

DESCRIPTION

Title of Invention

DICING DIE-BONDING INTEGRATED FILM, PRODUCTION
METHOD THEREFOR, AND SEMICONDUCTOR DEVICE
5 PRODUCTION METHOD

Technical Field

[0001] The present disclosure relates to a dicing die-bonding integrated
film, a method for producing the same, and a method for producing a
semiconductor device.

10 Background Art

[0002] A semiconductor device is produced by performing the following
steps. First, a dicing step of sticking an adhesive film for dicing to a
wafer and singularizing the wafer in that state into chips, is carried out.
Subsequently, an expansion step, a pickup step, a mounting step, a die-
15 bonding step, and the like are carried out.

[0003] In a production process for a semiconductor device, a film called
dicing die-bonding integrated film is used. This film has a structure in
which a base material layer, an adhesive layer, and a bonding adhesive
layer are laminated in this order, and the film is used, for example, as
20 follows. First, the surface on the bonding adhesive layer side is stuck to
a wafer, and the wafer is diced in a state in which the wafer is fixed by a
dicing ring. As a result, the wafer is singularized into a plurality of
chips. Subsequently, an adhesive force of the adhesive layer with
respect to the bonding adhesive layer is weakened by irradiating the
25 adhesive layer with active energy rays, and then chips are picked up,
together with adhesive pieces formed by singularizing the bonding

adhesive layer, from the adhesive layer. Subsequently, a semiconductor device is produced by performing a step of mounting a chip on a substrate or the like, with the adhesive piece interposed therebetween. Incidentally, a laminated body composed of a chip obtainable by performing a dicing step; and an adhesive piece attached to this chip, is referred to as DAF (Die Attach Film).

[0004] As described above, an adhesive layer (dicing film) in which the adhesive force is weakened by irradiation with active energy rays, is referred to as an active energy ray-curable type. In contrast, an adhesive layer in which the adhesive force remains constant without being irradiated with active energy rays in a production process for a semiconductor device, is referred to as a pressure-sensitive type. A dicing die-bonding integrated film including a pressure-sensitive type adhesive layer has merits in that a user (mainly a semiconductor device manufacturer) does not need to perform a step of irradiating with active energy rays, and that facilities for this purpose are unnecessary. In Patent Literature 1, the adhesive layer can be said to be an active energy ray-curable type from the viewpoint that the adhesive layer contains a component that is cured by active energy rays, while on the other hand, there is disclosed a dicing die-bonding integrated film which can also be said to be a pressure-sensitive type from the viewpoint that only a predetermined portion of the adhesive layer has been irradiated in advance with active energy rays so that the user does not need to irradiate active energy rays in the production process for a semiconductor device.

Citation List

Patent Literature

[0005] Patent Literature 1: Japanese Patent No. 4443962

Summary of Invention

Technical Problem

[0006] However, semiconductor devices, particularly devices called
5 memories, are widely used in personal computers, servers, smartphones,
and the like, and size reduction and high integration of circuits are
required. Along with such size reduction and high integration of
circuits, narrowing of the wiring width and the distance between wirings
is being investigated in the circuit design on wafers as well.

10 [0007] On the other hand, in wafer design, it is necessary to set a region
that does not have a circuit, which is called scribe lines, between chips
because the wafer is cut by a blade in a dicing step, and there is also a
demand for narrowing of the scribe lines. The dicing step is carried out
using a blade that rotates at a high speed. Therefore, in order to realize
15 the narrowing of scribe lines, it is necessary to use a blade having a
narrow width. However, when a blade having a narrow width (for
example, a blade having a width of about 10 to 50 μm) is used, a sufficient
distance between chips after the dicing step (hereinafter, this distance
may be referred to as "kerf (groove) width") may not be secured, and in
20 a pickup step, a phenomenon in which two or more chips are
simultaneously picked up (hereinafter, this phenomenon may be referred
to as "double die") may occur. When double die occurs, the production
efficiency is consequently decreased.

[0008] Furthermore, an expansion step that is carried out subsequent to
25 the dicing step is a step of pulling apart the singularized chips in order to
expand the width of a kerf. However, as chips become smaller, the

number of separating kerf lines increases, and the effect of the expansion step is dispersed, so that the effect is limited.

[0009] The present disclosure was achieved in view of the above-described circumstances, and a main object of the present disclosure is to provide a dicing die-bonding integrated film capable of securing a sufficient width of a kerf even when a blade having a narrow width is used, and a method for producing the dicing die-bonding integrated film.

Solution to Problem

[0010] An aspect of the present disclosure relates to a method for producing a semiconductor device. This method for producing a semiconductor device includes a first step of preparing a dicing die-bonding integrated film including a base material layer, an adhesive layer formed from an active energy ray-curable adhesive, the adhesive layer having a first surface facing the base material layer and a second surface on the opposite side of the first surface, and a bonding adhesive layer provided so as to cover a central part of the second surface of the adhesive layer; a second step of sticking a wafer to the bonding adhesive layer of the dicing die-bonding integrated film and sticking a dicing ring to the second surface of the adhesive layer; a third step of singularizing the wafer, together with the bonding adhesive layer and the adhesive layer, into a plurality of chips by blade dicing using a blade, to form cut bodies; a fourth step of picking up each chip, together with an adhesive piece formed by singularizing the bonding adhesive layer, from the adhesive layer of each cut body; and a fifth step of mounting the chip on a substrate or another chip, with the adhesive piece interposed therebetween. The adhesive layer has a first region corresponding to a region in the bonding

adhesive layer, to which a wafer is stuck, and a second region to which a dicing ring is stuck, and the first region is a region in a state of having an adhesive force decreased as compared with the second region by irradiation with active energy rays. With regard to the third step, the width of a kerf (kerf width) formed in the adhesive layer of a cut body by blade dicing is 75% or more with respect to the width of the blade (blade width). According to the investigation of the inventors of the present invention, it was found that when the width of a kerf formed in the adhesive layer of a cut body by blade dicing is 75% or more with respect to the width of the blade, there is a tendency that double die can be suppressed. Therefore, according to the above-described method for producing a semiconductor device, it is possible to enhance the production efficiency.

[0011] The width of the blade (blade width) may be 10 to 50 μm . Even when such a blade having a relatively narrow width is used, double die can be more sufficiently suppressed.

[0012] The plurality of chips may have a square or rectangular shape and may each have an area of 200 mm^2 or less.

[0013] An aspect of the present disclosure relates to a dicing die-bonding integrated film. This film includes a base material layer; an adhesive layer formed from an active energy ray-curable adhesive, the adhesive layer having a first surface facing the base material layer and a second surface on the opposite side of the first surface; and a bonding adhesive layer provided so as to cover a central part of the second surface. The adhesive layer has a first region including at least a region corresponding to the sticking position for a wafer in the bonding adhesive layer and a

second region located so as to surround the first region, and the first region is a region in a state in which the adhesive force has been decreased as compared with the second region by being irradiated with active energy rays. The active energy ray-curable adhesive includes a (meth)acrylic resin having a functional group capable of chain polymerization, the functional group is at least one selected from an acryloyl group and a methacryloyl group, and the content of the functional group in the (meth)acrylic resin is 0.4 mmol/g or more.

[0014] According to the dicing die-bonding integrated film, this film can be suitably used for the above-described method for producing a semiconductor device, and even when a blade having a narrow width is used, it is possible to secure a sufficient width of a kerf. By using such a dicing die-bonding integrated film, double die can be suppressed, and as a result, it is possible to enhance the production efficiency.

[0015] The active energy ray-curable adhesive may further include a crosslinking agent. When such a crosslinking agent is further included, the content of the crosslinking agent with respect to the total mass of the active energy ray-curable adhesive may be 0.1% to 15% by mass. The crosslinking agent may be a reaction product between a polyfunctional isocyanate having two or more isocyanate groups in one molecule and a polyhydric alcohol having three or more hydroxy groups in one molecule.

[0016] The bonding adhesive layer may be formed from an adhesive composition that includes a reactive group-containing (meth)acrylic copolymer, a curing accelerator, and a filler.

[0017] The dicing die-bonding integrated film may be one that is applied to a production process for a semiconductor device including a step of

singularizing a wafer into a plurality of chips each having an area of 200 mm² or less.

[0018] An aspect of the present disclosure relates to a method for producing a dicing die-bonding integrated film. A first embodiment of this production method includes, in the following order: a step of producing, on the surface of a base material layer, a laminated body including an adhesive layer formed from an active energy ray-curable adhesive and a bonding adhesive layer formed on the surface of the adhesive layer; and a step of irradiating a region constituting a first region of the adhesive layer included in the laminated body with active energy rays. Furthermore, a second embodiment of this production method includes, in the following order: a step of forming, on the surface of a base material layer, an adhesive layer formed from a composition whose adhesive force is decreased by being irradiated with active energy rays; a step of irradiating a region constituting a first region of the adhesive layer with active energy rays; and a step of laminating a bonding adhesive layer on the surface of the adhesive layer after being irradiated with active energy rays.

Advantageous Effects of Invention

[0019] According to the present disclosure, there are provided a dicing die-bonding integrated film capable of securing a sufficient width of a kerf even when a blade having a narrow width is used, and a method for producing the dicing die-bonding integrated film. Furthermore, according to the present disclosure, a method for producing a semiconductor device by using such a dicing die-bonding integrated film is provided. According to such a method for producing a semiconductor

device, it is possible to suppress double die, and it is possible to enhance the production efficiency.

