

DESCRIPTION

Title of Invention

DICING/DIE-BONDING DOUBLE FUNCTIONING FILM AND
5 METHOD FOR PRODUCING SAME, AND METHOD FOR
MANUFACTURING SEMICONDUCTOR DEVICE

Technical Field

[0001] The present disclosure relates to a dicing/die bonding integrated
film and a producing method therefor, and a method for manufacturing
10 a semiconductor device using this film.

Background Art

[0002] A semiconductor device is manufactured through the following
steps. First, a dicing step is executed in a state where an adhesive film
for dicing is pasted to a wafer. Thereafter, an expansion step, a pickup
15 step, a mounting step, a die bonding step, and the like are executed.

[0003] In a manufacturing process of a semiconductor device, a film
called a dicing/die bonding integrated film has been used. This film
has a structure in which a base layer, a pressure-sensitive adhesive layer,
and an adhesive layer are stacked in this order, and is used as follows,
20 for example. First, a wafer is diced in a state where a surface of the
adhesive layer is pasted to the wafer and the wafer is fixed with a dicing
ring. Thereby, the wafer is individuated into a plurality of chips.
Subsequently, the adhesive force of the pressure-sensitive adhesive
layer with respect to the adhesive layer is weakened by irradiating the
25 pressure-sensitive adhesive layer with ultraviolet rays, and then
adhesive pieces obtained by individuating the adhesive layer and chips

are picked up from the pressure-sensitive adhesive layer. Thereafter, a semiconductor device is manufactured through a step of mounting the chips on a substrate or the like through the adhesive pieces. Incidentally, a laminate including the chip obtained through the dicing step and the adhesive piece attached thereto is referred to as a DAF (Die Attach Film).

[0004] As described above, a pressure-sensitive adhesive layer (dicing film) whose adhesive force is weakened by irradiation of ultraviolet rays is referred to as a UV curable type. On the other hand, a pressure-sensitive adhesive layer which is not irradiated with ultraviolet rays in the manufacturing process of a semiconductor device and whose adhesive force is constant without any changes is referred to as a pressure-sensitive type. A dicing/die bonding integrated film provided with a pressure-sensitive type has merits in that users (mainly, semiconductor device manufacturers) need not execute a step of irradiation of ultraviolet rays and there is no need of facilities therefor. Patent Literature 1 discloses a dicing die-bonding film that can be called a UV curable type in terms that a pressure-sensitive adhesive layer contains a component to be cured by ultraviolet rays, whereas can also be called a pressure-sensitive type in terms that only a predetermined part of the pressure-sensitive adhesive layer is irradiated with ultraviolet rays in advance and users have no necessity of irradiation of ultraviolet rays in the manufacturing process of a semiconductor device.

Citation List

Patent Literature

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

Summary of Invention

Technical Problem

[0006] The pressure-sensitive adhesive layer of the dicing/die bond integrated film is required to have high adhesive force with respect to the adhesive layer and the dicing ring in the dicing step. When the adhesive force of the pressure-sensitive adhesive layer is not sufficient, a phenomenon that peeling occurs between the adhesive layer and the pressure-sensitive adhesive layer and thereby the chips fly together with the adhesive piece (hereinafter, this is referred to as "DAF flying") according to high-speed rotation of a dicing blade occurs, or a phenomenon that the dicing ring is peeled off from the pressure-sensitive adhesive layer by water flow of cutting water (hereinafter, this phenomenon is referred to as "ring peeling") occurs. The present inventors have focused on the fact that these phenomena become significant as the size of a chip to be manufactured by dicing is decreased. The present inventors have speculated that regarding primary factors with which these phenomena become significant, as the size of a chip is decreased, a longer time for dicing is required as compared to conventional cases, a wafer in the middle of being cut and a chip after being cut are exposed to impact of a dicing blade and cutting water over a long period of time.

[0007] In this regard, the present inventors have worked through development of a dicing/die bonding integrated film which can be applied to a step of dicing a wafer into a number of small chips (having an area of 9 mm² or less), is provided with a pressure-sensitive adhesive layer in which adhesive force of a specific part is lowered as compared

to other parts by irradiating the specific part with a predetermined amount of active energy rays (for example, ultraviolet rays) in advance, and satisfies the following properties. That is, the inventors have worked through development of a dicing/die bonding integrated film in which a region to which a dicing ring is pasted has high adhesive force capable of withstanding water flow of cutting water in the dicing step, whereas a region which is irradiated with a predetermined amount of active energy rays in advance withstands external force by a dicing blade or the like and has adhesive force suitable for picking-up performed later.

[0008] An object of the present disclosure is to provide a dicing/die bonding integrated film which can be applied to a step of dicing a wafer into a number of small chips (having an area of 9 mm² or less), can sufficiently suppress the DAF flying in the dicing step, and is provided with a pressure-sensitive adhesive layer with excellent pickup property, and a producing method therefor. Furthermore, another object of the present disclosure is to provide a method for manufacturing a semiconductor device using this dicing/die bonding integrated film.

Solution to Problem

[0009] An aspect of the present disclosure relates to a method for manufacturing a semiconductor device. This manufacturing method includes a step of preparing a dicing/die bonding integrated film including a base layer, a pressure-sensitive adhesive layer having a first surface facing the base layer and a second surface opposite to the first surface, and an adhesive layer provided to cover a center portion of the second surface of the pressure-sensitive adhesive layer, a step of pasting

a wafer to the adhesive layer of the dicing/die bonding integrated film and pasting a dicing ring to the second surface of the pressure-sensitive adhesive layer, a step of individuating the wafer into a plurality of chips having an area of 9 mm² or less (dicing step), a step of picking up the chip from the pressure-sensitive adhesive layer along with an adhesive piece obtained by individuating the adhesive layer, and a step of mounting the chip on a substrate or another chip through the adhesive piece, in which the pressure-sensitive adhesive layer has a first region corresponding to a region to which the wafer is pasted in the adhesive layer and a second region to which the dicing ring is pasted, the first region is a region in a state where adhesive force is lowered by irradiation of active energy rays as compared to the second region, and the adhesive force of the first region with respect to the adhesive layer as measured at a temperature of 23°C under conditions of a peeling angle of 30° and a peeling rate of 60 mm/min is 1.2 N/25 mm or more and 4.5 N/25 mm or less.

[0010] According to the method for manufacturing a semiconductor device, DAF flying in the dicing step can be sufficiently suppressed, excellent pickup property from the pressure-sensitive adhesive layer can be achieved, and thereby a semiconductor device can be manufactured with a sufficiently high yield.

[0011] An aspect of the present disclosure relates to a dicing/die bonding integrated film. This film includes a base layer, a pressure-sensitive adhesive layer having a first surface facing the base layer and a second surface opposite to the first surface, and an adhesive layer provided to cover a center portion of the second surface, in which

the pressure-sensitive adhesive layer has a first region including at least a region corresponding to a pasting position of a wafer in the adhesive layer, and a second region located to surround the first region, the first region is a region in a state where adhesive force is lowered by irradiation of active energy rays as compared to the second region, and the adhesive force of the first region with respect to the adhesive layer as measured at a temperature of 23°C under conditions of a peeling angle of 30° and a peeling rate of 60 mm/min is 1.2 N/25 mm or more and 4.5 N/25 mm or less.

[0012] By using the above-described dicing/die bonding integrated film in the manufacturing of a semiconductor device, DAF flying in the dicing step can be sufficiently suppressed, excellent pickup property from the pressure-sensitive adhesive layer can be achieved, and thereby a semiconductor device can be manufactured with a sufficiently high yield.

[0013] From the viewpoint of suppressing ring peeling in the dicing step, adhesive force of the second region in the pressure-sensitive adhesive layer with respect to a stainless steel substrate is preferably 0.2 N/25 mm or more. This adhesive force means a peeling strength as measured at a temperature of 23°C under conditions of a peeling angle of 90° and a peeling rate of 50 mm/min.

[0014] The first and second regions of the pressure-sensitive adhesive layer are formed, for example, by the same composition before irradiation of active energy rays, and the first region is formed through a step of irradiating a region that becomes the first region with active energy rays in an amount of 10 to 1000 mJ/cm².

[0015] An aspect of the present disclosure relates to a method for producing a dicing/die bonding integrated film. A first embodiment of this producing method includes a step of producing a laminate including a pressure-sensitive adhesive layer, which is formed by a composition whose adhesive force is lowered by irradiation of active energy rays, and the adhesive layer, which is formed on the surface of the pressure-sensitive adhesive layer, on the surface of the base layer, and a step of irradiating a region that becomes the first region of the pressure-sensitive adhesive layer included in the laminate with active energy rays, in this order. Meanwhile, a second embodiment of this producing method includes a step of forming a pressure-sensitive adhesive layer, which is formed by a composition whose adhesive force is lowered by irradiation of active energy rays, on the surface of the base layer, a step of irradiating a region that becomes the first region of the pressure-sensitive adhesive layer with active energy rays, and a step of stacking the adhesive layer on the surface of the pressure-sensitive adhesive layer after irradiation of active energy rays, in this order.

