesive agent or so. Among these, the acrylic based adhesive agent including the above mentioned acrylic based polymer (A1) is preferable from the point of the release force of the release sheet, the adhesive force against the ring frame and the re-releasable property from the ring frame. Note that, the above mentioned adhesive agent may be used alone or by combining two or more thereof.

[0118]

The thickness of the adhesive layer constituting the jig adhesion layer is preferably 2 to 20 μm , more preferably 3 to 15 μm , and further preferably 4 to 10 μm . If the thickness is less than 2 μm , then a sufficient release force and adhesive force may not be exhibited in some cases. If the thickness of the adhesive layer exceeds 20 μm ,

then the release force and the adhesive force may increase, and the effect of the present invention may not be exhibited, or the residues of the adhesive agent may remain to the ring frame when releasing it from the ring frame and may contaminate the ring frame.

[0119]

In case the adhesive member constituted by the base and the adhesive layer is used as the jig adhesion layer, the release sheet and the adhesive layer constituting the adhesive member are laminated.

As the adhesive agent forming the adhesive layer, it is the same as the adhesive layer of the adhesive member made of the single adhesive layer as mentioned in the above. Also, the thickness of the adhesive layer is the same as well.

[0120]

As the base constituting the jig adhesion layer, it is not particularly limited, for example polyolefin films such as polyethylene film, polypropylene film, ethylene vinylacetate copolymer film, ethylene-(meth)acrylic acid copolymer film, ethylene-(meth)acrylic ester copolymer film, ionomer resin film; polyvinyl chloride film, polyethyleneterephtharate film or so may be used. Among these, from the point of expansion property, polyethylene film and polyvinyl chloride film are preferable, and polyvinyl chloride film is more preferable.

[0121]

The thickness constituting the jig adhesion layer is preferably 15 to 200 μm , more preferably 30 to 150 μm , and even more preferably 40 to 100 μm .

[0122]

Also, in case of using the double-sided adhesive member comprising the core material as the jig adhesion layer, the double-sided adhesive member is made of the core material, adhesive layer for lamination formed on one side of the core material, and the adhesive layer for fixation formed on other side of the core material. The adhesive

layer for lamination is the adhesive layer adhered on the side of the support sheet 11. Also, the adhesive layer for fixation is the adhesive layer adhered on the side of the release sheet 13, and it is used for fixing the jig after the release sheet 13 is removed.

[0123]

As the core material of the double-sided adhesive member, those same as the base of the above mentioned adhesive member may be mentioned. Among these, from the point of the expansion property, polyolefin film and plasticized polyvinyl chloride film is preferable.

[0124]

The thickness of the core material is usually 15 to 200 μm , more preferably 30 to 150 μm , and even more preferably 40 to 100 μm .

[0125]

The adhesive layer for lamination and the adhesive layer for fixation of the double-sided adhesive member may be the layer made of the same adhesive agent or the different adhesive agent.

[0126]

The adhesive agent constituting the adhesive layer for fixation is appropriately selected so that the release force of the release sheet and the adhesive force against the ring frame at the outer peripheral part of the sheet for forming resin film is within the appropriate range; and also so that the adhesive force between the adhesive layer for fixation and the ring frame is smaller than the adhesive force between the support sheet and the adhesive layer for lamination. As such adhesive agent, for example the acrylic based adhesive agent, the rubber based adhesive agent, and the silicone adhesive agent may be mentioned. From the point of release force of the release sheet and the adhesive force against the ring frame at the outer peripheral of the sheet for forming resin film; and also from the point of the re-releasable property from the ring frame, the acrylic

based adhesive agent including the above mentioned acrylic based polymer (A1) is preferable. Also, the adhesive agent forming the adhesive layer for fixation may be used alone or by combining two or more thereof.

[0127]

The adhesive agent constituting the adhesive layer for lamination is not particularly limited, and for example the acrylic based adhesive agent, the rubber based adhesive agent and the silicone based adhesive agent may be mentioned. Among these, from the point of easy control of the adhesive force of the support sheet, the acrylic based adhesive agent including the above mentioned acrylic based polymer (A1) is preferable. Also, the adhesive agent forming the adhesive layer for lamination may be used alone or by combining two or more thereof.

[0128]

The thickness of the adhesive layer for lamination and the adhesive layer for fixation are the same as the thickness of the adhesive layer of the above mentioned adhesive member.

[0129]

By providing the jig adhesion layer, the sheet for forming resin film can be easily adhered on the jig such as ring frame or so.