Brief Description of Drawings

[0020] FIG. 1(a) is a plan view illustrating an embodiment of a dicing die-bonding integrated film, and FIG. 1(b) is a schematic cross-sectional view taken along the line B-B shown in FIG. 1(a).

FIG. 2 is a schematic diagram illustrating a state in which a dicing ring is stuck to the periphery of an adhesive layer of a dicing die-bonding integrated film, and a wafer is stuck to the surface of a bonding adhesive layer.

FIG. 3 is a schematic cross-sectional view of an embodiment of a semiconductor device.

FIG. 4(a), FIG. 4(b), FIG. 4(c), and FIG. 4(d) are cross-sectional views schematically illustrating a process for producing a DAF (laminated body of a chip and an adhesive piece).

FIG. 5(a) is a plan view schematically illustrating an embodiment of a cut body, and FIG. 5(b) is an enlarged view of portion E in FIG. 5(a).

FIG. 6 is a cross-sectional view schematically illustrating a process for producing the semiconductor device shown in FIG. 3.

FIG. 7 is a cross-sectional view schematically illustrating a process for producing the semiconductor device shown in FIG. 3.

FIG. 8 is a cross-sectional view schematically illustrating a process for producing the semiconductor device shown in FIG. 3.

Description of Embodiments

[0021] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the drawings. In the following

description, identical or equivalent parts will be assigned with the same reference numeral, and any overlapping description will not be repeated. Incidentally, the present invention is not intended to be limited to the following embodiments. According to the present specification, the expression (meth)acryl means acryl or methacryl, and the same also applies to other similar expressions such as (meth)acrylate.

[0022] <Dicing die-bonding integrated film>

FIG. 1(a) is a plan view illustrating a dicing die-bonding integrated film according to the present embodiment, and FIG. 1(b) is a schematic cross-sectional view taken along the line B-B shown in FIG. 1. A dicing die-bonding integrated film 10 (hereinafter, optionally simply referred to as "film 10") can be suitably used in a production process for a semiconductor device including a step of singularizing a wafer W into a plurality of chips each having an area of 200 mm² or less (and a subsequent step of picking up) (see FIG. 5(c) and FIG. 5(d)).

[0023] The film 10 includes a base material layer 1; an adhesive layer 3 having a first surface F1 facing the base material layer 1 and a second surface F2 on the opposite side of the first surface F1; and a bonding adhesive layer 5 provided so as to cover a central part of the second surface F2 of the adhesive layer 3, in this order. In the present embodiment, a situation in which one laminated body of an adhesive layer 3 and a bonding adhesive layer 5 is formed on a square-shaped base material layer 1 is mentioned as an example; however, a situation in which the base material layer 1 has a predetermined length (for example, 100 m or more), and laminated bodies of an adhesive layer 3 and a bonding adhesive layer 5 are disposed at a predetermined interval so as

to line up in the longitudinal direction of the base material layer 1, may also be adopted.

[0024] The film 10 includes a base material layer 1; an adhesive layer 3 having a first surface F1 facing the base material layer 1 and a second surface F2 on the opposite side of the first surface F1; and a bonding adhesive layer 5 provided so as to cover a central part of the second surface F2 of the adhesive layer 3, in this order. In the present embodiment, a situation in which one laminated body of an adhesive layer 3 and a bonding adhesive layer 5 is formed on a square-shaped base material layer 1 is mentioned as an example; however, a situation in which the base material layer 1 has a predetermined length (for example, 100 m or more), and laminated bodies of an adhesive layer 3 and a bonding adhesive layer 5 are disposed at a predetermined interval so as to line up in the longitudinal direction of the base material layer 1, may also be adopted.

[0025] (Adhesive layer)

The adhesive layer 3 has a first region 3a including at least a region R_w corresponding to a sticking position for a wafer W in the bonding adhesive layer 5; and a second region 3b located so as to surround the first region 3a. The broken lines in FIG. 1(a) and FIG. 1(b) indicate the boundary between the first region 3a and the second region 3b. The first region 3a and the second region 3b are formed from the same composition (active energy ray-curable adhesive) before irradiation with active energy rays. The first region 3a is a region in a state in which the adhesive force has been decreased as compared with the second region 3b, by being irradiated with active energy rays. The second

region 3b is a region in which a dicing ring DR can be stuck (see FIG. 2).
The second region 3b is a region that has not been irradiated with active
energy rays, and has high adhesive force with respect to the dicing ring
DR. The active energy rays may be at least one selected from ultraviolet
5 radiation, an electron beam, and visible light, and may be ultraviolet
radiation. The amount of irradiation with active energy rays is, for
example, 10 to 1000 mJ/cm², and may be 100 to 700 mJ/cm² or 100 to
500 mJ/cm².

[0026] The adhesive layer before irradiation with active energy rays is
10 formed from an active energy ray-curable adhesive including a
(meth)acrylic resin. The second region 3b that is not irradiated with
active energy rays can have the same composition as that of the adhesive
layer before irradiation with active energy rays. In the following
description, the components contained in the active energy ray-curable
15 adhesive will be described in detail.

[0027] [(Meth)acrylic resin]

The active energy ray-curable adhesive may include a
(meth)acrylic resin having a functional group capable of chain
polymerization. When such a (meth)acrylic resin is included, the
20 functional group may be at least one selected from an acryloyl group and
a methacryloyl group. The content of the functional group in the
(meth)acrylic resin may be 0.4 mmol/g or more. The content of the
functional group in the (meth)acrylic resin may be 0.5 mmol/g or more,
0.6 mmol/g or more, 0.7 mmol/g or more, 0.8 mmol/g or more, or 0.9
25 mmol/g or more, and may be 2.0 mmol/g or less, 1.8 mmol/g or less, 1.5
mmol/g or less, 1.2 mmol/g or less, or 1.0 mmol/g or less. When the

content of the functional group is 0.4 mmol/g or more, there is a tendency that a region in which the adhesive force has been appropriately decreased by irradiation with active energy rays (first region 3a in FIG. 1) is easily formed. Furthermore, the present inventors speculate that the kerf of the adhesive layer 3 formed by dicing is generated as the stress caused by curing shrinkage occurring due to curing by irradiation with active energy rays at the time of forming the first region 3a of the adhesive layer 3 is released by dicing, and when the amount of curing shrinkage of the (meth)acrylic resin and the like in the adhesive layer 3 is large, the width of the kerf (kerf width) is likely to be enlarged. Therefore, when the content of the functional group is 0.4 mmol/g or more, the amount of curing shrinkage of the adhesive layer 3 becomes sufficient, and even when a blade having a narrow width is used, it is possible to secure a sufficient kerf width. On the other hand, when the content of the functional group is 2.0 mmol/g or less, there is a tendency that excellent pickup properties are likely to be achieved.

[0028] The (meth)acrylic resin can be obtained by synthesizing the resin by a known method. Examples of the synthesis method include a solution polymerization method, a suspension polymerization method, an emulsion polymerization method, a bulk polymerization method, a precipitation polymerization method, a gas phase polymerization method, a plasma polymerization method, and a supercritical polymerization method. Furthermore, examples of the type of the polymerization reaction include radical polymerization, cationic polymerization, anionic polymerization, living radical polymerization, living cationic polymerization, living anionic polymerization, coordination

polymerization, and immortal polymerization, as well as techniques such as ATRP (atom transfer radical polymerization) and RAFT (reversible addition-fragmentation chain-transfer polymerization). Among these, synthesizing the resin by radical polymerization using a solution polymerization method has advantages such as high economic efficiency, high reaction rate, and easy polymerization control, as well as an advantage that a resin solution obtained by polymerization can be used and blended in as it is.

[0029] Here, a synthesis method for a (meth)acrylic resin will be described in detail by taking a method for obtaining a (meth)acrylic resin by radical polymerization using a solution polymerization method as an example.

[0030] The monomer used when synthesizing the (meth)acrylic resin is not particularly limited as long as it has one (meth)acryloyl group in one molecule. Specific examples thereof include aliphatic (meth)acrylates such as methyl (meth)acrylate, ethyl (meth)acrylate, butyl (meth)acrylate, isobutyl (meth)acrylate, tert-butyl (meth)acrylate, butoxyethyl (meth)acrylate, isoamyl (meth)acrylate, hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, heptyl (meth)acrylate, octyl heptyl (meth)acrylate, nonyl (meth)acrylate, decyl (meth)acrylate, undecyl (meth)acrylate, lauryl (meth)acrylate, tridecyl (meth)acrylate, tetradecyl (meth)acrylate, pentadecyl (meth)acrylate, hexadecyl (meth)acrylate, stearyl (meth)acrylate, behenyl (meth)acrylate, methoxy polyethylene glycol (meth)acrylate, ethoxy polyethylene glycol (meth)acrylate, methoxy polypropylene glycol (meth)acrylate, ethoxy polypropylene glycol (meth)acrylate, and mono(2-(meth)acryloyloxyethyl) succinate;

