

DESCRIPTION

Title of Invention

METHOD FOR MANUFACTURING SEMICONDUCTOR DEVICE,
FILM ADHESIVE AND ADHESIVE SHEET

5 Technical Field

[0001] The present invention relates to a method for manufacturing a semiconductor device, a film-form adhesive, and an adhesive sheet.

Background Art

[0002] Along with multifunctionalization of mobile telephones and the like, stacked multi chip packages (MCPs) obtained by laminating semiconductor elements in multiple stages and increasing the capacitance have been distributed. For the mounting of semiconductor elements, film-form adhesives that are advantageous in mounting processes are widely used as adhesives for die bonding. An example of multi-stage laminated packages using such film-form adhesives may be a chip-embedded type package. This is a package in which a semiconductor element is mounted (compression-bonded) in the lowest layer in a multi-stage laminated package, and a highly fluid film-form adhesive is mounted (compression-bonded) thereon so as to embed the semiconductor element. This package is mounted in memory packages for mobile telephones and mobile audio instruments, and the like.

[0003] Connection reliability may be mentioned as one of important characteristics required from semiconductor devices such as the above-mentioned stacked MCPs, and in order to enhance the connection reliability, film-form adhesives have been developed in consideration of

characteristics such as heat resistance, moisture resistance, and reflow resistance. Regarding such a film-form adhesive, for example, an adhesive sheet having a thickness of 10 to 250 μm has been suggested in Patent Literature 1, the adhesive sheet containing resins that include a particular high-molecular weight component and a thermosetting component including an epoxy resin as a main component, and also containing a filler. Furthermore, an adhesive composition containing a mixture including an epoxy resin and a phenolic resin, as well as an acrylic copolymer has been proposed in Patent Literature 2.

[0004] The connection reliability of a semiconductor device is also greatly dependent on whether a semiconductor element is mounted or not, without generating voids in the adhesive surface. For this reason, it has been devised to use a highly fluid film-form adhesive in order to mount a semiconductor element without generating voids, or to use a film-form adhesive having a low elastic modulus so as to cause the generated voids to disappear in a process for sealing a semiconductor element. For example, in Patent Literature 3, an adhesive sheet having low viscosity and low tack strength has been proposed.

Citation List

Patent Literature

[0005] Patent Literature 1: International Publication No. 2005/103180

Patent Literature 2: Japanese Unexamined Patent Publication No. 2002-220576

Patent Literature 3: Japanese Unexamined Patent Publication No. 2009-120830

Summary of Invention

Technical Problem

[0006] In the adhesive films of the above-described Patent Literatures 1 and 3 and the like, epoxy resins and the like are included in large quantities for the purpose of fluidity increase in order to embed chips (semiconductor elements) at the time of mounting. For this reason, heat curing proceeds due to the heat generated during the production process for a semiconductor device, and the adhesive film is highly elasticized. Therefore, the adhesive film is not deformed even under the high-temperature and high-pressure conditions at the time of sealing, and some of the voids formed at the time of mounting may not eventually disappear. On the other hand, the adhesive film of the above-described Patent Literature 2 or the like has a low elastic modulus, and therefore, voids can be cause to disappear in a sealing process. However, protrusion (bleeding) of the resin through chip edges after mounting increases, and there is a risk that the package portion around the chip may be contaminated. These problems will be described in more detail below.

[0007] In recent years, speeding up of the operation of chip-embedded type semiconductor devices is considered more important. Conventionally, a controller chip that control the operation of a semiconductor device is disposed at the uppermost stage of a laminated semiconductor element; however, in order to realize speeding up of the operation, a technology of packaging a semiconductor device having a controller chip disposed at the lowermost stage has been developed. As one form of such a package, a package in which the film-form adhesive used at the time of mounting a semiconductor element of the

second stage among the semiconductor elements laminated in multiple stages is made thick, and a controller chip is embedded inside this film-form adhesive, is attracting attention. A film-form adhesive used for such a use application requires high fluidity that allows embedding of the level differences attributed to a controller chip and wires connected to the controller chip, and the surface unevenness at the substrate surface. However, these problems can be solved by using a highly fluid film such as the adhesive sheet of Patent Literature 2.

[0008] However, what becomes a problem herein is that in a case in which a highly fluid resin is used, oozing out (bleeding) of the resin through chip edges occurs in a large quantity. Particularly, in a chip-embedded type semiconductor device, since the film-form adhesive is made thick for embedding, and the volume fraction of the chip to be embedded is excluded, the amount of bleeding becomes more noticeable. Pads and circuits for connecting wires are formed around a chip, and when the amount of bleeding is large, there is a risk that the package surface including these may be contaminated. Therefore, a film-form adhesive requires high fluidity for embedding a controller chip and wires, while it is necessary to maintain the fluidity low in order to suppress bleeding.

[0009] The present invention was achieved in view of the above-described circumstances, and it is an object of the invention to provide a method for manufacturing a semiconductor device, by which satisfactory chip embedding characteristics and low bleeding characteristics can be achieved in a well-balanced manner. It is another object of the present invention to provide a film-form adhesive

to be used for the above-described manufacturing method, and a dicing-die bonding integrated type adhesive sheet using the film-form adhesive.

Solution to Problem

5 [0010] In order to solve the above-described problems, the inventors of the present invention repeatedly conducted thorough investigations on the adjustment of the physical properties of a film-form adhesive that is used at the time of producing a semiconductor device. Further, the present inventors found that when the shear viscosity at a particular
10 frequency is in a particular range, and a film-form adhesive whose shear viscosity and frequency satisfy a particular relationship is used, both satisfactory chip embedding characteristics and low bleeding characteristics can be realized.

[0011] That is, in order to solve the above-described problems, the
15 present invention provides a method for manufacturing a semiconductor device, the method including a first mounting step of electrically connecting a first semiconductor element onto a substrate by means of a first wire, a lamination step of sticking a film-form adhesive on one side of a second semiconductor element having a larger area than the first
20 semiconductor element, and a second mounting step of placing the second semiconductor element having the film-form adhesive stuck thereto, such that the film-form adhesive covers the first semiconductor element, mounting the film-form adhesive, and thereby embedding the first wire and the first semiconductor element in the film-form adhesive,
25 in which the film-form adhesive has a shear viscosity at 80°C of 300 Pa·s or less as measured under the conditions of a frequency of 79.0 Hz,

and in a case in which the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz, 1.0 Hz, 10.0 Hz, and 79.0 Hz is designated as Y (Pa·s), the frequency is designated as X (Hz), and the relationship between X and Y is subjected to power approximation and is thereby represented by $Y = aX^b$, the gradient b is -0.67 or less.

[0012] According to the above-described method for manufacturing a semiconductor device, when the film-form adhesive used to mount (compression-bond) the second semiconductor element onto the first semiconductor element is such that the shear viscosity at 80°C as measured under the conditions of a frequency of 79.0 Hz is 300 Pa·s or less, the first semiconductor element and the first wire can be embedded by the film-form adhesive while the generation of voids is suppressed. Furthermore, when the gradient b, which is determined from the relationship between the frequency and the shear viscosity, for the film-form adhesive is -0.67 or less, protrusion (bleeding) of the film-form adhesive through the edges of the second semiconductor element can be suppressed. Thereby, a semiconductor device which has satisfactory chip embedding characteristics and in which bleeding is suppressed can be obtained.

[0013] Furthermore, regarding adhesive films such as those described in the above-described Patent Literatures 1 and 3, since the elastic modulus rapidly increases at the time of heat curing, the stress exerted on the chip during mounting cannot be sufficiently released, and a phenomenon called chip warpage, in which the adhesive film as well as the chip are warped, may also occur. In contrast, according to the method for manufacturing a semiconductor device of the present

invention, when a film-form adhesive that satisfies the above-mentioned conditions is used, the stress is not likely to remain in the film-form adhesive, and the chip warpage can also be suppressed.

5 [0014] According to the present invention, it is preferable for the film-form adhesive that the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz is 25,000 Pa·s or higher. When the shear viscosity at a frequency of 0.1 Hz is 25,000 Pa·s or higher, the protrusion (bleeding) of the film-form adhesive through the edges of the second semiconductor element can be further suppressed.

10 [0015] According to the present invention, it is preferable that the film-form adhesive includes an epoxy resin that is liquid at 25°C, as a thermosetting component. Thereby, the chip embedding characteristics are more easily enhanced.

15 [0016] According to the present invention, it is preferable that the film-form adhesive includes a thermoplastic component. Thereby, the chip embedding characteristics are more easily enhanced.

[0017] According to the present invention, it is preferable that the film-form adhesive includes an inorganic filler. Thereby, the handleability and the like of the film-form adhesive are enhanced, and
20 also, protrusion (bleeding) of the film-form adhesive through the edges of the second semiconductor element can be further suppressed.

[0018] The present invention also provides a film-form adhesive that is used in a semiconductor device in which a first semiconductor element is electrically connected onto a substrate by means of a first wire, and a
25 second semiconductor element having a larger area than the first semiconductor element is mounted on the first semiconductor element,

in order to mount the second semiconductor element and to also embed the first wire and the first semiconductor element, in which the shear viscosity at 80°C as measured under the conditions of a frequency of 79.0 Hz is 300 Pa·s or less, and in a case in which the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz, 1.0 Hz, 10.0 Hz, and 79.0 Hz is designated as Y (Pa·s), the frequency is designated as X (Hz), and the relationship between X and Y is subjected to power approximation and is thereby represented by $Y = aX^b$, the gradient b is -0.67 or less.

