

DESCRIPTION

Title of Invention

METHOD FOR MANUFACTURING SEMICONDUCTOR DEVICE
5 HAVING DOLMEN STRUCTURE, AND METHOD FOR
MANUFACTURING SUPPORT PIECE

Technical Field

[0001] The present disclosure relates to a manufacturing method for a
semiconductor device having a dolmen structure including a substrate, a
10 first chip disposed on the substrate, a plurality of support pieces
disposed around the first chip, on the substrate, and a second chip
disposed to be supported by the plurality of support pieces and to cover
the first chip. In addition, the present disclosure relates to a
manufacturing method for a support piece used in the manufacturing of
15 a semiconductor device having a dolmen structure. Note that, dolmen
is a type of stone tomb, and includes a plurality of pillar stones, and a
plate-shaped rock placed on the plurality of pillar stones. In the
semiconductor device having a dolmen structure, the support piece
corresponds to the "pillar stone", and the second chip corresponds to the
20 "plate-shaped rock".

Background Art

[0002] Recently, in the field of a semiconductor device, high
integration, downsizing, and speed-up have been required. As one
aspect of the semiconductor device, a structure in which a
25 semiconductor chip is laminated on a controller chip disposed on a
substrate has attracted attention. For example, in Patent Literature 1, a

semiconductor die assembly including a controller die, and a memory die supported by a support member on the controller die is disclosed. It can be said that a semiconductor assembly 100 illustrated in FIG. 1A of Patent Literature 1 has a dolmen structure. That is, the semiconductor assembly 100 includes a package substrate 102, a controller die 103 disposed on the surface of the package substrate 102, memory dies 106a and 106b disposed above the controller die 103, and support members 130a and 130b supporting the memory die 106a.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Publication No. 2017-515306

Summary of Invention

Technical Problem

[0004] In Patent Literature 1, it is disclosed that as the support member (a support piece), a semiconductor material such as silicon can be used, and more specifically, a fraction of a semiconductor material that is obtained by dicing a semiconductor wafer can be used (refer to [0012], [0014], and FIG. 2 of Patent Literature 1). In order to manufacture a support piece for a dolmen structure by using a semiconductor wafer, as with the manufacturing of the general semiconductor chip, for example, each of the following steps is required:

- (1) pasting a back grind tape to a semiconductor wafer;
- (2) performing back grinding with respect to the semiconductor wafer;
- (3) pasting a film including an adhesive layer and a bonding

adhesive layer (a dicing/die-bonding integrated film) to a dicing ring and the semiconductor wafer after the back grinding that is disposed in the dicing ring;

(4) peeling off the back grind tape from the semiconductor wafer;

(5) singulating the semiconductor wafer; and

(6) picking up a support piece from the adhesive layer, the support piece including a laminated body of a semiconductor chip and a bonding adhesive piece.

[0005] The present disclosure provides a manufacturing method for a support piece that is capable of efficiently manufacturing a support piece used in the manufacturing of a semiconductor device having a dolmen structure and is capable of contributing to the improvement of a production efficiency of a semiconductor device. In addition, the present disclosure provides a method for efficiently manufacturing a semiconductor device having a dolmen structure by using the support piece described above.

Solution to Problem

[0006] One aspect of the present disclosure relates to a manufacturing method for a support piece used in the manufacturing of a semiconductor device having a dolmen structure.

[0007] A first aspect of the manufacturing method according to the present disclosure includes the following steps:

(A) preparing a laminate film including a base material film, an adhesive layer, and a support piece formation film, in this order;

(B) forming a plurality of support pieces on a surface of the

adhesive layer by singulating the support piece formation film; and

(C) picking up the support piece in a state in which the support piece is thrust up from the base material film side by a plurality of needles.

5 The support piece formation film is any one of the following films:

 a film including a thermosetting resin layer;

 a film including a layer in which at least a part of a thermosetting resin layer is cured;

10 a multi-layer film including a thermosetting resin layer, and a resin layer having rigidity higher than that of the thermosetting resin layer; and

 a multi-layer film including a thermosetting resin layer, and a metal layer having rigidity higher than that of the thermosetting resin layer.

15 [0008] A second aspect of the manufacturing method according to the present disclosure includes the following steps:

 (A) preparing a laminate film including a base material film, an adhesive layer, and a support piece formation film, in this order;

20 (B) forming a plurality of support pieces on a surface of the adhesive layer by singulating the support piece formation film; and

 (C) picking up the support piece in a state in which the support piece is thrust up from the base material film side by a member having a flat tip surface.

25 The support piece formation film is any one of the following films:

a film including a thermosetting resin layer;

a film including a layer in which at least a part of a thermosetting resin layer is cured;

5 a multi-layer film including a thermosetting resin layer, and a resin layer having rigidity higher than that of the thermosetting resin layer; and

a multi-layer film including a thermosetting resin layer, and a metal layer having rigidity higher than that of the thermosetting resin layer.

10 [0009] In the present disclosure, the resin layer of the support piece formation film, for example, is a polyimide layer. The resin layer, for example, contains a material different from that of the thermosetting resin layer. The metal layer of the support piece formation film, for example, is a copper layer or an aluminum layer. Note that, the
15 rigidity of the thermosetting resin layer after thermal curing may be lower or higher than the rigidity of the resin layer or the metal layer.

The rigidity indicates the ability of an object to endure breaking against bending or twisting.

[0010] In the manufacturing method according to the present disclosure
20 described above, the support piece obtained by singulating the support piece formation film is used. Accordingly, the step of preparing the support piece can be simplified, compared to the manufacturing method of the related art in which the fraction of the semiconductor material that is obtained by dicing the semiconductor wafer is used as the support
25 piece. That is, in the related art, the steps of (1) to (6) described above were required, whereas since the support piece formation film does not

include a semiconductor wafer, the steps of (1), (2), and (4) relevant to the back grinding of the semiconductor wafer can be omitted. In addition, since the semiconductor wafer that is more expensive than a resin material is not used, the cost can also be reduced. Note that, since the thermosetting resin layer has adhesiveness with respect to other members (for example, the substrate), a bonding adhesive layer or the like may not be separately provided on the support piece.

[0011] According to the studies of the present inventors, pickup properties of the support piece from the adhesive layer depend on the ease of peeling on the interface between the support piece and the adhesive layer (hereinafter, referred to as "interface peeling") and the ease of peeling of the edge of the support piece from the adhesive layer (hereinafter, referred to as "edge peeling"). In the step (C) of the manufacturing method according to the first aspect described above, since the support piece is thrust up by the plurality of needles, the interface peeling between the support piece and the adhesive layer is likely to occur, and excellent pickup properties of the support piece from the adhesive layer can be attained.

[0012] The manufacturing method according to the second aspect described above is based on the findings of the present inventors that have been obtained from the following phenomena. That is, for example, there is a phenomenon that sufficient pickup properties are not capable of being attained in a pickup step of the support piece, even after the plurality of support pieces are formed on the surface of an ultraviolet-curable adhesive layer, and then, an adhesive force of the adhesive layer is decreased by ultraviolet irradiation. In order to

improve such a phenomenon, the present inventors have studied the type of thrust-up device used in the pickup step. As a result thereof, it has been found that a thrust-up device including a member having a flat tip surface is effective in the improvement of peeling properties of the edge of the support piece. By thrusting up the support piece from the base material film side with the flat tip surface, the support piece can be prevented from being marked by the thrust-up, and the edge of the support piece can be efficiently peeled off from the adhesive layer, compared to a case where the support piece is thrust up with the plurality of needles. Note that, a situation in which the edge of the support piece is less likely to be peeled off is not limited to a case where the ultraviolet-curable adhesive layer is adopted, but even in a case where a pressure-sensitive adhesive layer is adopted, for example, a part of the base material film may be cut beyond the support piece formation film and the adhesive layer at the time of singulating the support piece formation film.