alicyclic (meth)acrylates such as cyclopentyl (meth)acrylate, cyclohexyl
 (meth)acrylate, cyclopentyl (meth)acrylate, dicyclopentany
 (meth)acrylate, dicyclopentenyl (meth)acrylate, isobornyl
 (meth)acrylate, mono(2-(meth)acryloyloxyethyl) tetrahydrophthalate,
 5 and mono(2-(meth)acryloyloxyethyl) hexahydrophthalate; aromatic
 (meth)acrylates such as benzyl (meth)acrylate, phenyl (meth)acrylate, o-
 biphenyl (meth)acrylate, 1-naphthyl (meth)acrylate, 2-naphthyl
 (meth)acrylate, phenoxyethyl (meth)acrylate, p-cumyl phenoxyethyl
 (meth)acrylate, o-phenyl phenoxyethyl (meth)acrylate, 1-naphthoxyethyl
 10 (meth)acrylate, 2-naphthoxyethyl (meth)acrylate, phenoxy polyethylene
 glycol (meth)acrylate, nonylphenoxy polyethylene glycol (meth)acrylate,
 phenoxy polypropylene glycol (meth)acrylate, 2-hydroxy-3-
 phenoxypropyl (meth)acrylate, 2-hydroxy-3-(o-phenylphenoxy)propyl
 (meth)acrylate, 2-hydroxy-3-(1-naphthoxy)propyl (meth)acrylate, and 2-
 15 hydroxy-3-(2-naphthoxy)propyl (meth)acrylate; heterocyclic
 (meth)acrylates such as 2-tetrahydrofurfuryl (meth)acrylate, N-
 (meth)acryloyloxyethyl hexahydrophthalimide, and 2-
 (meth)acryloyloxyethyl N-carbazole; compounds having an ethylenically
 unsaturated group and an epoxy group, such as caprolactone modification
 20 products of these, ω -carboxypolycaprolactone mono(meth)acrylate,
 glycidyl (meth)acrylate, α -ethyl glycidyl (meth)acrylate, α -propyl
 glycidyl (meth)acrylate, α -butyl glycidyl (meth)acrylate, 2-methyl
 glycidyl (meth)acrylate, 2-ethyl glycidyl (meth)acrylate, 2-propyl
 glycidyl (meth)acrylate, 3,4-epoxybutyl (meth)acrylate, 3,4-epoxyheptyl
 25 (meth)acrylate, α -ethyl-6,7-epoxyheptyl (meth)acrylate, 3,4-
 epoxycyclohexyl methyl (meth)acrylate, o-vinylbenzyl glycidyl ether, m-

vinylbenzyl glycidyl ether, and p-vinylbenzyl glycidyl ether; compounds having an ethylenically unsaturated group and an oxetanyl group, such as (2-ethyl-2-oxetanyl)methyl (meth)acrylate, (2-methyl-2-oxetanyl)methyl (meth)acrylate, 2-(2-ethyl-2-oxetanyl)ethyl (meth)acrylate, 2-(2-methyl-2-oxetanyl)ethyl (meth)acrylate, 3-(2-ethyl-2-oxetanyl)propyl (meth)acrylate, and 3-(2-methyl-2-oxetanyl)propyl (meth)acrylate; compounds having an ethylenically unsaturated group and an isocyanate group, such as 2-(meth)acryloyloxyethyl isocyanate; and compounds having an ethylenically unsaturated group and a hydroxyl group, such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 3-chloro-2-hydroxypropyl (meth)acrylate, and 2-hydroxybutyl (meth)acrylate. Intended (meth)acrylic resins can be obtained by appropriately combining these.

[0031] The (meth)acrylic resin may have at least one functional group selected from a hydroxyl group, a glycidyl group (epoxy group), an amino group, and the like as a reaction point with a functional group-introducing compound that will be described below or a crosslinking agent. Examples of a monomer for synthesizing a (meth)acrylic resin having a hydroxyl group include compounds having an ethylenically unsaturated group and a hydroxyl group, such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 3-chloro-2-hydroxypropyl (meth)acrylate, and 2-hydroxybutyl (meth)acrylate. These may be used singly or in combination of two or more kinds thereof.

[0032] Examples of a monomer for synthesizing a (meth)acrylic resin having a glycidyl group include compounds having an ethylenically

unsaturated group and an epoxy group, such as glycidyl (meth)acrylate, α -ethyl glycidyl (meth)acrylate, α -propyl glycidyl (meth)acrylate, α -butyl glycidyl (meth)acrylate, 2-methyl glycidyl (meth)acrylate, 2-ethyl glycidyl (meth)acrylate, 2-propyl glycidyl (meth)acrylate, 3,4-epoxybutyl (meth)acrylate, 3,4-epoxyheptyl (meth)acrylate, α -ethyl-6,7-epoxyheptyl (meth)acrylate, 3,4-epoxycyclohexyl methyl (meth)acrylate, o-vinylbenzyl glycidyl ether, m-vinylbenzyl glycidyl ether, and p-vinylbenzyl glycidyl ether. These may be used singly or in combination of two or more kinds thereof.

[0033] A (meth)acrylic resin synthesized from these monomers includes a functional group capable of chain polymerization. The functional group capable of chain polymerization is, for example, at least one selected from an acryloyl group and a methacryloyl group. The functional group capable of chain polymerization can be introduced into, for example, a (meth)acrylic resin having at least one functional group selected from a hydroxyl group, a glycidyl group (epoxy group), an amino group, and the like as synthesized as described above, by reacting this (meth)acrylic resin with the following compound (functional group-introducing compound). That is, the content of the functional group in the (meth)acrylic resin can be adjusted by means of the amount of the functional group-introducing compound introduced. Specific examples of the functional group-introducing compound include 2-methacryloyloxyethyl isocyanate, meta-isopropenyl- α,α -dimethylbenzyl isocyanate, methacryloyl isocyanate, allyl isocyanate, 1,1-(bisacryloyloxymethyl)ethyl isocyanate; an acryloyl monoisocyanate compound obtainable by a reaction between a diisocyanate compound or

a polyisocyanate compound and hydroxyethyl (meth)acrylate or 4-hydroxybutylethyl (meth)acrylate; and an acryloyl monoisocyanate compound obtainable by a reaction between a diisocyanate compound or a polyisocyanate compound, a polyol compound, and hydroxyethyl (meth)acrylate. These may be used singly or in combination of two or more kinds thereof. Among these, the functional group-introducing compound may be 2-methacryloyloxyethyl isocyanate.

[0034] [Photopolymerization initiator]

The active energy ray-curable adhesive may further include a photopolymerization initiator. The photopolymerization initiator is not particularly limited as long as it generates an active species capable of chain polymerization when irradiated with active energy rays. The active energy rays may be at least one selected from ultraviolet radiation, electron beam, and visible light and may be ultraviolet radiation. Examples of the photopolymerization initiator include a photoradical polymerization initiator. Here, the active species capable of chain polymerization means a species that initiates a polymerization reaction by reacting with a functional group capable of chain polymerization.

[0035] Examples of the photoradical polymerization initiator include benzoin ketals such as 2,2-dimethoxy-1,2-diphenylethan-1-one; α -hydroxyketones such as 1-hydroxycyclohexyl phenyl ketone, 2-hydroxy-2-methyl-1-phenylpropan-1-one, and 1-[4-(2-hydroxyethoxy)phenyl]-2-hydroxy-2-methyl-1-propan-1-one; α -aminoketones such as 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butan-1-one and 1,2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropan-1-one; oxime esters such as 1-[4-(phenylthiol)phenyl]-1,2-octadione-2-(benzoyl)oxime; phosphine

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

[0036] The content of the photopolymerization initiator in the active energy ray-curable adhesive may be 0.1 to 30 parts by mass, 0.3 to 10 parts by mass, or 0.5 to 5 parts by mass, with respect to 100 parts by mass of the content of the (meth)acrylic resin. When the content of the photopolymerization initiator is 0.1 parts by mass or more, the adhesive

layer is sufficiently cured after being irradiated with active energy rays, and there is a tendency that pickup failure does not easily occur. When the content of the photopolymerization initiator is 30 parts by mass or less, there is a tendency that contamination of the bonding adhesive layer (transfer of the photopolymerization initiator to the bonding adhesive layer) can be prevented.

[0037] [Crosslinking agent]

The active energy ray-curable adhesive may further include a crosslinking agent. The crosslinking agent is used for the purpose of, for example, controlling the elastic modulus and/or adhesiveness of the adhesive layer. The crosslinking agent may be a compound having, in one molecule, two or more units of a functional group capable of reacting with at least one functional group selected from a hydroxyl group, a glycidyl group, an amino group, and the like carried by the (meth)acrylic resin. Examples of the bond formed by a reaction between the crosslinking agent and the (meth)acrylic resin include an ester bond, an ether bond, an amide bond, an imide bond, a urethane bond, and a urea bond.

[0038] According to the present embodiment, the crosslinking agent may be, for example, a polyfunctional isocyanate having two or more isocyanate groups in one molecule. When such a polyfunctional isocyanate is used, the compound easily reacts with a hydroxyl group, a glycidyl group, an amino group, and the like carried by the (meth)acrylic resin and can form a strong crosslinked structure.

[0039] Examples of the polyfunctional isocyanate having two or more isocyanate groups in one molecule include isocyanate compounds such

as 2,4-tolylene diisocyanate, 2,6-tolylene diisocyanate, 1,3-xylylene diisocyanate, 1,4-xylylene diisocyanate, diphenylmethane-4,4'-diisocyanate, diphenylmethane-2,4'-diisocyanate, 3-methyldiphenylmethane diisocyanate, hexamethylene diisocyanate, isophorone diisocyanate, dicyclohexylmethane-4,4'-diisocyanate, dicyclohexylmethane-2,4'-diisocyanate, and lysine isocyanate.

[0040] The crosslinking agent may be a reaction product (isocyanate group-containing oligomer) between a polyfunctional isocyanate and a polyhydric alcohol having two or more hydroxy groups in one molecule.