[0019] According to the film-form adhesive of the present invention, it is possible to obtain a semiconductor device which has satisfactory chip embedding characteristics and in which bleeding is suppressed. Furthermore, according to the film-form adhesive of the present invention, it is possible to obtain a semiconductor device in which chip warpage is suppressed.

[0020] It is preferable for the film-form adhesive of the present invention that the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz is 25,000 Pa·s or higher.

[0021] It is preferable that the film-form adhesive of the present invention includes an epoxy resin that is liquid at 25°C, as a thermosetting component.

[0022] It is preferable that the film-form adhesive of the present invention includes a thermoplastic component.

[0023] It is preferable that the film-form adhesive of the present invention includes an inorganic filler.

[0024] The present invention further provides a dicing-die bonding

integrated type adhesive sheet, in which the above-described film-form adhesive of the present invention is laminated on a dicing tape.

[0025] According to the dicing-die bonding integrated type adhesive sheet of the present invention, it is possible to obtain a semiconductor device which has satisfactory chip embedding characteristics and in which bleeding is suppressed. Furthermore, according to the dicing-die bonding integrated type adhesive sheet of the present invention, it is possible to obtain a semiconductor device in which the chip warpage is suppressed.

[0026] With regard to the dicing-die bonding integrated type adhesive sheet of the present invention, it is preferable that the thickness of the film-form adhesive is 20 to 200 μm . In order to sufficiently embed the first semiconductor element, the first wire, and the surface unevenness such as the wiring circuits of the substrate by means of the film-form adhesive, a sufficient thickness is required. However, it is preferable that the film-form adhesive is thinner so as to reduce bleeding. Therefore, from the viewpoint of achieving both of those in a well-balanced manner, it is desirable that the thickness of the film-form adhesive is in the above-described range.

[0027] It is preferable that the dicing-die bonding integrated type adhesive sheet of the present invention has a cover film provided on a surface of the film-form adhesive, the surface being on the opposite side of the surface where the dicing tape is provided. By having a cover film, the film-form adhesive can be protected.

Advantageous Effects of Invention

[0028] According to the present invention, a method for manufacturing

a semiconductor device, by which satisfactory chip embedding characteristics and low bleeding characteristics can be achieved in a well-balanced manner, can be provided. The present invention can also provide a film-form adhesive to be used for the above-described manufacturing method, and a dicing-die bonding integrated type adhesive sheet using the film-form adhesive.

Brief Description of Drawings

[0029] FIG. 1 is a view illustrating a film-form adhesive according to an embodiment of the present invention.

FIG. 2 is a view illustrating an adhesive sheet according to an embodiment of the present invention.

FIG. 3 is a view illustrating an adhesive sheet according to another embodiment of the present invention.

FIG. 4 is a view illustrating a dicing-die bonding integrated type adhesive sheet according to another embodiment of the present invention.

FIG. 5 is a view illustrating a dicing-die bonding integrated type adhesive sheet according to another embodiment of the present invention.

FIG. 6 is a view illustrating a semiconductor device.

FIG. 7 is a view illustrating a method for manufacturing a semiconductor device according to an embodiment of the present invention.

FIG. 8 is a view illustrating a subsequent step of FIG. 7.

FIG. 9 is a view illustrating a subsequent step of FIG. 8.

FIG. 10 is a view illustrating a subsequent step of FIG. 9.

FIG. 11 is a view illustrating a subsequent step of FIG. 10.

FIG. 12 is a double logarithmic graph showing the relationship between the shear viscosity (Y) of the film-form adhesives of Example 1 and Comparative Example 1 and the frequency (X).

5 FIG. 13 is an ultrasonographic image obtained by observing the state of generation of pores (voids) in the evaluation samples using the film-form adhesives of Example 4 and Comparative Examples 1 and 5.

Description of Embodiments

10 [0030] Hereinafter, suitable embodiments of the present invention will be described in detail with reference to the drawings. In the following description, the same reference numeral will be assigned to identical or equivalent parts, and any overlapping explanation will not be repeated. Furthermore, unless particularly stated otherwise, the positional relations such as vertical and transverse positions will be assumed to be

15 based on the positional relations illustrated in the drawings. Furthermore, the dimensional ratio of a drawing is not limited to the depicted ratio. Meanwhile, the term "(meth)acryl" according to the present specification means "acryl" and "methacryl" corresponding thereto.

20 [0031] (Film-form adhesive)

 FIG. 1 is a cross-sectional view schematically illustrating a film-form adhesive 10 according to the present embodiment. The film-form adhesive 10 is thermally curable and is obtained by molding an adhesive composition that can go through a semi-cured (stage B)

25 state and enter a completely cured product (stage C) state after a curing treatment, into a film form.

[0032] Regarding the film-form adhesive 10, the shear viscosity at 80°C as measured under the conditions of a frequency of 79.0 Hz is 300 Pa·s or less. The shear viscosity at 80°C as measured under the conditions of a frequency of 79.0 Hz affects the embedding characteristics at the time of embedding a semiconductor element such as a controller chip and wires in the film-form adhesive 10. When this value is 300 Pa·s or less, elasticity that is low to the extent that semiconductor elements and wires are sufficiently embedded, can be obtained, and thus satisfactory chip embedding characteristics can be obtained. The shear viscosity of the film-form adhesive 10 at 80°C as measured under the conditions of a frequency of 79.0 Hz is preferably 295 Pa·s or less, more preferably 290 Pa·s or less, and even more preferably 285 Pa·s or less, from the viewpoint of further enhancing the chip embedding characteristics. Furthermore, the shear viscosity of the film-form adhesive 10 at 80°C as measured under the conditions of a frequency of 79.0 Hz may be 200 Pa·s or more, may be 230 Pa·s or more, and may be 250 Pa·s or more, from the viewpoint of further reducing the oozing out (bleeding) of the resin through chip edges.

[0033] With regard to the film-form adhesive 10, in a case in which the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz, 1.0 Hz, 10.0 Hz, and 79.0 Hz is designated as Y (Pa·s), the frequency is designated as X (Hz), and the relationship between X and Y is subjected to power approximation and is thereby represented by $Y = aX^b$, the gradient b is -0.67 or less. The gradient b represents the magnitude of the dependency of the shear viscosity on the frequency, and as the value is smaller (the absolute value is larger), the dependency

on the frequency is high, while the difference between the shear viscosity at a relatively high frequency and the shear viscosity at a relatively low frequency becomes large. Then, when this gradient b is -0.67 or less, while the shear viscosity of the film-form adhesive 10 at the instant of applying heat and pressure and embedding semiconductor elements and wires is lowered, the shear viscosity during the period from embedding to cooling can be made relatively large. Thus, the resin flowing after embedding can be suppressed. As a result, oozing out (bleeding) of the resin through chip edges can be reduced. From the viewpoint of further reducing bleeding, the gradient b is preferably -0.68 or less, more preferably -0.69 or less, and even more preferably -0.70 or less. Furthermore, from the viewpoint of not impairing the film-forming properties and handleability, the gradient b may be -0.80 or more.

[0034] With regard to the film-form adhesive 10, from the viewpoint of further reducing oozing out (bleeding) of the resin from chip edges, the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz is preferably 25,000 Pa·s or higher, more preferably 27,000 Pa·s or higher, even more preferably 29,000 Pa·s or higher, and particularly preferably 30,000 Pa·s or higher. Furthermore, from the viewpoint of film-forming properties and processability for dicing and the like, the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz is preferably 50,000 Pa·s or less, more preferably 40,000 Pa·s or less, and even more preferably 35,000 Pa·s or less.

[0035] In a case in which it is attempted to lower the shear viscosity at 80°C of the film-form adhesive 10 as measured under the conditions of

a frequency of 79.0 Hz, for example, the shear viscosity can be adjusted by methods of increasing the content of component (a1) that will be described below, decreasing the content of component (b2) by increasing the content of component (b1), decreasing the content of component (c) or reducing the particle size, and the like. Furthermore, in a case in which it is attempted to increase the shear viscosity at 80°C of the film-form adhesive 10 as measured under the conditions of a frequency of 0.1 Hz, for example, the shear viscosity can be adjusted by methods of increasing the amount of component (a2) that will be described below, increasing the content of component (c), or increasing the molecular weight of component (b2). Meanwhile, in addition to the methods described above, it is possible to adjust the shear viscosity at 80°C of the film-form adhesive 10 as measured under the conditions of a frequency of 79.0 Hz and 0.1 Hz, by adjusting the type and amount of the components (a) to (e) that will be described below.

[0036] In a case in which it is attempted to lower the gradient b, there are occasions in which it is difficult to adjust the gradient b only by a method of adjusting the above-mentioned shear viscosity at a frequency of 79.0 Hz or 0.1 Hz. In a case in which it is attempted to lower the gradient b, for example, a method of adjusting the epoxy equivalent of the epoxy resin or the hydroxyl group equivalent of the phenolic resin of component (a2) that will be described below, may be mentioned. There is a tendency that by decreasing the epoxy equivalent of the epoxy resin or the hydroxyl group equivalent of the phenolic resin of component (a2), the dependency of the shear viscosity of the film-form adhesive 10 on the frequency is increased, and the gradient b can be

further decreased. Meanwhile, in addition to the methods described above, it is possible to adjust the gradient b by adjusting the type and amount of the components (a) to (e) that will be described below.