[0013] In a case where the support piece formation film is a film including a thermosetting resin layer or a film including a layer in which at least a part of a thermosetting resin layer is cured, from the viewpoint of attaining more excellent pickup properties, the step (B) may include a step of forming a cutout to the middle of the support piece formation film in a thickness direction, and a step of singulating the support piece formation film in a cooled state by expansion, in this order. On the other hand, in a case where the support piece formation film is a multi-layer film including a thermosetting resin layer, and a resin layer or a metal layer having rigidity higher than that of the thermosetting

resin layer, from the same viewpoint as described above, in the laminate film prepared in the step (A), the thermosetting resin layer may be positioned between the resin layer or the metal layer and the adhesive layer, and the step (B) may include a step of forming a cutout to the middle of the thermosetting resin layer in a thickness direction by cutting the resin layer or the metal layer of the support piece formation film, and a step of singulating the support piece formation film in a cooled state by expansion, in this order. In the step (B), since the thermosetting resin layer is half-cut, and then, the thermosetting resin layer is singulated by cool expansion, the edge of the bonding adhesive piece does not intrude into the adhesive layer, and excellent pickup properties can be attained more highly.

[0014] One aspect of the present disclosure relates to a manufacturing method for a semiconductor device having a dolmen structure. The manufacturing method includes the following steps:

(D) disposing a first chip on a substrate;

(E) disposing the plurality of support pieces manufactured by the manufacturing method according to present disclosure around the first chip or around a region in which the first chip is to be disposed, on the substrate;

(F) preparing an adhesive piece-attached chip including a second chip, and a bonding adhesive piece provided on one surface of the second chip; and

(G) constructing a dolmen structure by disposing the adhesive piece-attached chip on surfaces of the plurality of support pieces.

[0015] Either the step (D) or the step (E) may be performed first. In a

case where the step (D) is performed first, in the step (E), the plurality of support pieces may be disposed around the first chip, on the substrate. On the other hand, in a case where the step (E) is performed first, in the step (E), the plurality of support pieces may be disposed around the region in which the first chip is to be disposed, on the substrate, and then, in the step (D), the first chip may be disposed in the region.

Advantageous Effects of Invention

[0016] According to the present disclosure, a manufacturing method for a support piece that is capable of efficiently manufacturing a support piece used in the manufacturing of a semiconductor device having a dolmen structure and is capable of contributing to the improvement of a production efficiency of a semiconductor device is provided. In addition, according to the present disclosure, a method for efficiently manufacturing a semiconductor device having a dolmen structure by using the support piece described above is provided.

Brief Description of Drawings

[0017] FIG. 1 is a sectional view schematically illustrating an example of a semiconductor device according to the present disclosure.

FIG. 2(a) and FIG. 2(b) are plan views schematically illustrating an example of a positional relationship between a first chip and a plurality of support pieces.

FIG. 3(a) is a plan view schematically illustrating an example of a support piece formation laminate film, and FIG. 3(b) is a sectional view taken along line b-b of FIG. 3(a).

FIG. 4 is a sectional view schematically illustrating a step of

bonding an adhesive layer and a support piece formation film.

FIG. 5(a) is a sectional view schematically illustrating a state in which a dicing ring is pasted to a circumferential edge region of an adhesive layer, FIG. 5(b) is a sectional view schematically illustrating a state in which a support layer formation film is singulated, and FIG. 5(c) is a sectional view schematically illustrating a state in which an interval between the adjacent support pieces is widened by expansion.

FIG. 6(a) is a sectional view schematically illustrating a state in which an inside region of a base material film is heated by the blow of a heater, and FIG. 6(b) is a sectional view schematically illustrating a state in which a support piece is picked up while the support piece is thrust up by a plurality of needles.

FIG. 7 is a sectional view schematically illustrating a state in which a support piece is thrust up from a base material film side by a plurality of needles.

FIG. 8 is a sectional view schematically illustrating a state in which a plurality of support pieces are disposed around a first chip, on a substrate.

FIG. 9 is a sectional view schematically illustrating an example of an adhesive piece-attached chip.

FIG. 10 is a sectional view schematically illustrating a dolmen structure formed on a substrate.

FIG. 11 is a sectional view schematically illustrating a state in which a support piece is picked up while the support piece is thrust up by a member having a flat tip surface.

FIG. 12(a) to FIG. 12(c) are sectional views schematically

illustrating a state in which an edge of a support piece is peeled off from an adhesive layer by thrusting up the support piece with a multi-step thrust-up device.

FIG. 13(a) is a sectional view schematically illustrating a state in which a support piece formation film is half-cut, and FIG. 13(b) is a plan view schematically illustrating an example of the half-cut support piece formation film.

FIG. 14(a) and FIG. 14(b) are sectional views schematically illustrating other embodiments of the support piece formation laminate film, respectively.

FIG. 15(a) is a sectional view schematically illustrating a state in which a two-layer film illustrated in FIG. 14(a) is half-cut, and FIG. 15(b) is a sectional view schematically illustrating a state in which a three-layer film illustrated in FIG. 14(b) is half-cut.

Description of Embodiments

[0018] Hereinafter, embodiments of the present disclosure will be described in detail, with reference to the drawings. However, the present invention is not limited to the following embodiments. Note that, herein, a "(meth)acrylic acid" indicates an acrylic acid or a methacrylic acid, and "(meth)acrylate" indicates acrylate or methacrylate corresponding thereto. "A or B" may include either A or B, or may include both of A and B.

[0019] Herein, the term of "layer" also includes a structure having a shape formed on the entire surface and a structure having a shape formed on a part of the surface when seen in the plan view. In addition, herein, the term of "step" includes not only an independent step, but also

a step that is not clearly distinguishable from other steps insofar as a desired function of the step is attained. In addition, a numerical range represented by using "to" indicates a range including numerical values described before and after "to" as a minimum value and a maximum value, respectively.

[0020] Herein, in a case where there are a plurality of substances corresponding to each component in a composition, the content of each component in the composition indicates the total amount of the plurality of substances in the composition, unless otherwise noted. In addition, exemplified materials may be independently used, or two or more types thereof may be used by being combined, unless otherwise noted. In addition, in numerical ranges described in stages herein, an upper limit value or a lower limit value of a numerical range in one stage may be replaced with an upper limit value or a lower limit value of a numerical range in another stage. In addition, in a numerical range described herein, an upper limit value or a lower limit value of the numerical range may be replaced with values described in Examples.

[0021] (Semiconductor Device)

FIG. 1 is a sectional view schematically illustrating an example of a semiconductor device having a dolmen structure. A semiconductor device 100 illustrated in this drawing includes a substrate 10, a chip T1 (a first chip) disposed on the surface of the substrate 10, a plurality of support pieces Dc disposed around the chip T1, on the surface of the substrate 10, a chip T2 (a second chip) disposed above the chip T1, a bonding adhesive piece Tc interposed between the chip T2 and the plurality of support pieces Dc, chips T3

and T4 laminated on the chip T2, a plurality of wires w electrically connecting an electrode (not illustrated) on the surface of the substrate 10 and the chips T1 to T4, respectively, and a sealing material 50 filled in a gap between the chip T1 and the chip T2, or the like.

5 [0022] In this embodiment, the plurality of support pieces Dc, the chip T2, and the bonding adhesive piece Tc positioned between the support piece Dc and the chip T2 configure a dolmen structure on the substrate 10. The chip T1 is apart from the bonding adhesive piece Tc. By suitably setting the thickness of the support piece Dc, a space for the
10 wire w connecting an upper surface of the chip T1 and the substrate 10 can be ensured. Since the chip T1 is apart from the bonding adhesive piece Tc, short circuit of the wire w due to a contact between an upper portion of the wire w connected to the chip T1 and the chip T2 can be prevented. In addition, since it is not necessary that the wire is
15 embedded in the bonding adhesive piece Tc that is in contact with the chip T2, there is an advantage that the bonding adhesive piece Tc can be thinned.