[0130]

The sheet laminate for forming resin film 100 comprising layers as mentioned in the above is removed of the release sheet 13, then the resin film forming layer 12a is adhered on the adherend 32, then in some case the adherend 32 is subjected to desired processing such as dicing or so. Then, the support sheet 11 is released while the resin film forming layer 12a is kept adhered on the adherend 32. That is, it is used for the process including the step of transferring the resin film forming layer 12a to the adherend 32 from the support sheet 11.

[0131]

As the adherend applicable for the present invention, the material thereof is not particularly limited, and for example various articles such as semiconductor wafer, glass substrate, ceramic substrate and organic material substrate such as FPC or so, and the metal material such as fine parts or so; and chip or so which is made by separating said articles may be mentioned.

[0132]

The shape of the sheet laminate for forming resin film is a belt shape wherein the sheet for forming resin film including the support sheet and the resin film forming layer are laminated on the long release sheet, and this can be rolled up. Particularly, as shown in Fig.2, the embodiment wherein the sheet for forming resin film 10 comprising the support sheet 11 and the resin film forming layer 12a which is cut into a desired shape is stacked on the release sheet having long length in a releasable manner while being spaced apart in certain distance. Also, the shape of the sheet laminate for forming resin film can be a sheet form.

[0133]

In case the sheet for forming resin film including the support sheet and the resin film forming layer which is cut into a desired shape and stacked on the release sheet having long length in a releasable manner while being spaced apart in certain distance, the part where the sheet for forming resin film is stacked and the part where the sheet for forming resin film is not stacked will result in the sheet laminate for forming resin film having uneven thickness. If such sheet laminate for forming resin film having uneven thickness is rolled up, the pressure of the roll becomes uneven due to the uneven thickness, thus the roll may deform. Therefore, for the sheet laminate for forming resin film having such embodiment, the thickness is preferably uniform. Thus, as shown in Fig.2, small space is taken at the outside of the sheet for forming resin film which has

been cut into desired shape, and the surrounding tape 14 having the same thickness as the sheet for forming resin film 10 is adhered along the both peripheral part 17 at the short length direction of the release sheet 13 having long length. Here, the space between the sheet for forming resin film 10 and the surrounding tape 14 are preferably 1 to 20 mm or so, and more preferably 2 to 10 mm or so. Due to the surrounding tape 14, the uneven thickness can be solved, thus the above mentioned problems can be easily avoided.

[0134]

Production of the sheet laminate for forming resin film

Next, the production method of the sheet laminate for forming resin film wherein the sheet for forming resin film cut into a desired shape stacked in a releasable manner on the release sheet having long length while being spaced apart in certain distance will be explained using the sheet laminate for forming resin film of the first embodiment. However, the sheet laminate for forming resin film of the present invention is not limited to those produced by such production method.

[0135]

First, as shown in Fig.5a, the laminated body is prepared wherein the first release sheet 15 is laminated on the adhesive layer 11b of the adhesive sheet (the support sheet 11) made of the base 11a and the adhesive layer 11b. Then, as shown in Fig.5b, the first release sheet 15 is half-cut to have a desired shape.

[0136]

Specifically, the laminated body comprising the adhesive sheet having long length (hereinafter it may be referred as “the long adhesive sheet 11”) and the first release sheet 15 having long length (hereinafter, it may be referred as “the long first release sheet 15”) is prepared. Note that, the long first release sheet 15 is laminated on the adhesive layer 11b of the long adhesive sheet 11.

[0137]

Next, as shown in Fig.5b, the laminated body is cut (half-cut) so that the long first release sheet 15 is completely cut to have a desired shape, but the long adhesive sheet 11 is not completely cut. This half-cut is carried out by the device (a rotary blade or a flat blade) and the method which are widely used for the die-cut. The depth of cut at this time is not particularly limited, as long as the long first release sheet 15 is not completely cut. In case of cutting the long adhesive sheet 11, as shown in Fig.3 and Fig.5, the incision D1 having the depth of cut d1 is formed. The effect of the depth of cut d1 of the incision D1 formed as such is as mentioned in the above.

[0138]

Next, the adhesive tape for releasing (not shown in the figure) is adhered to the longitudinal direction of the long first release sheet 15. Then, by removing the adhesive tape for releasing, the release sheet 15b cut into a desired shape is removed as shown in Fig.5c, and the remaining part 15a of the long first release sheet 15 is left on the long adhesive sheet 11, thereby the laminated body (hereinafter, it may be referred as “the first laminate”) formed with the opening 15c having the desired shape is obtained. The first laminate is the laminated body having the remaining part 15a of the long first release sheet 15 and the long adhesive sheet 11.

