

DESCRIPTION

Title of Invention

SEMICONDUCTOR DEVICE PRODUCTION METHOD AND
5 FILM-SHAPED ADHESIVE

Technical Field

[0001] The present invention relates to a semiconductor device production method and a film-shaped adhesive.

Background Art

10 [0002] An adhesive sheet that enables a wire-embedded semiconductor device in which irregularities caused by a substrate wiring in a semiconductor device and wires attached to a semiconductor chip and the like are able to be filled in to be obtained is known (for example, Patent Literatures 1 and 2). The adhesive sheet contains a
15 thermosetting component as a main component so that high fluidity is exhibited during filling in of irregularities.

[0003] In recent years, increasing the speed of operations of such a wire-embedded semiconductor device has been considered to be important. Conventionally, a controller chip that controls operations of
20 a semiconductor device is disposed as the uppermost stage of laminated semiconductor elements, but in order to realize high-speed operations, a package technology for a semiconductor device in which a controller chip is disposed as the lowermost part has been developed. As one form of such a package, among semiconductor elements laminated in
25 multiple stages, a package in which a film-shaped adhesive used when the second semiconductor element is press-bonded is thickened and a

controller chip is embedded in the film-shaped adhesive is being focused on. The film-shaped adhesive used for such an application requires high fluidity so that a controller chip, a wire connected to the controller chip, level differences caused by irregularities on the surface of a substrate, and the like can be embedded.

Citation List

Patent Literature

[0004] [Patent Literature 1] PCT International Publication No. WO 2005/103180

[Patent Literature 2] Japanese Unexamined Patent Publication No. 2009-120830

Summary of Invention

Technical Problem

[0005] However, when an adhesive sheet simply having high fluidity before curing like the adhesive sheets described in Patent Literature 1 and 2 is used, there is a problem of the entire semiconductor device being easily warped after curing as the semiconductor element becomes thinner. In addition, when voids are generated during press-bonding using the adhesive sheet, there is a problem of the voids being not easily removed in a conventional operation. Therefore, currently, further studies are required to secure connection reliability of the obtained semiconductor device. Here, in particular, for removal of voids in the latter case, it is possible to separately provide a step of heating and pressurizing using a pressure oven or the like. However, due to the increase in the number of steps, the lead time becomes longer than that of general-purpose products.

[0006] Therefore, an object of the present invention is to provide a semiconductor device production method through which it is possible to obtain a semiconductor device having excellent connection reliability while minimizing an increase in a lead time. Another object of the present invention is to provide a film-shaped adhesive used in the production method.

Solution to Problem

[0007] The present invention provides a semiconductor device production method including a first die bonding step in which a first semiconductor element is electrically connected to a substrate with a first wire therebetween, a lamination step in which a film-shaped adhesive having a shear elastic modulus at 150°C of 1.5 MPa or less is attached to one surface of a second semiconductor element having a larger area than the first semiconductor element, and a second die bonding step in which the second semiconductor element to which the film-shaped adhesive is attached is disposed so that the film-shaped adhesive covers the first semiconductor element, the film-shaped adhesive is press-bonded, and thus the first wire and the first semiconductor element are embedded in the film-shaped adhesive.

[0008] According to the present invention, it is possible to obtain a semiconductor device having excellent connection reliability while minimizing an increase in a lead time. More specifically, when a film-shaped adhesive having a shear elastic modulus at 150°C of 1.5 MPa or less is used, in particular, voids generated in the second die bonding step can be eliminated in a sealing step which is a post-step. Accordingly, there is no need to separately provide a special step for

eliminating voids and the lead time does not increase.

[0009] In the present invention, when a strain of 5% is applied to a film-shaped adhesive at a frequency of 1 Hz, heating is performed from room temperature to 125°C at a rate of temperature increase of 5°C/min and maintained for 1 hour, and heating is then additionally performed to 150°C at a rate of temperature increase of 5°C/min and maintained for 45 minutes, the shear elastic modulus at 150°C can then be measured using a dynamic viscoelasticity measuring device.

[0010] In the present invention, preferably, the film-shaped adhesive has a tensile elastic modulus at 170 to 190°C after curing of 15 MPa or less. Since the film-shaped adhesive has low elasticity after curing, it is possible to obtain favorable embedding properties and stress relaxation properties during a sealing step. For example, even if a thin second semiconductor element is used, it is possible to minimize warping of the semiconductor device after the film-shaped adhesive is cured. Accordingly, stress of the semiconductor device is relaxed and a semiconductor device exhibiting favorable connection reliability is easily obtained.

[0011] In the present invention, preferably, the film-shaped adhesive has a shear viscosity of 15,000 Pa·s or less at 80°C. Accordingly, favorable embedding properties are easily obtained.

[0012] In the present invention, preferably, the film-shaped adhesive includes an acrylic resin and an epoxy resin. When a thermoplastic component and a thermosetting component are used in combination, favorable embedding properties, thermosetting properties and stress relaxation properties are easily obtained.

[0013] In the present invention, preferably, the acrylic resin includes a first acrylic resin having a weight average molecular weight of 100,000 to 500,000 and a second acrylic resin having a weight average molecular weight of 600,000 to 1,000,000, and the content of the first acrylic resin is 50 mass% or more with respect to a total mass of the acrylic resin. When the width of the molecular weight distribution is widened in this manner, stress relaxation properties are improved, and warping of the substrate after curing is easily reduced. In addition, embedding properties are easily improved while maintaining film-forming properties and adhesive properties.

[0014] In the present invention, preferably, the film-shaped adhesive includes at least one of an inorganic filler and an organic filler. Accordingly, it is possible to further improve handling properties of the film-shaped adhesive and the like and it is possible to obtain more favorable mechanical properties such as a shear elastic modulus and an adhesive strength.

[0015] In addition, the present invention provides a film-shaped adhesive which is used for press-bonding a second semiconductor element and embedding a first wire and a first semiconductor element and which has a shear elastic modulus at 150°C of 1.5 MPa or less in a semiconductor device in which the first semiconductor element is electrically connected to a substrate with the first wire therebetween and the second semiconductor element having a larger area than the first semiconductor element is press-bonded to the first semiconductor element. When the film-shaped adhesive of the present invention is used, it is possible to obtain a semiconductor device having excellent

connection reliability while minimizing an increase in a lead time.

[0016] In this film-shaped adhesive of the present invention, preferably, a tensile elastic modulus at 170 to 190°C after curing is 15 MPa or less.

[0017] In this film-shaped adhesive of the present invention, preferably, the film-shaped adhesive has a shear viscosity of 15,000 Pa·s or less at 80°C.

[0018] Preferably, this film-shaped adhesive of the present invention includes an acrylic resin and an epoxy resin.