Examples of the polyhydric alcohol having two or more hydroxy groups in one molecule include ethylene glycol, propylene glycol, butylene glycol, 1,6-hexanediol, 1,8-octanediol, 1,9-nonanediol, 1,10-decanediol, 1,11-undecanediol, 1,12-dodecanediol, glycerin, trimethylolpropane, pentaerythritol, dipentaerythritol, 1,4-cyclohexanediol, and 1,3-cyclohexanediol.

[0041] Among these, the crosslinking agent may be a reaction product (isocyanate group-containing oligomer) between a polyfunctional isocyanate having two or more isocyanate groups in one molecule and a polyhydric alcohol having three or more hydroxy groups in one molecule.

By using such an isocyanate group-containing oligomer as the crosslinking agent, the adhesive layer 3 forms a compact crosslinked structure, and as a result, there is a tendency that the adhesive adhering to the bonding adhesive layer 5 in the pickup step can be sufficiently suppressed.

[0042] The content of the crosslinking agent in the active energy ray-curable adhesive can be appropriately set according to the cohesive force,

the elongation percentage at break, the adhesiveness to the bonding adhesive layer, and the like required of the adhesive layer. Specifically, the content of the crosslinking agent may be, for example, 3 to 30 parts by mass, 4 to 15 parts by mass, and 7 to 10 parts by mass, with respect to 100 parts by mass of the content of the (meth)acrylic resin. By setting the content of the crosslinking agent to the above-described range, both the characteristics required from the adhesive layer in the dicing step and the characteristics required from the adhesive layer in the die-bonding step can be achieved in a well-balanced manner, and excellent pickup properties can also be achieved.

[0043] When the content of the crosslinking agent is 3 parts by mass or more with respect to 100 parts by mass of the content of the (meth)acrylic resin, formation of a crosslinked structure is less likely to be insufficient, and in the pickup step, there is a tendency that the interface adhesive force to the bonding adhesive layer is sufficiently decreased while failure is less likely to occur at the time of picking up. On the other hand, when the content of the crosslinking agent is 30 parts by mass or less with respect to 100 parts by mass of the content of the (meth)acrylic resin, the adhesive layer is less likely to become excessively hard, and there is a tendency that chips are not easily peeled off in the expansion step.

[0044] The content of the crosslinking agent with respect to the total mass of the active energy ray-curable adhesive may be, for example, 0.1% to 15% by mass, 3% to 15% by mass, or 5% to 15% by mass. When the content of the crosslinking agent is 0.1% by mass or more, a region in which the adhesive force has been appropriately decreased (first region 3a) by irradiation with active energy rays is likely to be formed,

and when the content is 15% by mass or less, excellent pickup properties tend to be easily achieved.

[0045] The thickness of the adhesive layer 3 may be appropriately set according to the conditions (temperature, tensile force, and the like) of the expansion step, and for example, the thickness may be 1 to 200 μm , 5 to 50 μm , or 10 to 20 μm . When the thickness of the adhesive layer 3 is 1 μm or more, adhesiveness is less likely to be insufficient, and when the thickness is 200 μm or less, the kerf width becomes wide at the time of expanding (stress is not relieved when the pin is pushed up), while there is a tendency that picking up is less likely to be insufficiently achieved.

[0046] The adhesive layer 3 is formed on the base material layer 1. Regarding the method for forming the adhesive layer 3, a known technique can be employed. For example, a laminated body of the base material layer 1 and the adhesive layer 3 may be formed by a two-layer extrusion method; a varnish of an active energy ray-curable adhesive (varnish for forming an adhesive layer) may be prepared, and this varnish may be applied on the surface of the base material layer 1; or the adhesive layer 3 may be formed on a release-treated film, and this may be transferred onto the base material layer 1.

[0047] The varnish of the active energy ray-curable adhesive (varnish for forming an adhesive layer) may be an organic solvent that can dissolve the (meth)acrylic resin, the photopolymerization initiator, and the crosslinking agent and is volatilized by heating. Specific examples of the organic solvent include aromatic hydrocarbons such as toluene, xylene, mesitylene, cumene, and p-cymene; cyclic ethers such as

tetrahydrofuran and 1,4-dioxane; alcohols such as methanol, ethanol, isopropanol, butanol, ethylene glycol, and propylene glycol; ketones such as acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone, and 4-hydroxy-4-methyl-2-pentanone; esters such as methyl acetate, ethyl acetate, butyl acetate, methyl lactate, ethyl lactate, and γ -butyrolactone; carbonic acid esters such as ethylene carbonate and propylene carbonate; polyhydric alcohol alkyl ethers such as ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monobutyl ether, ethylene glycol dimethyl ether, ethylene glycol diethyl ether, propylene glycol monomethyl ether, propylene glycol monoethyl ether, propylene glycol dimethyl ether, propylene glycol diethyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, diethylene glycol dimethyl ether, and diethylene glycol diethyl ether; polyhydric alcohol alkyl ether acetates such as ethylene glycol monomethyl ether acetate, ethylene glycol monoethyl ether acetate, ethylene glycol monobutyl ether acetate, propylene glycol monomethyl ether acetate, propylene glycol monoethyl ether acetate, diethylene glycol monomethyl ether acetate, and diethylene glycol monoethyl ether acetate; and amides such as N,N-dimethylformamide, N,N-dimethylacetamide, and N-methyl-2-pyrrolidone. Regarding these organic solvents, one kind thereof may be used alone, or two or more kinds thereof may be used in combination.

[0048] Among these, from the viewpoints of solubility and the boiling point, the organic solvent may be at least one selected from the group consisting of toluene, methanol, ethanol, isopropanol, acetone, methyl ethyl ketone, methyl isobutyl ketone, cyclohexanone, methyl acetate,

ethyl acetate, butyl acetate, ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, propylene glycol monomethyl ether, propylene glycol monoethyl ether, diethylene glycol dimethyl ether, ethylene glycol monomethyl ether acetate, propylene glycol monomethyl ether acetate, and N,N-dimethylacetamide. The solid content concentration of the varnish is usually 10% to 60% by mass.

[0049] (Base material layer)

Regarding the base material layer 1, a known polymer sheet or film can be used, and the base material layer 1 is not particularly limited as long as it can be subjected to the expansion step under low temperature conditions. Specific examples of the base material layer 1 include polyolefins such as crystalline polypropylene, amorphous polypropylene, high-density polyethylene, medium-density polyethylene, low-density polyethylene, ultralow-density polyethylene, low-density linear polyethylene, polybutene, and polymethylpentene; an ethylene-vinyl acetate copolymer, an ionomer resin, an ethylene-(meth)acrylic acid copolymer, an ethylene-(meth)acrylic acid ester (random, alternating) copolymer, an ethylene-butene copolymer, an ethylene-hexene copolymer, polyurethane; polyesters such as polyethylene terephthalate and polyethylene naphthalate; polycarbonate, polyimide, polyether ether ketone, polyimide, polyetherimide, polyamide, total aromatic polyamide, polyphenyl sulfide, aramid (paper), glass, glass cloth, a fluororesin, polyvinyl chloride, polyvinylidene chloride, a cellulose-based resin, a silicone resin, a mixture obtained by mixing a plasticizer with these, or a cured product that has been crosslinked by irradiation with an electron beam.

[0050] The base material layer 1 may be a base material layer having a surface that includes at least one resin selected from the group consisting of polyethylene, polypropylene, a polyethylene-polypropylene random copolymer, and a polyethylene-polypropylene block copolymer as a main component, this surface being in contact with the adhesive layer 3. These resins can be satisfactory base materials even from the viewpoints of the characteristics such as Young's modulus, stress relaxation properties, and melting point, as well as the price, waste material recycling after use, and the like. The base material layer 1 may be a single layer and may also have a multilayer structure in which layers formed from different materials are laminated, as necessary. From the viewpoint of controlling the adhesiveness to the adhesive layer 3, the surface of the base material layer 1 may be subjected to a surface roughening treatment such as a mattifying treatment or a corona treatment.

[0051] (Bonding adhesive layer)

To the bonding adhesive layer 5, an adhesive composition that constitutes a known die-bonding film can be applied. Specifically, the adhesive composition constituting the bonding adhesive layer 5 may include a reactive group-containing (meth)acrylic copolymer, a curing accelerator, and a filler. According to a bonding adhesive layer 5 including these components, there is a tendency of having features such as that the adhesiveness between the chip and the substrate and between a chip and another chip is excellent, electrode embedding properties, wire embedding properties, and the like can also be imparted, adhesion can be achieved at a low temperature in the die-bonding step, excellent curing

can be attained in a short period of time, and excellent reliability is exhibited after molding with an encapsulating agent.

[0052] The reactive group-containing (meth)acrylic copolymer may be, for example, an epoxy group-containing (meth)acrylic copolymer. The epoxy group-containing (meth)acrylic copolymer may be a copolymer obtainable by using glycidyl (meth)acrylate as a raw material in an amount of 0.5% to 6% by mass with respect to the obtainable copolymer.

When the content of glycidyl (meth)acrylate is 0.5% by mass or more, high adhesive force is easily obtained, and when the content is 6% by mass or less, there is a tendency that gelation can be suppressed. The

monomer constituting the remaining portion of the reactive group-containing (meth)acrylic copolymer may be, for example, an alkyl (meth)acrylate having an alkyl group with 1 to 8 carbon atoms, such as methyl (meth)acrylate, styrene, acrylonitrile, or the like. Among these,

the monomer constituting the remaining portion of the reactive group-containing (meth)acrylic copolymer may be ethyl (meth)acrylate and/or butyl (meth)acrylate. The mixing ratio can be adjusted in consideration of the T_g of the reactive group-containing (meth)acrylic copolymer.