[0139]

Next, the laminated body comprising the resin film forming layer 12 on the release sheet 16 having long length (hereinafter it may be referred as “the sheet for transferring resin film forming layer 16”) is prepared. As the production method of the laminated body, the resin film forming layer 12 formed into a film form in advance may be laminated on the sheet for transferring resin film forming layer 16, or the resin film forming composition for forming the resin film forming layer 12 may be coated and dried on the sheet for transferring resin film forming layer 16.

[0140]

Then, as shown in Fig.5d, the resin film forming layer 12 of the laminated body including the sheet for transferring resin film forming layer 16 and the resin film forming layer 12 is adhered on the opening part 15c of the first laminate. By such step, a part of the resin film forming layer 12 fits to the opening part 15c.

[0141]

Next, as shown in Fig.5e, when the boundary between the remaining part 15a of the long first release sheet 15 and the long adhesive sheet 11 is the initial release point, then the resin film forming layer 12 is cleaved into the shape fitting to the opening part 15c, thus the resin film forming layer 12a having the desired shape remains on the adhesive layer 11b of the long adhesive sheet 11. The laminated body of the sheet for transferring resin film forming layer 16, the remaining part 12b of the resin film forming layer 12 and the remaining part 15a of the long first release sheet 15 are continuous in a longitudinal direction, thus by removing said laminated body, the laminated body (the sheet for forming resin film 10 continuous in the longitudinal direction) wherein the resin film forming layer 12a having a desired shape aligned on the adhesive layer 11b of the long adhesive sheet 11 is obtained. By setting the breaking elongation and the breaking strength of the resin film forming layer within the predetermined range, the cleaving property of the resin film forming layer can be improved.

[0142]

Further, as shown in Fig.5F, the second release sheet 13 having a long length (hereinafter, it may be referred as “the second long release sheet 13”) is adhered to the face of above mentioned laminated body having the resin film forming layer 12a, thereby the laminated body (hereinafter, it may be referred as “the second laminate”) comprising the resin film forming layer 12a between the long second release sheet 13

and the long adhesive sheet 11 is obtained. Then, the long adhesive sheet 11 of the second laminate is cut from the long adhesive sheet 11 side into a desired shape and having the size equal or longer than the inner diameter of the ring frame and equal or smaller than the outer diameter of the ring frame. Here, the cleaving is done so that the center point of the resin film forming layer 12a matches with the center point of the long adhesive sheet 11 after being cut. Here, the depth of cut is not particularly limited as long as the long adhesive sheet 11 is completely cut. In case of cutting the long second release sheet 13, as shown in Fig.3 and Fig.5g, the incision D2 having the depth of cut d2 is formed. The effect of the depth of cut d2 of the incision D2 formed as such is as mentioned in the above.

[0143]

Then, while the adhesive sheet 11 having the desired shape is kept remained on the long second release sheet 13, the remaining long adhesive sheet is removed. As a result, the sheet laminate for forming resin film 100 according to the present invention is obtained wherein the sheet for forming resin film 10 comprising the resin film forming layer 12a having the desired shape and the adhesive sheet (the support sheet 11) is laminated on the long second release sheet 13.

[0144]

Note that, when cutting the long adhesive sheet in above, the long adhesive sheet is cut into a desired shape, and the small space is taken apart towards the outside of the long adhesive sheet 11 having said shape, and preferably the adhesive sheet as the surrounding tape 14 is left along the both peripheral part 17 in the short length direction of the long second release sheet 13. Then, the adhesive sheet 11 having the desired shape and the surrounding tape 14 are remained on the long second release sheet 13, then the remaining adhesive sheet is removed, thereby the sheet laminate for forming resin film 100 wherein the support tape 14, and the sheet for forming resin film 10

comprising the adhesive sheet 11 and the resin film forming layer 12a are continuously adhered on the release sheet 13 having the long length is obtained.

[0145]

Production method of the semiconductor device

The method of use of the sheet laminate for forming resin film according to the present invention will be described based on the example of applying the sheet laminate for forming resin film of the first embodiment shown in Fig.2 and Fig.3 to the production method of the semiconductor.

[0146]

The production method of the first semiconductor device preferably comprises steps of adhering the resin film forming layer of the sheet laminate for forming resin film to the adherend, forming a chip by dicing the adherend, releasing from the support sheet while adhering the resin film forming layer to any one face of the chip, then mounting the chip on the base or on other chip via the resin film forming layer. The resin film forming layer is the adhesive film for the chip and the base or other chip.

[0147]

Hereinafter, the example of using the silicon wafer as the adherend will be explained.