[0019] In this film-shaped adhesive of the present invention, preferably, the acrylic resin includes a first acrylic resin having a weight average molecular weight of 100,000 to 500,000 and a second acrylic resin having a weight average molecular weight of 600,000 to 1,000,000, and the content of the first acrylic resin is 50 mass% or more with respect to a total mass of the acrylic resin.

[0020] Preferably, this film-shaped adhesive of the present invention includes at least one of an inorganic filler and an organic filler.

Advantageous Effects of Invention

[0021] According to the present invention, it is possible to provide a semiconductor device production method through which it is possible to obtain a semiconductor device having excellent connection reliability while minimizing an increase in a lead time. In addition, according to the present invention, it is possible to provide a film-shaped adhesive used in the production method.

Brief Description of Drawings

[0022] FIG. 1 is a diagram showing a film-shaped adhesive according to an embodiment of the present invention.

FIG. 2 is a diagram showing an adhesive sheet.

FIG. 3 is a diagram showing another adhesive sheet.

FIG. 4 is a diagram showing another adhesive sheet.

FIG. 5 is a diagram showing another adhesive sheet.

5 FIG. 6 is a diagram showing a semiconductor device.

FIG. 7 is a diagram showing a semiconductor device production method according to an embodiment of the present invention.

FIG. 8 is a diagram showing a step subsequent to that of FIG. 7.

FIG. 9 is a diagram showing a step subsequent to that of FIG. 8.

10 FIG. 10 is a diagram showing a step subsequent to that of FIG. 9.

FIG. 11 is a diagram showing a step subsequent to that of FIG. 10.

Description of Embodiments

[0023] Preferable embodiments of the present invention will be described below in detail with reference to the drawings. In the following description, the same or corresponding components will be denoted with the same reference numerals and redundant description thereof will be omitted. In addition, positional relationships such as above, below, left, and right are based on the positional relationships shown in the drawings unless otherwise specified. In addition, dimensional ratios in the drawings are not limited to the illustrated ratios. Here, in this specification, the term “(meth)acryl” include “acryl” and a corresponding “methacryl.”

[0024] (Film-shaped adhesive)

25 FIG. 1 is a cross-sectional view schematically showing a film-shaped adhesive 10 according to the present embodiment. The

film-shaped adhesive 10 is thermosetting and is obtained by molding an adhesive composition into a film, which can be in a semi-cured (B stage) state and can be in a completely cured product (C stage) state after a curing treatment.

5 [0025] The film-shaped adhesive 10 has a shear elastic modulus at 150°C of 1.5 MPa or less. In order to more easily obtain a semiconductor device having excellent connection reliability while minimizing an increase in the lead time, the shear elastic modulus is preferably 1.2 MPa or less, more preferably 1.0 MPa or less, and still
10 more preferably 0.8 MPa or less. The lower limit of the shear elastic modulus is not particularly limited, but can be 0.01 MPa in order to curb excessive fluidity. Here, as will be described below, the shear elastic modulus can be adjusted by adjusting the types and amounts of components (a) to (f). Examples of guidelines for lowering the shear
15 elastic modulus at 150°C (to 1.5 MPa or less) include increasing the amount of a component (a1), reducing the amount of a component (a2), lowering the weight average molecular weight of the component (b), reducing the amount of the component (c), reducing the amount of the component (d), and reducing the amount of the component (e), but the
20 present invention is not limited thereto.

[0026] The film-shaped adhesive 10 preferably has a tensile elastic modulus at 170 to 190°C after curing of 15 MPa or less. In order to more easily obtain favorable embedding properties and stress relaxation properties, the tensile elastic modulus is more preferably 12 MPa or
25 less, still more preferably 10 MPa or less, and particularly preferably 8 MPa or less. The lower limit of the tensile elastic modulus is not

particularly limited, but can be 1 MPa in order to secure appropriate adhesive properties. The tensile elastic modulus can be measured using, for example, a dynamic viscoelasticity measuring device at a frequency of 10 Hz.

[0027] The film-shaped adhesive 10 preferably has a shear viscosity at 80°C of 15,000 Pa·s or less. In order to easily obtain favorable embedding properties, the shear viscosity is more preferably 10,000 Pa·s or less and still more preferably 9,000 Pa·s or less. The lower limit of the shear viscosity is not particularly limited, but can be 1,000 Pa·s in order to curb excessive fluidity. The shear viscosity can be measured using, for example, a dynamic viscoelasticity measuring device.

[0028] Components contained in the film-shaped adhesive 10 are not particularly limited, and examples thereof may include (a) a thermosetting component, (b) a thermoplastic component, (c) an inorganic filler, (d) an organic filler, (e) a curing promoting agent, and (f) other components. Properties of the film-shaped adhesive 10 can be adjusted by adjusting the types and amounts of these components (a) to (f).

[0029] (a) Thermosetting component

Examples of thermosetting components include a thermosetting resin. In particular, in consideration of heat resistance and humidity resistance required when a semiconductor element is mounted, an epoxy resin, a phenolic resin or the like is preferable as the thermosetting component.

[0030] For example, regarding the epoxy resin, generally known epoxy resins such as an aromatic ring-containing epoxy resin, a

heterocycle-containing epoxy resin, and an alicyclic epoxy resin can be used. In addition, the epoxy resin may be a multifunctional epoxy resin. Regarding the epoxy resin, specifically, for example, a bisphenol A type epoxy resin, a bisphenol F type epoxy resin, a bisphenol E type epoxy resin, a bifunctional epoxy resin obtained by modifying these bisphenol type epoxy resins, a cresol novolak type epoxy resin, a bisphenol A novolak type epoxy resin, a fluorene-modified epoxy resin, a triphenylmethane type epoxy resin, a biphenyl type epoxy resin, a glycidylamine type epoxy resin, a naphthalene-modified epoxy resin, or the like can be used.

[0031] Examples of epoxy resins include YDF series and YDCN series (commercially available from NSCC Epoxy Manufacturing Co., Ltd.) and EPOX-MK series and VG-3101L (commercially available from Printec Corporation).

[0032] In addition, examples of phenolic resins include a novolak type phenolic resin, a zylock type phenolic resin, a biphenyl type phenolic resin, a triphenylmethane type phenolic resin, and a modified phenolic resin in which a hydrogen atom on a phenol ring is substituted with an aryl group. Here, regarding the phenolic resin, in consideration of heat resistance, a phenolic resin which has a water absorption rate of 2 mass% or less after being put into a temperature and humidity testing chamber at 85°C and an RH of 85% for 48 hours and a heating mass reduction rate (rate of temperature increase: 5°C/min, atmosphere: nitrogen) at 350°C measured using a thermogravimetric analyzer (TGA) that is less than 5 mass% is preferable.