When T_g is -10°C or higher, there is a tendency that the tackiness of the bonding adhesive layer 5 in a B stage state can be suppressed from being excessively high, and there is a tendency that excellent handleability is obtained. Incidentally, the glass transition point (T_g) of the epoxy

group-containing (meth)acrylic copolymer may be, for example, 30°C or lower. The polymerization method is not particularly limited; however, examples include pearl polymerization and solution polymerization.

Examples of a commercially available epoxy group-containing

(meth)acrylic copolymer include HTR-860P-3 (trade name, manufactured by Nagase ChemteX Corp.).

[0053] The weight average molecular weight of the epoxy group-containing (meth)acrylic copolymer may be 100000 from the viewpoints of adhesiveness and heat resistance, and may be 300000 to 3000000, or 500000 to 2000000. When the weight average molecular weight is 3000000 or less, deterioration of the fillability between the chip and the substrate supporting this chip can be suppressed. The weight average molecular weight is a polystyrene-equivalent value obtained by gel permeation chromatography method (GPC) using a calibration curve based on polystyrene standards.

[0054] The curing accelerator may be, for example, a tertiary amine, an imidazole, or a quaternary ammonium salt. Specific examples of the curing accelerator include 2-methylimidazole, 2-ethyl-4-methylimidazole, 1-cyanoethyl-2-phenylimidazole, and 1-cyanoethyl-2-phenylimidazolium trimellitate. These may be used singly, or two or more kinds thereof may be used in combination.

[0055] The filler may be an inorganic filler. Specific examples of the inorganic filler include aluminum hydroxide, magnesium hydroxide, calcium carbonate, magnesium carbonate, calcium silicate, magnesium silicate, calcium oxide, magnesium oxide, aluminum oxide, aluminum nitride, aluminum borate whiskers, boron nitride, crystalline silica, and amorphous silica. These may be used singly, or two or more kinds thereof may be used in combination.

[0056] The adhesive composition may further include an epoxy resin and an epoxy resin curing agent. Examples of the epoxy resin include a

bisphenol A type epoxy resin, a bisphenol F type epoxy resin, a bisphenol S type epoxy resin, an alicyclic epoxy resin, an aliphatic chain-like epoxy resin, a phenol novolac type epoxy resin, a cresol novolac type epoxy resin, a bisphenol A novolac type epoxy resin, diglycidyl etherified product of biphenol, diglycidyl etherified product of naphthalenediol, diglycidyl etherified product of a phenol, diglycidyl etherified product of an alcohol; bifunctional epoxy resins such as alkyl-substituted products, halides, and hydrogenation products of the above-described compounds; and novolac type epoxy resins. Furthermore, other epoxy resins that are generally known, such as a polyfunctional epoxy resin and a heterocyclic ring-containing epoxy resin, may also be applied. These can be used singly or in combination of two or more kinds thereof. Incidentally, components other than epoxy resins may also be included as impurities, to the extent that does not impair the characteristics.

[0057] Regarding the epoxy resin curing agent, for example, a phenol resin obtainable by reacting a phenol compound and a xylylene compound, which is a divalent linking group, without catalyst or in the presence of an acid catalyst may be mentioned. Examples of the phenol compound that is used for the production of a phenol resin include phenol, o-cresol, m-cresol, p-cresol, o-ethylphenol, p-ethylphenol, o-n-propylphenol, m-n-propylphenol, p-n-propylphenol, o-isopropylphenol, m-isopropylphenol, p-isopropylphenol, o-n-butylphenol, m-n-butylphenol, p-n-butylphenol, o-isobutylphenol, m-isobutylphenol, p-isobutylphenol, octylphenol, nonylphenol, 2,4-xyleneol, 2,6-xyleneol, 3,5-xyleneol, 2,4,6-trimethylphenol, resorcin, catechol, hydroquinone, 4-methoxyphenol, o-phenylphenol, m-phenylphenol, p-phenylphenol, p-

cyclohexylphenol, o-allylphenol, p-allylphenol, o-benzylphenol, p-benzylphenol, o-chlorophenol, p-chlorophenol, o-bromophenol, p-bromophenol, o-iodophenol, p-iodophenol, o-fluorophenol, m-fluorophenol, and p-fluorophenol. These phenol compounds may be used singly, or two or more kinds thereof may be used as mixtures.

Regarding the xylylene compound, which is a divalent linking group used for the production of the phenol resin, xylylene dihalide, xylylene diglycol, and derivatives thereof as shown below can be used. That is, specific examples of the xylylene compound include α,α' -dichloro-p-xylene, α,α' -dichloro-m-xylene, α,α' -dichloro-o-xylene, α,α' -dibromo-p-xylene, α,α' -dibromo-m-xylene, α,α' -dibromo-o-xylene, α,α' -diiodo-p-xylene, α,α' -diiodo-m-xylene, α,α' -diiodo-o-xylene, α,α' -dihydroxy-p-xylene, α,α' -dihydroxy-m-xylene, α,α' -dihydroxy-o-xylene, α,α' -dimethoxy-p-xylene, α,α' -dimethoxy-m-xylene, α,α' -dimethoxy-o-xylene, α,α' -diethoxy-p-xylene, α,α' -diethoxy-m-xylene, α,α' -diethoxy-o-xylene, α,α' -di-n-propoxy-p-xylene, α,α' -di-n-propoxy-m-xylene, α,α' -di-n-propoxy-o-xylene, α,α' -diisopropoxy-p-xylene, α,α' -diisopropoxy-m-xylene, α,α' -diisopropoxy-o-xylene, α,α' -di-n-butoxy-p-xylene, α,α' -di-n-butoxy-m-xylene, α,α' -di-n-butoxy-o-xylene, α,α' -diisobutoxy-p-xylene, α,α' -diisobutoxy-m-xylene, α,α' -diisobutoxy-o-xylene, α,α' -di-tert-butoxy-p-xylene, α,α' -di-tert-butoxy-m-xylene, and α,α' -di-tert-butoxy-o-xylene. These may be used singly or in combination of two or more kinds thereof.

[0058] When a phenol compound and a xylylene compound are caused to react, a phenol resin is obtained by causing the compounds to react using acidic catalysts, such as mineral acids such as hydrochloric acid,

sulfuric acid, phosphoric acid, and polyphosphoric acid; organic carboxylic acids such as dimethylsulfuric acid, diethylsulfuric acid, p-toluenesulfonic acid, methanesulfonic acid, and ethanesulfonic acid; super strong acids such as trifluoromethanesulfonic acid; strongly acidic ion exchange resins such as an alkanesulfonic acid type ion exchange resin; super strong acid ion exchange resins such as a perfluoroalkanesulfonic acid type ion exchange resin (trade name: NAFION, Nafion, manufactured by Du Pont, Inc., "NAFION" is a registered trademark); natural and synthetic zeolites; and activated white clay (acidic white clay), until the xylylene compound as a raw material substantially disappears at 50°C to 250°C and the reaction composition becomes constant. The reaction time can be appropriately set according to the raw materials and can be set to, for example, about 1 hour to 15 hours, and the reaction time can be determined while tracking the reaction composition by GPC (gel permeation chromatography) or the like.

[0059] The thickness of the bonding adhesive layer 5 may be, for example, 1 to 300 μm , 5 to 150 μm , or 10 to 100 μm . When the thickness of the bonding adhesive layer 5 is 1 μm or more, the adhesiveness tends to be superior, and when the thickness is 300 μm or less, the dividability at the time of expansion and the pickup properties tend to be superior.

[0060] <Method for producing dicing die-bonding integrated film>

A method for producing the film 10 includes, in the following order, a step of producing, on the surface of a base material layer 1, a laminated body including an adhesive layer formed from an active energy ray-curable adhesive whose adhesive force is decreased by irradiation

with active energy rays, and a bonding adhesive layer 5 formed on the surface of the adhesive layer; and a step of irradiating a region that constitutes the first region 3a of the adhesive layer included in the laminated body with active energy rays. The amount of irradiation with active energy rays for the region that constitutes the first region 3a may be, for example, 10 to 1000 mJ/cm², 100 to 700 mJ/cm², or 100 to 500 mJ/cm². This production method is a method of first producing a laminated body of an adhesive layer and a bonding adhesive layer 5 and then irradiating a particular region of the adhesive layer with active energy rays.

[0061] <Semiconductor device and method for producing the same>

FIG. 3 is a cross-sectional view schematically illustrating a semiconductor device according to the present embodiment. The semiconductor device 100 shown in this diagram includes a substrate 70; four chips S1, S2, S3, and S4 laminated on the surface of the substrate 70; wires W1, W2, W3, and W4 electrically connecting electrodes (not shown in the diagram) and the four chips S1, S2, S3, and S4 on the surface of the substrate 70; and an encapsulation layer 50 encapsulating these.

[0062] The substrate 70 is, for example, an organic substrate and may be a metal substrate such as a lead frame. From the viewpoint of suppressing warpage of the semiconductor device 100, the thickness of the substrate 70 may be, for example, 70 to 140 μm or 80 to 100 μm.