[0023] As illustrated in FIG. 1, the bonding adhesive piece Tc between the chip T1 and the chip T2 covers a region of the chip T2 facing the
20 chip T1 and continuously extends to the circumferential edge side of the chip T2 from the region. That is, one bonding adhesive piece Tc covers the region of the chip T2 and adheres the chip T2 and the plurality of support pieces to each other by being interposed therebetween. Note that, in FIG. 1, an aspect is illustrated in which the
25 bonding adhesive piece Tc is provided to cover the entire one surface (a lower surface) of the chip T2. However, since the bonding adhesive

piece Tc can be contracted in a manufacturing procedure of the semiconductor device 100, the bonding adhesive piece Tc may substantially cover the entire one surface (the lower surface) of the chip T2, and for example, there may be a portion that is not covered with the bonding adhesive piece Tc in a part of the circumferential edge of the chip T2. In FIG. 1, the lower surface of the chip T2 corresponds to a back surface of a chip. Recently, concavities and convexities are commonly formed on the back surface of the chip. Since substantially the entire back surface of the chip T2 is covered with the bonding adhesive piece Tc, the occurrence of a crack or a split on the chip T2 can be suppressed.

[0024] The substrate 10 may be an organic substrate, or may be a metal substrate such as a lead frame. The thickness of substrate 10, for example, is 90 to 300 μm , and may be 90 to 210 μm , from the viewpoint of suppressing the warpage of the semiconductor device 100.

[0025] The chip T1, for example, is a controller chip, and is adhered to the substrate 10 by a bonding adhesive piece T1c and is electrically connected to the substrate 10 by the wire w. The shape of the chip T1 in the planar view, for example, is a quadrangular shape (a square shape or a rectangular shape). The length of one side of the chip T1, for example, is less than or equal to 5 mm, and may be 2 to 5 mm or 1 to 5 mm. The thickness of the chip T1, for example, is 10 to 150 μm , and may be 20 to 100 μm .

[0026] The chip T2, for example, is a memory chip, and is adhered onto the support piece Dc via the bonding adhesive piece Tc. The chip T2 has a size larger than that of the chip T1, in the planar view. The shape

of the chip T2 in the planar view, for example, is a quadrangular shape (a square shape or a rectangular shape). The length of one side of the chip T2, for example, is less than or equal to 20 mm, and may be 4 to 20 mm or 4 to 12 mm. The thickness of the chip T2, for example, is 10 to 170 μm , and may be 20 to 120 μm . Note that, the chips T3 and T4, for example, are a memory chip, and are adhered onto the chip T2 via the bonding adhesive piece Tc. The length of one side of the chips T3 and T4 may be identical to that of the chip T2, and the thickness of the chips T3 and T4 may also be identical to that of the chip T2.

[0027] The support piece Dc serves in the role of a spacer for forming a space around the chip T1. The support piece Dc contains a cured product of a thermosetting resin composition. Note that, as illustrated in FIG. 2(a), two support pieces Dc (Shape: a rectangular shape) may be disposed in separated positions on both sides of the chip T1, or as illustrated in FIG. 2(b), one support piece Dc (Shape: a square shape, a total of 4) may be disposed in each position corresponding to the corner of the chip T1. The length of one side of the support piece Dc in the planar view, for example, is less than or equal to 20 mm, and may be 1 to 20 mm or 1 to 12 mm. The thickness (the height) of the support piece Dc, for example, is 10 to 180 μm , and may be 20 to 120 μm .

[0028] <First Embodiment>

(Manufacturing Method for Support Piece)

A manufacturing method for a support piece according to this embodiment includes the following steps:

(A) preparing a support piece formation laminate film 20 (hereinafter, may be referred to as a "laminate film 20") including a base

material film 1, an adhesive layer 2 that includes a first surface f1 facing the base material film 1 and a second surface f2 on the opposite side, and a support piece formation film D disposed to cover the central portion of the second surface f2 of the adhesive layer 2, in this order (refer to FIG. 3(a) and FIG. 3(b));

(B) plurality of support pieces on the second surface f2 of the adhesive layer 2 by singulating the support piece formation film D (refer to FIG. 5(b)); and

(C) picking up the support piece Da in a state in which the support piece is thrust up from the base material film side by a plurality of needles N (refer to FIG. 6(b)).

Note that, the support piece Dc illustrated in FIG. 1 is in a state after the thermosetting resin composition is cured. On the other hand, the support piece Da is in a state before the thermosetting resin composition is completely cured.

[0029] [Step (A)]

The laminate film 20 includes the base material film 1, the adhesive layer 2, and the support piece formation film D. The base material film 1, for example, is a polyethylene terephthalate film (a PET film) or a polyolefin film. A film having thermal contractility may be used as the base material film 1. The adhesive layer 2 includes the first surface f1 facing the base material film 1, and the second surface f2 on the opposite side. The adhesive layer 2 is formed into a circular shape by punching or the like (refer to FIG. 3(a)). The adhesive layer 2 contains a pressure-sensitive adhesive agent. Note that, the adhesive layer 2 may or may not contain a resin having a photoreactive

carbon-carbon double bond. For example, a predetermined region of the adhesive layer 2 may be irradiated with an ultraviolet ray to decrease the adhesiveness of the region, and for example, the resin having a photoreactive carbon-carbon double bond may remain.

5 [0030] The support piece formation film D is formed into a circular shape by punching or the like, and has a diameter smaller than that of the adhesive layer 2 (refer to FIG. 3(a)). The support piece formation film D contains a thermosetting resin composition. The thermosetting resin composition configuring the support piece formation film D can be
10 in a semi-cured (a B-stage) state, and then, in a completely cured product (a C-stage) state by the subsequent curing treatment. The thermosetting resin composition contains an epoxy resin, a curing agent, and an elastomer (for example, an acrylic resin), and as necessary, further contains an inorganic filler, a curing accelerator, and the like.
15 The details of the thermosetting resin composition configuring the support piece formation film D will be described below.

[0031] The laminate film 20, for example, can be prepared by bonding a first laminate film including the base material film 1 and the adhesive layer 2 on the surface of the base material film 1, and a second laminate
20 film including a cover film 3 and the support piece formation film D on the surface of the cover film 3 (refer to FIG. 4). The first laminate film is obtained through a step of forming the adhesive layer on the surface of the base material film 1 by coating, and a step of processing the adhesive layer into a predetermined shape (for example, a circular
25 shape) by punching or the like. The second laminate film is obtained through a step of forming the support piece formation film on the

surface of the cover film 3 (for example, a PET film or a polyethylene film) by coating, and a step of processing the support piece formation film into a predetermined shape (for example, a circular shape) by punching or the like. When the laminate film 20 is used, the cover film 3 is peeled off at a suitable timing.

[0032] [Step (B)]

As illustrated in FIG. 5(a), a dicing ring DR is pasted to the laminate film 20. That is, the dicing ring DR is pasted to a circumferential edge region 2a of the adhesive layer 2 such that the support piece formation film D is disposed inside the dicing ring DR. The support piece formation film D is singulated by dicing (refer to FIG. 5(b)). Accordingly, a plurality of support pieces Da are obtained from the support piece formation film D. After that, as illustrated in FIG. 5(c), a tensile force is imparted to the base material film 1 by thrusting up an inside region 1a of the base material film 1 in the dicing ring DR with a ring R. Accordingly, an interval between the adjacent support pieces Da can be widened. Note that, it is preferable that a cutout for singulation is formed to the outer edge of the support piece formation film D. The diameter of the support piece formation film D, for example, may be 300 to 310 mm or 300 to 305 mm. The shape of the support piece formation film D in the planar view is not limited to a circular shape illustrated in FIG. 3(a), and may be a quadrangular shape (a square shape or a rectangular shape).

[0033] In a case where the film having thermal contractility is used as the base material film 1, after the step (B), the inside region 1a may be contracted by heating the inside region 1a of the base material film 1 in

the dicing ring DR. FIG. 6(a) is a sectional view schematically illustrating a state in which the inside region 1a is heated by the blow of a heater H. A state in which the interval between the adjacent support pieces Da is widened can be maintained by contracting the inside region 1a into an annular shape and by imparting a tensile force to the base material film 1. Accordingly, the occurrence of a pickup error can be further suppressed, and the visibility of the support piece Da in a pickup step can be improved.