[0033] Examples of phenolic resins include Phenolite KA and TD series

(commercially available from DIC), and HE series (commercially available from Air Water Inc.).

[0034] When an epoxy resin and a phenolic resin are used in combination as the thermosetting component (a), the mixing ratio of the epoxy resin and the phenolic resin is preferably 0.70/0.30 to 0.30/0.70 in terms of the equivalent ratio between an epoxy equivalent and a hydroxyl equivalent, and more preferably 0.65/0.35 to 0.35/0.65, still more preferably 0.60/0.40 to 0.40/0.60, and particularly preferably 0.60/0.40 to 0.50/0.50. When the mixing ratio is within the above range, the film-shaped adhesive 10 having excellent curability, fluidity, and the like is easily obtained.

[0035] Here, in order to minimize warping of the semiconductor device after curing, it is preferable to combine thermosetting resins with different curing rates. Specifically, among the epoxy resins and phenolic resins exemplified above, for example, a combination of (a1) a resin having a softening point of 60°C or lower or being a liquid at room temperature (not particularly limited as long as it has an adhesive action according to curing) and (a2) a resin having a softening point of higher than 60°C (solid at room temperature) is preferably used. In addition, the term “room temperature” here means 5 to 35°C.

[0036] The content of the component (a1) is preferably 10 to 50 mass% and more preferably 20 to 40 mass% with respect to the total mass of the component (a). Accordingly, it is easy to achieve both embedding properties and process suitability such as for dicing and pickup.

[0037] The content of the component (a2) is preferably 10 mass% or more and more preferably 15 mass% or more with respect to the total

mass of the component (a). Accordingly, it is easy to adjust film-forming properties, fluidity, stress relaxation properties, and the like. Here, the upper limit of the content of the component (a2) is not particularly limited, but can be 90 mass% with respect to the total mass of the component (a).

[0038] (b) Thermoplastic component

Regarding the thermoplastic component (b), it is preferable to use a thermoplastic component having a high proportion of monomers with crosslinkable functional groups and a low molecular weight and a thermoplastic component having a low proportion of monomers with crosslinkable functional groups and a high molecular weight in combination. For example, the component (b) preferably includes (b1) a thermoplastic component having 5 to 15 mol% of monomer units having a crosslinkable functional group with respect to the total amount of monomer units, a weight average molecular weight of 100,000 to 500,000, and a glass transition temperature T_g of -50 to 50°C , and (b2) a thermoplastic component having a ratio of 1 to 7 mol% of monomer units having a crosslinkable functional group with respect to the total amount of monomer units, a weight average molecular weight of 600,000 to 1,000,000, and a glass transition temperature T_g of -50 to 50°C .

[0039] The component (b) is preferably an acrylic resin (acrylic resin) which is a thermoplastic resin and more preferably an acrylic resin having a glass transition temperature T_g of -50°C to 50°C such as an epoxy group-containing (meth)acrylic copolymer obtained by polymerizing functional monomers having an epoxy group or a glycidyl

group as a crosslinkable functional group such as glycidyl acrylate, and glycidyl methacrylate.

[0040] Regarding such an acrylic resin, an epoxy group-containing (meth)acrylic acid ester copolymer, an epoxy group-containing acrylic rubber or the like can be used, and an epoxy group-containing acrylic rubber is more preferable. The epoxy group-containing acrylic rubber is an acrylic rubber having an epoxy group which includes an acrylic ester as a main component, and is mainly composed of a copolymer of butyl acrylate, acrylonitrile, and the like or a copolymer of ethyl acrylate, acrylonitrile, and the like.

[0041] Here, regarding the crosslinkable functional group of the component (b), in addition to an epoxy group, crosslinkable functional groups such as an alcoholic or phenolic hydroxyl group, and a carboxyl group may be exemplified.

[0042] In the component (b1), in order to easily exhibit a high adhesive strength and easily lower the shear elastic modulus at 150°C, the amount of monomer units having a crosslinkable functional group is preferably 5 to 15 mol% and more preferably 5 to 10 mol% with respect to the total amount of monomer units.

[0043] In the component (b2), in order to easily curb an excessive increase in the elastic modulus after curing, the amount of monomer units having a crosslinkable functional group is preferably 1 to 7 mol% and more preferably 2 to 5 mol% with respect to the total amount of monomer units.

[0044] The weight average molecular weight of the component (b1) (first acrylic resin) is preferably 100,000 to 500,000. When the weight

average molecular weight of the component (b1) is 100,000 or more, film-forming properties of the film can become more favorable and the adhesive strength and heat resistance of the film-shaped adhesive 10 can be further improved. When the weight average molecular weight of the component (b1) is 500,000 or less, since the shear viscosity is easily reduced, embedding properties of the film-shaped adhesive 10 become more favorable.

[0045] The weight average molecular weight of the component (b2) (second acrylic resin) is preferably 600,000 to 1,000,000. When the weight average molecular weight of the component (b2) is 600,000 or more, an effect of improving film-forming properties is further improved in combined use with the component (b1). When the weight average molecular weight of the component (b2) is 1,000,000 or less, since the shear viscosity of the uncured film-shaped adhesive 10 is easily reduced, embedding properties become more favorable. In addition, the machinability of the uncured film-shaped adhesive 10 may be improved and the quality of dicing may become more favorable.

[0046] The weight average molecular weight is a polystyrene conversion value obtained by a gel permeation chromatography method (GPC) using a calibration curve in terms of polystyrene standards.

[0047] In addition, the glass transition temperature T_g of the component (b1) and the component (b2) is preferably -50 to 50°C . When the glass transition temperature T_g is 50°C or lower, the flexibility of the film-shaped adhesive 10 becomes more favorable. On the other hand, when the glass transition temperature T_g is -50°C or higher, since the flexibility of the film-shaped adhesive 10 does not become too high, it is

easy to cut the film-shaped adhesive 10 when the semiconductor wafer is diced. Therefore, it is easy to minimize deterioration of dicing properties due to the occurrence of burrs.

[0048] The glass transition temperature T_g of the entire component (b) is preferably -20°C to 40°C and more preferably -10°C to 30°C . Accordingly, since the film-shaped adhesive 10 is easily cut during dicing, resin waste is less likely to be generated, the adhesive strength and heat resistance of the film-shaped adhesive 10 are easily improved, and high fluidity of the uncured film-shaped adhesive 10 is easily exhibited.

[0049] The glass transition temperature T_g can be measured using a thermal differential scanning calorimeter (for example, "Thermo Plus 2" commercially available from Rigaku Corporation).