[0037] The shear viscosity of the film-form adhesive 10 can be measured by adjusting the frequency while applying a strain of 5% to the film-form adhesive 10 that has been maintained at 80°C, using a dynamic viscoelasticity apparatus (for example, trade name "ARES" manufactured by TA Instruments, or the like). More specifically, for example, a parallel cone-plate jig having a diameter of 8 mm is set up in a dynamic viscoelasticity apparatus, a measurement sample of the film-form adhesive 10 is set up here, the frequency is varied in a discrete mode to 0.1 Hz, 1.0 Hz, 10.0 Hz, and 79.0 Hz while a strain of 5% is applied at 80°C to the measurement sample, and thereby the shear viscosity at every frequency can be measured. The thickness of the film-form adhesive 10 to be used as the measurement sample can be set to, for example, 440 μm . The film-form adhesive 10 to be used as the measurement sample is in a pre-curing state (uncured state) and is in, for example, a semi-cured (stage B) state. Meanwhile, the conditions such as the diameter of the parallel cone-plate jig and the thickness of the measurement sample are not limited to the above-mentioned conditions, and different conditions may also be employed. When these conditions are inputted in advance into the measuring apparatus as measurement parameters, measurement results with the influence of the conditions being compensated are obtained. Therefore, even if the conditions are changed, the same value is obtained as compensated measurement results.

[0038] The gradient b can be determined as the value of b when the shear viscosity is designated as Y (Pa·s), the frequency is designated as X (Hz), and the relationship between X and Y is subjected to power approximation from the shear viscosity obtained at every frequency as measured by the above-described method and is represented by $Y = aX^b$. Meanwhile, with regard to the power approximation formula, a and b are constants, and b represents the gradient of a power approximation curve of X and Y in a case in which the coordinates (X , Y) are plotted in a double logarithmic graph.

[0039] Furthermore, it is preferable for the film-form adhesive 10 that the adhesive force after curing to a substrate coated with AUS308 is 1.0 MPa or higher. In this case, the connection reliability of the resulting semiconductor device is more satisfactory.

[0040] In order to adjust the adhesive force between the substrate coated with AUS308 and the film-form adhesive 10 after curing to 1.0 MPa or higher, for example, the adhesive force can be adjusted by reducing the amount of component (a2) that will be described below, and increasing the content of (c) an inorganic filler. Furthermore, from the viewpoint of obtaining sufficient adhesiveness, it is preferable to add a coupling agent that will be described below, and the like.

[0041] The incorporated components of the film-form adhesive 10 are not particularly limited; however, for example, the incorporated components can include (a) a thermosetting component, (b) a thermoplastic component, (c) an inorganic filler, (d) a curing accelerator, (e) other components, and the like. By adjusting the type and amount of these components (a) to (e), the characteristics of the

film-form adhesive 10 can be adjusted.

[0042] (a) Thermosetting component

As the thermosetting component, a thermosetting resin may be mentioned. Particularly, from the viewpoints of heat resistance and moisture resistance required in the case of mounting a semiconductor element, an epoxy resin, a phenolic resin, or the like is preferred as the thermosetting component.

[0043] Regarding the epoxy resin and the phenolic resin, for example, (a1) a resin that has a softening point of 60°C or lower or is liquid at normal temperature (25°C) may be mentioned, and the resin is not particularly limited as long as it is cured and then acquires adhering action. Examples of the epoxy resin corresponding to such component (a1) include bifunctional epoxy resins and the like obtained by modifying a bisphenol A type epoxy resin, a bisphenol F type epoxy resin, a bisphenol E type epoxy resin, and the like. Furthermore, examples of the phenolic resin corresponding to component (a1) include EP-4088 manufactured by ADEKA Corporation, CELLOXIDE 2021P manufactured by Daicel Corporation, and the like.

[0044] Regarding the epoxy resin and the phenolic resin, for example, (a2) an epoxy resin having a softening point of higher than 60°C (solid at normal temperature (25°C)) and an epoxy equivalent of 500 or less, and a phenolic resin having a softening point of higher than 60°C (solid at normal temperature) and a hydroxyl group equivalent of 300 or less, may be mentioned. Regarding the epoxy resin corresponding to such component (a2), there may be mentioned, as dicyclopentadiene type epoxy resins, HP-7200L (epoxy equivalent 242 to 252), HP-7200

(epoxy equivalent 254 to 264), and HP-7200H (epoxy equivalent 272 to 284) manufactured by DIC Corporation; as cresol novolac type epoxy resins, YDCN-700-10 (epoxy equivalent 198 to 210) manufactured by NSCC Epoxy Manufacturing Co., Ltd.; and the like. Furthermore, as the phenolic resin corresponding to component (a2), a dicyclopentadiene type phenolic resin and the like may be mentioned. Examples of the phenolic resin corresponding to such component (a2) include HE series (for example, HE-100C-30 (hydroxyl group equivalent 174)) manufactured by AIR WATER INC., and the like.

[0045] The epoxy equivalent of the epoxy resin and the hydroxyl group equivalent of the phenolic resin, which correspond to the component (a2), are preferably 500 or less, more preferably 400 or less, even more preferably 300 or less, and particularly preferably 200 or less, from the viewpoint of making the value of the gradient b small. Furthermore, the epoxy equivalent of the epoxy resin and the hydroxyl group equivalent of the phenolic resin, which correspond to the component (a2), may be 100 or more.

[0046] The component (a2) is not particularly limited; however, it is preferable that the component (a2) includes an epoxy resin having a dicyclopentadiene skeleton (dicyclopentadiene type epoxy resin) or a phenolic resin having a dicyclopentadiene skeleton (dicyclopentadiene type phenolic resin). These may be used in combination. When these are used, it is easy to make the value of the gradient b for the film-form adhesive 10 smaller (to make the absolute value larger). Furthermore, when these are used, it is easy to decrease the shear viscosity at 80°C of the film-form adhesive in an uncured state as

measured under the conditions of a frequency of 79.0 Hz, and to increase the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz. Therefore, it is easy to achieve satisfactory chip embedding characteristics and low bleeding characteristics in a well-balanced manner.

[0047] An epoxy resin other than the above-mentioned component (a1) and component (a2) may be used in combination as the (a) thermosetting component. For example, novolac type epoxy resins such as a phenol novolac type epoxy resin and a cresol novolac type epoxy resin, and the like can be used. Furthermore, as the epoxy resin, generally known epoxy resins such as a polyfunctional epoxy resin, a glycidylamine type epoxy resin, a heterocyclic ring-containing epoxy resin, and an alicyclic epoxy resin, can also be used.

[0048] Furthermore, a phenolic resin other the above-mentioned component (a1) and component (a2) may be used in combination as the (a) thermosetting resin. For example, PHENOLITE KA, TD series manufactured by DIC Corporation; MILEX XLC-series and LX series (for example, MILEX XLC-LL) manufactured by Mitsui Chemicals, Inc.; and the like may be mentioned. Meanwhile, from the viewpoint of heat resistance, a phenolic resin whose water absorption ratio after introduction into a constant-temperature, constant-humidity chamber at 85°C and 85%RH for 48 hours is 2% by mass or less, and whose mass loss on heating to 350°C (rate of temperature increase: 5°C/min, atmosphere: nitrogen) as measured with a thermogravimetric analysis (TGA) is less than 5% by mass, is preferred.

[0049] In a case in which an epoxy resin and a phenolic resin are used

in combination as the (a) thermosetting component, the mixing ratio of the epoxy resin and the phenolic resin as an equivalent ratio of the respective epoxy equivalent and hydroxyl group equivalent of the resins is preferably 0.70/0.30 to 0.30/0.70, more preferably 0.65/0.35 to 0.35/0.65, even 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 in the above-described range, a film-form adhesive 10 having excellent curability, fluidity, and the like is easily obtained.

[0050] The content of the component (a1) is preferably 5% to 60% by mass, and more preferably 10% to 55% by mass, based on the total mass of the component (a). Thereby, fluidity of the film-form adhesive before curing is easily secured.

[0051] The content of the component (a2) is preferably 40% to 95% by mass, and more preferably 45% to 90% by mass, based on the total mass of the component (a). When the content of the component (a2) is in the above-described range (particularly, when the content is larger than or equal to the lower limit value), the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 0.1 Hz is easily increased, and oozing out (bleeding) of the resin through chip edges is easily reduced.

[0052] The content of the component (a) is preferably 30% to 80% by mass, and more preferably 40% to 60% by mass, based on the total mass of the film-form adhesive 10. When the content of the component (a) is 40% by mass or more, the shear viscosity at 80°C of the film-form adhesive in an uncured state as measured under the conditions of a frequency of 79.0 Hz is easily reduced, the embedding

characteristics are more satisfactory, and also, the curing characteristics as a thermosetting adhesive become satisfactory. Thus, it is easier to suppress peeling of the film-form adhesive from the substrate or generation of gas bubbles inside the film-form adhesive, and the adhesion reliability is enhanced. On the other hand, when the content of the component (a) is 80% by mass or less, it is easy to control the stability at the time of coating and the reliability after mounting.