[0148]

The circuit may be formed to the surface of the wafer by various conventional methods which have been widely used such as etching method and lift-off method or so. Next, the opposite side (backside) of the circuit face of semiconductor wafer is ground. The grinding method is not particularly limited, and it may be ground by known means such as grinder or so. When carrying out the backside grinding, in order to protect the circuit on the front side, the adhesive sheet so called surface protection sheet is laminated to the circuit surface. The backside grinding is carried out by fixing the

circuit face side of the wafer (that is the surface protection sheet side) to the chuck table or so, and then the backside which is not formed with the circuit is ground by the grinder. The thickness after the wafer of after the grinding is not particularly limited, however usually it is 50 to 500 μm or so.

[0149]

Then, if needed, the fracture layer generated during the backside grinding is removed. The removal of the fracture layer is carried out by chemical etching and plasma etching or so.

[0150]

After forming the circuit and grinding the backside, the resin film forming layer of the sheet laminate for forming resin film is adhered to the backside of the wafer. The method of adhering is not particularly limited, and for example the resin film forming layer is adhered to the semiconductor wafer by the steps shown in Fig.1a to Fig.1d.

[0151]

Fig.1a to Fig.1d show series of steps carrying out the process of adhering the sheet for forming resin film 10 to the semiconductor as the adherend 32. As shown in Fig.1a, in the sheet laminate for forming resin film 100, the release sheet 13 functions as the carrier film, while being supported by two rolls 62 and 66, and the peel plate 64, one end of the release sheet 13 is wrapped around the roll core 44 having the circular column shape while being connected to the roll core 44 thereby the first roll 42 is formed, and the other end of the release sheet 13 is wrapped around the roll core 54 having the circular column shape while being connected to the roll core 54 thereby the second roll 52 is formed. Further, the roll core 54 of the second roll 52 is connected with the motor for driving roll core (not shown in the figure) to rotate said roll core 54, thereby the release sheet 13 which has been released from the sheet for forming resin film 10 can be wrapped at the predetermined speed.

[0152]

First, when the motor for driving roll core rotates, the roll core 54 of the second roll 52 rotates, the sheet for forming resin film 10 is pulled out of the first roll 42 from the sheet laminate for forming resin film 100 which is wrapped around the roll core 44 of the first roll 42. Then, the sheet for forming resin film 10 being pulled out is guided on to the semiconductor wafer 32 having the circular disk form arranged on the movable stage 36, and the sheet for forming resin film 10 is guided on to the ring frame 34 which is arranged to surround the semiconductor wafer 32.

[0153]

Next, the sheet for forming resin film 10 is released from the release sheet 13. Here, as shown in Fig.1a, the peel plate 64 may be contacted from the side of the release sheet 13 of the sheet for forming resin film 10.

Here, as shown in Fig.1d, in case the incision D2 is formed, the release sheet 13 is bent to the peel plate 64 side towards the incision D2, thereby the initial release point is easily made between the release sheet 13 and the sheet for forming resin film 10. Further, in order to make the initial release point more efficiently, air may be blown to the boundary between the release sheet 13 and the sheet for forming resin film 10. As a result, the releasing from the sheet for forming resin film 10 becomes easier.

[0154]

Next, as shown in Fig.1c, the sheet for forming resin film 10 is adhered so that it adheres with the ring frame 34 and the semiconductor wafer 32. Here, the sheet for forming resin film 10 is pressure adhered to the semiconductor wafer 32 by the roll 68. Then, as shown in Fig.1d, the adhesion of the sheet for forming resin film 10 to the semiconductor wafer 32 is completed; thereby the semiconductor having the sheet for forming resin film is obtained.

[0155]

According to such process, the adhesion of the sheet for forming resin film 10 to the semiconductor wafer 32 can be carried out continuously by automated steps. As the device carrying out such adhesion process of the sheet for forming resin film 10 to the semiconductor wafer 32, for example RAD 2500 (product name) made by Lintec Corporation or so may be mentioned.

[0156]

Further, in case of adhering the sheet for forming resin film 10 to the semiconductor wafer 32, the sheet for forming resin film 10 can be easily released from the release sheet 13 using the sheet laminate for forming resin film 100 according to the present invention.

[0157]

If the resin film forming layer does not have a tackiness at room temperature, then it may be heated appropriately (although it is not to be limited in any way, preferably it is 40 to 80°C).

[0158]

In case the resin film forming layer comprises the energy ray reactable compound (B21) and the curable polymer component (AB) comprising the functional group reacting by the energy ray, the energy ray is irradiated to the resin film forming layer from the support sheet side to pre-cure the resin film forming layer, thereby the cohesive force of the resin film forming layer is enhanced, and the adhesive force between the resin film forming layer and the support sheet may be decreased.

[0159]

Then, using the cutting means such as dicing saw or so, the above mentioned semiconductor wafer is cut and the semiconductor chip is obtained. The depth of cut at this time is determined by taking into consideration of the abrasion of the dicing saw and the total thickness of the semiconductor wafer and the resin film forming layer.