[0050] The component (b) is available as a commercial product. Examples of the component (b1) include an acrylic rubber HTR-860P-30B-CHN (product name, commercially available from Nagase ChemteX Corporation). This compound is a compound having a glycidyl moiety as a crosslinkable moiety and using an acrylic rubber made of acrylic acid derivatives as a base resin, and having a weight average molecular weight of 230,000, and a glass transition temperature T_g of -7°C . In addition, examples of the component (b2) include an acrylic rubber HTR-860P-3CSP (product name, commercially available from Nagase ChemteX Corporation).

[0051] The content of the component (b1) (first acrylic resin) is preferably 50 mass% or more and more preferably 70 mass% or more with respect to the total mass of the component (b) (acrylic resin).

Accordingly, favorable embedding properties, stress relaxation properties, film-forming properties, adhesive properties, and the like are easily obtained. Here, the upper limit of the content of the component (b1) is not particularly limited, but can be 90 mass% with respect to the total mass of the component (b).

[0052] The content of the component (b2) is preferably 10 mass% or more and more preferably 30 mass% or more with respect to the total mass of the component (b), since then film-forming properties, adhesive properties, elastic modulus, and the like are easily adjusted. Here, the upper limit of the content of the component (b2) is not particularly limited, but can be 50 mass% with respect to the total mass of the component (b).

[0053] The content of the component (b) is preferably 20 to 160 parts by mass and more preferably 50 to 120 parts by mass with respect to 100 parts by mass of the component (a). When the content of the component (b) is the lower limit value or more, favorable film-forming properties, embedding properties, adhesive properties, stress relaxation properties, and the like are easily obtained. On the other hand, when the content of the component (b) is the upper limit value or less, favorable film-forming properties, embedding properties, and the like are easily obtained.

[0054] (c) Inorganic filler

Regarding the component (c), in order to improve dicing properties of the film-shaped adhesive 10 in the B stage state, improve handling properties of the film-shaped adhesive 10, improve thermal conductivity, adjust the shear viscosity (melt viscosity), impart

thixotropic properties, and improve the adhesive strength, a silica filler or the like is preferable.

[0055] The component (c) preferably contains two or more types of fillers having different average particle sizes in order to improve dicing properties of the uncured film-shaped adhesive 10, and for sufficient adhesive strength after curing to be exhibited. The component (c) preferably includes, for example, (c1) a first filler having an average particle size of 0.2 μm or more in order to improve dicing properties of the uncured film-shaped adhesive 10 and (c2) a second filler having an average particle size of less than 0.2 μm in order for sufficient adhesive strength after curing to be exhibited.

[0056] The average particle size is a value obtained when acetone is used as a solvent for analysis using a laser diffraction type particle size distribution measuring device. It is more preferable to have a large difference between average particle sizes of the first and second fillers to the extent that it is possible to determine that these respective fillers are contained through analysis using a particle size distribution measuring device.

[0057] The content of the component (c1) is preferably 30 mass% or more with respect to the total mass of the component (c). When the content of the component (c1) is 30 mass% or more, it is easy to minimize deterioration of breakability of the film and deterioration of fluidity of the uncured film-shaped adhesive 10. Here, the upper limit of the content of the component (c1) is not particularly limited, but can be 95 mass% with respect to the total mass of the component (c).

[0058] The content of the component (c2) is preferably 5 mass% or

more with respect to the total mass of the component (c). When the content of the component (c2) is 5 mass% or more, the adhesive strength after curing is easily improved. Here, the upper limit of the content of the component (c2) can be 30 mass% with respect to the total mass of the component (c) in order to secure appropriate fluidity.

[0059] The content of the component (c) is preferably 10 to 90 parts by mass with respect to 100 parts by mass of the component (a). When the content of the component (c) is the lower limit value or more, deterioration of dicing properties of the uncured film-shaped adhesive 10 and reduction in the adhesive strength after curing tend to be easily minimized. On the other hand, when the content of the component (c) is the upper limit value or less, reduction in the fluidity of the uncured film-shaped adhesive 10 and increase in the elastic modulus after curing tend to be easily minimized.

[0060] (d) Organic filler

In consideration of improving dicing properties of the film-shaped adhesive 10, improving handling properties of the film-shaped adhesive 10, adjusting the shear viscosity (melt viscosity), and improving the adhesive strength, and stress relaxation properties after curing and the like, the component (d) is preferably a styrene-PMMA modified rubber filler, a silicone-modified rubber filler, or the like. The average particle size of the component (d) is preferably 0.2 μm or less in order to easily exhibit sufficient adhesive strength after curing.

[0061] The content of the component (d) is preferably 0 to 50 parts by mass with respect to 100 parts by mass of the component (c).

[0062] (e) Curing promoting agent

In order to obtain favorable curability, a curing promoting agent (e) is preferably used. In consideration of reactivity, an imidazole compound is preferably used as the component (e). Here, when the reactivity of the component (e) is too high, not only does the shear viscosity easily increase due to heating in a step of producing the film-shaped adhesive 10 but also deterioration over time tends to easily occur. On the other hand, when the reactivity of the component (e) is too low, the curability of the film-shaped adhesive 10 tends to easily decrease. When the film-shaped adhesive 10 that is not sufficiently cured is directly put into a product, sufficient adhesive properties are not obtained, and connection reliability of the semiconductor device may be deteriorated.

[0063] When the component (e) is contained, the curability of the film-shaped adhesive 10 is further improved. On the other hand, when the content of the component (e) is too large, not only does the shear viscosity easily increase due to heating in a step of producing the film-shaped adhesive 10 but also deterioration over time tends to easily occur. In this regard, the content of the component (e) is preferably 0 to 0.20 parts by mass with respect to 100 parts by mass of the component (a).

[0064] (f) Other components

In addition to the above components, in order to improve adhesive properties, appropriate amounts of other components that can be used in this technical field may be additionally added. Examples of such a component include a coupling agent. Examples of coupling

agents include γ -ureidopropyltriethoxysilane,
 γ -mercaptopropyltrimethoxysilane,
3-phenylaminopropyltrimethoxysilane, and
3-(2-aminoethyl)aminopropyltrimethoxysilane.

5 [0065] (Film-shaped adhesive)

The film-shaped adhesive 10 can be obtained according to, for example, a step of applying a varnish of an adhesive composition containing the above component to a base film to form a varnish layer, a step of removing a solvent from the varnish layer by heating and drying,
10 and a step of removing the base film.

[0066] The varnish can be prepared by mixing and kneading an adhesive composition containing the above component in an organic solvent. Mixing and kneading can be performed using a dispersing machine such as a general stirrer, a Raikai mixer, a three-roller, and a
15 ball mill. These instruments can be used in an appropriate combination. The varnish can be applied using, for example, a comma coater or a die coater. Varnish heating and drying conditions are not particularly limited as long as an organic solvent used is sufficiently volatilized, and examples of conditions include 60 to 200°C for 0.1 to
20 90 minutes.