[0053] (b) Thermoplastic component

As the (b) thermoplastic component, it is preferable to use a thermoplastic component having a crosslinkable functional group such as a glycidyl group and having a high molecular weight, and a thermoplastic component having a crosslinkable functional group other than a glycidyl group, such as a carboxyl group or a hydroxyl group, and having a low molecular weight, in combination. For example, it is preferable that the component (b) includes: (b1) a thermoplastic component having a monomer unit that has at least a glycidyl group as a crosslinkable functional group at a proportion of 3% to 15% by mass with respect to the total amount of monomer units, having a weight average molecular weight of 700,000 to 2,000,000, and having a glass transition temperature T_g of -50°C to 50°C ; and (b2) a thermoplastic component having a monomer unit that does not have a glycidyl as a crosslinkable functional group but has a crosslinkable functional group other than a glycidyl group (for example, a carboxyl group, a hydroxyl group, and the like) at a proportion of 1% to 7% by mass with respect to the total amount of monomer units, having a weight average molecular weight of 500,000 to 900,000, and having a glass transition temperature

Tg of -50°C to 50°C.

5 [0054] Regarding the component (b), an acrylic resin (acryl-based resin) as a thermoplastic resin is preferred, and an acrylic resin such as an epoxy group-containing (meth)acrylic copolymer, which has a glass transition temperature Tg of -50°C to 50°C and is obtainable by polymerizing functional monomers having an epoxy group or a glycidyl group as a crosslinkable functional group, such as glycidyl acrylate and glycidyl methacrylate, is more preferred.

10 [0055] As 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 preferred. An epoxy group-containing acrylic rubber is an acrylic rubber having epoxy groups, which includes an acrylic acid ester as a main component and is formed mainly from a copolymer of butyl acrylate, acrylonitrile, and the like, a copolymer of ethyl acrylate, acrylonitrile, and the like, or the like.

15 [0056] Meanwhile, regarding the crosslinkable functional group of the component (b), crosslinkable functional groups other than an epoxy group, such as an alcoholic or phenolic hydroxyl group, and a carboxyl group, may be mentioned.

20 [0057] With regard to the component (b1), from the viewpoint of further enhancing the adhesive force after curing, the proportion of the monomer unit having a crosslinkable functional group is preferably 3% to 15% by mass, and more preferably 5% to 10% by mass, with respect to the total amount of monomer units.

25 [0058] With regard to the component (b2), from the viewpoint of

further enhancing the adhesive force after curing, the proportion of the monomer unit having a crosslinkable functional group is preferably 1% to 7% by mass, and more preferably 1% to 5% by mass, with respect to the total amount of monomer units.

- 5 [0059] The weight average molecular weight of the component (b1) is preferably from 700,000 to 2,000,000. When the weight average molecular weight of the component (b1) is 700,000 or more, the film-forming properties are more satisfactory, and also, the adhesive strength and heat resistance of the film-form adhesive 10 can be further
- 10 increased. When the weight average molecular weight of the component (b1) is 2,000,000 or less, the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 79.0 Hz is easily reduced, and therefore, the embedding characteristics are more satisfactory.
- 15 [0060] The weight average molecular weight of the component (b2) is preferably from 500,000 to 900,000. When the weight average molecular weight of the component (b2) is 500,000 or more, the effect of enhancing the film-forming properties by combined use of the component (b2) with the component (b1) is more satisfactory. Also,
- 20 the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 0.1 Hz is easily increased, and oozing out (bleeding) of the resin through chip edges is easily reduced. When the weight average molecular weight of the component (b2) is 900,000 or less, the shear viscosity at 80°C of the
- 25 film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 79.0 Hz is easily reduced, and therefore,

the embedding characteristics are more satisfactory. Furthermore, when the weight average molecular weight of the component (b2) is 900,000 or less, the machinability of the film-form adhesive 10 in an uncured state may be improved, and the quality of dicing may be more satisfactory.

[0061] The weight average molecular weight is a value calculated relative to polystyrene standards, obtainable by a gel permeation chromatography method (GPC) using a calibration curve based on polystyrene standards.

[0062] Furthermore, the glass transition temperature T_g of the component (b1) and the component (b2) is preferably -50°C to 50°C . When the glass transition temperature T_g is 50°C or lower, the flexibility of the film-form adhesive 10 is more satisfactory. On the other hand, when the glass transition temperature T_g is -50°C or higher, since the flexibility of the film-form adhesive 10 does not become too high, it is easy to cut the film-form adhesive 10 at the time of dicing the semiconductor wafer. For this reason, it is easy to suppress deterioration of the dicing characteristics caused by the occurrence of burrs.

[0063] The glass transition temperature T_g of the component (b) as a whole is preferably -20°C to 40°C , and more preferably -10°C to 30°C . Thereby, the film-form adhesive 10 is easily cut at the time of dicing, and therefore, resin residue is not likely to be generated. The adhesive force and heat resistance of the film-form adhesive 10 are easily increased, and high fluidity of the film-form adhesive 10 in an uncured state is easily expressed.

[0064] The glass transition temperature T_g can be measured using a thermal differential scanning calorimeter (for example, "Thermo Plus 2" manufactured by Rigaku Corporation).

5 [0065] The component (b) can be purchased as a commercially available product. For example, as the component (b1), acrylic rubber HTR-860P-3CSP (trade name, manufactured by Nagase ChemteX Corporation), and the like may be mentioned. This compound is a compound containing, as a base resin, an acrylic rubber having a glycidyl site as a crosslinkable site and formed from an acrylic acid
10 derivative, and the weight average molecular weight is 1,000,000, while the glass transition temperature T_g is 15°C. Furthermore, as the component (b2), SG-708-6 (trade name, manufactured by Nagase ChemteX Corporation), and the like may be mentioned. This compound is a compound based on an acrylic rubber having a carboxyl
15 group and a hydroxyl group, and the weight average molecular weight is 700,000, while the glass transition temperature T_g is 4°C.

[0066] The content of the component (b1) is preferably 50% by mass or more, and more preferably 55% to 90% by mass, based on the total mass of the component (b). When the content of the component (b1)
20 is 50% by mass or more, the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 79.0 Hz is easily reduced, and therefore, the embedding characteristics are more satisfactory. On the other hand, when the content of the component (b1) is 90% by mass or less, the adhesive
25 strength after curing is more satisfactory.

[0067] The content of the component (b2) is preferably 10% by mass or

more, and more preferably 10% to 45% by mass, based on the total mass of the component (b). When the content of the component (b2) is in the above-described range, curing proceeds while the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 79.0 Hz is maintained, and therefore, a satisfactory cured product can be obtained.

[0068] The content of the component (b) is preferably 20 to 80 parts by mass, and more preferably 30 to 50 parts by mass, with respect to 100 parts by mass of the component (a). When the content of the component (b) is 30 parts by mass or more, decrease in the flexibility of the film-form adhesive can be suppressed, the film-form adhesive is easily further elasticized after heating, and bleeding can be suppressed. On the other hand, when the content of the component (b) is 80 parts by mass or less, the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 79.0 Hz is easily reduced, and fluidity is further enhanced. Therefore, the embedding characteristics are more satisfactory.

[0069] (c) Inorganic filler

As the component (c), from the viewpoints of enhancement of the dicing characteristics of the film-form adhesive 10 in a stage B state, enhancement of the handleability of the film-form adhesive 10, enhancement of the thermal conductivity, adjustment of the shear viscosity (melt viscosity), impartation of thixotropic properties, enhancement of the adhesive force, and the like, a silica filler or the like is preferred.

[0070] It is preferable that the component (c) includes two or more

kinds of fillers having different average particle sizes, for the purpose of enhancing the dicing characteristics of the film-form adhesive 10 in an uncured state and sufficiently expressing the adhesive force after curing. Regarding the component (c), for example, (c1) a first filler having an average particle size of 0.2 μm or more intended for enhancing the dicing characteristics of the film-form adhesive 10 in an uncured state, and (c2) a second filler having an average particle size of less than 0.2 μm intended for sufficiently expressing the adhesive force after curing may be mentioned. However, as long as dicing characteristics and the adhesive force can be guaranteed, the first filler and the second filler may be used each independently or may be used in combination.

[0071] The average particle size is designated as a value obtainable in a case in which an analysis is performed using a laser diffraction type particle size distribution analyzer and using acetone as a solvent. Regarding the average particle sizes of the first and second fillers, it is more preferable that in a case in which an analysis is performed with a particle size distribution analyzer, the difference between the average particle sizes is large to the extent that inclusion of the respective fillers can be discriminated.

[0072] The content of the component (c1) is, in a case in which the component is used in combination with the component (c2), preferably 30% by mass or more based on the total mass of the component (c). When the content of the component (c1) is 30% by mass or more, deterioration of the dicing characteristics of the film and deterioration of the fluidity of the film-form adhesive 10 in an uncured state are easily suppressed.

[0073] The content of the component (c2) is, in a case in which the component is used in combination with the component (c1), preferably 50% by mass or more based on the total mass of the component (c). When the content of the component (c2) is 50% by mass or more, the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 79.0 Hz is easily reduced. Therefore, the embedding characteristics are more satisfactory, and also, the adhesive force after curing is easily expressed sufficiently.

[0074] The average particle size of the component (c) as a whole is preferably 0.05 to 0.5 μm , and more preferably 0.2 to 0.4 μm . When the average particle size of the component (c) as a whole is in the above-described range, the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 79.0 Hz is easily reduced, and the embedding characteristics are more satisfactory.