Also, as the cutting means, laser light can be used.

Note that, the energy ray irradiation may be carried out any time between after laminating to the semiconductor wafer and before releasing from the semiconductor chip (pickup); and for example, it may be carried out after the dicing and it may be carried out after the following described expanding step but the energy ray irradiation is done between after laminating to the semiconductor chip and before dicing. Further, the energy ray irradiation can be carried out in plurality of times.

[0160]

Next, if needed, by expanding of the sheet for forming resin film, the space between the semiconductor chips is widened; thereby the pickup of the semiconductor chip can be carried out easily. At this time, the resin film forming layer and the support sheet slides against each other and the adhesive force between the resin film forming layer and the support sheet declines, thereby the pickup property of the semiconductor chip improves. By carrying out the pickup of the semiconductor chip as such, the semiconductor chip can be released from the support sheet while the resin film forming layer being cut is remained on the backside of the semiconductor chip.

[0161]

Also, as the method for obtaining the semiconductor chip by cutting the semiconductor wafer, so called pre-dicing method can be used. Specifically, a groove is formed having a depth shallower than the wafer thickness from the surface of the semiconductor wafer formed with the circuit on the surface, then the sheet for forming resin film of the sheet laminate for forming resin film according to the present invention is adhered as the surface protection sheet to the circuit formed face. Then, the thickness of the wafer is thinned by carrying out the backside grinding of the above mentioned semiconductor wafer, and also the separation into individual chip is carried out at the end. The method of cutting the resin film forming layer into chip size is not particularly

limited, but for example the laser dicing method can be used.

[0162]

Next, the semiconductor chip is mounted on the surface of the base or other semiconductor chip (the lower chip) via the resin film forming layer (hereinafter, the base or the lower chip surface where the chip is mounted is referred as “the chip mounting part”).

[0163]

The pressure applied when mounting the chip is usually 1 kPa to 200 MPa. Also, the chip mounting part may be applied with heat prior to the mounting of the semiconductor chip, or it may be applied with heat after mounting the chip. The heating temperature is usually 80 to 200°C, more preferably 100 to 180°C, and the heating time is usually 0.1 second to 5 minutes, and preferably 0.5 seconds to 3 minutes.

[0164]

After mounting the semiconductor chip to the chip mounting part, further heating may be carried out if needed. The heating condition at this time is within the heating temperature range of mentioned in above, and the heating time is usually 1 to 180 minutes, and preferably 10 to 120 minutes.

[0165]

Also, after the mounting, it may be temporary adhered without carrying out the heat applying treatment, and the resin film forming layer may be cured using the heat for the resin sealing which is usually carried out at the package production. By going through such steps, the resin film forming layer is cured, thereby the semiconductor device wherein the semiconductor chip and the chip mounting part are strongly adhered can be obtained. The resin film forming layer is fluidized under the die bonding condition, thus it is embedded into the roughness of the chip mounting part, and the void is prevented from being generated thus the reliability of the semiconductor

increases.

[0166]

Also, as the second production method of the semiconductor device, preferably the resin film forming layer of the sheet for forming resin film is adhered to the backside of the semiconductor wafer formed with the circuit on the surface, then the semiconductor chip comprising the resin film on the backside is obtained. The resin film is the protective film of the semiconductor chip. Also, the second production method of the semiconductor device preferably includes the following steps (1) to (3), and the steps (1) to (3) can be carried out in any order.

Step (1): obtaining the resin film by curing the resin film forming layer

Step (2): releasing the support sheet from the resin film forming layer or the resin film

Step (3): dicing the semiconductor wafer with the resin film forming layer or the resin film

[0167]

First, the resin film forming layer of the sheet for forming resin film is adhered to the backside of the semiconductor wafer. This step is the same as the adhering step of the first production method of the semiconductor device.

[0168]

Then, the steps (1) to (3) are carried out in any order. For example, the steps (1) to (3) may be carried out by any one of, in the order of steps (2), (1), (3); in the order of steps (1), (2), (3); in the order of steps (1), (3), (2); in the order of steps (3), (1), (2); or in the order of steps (3), (2), (1). The details of this process are described in JP Patent Application Laid Open No.2002-280329. As one example, the case of carrying out in the order of (2), (1) (3) will be explained.

[0169]

First, the resin film forming layer of the sheet for forming resin film is adhered to the backside of the semiconductor wafer formed with the circuit on the surface. Then, the support sheet is released from the resin film forming layer, thereby the laminated body of semiconductor wafer and the resin film forming layer is obtained.