[0067] The organic solvent is not particularly limited as long as the above component can be uniformly dissolved, kneaded or dispersed, and conventionally known organic solvents can be used. Examples of such a solvent include ketone solvents such as acetone, methyl ethyl
25 ketone, methyl isobutyl ketone, and cyclohexanone, and dimethylformamide, dimethylacetamide, N-methylpyrrolidone, toluene,

and xylene. Methyl ethyl ketone, cyclohexanone, or the like is preferably used because the drying rate is high and the price is low.

[0068] The base film is not particularly limited, and examples thereof include a polyester film (such as a polyethylene terephthalate film), a polypropylene film (such as an oriented polypropylene (OPP) film), a polyimide film, a polyetherimide film, a polyether naphthalate film, and a methylpentene film.

[0069] The thickness of the film-shaped adhesive 10 is preferably 20 to 200 μm so that irregularities of a first wire and a first semiconductor element, and a wiring circuit of a substrate and the like are sufficiently filled. In addition, when the thickness is 20 μm or more, sufficient adhesive strength is easily obtained, and when the thickness is 200 μm or less, it is easy to meet the demand for reducing the size of the semiconductor device. In this regard, the thickness of the film-shaped adhesive 10 is more preferably 30 to 200 μm and still more preferably 40 to 150 μm .

[0070] Examples of a method of obtaining the thick film-shaped adhesive 10 include a method of bonding the film-shaped adhesives 10.

[0071] (Adhesive sheet)

As shown in FIG. 2, an adhesive sheet 100 includes the film-shaped adhesive 10 on a base film 20. The adhesive sheet 100 can be obtained without removing the base film 20 in a step of obtaining the film-shaped adhesive 10.

[0072] As shown in FIG. 3, an adhesive sheet 110 further includes a cover film 30 on the surface opposite to the base film 20 of the adhesive sheet 100. Examples of the cover film 30 include a PET film, a PE

film, and an OPP film.

[0073] The film-shaped adhesive 10 may be laminated on a dicing tape. When a dicing/die bonding integrated adhesive sheet obtained in this manner is used, a step of performing lamination on the semiconductor wafer can be performed at one time, and work efficiency can be improved.

[0074] Examples of dicing tapes include plastic films such as a polytetrafluoroethylene film, a polyethylene terephthalate film, a polyethylene film, a polypropylene film, a polymethylpentene film, and a polyimide film. As necessary, a surface treatment such as a primer treatment, a UV treatment, a corona discharge treatment, a polishing treatment, and an etching treatment may be performed on the dicing tape.

[0075] The dicing tape is preferably sticky. Examples of such a dicing tape include those obtained by imparting stickiness to the plastic film and those obtained providing a sticky layer on one surface of the plastic film.

[0076] Examples of such a dicing/die bonding integrated adhesive sheet include an adhesive sheet 120 shown in FIG. 4 and an adhesive sheet 130 shown in FIG. 5. As shown in FIG. 4, the adhesive sheet 120 has a structure including a dicing tape 60 in which a sticky layer 50 is provided on a base film 40 that can secure elongation when a tensile tension is applied as a support base and the film-shaped adhesive 10 provided on the sticky layer 50 of the dicing tape 60. As shown in FIG. 5, the adhesive sheet 130 has a structure in which the base film 20 is additionally provided on the surface of the film-shaped adhesive 10 in

the adhesive sheet 120.

[0077] Examples of the base film 40 include the above plastic film described in the dicing tape. In addition, the sticky layer 50 can be formed using, for example, a resin composition containing a liquid component and a thermoplastic component and having appropriate tack strength. Examples of a method of obtaining the dicing tape 60 include a method of applying the resin composition to the base film 40 and drying it to form the sticky layer 50, and a method of bonding the sticky layer 50 first formed on another film such as a PET film with the base film 40.

[0078] Examples of a method of laminating the film-shaped adhesive 10 on the dicing tape 60 include a method of directly applying a varnish of the above adhesive composition to the dicing tape 60 and drying it, a method of screen printing a varnish on the dicing tape 60, and a method of preparing the film-shaped adhesive 10 in advance, and laminating it on the dicing tape 60 by pressing and hot roll lamination. Lamination by hot roll lamination is preferable because continuous production is possible and efficiency is high.

[0079] The thickness of the dicing tape 60 is not particularly limited, but can be appropriately determined based on the knowledge of those skilled in the art depending on the thickness of the film-shaped adhesive 10 and applications of the dicing/die bonding integrated adhesive sheet. Here, when the thickness of the dicing tape 60 is 60 μm or more, deterioration of handling properties, tearing due to expansion, and the like tend to be easily minimized. On the other hand, when the thickness of the dicing tape is 180 μm or less, it is easy to achieve both

economic efficiency and favorable handling properties.

[0080] (Semiconductor device)

FIG. 6 is a cross-sectional view showing a semiconductor device. As shown in FIG. 6, a semiconductor device 200 is a semiconductor device in which a second semiconductor element Waa is laminated on a first semiconductor element Wa. Specifically, the first semiconductor element Wa on the first stage is electrically connected to a substrate 14 with a first wire 88 therebetween, the second semiconductor element Waa on the second stage whose area is larger than the area of the first semiconductor element Wa is press-bonded to the first semiconductor element Wa with the film-shaped adhesive 10 therebetween, and the first wire 88 and the first semiconductor element Wa are embedded in the film-shaped adhesive 10 to obtain a wire-embedded semiconductor device. In addition, in the semiconductor device 200, additionally, the substrate 14 is electrically connected to the second semiconductor element Waa with a second wire 98 therebetween, and the second semiconductor element Waa is sealed with a sealing material 42.

[0081] The thickness of the first semiconductor element Wa is 10 to 170 μm , and the thickness of the second semiconductor element Waa is 20 to 400 μm . The first semiconductor element Wa embedded into the film-shaped adhesive 10 is a controller chip for driving the semiconductor device 200.

[0082] The substrate 14 is formed of an organic substrate 90 in which circuit patterns 84 and 94 are each formed at two places on the surface thereof. The first semiconductor element Wa is press-bonded to the

circuit pattern 94 with an adhesive 41 therebetween, and the second semiconductor element Waa is press-bonded to the substrate 14 with the film-shaped adhesive 10 therebetween so that it covers the circuit pattern 94 onto which no first semiconductor element Wa is press-bonded, the first semiconductor element Wa, and a part of the circuit pattern 84. Irregularities caused by the circuit patterns 84 and 94 on the substrate 14 are filled with the film-shaped adhesive 10. Then, the second semiconductor element Waa, the circuit pattern 84, and the second wire 98 are sealed with the resin sealing material 42.