[0034] [Step (C)]

As illustrated in FIG. 6(b), the support piece Da is thrust up by a thrust-up device including the plurality of needles N. For example, DB-830 plus+ (Product Name), manufactured by FASFORD TECHNOLOGY CO., LTD., can be used as the thrust-up device. By thrusting up the support piece Da from the base material film 1 side with the plurality of needles N, a pressing force can be locally applied to the interface between the adhesive layer 2 and the support piece Da (refer to FIG. 7). Accordingly, interface peeling between the adhesive layer 2 and the support piece Da is efficiently advanced, and excellent pickup properties can be attained. Note that, the tip of the needle N may be rounded or flat from the viewpoint of preventing the support piece Da from being marked by the thrust-up.

[0035] The support piece Da in a thrust-up state is picked up by being sucked with an adsorption collet C. For example, RUBBER TIP RHAH-CA010005001 (Product Name), manufactured by Micro-Mechanics Holdings Ltd., can be used as the adsorption collet C. Note that, a curing reaction of a thermosetting resin may be advanced

by heating the support piece formation film D before dicing or the support piece Da before thrust-up. Since the support piece Da is suitably cured at the time of being picked up, more excellent pickup properties can be attained.

5 [0036] (Manufacturing Method for Semiconductor Device)

A manufacturing method for the semiconductor device 100 will be described. A manufacturing method according to this embodiment includes the following steps:

(D) disposing the first chip T1 on the substrate 10;

10 (E) disposing the plurality of support pieces Da around the first chip T1, on the substrate 10 (refer to FIG. 8);

(F) preparing an adhesive piece-attached chip T2a including a second chip T2, and a bonding adhesive piece Ta provided on one surface of the second chip T2 (refer to FIG. 9);

15 (G) constructing a dolmen structure by disposing the adhesive piece-attached chip T2a on the surfaces of the plurality of support pieces Dc (refer to FIG. 10); and

(H) sealing the gap between the chip T1 and the chip T2, or the like, with the sealing material 50 (refer to FIG. 1).

20 [0037] [Step (D)]

The step (D) is a step of disposing the first chip T1 on the substrate 10. For example, first, the chip T1 is disposed in a predetermined position on the substrate 10 via the bonding adhesive layer T1c. After that, the chip T1 is electrically connected to the
25 substrate 10 by the wire w. The step (D) may be a step performed before the step (E), or may be a step performed before the step (A),

between the step (A) and the step (B), between the step (B) and the step (C), or between the step (C) and the step (E).

[0038] [Step (E)]

The step (E) is a step of disposing the plurality of support pieces Da around the first chip T1, on the substrate 10. Through this step, a structural body 30 illustrated in FIG. 8 is prepared. The structural body 30 includes the substrate 10, and the chip T1 and the plurality of support pieces Da disposed on the surface of the substrate 10. The support piece Da may be disposed by a compression treatment. It is preferable that the compression treatment, for example, is performed in a condition of 80 to 180°C and 0.01 to 0.50 MPa, for 0.5 to 3.0 seconds. Note that, the support piece Da may become the support piece Dc by being completely cured at a time point of the step (E), or may not be completely cured at the time point. It is preferable that the support piece Da becomes the support piece Dc by being completely cured at a time point before the step (G) starts.

[0039] [Step (F)]

The step (F) is a step of preparing the adhesive piece-attached chip T2a illustrated in FIG. 9. The adhesive piece-attached chip T2a includes the chip T2, and the bonding adhesive piece Ta provided on one surface of the chip T2. The adhesive piece-attached chip T2a, for example, can be obtained by using a semiconductor wafer and a dicing/die-bonding integrated film through a dicing step and a pickup step.

[0040] [Step (G)]

The step (G) is a step of disposing the adhesive piece-attached

chip T2a above the chip T1 such that the bonding adhesive piece Ta is in contact with the upper surfaces of the plurality of support pieces Dc. Specifically, the chip T2 is compressed against the upper surface of the support piece Dc via the bonding adhesive piece Ta. It is preferable that such a compression treatment, for example, is performed in a condition of 80 to 180°C and 0.01 to 0.50 MPa, for 0.5 to 3.0 seconds. Next, the bonding adhesive Ta is cured by heating. It is preferable that such a curing treatment, for example, is performed in a condition of 60 to 175°C and 0.01 to 1.0 MPa, for longer than or equal to 5 minutes. Accordingly, the bonding adhesive piece Ta is cured to be the bonding adhesive Tc. Through this step, the dolmen structure is constructed on the substrate 10 (refer to FIG. 10). Since the chip T1 is apart from the adhesive piece-attached chip T2a, the short circuit of the wire w due to the contact between the upper portion of the wire w and the chip T2 can be prevented. In addition, since it is not necessary that the wire is embedded in the bonding adhesive piece Ta that is in contact with the chip T2, there is an advantage that the bonding adhesive piece Ta can be thinned.

[0041] The chip T3 is disposed on the chip T2 via a bonding adhesive piece, and the chip T4 is disposed on the chip T3 via a bonding adhesive piece, before the step (H) and after the step (G). The bonding adhesive piece may contain the same thermosetting resin composition as that of the bonding adhesive piece Ta described above, and becomes the bonding adhesive piece Tc by heating and curing (refer to FIG. 1). On the other hand, each of the chips T2, T3, and T4 is electrically connected to the substrate 10 by the wire w. Note that, the number of

chips to be laminated above the chip T1 is not limited to 3 described in this embodiment, and may be suitably set.

[0042] [Step (H)]

The step (H) is a step of sealing the gap between the chip T1 and the chip T2, or the like, with the sealing material 50. Through this step, the semiconductor device 100 illustrated in FIG. 1 is completed.

[0043] (Thermosetting Resin Composition Configuring Support Piece Formation Film)

As described above, the thermosetting resin composition configuring the support piece formation film D contains the epoxy resin, the curing agent, and the elastomer, and as necessary, further contains the inorganic filler, the curing accelerator, and the like. According to the studies of the present inventors, it is preferable that the support piece Da and the support piece Dc after curing have the following properties:

Property 1: when the support piece Da is thermally compressed in a predetermined position of the substrate 10, a position shift is less likely to occur (a melt viscosity of the support piece Da at 120°C, for example, is 4300 to 50000 Pa·s or 5000 to 40000 Pa·s);

Property 2: in the semiconductor device 100, the support piece Dc exhibits stress relieving properties (the thermosetting resin composition contains the elastomer (a rubber component));

Property 3: adhesion strength respect to the bonding adhesive piece Tc of the adhesive piece-attached chip is sufficiently high (die shear strength of the support piece Dc with respect to the bonding adhesive piece Tc, for example, is 2.0 to 7.0 Mpa or 3.0 to 6.0 Mpa);

Property 4: a contraction rate associated with curing is

sufficiently small;

Property 5: the visibility of the support piece Da by a camera is excellent in the pickup step (the thermosetting resin composition, for example, contains a colorant); and

5 Property 6: the support piece Dc has sufficient mechanical strength.

[0044] [Epoxy Resin]

10 The epoxy resin is not particularly limited insofar as having an adhesion function by curing. A difunctional epoxy resin such as a bisphenol A type epoxy resin, a bisphenol F type epoxy resin, and a bisphenol S type epoxy resin, a novolac type epoxy resin such as a phenol novolac type epoxy resin and a cresol novolac type epoxy resin, and the like can be used. In addition, generally known epoxy resins such as a polyfunctional epoxy resin, a glycidyl amine type epoxy resin, 15 a heterocyclic ring-containing epoxy resin, or an alicyclic epoxy resin can be applied. One type of the epoxy resins may be independently used, or two or more types thereof may be used together.