Advantageous Effects of Invention

[0016] According to the present disclosure, there is provided a dicing/die bonding integrated film which can be applied to a step of dicing a wafer into a number of small chips, can sufficiently suppress the DAF flying in the dicing step, and is provided with a pressure-sensitive adhesive layer with excellent pickup property. Furthermore, according to the present disclosure, there are provided a method for producing a dicing/die bonding integrated film and a method for manufacturing a semiconductor device using the film.

Brief Description of Drawings

[0017] 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 line B-B illustrated in FIG. 1(a).

5 FIG. 2 is a schematic diagram illustrating a state where a dicing ring is pasted to the periphery of a pressure-sensitive adhesive layer of the dicing/die bonding integrated film and a wafer is pasted to a surface of an adhesive layer.

10 FIG. 3 is a cross-sectional view schematically illustrating a state where a 30° peeling strength of the pressure-sensitive adhesive layer with respect to the adhesive layer is measured.

 FIG. 4 is a schematic cross-sectional view illustrating an embodiment of a semiconductor device.

15 FIG. 5(a) to FIG. 5(d) are cross-sectional views schematically illustrating a process of producing a DAF (a laminate of a chip and an adhesive piece).

 FIG. 6 is a cross-sectional view schematically illustrating a process of manufacturing the semiconductor device illustrated in FIG. 4.

20 FIG. 7 is a cross-sectional view schematically illustrating a process of manufacturing the semiconductor device illustrated in FIG. 4.

 FIG. 8 is a cross-sectional view schematically illustrating a process of manufacturing the semiconductor device illustrated in FIG. 4.

Description of Embodiments

25 [0018] Hereinafter, embodiments of the present disclosure will be specifically described with reference to the drawings. In the following description, the same or similar portions are denoted with the same

reference signs and repeated description is omitted. Incidentally, the present invention is not limited to the following embodiments. In the present specification, (meth)acryl means acryl or methacryl.

[0019] <Dicing/die bonding integrated film>

FIG. 1(a) is a plan view illustrating a dicing/die bonding integrated film of the present embodiment, and FIG. 1(b) is a schematic cross-sectional view taken along line B-B of FIG. 1. A dicing/die bonding integrated film 10 (hereinafter, simply referred to as the "film 10" depending on circumstances) is applied to a manufacturing process of a semiconductor device which includes a dicing step of individuating a wafer W into a plurality of chips having an area of 9 mm² or less and a pickup step performed thereafter (see FIG. 5(c) and FIG. 5(d)).

[0020] The film 10 includes a base layer 1, a pressure-sensitive adhesive layer 3 having a first surface F1 facing the base layer 1 and a second surface F2 opposite to the first surface F1, and an adhesive layer 5 provided to cover a center portion of the second surface F2 of the pressure-sensitive adhesive layer 3 in this order. In the present embodiment, an embodiment in which one laminate of the pressure-sensitive adhesive layer 3 and the adhesive layer 5 is formed on the base layer 1 having a square shape is exemplified, but an embodiment in which the base layer 1 has a predetermined length (for example, 100 m or more) and laminates of the pressure-sensitive adhesive layer 3 and the adhesive layer 5 are disposed with a predetermined interval to be arranged in a longitudinal direction thereof may be employed.

[0021] (Pressure-sensitive adhesive layer)

The pressure-sensitive adhesive layer 3 has a first region 3a including at least a region R_w corresponding to a pasting position of the wafer W in the adhesive layer 5, and a second region 3b located to surround the first region 3a. Broken lines in FIG. 1(a) and FIG. 1(b) indicate a boundary between the first region 3a and the second region 3b. The first region 3a and the second region 3b are formed by the same composition before irradiation of active energy rays. The first region 3a is a region in a state where the adhesive force is lowered as compared to the second region 3b by irradiation of active energy rays such as ultraviolet rays. The second region 3b is a region to which the dicing ring DR is pasted (see FIG. 2). The second region 3b is a region which is not irradiated with active energy rays and has high adhesive force with respect to the dicing ring DR.

[0022] The adhesive force of the first region 3a with respect to the adhesive layer 5 is 1.2 N/25 mm or more and 4.5 N/25 mm or less. This adhesive force is a 30° peeling strength as measured at a temperature of 23°C under conditions of a peeling angle of 30° and a peeling rate of 60 mm/min. FIG. 3 is a cross-sectional view schematically illustrating a state where a 30° peeling strength of the pressure-sensitive adhesive layer 3 is measured in a state where the adhesive layer 5 of a measurement sample (width 25 mm × length 100 mm) is fixed to a support plate 80. By setting the adhesive force (30° peeling strength) of the first region 3a with respect to the adhesive layer 5 to the above-described range, both suppression of DAF flying at the time of dicing and excellent pickup property can be sufficiently highly achieved. Thereby, a semiconductor device can be manufactured with

a sufficiently high yield. The lower limit value of this adhesive force may be 1.5 N/25 mm or 2.0 N/25 mm, and the upper limit value may be 3.5 N/25 mm or 2.5 N/25 mm.

[0023] As described above, the film 10 is suitable for the dicing step of individuating a wafer into a plurality of chips having an area of 9 mm² or less and the subsequent pickup step. The present inventors have focused on a difference between the pickup behavior of a small chip having a size of 3 mm × 3 mm or less (having an area of 9 mm² or less) and the pickup behavior of a large chip, for example, having a size of about 8 mm × 6 mm and then conducted studies, and as a result, the adhesive force of the first region 3a with respect to the adhesive layer 5 is specified to the above-described range (1.2 N/25 mm or more and 4.5 N/25 mm or less). That is, in a case where a large chip is picked up by thrusting up a center portion of the large chip from the lower side by a pin of a thrust-up jig, when the 30° peeling strength of the first region 3a with respect to the adhesive layer 5 is in the above-described range, the peeling of the interface between the pressure-sensitive adhesive layer and the adhesive piece is advanced toward the center portion from the edge portion of the DAF in accordance with the ascending of the pin; however, since the adhesive force of the pressure-sensitive adhesive layer is too strong, the interface peeling does not follow the ascending of the pin, and thus the chip is excessively deformed to be broken or pickup errors are likely to occur. That is, the present inventors have found out that the pickup property of the large chip is mainly dominated by the peeling of the interface between the pressure-sensitive adhesive layer and the adhesive piece, and the adhesive force of the

pressure-sensitive adhesive layer with respect to the adhesive layer has to be set to be smaller than the lower limit value (1.2 N/25 mm) in the above-described range. On the other hand, the present inventors have found out that the pickup property of the small chip is mainly dominated by the peeling of the edge portion of the DAF, and if peeling of the edge portion occurs once due to thrusting-up by the pin, the peeling of the interface between the pressure-sensitive adhesive layer and the adhesive piece is smoothly advanced thereafter. Therefore, even when the adhesive force of the first region 3a with respect to the adhesive layer 5 is relatively strong, in the case of a small chip, excellent pickup property can be achieved. Furthermore, when the adhesive force of the first region 3a with respect to the adhesive layer 5 is relatively strong, DAF flying in the dicing step can be sufficiently suppressed.

[0024] The first region 3a having adhesive force in the above-described range with respect to the adhesive layer 5 is formed by irradiation of active energy rays. The present inventors have found out that lowering of the adhesive force of the pressure-sensitive adhesive layer by irradiation of active energy rays affects the peeling of the edge portion of the DAF. That is, when the adhesive force of the first region 3a is excessively lowered by irradiation of active energy rays, the 30° peeling strength of the first region 3a with respect to the adhesive layer 5 is decreased; on the other hand, in a case where a target to be picked up is a small chip, there is a tendency that the edge portion of the DAF is less likely to be peeled off, and thus the chip is excessively deformed to be broken or pickup errors are likely to occur. The adhesive force (1.2 N/25 mm or more and 4.5 N/25 mm or less) of the first region 3a with

respect to the adhesive layer 5 can also be said that the adhesive force before irradiation of active energy rays is not excessively lowered, and thereby, even in the case of a small chip, peeling at the edge portion of the DAF is caused to easily occur. In the present embodiment, the adhesive force of the first region 3a of the pressure-sensitive adhesive layer 3 can be adjusted, for example, by relatively decreasing the amount of the cross-linking agent in the adhesive layer, lowering the irradiance level of active energy rays, or the like.

[0025] The adhesive force of the second region 3b with respect to a stainless steel substrate is preferably 0.2 N/25 mm or more. This adhesive force is a 90° peeling strength as measured at a temperature of 23°C under conditions of a peeling angle of 90° and a peeling rate of 50 mm/min. When this adhesive force is 0.2 N/25 mm or more, ring peeling at the time of dicing can be sufficiently suppressed. The lower limit value of this adhesive force may be 0.3 N/25 mm or 0.4 N/25 mm, and the upper limit value is, for example, 2.0 N/25 mm and may be 1.0 N/25 mm.

[0026] The pressure-sensitive adhesive layer before irradiation of active energy rays is, for example, formed by an adhesive composition containing a (meth)acrylic resin, a photopolymerization initiator, and a cross-linking agent. The second region 3b which is not irradiated with active energy rays is formed by the same composition as that of the pressure-sensitive adhesive layer before irradiation of active energy rays. Hereinafter, components contained in the adhesive composition will be specifically described.