[0063] The four chips S1, S2, S3, and S4 are laminated with a cured product 5C of an adhesive piece 5P interposed therebetween. The shape of the chips S1, S2, S3, and S4 in a plan view is, for example, a square shape or a rectangular shape. The area of the chips S1, S2, S3, and S4

may be, for example, 200 mm² or less, 150 mm² or less, 100 mm² or less, 50 mm² or less, 30 mm² or less, 20 mm² or less, 10 mm² or less, or 9 mm² or less, and may be 0.1 to 200 mm², 0.1 to 150 mm², 0.1 to 100 mm², 0.1 to 50 mm², 0.1 to 30 mm², 0.1 to 20 mm², 0.1 to 10 mm², or 0.1 to 9 mm².

5 The length of one side of the chips S1, S2, S3, and S4 may be, for example, 0.1 to 20 mm, 0.1 to 15 mm, 0.1 to 10 mm, 0.1 to 8 mm, 0.1 to 6 mm, 0.1 to 3 mm, 0.1 to 2 mm, or 0.1 to 1 mm. The thickness of the chips S1, S2, S3, and S4 may be, for example, 10 to 170 μm or 25 to 100 μm. Incidentally, the lengths of one side of the four chips S1, S2, S3,
10 and S4 may be the same or may be different from each other, and the same also applies to the thickness.

[0064] A method for producing the semiconductor device 100 includes a first step of preparing the above-mentioned film 10; a second step of sticking a wafer W to the bonding adhesive layer 5 of the film 10 and
15 sticking a dicing ring DR to the second surface F2 of the adhesive layer 3; a third step of singularizing the wafer W, together with the bonding adhesive layer 5 and the adhesive layer 3, into a plurality of chips S by blade dicing using a blade to form cut bodies 20 (dicing step); a fourth step of picking up a DAF 8 (laminated body of a chip S1 and an adhesive
20 piece 5P, see FIG. 4(d)) from the first region 3a of the adhesive layer 3 of a cut body 20; and a fifth step of mounting the chip S1 on a substrate 70, with the adhesive piece 5P interposed therebetween.

[0065] An example of the method for producing the DAF 8 will be described with reference to FIG. 4(a), FIG. 4(b), FIG. 4(c), FIG. 4(d) and
25 FIG. 5(a). First, the above-mentioned film 10 is prepared. As shown in FIG. 4(a) and FIG. 4(b), the film 10 is stuck such that the bonding

adhesive layer 5 comes into contact with one surface of the wafer W. Furthermore, a dicing ring DR is stuck to the second surface F2 of the adhesive layer 3.

[0066] Next, the wafer W, the bonding adhesive layer 5, and the adhesive layer 3 are diced by blade dicing using a blade. As a result, as shown in FIG. 4(c) and FIG. 5(a), the wafer W is singularized together with the bonding adhesive layer 5 and the adhesive layer 3 to obtain chips S. The bonding adhesive layer 5 is also singularized to obtain adhesive pieces 5P. In this manner, cut bodies 20 are formed. Incidentally, prior to the dicing of the wafer W, the wafer W may be made into a thin film by grinding.

[0067] Kerfs are formed in the adhesive layer 3 of the cut bodies 20 by the above-described blade dicing. The kerf width formed in the adhesive layer 3 of cut bodies 20 by blade dicing is 75% or greater with respect to the blade width, and the kerf width may be 78% or greater or 80% or greater. By providing such a kerf width, double die can be suppressed, and consequently, it is possible to enhance the production efficiency. The adhesive layer 3 shrinks as a result of dicing. That is, the kerf width may be greater than 100%. The kerf width formed in the adhesive layer 3 of the cut bodies 20 by blade dicing may be 160% or less or 150% or less with respect to the blade width. Kerfs that are formed by dicing are generated when the stress caused by curing shrinkage occurring due to curing by irradiation with active energy rays at the time of forming the first region 3a of the adhesive layer 3, is released by dicing, and the present inventors contemplate that when the amount of curing shrinkage of the (meth)acrylic resin and the like in the adhesive layer 3 is

large, the width (kerf width) is easily expandable. The above-mentioned dicing die-bonding integrated film has a sufficient amount of curing shrinkage, and by using this, it is possible to form a kerf width that satisfies the above-described requirements. Incidentally, regarding the
5 kerf width, the distance between the adhesive layers between adjacent chips is measured at a plurality of sites (at least three sites) using an optical microscope, and the average value of these can be applied.

[0068] With regard to the production of a dicing film (adhesive layer), when the adhesive layer is subjected to a pressurization treatment such as
10 pressing in one direction with a rubber roll or the like, the kerf widths formed by the direction of blade dicing may be different. Hereinafter, this will be described with reference to FIG. 5(b). With regard to the case of performing a pressurization treatment such as pressing the adhesive layer in one direction with a rubber roll or the like, when this
15 one direction is designated as direction A, a direction that is the same as the direction A is designated as direction Ch1, and a direction orthogonal to Ch1 is designated as direction Ch2, the kerf width WCh1 between chips adjacent to each other in the direction Ch1 (kerf width formed by dicing in the direction Ch2) and the kerf width WCh2 between chips
20 adjacent to each other in the direction Ch2 (kerf width formed by dicing in the direction Ch1) may be different from each other. Conventionally, the kerf width WCh1 tends to have a larger swing width than the kerf width WCh2. With regard to the relationship between the kerf width WCh1 and kerf width WCh2 and the above-described kerf width
25 conditions, it is desirable that either the kerf width WCh1 or the kerf width WCh2 satisfies the above-described kerf width conditions;

however, from the viewpoint of more reliably suppressing double die, it is preferable that both the kerf width WCh1 and the kerf width WCh2 satisfy the above-described kerf width conditions.

[0069] The kerf width formed in the adhesive layer 3 of the cut body 20 by blade dicing may be, for example, 10 μm or more, 13 μm or more, 15 μm or more, or 17 μm or more. When the kerf width is 10 μm or more, there is a tendency that double die can be suppressed, and when the kerf width is 13 μm or more, there is a tendency that double die can be more reliably suppressed. The upper limit of the kerf width is not particularly limited; however, the upper limit can be, for example, set to 50 μm or less.

[0070] The blade width may be 10 to 50 μm and may also be 10 to 30 μm or 10 to 25 μm . Even when such a blade having a relatively narrow width is used, double die can be more sufficiently suppressed. Incidentally, regarding the blade width, for example, an actually measured value that can be determined from an incision in a silicon wafer using an optical microscope can be applied. The method for measuring the actually measured value may be, for example, the method described in Examples.

[0071] After dicing, while the chips S are separated apart from each other by expanding the base material layer 1 at normal temperature or under cooling conditions as shown in FIG. 4(d) without irradiating the adhesive layer 3 with active energy rays, the adhesive pieces 5P are peeled off from the adhesive layer 3 by pushing up with a pin 42, and the DAF8 is suctioned and picked up using a suction collet 44.

[0072] The method for producing the semiconductor device 100 will be

specifically described with reference to FIG. 6, FIG. 7, and FIG. 8. First, as shown in FIG. 6, a first-stage chip S1 (chip S) is pressure-bonded at a predetermined position of the substrate 70, with the adhesive piece 5P interposed therebetween. Next, the adhesive piece 5P is cured by heating. As a result, the adhesive piece 5P is cured to form a cured product 5C. The curing treatment of the adhesive piece 5P may be carried out in a pressurized atmosphere, from the viewpoint of reducing voids.

[0073] A second-stage chip S2 is mounted on the surface of the chip S1 in the same manner as in the mounting of the chip S1 on the substrate 70. Furthermore, by mounting third-stage and fourth-stage chips S3 and S4, a structural body 60 shown in FIG. 7 is produced. The chips S1, S2, S3, and S4 and the substrate 70 are electrically connected using wires W1, W2, W3, and W4 (see FIG. 8), and then the semiconductor elements and the wires are encapsulated by an encapsulation layer 50 to complete the semiconductor device 100 shown in FIG. 3.

[0074] Thus, embodiments of the present disclosure have been described in detail; however, the present invention is not intended to be limited to the above-described embodiments. For example, in the above-described embodiment, a film 10 including a base material layer 1, an adhesive layer 3, and a bonding adhesive layer 5 in this order has been described as an example; however, an embodiment that does not include a bonding adhesive layer 5 is also acceptable. Furthermore, the film 10 may further include a cover film (not shown in the diagram) that covers the bonding adhesive layer 5.

Examples

[0075] Hereinafter, the present disclosure will be more specifically described based on Examples; however, the present invention is not intended to be limited to these Examples. Incidentally, unless particularly stated otherwise, reagents were used for all the chemicals.

5 [0076] <Production Example 1>

[Synthesis of acrylic resin (A-1)]

The following components were introduced into a flask equipped with a three-one motor, a stirring blade, and a nitrogen inlet tube and having a capacity of 2000 mL.

- 10 · Ethyl acetate (solvent): 635 parts by mass
- 2-Ethylhexyl acrylate: 395 parts by mass
- 2-Hydroxyethyl acrylate: 100 parts by mass
- Methacrylic acid: 5 parts by mass
- Azobisisobutyronitrile: 0.08 parts by mass

15 [0077] The contents were stirred until the contents became sufficiently uniform, subsequently bubbling was performed for 60 minutes at a flow rate of 500 mL/min, and dissolved oxygen in the system was degassed. The temperature was increased up to 78°C for one hour, and after the temperature increase, polymerization was performed for 6 hours. Next,
20 the reaction solution was transferred into an autoclave equipped with a three-one motor, a stirring blade, and a nitrogen inlet tube and having a capacity of 2000 mL, and the reaction solution was heated for 4.5 hours under the conditions of 120°C and 0.28 MPa and then cooled to room temperature (25°C; hereinafter, the same).