[0045] [Curing Agent]

20 Examples of the curing agent include a phenolic resin, an ester compound, aromatic amine, aliphatic amine, and an acid anhydride. Among them, the phenolic resin is preferable from the viewpoint of attaining high die shear strength. Examples of a commercially available product of the phenolic resin include LF-4871 (Product Name, a BPA novolac type phenolic resin), manufactured by DIC Corporation, 25 HE-100C-30 (Product Name, a phenyl aralkyl type phenolic resin), manufactured by AIR WATER INC., PHENOLITE KA and TD series,

manufactured by DIC Corporation, Milex XLC-series and XL series (for example, Milex XLC-LL), manufactured by Mitsui Chemicals, Inc., HE series (for example, HE100C-30), manufactured by AIR WATER INC., MEHC-7800 series (for example, MEHC-7800-4S),
5 manufactured by MEIWA PLASTIC INDUSTRIES, LTD., and JDPP series, manufactured by JFE Chemical Corporation. One type of the curing agents may be independently used, or two or more types thereof may be used together.

[0046] In a compounding amount of the epoxy resin and the phenolic resin, an equivalent ratio of an epoxy equivalent and a hydroxyl group equivalent is preferably 0.6 to 1.5, is more preferably 0.7 to 1.4, and is even more preferably 0.8 to 1.3, from the viewpoint of attaining high die shear strength. By setting a compounding ratio to be in the range described above, both of curing properties and fluidity are easily
10 attained to a sufficiently high level.

[0047] [Elastomer]

Examples of the elastomer include an acrylic resin, a polyester resin, a polyamide resin, a polyimide resin, a silicone resin, polybutadiene, acrylonitrile, epoxy-modified polybutadiene, maleic anhydride-modified polybutadiene, phenol-modified polybutadiene, and
20 carboxy-modified acrylonitrile.

[0048] As the elastomer, an acrylic resin is preferable, and an acrylic resin such as an epoxy group-containing (meth)acrylic copolymer obtained by polymerizing a functional monomer having an epoxy group or a glycidyl group as a cross-linkable functional group, such as
25 glycidyl acrylate or glycidyl methacrylate, is more preferable, from the

viewpoint of attaining high die shear strength. Among the acrylic resins, an epoxy group-containing (meth)acrylic acid ester copolymer and epoxy group-containing acrylic rubber are preferable, and the epoxy group-containing acrylic rubber is more preferable. The epoxy group-containing acrylic rubber is rubber having an epoxy group that contains acrylic acid ester as a main component and mainly contains a copolymer such as butyl acrylate and acrylonitrile, and a copolymer such as ethyl acrylate and acrylonitrile, and the like. Note that, the acrylic resin may have not only the epoxy group but also a cross-linkable functional group such as alcoholic or phenolic hydroxyl group and carboxyl group.

[0049] Examples of a commercially available product of the acrylic resin include SG-70L, SG-708-6, WS-023 EK30, SG-280 EK23, and a SG-P3 solvent-changed product (Product Name, acrylic rubber, Weight Average Molecular Weight: 800000, Tg: 12°C, Solvent: cyclohexanone), manufactured by Nagase ChemteX Corporation, and the like.

[0050] A glass transition temperature (Tg) of the acrylic resin is preferably -50 to 50°C, and is more preferably -30 to 30°C, from the viewpoint of attaining high die shear strength. A weight average molecular weight (Mw) of the acrylic resin is preferably 100000 to 3000000, and is more preferably 500000 to 2000000, from the viewpoint of attaining high die shear strength. Here, Mw indicates a value that is measured by gel permeation chromatography (GPC) and is converted by using a calibration curve of standard polystyrene. Note that, there is a tendency that a highly elastic bonding adhesive piece can be formed by using the acrylic resin having a narrow molecular weight

distribution.

[0051] The amount of acrylic resin contained in the thermosetting resin composition is preferably 10 to 200 parts by mass, and is more preferably 20 to 100 parts by mass, with respect to the total of 100 parts by mass of the epoxy resin and an epoxy resin curing agent, from the viewpoint of attaining high die shear strength.

[0052] [Inorganic Filler]

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. One type of the inorganic fillers may be independently used, or two or more types thereof may be used together.

[0053] An average particle diameter of the inorganic filler is preferably 0.005 μm to 1.0 μm , and is more preferably 0.05 to 0.5 μm , from the viewpoint of attaining high die shear strength. It is preferable that the surface of the inorganic filler is chemically modified, from the viewpoint of attaining high die shear strength. A silane coupling agent is suitable as a material for chemically modifying the surface. Examples of the type of functional group of the silane coupling agent include a vinyl group, an acryloyl group, an epoxy group, a mercapto group, an amino group, a diamino group, an alkoxy group, and an ethoxy group.

[0054] The content of the inorganic filler is preferably 20 to 200 parts by mass, and is more preferably 30 to 100 parts by mass, with respect to

100 parts by mass of resin components of the thermosetting resin composition, from the viewpoint of attaining high die shear strength.

[0055] [Curing Accelerator]

Examples of the curing accelerator include imidazoles and derivatives thereof, an organic phosphorus-based compound, secondary amines, tertiary amines, and a quaternary ammonium salt. An imidazole-based compound is preferable from the viewpoint of attaining high die shear strength. Examples of the imidazoles include 2-methyl imidazole, 1-benzyl-2-methyl imidazole, 1-cyanoethyl-2-phenyl imidazole, 1-cyanoethyl-2-methyl imidazole, and the like. One type of the curing accelerators may be independently used, or two or more types thereof may be used together.

[0056] The content of the curing accelerator in the thermosetting resin composition is preferably 0.04 to 3 parts by mass, and is more preferably 0.04 to 0.2 parts by mass, with respect to the total of 100 parts by mass of the epoxy resin and the epoxy resin curing agent, from the viewpoint of attaining high die shear strength.

[0057] <Second Embodiment>

A second embodiment of the manufacturing method for the support piece Da will be described. In the first embodiment, an aspect has been exemplified in which the plurality of needles are used in the (C), but a member having a flat tip surface may be used instead of step the plurality of needles. Hereinafter, a difference from the first embodiment will be mainly described.

[0058] The adhesive layer 2 in this embodiment contains an ultraviolet-curable adhesive agent. That is, the adhesive layer 2 has

properties of decreasing adhesiveness by being irradiated with an ultraviolet ray. In this case, as illustrated in FIG. 5(b), the plurality of support pieces Da are obtained by dicing the support piece formation film D, and then, the adhesive layer 2 is irradiated with an ultraviolet ray. Accordingly, an adhesive force between the adhesive layer 2 and the support piece Da is decreased. Since a tensile force is imparted to the base material film 1 by using the ring R and the heater H, after the ultraviolet irradiation, the interval between the adjacent support pieces Da is widened (refer to FIG. 5(c) and FIG. 6(a)).

[0059] In the step (C) of this embodiment, as illustrated in FIG. 11, the support piece Da is thrust up by a thrust-up device including a member P having a flat tip surface F. For example, DB-830 plus+ (Product Name), manufactured by FASFORD TECHNOLOGY CO., LTD., can be used as the thrust-up device. Note that, the support piece Da may be thrust up by using a three-step thrust-up device illustrated in FIG. 12(a) to FIG. 12(c). The three-step thrust-up device includes a first tubular member P1, a second tubular member P2 contained in the first tubular member P1, and a member P contained in the second tubular member P2. All tip surfaces F1, F2, and F of the members are flat and are flush with each other in a state where the tip surface F1 of the first tubular member P1 abuts on the base material film 1 (refer to FIG. 12(a)). After that, the second tubular member P2 protrudes from the first tubular member P1 to further thrust up the support piece Da (refer to FIG. 12(b)). Next, the member P protrudes from the second tubular member P2 to further thrust up the central portion of the support piece Da (refer to FIG. 12(c)). As described above, by thrusting up the

support piece Da from the base material film 1 side with the flat surface, the edge of the support piece Da can be efficiently peeled off from the adhesive layer 2, and more excellent pickup properties can be attained.