[0075] The content of the component (c) is preferably 30 to 70 parts by mass, and more preferably 40 to 65 parts by mass, with respect to 100 parts by mass of the component (a). When the content of the component (c) is more than or equal to the lower limit value, deterioration of the dicing characteristics of the film-form adhesive 10 in an uncured state and decrease in the adhesive force after curing are easily suppressed. Also, there is a tendency that the shear viscosity at 80°C of the film-form adhesive 10 in an uncured state as measured under the conditions of a frequency of 0.1 Hz is easily increased, and oozing out (bleeding) of the resin through chip edges is easily reduced.

On the other hand, when the content of the component (c) is less than or equal to the upper limit value, there is a tendency that the shear viscosity at 80°C of the film-form adhesive in an uncured state as measured under the conditions of a frequency of 79.0 Hz is easily reduced, the embedding characteristics is more satisfactory, and also, an increase in the elastic modulus after curing is easily suppressed.

[0076] (d) Curing accelerator

For the purpose of obtaining satisfactory curability, it is preferable to use (d) a curing accelerator. Regarding the component (d), an imidazole-based compound is preferred from the viewpoint of reactivity. Meanwhile, when the reactivity of the component (d) is too high, there is a tendency that not only the shear viscosity is easily increased by heating during the production process for the film-form adhesive 10, but also deterioration with the lapse of time is easily caused. On the other hand, when the reactivity of the component (d) is too low, there is a tendency that the curability of the film-form adhesive 10 is easily deteriorated. When the film-form adhesive 10 is mounted in a manufactured product while not being sufficiently cured, sufficient adhesiveness cannot be obtained, and there is a possibility that the connection reliability of the semiconductor device may be deteriorated.

[0077] Furthermore, in a case in which the content of the component (d) is too small, the curability of the film-form adhesive 10 tends to be easily decreased. On the other hand, in a case in which the content of the component (d) is too large, there is a tendency that not only the shear viscosity is easily increased by heating during the production process for the film-form adhesive 10, but also deterioration with the

lapse of time is easily caused. From such a viewpoint, the content of the component (d) is preferably 0 to 0.20 parts by mass, and more preferably 0.05 to 0.20 parts by mass, with respect to 100 parts by mass of the component (a).

5 [0078] (e) Other components

In addition to the above-described components, from the viewpoint of enhancing the adhesiveness, other components that can be used in the present technical field may also be used in appropriate amounts. Regarding such a component, for example, a coupling agent
10 may be mentioned. Examples of the coupling agent include γ -ureidopropyltriethoxysilane, γ -mercaptopropyltrimethoxysilane, 3-phenylaminopropyltrimethoxysilane, 3-(2-aminoethyl)aminopropyltrimethoxysilane, and the like.

[0079] The content of the coupling agent is preferably 0 to 5 parts by
15 mass, and more preferably 0.1 to 1 part by mass, with respect to 100 parts by mass of the component (a). When the content of the coupling agent is more than or equal to the lower limit value, the wettability for the chip surface or the substrate as an adherend is improved, and the adhesive force and reliability tend to be enhanced. On the other hand,
20 when the content of the coupling agent is less than or equal to the upper limit value, there is a tendency that the generation of gas bubbles concomitant to expansion at the time of heating is easily suppressed.

[0080] (Film-form adhesive)

The film-form adhesive 10 can be obtained by, for example, a
25 step of applying a varnish of an adhesive composition including the above-described components on a base material film and thereby

forming a layer of the varnish; a step of removing the solvent from the layer of the varnish by heating and drying; and a step of removing the base material film.

5 [0081] The varnish can be prepared by subjecting an adhesive composition including the above-described components to mixing, kneading, and the like in an organic solvent. For the mixing and kneading, conventional dispersing machines such as a stirrer, a grinding machine, a three-roll mill, and a ball mill can be used. These instruments can be used in appropriate combination. Application of
10 the varnish can be carried out using, for example, a coating machine. The conditions for heating and drying the varnish are not particularly limited as long as the conditions are conditions in which the used organic solvent is sufficiently volatilized, and for example, the conditions for heating and drying can be set to 60°C to 200°C for 0.1 to
15 90 minutes.

[0082] The organic solvent is not particularly limited as long as the organic solvent can uniformly dissolve, knead or disperse the above-described components, and conventionally known solvents can be used. Examples of such a solvent include ketone-based solvents
20 such as acetone, methyl ethyl ketone, methyl isobutyl ketone, and cyclohexanone; dimethylformamide, dimethylacetamide, N-methylpyrrolidone, toluene, xylene, and the like. From the viewpoint that the drying speed is fast, and the price is cheap, it is preferable to use methyl ethyl ketone, cyclohexanone, or the like.

25 [0083] The above-described base material film is not particularly limited, and examples include a polyester film (polyethylene

terephthalate film or the like), a polypropylene film (oriented polypropylene (OPP) film or the like), a polyimide film, a polyetherimide film, a polyether naphthalate film, a methylpentene film, and the like.

5 [0084] The thickness of the film-form adhesive 10 is preferably 20 to 200 μm , so that the first wire and the first semiconductor element, and the surface unevenness such as the wiring circuit of the substrate can be sufficiently embedded. Furthermore, when the thickness is 20 μm or more, sufficient adhesive force is easily obtained, and when the
10 thickness is 200 μm or less, it is easy to cope with the demand for size reduction of the semiconductor device. From such a viewpoint, the thickness of the film-form adhesive 10 is more preferably 30 to 200 μm , and even more preferably 40 to 150 μm .

[0085] Regarding a method for obtaining a thick film-form adhesive 10,
15 a method of pasting together film-form adhesives 10 may be mentioned.

[0086] (Adhesive sheet)

An adhesive sheet 100 includes, as illustrated in FIG. 2, a film-form adhesive 10 on a base material film 20. The adhesive sheet 100 can be obtained by not removing the base material film 20 in the
20 process of obtaining the film-form adhesive 10.

[0087] An adhesive sheet 110 further includes, as illustrated in FIG. 3, a cover film 30 on the surface of the adhesive sheet 100 on the opposite side of the base material film 20. Examples of the cover film 30 include a PET film, a PE film, an OPP film, and the like.

25 [0088] The film-form adhesive 10 may be laminated on a dicing tape. By using a dicing-die bonding integrated type adhesive sheet obtainable

thereby, a process for lamination to a semiconductor wafer can be carried out all at once, and the efficiency of the operation can be increased.

5 [0089] Examples of the dicing tape 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. The dicing tape may be subjected to a surface treatment such as a primer treatment, a UV treatment, a corona discharge treatment, a polishing treatment, or an etching treatment, as
10 necessary.

[0090] It is preferable that the dicing tape has tacky adhesiveness. Regarding such a dicing tape, a dicing tape obtained by giving tacky adhesiveness to the above-described plastic film, or a dicing tape obtained by providing a tacky adhesive layer on one side of the
15 above-described plastic film may be mentioned.

[0091] Regarding such a dicing-die bonding integrated type adhesive sheet, an adhesive sheet 120 illustrated in FIG. 4 and an adhesive sheet 130 illustrated in FIG. 5 may be mentioned. As illustrated in FIG. 4, the adhesive sheet 120 has a structure in which a dicing tape 60 having a tacky adhesive layer 50 provided on a base material film 40 that can secure elongation when pulling tension is applied, is used as a supporting base material, and a film-form adhesive 10 is provided on the tacky adhesive layer 50 of the dicing tape 60. As illustrated in FIG. 5, the adhesive sheet 130 has a structure in which a base material film
20 20 is further provided on the surface of the film-form adhesive 10 in the adhesive sheet 120.
25

[0092] As the base material film 40, the above-described plastic films described in connection with the dicing tape may be mentioned. Furthermore, the tacky adhesive layer 50 can be formed using, for example, a resin composition that includes a liquid component and a thermoplastic component and has appropriate tack strength. In order to obtain a dicing tape 60, a method of applying this resin composition on a base material film 40, drying the resin composition, and forming the tacky adhesive layer 50; a method of pasting together the tacky adhesive layer 50 that has been once formed on another film such as a PET film, with a base material film 40; and the like may be mentioned.

[0093] Regarding the method of laminating the film-form adhesive 10 on the dicing tape 60, a method of directly applying a varnish of the above-described adhesive composition on the dicing tape 60 and drying the varnish; a method of screen printing the varnish on the dicing tape 60; a method of producing in advance the film-form adhesive 10 and laminating this on the dicing tape 60 by means of pressing or hot roll lamination; and the like may be mentioned. From the viewpoint that production can be carried out continuously, and the efficiency is satisfactory, lamination by hot roll lamination is preferred.

[0094] The thickness of the dicing tape 60 is not particularly limited and can be appropriately determined based on the knowledge of those ordinarily skilled in the art, according to the thickness of the film-form adhesive 10 and the use application of the dicing-die bonding integrated type adhesive sheet. Meanwhile, when the thickness of the dicing tape 60 is 60 μm or more, there is a tendency that deterioration of the handleability, breakage caused by expansion in a process of detaching

semiconductor elements that have been individualized by dicing from the dicing tape 60, and the like can be easily suppressed. On the other hand, when the thickness of the dicing tape is 180 μm or less, economic efficiency and good handleability are easily achieved in a well-balance manner. From the above description, the thickness of the dicing tape 60 is preferably 180 μm or less, and more preferably 60 to 180 μm .