Next, the resin film forming layer is cured to form the resin film on the entire face of the wafer. In case the resin film forming layer includes the epoxy compound (B11) and/or the curable polymer component (AB) comprising the epoxy group, then the resin film forming layer is heat cured. In case the resin film forming layer comprises the energy ray reactable compound (B21) and/or the curable polymer component (AB) comprising the functional group reacting by the energy ray, then the resin film forming layer is cured by energy ray irradiation. In case the epoxy compound (B11) and/or the curable polymer component (AB) comprising the epoxy group, and the energy ray reactable compound (B21) and/or the curable polymer component (AB) comprising the functional group reacting by the energy ray are used together, then the heat curing and the energy ray curing may be carried out at the same time, or may be carried out sequentially. As the irradiated energy ray, ultraviolet (UV) ray or electron beam (EB) or so may be mentioned, and preferably ultraviolet ray is used. As a result, the resin film made of cured resin is formed at the backside of the wafer, and the strength is enhanced compared to that of the wafer alone, thus breaking caused when handling the thinned wafer can be reduced. Also, the resin film thickness has excellent evenness compared to the coating method wherein the resin film coating solution is directly coated to the backside of the wafer or chip the made into a film.

[0170]

Next, the laminated body of the semiconductor wafer and the resin film is diced for each circuit formed on the wafer surface. The dicing is carried out by cutting the wafer and the resin film together. The dicing of the wafer is carried out by usual method

using the dicing sheet. As a result, the semiconductor chip comprising the resin film on the backside is obtained.

[0171]

Next, the resin film may be carried out with laser printing. The laser printing is carried out by a laser marking method, and the product number or so is marked to the protective film by grinding off the surface of the protective film by irradiating the laser beam. Note that, the laser printing may be carried out before curing the resin film forming layer.

[0172]

Lastly, by picking up the diced chip by the general means such as collet or so, the semiconductor chip with the resin film at backside is obtained. Further, the semiconductor device can be produced by mounting the semiconductor chip on the predetermined base by face down method. Also, the semiconductor device can be produced by adhering the semiconductor chip comprising the resin film on the backside on the base or on other members (on the chip mounting part) such as other semiconductor chip or so. According to the production method of the semiconductor device using the sheet laminate for forming resin film according to the present invention, the resin film having high thickness evenness can be easily formed to the backside of the chip, and cracks scarcely occurs during the dicing step or during the packaging.

[0173]

Note that, in case the step (3) is carried out after adhering the resin film forming layer of the sheet for forming resin film to the backside of the semiconductor wafer and before the step (2), the sheet for forming resin film can function as the dicing sheet. That is, it can be used as the sheet for supporting the semiconductor wafer during the dicing step. In this case, the semiconductor wafer is adhered to the inner peripheral part of the sheet for forming resin film via the resin film forming layer, and by the outer

peripheral part of the sheet for forming resin film adhering with other jig such as ring frame or so, the sheet for forming resin film to the semiconductor wafer is fixed to the device and the dicing is carried out.

[0174]

Also, in case of carrying out steps (3), (2), (1) in this order, the semiconductor chip comprising the resin film forming layer at the backside is mounted on the predetermined mounting part by face down method, then the resin film forming layer can be cured using the heat used for the resin sealing which is usually carried out for the package production.

EXAMPLE

[0175]

Hereinafter, the present invention will be described based on the examples; however the present invention is not to be limited thereto. The measurement and evaluation method used in the present invention are as shown in below.

[0176]

<Verification of the incision >

Regarding the release sheet of the sheet laminate for forming resin film, the verification of not having the incision along the outer peripheral part of the resin film forming layer from the face of the resin film forming layer side was done by observing the surface of the release sheet for 4 arbitrary points along the outer peripheral part of the resin film forming layer using the optical microscope at the magnification of 300x.

[0177]

<Breaking elongation of the resin film forming layer>

The breaking elongation of resin film forming layer was measured using a universal tensile tester (TENSILON/RTA-T-2M manufactured by ORIENTEC Co., LTD.) in accordance with JIS K7161:1994 (ISO 527-1:1993), under the condition of

23°C, the humidity of 50%, and at the tensile speed of 200 mm/min.

[0178]

<Breaking strength of the resin film forming layer>

The breaking strength of the resin film forming layer was measured in accordance with JIS K7127:1999.

[0179]

<Transferring property of the resin film forming layer to the adhesive layer>

When the resin film forming layer was cleaved into a desired shape along the outer peripheral of the opening and in case the resin film forming layer was able to transfer to the adhesive layer, then it was evaluated as “A”. Also, when it was able to transfer to the adhesive layer but a cracking at the end part (outer peripheral part) of the resin film forming layer caused by the cleaving was visually confirmed, then it was evaluated as “B”. On the other hand, in case the resin film forming layer was unable to transfer to the adhesive layer, then it was evaluated as “C”.