[0060] A thrust-up method of the support piece Da using the three-step thrust-up device is not limited to the above. For example, first, the support piece Da is thrust up via the base material film 1 in a state where the tip surfaces F1, F2, and F are flush with each other. After that, the first tubular member P1 may be lowered, and then, the second tubular member P2 may be lowered. According to such a method, the support piece Da can be picked up by comparatively low thrust-up. Note that, the number of steps of the thrust-up device is not limited to three steps, and may be at least two steps. That is, the multi-step thrust-up device may include a tubular member, and a columnar member P contained in the tubular member, and the members may be independently driven in a vertical direction.

[0061] <Third Embodiment>

Hereinafter, a third embodiment of the manufacturing method for the support piece Da will be described. In the embodiments described above, a case has been exemplified in which the support piece Da is formed by completely cutting the support piece formation film D, but in the step (B), the support piece formation film D may be half-cut, and then, the base material film 1 may be subjected to cool expansion to form the support piece Da. Hereinafter, a difference from the embodiments described above will be mainly described.

[0062] The dicing ring DR is pasted to the laminate film 20 (refer to FIG. 5(a)), and then, as illustrated in FIG. 13(a), a cutout G is formed to

the middle of the support piece formation film D in a thickness direction. Accordingly, a laminate film 25 including the half-cut support piece formation film D is obtained. The cutout G, for example, may be formed by a blade or a laser. In a case where the thickness of the support piece formation film D is set to 100, the depth of the cutout G may be 25 to 50, and may be 30 to 40. The cutout G is formed into the shape of a grid (refer to FIG. 13(b)). Note that, the pattern of the cutout G is not limited to the shape of a grid, and may be a pattern according to the shape of the support piece Da.

[0063] After that, for example, the support piece formation film D is singulated by cool expansion in a temperature condition of -15 to 0°C. Accordingly, the plurality of support pieces Da are obtained from the support piece formation film D. A tensile force may be imparted to the base material film 1 by thrusting up the inside region 1a of the base material film 1 in the dicing ring DR with the ring R (refer to FIG. 5(c)). In the step (B), since the support piece formation film D is half-cut, and then, the support piece formation film D is singulated by cool expansion, the edge of the support piece Da does not intrude into the adhesive layer 2, and excellent pickup properties can be attained.

[0064] As described above, the embodiments of the present disclosure have been described in detail, but the present invention is not limited to the embodiments described above. For example, in the first embodiment described above, the laminate film 20 including the pressure-sensitive adhesive layer 2 has been exemplified, but the adhesive layer 2 may be an ultraviolet-curable adhesive layer. In a case where the adhesive layer 2 according to the third embodiment is

the ultraviolet-curable adhesive layer, as described above, since the edge of the support piece Da does not intrude into the adhesive layer 2, excellent pickup properties can be attained even in a case where the adhesive layer 2 is cured by being irradiated with an ultraviolet ray.

5 [0065] In the second embodiment described above, the laminate film 20 including the ultraviolet-curable adhesive layer 2 has been exemplified, but the adhesive layer 2 may be a pressure-sensitive adhesive layer. Note that, the pressure-sensitive adhesive layer may or may not contain a resin having a photoreactive carbon-carbon double bond. For
10 example, a predetermined region of the adhesive layer may be irradiated with an ultraviolet ray to decrease the adhesiveness of the region, and for example, the resin having a photoreactive carbon-carbon double bond may remain.

[0066] In the embodiments described above, as illustrated in FIG. 3(b),
15 the support piece formation laminate film 20 including the support piece formation film D including the thermosetting resin layer has been exemplified, but the support piece formation laminate film may include a layer in which at least a part of a thermosetting resin layer is cured. In addition, the support piece formation laminate film may include a
20 multi-layer film including a thermosetting resin layer, and a resin layer or a metal layer having rigidity higher than that of the thermosetting resin layer. A support piece formation laminate film 20A illustrated in FIG. 14(a) includes a two-layer film D2 (a support piece formation film) including a thermosetting resin layer 5, and a resin layer 6 having
25 rigidity higher than that of the thermosetting resin layer. That is, in the support piece formation laminate film 20A, the thermosetting resin layer

5 is disposed between the adhesive layer 2 and the resin layer 6 that is the outermost surface. Note that, the thermosetting resin layer 5 contains the thermosetting resin composition configuring the support piece formation film D according to the first embodiment. The thickness of the resin layer 6, for example, is 5 to 100 μm , and may be 10 to 90 μm or 20 to 80 μm . The resin layer 6, for example, is a polyimide layer.

[0067] A support piece formation laminate film 20B illustrated in FIG. 14(b) includes a three-layer film D3 (a support piece formation film) including the resin layer 6 having rigidity higher than that of the thermosetting resin layer, and two thermosetting resin layers 5a and 5b interposing the resin layer 6 therebetween. In the support piece formation laminate film 20B, the three-layer film D3 is disposed on the surface of the adhesive layer 2.

[0068] As with the first embodiment, for example, the two-layer film D2 may be completely cut by a blade or a laser, or as with the third embodiment, the two-layer film D2 may be half-cut, and then, may be singulated by cool expansion. FIG. 15(a) is a sectional view schematically illustrating a state in which the two-layer film D2 is half-cut. As illustrated in FIG. 15(a), the cutout G may be formed to the middle of the thermosetting resin layer 5 in a thickness direction by cutting the resin layer 6 of the two-layer film D2. Accordingly, a laminate film 25A including the half-cut two-layer film D2 is obtained. A plurality of resin pieces 6p are formed by singulating the resin layer 6. In a case where the thickness of the thermosetting resin layer 5 is set to 100, the cutout G may be formed by cutting the thermosetting resin

layer 5 to a thickness of 10 to 75 (more preferably 25 to 50).

[0069] As with the first embodiment and the second embodiment, for example, the three-layer film D3 may be completely cut by a blade or a laser, or as with the third embodiment, the three-layer film D3 may be half-cut, and then, may be singulated by cool expansion. FIG. 15(b) is a sectional view schematically illustrating a state in which the three-layer film D3 is half-cut. As illustrated in FIG. 15(b), the cutout G may be formed to the middle of the thermosetting resin layer 5b in a thickness direction by cutting the thermosetting resin layer 5a and the resin layer 6 of the three-layer film D3. Accordingly, a laminate film 25B including the half-cut three-layer film D3 is obtained. A plurality of bonding adhesive pieces 5p are formed by singulating the thermosetting resin layer 5a, and the plurality of resin pieces 6p are formed by singulating the resin layer 6. In a case where the thickness of the thermosetting resin layer 5b is set to 100, the cutout G may be formed by cutting the thermosetting resin layer 5b to a thickness of 10 to 75 (more preferably 25 to 50).

[0070] Since the support piece formation laminate films 20A and 20B include the resin layer 6 having rigidity higher than that of the thermosetting resin layer 5, excellent pickup properties can be attained without performing a thermal curing treatment with respect to the thermosetting resin layer 5 after being singulated by dicing.

[0071] In the support piece formation laminate films 20A and 20B, a metal layer having rigidity higher than that of the thermosetting resin layer (for example, a copper layer or an aluminum layer) may be adopted instead of the resin layer 6. The thickness of the metal layer,

for example, is 5 to 100 μm , and may be 10 to 90 μm or 20 to 80 μm . Since the support piece formation laminate films 20A and 20B include the metal layer, in addition to excellent pickup properties, excellent visibility of the support piece can be attained in the pickup step by optical contrast between a resin material and a metal material. Note that, in a case where the support piece formation laminate films 20A and 20B include the metal layer, the edge of a metal piece (obtained by singulating the metal layer) is likely to intrude into the adhesive layer 2 due to the malleability of a metal. In a case where the adhesive layer 2 is a pressure-sensitive adhesive layer, since a step of curing the adhesive layer 2 by ultraviolet irradiation is not performed between the singulating step and the pickup step, excellent pickup properties can be attained even in a case where the edge of the metal piece intrudes into the adhesive layer 2.