[0083] (Semiconductor device production method)

A semiconductor device is produced by a semiconductor device production method including a first die bonding step in which a first semiconductor element is electrically connected to a substrate with a first wire therebetween, a lamination step in which a film-shaped adhesive having a shear elastic modulus at 150°C of 1.5 MPa or less is attached to one surface of a second semiconductor element having a larger area than the first semiconductor element, and a second die bonding step in which the second semiconductor element to which the film-shaped adhesive is attached is disposed so that the film-shaped adhesive covers the first semiconductor element, the film-shaped adhesive is press-bonded, and thus the first wire and the first semiconductor element are embedded in the film-shaped adhesive. Hereinafter, procedures of producing the semiconductor device 200 will be exemplified in detail.

[0084] First, as shown in FIG. 7, the first semiconductor element Waa with the adhesive 41 is press-bonded to the circuit pattern 94 on the

substrate 14, and the circuit pattern 84 on the substrate 14 is electrically connected to the first semiconductor element Wa with the first wire 88 therebetween (first die bonding step).

[0085] Next, the adhesive sheet 100 is laminated on one surfaces of a semiconductor wafer (for example, 8-inch size), the base film 20 is peeled off, and the film-shaped adhesive 10 is attached to one surface of the semiconductor wafer. Then, the dicing tape 60 is bonded to the film-shaped adhesive 10, and then diced into a predetermined size (for example, 7.5 square mm), and the dicing tape 60 is peeled off. Thereby, as shown in FIG. 8, the second semiconductor element Waa to which the film-shaped adhesive 10 is attached is obtained (lamination step).

[0086] The lamination step is preferably performed at 50 to 100°C, and more preferably performed at 60 to 80°C. When the temperature in the lamination step is 50°C or higher, favorable adhesion to the semiconductor wafer can be obtained. When the temperature in the lamination step is 100°C or lower, since the film-shaped adhesive 10 in the lamination step is prevented from excessively flowing, for example, it is possible to prevent the thickness from changing.

[0087] Examples of a dicing method include a method of performing blade dicing using a rotary blade, a method of cutting the film-shaped adhesive 10 or both the wafer and the film-shaped adhesive 10 with a laser, and a general-purpose method such as extension at room temperature or under cooling conditions.

[0088] Then, the second semiconductor element Waa to which the film-shaped adhesive 10 is attached is press-bonded to the substrate 14

to which the first semiconductor element Wa is connected via the wire 88. Specifically, as shown in FIG. 9, the second semiconductor element Waa to which the film-shaped adhesive 10 is attached is disposed so that the film-shaped adhesive 10 covers the first semiconductor element Wa, and as shown in FIG. 10, the second semiconductor element Waa is then press-bonded to the substrate 14, and thereby the second semiconductor element Waa is fixed to the substrate 14 (second die bonding step). In the second die bonding step, preferably, the film-shaped adhesive 10 is press-bonded under conditions of 80 to 180°C and 0.01 to 0.50 MPa for 0.5 to 3.0 seconds.

[0089] Next, as shown in FIG. 11, the substrate 14 is electrically connected to the second semiconductor element Waa with the second wire 98, and the circuit pattern 84, the second wire 98, and the entire second semiconductor element Waa are then sealed with the sealing material 42 under conditions of 170 to 180°C and 5 to 8 MPa (sealing step). The semiconductor device 200 can be produced through such a step.

[0090] As described above, the semiconductor device 200 is produced using a film-shaped adhesive which is used for press-bonding a second semiconductor element and embedding a first wire and a first semiconductor element and which has a shear elastic modulus at 150°C of 1.5 MPa or less in a semiconductor device in which the first semiconductor element is electrically connected to a substrate with the first wire therebetween and the second semiconductor element having a larger area than the first semiconductor element is press-bonded to the first semiconductor element. When a film-shaped adhesive having a

shear elastic modulus at 150°C of 1.5 MPa or less is used, particularly, voids generated in the second die bonding step can be eliminated in the sealing step which is a post-step. Accordingly, a special step for eliminating voids is not separately required, and it is possible to minimize an increase in the lead time.

[0091] While preferable embodiments of the present invention have been described above, the present invention is not necessarily limited to the above embodiments. For example, appropriate modifications can be made as follows without departing from the spirit and scope of the invention.

[0092] In the semiconductor device 200, the substrate 14 is the organic substrate 90 in which the circuit patterns 84 and 94 are each formed at two places on the surface thereof, but the substrate 14 is not limited thereto, and a metal substrate such as a lead frame may be used.

[0093] The semiconductor device 200 has a configuration in which the second semiconductor element Waa is laminated on the first semiconductor element Wa and the semiconductor elements are laminated in two stages, but the configuration of the semiconductor device is not limited thereto. A third semiconductor element may be additionally laminated on the second semiconductor element Waa, or a plurality of semiconductor elements may be additionally laminated on the second semiconductor element Waa. When the number of semiconductor elements laminated increases, it is possible to increase the capacity of the obtained semiconductor device.

[0094] In the semiconductor device production method according to the present embodiment, in the lamination step, the adhesive sheet 100

shown in FIG. 2 is laminated on one surface of the semiconductor wafer, the base film 20 is peeled off, and thus the film-shaped adhesive 10 is attached. However, the adhesive sheet used during lamination is not limited thereto. The dicing/die bonding integrated adhesive sheets 120 and 130 shown in FIGS. 4 and 5 can be used in place of the adhesive sheet 100. In this case, it is not necessary to separately attach the dicing tape 60 when the semiconductor wafer is diced.

[0095] In the lamination step, rather than the semiconductor wafer, semiconductor elements obtained by separating a semiconductor wafer into pieces may be laminated on the adhesive sheet 100. In this case, the dicing step can be omitted.

[Examples]

[0096] The present invention will be described below in detail with reference to examples. However, the present invention is not limited to the following examples.

[0097] (Examples 1 and 2 and Comparative Examples 1 to 3)

According to Table 1 (unit: parts by mass), an epoxy resin and a phenolic resin, which are a thermosetting resin, and an inorganic filler were weighed out to obtain a composition, and cyclohexanone was additionally added thereto and the mixture was stirred and mixed. An acrylic rubber, which is a thermoplastic resin, was added thereto and the mixture was stirred, and a coupling agent and a curing promoting agent were then additionally added thereto, and the mixture was stirred until respective components became uniform to obtain a varnish. Here, product names of respective components in Table 1 are as follows.