25 [0078] Next, 490 parts by mass of ethyl acetate was added thereto, subsequently the mixture was stirred, and the contents were diluted. To

this, 0.10 parts by mass of dioctyltin dilaurate as a urethanization catalyst was added, subsequently 48.6 parts by mass of 2-methacryloyloxyethyl isocyanate (manufactured by Showa Denko K.K., KARENZ MOI (trade name)) was added thereto, and the mixture was reacted for 6 hours at 70°C and then cooled to room temperature. Next, ethyl acetate was further added thereto, the non-volatile component content in the acrylic resin solution was adjusted to be 35% by mass, and a solution including an acrylic resin (A-1) having a functional group capable of chain polymerization of Production Example 1 was obtained.

[0079] The solution including the acrylic resin (A-1) obtained as described above was dried overnight in a vacuum at 60°C. The solid content obtained by this process was subjected to elemental analysis with a fully automated elemental analyzer (manufactured by Elementar Analysensysteme GmbH, trade name: varioEL), the content of the functional group derived from the introduced 2-methacryloxyethyl isocyanate was calculated from the nitrogen content, and the content was 0.50 mmol/g.

[0080] Furthermore, the polystyrene-equivalent weight average molecular weight of the acrylic resin (A-1) was determined by using the following apparatus. That is, GPC measurement was carried out using SD-8022/DP-8020/RI-8020 manufactured by Tosoh Corp., using Gelpack GL-A150-S/GL-A160-S manufactured by Hitachi Chemical Co., Ltd. as columns; and using tetrahydrofuran as an eluent. As the result, the polystyrene-equivalent weight average molecular weight was 800000. The hydroxyl group value and the acid value measured according to the method described in JIS K0070 were 56.1 mg KOH/g

and 6.5 mg KOH/g, respectively. The results are shown together in Table 1.

[0081] <Production Example 2>

[Synthesis of acrylic resin (A-2)]

5 A solution including an acrylic resin (A-2) of Production Example 2 was obtained by a technique similar to that of Production Example 1, except that the raw material monomer composition shown in Production Example 1 of Table 1 was changed to the raw material monomer composition shown in Production Example 2 of Table 1. The measurement results for the characteristics of the acrylic resin (A-2) of
10 Production Example 2 are shown in Table 1.

[0082] <Production Example 3>

[Synthesis of acrylic resin (A-3)]

15 A solution including an acrylic resin (A-3) of Production Example 3 was obtained by a technique similar to that of Production Example 1, except that the raw material monomer composition shown in Production Example 1 of Table 1 was changed to the raw material monomer composition shown in Production Example 3 of Table 1. The measurement results for the characteristics of the acrylic resin (A-3) of
20 Production Example 3 are shown in Table 1.

[0083] <Production Example 4>

[Synthesis of acrylic resin (A-4)]

25 A solution including an acrylic resin (A-4) of Production Example 4 was obtained by a technique similar to that of Production Example 1, except that the raw material monomer composition shown in Production Example 1 of Table 1 was changed to the raw material monomer

composition shown in Production Example 4 of Table 1. The measurement results for the characteristics of the acrylic resin (A-4) of Production Example 4 are shown in Table 1.

[0084] <Production Example 5>

5 [Synthesis of acrylic resin (A-5)]

A solution including an acrylic resin (A-5) of Production Example 5 was obtained by a technique similar to that of Production Example 1, except that the raw material monomer composition shown in Production Example 1 of Table 1 was changed to the raw material monomer composition shown in Production Example 5 of Table 1. The measurement results for the characteristics of the acrylic resin (A-5) of Production Example 5 are shown in Table 1.

10

[0085] Table 1

Acrylic resin	Production Example 1	Production Example 2	Production Example 3	Production Example 4	Production Example 5
	(A-1)	(A-2)	(A-3)	(A-4)	(A-5)
Raw material monomer (parts by mass)	2-Ethylhexyl acrylate	79	80	79	79
	2-Hydroxyethyl acrylate	20	19	20	20
	2-Hydroxyethyl methacrylate	-	-	-	-
	Methacrylic acid	1	1	1	1
	(Total)	(100)	(100)	(100)	(100)
	2-Methacryloxyethyl isocyanate	9.7	16.2	4.9	3.2
Weight average molecular weight					
		80×10^4	80×10^4	40×10^4	80×10^4
Hydroxyl group value (mgKOH/g)		56.1	32.8	29.3	75.5
Acid value (mgKOH/g)		6.5	6.5	6.5	6.5
Content of functional group capable of chain polymerization (mmol/g)		0.5	0.9	0.3	0.2

[0086] <Example 1>

[Production of dicing film (adhesive layer)]

A varnish of an active energy ray-curable adhesive (varnish for forming an adhesive layer) was prepared by mixing the following components (see Table 2). The amount of ethyl acetate (solvent) was adjusted such that the total solid content of the varnish was 25% by mass.

· Solution including acrylic resin (A-1) of Production Example 1: 100 parts by mass (solid content)

· Photopolymerization initiator (B-1) (1-hydroxycyclohexyl phenyl ketone, manufactured by Ciba Specialty Chemicals, Inc., IRGACURE 184, "IRGACURE" is a registered trademark): 1.0 parts by mass

· Crosslinking agent (C-1) (polyfunctional isocyanate (reaction product between tolylene diisocyanate and trimethylolpropane), manufactured by Nippon Polyurethane Industry Co., Ltd., CORONATE L, solid content 75%): 8.0 parts by mass (solid content)

· Ethyl acetate (solvent)

[0087] A polyethylene terephthalate film (width 450 mm, length 500 mm, thickness 38 μ m) that had been subjected to a release treatment on one surface was prepared. The varnish of the active energy ray-curable adhesive was applied using an applicator on the surface that had been subjected to a release treatment, and then the varnish was dried for 5 minutes at 80°C. As a result, a laminated body (dicing film) composed of a polyethylene terephthalate film and an adhesive layer having a thickness of 30 μ m and formed thereon was obtained.

[0088] A polyolefin film (width 450 mm, length 500 mm, thickness 80

μm) that had been subjected to a corona treatment on one surface was prepared. The surface that had been subjected to a corona treatment and the adhesive layer of the above-described laminated body were stuck together at room temperature. Next, the adhesive layer was transferred onto the polyolefin film (cover film) by pressing the assembly by moving a rubber roll in one direction. Subsequently, the assembly was left to stand for three days at room temperature to obtain a cover film-attached dicing film.

[0089] [Production of die-bonding film (bonding adhesive layer)]

A varnish for forming a bonding adhesive layer was prepared by mixing the following components. First, cyclohexanone (solvent) was added to a mixture including the following components, the mixture was stirred and mixed, and then the mixture was further kneaded for 90 minutes using a bead mill.

- Epoxy resin (YDCN-700-10 (trade name), manufactured by Nippon Steel & Sumikin Chemical Co., Ltd., cresol novolac type epoxy resin, epoxy equivalent: 210, molecular weight: 1200, softening point: 80°C): 14 parts by mass

- Phenol resin (MILEX XLC-LL (trade name), manufactured by Mitsui Chemicals, Inc., phenol resin, hydroxyl group equivalent: 175, coefficient of water absorption: 1.8%, heating weight reduction rate at 350°C: 4%): 23 parts by mass

- Silane coupling agent (NUC A-189 (trade name), manufactured by Nippon Unicar Co., Ltd., γ-mercaptopropyltrimethoxysilane): 0.2 parts by mass

- Silane coupling agent (NUCA-1160 (trade name), manufactured

by Nippon Unicar Co., Ltd., γ -ureidopropyltriethoxysilane): 0.1 parts by mass

· Filler (SC2050-HLG (trade name), manufactured by Admatechs Co., Ltd., silica, average particle size 0.500 μm): 32 parts by mass

5 [0090] The following components were further added to the mixture obtained as described above, and the mixture was subjected to processes of stirring, mixing, and vacuum degassing to obtain a varnish for forming a bonding adhesive layer (varnish of an adhesive composition including at least a reactive group-containing (meth)acrylic copolymer, a curing
10 accelerator, and a filler).

· Epoxy group-containing acrylic copolymer (HTR-860P-3 (trade name), manufactured by Nagase ChemteX Corp., weight average molecular weight: 800000): 16 parts by mass

· Curing accelerator (CUREZOL 2PZ-CN (trade name),
15 manufactured by Shikoku Chemicals Corp., 1-cyanoethyl-2-phenylimidazole, "CUREZOL" is a registered trademark): 0.1 parts by mass

[0091] A polyethylene terephthalate film (thickness 35 μm) that had been subjected to a release treatment on one surface was prepared. The
20 varnish for forming a bonding adhesive layer was applied using an applicator on the surface that had been subjected to a release treatment, and then the varnish was heated and dried for 5 minutes at 140°C. As a result, a laminated body (die-bonding film) composed of a polyethylene terephthalate film (carrier film) and a bonding adhesive layer (B stage
25 state) having a thickness of 25 μm formed thereon was obtained.