[0027] [(Meth)acrylic resin]

The pressure-sensitive adhesive composition contains a (meth)acrylic resin having a chain polymerizable functional group, and the functional group is preferably at least one selected from an acryloyl group and a methacryloyl group. The content of the functional group in the pressure-sensitive adhesive layer before irradiation of active energy rays is, for example, 0.1 to 1.2 mmol/g, and may be 0.3 to 1.0 mmol/g or 0.5 to 0.8 mmol/g. When the content of the functional group is 0.1 mmol/g or more, a region (first region 3a) whose adhesive force is properly lowered by irradiation of active energy rays is easily formed; on the other hand, when the content thereof is 1.2 mmol/g or less, excellent pickup property is easily achieved.

[0028] The (meth)acrylic resin can be obtained by performing synthesis according to 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, as the type of polymerization reaction, methods such as ATRP (atom transfer radical polymerization) and RAFT (reversible addition-fragmentation chain transfer polymerization) are exemplified in addition to radical polymerization, cationic polymerization, anionic polymerization, living radical polymerization, living cationic polymerization, living anionic polymerization, coordination polymerization, immortal polymerization, and the like. Of these, synthesis by radical polymerization using a solution polymerization method has advantages in that a resin solution

obtained by polymerization can be used without any changes and then can be mixed, in addition to the merits of economic efficiency, a high reaction rate, ease of polymerization control, and the like.

[0029] Herein, a method of synthesizing a (meth)acrylic resin will be specifically described by using, as an example, a method of obtaining a (meth)acrylic resin by radical polymerization using a solution polymerization method.

[0030] The monomer used when a (meth)acrylic resin is synthesized 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, octylheptyl (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, methoxypolyethylene glycol (meth)acrylate, ethoxypolyethylene glycol (meth)acrylate, methoxypolypropylene glycol (meth)acrylate, ethoxypolypropylene glycol (meth)acrylate, and mono(2-(meth)acryloyloxyethyl)succinate; alicyclic (meth)acrylates such as cyclopentyl (meth)acrylate, cyclohexyl (meth)acrylate, cyclopentyl (meth)acrylate, dicyclopentanyl (meth)acrylate, dicyclopentenyl (meth)acrylate, isobornyl (meth)acrylate, mono(2-(meth)acryloyloxyethyl)tetrahydrophthalate, 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-cumylphenoxyethyl
 5 (meth)acrylate, o-phenylphenoxyethyl (meth)acrylate, 1-naphthoxyethyl
 (meth)acrylate, 2-naphthoxyethyl (meth)acrylate, phenoxypolyethylene
 glycol (meth)acrylate, nonylphenoxypolyethylene glycol (meth)acrylate,
 phenoxypolypropylene glycol (meth)acrylate,
 2-hydroxy-3-phenoxypropyl (meth)acrylate,
 10 2-hydroxy-3-(o-phenylphenoxy)propyl (meth)acrylate,
 2-hydroxy-3-(1-naphthoxy)propyl (meth)acrylate, and
 2-hydroxy-3-(2-naphthoxy)propyl (meth)acrylate; heterocyclic
 (meth)acrylates such as 2-tetrahydrofurfuryl (meth)acrylate,
 N-(meth)acryloyloxyethylhexahydrophthalimide, and
 15 2-(meth)acryloyloxyethyl-N-carbazole, and caprolactone-modified
 products thereof; compounds having an ethylenically unsaturated group
 and an epoxy group such as ω -carboxy-polycaprolactone
 mono(meth)acrylate, glycidyl (meth)acrylate, α -ethylglycidyl
 (meth)acrylate, α -propylglycidyl (meth)acrylate, α -butylglycidyl
 20 (meth)acrylate, 2-methylglycidyl (meth)acrylate, 2-ethylglycidyl
 (meth)acrylate, 2-propylglycidyl (meth)acrylate, 3,4-epoxybutyl
 (meth)acrylate, 3,4-epoxyheptyl (meth)acrylate,
 α -ethyl-6,7-epoxyheptyl (meth)acrylate, 3,4-epoxycyclohexylmethyl
 (meth)acrylate, o-vinylbenzylglycidyl ether, m-vinylbenzylglycidyl
 25 ether, and p-vinylbenzylglycidyl 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,

5 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
 10 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate,
 4-hydroxybutyl (meth)acrylate, 3-chloro-2-hydroxypropyl
 (meth)acrylate, and 2-hydroxybutyl (meth)acrylate, and target
 (meth)acrylic resins can be obtained by appropriately combining these
 compounds.

15 [0031] The (meth)acrylic resin preferably has at least one functional
 group selected from a hydroxyl group, a glycidyl group, an amino
 group, and the like, as a reactive site with a functional group-introduced
 compound or a cross-linking agent described below. Examples of a
 monomer for synthesizing a (meth)acrylic resin having a hydroxyl
 20 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, and these can be used alone or can be used in
 25 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 -ethylglycidyl (meth)acrylate, α -propylglycidyl (meth)acrylate, α -butylglycidyl (meth)acrylate, 2-methylglycidyl (meth)acrylate, 2-ethylglycidyl (meth)acrylate, 2-propylglycidyl (meth)acrylate, 3,4-epoxybutyl (meth)acrylate, 3,4-epoxyheptyl (meth)acrylate, α -ethyl-6,7-epoxyheptyl (meth)acrylate, 3,4-epoxycyclohexylmethyl (meth)acrylate, o-vinylbenzylglycidyl ether, m-vinylbenzylglycidyl ether, and p-vinylbenzylglycidyl ether, and these can be used alone or can be used in combination of two or more kinds thereof.

[0033] The (meth)acrylic resins synthesized from these monomers preferably contain a chain polymerizable functional group. The chain polymerizable functional group is, for example, at least one selected from an acryloyl group and a methacryloyl group. The chain polymerizable functional group can be introduced into a (meth)acrylic resin, for example, by reacting the following compounds (functional group-introduced compounds) with the (meth)acrylic resin synthesized as described above. Specific examples of the functional group-introduced compounds include 2-methacryloyloxyethyl isocyanate, meta-isopropenyl- α,α -dimethylbenzyl isocyanate, methacryloyl isocyanate, allyl isocyanate, 1,1-(bisacryloyloxymethyl)ethyl isocyanate; an acryloyl monoisocyanate compound obtained by reacting a diisocyanate compound or a polyisocyanate compound with a hydroxyethyl (meth)acrylate or 4-hydroxybutyl ethyl (meth)acrylate; and an acryloyl monoisocyanate compound obtained by reacting a diisocyanate

compound or a polyisocyanate compound, a polyol compound, and hydroxyethyl (meth)acrylate. Of these, particularly, 2-methacryloyloxyethyl isocyanate is preferred. These compounds can be used alone or can also be used in combination of two or more kinds thereof.

[0034] [Photopolymerization initiator]

The photopolymerization initiator is not particularly limited as long as it generates a chain polymerizable active species by irradiation of active energy rays (at least one selected from ultraviolet rays, electron beams, and visible rays), and for example, a photoradical polymerization initiator is exemplified. Herein, the chain polymerizable active species means one which reacts with a chain polymerizable functional group to start a polymerization reaction.

[0035] Examples of the photoradical polymerization initiator include benzoin ketals such as 2,2-dimethoxy-1,2-diphenylethane-1-one; α -hydroxyketones such as 1-hydroxycyclohexylphenylketone, 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-(phenylthio)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 2-(o-chlorophenyl)-4,5-diphenylimidazole dimer,
 2-(o-chlorophenyl)-4,5-di(methoxyphenyl)imidazole dimer,
 2-(o-fluorophenyl)-4,5-diphenylimidazole dimer,
 2-(o-methoxyphenyl)-4,5-diphenylimidazole dimer, and
 2-(p-methoxyphenyl)-4,5-diphenylimidazole dimer; benzophenone
 compounds such as benzophenone,
 N,N'-tetramethyl-4,4'-diaminobenzophenone,
 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, methyl benzoin, and
 ethyl benzoin; benzyl compounds such as benzyl dimethyl ketal;
 acridine compounds such as 9-phenylacridine and 1,7-bis(9,9'-acridinyl
 heptane); and N-phenylglycine and coumarin.

[0036] The content of the photopolymerization initiator in the
 pressure-sensitive adhesive composition is, for example, 0.1 to 30 parts
 by mass, preferably 0.3 to 10 parts by mass, and more preferably 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 less than 0.1 parts by mass, the adhesive layer is not

sufficiently cured after irradiation of active energy rays, and thus a pickup failure is likely to occur. When the content of the photopolymerization initiator exceeds 30 parts by mass, contamination of the adhesive layer (transfer of the photopolymerization initiator to the adhesive layer) is likely to occur.

[0037] [Cross-linking agent]

The cross-linking agent is used for controlling the elastic modulus and/or adhesion of the pressure-sensitive adhesive layer, for example. The cross-linking agent may be a compound having, in one molecule, two or more functional groups which can react with at least one functional group selected from a hydroxyl group, a glycidyl group, an amino group, and the like of the above-described (meth)acrylic resin. Examples of a bond to be formed by reaction between the cross-linking 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] In the present embodiment, as the cross-linking agent, a compound having two or more isocyanate groups in one molecule is preferably adopted. When such a compound is used, the cross-linking agent easily reacts with a hydroxyl group, a glycidyl group, an amino group, and the like of the (meth)acrylic resin, and thereby a strong cross-linked structure can be formed.