[0095] (Semiconductor device)

FIG. 6 is a cross-sectional view illustrating a semiconductor device. As illustrated in FIG. 6, a semiconductor device 200 is a semiconductor device in which a second semiconductor element Waa is stacked on a first semiconductor element Wa. More particularly, the semiconductor device 200 is a wire-embedded type (chip-embedded type) semiconductor device in which a first semiconductor element Wa of a first stage is electrically connected onto a substrate 14 by means of a first wire 88, a second semiconductor element Waa of a second stage having a larger area than the first semiconductor element Wa is mounted (compression-bonded) onto the first semiconductor element Wa by means of the film-form adhesive 10, and thereby the first wire 88 and the first semiconductor element Wa are embedded in a film-form adhesive 10. Furthermore, in the semiconductor device 200, the substrate 14 and the second semiconductor element Waa are further electrically connected by means of the second wire 98, and the second semiconductor element Waa is also sealed with a sealing material 42.

[0096] 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 inside the

film-form adhesive 10 is a controller chip for driving the semiconductor device 200.

[0097] The substrate 14 is formed from an organic substrate 90 having circuit patterns 84 and 94 formed on the surface. The first semiconductor element Wa is mounted (compression-bonded) onto the circuit pattern 94 by means of an adhesive 41, and the second semiconductor element Waa is mounted (compression-bonded) onto the substrate 14 by means of the film-form adhesive 10 so as to cover any circuit pattern 94 onto which the first semiconductor element Wa is not mounted (compression-bonded), the first semiconductor element Wa, and a portion of the circuit pattern 84. The surface unevenness attributed to the circuit patterns 84 and 94 on the substrate 14 is embedded by the film-form adhesive 10. Further, the second semiconductor element Waa, the circuit pattern 84, and the second wire 98 are sealed by a sealing material 42 made of a resin.

[0098] (Method for manufacturing semiconductor device)

The semiconductor device is produced by a method for manufacturing a semiconductor device, the method including a first mounting step of electrically connecting a first semiconductor element onto a substrate by means of a first wire, a lamination step of sticking a film-form adhesive on one side of a second semiconductor element having a larger area than the first semiconductor element, the film-form adhesive being a film-form adhesive which has a shear viscosity at 80°C of 300 Pa·s or less as measured under the conditions of a frequency of 79.0 Hz, and for which in a case in which the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz, 1.0 Hz, 10.0

Hz, and 79.0 Hz is designated as Y (Pa·s), the frequency is designated as X (Hz), and the relationship between X and Y is subjected to power approximation and is thereby represented by $Y = aX^b$, the gradient b is -0.67 or less, and a second mounting step of placing the second semiconductor element having the film-form adhesive stuck thereto, such that the film-form adhesive covers the first semiconductor element, compression-bonding the film-form adhesive, and thereby embedding the first wire and the first semiconductor element in the film-form adhesive. Hereinafter, the production procedure for the semiconductor device 200 will be specifically described as an example.

[0099] First, as illustrated in FIG. 7, the adhesive 41-attached first semiconductor element Wa was mounted on the circuit pattern 94 on the substrate 14, and the circuit pattern 84 on the substrate 14 and the first semiconductor element Wa were electrically connected by means of the first wire 88 (first mounting step).

[0100] Next, an adhesive sheet 100 is laminated on one side of a semiconductor wafer (for example, 8-inch size, thickness 50 μ m), a base material film 20 is peeled off, and thereby the film-form adhesive 10 is stuck on one side of the semiconductor wafer. Then, a dicing tape 60 is pasted to the film-form adhesive 10, subsequently the semiconductor wafer is diced into a predetermined size (for example, 7.5 mm on each side), and the dicing tape 60 is peeled off. Thereby, as illustrated in FIG. 8, a second semiconductor element Waa having the film-form adhesive 10 stuck thereto is obtained (lamination step).

[0101] It is preferable that the lamination step is carried out at 50°C to 100°C, and it is more preferable that the lamination step is carried out at

60°C to 80°C. When the temperature of the lamination step is 50°C or higher, satisfactory adhesiveness to the semiconductor wafer can be obtained. When the temperature of the lamination step is 100°C or lower, since the film-form adhesive 10 excessively flowing during the lamination step is suppressed, the occurrence of a change in the thickness and the like can be prevented.

[0102] Regarding the dicing method, a method of performing blade dicing using a rotating blade, a method of cutting the film-form adhesive 10 or both the wafer and the film-form adhesive 10 using a laser, a general-purpose method of expanding under normal temperature or cooling conditions, and the like may be mentioned.

[0103] Then, the second semiconductor element Waa having the film-form adhesive 10 stuck thereto is mounted (compression-bonded) onto the substrate 14, onto which the first semiconductor element Wa is connected by means of the wire 88. Specifically, as illustrated in FIG. 9, the second semiconductor element Waa having the film-form adhesive 10 stuck thereto is placed such that the film-form adhesive 10 covers the first semiconductor element Wa, and subsequently, as illustrated in FIG. 10, the second semiconductor element Waa is compression-bonded onto the substrate 14. Thereby, the second semiconductor element Waa is fixed to the substrate 14 (second mounting step). In the second mounting step, it is preferable that the film-form adhesive 10 is compression-bonded for 0.5 to 3.0 seconds under the conditions of 80°C to 180°C and 0.01 to 0.50 MPa. After the second mounting step, the film-form adhesive 10 may be further pressed and heated for 5 minutes or longer under the conditions of 60°C

to 175°C and 0.3 to 0.7 MPa.

[0104] Next, as illustrated in FIG. 11, the substrate 14 and the second semiconductor element Waa are electrically connected by means of a second wire 98, and then the circuit pattern 84, the second wire 98, and the entire second semiconductor element Waa are sealed with a sealing material 42 under the conditions of 170°C to 180°C and 5 to 8 MPa (sealing step). By going through such steps, the semiconductor device 200 can be produced.

[0105] As described above, the semiconductor device 200 is produced using a film-form adhesive that is used in a semiconductor device in which a first semiconductor element is electrically connected onto a substrate by means of a first wire, and a second semiconductor element having a larger area than the first semiconductor element is also mounted on the first semiconductor element, in order to mount the second semiconductor element and to also embed the first wire and the first semiconductor element, the film-form adhesive being a film-form adhesive which has a shear viscosity at 80°C of 300 Pa·s or less as measured under the conditions of a frequency of 79.0 Hz, and for which in a case in which the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz, 1.0 Hz, 10.0 Hz, and 79.0 Hz is designated as Y (Pa·s), the frequency is designated as X (Hz), and the relationship between X and Y is subjected to power approximation and is thereby represented by $Y = aX^b$, the gradient b is -0.67 or less. By using a film-form adhesive that satisfies the above-described conditions, in the second mounting step, the first semiconductor element and the first wire can be embedded by the film-form adhesive while the

generation of voids is suppressed, and protrusion (bleeding) of the film-form adhesive through the edges of the second semiconductor element can be suppressed. Furthermore, by using a film-form adhesive that satisfies the above-described conditions, stress does not easily remain in the film-form adhesive during the second mounting step, and warping of the film-form adhesive as well as the second semiconductor element can be suppressed.

[0106] Thus, suitable embodiments of the present invention have been described; however, the present invention is not intended to be necessarily limited to the above-described embodiments. For example, appropriate modifications may be made to the extent that the gist is maintained as follows.

[0107] With regard to the semiconductor device 200, the substrate 14 was an organic substrate 90 having circuit patterns 84 and 94 respectively formed at two sites each on the surface. However, the substrate 14 is not limited to this, and a metal substrate such as a lead frame may also be used.

[0108] The semiconductor device 200 has a configuration in which the second semiconductor element Waa is laminated on the first semiconductor element Wa, and semiconductor elements are laminated in two stages. However, the configuration of the semiconductor device is not limited to this. A third semiconductor element may be further laminated on the second semiconductor element Waa, and a plurality of semiconductor elements may be further laminated on the second semiconductor element Waa. As the number of semiconductor elements to be laminated increases, the capacitance of the resulting

semiconductor device can be increased.

5 [0109] In the method for manufacturing a semiconductor device according to the present embodiment, the film-form adhesive 10 is stuck in the lamination step by laminating the adhesive sheet 100 illustrated in FIG. 2 on one side of a semiconductor wafer and peeling off the base material film 20; however, the adhesive sheet to be used at the time of lamination is not limited to this. Instead of the adhesive sheet 100, the dicing-die bonding integrated type adhesive sheets 120 and 130 illustrated in FIGS. 4 and 5 can be used. In this case, it is not necessary to separately stick the dicing tape 60 at the time of dicing the semiconductor wafer.

10 [0110] During the lamination step, it is also acceptable that not a semiconductor wafer but semiconductor elements obtained by individualizing a semiconductor wafer are laminated to the adhesive sheet 100. In this case, the dicing step can be omitted.

Examples

[0111] Hereinafter, the present invention will be more specifically described by way of Examples. However, the present invention is not intended to be limited to the following Examples.