[0098] (Epoxy resin)

- YDF-8170C: (product name, commercially available from NSCC Epoxy Manufacturing Co., Ltd., bisphenol F type epoxy resin: epoxy equivalent of 159, liquid at room temperature, weight average molecular weight of about 310)
- 5 R710: (product name, commercially available from Printec Corporation, bisphenol E type epoxy resin: epoxy equivalent of 170, liquid at room temperature, weight average molecular weight of about 340)
- YDCN-700-10: (product name, commercially available from NSCC Epoxy Manufacturing Co., Ltd., cresol novolak type epoxy resin: epoxy
- 10 equivalent of 210, softening point of 75 to 85°C)
- VG-3101L: (product name, commercially available from Printec Corporation, multifunctional epoxy resin: epoxy equivalent of 210, softening point of 39 to 46°C)
- [0099] (Phenolic resin)
- 15 HE100C-30: (product name, commercially available from Air Water Inc., phenolic resin: hydroxyl equivalent of 175, softening point of 79°C, water absorption rate of 1 mass%, heating mass reduction rate of 4 mass%)
- HE200C-10: (product name, commercially available from Air Water
- 20 Inc., phenolic resin: hydroxyl equivalent of 200, softening point of 65 to 76°C, water absorption rate of 1 mass%, heating mass reduction rate of 4 mass%)
- HE910-10: (product name, commercially available from Air Water Inc., phenolic resin: hydroxyl equivalent of 101, softening point of 83°C,
- 25 water absorption rate of 1 mass%, heating mass reduction rate of 3 mass%)

[0100] (Inorganic filler)

SC2050-HLG: (product name, commercially available from Admatechs,
silica filler dispersion solution: average particle size of 0.50 μm)

SC1030-HJA: (product name, commercially available from Admatechs,
silica filler dispersion solution: average particle size of 0.25 μm)

AEROSIL R972: (product name, commercially available from Nippon
Aerosil Co., Ltd., silica: average particle size of 0.016 μm)

[0101] (Acrylic rubber)

HTR-860P-3CSP: (sample name: commercially available from Nagase
ChemteX Corporation, acrylic rubber: weight average molecular weight
of 800,000, glycidyl functional group monomer proportion of 3 mol%,
Tg of 12°C)

HTR-860P-30B-CHN: (sample name, commercially available from
Nagase ChemteX Corporation, acrylic rubber: weight average
molecular weight of 230,000, glycidyl functional group monomer
proportion of 8 mol%, Tg of -7°C)

[0102] (Coupling agent)

A-189: (product name, commercially available from Momentive
Performance Materials Japan LLC, γ -mercaptopropyltrimethoxysilane)

A-1160: (product name, commercially available from Momentive
Performance Materials Japan LLC, γ -ureidopropyltriethoxysilane)

[0103] (Curing promoting agent)

Curezol 2PZ-CN: (product name, commercially available from Shikoku
Chemical Corporation, 1-cyanoethyl-2-phenylimidazole)

[0104]

[Table 1]

		Example 1	Example 2	Comparative Example 1	Comparative Example 2	Comparative Example 3
Epoxy resin	YDF-8170C	-	-	-	11.2	14.2
	R710	11.6	10.9	-	-	-
	YDCN-700-10	16.9	0.4	13.2	17.8	16.2
	VG-3101L	-	15.1	-	-	-
Phenolic resin	HE-100C-30	0.7	10.9	11	2.8	23.2
	HE-200C-10	4.7	8.8	-	22.1	0
	HE910-10	9.4	4.4	-	-	-
Inorganic filler	SC2050-HLG	-	-	-	21	29.3
	SC1030-HJA	34	32.4	-	-	-
	AEROSIL R972	0.5	0.5	7.8	1.9	-
Acrylic rubber	HTR-860P-3CSP	6.5	7.9	66.4	6.8	16.7
	HTR-860P-30B-CHN	15.2	18.5	-	15.9	-
Coupling agent	A-189	0.1	0.2	0.4	0.1	0.1
	A-1160	0.2	0.2	1.2	0.4	0.2
Curing promoting agent	Curezol 2PZ-CN	0.1 or less	0.1 or less	0.03	0.1	0.1

(unit: parts by mass)

[0105] Next, the obtained varnish was filtered through a 100-mesh filter, and vacuum-degassed. The varnish after vacuum degassing was applied to a polyethylene terephthalate (PET) film (with a thickness of 38 μm) on which a mold release treatment was performed, which was a base film. The applied varnish was heated and dried in two steps: at 90°C for 5 minutes, and then at 140°C for 5 minutes. Thereby, an adhesive sheet including a film-shaped adhesive with a thickness of 60 μm in a B stage state on the PET film was obtained.

[0106] <Evaluation of various physical properties>

The obtained film-shaped adhesives were evaluated as follows.

The evaluate results are shown in Table 2.

[0107] [Measurement of shear elastic modulus]

The base film was peeled off and removed from the film-shaped adhesive and the film-shaped adhesive was cut into a 10 square mm in the thickness direction. A plurality of these were prepared and bonded together to obtain a 10 square mm film-shaped adhesive evaluation

sample with a thickness of 360 μm . A circular aluminum plate jig with a diameter of 8 mm was set in a dynamic viscoelastic device ARES (commercially available from TA Instruments Japan Inc.), and the evaluation sample was inserted into the jig. Then, when a strain of 5% was applied to the evaluation sample at a frequency of 1 Hz, heating was performed from room temperature (30°C) to 125°C at a rate of temperature increase of 5°C/min and the sample was left for 1 hour, and heating was then additionally performed to 150°C at a rate of temperature increase of 5°C/min, and the sample was left for 45 minutes. Then, the value of the shear elastic modulus at 150°C was recorded.

[0108] [Measurement of shear viscosity]

As in the measurement of the shear elastic modulus, when a strain of 5% was applied to the evaluation sample at a frequency of 1 Hz and heating was performed from room temperature (30°C) to 140°C at a rate of temperature increase of 5°C/min, the shear viscosity was measured. Then, the measured value at 80°C was recorded.

[0109] [Measurement of tensile elastic modulus after curing]

The base film was peeled off and removed from the film-shaped adhesive and the film-shaped adhesive was then cut into a size with a width of 4 mm and a length of 30 mm. This was heated at 120°C for 2 hours and at 170°C for 3 hours to obtain an evaluation sample in which the film-shaped adhesive was cured. Then, the evaluation sample was set in a dynamic viscoelastic device (product name: Rheogel-E4000, commercially available from UMB), a tensile load was applied and the tensile elastic modulus was measured under conditions of a frequency of

10 Hz and a rate of temperature increase of 3°C/min. Then, the measured values at 170 to 190°C were recorded.

[0110] [Evaluation of embedding properties after press-bonding]

Two film-shaped adhesives of the adhesive sheets were bonded together to have a thickness of 120 µm, and the result was attached to a semiconductor wafer (8 inches) with a thickness of 100 µm at 70°C. Next, this was diced into a size of 7.5 square mm to obtain a semiconductor element with an adhesive sheet.