[0039] Examples of the compound 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-xylene 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] As the cross-linking agent, a reaction product between the above-described isocyanate compound and a polyhydric alcohol having two or more OH groups in one molecule (an isocyanate group-containing oligomer) may be adopted. Examples of the polyhydric alcohol having two or more OH 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, pentaerythritol, dipentaerythritol, 1,4-cyclohexanediol, and 1,3-cyclohexanediol.

[0041] Of these, the cross-linking agent is further desirably a reaction product between a polyfunctional isocyanate having two or more isocyanate groups in one molecule and a polyhydric alcohol having three or more OH groups in one molecule (an isocyanate group-containing oligomer). By using such an isocyanate group-containing oligomer as a cross-linking agent, the pressure-sensitive adhesive layer 3 forms a dense cross-linked structure, and thereby adhesion of the pressure-sensitive adhesive to the adhesive layer 5 in the pickup step can be sufficiently suppressed.

[0042] The content of the cross-linking agent in the pressure-sensitive adhesive composition may be appropriately set according to cohesion force and elongation rate at break required for the pressure-sensitive adhesive layer, adhesiveness with the adhesive layer 5, and the like. Specifically, the content of the cross-linking agent is, for example, 3 to

30 parts by mass, and is preferably 4 to 15 parts by mass and more preferably 7 to 10 parts by mass, with respect to 100 parts by mass of the content of the (meth)acrylic resin. When the content of the cross-linking agent is set in the above-described range, a property required for the pressure-sensitive adhesive layer in the dicing step and a property required for the pressure-sensitive adhesive layer 3 in the die bonding step can be achieved in a balanced manner, and excellent pickup property can be achieved.

[0043] When the content of the cross-linking agent is less than 3 parts by mass with respect to 100 parts by mass of the content of the (meth)acrylic resin, the formation of the cross-linked structure is likely to become insufficient, and thereby the sticking force of the interface with the adhesive layer 5 is not sufficiently lowered in the pickup step, and thus defects are likely to occur at the time of picking-up. On the other hand, when the content of the cross-linking agent exceeds 30 parts by mass with respect to 100 parts by mass of the content of the (meth)acrylic resin, the pressure-sensitive adhesive layer 3 is likely to be excessively cured, and thereby a semiconductor chip is likely to be peeled off in the expansion step.

[0044] The content of the cross-linking agent is, for example, 0.1 to 20% by mass and may be 3 to 17% by mass or 5 to 15% by mass, with respect to the total mass of the pressure-sensitive adhesive composition. When the content of the cross-linking agent is 0.1% by mass or more, a region (first region 3a) whose adhesive force is properly lowered by irradiation of active energy rays is easily formed; on the other hand, when the content thereof is 15% by mass or less, excellent pickup

property is easily achieved.

[0045] The thickness of the pressure-sensitive adhesive layer 3 may be appropriately set according to conditions (such as a temperature and a tension) of the expansion step, and is, for example, 1 to 200 μm , preferably 5 to 50 μm , and more preferably 10 to 20 μm . When the thickness of the pressure-sensitive adhesive layer 3 is less than 1 μm , adhesion is likely to become insufficient, and when the thickness exceeds 200 μm , a kerf width at the time of expansion is narrow (a stress is alleviated at the time of the pin being thrust up) and picking-up is likely to become insufficient.

[0046] The pressure-sensitive adhesive layer 3 is formed on the base layer 1. As a method of forming the pressure-sensitive adhesive layer 3, a known method can be adopted. For example, a laminate of the base layer 1 and the pressure-sensitive adhesive layer 3 may be formed by a two layer extrusion method, and a varnish for forming the pressure-sensitive adhesive layer 3 may be prepared and applied to the surface of the base layer 1 or the pressure-sensitive adhesive layer 3 may be formed on a film subjected to a mold release treatment and transferred to the base layer 1.

[0047] The varnish for forming the pressure-sensitive adhesive layer 3 is preferably prepared by using an organic solvent that can dissolve the (meth)acrylic resin, the photopolymerization initiator, and the cross-linking agent and volatilizes 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 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-methylpyrrolidone.

[0048] Of these, from the viewpoint of solubility and a boiling point, for example, 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 are preferred. These organic solvents may be used alone or may be used in combination of two or more kinds thereof. The solid content concentration of the varnish is generally preferably 10 to 60% by mass.

[0049] (Base layer)

As the base layer 1, known polymer sheets or films can be used, and the base layer 1 is not particularly limited as long as an expansion step can be executed in the base layer in a low temperature condition. Specifically, examples of the base layer 1 include polyolefins such as crystalline polypropylene, amorphous polypropylene, high-density polyethylene, intermediate-density polyethylene, low-density polyethylene, very low-density polyethylene, low-density linear polyethylene, polybutene, and polymethylpentene; an ethylene-vinylacetate copolymer; an ionomer resin; an ethylene-(meth)acrylic acid copolymer; an ethylene-(meth)acrylic acid ester (random or alternating) copolymer; an ethylene-butene copolymer; an ethylene-hexene copolymer; polyurethane; polyesters such as polyethylene terephthalate and polyethylene naphthalate; polycarbonate; polyimide; polyetheretherketone; polyimide; polyetherimide; polyamide; whole aromatic polyamides; polyphenylsulfide; aramid (paper); glass; glass cloth; a fluorine resin; polyvinyl chloride; polyvinylidene chloride; a cellulose-based resin; a silicone resin; or mixtures obtained by mixing a plasticizer with these components or cured products subjected to cross-linkage by electron beam irradiation.

[0050] It is preferable that the base layer 1 has a surface having, as a

main component, at least one resin selected from polyethylene, polypropylene, a polyethylene-polypropylene random copolymer, and a polyethylene-polypropylene block copolymer, and this surface is in contact with the pressure-sensitive adhesive layer 3. These resins are favorable base materials also from the viewpoints of characteristics such as a Young's modulus, stress alleviation property, and a melting point, costs, waste material recycle after use, and the like. The base layer 1 may be a single layer, but may have a multi-layered structure in which layers formed by different materials are stacked, as necessary. In order to control adhesiveness with the pressure-sensitive adhesive layer 3, a surface roughening treatment such as a matting treatment or a corona treatment may be performed with respect to the surface of the base layer 1.

[0051] (Adhesive layer)

A known adhesive composition constituting a die bonding film can be applied to the adhesive layer 5. Specifically, a adhesive composition constituting the adhesive layer 5 preferably contains an epoxy group-containing acrylic copolymer, an epoxy resin, and an epoxy resin curing agent. According to the adhesive layer 5 containing these components, there are characteristics that adhesiveness between a chip and a substrate and between chips is excellent, electrode embeddability, wire embeddability, and the like can also be imparted, adhesion can be performed at a low temperature in the die bonding step, excellent curing is obtainable in a short time, excellent reliability is obtained after molding with a sealing agent, and the like, which are preferable.

[0052] 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 linear aliphatic epoxy resin, a phenol novolak type epoxy resin, a cresol novolak type epoxy resin, a bisphenol A novolak type epoxy resin, a diglicidyletherified product of biphenol, a diglicidyletherified product of naphthalenediol, a diglicidyletherified product of phenols, a diglycidyletherified product of alcohols, and a bifunctional epoxy resin of an alkyl-substitution product, halide, hydrogen additive, or the like of these materials, and a novolak type epoxy resin. Furthermore, generally known other epoxy resins such as a polyfunctional epoxy resin and a heterocyclic ring-containing epoxy resin may be applied. These can be used alone or can be used in combination of two or more kinds thereof. Incidentally, components other than the epoxy resins may be contained as impurities in a range that does not impair properties.

[0053] As the epoxy resin curing agent, for example, those like a phenolic resin that can be obtained by reacting a phenolic compound with a xylylene compound, which is a bivalent linking group, in the absence of a catalyst or in the presence of an acid catalyst are exemplified. Examples of the phenolic compound used in the production of the phenolic 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-xylenol, 2,6-xylenol,

3,5-xylenol, 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 phenolic compounds may be used alone or may be used as a mixture of two or more kinds thereof. As the xylylene compound, which is a bivalent linking group, used in the production of the phenolic resin, xylylene dihalide, xylylene diglycol, and a derivative thereof listed below can be used. That is, examples thereof 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' -di-isopropoxy-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 can be used alone or can be used in combination of two or more kinds thereof.

[0054] When the phenolic compound and the xylylene compound described above are reacted with each other, the reaction can be performed by using an acidic catalyst such as mineral acids such as hydrochloric acid, sulfuric acid, phosphoric acid, and polyphosphoric acid; organic carboxylic acids such as dimethyl sulphate, diethyl sulphate, p-toluenesulfonic acid, methanesulfonic acid, and ethanesulfonic acid; superacids such as trifluoromethanesulfonic acid; strong acid ion-exchange resins such as an alkanesulfonic acid type ion-exchange resin; superacid type ion-exchange resins such as a perfluoroalkanesulfonic acid type ion-exchange resin (trade name: Nafion manufactured by Du Pont, "Nafion" is the registered trademark); natural and synthetic zeolites; and activated clay (acid clay), until the xylylene compound serving as a raw material substantially disappears at 50°C to 250°C and the reaction composition becomes constant. Although depending on a raw material and a reaction temperature, a reaction time is approximately 1 to 15 hours, and in practice, may be decided while following a reaction composition by GPC (gel permeation chromatography) or the like.