Examples

[0072] Hereinafter, the present disclosure will be described by Examples, but the present invention is not limited to these Examples.

[0073] (Preparation of Varnish A)

A varnish A for a support piece formation film was prepared by using the following materials:

- Epoxy Resin 1: YDCN-700-10: (Product Name, manufactured by Nippon Steel & Sumikin Chemical Co., Ltd., a cresol novolac type epoxy resin, a solid at 25°C) 5.4 parts by mass;

- Epoxy Resin 2: YDF-8170C: (Product Name, manufactured by Nippon Steel & Sumikin Chemical Co., Ltd., a liquid bisphenol F type epoxy resin, a liquid at 25°C) 16.2 parts by mass;

· Phenolic Resin (Curing Agent): LF-4871: (Product Name, manufactured by DIC Corporation, a BPA novolac type phenolic resin) 13.3 parts by mass;

· Inorganic Filler: SC2050-HLG: (Product Name, manufactured by Admatechs Company Limited, a silica filler dispersion liquid, an average particle diameter of 0.50 μm) 49.8 parts by mass;

· Elastomer: a SG-P3 solvent-changed product: (Product Name, manufactured by Nagase ChemteX Corporation, acrylic rubber, Weight Average Molecular Weight: 800000, Tg: 12°C, Solvent: cyclohexanone) 14.9 parts by mass;

· Coupling Agent 1: A-189: (Product Name, manufactured by GE Toshiba Silicones Co., Ltd., γ -mercaptopropyl trimethoxy silane) 0.1 parts by mass;

· Coupling Agent 2: A-1160: (Product Name, manufactured by GE Toshiba Silicones Co., Ltd., γ -ureidopropyl triethoxy silane) 0.3 parts by mass;

· Curing Accelerator: CUREZOL 2PZ-CN: (Product Name, manufactured by SHIKOKU CHEMICALS CORPORATION, 1-cyanoethyl-2-phenyl imidazole) 0.05 parts by mass; and

· Solvent: cyclohexane.

[0074] (Preparation of Varnish B)

A varnish B for a support piece formation film was prepared by using the following materials:

· Epoxy Resin: YDCN-700-10: (Product Name, manufactured by Nippon Steel & Sumikin Chemical Co., Ltd., a cresol novolac type epoxy resin, a solid at 25°C) 13.2 parts by mass;

· Phenolic Resin (Curing Agent): HE-100C-30: (Product Name, manufactured by AIR WATER INC., a phenyl aralkyl type phenolic resin) 11.0 parts by mass;

· Inorganic Filler: AEROSIL R972: (Product Name, manufactured by NIPPON AEROSIL CO., LTD., silica, an average particle diameter of 0.016 μm) 7.8 parts by mass;

· Elastomer: a SG-P3 solvent-changed product: (Product Name, manufactured by Nagase ChemteX Corporation, acrylic rubber, Weight Average Molecular Weight: 800000, Tg: 12°C, Solvent: cyclohexanone) 66.4 parts by mass;

· Coupling Agent 1: A-189: (Product Name, manufactured by GE Toshiba Silicones Co., Ltd., γ -mercaptopropyl trimethoxy silane) 0.4 parts by mass;

· Coupling Agent 2: A-1160: (Product Name, manufactured by GE Toshiba Silicones Co., Ltd., γ -ureidopropyl triethoxy silane) 1.15 parts by mass;

· Curing Accelerator: CUREZOL 2PZ-CN: (Product Name, manufactured by SHIKOKU CHEMICALS CORPORATION, 1-cyanoethyl-2-phenyl imidazole) 0.03 parts by mass; and

· Solvent: cyclohexane.

[0075] <Example 1A>

As described above, a solid content ratio of the varnish A was adjusted to 40 mass% by using cyclohexanone as a solvent. The varnish A was filtered with a 100-mesh filter and was vacuum-defoamed. As a film to be coated with the varnish A, a polyethylene terephthalate (PET) film (a thickness of 38 μm) subjected

to a mold release treatment was prepared. The varnish A after being vacuum-defoamed was applied onto the surface of the PET film that had been subjected to the mold release treatment. The applied varnish A was heated and dried in two stages at 90°C for 5 minutes, and then, at 140°C for 5 minutes. Accordingly, a thermosetting resin layer A in a B-stage state (a semi-cured state) was prepared on the surface of the PET film.

[0076] A laminate film including a pressure-sensitive adhesive layer was prepared in the following procedure. In an adhesive agent, 2-ethyl hexyl acrylate and methyl methacrylate were used as a main monomer, and an acrylic copolymer using hydroxy ethyl acrylate and an acrylic acid as a functional group monomer was obtained by a solution polymerization method. A weight average molecular weight of the synthesized acrylic copolymer was 400000, and a glass transition point was -38°C. An adhesive agent solution was prepared in which 100 parts by mass of the acrylic copolymer was compounded with 10 parts by mass of a polyfunctional isocyanate cross-linking agent (manufactured by Mitsubishi Chemical Corporation, Product Name: MITEC NY730-T), and was applied onto the surface of polyethylene terephthalate (a thickness of 25 μm) that had been subjected to a mold release treatment and was dried such that the thickness of the adhesive agent at the time of drying was 10 μm . Further, 100 μm of a polyolefin base material containing polypropylene/vinyl acetate/polypropylene was laminated on an adhesive agent surface. Such an adhesive film was left to stand at a room temperature for 2 weeks and was sufficiently aged to obtain a dicing tape.

[0077] The thermosetting resin layer A having a thickness of 50 μm was cured by being heated at 110°C for 1 hour, and then, heated at 130°C for 3 hours to obtain a curing resin layer A. The curing resin layer A was bonded to the adhesive layer of the dicing tape on a hot plate at 70°C by using a rubber roll. Through this step, a laminated body of the support piece formation film and the dicing tape was obtained.

[0078] <Example 2A>

A laminated body of a support piece formation film and a dicing tape was obtained as with Example 1A, except that the thermosetting resin layer A was cured by being heated at 110°C for 1 hour, and then, heated at 110°C for 2 hours instead of being heated at 130°C for 3 hours.

[0079] <Example 3A>

A thermosetting resin layer B was formed on the surface of the PET film by using the varnish B instead of the varnish A, and the thermosetting resin layer B was bonded to the adhesive layer of the dicing tape on a hot plate at 70°C by using a rubber roll, and then, a polyimide film (a thickness of 25 μm) was bonded to the thermosetting resin layer B by a rubber roll. Through this step, a laminated body of the support piece formation film and the dicing tape was obtained.

[0080] Pickup properties of the support piece formation films of Examples 1A to 3A were evaluated. That is, a dicing ring was laminated on the dicing tapes of the laminated bodies according to Examples 1A to 3A in a condition of 70°C. The support piece formation film was singulated by using a dicer in a condition of a height

of 55 μm . Accordingly, a support piece having a size of 10 mm $\times$ 10 mm was obtained. After that, the support piece was picked up in a state of being expanded (Expansion Amount: 3 mm) with a die bonder. A thrust-up device including nine needles (DB-830 plus+ (Product Name), manufactured by FASFORD TECHNOLOGY CO., LTD.) was used as a thrust-up jig, and a condition was a thrust-up rate of 10 mm/second and a thrust-up height of 350 μm . In each of Examples, six support pieces were tried to be picked up, and in any of Examples 1A to 3A, all of six support pieces were capable of being picked up.

[0081] <Example 1B>

A laminated body of a support piece formation film and a dicing tape was obtained as with Example 1A, except that a dicing tape including an ultraviolet-curable adhesive layer instead of the pressure-sensitive adhesive layer was used.