20 [0112] (Examples 1 to 4 and Comparative Examples 1 to 8)

Varnishes were prepared by mixing, by the following procedure, various components with the product names and composition ratios (unit: parts by mass) shown in Table 1 and Table 2. First, an epoxy resin and a phenolic resin as thermosetting resins, and an inorganic filler were respectively weighed, and thereby a composition was obtained. Furthermore, cyclohexanone was added thereto, and the resulting

mixture was stirred and mixed. To this, an acrylic rubber as a thermoplastic resin was added, the mixture was stirred, and then a coupling agent and a curing accelerator were added thereto. The mixture was stirred until the various components would become uniform, and thus a varnish was obtained. Meanwhile, the product names of the various components in Table 1 and Table 2 mean the following.

[0113] (Epoxy resin)

HP-7200L: trade name, manufactured by DIC Corporation, dicyclopentadiene type epoxy resin, epoxy equivalent 242 to 252, softening point 50°C to 60°C, solid at 25°C

VG3101L: trade name, manufactured by Printec Corporation, polyfunctional epoxy resin, epoxy equivalent 210, softening point 39°C to 46°C, solid at 25°C

YDCN-700-10: trade name, manufactured by NSCC Epoxy Manufacturing Co., Ltd., cresol novolac type epoxy resin, epoxy equivalent 210, softening point 75°C to 85°C, solid at 25°C

EXA-830CRP: manufactured by DIC Corporation, bisphenol F type epoxy resin, epoxy equivalent 155 to 163, molecular weight 298.3, liquid at 25°C

CELLOXIDE 2021P: trade name, manufactured by Daicel Corporation, 3',4'-epoxycyclohexylmethyl 3,4-epoxycyclohexanecarboxylate, epoxy equivalent 128 to 145, molecular weight 252.3, liquid at 25°C

[0114] (Phenolic resin)

HE-100C-30: trade name, manufactured by AIR WATER INC.,

phenolic resin, hydroxyl group equivalent 175, softening point 79°C, water absorption ratio 1% by mass, mass loss on heating 4% by mass, solid at 25°C

[0115] (Inorganic filler)

5 SC2050-HLG: trade name, manufactured by Admatechs Company Limited, silica filler dispersion liquid, average particle size 0.50 μm

(Organic filler)

10 EXL-2655: trade name, manufactured by Rohm And Haas Japan K.K., core-shell type organic microparticles, average particle size 200 μm

X-52-854: trade name, manufactured by Shin-Etsu Chemical Co., Ltd., silicone resin powder, average particle size 0.7 μm

15 X-52-7030: trade name, manufactured by Shin-Etsu Chemical Co., Ltd., silicone composite powder, average particle size 0.8 μm

[0116] (Coupling agent)

A-189: trade name, manufactured by Momentive Performance Materials Japan LLC, γ-mercaptopropyltrimethoxysilane

20 A-1160: trade name, manufactured by Momentive Performance Materials Japan LLC, γ-ureidopropyltriethoxysilane

[0117] (Curing accelerator)

2PZ-CN: trade name, manufactured by SHIKOKU CHEMICALS CORPORATION, 1-cyanoethyl-2-phenylimidazole

[0118] (Acrylic rubber)

25 HTR-860P-3CSP: sample name, manufactured by Nagase ChemteX Corporation, weight average molecular weight 1,000,000,

ratio of glycidyl functional group monomer 3% by mass, Tg 15°C

SG-708-6: sample name, manufactured by Nagase ChemteX Corporation, weight average molecular weight 700,000, acid value 9 mg KOH/g, Tg 4°C

5 [0119] Next, the varnish thus obtained was filtered through a 100-mesh filter and was subjected to vacuum degassing. The varnish after vacuum degassing was applied on a polyethylene terephthalate (PET) film (thickness 38 μm) that had been subjected to a mold release treatment, as a base material film. Application was carried out using a
10 coating machine (manufactured by Techno Smart Corp., since it is a custom-made product, the product number is not known) under the conditions of a coating speed of 1 m/min. The varnish thus applied was dried by heating in two stages for 5 minutes at 90°C and subsequently for 5 minutes at 140°C. In this way, an adhesive film
15 including a film-form adhesive (first film-form adhesive) having a thickness of 20 μm in a stage B state on a PET film was obtained. Next, the adhesive film thus obtained and a dicing tape (manufactured by Hitachi Maxell, Ltd., trade name: SD-3004) having a tacky adhesive layer (thickness 30 μm) provided on a base material film (thickness 90
20 μm) were pasted together such that the surface on the film-form adhesive side of the adhesive film and the surface on the tacky adhesive layer side of the dicing tape were tightly adhered. Thus, a first dicing-die bonding integrated type adhesive sheet was obtained. Furthermore, the process was carried out in the same manner as
25 described above, except that the thickness of the film-form adhesive was changed to 110 μm , and thereby a second dicing-die bonding

integrated type adhesive sheet including a second film-form adhesive having a thickness of 110 μm was obtained.

[0120] <Evaluation of various physical properties>

For the dicing-die bonding integrated type adhesive sheets thus obtained, the following evaluations were carried out. The evaluation results are presented in Table 1 and Table 2.

[0121] [Measurement of shear viscosity]

The shear viscosity of the film-form adhesive was evaluated by the following method. The base material film and the dicing tape were peeled off from the first dicing-die bonding integrated type adhesive sheet, and only the first film-form adhesive (thickness 110 μm) was taken out. The first film-form adhesive was placed on a hot plate that was maintained at 70°C, and the same first film-form adhesive was thermally laminated thereon. This was repeated for four-layer portions, and a laminated sample of the film-form adhesive having a thickness of 440 μm was produced. This laminated sample was punched into a circle shape having a diameter of 8 mm, and thereby a measurement sample having a diameter of 8 mm ϕ and a thickness of 440 μm was obtained. A parallel cone-plate jig having a diameter of 8 mm was set up in a dynamic viscoelasticity apparatus, ARES (manufactured by TA Instruments), and the measurement sample was set up here. Regarding the measurement, the frequency was varied in a discrete mode to 0.1 Hz, 1.0 Hz, 10.0 Hz, and 79.0 Hz while a strain of 5% was applied at 80°C to the measurement sample, and thereby the shear viscosity at every frequency was measured.

[0122] The shear viscosity was designated as η (Pa·s), the frequency

was designated as X (Hz), and from the shear viscosity at every frequency thus measured, the relationship between X and Y was subjected to power approximation and was thereby represented by $Y = aX^b$. Thus, the value of b was determined. Here, a and b are constants, and b represents the gradient of a power approximation curve of X and Y obtainable in the case of plotting the coordinates (X, Y) in a double logarithmic graph. These results are presented in Tables 1 and 2. Furthermore, FIG. 12 presents a double logarithmic graph representing the relationship between the shear viscosity of the film-form adhesives of Example 1 and Comparative Example 1, and the frequency.

[0123] [Production of evaluation sample]

The embedding characteristics and the amount of bleeding of the film-form adhesives were evaluated by the following methods. The base material film on the first film-form adhesive side of the first dicing-die bonding integrated type adhesive sheet was peeled off, a semiconductor wafer (silicon wafer) having a thickness of 50 μm and a wafer ring were stuck to the first film-form adhesive at a stage temperature of 70°C, and thus a dicing sample was produced. Next, the dicing sample was cut using a full automatic dicer, DFD-6361 (trade name, manufactured by DISCO Inc.). Cutting was carried out under the cutting conditions of a speed of blade rotation of 40,000 rpm, a cutting speed of 50 mm/sec, and a chip size of 3.2 mm $\times$ 5.5 mm, and pieces were picked up from the cut dicing sample. Thus, a first film-form adhesive (thickness 20 μm)-attached first semiconductor element was obtained.

[0124] A second film-form adhesive (thickness 110 μm)-attached second semiconductor element was obtained by a technique similar to the method for producing the first film-form adhesive-attached first semiconductor element, except that the second dicing-die bonding integrated type adhesive sheet was used, a semiconductor wafer having a thickness of 100 μm was used, and cutting was carried out under the conditions of a chip size of 5.7 mm $\times$ 12 mm.

[0125] The first film-form adhesive-attached first semiconductor element and the second film-form adhesive-attached second semiconductor element thus obtained were mounted on an evaluation substrate coated with AUS308 (manufactured by TAIYO HOLDINGS CO., LTD., thickness 260 μm), using a compression-bonding machine (DIE BONDER manufactured by Besi, trade name: Esec 2100sD PPPplus). Regarding the mounting conditions, first, the first film-form adhesive-attached first semiconductor element was compression-bonded under the conditions of 120°C, for 1 second, and 0.3 MPa, and the second film-form adhesive-attached second semiconductor element was compression-bonded thereonto under the conditions of 120°C, for 1.5 seconds, and 0.2 MPa, so as to embed the first semiconductor element. At this time, the first semiconductor element was aligned so as to come right in the middle of the second semiconductor element. Thereby, an evaluation sample was obtained.

[0126] [Evaluation of amount of bleeding]

For an evaluation sample obtained by the above-described technique, the top face of the second semiconductor element was observed using a microscope (manufactured by KEYENCE

CORPORATION, trade name: VHX-5000). By taking the edges of the second semiconductor element as starting points, the protrusion widths of the second film-form adhesive through the edges were measured, and thereby the amount of bleeding (μm) was determined. At this time, the maximum value of the protrusion widths was designated as the amount of bleeding. The results are presented in Table 1 and Table 2.