[0055] The epoxy group-containing acrylic copolymer is preferably a copolymer obtained by using glycidyl acrylate or glycidyl methacrylate as a raw material in an amount of 0.5 to 6% by mass with respect to a copolymer to be obtained. When this amount is 0.5% by mass or more, high adhesive force is easily obtained; on the other hand, when this amount is 6% by mass or less, gelation can be suppressed. For the

remaining part, alkyl acrylates having an alkyl group having 1 to 8 carbon atoms, such as methyl acrylate or methyl methacrylate, and a mixture of alkyl methacrylate, styrene, acrylonitrile, and the like can be used. Of these, ethyl (meth)acrylate and/or butyl (meth)acrylate are particularly preferable. The mixing ratio is preferably adjusted in consideration of Tg of the copolymer. When Tg is lower than -10°C, the tackiness of the adhesive layer 5 in the B-stage state tends to increase, and handleability tends to deteriorate. Incidentally, the upper limit value of the glass transition point (Tg) of the epoxy group-containing acrylic copolymer is, for example, 30°C. The polymerization method is not particularly limited, and for example, pearl polymerization and solution polymerization are exemplified. As a commercially available epoxy group-containing acrylic copolymer, for example, HTR-860P-3 (trade name, manufactured by Nagase ChemteX Corporation) is exemplified.

[0056] The weight average molecular weight of the epoxy group-containing acrylic copolymer is 100000 or more, when the weight average molecular weight is in this range, adhesiveness and heat resistance are high, and the weight average molecular weight is preferably 300000 to 3000000 and more preferably 500000 to 2000000. When the weight average molecular weight is 3000000 or less, a decrease in fillability between a semiconductor chip and a substrate supporting the semiconductor chip can be suppressed. The weight average molecular weight is a value in terms of polystyrene using a calibration curve of standard polystyrene by gel permeation chromatography (GPC).

[0057] The adhesive layer 5 may further contain, as necessary, curing accelerators such as tertiary amine, imidazoles, and quaternary ammonium salts. 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 alone or may be used in combination of two or more kinds thereof.

[0058] The adhesive layer 5 may further contain, as necessary, 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 whisker, boron nitride, crystalline silica, and amorphous silica. These may be used alone or may be used in combination of two or more kinds thereof.

[0059] The thickness of the adhesive layer 5 is, for example, 1 to 300 μm , preferably 5 to 150 μm , more preferably 10 to 100 μm . When the thickness of the adhesive layer 5 is less than 1 μm , adhesiveness is likely to become insufficient; on the other hand, when the thickness thereof exceeds 300 μm , separation property at the time of expansion and pickup property are likely to become insufficient.

[0060] Incidentally, the adhesive layer 5 may be an embodiment not including a thermosetting resin. For example, in a case where the adhesive layer 5 contains a reactive group-containing (meth)acrylic copolymer, it is sufficient that the adhesive layer 5 contains a reactive group-containing (meth)acrylic copolymer, a curing accelerator, and a

filler (see Example 4).

[0061] <Method for producing dicing/die bonding integrated film>

The method for producing the film 10 includes a step of producing a laminate, which includes a pressure-sensitive adhesive layer formed by a pressure-sensitive adhesive composition whose adhesive force is lowered by irradiation of active energy rays and the adhesive layer 5 formed on the surface of the pressure-sensitive adhesive layer, on the surface of the base layer 1, and a step of irradiating a region that becomes the first region 3a of the pressure-sensitive adhesive layer included in the laminate in this order. The irradiance level of active energy rays with respect to the region that becomes the first region 3a is, for example, 10 to 1000 mJ/cm² and may be 100 to 700 mJ/cm² or 200 to 500 mJ/cm².

[0062] In the above-described manufacturing method, a laminate of the pressure-sensitive adhesive layer and the adhesive layer 5 is produced in advance, and then a specific region of the pressure-sensitive adhesive layer is irradiated with active energy rays. As described below, the first region 3a may be formed by irradiating the pressure-sensitive adhesive layer with active energy rays before being pasted with the adhesive layer 5. That is, the method for producing the film 10 may include a step of forming a pressure-sensitive adhesive layer formed by a composition whose adhesive force is lowered by irradiation of active energy rays, on the surface of the base layer 1, a step of irradiating a region that becomes the first region 3a of the pressure-sensitive adhesive layer with active energy rays, and a step of stacking the adhesive layer 5 on the surface of the pressure-sensitive adhesive layer

3 after irradiation of active energy rays, in this order.

[0063] <Semiconductor device and manufacturing method therefor>

FIG. 4 is a cross-sectional view schematically illustrating a semiconductor device of the present embodiment. A semiconductor device 100 illustrated in this drawing includes a substrate 70, four chips S1, S2, S3, and S4 stacked on a surface of the substrate 70, wires W1, W2, W3, and W4 electrically connecting an electrode (not illustrated) on the surface of the substrate 70 to the four chips S1, S2, S3, and S4, and a sealing layer 50 sealing these components.

[0064] The substrate 70 is, for example, an organic substrate and may be a metal substrate such as a lead frame. Regarding the substrate 70, from the viewpoint of suppressing the bowing of the semiconductor device 100, the thickness of the substrate 70 is, for example, 70 to 140 μm and may be 80 to 100 μm .

[0065] The four chips S1, S2, S3, and S4 are stacked via a cured product 5C of the adhesive piece 5P. The shape of the chips S1, S2, S3, and S4 in plan view is, for example, a square shape or a rectangular shape. The area of the chips S1, S2, S3, and S4 is 9 mm^2 or less and may be 0.1 to 4 mm^2 or 0.1 to 2 mm^2 . The length of one side of the chips S1, S2, S3, and S4 is, for example, 3 mm or less and may be 0.1 to 2.0 mm and 0.1 to 1.0 mm. The thickness of the chips S1, S2, S3, and S4 is, for example, 10 to 170 μm and may be 25 to 100 μm . Incidentally, the lengths of one sides of the four chips S1, S2, S3, and S4 may be the same as or different from one another, and the same applies the thickness.

[0066] The method for manufacturing the semiconductor device 100

includes a step of preparing the above-described film 10, a step of pasting the wafer W to the adhesive layer 5 of the film 10 and pasting the dicing ring DR to the second surface F2 of the pressure-sensitive adhesive layer 3, a step of individuating the wafer W into a plurality of chips S having an area of 9 mm² or less (dicing step), a step of picking up a DAF 8 (a laminate of the chip S1 and the adhesive piece 5P, see FIG. 5(d)) from the first region 3a of the pressure-sensitive adhesive layer 3, and a step of mounting the chip S1 on the substrate 70 through the adhesive piece 5P.

[0067] An example of the method for producing the DAF 8 will be described with reference to FIG. 5(a) to FIG. 5(d). First, the above-described film 10 is prepared. As illustrated in FIG. 5(a) and FIG. 5(b), the film 10 is pasted so that the adhesive layer 5 is in contact with one surface of the wafer W. Furthermore, the dicing ring DR is pasted to the second surface F2 of the pressure-sensitive adhesive layer 3.

[0068] The wafer W, the adhesive layer 5, and the pressure-sensitive adhesive layer 3 are diced. Thereby, as illustrated in FIG. 5(c), the wafer W is individuated to obtain the chips S. The adhesive layer 5 is also individuated to obtain the adhesive pieces 5P. As the dicing method, a method using a dicing blade or laser is exemplified. Incidentally, the thickness may be decreased by grinding the wafer W prior to the dicing of the wafer W.

[0069] After dicing, without irradiating the pressure-sensitive adhesive layer 3 with active energy rays, as illustrated in FIG. 5(d), while the chips S are separated from each other by expanding the base layer 1 at

normal temperature or under cooling conditions, the adhesive piece 5P is peeled off from the pressure-sensitive adhesive layer 3 by being thrust up by a pin 42, and the DAF 8 is sucked by a suction collet 44 so as to be picked up.

5 [0070] The method for manufacturing the semiconductor device 100 will be specifically described with reference to FIG. 6 to FIG. 8. First, as illustrated in FIG. 6, the chip S1 (chip S) at the first stage is pressure-bonded to a predetermined position of the substrate 70 through the adhesive piece 5P. Next, the adhesive piece 5P is cured by heating.
10 Thereby, the adhesive piece 5P is cured to obtain the cured product 5C. The curing treatment of the adhesive piece 5P may be executed under a pressurized atmosphere from the viewpoint of reducing voids.