[0082] The dicing tape including the ultraviolet-curable adhesive layer was prepared in the following procedure. A copolymer was obtained by solution radical polymerization using 83 parts by mass of 2-ethyl hexyl acrylate, 15 parts by mass of 2-hydroxy ethyl acrylate, and 2 parts by mass of a methacrylic acid as a raw material, and ethyl acetate as a solvent. Such an acrylic copolymer was reacted with 12 parts by mass of 2-methacryloyloxyethyl isocyanate to synthesize an ultraviolet reactive acrylic copolymer having a carbon-carbon double bond. In the reaction described above, 0.05 parts of hydroquinone monomethyl ether was used as a polymerization inhibitor. A weight average molecular weight of the synthesized acrylic copolymer was measured by GPC and was 300000 to 700000. The acrylic copolymer obtained

as described above, 2.0 parts of a polyisocyanate compound (manufactured by Nippon Polyurethane Industry Co., Ltd., Product Name: CORONATE L) as a curing agent in terms of a solid content, and 0.5 parts of 1-hydroxy cyclohexyl phenyl ketone as a photopolymerization initiator were mixed to prepare an ultraviolet-curable adhesive agent solution. Such an ultraviolet-curable adhesive agent solution was applied onto a polyethylene terephthalate peeling film (Thickness: 38 μm) and was dried such that the thickness after drying was 10 μm . After that, a polyolefin film (Thickness: 90 μm) of which one surface had been subjected to a corona discharge treatment was bonded to the adhesive layer. The obtained laminate film was aged in a constant-temperature bath at 40°C for 72 hours to obtain the dicing tape.

[0083] <Example 2B>

A laminated body of a support piece formation film and a dicing tape was obtained as with Example 2A, except that a dicing tape including an ultraviolet-curable adhesive layer instead of the pressure-sensitive adhesive layer was used.

[0084] <Example 3B>

A laminated body of a support piece formation film and a dicing tape was obtained as with Example 3A, except that a dicing tape including an ultraviolet-curable adhesive layer instead of the pressure-sensitive adhesive layer was used.

[0085] Pickup properties of the support piece formation films of Examples 1B to 3B were evaluated. That is, a dicing ring was laminated on the dicing tapes of the laminated bodies according to

Examples 1B to 3B in a condition of 70°C. The support piece formation film was singulated by using a dicer in a condition of a height of 55 μm. Accordingly, a support piece having a size of 10 mm × 10 mm was obtained. An ultraviolet ray was applied toward the adhesive layer of the support piece from the dicing tape side with a halogen lamp in a condition of 80 mW/cm² and 200 mJ/cm². After that, the support piece was picked up in a state of being expanded (Expansion Amount: 3 mm) with a die bonder. A thrust-up device including a tip portion (DB-830 plus+ (Product Name), manufactured by FASFORD TECHNOLOGY CO., LTD.) having a configuration (three-step) illustrated in FIG. 12(a) to FIG. 12(c) was used as a thrust-up jig, and a condition was a thrust-up rate of 10 mm/second and a thrust-up height of 1200 μm. In each of Examples, six support pieces were tried to be picked up, and in any of Examples 1B to 3B, all of six support pieces were capable of being picked up.

Industrial Applicability

[0086] According to the present disclosure, a manufacturing method for a support piece that is capable of efficiently manufacturing a support piece used in the manufacturing of a semiconductor device having a dolmen structure and is capable of contributing to the improvement of a production efficiency of a semiconductor device is provided. In addition, according to the present disclosure, a method for efficiently manufacturing a semiconductor device having a dolmen structure by using the support piece described above is provided.

Reference Signs List

[0087] 1: base material film, 1a: inside region, 2: adhesive layer, 2a:

circumferential edge region, 5, 5a, 5b: thermosetting resin layer, 5p:
 bonding adhesive piece, 6: resin layer, 6p: resin piece, 10: substrate, 20,
 20A, 20B: support piece formation laminate film, 25, 25A, 25B:
 laminate film, 50: sealing material, 100: semiconductor device, C:
 5 adsorption collet, D: support piece formation film, D2: two-layer film
 (support piece formation film), D3: three-layer film (support piece
 formation film), Da: support piece, Dc: support piece (cured product),
 DR: dicing ring, F, F1, F2: tip surface, G: cutout, H: heater, P: member,
 P1: first tubular member, P2: second tubular member, N: needle, T1:
 10 first chip, T2: second chip, T2a: adhesive piece-attached chip, Ta:
 bonding adhesive piece, Tc: bonding adhesive piece (cured product).

CLAIMS

1. A manufacturing method for a support piece used in manufacturing of a semiconductor device having a dolmen structure including a substrate, a first chip disposed on the substrate, a plurality of support pieces disposed around the first chip, on the substrate, and a second chip disposed to be supported by the plurality of support pieces and to cover the first chip, the method comprising:

(A) preparing a laminate film including a base material film, an adhesive layer, and a support piece formation film, in this order;

(B) forming a plurality of support pieces on a surface of the adhesive layer by singulating the support piece formation film; and

(C) picking up the support piece in a state in which the support piece is thrust up from the base material film side by a plurality of needles,

wherein the support piece formation film is a film including a thermosetting resin layer or a film including a layer in which at least a part of a thermosetting resin layer is cured, or a multi-layer film including a thermosetting resin layer, and a resin layer or a metal layer having rigidity higher than that of the thermosetting resin layer.

2. A manufacturing method for a support piece used in manufacturing of a semiconductor device having a dolmen structure including a substrate, a first chip disposed on the substrate, a plurality of support pieces disposed around the first chip, on the substrate, and a second chip disposed to be supported by the plurality of support pieces and to cover the first chip, the method comprising:

(A) preparing a laminate film including a base material film, an

adhesive layer, and a support piece formation film, in this order;

(B) forming a plurality of support pieces on a surface of the adhesive layer by singulating the support piece formation film; and

(C) picking up the support piece in a state in which the support piece is thrust up from the base material film side by a member having a flat tip surface,

wherein the support piece formation film is a film including a thermosetting resin layer or a film including a layer in which at least a part of a thermosetting resin layer is cured, or a multi-layer film including a thermosetting resin layer, and a resin layer or a metal layer having rigidity higher than that of the thermosetting resin layer.

3. The manufacturing method for a support piece according to claim 1 or 2,

wherein the resin layer is a polyimide layer.

4. The manufacturing method for a support piece according to claim 1 or 2,

wherein the metal layer is a copper layer or an aluminum layer.

5. The manufacturing method for a support piece according to claim 1 or 2,

wherein the support piece formation film is a film including a thermosetting resin layer, or a film including a layer in which at least a part of a thermosetting resin layer is cured, and

the step (B) includes a step of forming a cutout to the middle of the support piece formation film in a thickness direction, and a step of singulating the support piece formation film in a cooled state by expansion, in this order.

6. The manufacturing method for a support piece according to any one of claims 1 to 4,

wherein the support piece formation film is a multi-layer film including a thermosetting resin layer, and a resin layer or a metal layer having rigidity higher than that of the thermosetting resin layer, and in the laminate film, the thermosetting resin layer is positioned between the resin layer or the metal layer and the adhesive layer, and

the step (B) includes a step of forming a cutout to the middle of the thermosetting resin layer in a thickness direction by cutting the resin layer or the metal layer of the support piece formation film, and a step of singulating the support piece formation film in a cooled state by expansion, in this order.

7. The manufacturing method for a support piece according to any one of claims 1 to 6,

wherein the adhesive layer is a pressure-sensitive adhesive layer.

8. The manufacturing method for a support piece according to any one of claims 1 to 6,

wherein the adhesive layer is an ultraviolet-curable adhesive layer.

9. A manufacturing method for a semiconductor device having a dolmen structure including a substrate, a first chip disposed on the substrate, a plurality of support pieces disposed around the first chip, on the substrate, and a second chip disposed to be supported by the plurality of support pieces and to cover the first chip, the method comprising:

(D) disposing a first chip on a substrate;

(E) disposing the plurality of support pieces manufactured by the manufacturing method according to any one of claims 1 to 8 around the first chip or around a region in which the first chip is to be disposed, on the substrate;

5 (F) preparing a adhesive piece-attached chip including a second chip, and an adhesive agent piece provided on one surface of the second chip; and

 (G) constructing a dolmen structure by disposing the adhesive piece-attached chip on surfaces of the plurality of support pieces.

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