[0180]

Preparation of the composition for forming resin film

Each component shown in below was blended in the amount shown in Table 1; thereby the compositions for forming resin film 1 to 5 were prepared.

Acrylic polymer (AB): acrylic polymer (the weight average molecular weight: 800,000 and the glass transition temperature: -28°C) comprising 55 parts by weight of butyl acrylate, 10 parts by weight of methyl acrylate, 20 parts by weight of glycidyl methacrylate, and 15 parts by weight of 2-hydroxyethylacrylate

Acrylic polymer (A1): acrylic polymer (the weight average molecular weight: 1,200,000 and the glass transition temperature: 8°C made by TOYOCEM CO., LTD) comprising 95 parts by weight of methyl acrylate, and 5 parts by weight of 2-hydroxyethylacrylate

Non-acrylic resin (A2): polyester resin (VYLON 220 made by TOYOBO CO., LTD)

Epoxy compound (B11-1): epoxy resin (EPICLON EXA-4850-150 made by DIC Corporation)

Epoxy compound (B11-2): epoxy resin (EPPN-502H made by Nippon Kayaku Co.,Ltd)

Epoxy compound (B11-3): epoxy resin (CNA-147 made by Nippon Kayaku Co.,Ltd)

Heat curing agent (B12-1): phenol resin (MEH-7851-4H made by MEIWA PLASTIC INDUSTRIES,LTD)

Heat curing agent (B12-2): phenol resin (MILEX XLC-4L made by Mitsui Chemicals, Inc)

Curing catalyst (B13): 2PHZ-PW made by SHIKOKU CHEMICALS CORPORATION

Inorganic filler (C-1): silica filler (SC2050-MA, the particle diameter: 500 nm made by Admatechs)

Inorganic filler (C-2): silica filler (YAO50C-MJA, made by Admatechs)

Coupling agent (E-1): silane coupling agent (KBM-403 made by Shin-Etsu Co., Ltd)

Coupling agent (E-2): silane coupling agent (KBE-403 made by Shin-Etsu Co., Ltd)

Coupling agent (E-3): silane coupling agent (X-41-1056 made by Shin-Etsu Co., Ltd)

Coupling agent (E-4): silane coupling agent (MKC silicate MSEP2 made by MITSUI CHEMICALS, INC.)

Crosslinking agent: aromatic polyvalent isocyanate (CORONATE L made by

NIPPON POLYURETHANE INDUSTRY Co., Ltd.)

[0181]

[Table 1]

Table 1

	Composition for forming resin film				
	1	2	3	4	5
Acrylic based polymer (AB)	10.16	30.06	50		
Acrylic based polymer (A1)				57.8	52.91
Non-acrylic based resin (A2)	12.19	9.49	6.79		
Epoxy compound (B11-1)	24.59	19.14	13.69		
Epoxy compound (B11-2)	14.27	11.11	7.94		
Epoxy compound (B11-3)				17.34	5.29
Heat curing agent (B12-1)	29.85	23.24	16.62		
Heat curing agent (B12-2)				3.47	1.06
Curing catalyst (B13)	0.18	0.14	0.1		
Inorganic filler (C-1)	8.13	6.33	4.52		
Inorganic filler (C-2)				20.23	39.68
Coupling agent (E-1)	0.17	0.14	0.1		
Coupling agent (E-2)	0.2	0.16	0.11		
Coupling agent (E-3)	0.24	0.19	0.14		
Coupling agent (E-4)				0.29	0.26
Crosslinking agent				0.87	0.79

unit: parts by weight (interms of solid portion)

[0182]

(Example 1)

The obtained methylethyl ketone solution of the composition for forming resin film (the solid portion concentration of 61 wt%) was coated and dried (the drying condition: 1 minute in the oven at 100°C) on the surface of the sheet for transferring resin film (SPPET381031 made by Lintec Corporation) which is release treated, thereby the resin film forming layer having the thickness of 7 μm was formed on the sheet for transferring resin film.

[0183]

Next, the adhesive sheet (D-175 made by Lintec Corporation, the adhesive layer thickness: 10 μm, the base thickness: 80 μm) was prepared as the support sheet, the first

release sheet (SPPET 381031, thickness: 38 μ m) was laminated on the adhesive layer, thereby the laminated body having the support sheet and the first release sheet was obtained. Next, the laminated body was cut from the first release sheet side to form the circular shape having the depth of cut 60 μ m and the diameter of 330 mm. Thereby, the incision D1 having the depth of cut of about 20 μ m were formed at the support sheet.