[0071] Similarly to the mounting of the chip S1 with respect to the substrate 70, the chip S2 at the second stage is mounted on the surface
15 of the chip S1. Further, the chips S3 and S4 at the third and fourth stages are mounted, and thereby a structure 60 illustrated in FIG. 7 is produced. After the chips S1, S2, S3, and S4 and the substrate 70 are electrically connected by the wires W1, W2, W3, and W4 (see FIG. 8), the semiconductor element and the wires are sealed by the sealing layer
20 50, and thereby the semiconductor device 100 illustrated in FIG. 4 is completed.

[0072] Hereinbefore, embodiments of the present disclosure have been described in detail, but the present invention is not limited to the above embodiments. For example, in the above-described embodiment, the
25 film 10 including the base layer 1, the pressure-sensitive adhesive layer 3, and the adhesive layer 5 in this order has been exemplified, but an

embodiment not including the adhesive layer 5 may be employed. Furthermore, the film 10 may further include a cover film (not illustrated) covering the adhesive layer 5.

Examples

[0073] Hereinafter, the present disclosure will be described in more detail on the basis of Examples; however, the present invention is not limited to these Examples. Incidentally, unless otherwise specified, reagents were used as chemicals.

[0074] <Example 1>

[Synthesis of acrylic resin (Production Example 1)]

The following components were put into a 2000-ml flask equipped with a three-one motor, a stirring blade, and a nitrogen gas introducing pipe.

- Ethyl acetate (solvent): 635 g
- 2-Ethylhexyl acrylate: 395 g
- 2-Hydroxyethyl acrylate: 100 g
- Methacrylic acid: 5 g
- Azobisisobutyronitrile: 0.08 g

[0075] After the contents were sufficiently stirred until being homogeneous, bubbling was executed for 60 minutes at a flow rate of 500 ml/min to remove dissolved oxygen in the system. The temperature was increased to 78°C over 1 hour, and polymerization was performed for 6 hours after increasing temperature. Next, the reaction solution was transferred to a 2000-ml pressurizing oven equipped with a three-one motor, a stirring blade, and a nitrogen gas introducing pipe, heated at 120°C and 0.28 MPa for 4.5 hours, and then cooled to room

temperature (25°C, the same applies hereinafter).

[0076] Next, 490 g of ethyl acetate was added, and the mixture was stirred and diluted. After 0.025 g of methoquinone as a polymerization inhibitor and 0.10 g of dioctyltin dilaurate as a urethane-forming catalyst were added thereto, 42.5 g of 2-methacryloxyethyl isocyanate (Karenc MOI (trade name) manufactured by Showa Denko K.K.) was added, and the resultant product was reacted at 70°C for 6 hours and then cooled to room temperature. Subsequently, ethyl acetate was added so that the content of non-volatile components in the acrylic resin solution became 35% by mass, and thereby a solution containing the (A) acrylic resin (Production Example 1) having a chain polymerizable functional group was obtained.

[0077] The solution containing the (A) acrylic resin obtained as described above was vacuum-dried at 60°C over night. The solid content obtained according to this was subjected to elemental analysis with a full automatic elemental analysis apparatus (trade name: varioEL manufactured by Elementar), the content of the introduced 2-methacryloxyethyl isocyanate was calculated from the content of nitrogen, and as a result, the content thereof was 0.50 mmol/g.

[0078] Furthermore, the weight average molecular weight of the (A) acrylic resin in terms of polystyrene was obtained using the following apparatus. That is, GPC measurement was performed by using SD-8022/DP-8020/RI-8020 manufactured by Tosoh Corporation, using Gelpack GL-A150-S/GL-A160-S manufactured by Hitachi Chemical Company, Ltd. as a column, and using tetrahydrofuran as an eluent. As a result, the weight average molecular weight in terms of polystyrene

was 800000. The hydroxyl value and the acid value measured according to the methods described in JIS K0070 were 61.1 mgKOH/g and 6.5 mgKOH/g, respectively. These results are collectively shown in Table 1.

5 [0079] [Production of dicing film (pressure-sensitive adhesive layer)]

The following components were mixed and thereby a varnish for forming a pressure-sensitive adhesive layer was prepared (see Table 2). The amount of ethyl acetate (solvent) was adjusted so that the total amount of solid content of the varnish became 25% by mass.

10 · (A) Acrylic resin solution (Production Example 1): 100 g (solid content)

 · (B) Photopolymerization initiator (1-hydroxy cyclohexyl phenyl ketone, IRGACURE 184 manufactured by Ciba Specialty Chemicals Co., Ltd., "IRGACURE" is the registered trademark): 0.8 g

15 · (B) Photopolymerization initiator
(bis(2,4,6-trimethylbenzoyl)-phenylphosphine oxide, IRGACURE 819 manufactured by Ciba Specialty Chemicals Co., Ltd., "IRGACURE" is the registered trademark): 0.2 g

 · (C) Cross-linking agent (polyfunctional isocyanate, Coronate L manufactured by Nippon Polyurethane Industry Co., Ltd., solid content: 75%): 8.0 g (solid content)

 · Ethyl acetate (solvent)

[0080] A polyethylene terephthalate film (width: 450 mm, length: 500 mm, thickness: 38 μ m) whose one surface was subjected to the mold release treatment was prepared. A varnish for forming a pressure-sensitive adhesive layer was applied to the surface subjected to

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the mold release treatment by using an applicator and then dried at 80°C for 5 minutes. Thereby, a laminate (dicing film) including the polyethylene terephthalate film and the pressure-sensitive adhesive layer having a thickness of 30 μm which is formed thereon was obtained.

[0081] A polyolefin film (width: 450 mm, length: 500 mm, thickness: 80 μm) whose one surface was subjected to the corona treatment was prepared. The surface subjected to the corona treatment and the adhesive layer of the laminate was pasted at room temperature. Subsequently, the pressure-sensitive adhesive layer was transferred to the polyolefin film (cover film) by being pushed by a rubber roll. Thereafter, the resultant product was left to stand for 3 days at room temperature, and thereby a cover film-attached dicing film was obtained.

[0082] [Production of die bonding film (adhesive layer A)]

First, cyclohexanone (solvent) was added to the following compositions, and the resultant product was stirred and mixed and then further kneaded for 90 minutes by using a bead mill.

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

- Phenolic resin (MILEX XLC-LL (trade name), manufactured by Mitsui Chemicals, Inc., phenolic resin, hydroxyl equivalent: 175, water absorption percentage: 1.8%, heating mass decrease rate at 350°C: 4%): 23 parts by mass

· Silane coupling agent (NUC A-189 (trade name) manufactured by NUC Corporation, γ -mercaptopropyl trimethoxysilane): 0.2 parts by mass

· Silane coupling agent (NUCA-1160 (trade name), manufactured by Nippon Unicar Company Limited, γ -ureidopropyl triethoxysilane): 0.1 parts by mass

· Filler ("SC2050-HLG (trade name), manufactured by Admatechs Company Limited, silica, average particle diameter: 0.500 μm): 32 parts by mass

[0083] The following components were added to the composition obtained as described above, the resultant product was subjected to a stirring and mixing step and a vacuum deaeration, and thereby a varnish for forming an adhesive layer was obtained.

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

· Curing accelerator (CUREZOL 2PZ-CN (trade name), manufactured by SHIKOKU CHEMICALS CORPORATION, 1-cyanoethyl-2-phenylimidazole, "CUREZOL" is the registered trademark) 0.0.1 parts by mass

[0084] A polyethylene terephthalate film (thickness: 35 μm) whose one surface was subjected to the mold release treatment was prepared. A varnish for forming an adhesive layer was applied to the surface subjected to the mold release treatment by using an applicator and then dried by heating at 140°C for 5 minutes. Thereby, a laminate (die bonding film) including the polyethylene terephthalate film (carrier

film) and the adhesive layer (B-stage state) having a thickness of 20 μm which is formed thereon was obtained.

[0085] [Production of dicing/die bonding integrated film]

The die bonding film including the adhesive layer and the carrier film was cut into a circle having a diameter of 335 mm for each carrier film. The dicing film from which the polyethylene terephthalate film was peeled off was pasted thereto at room temperature and left to stand at room temperature for one day. Thereafter, the dicing film was cut into a circle having a diameter of 370 mm. The region (the first region of the pressure-sensitive adhesive layer) corresponding to a pasting position of the wafer in the adhesive layer of the dicing/die bonding integrated film obtained in this way was irradiated with ultraviolet rays as described below. That is, ultraviolet rays were partially applied at 70 W and an irradiance level of 150 mJ/cm^2 by using a pulsed xenon lamp. Incidentally, a part of an inner diameter of 318 mm from the center of the film was irradiated with ultraviolet rays by using a blackout curtain. In this way, a plurality of dicing/die bonding integrated films for being provided to various evaluation tests described below were obtained.

[0086] <Example 2>

A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 1, except that the irradiance level of ultraviolet rays was set to 300 mJ/cm^2 instead of 150 mJ/cm^2 .

[0087] <Example 3>

A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 1, except that the irradiance level of

ultraviolet rays was set to 500 mJ/cm² instead of 150 mJ/cm².

[0088] <Example 4>

A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 1, except that a die bonding film having an adhesive layer B formed as follows was used instead of the die bonding film having an adhesive layer A as a die bonding film.

[Production of die bonding film (adhesive layer B)]

First, cyclohexanone (solvent) was added to the following component, and the resultant product was stirred and mixed and then further kneaded for 90 minutes by using a bead mill.