[0127] [Evaluation of embedding characteristics]

(Embedding characteristics before curing)

For an evaluation sample obtained by the above-described technique, the sample as a whole was observed in a reflection mode at 75 MHz using an ultrasonic digital image diagnostic apparatus (manufactured by Insight k.k., trade name: IS-350). The embedding characteristics before curing was evaluated by checking whether voids were verified inside the layer of the second film-form adhesive. The embedding characteristics were evaluated by the following criteria. The results are presented in Table 1 and Table 2. Furthermore, FIG. 13 shows ultrasonographic images obtained by observing the state of generation of pores (voids) in the evaluation samples using the film-form adhesives of Example 4 and Comparative Examples 1 and 5.

⊙: Pores (voids) were not recognized.

○: With respect to the area obtained by subtracting the area of the first semiconductor chip from the area of the second film-form adhesive after mounting, the area proportion of pores (voids) was less than 5%.

△: With respect to the area obtained by subtracting the area of the first semiconductor chip from the area of the second film-form

adhesive after mounting, the area proportion of pores (voids) was 5% or more and less than 10%.

5 ×: With respect to the area obtained by subtracting the area of the first semiconductor chip from the area of the second film-form adhesive after mounting, the area proportion of pores (voids) was 10% or more.

[0128] (Embedding characteristics after curing)

10 After the evaluation of the embedding characteristics before curing, the evaluation sample was introduced into a pressurized oven and was subjected to a heating treatment at 140°C and 0.6 MPa for 45 minutes. Thus, the second film-form adhesive was cured. After curing, the embedding characteristics after curing were evaluated by a method similar to that for the embedding characteristics before curing as described above. The results are presented in Table 1 and Table 2.

[0129] [Table 1]

		Example 1	Example 2	Example 3	Example 4
Solid epoxy	HP-7200L	20.6	20.6	-	19.1
	VG3101L	-	-	22.1	-
	YDCN-700-10	-	-	-	-
Liquid epoxy	EXA-830CRP	8.5	8.5	-	10
	CELLOXIDE 2021P	-	-	7	-
Phenolic resin	HE-100C-30	20.6	20.6	20.6	20.6
Filler	SC2050-HLG	31.8	31.8	31.8	31.8
	EXL-2655	-	-	-	-
	X-52-854	-	-	-	-
	X-52-7030	-	-	-	-
Coupling agent	A-189	0.1	0.1	0.1	0.1
	A-1160	0.2	0.2	0.2	0.2
Curing accelerator	2PZ-CN	0.1	0.1	0.1	0.1
Acrylic rubber	HTR-860P-3CSP	18.1	16.3	16.3	18.1
	SG-708-6	-	1.8	1.8	-
Shear viscosity at 0.1 Hz [Pa·s]		32,184	32,350	30,599	32,858
Shear viscosity at 1.0 Hz [Pa·s]		5,776	5,538	5,660	5,854
Shear viscosity at 10.0 Hz [Pa·s]		1,045	990	1,084	1,021
Shear viscosity at 79.0 Hz [Pa·s]		283	276	300	262
Gradient b		-0.71	-0.72	-0.70	-0.73
Embedding characteristics before curing		○	○	○	○
Embedding characteristics after curing		⊙	⊙	⊙	⊙
Amount of bleeding [μm]		61.3	59.8	63.5	63.6

[0130] [Table 2]

		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6	Comparative Example 7	Comparative Example 8
Solid epoxy	HP-7200L	-	14.7	11.1	7.4	-	20.6	20.6	20.6
	VG3101L	-	-	-	-	-	-	-	-
	YDCN-700-10	16.2	7.4	11.1	14.7	11.0	-	-	-
Liquid epoxy	EXA-830CRP	14.2	-	-	-	13.0	8.5	8.5	8.5
	CELLOXIDE 2021P	-	7	7	7	-	-	-	-
Phenolic resin	HE-100C-30	23.2	20.6	20.6	20.6	18.7	20.6	20.6	20.6
Filler	SC2050-HLG	29.3	31.8	31.8	31.8	39.0	-	-	15.9
	EXL-2655	-	-	-	-	-	-	-	15.9
	X-52-854	-	-	-	-	-	31.8	-	-
	X-52-7030	-	-	-	-	-	-	31.8	-
Coupling agent	A-189	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	A-1160	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Curing accelerator	2PZ-CN	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Acrylic rubber	HTR-860P-3CSP	16.7	18.1	18.1	18.1	18.0	18.1	18.1	18.1
	SG-708-6	-	-	-	-	-	-	-	-
Shear viscosity at 0.1 Hz [Pa·s]		18,561	15,935	15,705	15,911	39,293	64,144	116,000	48,354
Shear viscosity at 1.0 Hz [Pa·s]		4,224	3,002	3,059	3,004	7,322	11,500	18,461	8,506
Shear viscosity at 10.0 Hz [Pa·s]		1,085	626	722	714	1,659	2,035	2,863	1,583
Shear viscosity at 79.0 Hz [Pa·s]		420	203	262	270	560	510	658	406
Gradient b		-0.57	-0.66	-0.62	-0.61	-0.64	-0.73	-0.78	-0.72
Embedding characteristics before curing		△	○	○	○	×	×	×	×
Embedding characteristics after curing		⊙	⊙	⊙	⊙	×	△	△	△
Amount of bleeding [μm]		120.0	94.6	81.2	95.5	60.0	67.2	60.2	78.8

[0131] As can be seen from the results shown in Table 1 and Table 2, in all of Examples 1 to 4, the proportion of voids in the evaluation of the embedding characteristics before curing was 5% or less, voids were not recognized in the evaluation of the embedding characteristics after curing in a pressurized oven, and the amount of bleeding was 70 μm or less. On the other hand, in Comparative Example 1, the proportion of voids in the evaluation of the embedding characteristics before curing was 5% or more and less than 10%, and the amount of bleeding was larger by approximately twice the amount of Examples. Furthermore, in Comparative Examples 2 to 4, the amount of bleeding was 80 μm or more in all cases. Furthermore, in Comparative Examples 5 to 8, the proportion of voids in the evaluation of the embedding characteristics before curing was 10% or more, and even after the curing in a pressurized oven, voids could not be caused to disappear.

Reference Signs List

[0132] 10: film-form 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

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

5 a first mounting step of electrically connecting a first semiconductor element onto a substrate by means of a first wire;

a lamination step of sticking a film-form adhesive on one side of a second semiconductor element having a larger area than the first semiconductor element; and

10 a second mounting step of placing the second semiconductor element having the film-form adhesive stuck thereto, such that the film-form adhesive covers the first semiconductor element, mounting the film-form adhesive, and thereby embedding the first wire and the first semiconductor element in the film-form adhesive,

15 wherein the film-form adhesive has a shear viscosity at 80°C of 300 Pa·s or less as measured under the conditions of a frequency of 79.0 Hz, and in a case in which the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz, 1.0 Hz, 10.0 Hz, and 79.0 Hz is designated as Y (Pa·s), the frequency is designated as X (Hz), and the relationship between X and Y is subjected to power approximation and is thereby represented by $Y = aX^b$, the gradient b is -0.67 or less.

2. The manufacturing method according to claim 1, wherein the film-form adhesive has a shear viscosity at 80°C of 25,000 Pa·s or higher as measured under the conditions of a frequency of 0.1 Hz.

25 3. The manufacturing method according to claim 1 or 2, wherein the film-form adhesive includes an epoxy resin that is liquid at 25°C, as a thermosetting component.

4. The manufacturing method according to any one of claims 1 to 3, wherein the film-form adhesive includes a thermoplastic component.
5. The manufacturing method according to any one of claims 1 to 4, wherein the film-form adhesive includes an inorganic filler.
- 5 6. A film-form adhesive, used in a semiconductor device in which a first semiconductor element is electrically connected onto a substrate by means of a first wire, and a second semiconductor element having a larger area than the first semiconductor element is mounted on the first semiconductor element, in order to mount the second semiconductor element and to also embed the first wire and the first semiconductor element,
- 10 wherein the shear viscosity at 80°C as measured under the conditions of a frequency of 79.0 Hz is 300 Pa·s or less, and in a case in which the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz, 1.0 Hz, 10.0 Hz, and 79.0 Hz is designated as Y (Pa·s), the frequency is designated as X (Hz), and the relationship between X and Y is subjected to power approximation and is thereby represented by $Y = aX^b$, the gradient b is -0.67 or less.
- 15 7. The film-form adhesive according to claim 6, wherein the shear viscosity at 80°C as measured under the conditions of a frequency of 0.1 Hz is 25,000 Pa·s or higher.
- 20 8. The film-form adhesive according to claim 6 or 7, comprising an epoxy resin that is liquid at 25°C, as a thermosetting component.
9. The film-form adhesive according to any one of claims 6 to 8, comprising a thermoplastic component.
- 25 10. The film-form adhesive according to any one of claims 6 to 9,

comprising an inorganic filler.

11. A dicing-die bonding integrated type adhesive sheet, having the film-form adhesive according to any one of claims 6 to 10 laminated on a dicing tape.

5 12. The adhesive sheet according to claim 11, wherein the thickness of the film-form adhesive is 20 to 200 μm .

13. The adhesive sheet according to claim 11 or 12, having a cover film provided on a surface of the film-form adhesive, the surface being on the opposite side of the surface where the dicing tape is provided.

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