[0184]

Next, the adhesive sheet for releasing was adhered to the release sheet side of the laminated body, and then the adhesive sheet for releasing was removed. Thereby, the first release sheet of the circular shape having the diameter of 330 mm was removed, and the remaining part of the first release sheet was laminated on the adhesive sheet, thereby the first laminate comprising the incision was obtained.

[0185]

Next, the resin film forming layer of the above obtained laminated body comprising the sheet for transferring resin film forming layer and the resin film forming layer was adhered to the opening side of the first laminate, thereby the resin film forming layer was fit to the opening.

[0186]

Then, by using the boundary between the remaining part of the first release sheet and the adhesive sheet as the initial release point, the releasing was carried out, and the resin film forming layer was cleaved into a form which fits to the opening, thereby the resin film forming layer of circular shape having the diameter of 330 mm was remained on the adhesive layer of the adhesive sheet. Then, the transferring property of the resin film forming layer to the adhesive layer was evaluated. The result is shown in Table 2.

[0187]

Then, the second release sheet (SPPET 381031, the thickness: 38 μ m) was laminated to the face comprising the resin film forming layer of the adhesive sheet,

thereby the second laminate comprising the resin film forming layer between the second release sheet and the adhesive sheet was obtained.

[0188]

Next, the second laminate was cut from the adhesive sheet side to form the circular shape having the diameter of 370 mm and the depth of cut of 110 μm so that the center point of the adhesive sheet matches with that of the resin film forming layer. Thereby, the incision D2 having the depth of cut d2 of about 20 μm was formed to the second release sheet. Lastly, while leaving the adhesive sheet of circular shape having the diameter of 370 mm on the second release sheet, the remaining part of the adhesive sheet was removed, and the sheet laminate for forming resin film which is the embodiment shown in Fig.3 was obtained.

The release sheet (the second release sheet) of the sheet laminate for forming resin film of the example 1 was confirmed not to have the incision along the outer peripheral of the resin film forming layer from the resin film forming layer side.

[0189]

(Example 2 to 5)

The sheet laminate for forming resin film was obtained as same as the sample 1 except for using the compositions for forming resin film 2 to 5 instead of the composition for forming resin film 1 used in the example 1.

The release sheets of the sheet laminate for forming resin film of the examples 2 to 5 were confirmed not to have the incision along the outer peripheral of the resin film forming layer from the resin film forming layer side.

[0190]

[Table 2]

Table 2

	Composition for forming resin film	Breaking elongation (%)	breaking strength (N/mm ²)	Transferring property to adhesive layer
Example 1	1	400	3	A
Example 2	2	600	3	A
Example 3	3	1000	2	A
Example 4	4	700	30	B
Example 5	5	500	20	B

[0191]

For the sheet laminate for forming resin film of the examples 4 and 5, the evaluation of the transferring property of the resin film forming layer to the adhesive layer were “B”. In case the chipping was visually confirmed at the end part (the outer peripheral part) of the resin film forming layer, the adhesiveness of the resin film forming layer at the end part to the adherend declines, thus the productivity of the semiconductor device may be compromised in some cases.

NUMERICAL REFERENCES

[0192]

100: Sheet laminate for forming resin film

10: Sheet for forming resin film

11: Support sheet

12 (12a): Resin film forming layer

13: Release sheet (second release sheet)

D1: Incision

D2: Incision

CLAIMS

1. A sheet laminate for forming resin film comprising a sheet for forming resin film including a support sheet and a resin film forming layer, and a release sheet laminated at the resin film forming layer side, wherein

said release sheet does not comprise an incision along an outer peripheral part of the resin film forming layer from the resin film forming layer side, and

a breaking elongation of the resin film forming layer is 1000% or less, and a breaking strength is 10 N/mm² or less.

2. The sheet laminate for forming resin film as set forth in claim 1, wherein the support sheet comprises an incision along an outer peripheral part of the resin film forming layer from the resin film forming layer side, and

a depth of the incision is 0 μ m or more and 2/3 or less of the thickness of the support sheet.

3. A production method of a sheet laminate for forming resin film comprising steps of,

cutting a first release sheet of a laminate including a support sheet and the first release sheet,

obtaining a first laminate comprising an opening by removing the first release sheet being cut,

leaving the resin film forming layer having a shape of the opening on the support sheet which is left on the support sheet by adhering the resin film forming layer to the opening side of the first laminate then by cleaving the resin film forming layer along the shape of the opening,

obtaining a second laminate by laminating a second release sheet to side of the resin film forming layer having the shape of the opening, and

cutting the second laminate from the support sheet side.