[0092] [Production of dicing die-bonding integrated film]

The die-bonding film composed of a bonding adhesive layer and a carrier film was cut, together with the carrier film, into a circular shape having a diameter of 335 mm. To the cut die-bonding film, a dicing film from which the polyethylene terephthalate film had been peeled off was stuck at room temperature, and then the assembly was left to stand for one day at room temperature. Subsequently, the dicing film was cut into a circular shape having a diameter of 370 mm to obtain a laminated body. A region (first region of the adhesive layer) corresponding to a sticking position for a wafer in the bonding adhesive layer of the laminated body obtained as such, was irradiated with ultraviolet radiation as follows. That is, the laminated body was partially irradiated with ultraviolet radiation at 70 W in an amount of irradiation of 300 mJ/cm² using a pulsed xenon lamp. Incidentally, the irradiation with ultraviolet radiation was carried out on a portion having an inner diameter of 318 mm from the center of the film using a blackout curtain. In this manner, a dicing die-bonding integrated film of Example 1 to be supplied to various evaluation tests that will be described below was obtained.

[0093] [Evaluation tests]

(Measurement of kerf width)

The dicing die-bonding integrated film of Example 1 and a wafer (silicon, diameter 12 inches, thickness 50 μm) were stuck together by heating for 10 seconds at 80°C. Subsequently, in order to obtain a plurality of quadrangular chips having a predetermined size under the following dicing conditions, incisions were inserted at a predetermined interval in the same direction as the direction in which the rubber roll was moved when the adhesive layer was transferred onto the polyolefin film

(cover film) in the above-described section "Production of dicing film (adhesive layer)", incisions were further inserted at a predetermined interval in a direction orthogonal to the direction in which the rubber roll was moved, and the dicing die-bonding integrated film and the wafer were singularized into a plurality of adhesive piece-attached chips.

- Dicer: manufactured by DISCO Corp., DFD-6361
- Blade: manufactured by DISCO Corp., ZH05-SD4000-N1-70-BB

BB

- Speed of blade rotation: 40000 rpm
- Dicing velocity: 30 mm/s
- Incision depth from the surface of the adhesive layer to the base material layer: 20 μ m
- Cutting mode: Downcutting
- Chip size: 10 mm $\times$ 10 mm

[0094] For the singularized wafer, the direction in which the rubber roll was moved when the adhesive layer was transferred onto the polyolefin film (cover film) in the above-described section "Production of dicing film (adhesive layer)" was designated as direction Ch1, a direction orthogonal to Ch1 was designated as direction Ch2, and the kerf width WCh1 between chips adjacent to each other in the direction Ch1 and the kerf width WCh2 between chips adjacent to each other in the direction Ch2 were measured using an optical microscope. For the measurement, the measurement site was set at three places, and the average value of these was determined as the kerf width. The results are presented in Table 2.

[0095] (Measurement of blade width)

The dicing die-bonding integrated film of Example 1 and a wafer having a thickness of 400 μm were stuck together by heating for 10 seconds at 80°C. Subsequently, an incision was inserted once, by setting the incision depth from the surface of the wafer into the bonding adhesive layer to 100 μm , under the same conditions as the dicing conditions for the above-described measurement of kerf width. Next, the wafer was cut so as to be orthogonal to this incision depth, and the cut surface obtained in this cutting was observed. The width at a position at a height of 20 μm from the bottom of dicing was measured as the blade width. The blade width was 20.8 μm . In the evaluation test, this value was used as the blade width for the calculation of the ratio of the kerf width with respect to the blade width.

[0096] (Calculation of ratio of kerf width with respect to blade width)

The ratio of the kerf width with respect to the blade width was calculated from the obtained kerf width and blade width. The results are presented in Table 2.

[0097] <Examples 2 to 11 and Comparative Examples 1 and 2>

Evaluation tests were carried out in the same manner as in Example 1, except that the composition of the adhesive layer and the amount of ultraviolet irradiation indicated for Example 1 in Table 2 were changed to the compositions of the adhesive layer and the amounts of ultraviolet irradiation indicated for the various Examples and various Comparative Examples in Table 2, Table 3, and Table 4, and the dicing conditions indicated for Example 1 in Table 2 were changed to the dicing conditions indicated for the various Examples and various Comparative Examples in Table 2, Table 3, and Table 4. Incidentally, the

photopolymerization initiator (B-2) is 2-hydroxy-1-{4-[4-(2-hydroxy-2-methylpropionyl)-benzyl]-phenyl}-2-methylpropan-1-one (manufactured by Ciba Specialty Chemicals, Inc., IRGACURE 127, "IRGACURE" is a registered trademark). The results are presented in Table 2, Table 3, and Table 4.

5

[0098] Table 2

		Unit	Exam. 1	Exam. 2	Exam. 3	Exam. 4	Exam. 5	Exam. 6		
Composition of adhesive layer	Acrylic resin	Parts by mass	100	100	-	-	-	-		
		Parts by mass	-	-	100	100	-	-		
		Parts by mass	-	-	-	-	100	100		
		Parts by mass	-	-	-	-	-	-		
		Parts by mass	-	-	-	-	-	-		
	Photopolymerization initiator	Parts by mass	1	1	-	-	1	1		
		Parts by mass	-	-	1	1	-	-		
		Parts by mass	8	8	6	6	6	6		
	Amount of ultraviolet irradiation		300	300	300	300	300	300		
	Chip size		10 × 10	3 × 3	10 × 10	3 × 3	10 × 10	3 × 3		
Kerf width		WC h1	WC h1	WC h1	WC h1	WC h1	WC h1	WC h1		
		WC h2	WC h2	WC h2	WC h2	WC h2	WC h2	WC h2		
Ratio of kerf width with respect to blade width		μm	17.7	16.8	28.8	24.6	30.3	26.5	25.2	
		%	85	81	138	118	146	142	127	121

[0100] Table 4

		Unit	Comp. Exam. 1	Comp. Exam. 2		
Composition of adhesive layer	(A-1)	Parts by mass	-	-		
	(A-2)	Parts by mass	-	-		
	(A-3)	Parts by mass	-	-		
	(A-4)	Parts by mass	100	-		
	(A-5)	Parts by mass	-	100		
	(B-1)	Parts by mass	-	-		
	(B-2)	Parts by mass	1	1		
	(C-1)	Parts by mass	6	6		
Amount of ultraviolet irradiation		mJ/cm ²	300	300		
Chip size		mm	3 × 3			
Kerf width			WCh1	WCh2	WCh1	WCh2
		μm	13.9	11.8	13.8	12.7
Ratio of kerf width with respect to blade width		%	67	57	67	61

[0101] As shown in Table 2, Table 3, and Table 4, when the dicing die-bonding integrated films of Examples 1 to 11, which had an adhesive layer formed from an active energy ray-curable adhesive, and in which the content of the functional group in the (meth)acrylic resin was 0.4 mmol/g or more, were used, the kerf width was 75% or greater with respect to the blade width, whereas when the dicing die-bonding integrated films of Comparative Examples 1 and 2 that did not satisfy these requirements were used, the kerf width was less than 75% with respect to the blade width. From these results, it was verified that the dicing die-bonding integrated film of the present disclosure can secure a sufficient kerf width even when a blade having a narrow width is used.

Reference Signs List

[0102] 1: base material layer, 3: adhesive layer, 3a: first region, 3b: second region, 5: bonding adhesive layer, 5P: adhesive piece, 5C: cured product, 8: DAF, 10: dicing die-bonding integrated film (film), 20: cut body, 42: pin, 44: suction collet, 50: encapsulation layer, 60: structure, 70: substrate, 100: semiconductor device, DR: dicing ring, F1: first surface, F2: second surface, Rw: region, S1, S2, S3, S4, S: chip, W: wafer, W1, W2, W3, W4: wire, WCh1, WCh2: kerf width.

CLAIMS

[Claim 1] A method for producing a semiconductor device, the method comprising:

preparing a dicing die-bonding integrated film, the dicing die-bonding integrated film including a base material layer, an adhesive layer formed from an active energy ray-curable adhesive, the adhesive layer having a first surface facing the base material layer and a second surface on the opposite side of the first surface, and a bonding adhesive layer provided so as to cover a central part of the second surface of the adhesive layer;

sticking a wafer to the bonding adhesive layer of the dicing die-bonding integrated film and sticking a dicing ring to the second surface of the adhesive layer;

singularizing the wafer, together with the bonding adhesive layer and the adhesive layer, into a plurality of chips by blade dicing using a blade to form cut bodies;

picking up each of the chips, together with an adhesive piece obtained by singularizing the bonding adhesive layer, from the adhesive layer of each of the cut bodies; and

mounting the chip on a substrate or another chip, with the adhesive piece interposed therebetween,

wherein the adhesive layer has a first region corresponding to a region in the bonding adhesive layer, to which the wafer is stuck, and a second region to which the dicing ring is stuck,

the first region is a region in a state of having an adhesive force decreased as compared with the second region by irradiation with active

energy rays, and

a kerf width formed in the adhesive layer of the cut body by the blade dicing is 75% or greater with respect to the width of the blade.

[Claim 2] The method for producing a semiconductor device according to claim 1,

wherein the width of the blade is 10 to 50 μm .

[Claim 3] The method for producing a semiconductor device according to claim 1 or 2,

wherein the plurality of chips have a square or rectangular shape, and each chip has an area of 200 mm^2 or less.

[Claim 4] The method for producing a semiconductor device according to any one of claims 1-3,

wherein the active energy ray-curable adhesive includes a (meth)acrylic resin having a functional group capable of chain polymerization,

the functional group is at least one selected from an acryloyl group and a methacryloyl group, and

the content of the functional group in the (meth)acrylic resin is 0.4 mmol/g or more.