- Filler ("SC2050-HLG (trade name), manufactured by Admatechs Company Limited, silica, average particle diameter: 0.500 μm): 50 parts by mass

The following components were added to the composition obtained as described above, the resultant product was subjected to a stirring and mixing step and a vacuum deaeration, and thereby a varnish for forming an adhesive layer was obtained.

- Epoxy group-containing acrylic copolymer (HTR-860P-3 (trade name), manufactured by Nagase ChemteX Corporation, weight average molecular weight: 800000): 100 parts by mass

- Curing accelerator (CUREZOL 2PZ-CN (trade name), manufactured by SHIKOKU CHEMICALS CORPORATION, 1-cyanoethyl-2-phenylimidazole, "CUREZOL" is the registered trademark) 0.1 parts by mass

[0089] <Example 5>

A solution of the (A) acrylic resin according to Production

Example 2 produced by the same method as in Production Example 1 was obtained using the raw material monomer composition shown in Production Example 2 instead of the raw material monomer composition shown in Production Example 1 of Table 1. A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 2, except that this solution was used.

[0090] <Example 6>

A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 5, except that the amount of the cross-linking agent in the pressure-sensitive adhesive layer was set to 4.0 parts by mass instead of 8.0 parts by mass, and the irradiance level of ultraviolet rays was set to 500 mJ/cm² instead of 300 mJ/cm².

[0091] <Example 7>

A solution of the (A) acrylic resin according to Production Example 3 produced by the same method as in Production Example 1 was obtained using the raw material monomer composition shown in Production Example 3 instead of the raw material monomer composition shown in Production Example 1 of Table 1. A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 2, except that this solution was used.

[0092] <Example 8>

A solution of the (A) acrylic resin according to Production Example 4 produced by the same method as in Production Example 1 was obtained using the raw material monomer composition shown in Production Example 4 instead of the raw material monomer composition shown in Production Example 1 of Table 1. A plurality of

dicing/die bonding integrated films were obtained in the same manner as in Example 3, except that this solution was used.

[0093] <Comparative Example 1>

A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 1, except that the amount of the cross-linking agent in the pressure-sensitive adhesive layer was set to 15.0 parts by mass instead of 8.0 parts by mass.

[0094] <Comparative Example 2>

A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 5, except that the irradiance level of ultraviolet rays was set to 500 mJ/cm² instead of 300 mJ/cm².

[0095] <Comparative Example 3>

A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 8, except that the irradiance level of ultraviolet rays was set to 150 mJ/cm² instead of 500 mJ/cm².

[0096] <Comparative Example 4>

A solution of the (A) acrylic resin according to Production Example 5 produced by the same method as in Production Example 1 was obtained using the raw material monomer composition shown in Production Example 5 instead of the raw material monomer composition shown in Production Example 1 of Table 1. A plurality of dicing/die bonding integrated films were obtained in the same manner as in Example 1, except that this solution was used and irradiation of ultraviolet rays was not performed.

[0097] [Evaluation test]

(1) Measurement of adhesive force (30° peeling strength) of

pressure-sensitive adhesive layer with respect to adhesive layer

The adhesive force of the pressure-sensitive adhesive layer (ultraviolet ray-irradiated region) with respect to the adhesive layer was evaluated by measuring 30° peeling strength. That is, a measurement sample having a width of 25 mm and a length of 100 mm was cut from the dicing/die bonding integrated film. The laminate of the pressure-sensitive adhesive layer (ultraviolet ray-irradiated region) and the adhesive layer was used as the measurement sample. The peeling strength of the pressure-sensitive adhesive layer (ultraviolet ray-irradiated region) with respect to the adhesive layer was measured by using a tension tester. The measurement conditions were set to a peeling angle of 30° and a tension rate of 60 mm/min. Incidentally, the storage of the sample and the measurement of the peeling strength were performed in an environment of a temperature of 23°C and a relative humidity of 40%.

[0098] (2) Measurement of 15° peeling strength of pressure-sensitive adhesive layer with respect to adhesive layer

The 15° peeling strength was measured in the same manner as in the measurement of the 30° peeling strength described above, except that the peeling angle was set to 15° and the tension rate was set to 150 mm/min (2.5 mm/sec). Incidentally, this measurement conditions are the same conditions described in claim 1 of Patent Literature 1.

[0099] (3) Measurement of adhesive force (90° peeling strength) of pressure-sensitive adhesive layer with respect to stainless steel substrate

The adhesive force of the pressure-sensitive adhesive layer (ultraviolet ray-non-irradiated region) with respect to the stainless steel

substrate was evaluated by measuring 90° peeling strength. That is, a measurement sample having a width of 25 mm and a length of 100 mm was cut from the dicing/die bonding integrated film. The laminate of the pressure-sensitive adhesive layer (ultraviolet ray-non-irradiated region) and the adhesive layer was used as the measurement sample. After the surface of the sample at the side of the pressure-sensitive adhesive layer was pasted to a stainless steel substrate (SUS430BA), the peeling strength of the pressure-sensitive adhesive layer (ultraviolet ray-non-irradiated region) with respect to the stainless steel substrate was measured by using an Autograph "AGS-1000" manufactured by SHIMADZU CORPORATION. The measurement conditions were set to a peeling angle of 90° and a peeling rate of 50 mm/min.

[0100] (4) Evaluation of dicing property

The dicing/die bonding integrated film was pasted to a wafer (diameter: 8 inches, thickness: 50 μm) under a condition of 80°C × 10 sec. Thereafter, the dicing of the wafer was performed under the following conditions.

<Dicing conditions>

- Dicer: DFD-651 manufactured by DISCO Corporation
- Blade: 27HECC manufactured by DISCO Corporation
- Blade rotation number: 40000 rpm
- Dicing rate: 30 mm/sec
- Dicing depth: 25 μm
- Cutting mode: Down-cutting
- Dicing size: 1.0 mm × 1.0 mm

[0101] (Evaluation of peeling of adhesive piece from pressure-sensitive

adhesive layer)

At the time of dicing, whether or not peeling of the adhesive piece from the pressure-sensitive adhesive layer occurred was checked. During dicing one wafer, a sample in which flying of the laminate and the above-described peeling were not recognized was evaluated as "A", and a sample in which flying of the laminate or the above-described peeling even at a small area was recognized was evaluated as "B".

[0102] (Evaluation of peeling of chip from adhesive layer)

At the time of dicing, whether or not peeling of the chip from the adhesive layer occurred was checked. During dicing one wafer, a sample in which flying of the chip did not occur even once was evaluated as "A", and a sample in which flying of the chip occurred even once was evaluated as "B".

[0103] (Cracks)

Whether or not chipping of a chip occurs was evaluated by checking a cut cross-section of the chip after dicing with a microscope. Cut cross-sections of 25 chips were observed, a sample in which chipping was not recognized at all was evaluated as "A", and a sample in which chipping was slightly recognized was evaluated as "B".

[0104] (Presence or absence of ring peeling)

Whether or not a phenomenon that the dicing ring is peeled off from the pressure-sensitive adhesive layer at the time of dicing (ring peeling) occurred was evaluated by visual inspection. A sample in which the ring peeling did not occur was evaluated as "A", and a sample in which the ring peeling occurred was evaluated as "B".

[0105] (5) Evaluation of pickup property

The pickup property of the chip after the dicing step was evaluated by using a flexible die holder "DB-730" manufactured by Renesas Eastern Japan Semiconductor, Inc. "RUBBER TIP 13-087E-33 (size: 1 × 1 mm)" manufactured by Micromechanics, Inc. was used as a collet for pickup and "EJECTOR NEEDLE SEN2-83-05 (diameter: 0.7 mm, tip end shape: semicircle having a diameter of 350 μm)" manufactured by Micromechanics, Inc. was used as a thrust-up pin. One thrust-up pin was disposed at the center portion. The pickup property was evaluated under conditions of a thrust-up rate of the pin of 10 mm/sec and a thrust-up height of 75 μm at the time of pickup. 100 chips were continuously picked up, a case where chip breakage, pickup error, or the like did not occur was evaluated as "A", and a case where chip breakage or pickup error occurs even in one chip was determined as "B". Incidentally, regarding a sample in which the ring peeling occurred at the time of dicing, after an integrated sample was produced again, a ring adhesion portion was reinforced with a pressure-sensitive adhesive tape and diced and then evaluation was performed.