On the other hand, a dicing/die bonding integrated film (commercially available from Hitachi Chemical Company, HR-9004-10 (with a thickness of 10 µm)) was attached to a semiconductor wafer (8 inches) with a thickness of 50 µm at 70°C. Next, this was diced into a size of 3.0 square mm to obtain the above chip with an integrated film. The chip with an integrated film was press-bonded to an evaluation substrate having a maximum surface roughness of 6 µm under conditions of 120°C and 0.20 MPa for 2 seconds, and then heated at 120°C for 2 hours, and the integrated film was semi-cured. Thereby, a substrate with a chip was obtained.

A semiconductor element with an adhesive sheet was press-bonded to the obtained substrate with a chip under conditions of 120°C and 0.20 MPa for 2 seconds. In this case, a chip that was press-bonded in advance was aligned so that it was at the center of the semiconductor element with an adhesive sheet. As in measurement of the shear elastic modulus, the obtained structure was heated at 125°C for 1 hour and at 150°C for 45 minutes.

A structure that was naturally cooled to room temperature after

heating was analyzed using an ultrasonic C-SCAN image diagnostic device (commercially available from Insight Co., Ltd., part number IS350, probe: 75 MHz), and embedding properties after press-bonding were checked. The embedding properties after press-bonding were evaluated according to the following criteria.

○: A proportion of a void area with respect to the press-bonded film area was less than 10%

×: A proportion of a void area with respect to the press-bonded film area was 10% or more.

[0111] [Evaluation of void embedding properties after sealing]

A surface on which the semiconductor element having the structure obtained in the evaluation of embedding properties after press-bonding was mounted was sealed using a molding sealing material (commercially available from Hitachi Chemical Company, product name: CEL-9700HF). Sealing was performed using a molding machine MH-705-1 (commercially available from Apic Yamada Corporation) under sealing conditions of 175°C and 6.9 MPa for 120 seconds. The obtained sealing sample was analyzed in the same manner as in the evaluation of embedding properties after press-bonding, and void embedding properties after sealing were evaluated. Evaluation criteria were as follows.

○: A proportion of a void area with respect to the press-bonded film area was less than 5%.

×: A proportion of a void area with respect to the press-bonded film area was 5% or more.

[0112] [Evaluation of amount of warping]

A structure was prepared as in the evaluation of embedding properties after press-bonding. This structure was heated at 170°C for 3 hours, the film-shaped adhesive was cured, and then a difference in height for 8 mm in the diagonal direction of the semiconductor element was measured using a surface roughness meter. A difference between the maximum value and the minimum value of the obtained measured value was recorded as the amount of warping of the structure.

[0113]

[Table 2]

	Example 1	Example 2	Comparative Example 1	Comparative Example 2	Comparative Example 3
Shear elastic modulus (MPa)	0.4	1.0	1.6	13.0	50.0
Shear viscosity (Pa·s)	5,900	8,000	30,000	4,200	3,500
Elastic modulus after curing (MPa)	6	8	4	15	23
Embedding properties after press-bonding	○	○	×	○	○
Void embedding properties after sealing	○	○	-	×	×
Amount of warping (μm)	35	29	-	45	51

Reference Signs List

[0114] 10 Film-shaped adhesive

14 Substrate

42 Resin (sealing material)

88 First wire

98 Second wire

200 Semiconductor device

Wa First semiconductor element

Waa Second semiconductor element

CLAIMS

[Claim 1]

A semiconductor device production method, comprising:

a first die bonding step in which a first semiconductor element is
5 electrically connected to a substrate with a first wire therebetween;

a lamination step in which a film-shaped adhesive having a
shear elastic modulus at 150°C of 1.5 MPa or less is attached to one
surface of a second semiconductor element having a larger area than the
first semiconductor element; and

10 a second die bonding step in which the second semiconductor
element to which the film-shaped adhesive is attached is disposed so
that the film-shaped adhesive covers the first semiconductor element,
the film-shaped adhesive is press-bonded, and thus the first wire and the
first semiconductor element are embedded in the film-shaped adhesive.

15 [Claim 2]

The production method according to claim 1,

wherein the film-shaped adhesive has a tensile elastic modulus
at 170 to 190°C after curing of 15 MPa or less.

[Claim 3]

20 The production method according to claim 1 or 2,

wherein the film-shaped adhesive has a shear viscosity of
15,000 Pa·s or less at 80°C.

[Claim 4]

The production method according to any one of claims 1 to 3,

25 wherein the film-shaped adhesive includes an acrylic resin and
an epoxy resin.

[Claim 5]

The production method according to claim 4,

wherein the acrylic resin includes a first acrylic resin having a weight average molecular weight of 100,000 to 500,000 and a second acrylic resin having a weight average molecular weight of 600,000 to 1,000,000, and the content of the first acrylic resin is 50 mass% or more with respect to a total mass of the acrylic resin.

[Claim 6]

The production method according to any one of claims 1 to 5,

wherein the film-shaped adhesive includes at least one of an inorganic filler and an organic filler.

[Claim 7]

A film-shaped adhesive which is used for press-bonding a second semiconductor element and embedding a first wire and a first semiconductor element and which has a shear elastic modulus at 150°C of 1.5 MPa or less in a semiconductor device in which the first semiconductor element is electrically connected to a substrate with the first wire therebetween and the second semiconductor element having a larger area than the first semiconductor element is press-bonded to the first semiconductor element,.

[Claim 8]

The film-shaped adhesive according to claim 7,

wherein a tensile elastic modulus at 170 to 190°C after curing is 15 MPa or less.

[Claim 9]

The film-shaped adhesive according to claim 7 or 8,

wherein a shear viscosity at 80°C is 15,000 Pa·s or less.

[Claim 10]

The film-shaped adhesive according to any one of claims 7 to 9,
comprising

5 an acrylic resin and an epoxy resin.

[Claim 11]

The film-shaped adhesive according to claim 10,

 wherein the acrylic resin includes a first acrylic resin having a
weight average molecular weight of 100,000 to 500,000 and a second
10 acrylic resin having a weight average molecular weight of 600,000 to
1,000,000, and the content of the first acrylic resin is 50 mass% or more
with respect to a total mass of the acrylic resin.

[Claim 12]

 The film-shaped adhesive according to any one of claims 7 to
15 11, comprising

 at least one of an inorganic filler and an organic filler.