[0106] [Table 1]

Acrylic resin		Production Example 1	Production Example 2	Production Example 3	Production Example 4	Production Example 5
Raw material monomer (parts by mass)	2-Ethylhexyl acrylate	79	79	79	79	90
	2-Hydroxyethyl acrylate	20	20	20	20	9.5
	Methacrylic acid	1	1	1	1	0.5
	(Total)	(100)	(100)	(100)	(100)	(100)
	2-Methacryloxyethyl isocyanate	8.5	12.2	16.2	4.9	0.0
Weight average molecular weight		8.0×10^5	8.0×10^5	8.0×10^5	8.0×10^5	8.0×10^5
Hydroxyl value (mgKOH/g)		61.1	46.9	32.7	75.3	9.5
Acid value (mgKOH/g)		6.5	6.5	6.5	6.5	3.3
Amount (mmol/g) of chain polymerizable functional group		0.5	0.7	0.9	0.3	0.0

[0107] [Table 2]

	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8
Composition of pressure-sensitive adhesive layer (parts by mass)	100	100	100	100	-	-	-	-
	Production Example 1							
	Production Example 2	-	-	-	-	100	-	-
	Production Example 3	-	-	-	-	-	100	-
	Production Example 4	-	-	-	-	-	-	100
	Production Example 5	-	-	-	-	-	-	-
Acrylic resin	Photopolymerization initiator	0.8	0.8	0.8	0.8	0.8	0.8	0.8
		0.2	0.2	0.2	0.2	0.2	0.2	0.2
		8.0	8.0	8.0	8.0	8.0	4.0	8.0
Adhesive layer	A	A	A	B	A	A	A	A
Irradiance level (mJ/cm ²) of ultraviolet rays	150	300	500	300	300	500	300	500
30° Peeling strength (N/25 mm) of pressure-sensitive adhesive layer (UV-irradiated region) with respect to adhesive layer	3.59	2.28	1.25	2.67	1.54	1.37	1.25	3.9
15° Peeling strength (N/25 mm) of pressure-sensitive adhesive layer (UV-irradiated region) with respect to adhesive layer	10.70	4.83	3.02	5.74	3.66	3.23	2.92	12.01
90° Peeling strength (N/25 mm) of pressure-sensitive adhesive layer (UV-non-irradiated region) with respect to stainless steel substrate	0.33	0.33	0.33	0.33	0.36	0.43	0.33	0.40
Dicing property	Chip flying	A	A	A	A	A	A	A
	DAF flying	A	A	A	A	A	A	A
	Cracks	A	A	A	A	A	A	A
	Ring peeling	A	A	A	A	A	A	A
Pickup property (%)	A	A	A	A	A	A	A	A

[0108] [Table 3]

		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Composition of pressure-sensitive adhesive layer (parts by mass)	Acrylic resin	Production Example 1	100	-	-
		Production Example 2	-	100	-
		Production Example 3	-	-	-
		Production Example 4	-	-	100
		Production Example 5	-	-	-
	Photopolymerization initiator	IRGACURE 184	0.8	0.8	0.8
IRGACURE 819		0.2	0.2	0.2	
Adhesive layer	Cross-linking agent	15.0	8.0	8.0	8.0
		A	A	A	A
		300	500	150	0
Irradiance level (mJ/cm ²) of ultraviolet rays					
30° Peeling strength (N/25 mm) of pressure-sensitive adhesive layer (UV-irradiated region) with respect to adhesive layer		0.72	1.01	4.6	3.00
15° Peeling strength (N/25 mm) of pressure-sensitive adhesive layer (UV-irradiated region) with respect toadhesive layer		1.57	2.41	14.32	7.29
90° Peeling strength (N/25 mm) of adhesive layer (UV-non-irradiated region) with respect to stainless steel substrate		0.08	0.36	0.33	0.15
Dicing property	Chip flying	B	B	A	A
	DAF flying	B	B	A	A
	Cracks	B	A	A	A
	Ring peeling	B	A	A	B
Pickup property (%)		A	A	B	A

Industrial Applicability

[0109] According to the present disclosure, there is provided a dicing/die bonding integrated film which can be applied to a step of dicing a wafer into a number of small chips, can sufficiently suppress the DAF flying in the dicing step, and is provided with a pressure-sensitive adhesive layer with excellent pickup property. Furthermore, according to the present disclosure, there are provided a method for producing a dicing/die bonding integrated film and a method for manufacturing a semiconductor device using the film.

Reference Signs List

[0110] 1: base layer, 3: pressure-sensitive adhesive layer, 3a: first region, 3b: second region, 5: adhesive layer, 5P: adhesive piece, 5C: cured product, 8: DAF, 10: dicing/die bonding integrated film, 70: substrate, 100: semiconductor device, DR: dicing ring, F1: first surface, F2: second surface, S, S1, S2, S3, S4: chip, W: wafer.

CLAIMS

1. A method for manufacturing a semiconductor device, the method comprising:

a step of preparing a dicing/die bonding integrated film including a base layer, a pressure-sensitive adhesive layer having a first surface facing the base layer and a second surface opposite to the first surface, and an adhesive layer provided to cover a center portion of the second surface of the pressure-sensitive adhesive layer;

a step of pasting a wafer to the adhesive layer of the dicing/die bonding integrated film and pasting a dicing ring to the second surface of the pressure-sensitive adhesive layer;

a step of individuating the wafer into a plurality of chips having an area of 9 mm² or less;

a step of picking up the chip from the pressure-sensitive adhesive layer along with an adhesive piece obtained by individuating the adhesive layer; and

a step of mounting the chip on a substrate or another chip through the adhesive piece, wherein

the pressure-sensitive adhesive layer has a first region corresponding to a region to which the wafer is pasted in the adhesive layer and a second region to which the dicing ring is pasted,

the first region is a region in a state where adhesive force is lowered by irradiation of active energy rays as compared to the second region, and

the adhesive force of the first region with respect to the adhesive layer as measured at a temperature of 23°C under conditions of a

peeling angle of 30° and a peeling rate of 60 mm/min is 1.2 N/25 mm or more and 4.5 N/25 mm or less.

2. The method for manufacturing a semiconductor device according to claim 1, wherein adhesive force of the second region with respect to a stainless steel substrate as measured at a temperature of 23°C under conditions of a peeling angle of 90° and a peeling rate of 50 mm/min is 0.2 N/25 mm or more.

3. The method for manufacturing a semiconductor device according to claim 1 or 2, wherein the plurality of chips have a square shape or a rectangular shape and have a side of 3 mm or less.

4. The method for manufacturing a semiconductor device according to any one of claims 1 to 3, wherein the first and second regions of the pressure-sensitive adhesive layer are formed by the same composition before irradiation of active energy rays, and

the first region is formed through a step of irradiating a region that becomes the first region with active energy rays in an amount of 10 to 1000 mJ/cm².

5. A dicing/die bonding integrated film comprising:

a base layer;

a pressure-sensitive adhesive layer having a first surface facing the base layer and a second surface opposite to the first surface; and

an adhesive layer provided to cover a center portion of the second surface, wherein

the pressure-sensitive adhesive layer has a first region including at least a region corresponding to a pasting position of a wafer in the adhesive layer, and a second region located to surround the first region,

the first region is a region in a state where adhesive force is lowered by irradiation of active energy rays as compared to the second region, and

the adhesive force of the first region with respect to the adhesive layer as measured at a temperature of 23°C under conditions of a peeling angle of 30° and a peeling rate of 60 mm/min is 1.2 N/25 mm or more and 4.5 N/25 mm or less.

6. The dicing/die bonding integrated film according to claim 5, wherein adhesive force of the second region with respect to a stainless steel substrate as measured at a temperature of 23°C under conditions of a peeling angle of 90° and a peeling rate of 50 mm/min is 0.2 N/25 mm or more.

7. The dicing/die bonding integrated film according to claim 5 or 6, wherein the dicing/die bonding integrated film is applied to a semiconductor device manufacturing process including a step of individuating a wafer into a plurality of chips having an area of 9 mm² or less.

8. The dicing/die bonding integrated film according to any one of claims 5 to 7, wherein the second region contains a (meth)acrylic resin having a chain polymerizable functional group,

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

a content of the functional group in the second region is 0.1 mmol/g to 1.2 mmol/g.

9. The dicing/die bonding integrated film according to any one of claims 5 to 8, wherein the second region contains a cross-linking agent,

and

a content of the cross-linking agent in the second region is 0.1 to 20% by mass.

10. The dicing/die bonding integrated film according to claim 9,
5 wherein the cross-linking agent is a reaction product between a polyfunctional isocyanate having two or more isocyanate groups in one molecule and a polyhydric alcohol having three or more OH groups in one molecule.

11. The dicing/die bonding integrated film according to any one of
10 claims 5 to 10, wherein the adhesive layer is formed by a composition containing an energy curable group-containing (meth)acrylic copolymer, a curing accelerator, and a filler.

12. A method for producing the dicing/die bonding integrated film
15 according to any one of claims 5 to 11, the method comprising, in following order:

a step of preparing a laminate including a pressure-sensitive adhesive layer, which is formed by a composition whose adhesive force is lowered by irradiation of active energy rays, and the adhesive layer, which is formed on the surface of the pressure-sensitive adhesive layer,
20 on the surface of the base layer; and

a step of irradiating a region that becomes the first region of the pressure-sensitive adhesive layer included in the laminate with active energy rays.

13. A method for producing the dicing/die bonding integrated film
25 according to any one of claims 5 to 11, the method comprising, in following order:

a step of forming a pressure-sensitive adhesive layer, which is formed by a composition whose adhesive force is lowered by irradiation of active energy rays, on the surface of the base layer;

5 a step of irradiating a region that becomes the first region of the pressure-sensitive adhesive layer with active energy rays; and

a step of stacking the adhesive layer on the surface of the pressure-sensitive adhesive layer after irradiation of the active energy rays.