DESCRIPTION

TITLE OF THE INVENTION: METHOD OF MANUFACTURING ELECTRONIC COMPONENT DEVICE

TECHNICAL FIELD

[0001]

The present invention relates to a method of manufacturing an electronic component device.

BACKGROUND ART

[0002]

In recent years, a sealing sheet has been known which is used to seal an electronic component mounted on a mounted substrate (for example, refer to Patent Document 1).

[0003]

Patent Document 1 describes that a sealing sheet is arranged on an electronic component that is mounted on a mounted substrate and the sealing sheet is pressed in a prescribed condition to embed the electronic component into the sealing sheet, and then the sealing sheet is cured to produce an electronic component device in which the electronic component is sealed.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0004]

Patent Document 1: JP-A-2013-7028

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005]

In the electronic component device, it is desired that the generation of voids is further reduced. By earnest investigation, the present inventors have found that the outer peripheral part (a part where no electronic component is located directly underneath) of the sealing sheet hangs down when the sealing sheet is soft and is arranged on the electronic component, and voids are easily generated in the electronic component device to be manufactured when the sealing sheet is pressed in the state in which air is trapped between the sealing sheet and the mounted substrate.

[0006]

The present invention has been made in consideration of the above-described problem, and an object thereof is to provide a method of manufacturing an electronic component device, the method being capable of suppressing the generation of voids in an electronic component device to be manufactured.

MEANS FOR SOLVING THE PROBLEMS

[0007]

The present inventors have found that the above-described object can be achieved by adopting the following configuration,

and completed the present invention.

[0008]

That is, the present invention is a method of manufacturing an electronic component device, comprising:

a step A of preparing a laminate with an electronic component mounted on a body to be mounted;

a step B of preparing a sealing sheet;

a step C of arranging the sealing sheet on a heating plate and arranging the laminate on the sealing sheet with a surface on which the electronic component is mounted facing downward; and

a step D of performing hot press to embed the electronic component into the sealing sheet after the step C.

[0009]

According to the method of manufacturing an electronic component device of the present invention, the sealing sheet is arranged on the heating plate and the laminate is arranged on the sealing sheet with a surface on which the electronic component is mounted facing downward (step C). The laminate with an electronic component mounted is arranged on the sealing sheet, the space between the sealing sheet and the body to be mounted is not closed. When hot press is performed in this state to embed the electronic component into the sealing sheet, air in the space escapes outside. As a result, the generation of voids can be suppressed in the electronic component device to be manufactured.

[0010]

In the above-described configuration, the sealing sheet preferably has a minimum melt viscosity at 0 to 200°C of 100,000 Pa•s or less. If the minimum melt viscosity of the sealing sheet at 0 to 200°C is 100,000 Pa•s or less, the embedding property of the electronic component into the sealing sheet is improved.

[0011]

In the above-described configuration, the sealing sheet preferably has an outer circumferential length of 500 mm or more. In the present invention, the laminate with an electronic component mounted is arranged on the sealing sheet. Because of that, the space between the sealing sheet and the body to be mounted is not closed even when the sealing sheet has a large area with the outer circumferential length being 500 mm or more. Therefore, when hot press is performed in this state to embed the electronic component into the sealing sheet, air in the space escapes outside. Therefore, according to the above-described configuration, a large area can be collectively sealed while suppressing the generation of voids.

The outer circumferential length of the sealing sheet refers to the whole outer circumferential length of the sealing sheet. For example, when the sealing sheet is rectangular, it refers to [(Length) × 2 + (Width) × 2], and when the sealing sheet is circular, it refers to the whole circumference [2 × π × (Radius)].

EFFECT OF THE INVENTION

[0012]

The present invention can provide a method of manufacturing an electronic component device, the method being capable of suppressing the generation of voids in the electronic component device to be manufactured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a schematic cross sectional view for explaining a method of manufacturing an electronic component device according to one embodiment of the present invention.

Fig. 2 is a schematic cross sectional view for explaining the method of manufacturing an electronic component device according to one embodiment of the present invention.

Fig. 3 is a schematic cross sectional view for explaining the method of manufacturing an electronic component device according to one embodiment of the present invention.

Fig. 4 is a schematic cross sectional view for explaining the method of manufacturing an electronic component device according to one embodiment of the present invention.

Fig. 5 is a schematic cross sectional view for explaining the method of manufacturing an electronic component device according to one embodiment of the present invention.

Fig. 6 is a schematic cross sectional view for explaining the method of manufacturing an electronic component device

according to one embodiment of the present invention.

Fig. 7 is a schematic front view for explaining a method of evaluating an embedding property in examples.

MODE FOR CARRYING OUT THE INVENTION

[0014]

An embodiment of the present invention will be explained below with reference to the drawings. However, the present invention is not limited only to these embodiments.

[0015]

A method of manufacturing an electronic component device according to the present embodiment includes at least:

a step A of preparing a laminate with an electronic component mounted on a body to be mounted;

a step B of preparing a sealing sheet;

a step C of arranging the sealing sheet on a heating plate and arranging the laminate on the sealing sheet with a surface on which the electronic component is mounted facing downward; and

a step D of performing hot press to embed the electronic component into the sealing sheet after the step C.

[0016]

The electronic component is not especially limited as long as it is mounted on a body to be mounted and exhibits a function as an electronic component. Examples of the electronic component include a SAW (Surface Acoustic Wave)

filter; MEMS (Micro Electro Mechanical Systems) such as a pressure sensor and a vibration sensor; an IC such as an LSI; a semiconductor element such as a transistor; a capacitor; and an electronic device such as a resistor.

[0017]

The body to be mounted is not especially limited. Examples thereof include a printed circuit board and a semiconductor wafer.

[0018]

A specific example of the laminate includes a laminate in which CoW (Chip on Wafer) connection is performed between a semiconductor element (for example, a semiconductor chip) as the electronic component and a semiconductor wafer as the body to be mounted.

[0019]

Below, a case is explained in which a semiconductor chip is used as the electronic component and a semiconductor wafer is used as the body to be mounted.

[0020]

Figs. 1 to 6 are schematic cross sectional views for explaining the method of manufacturing an electronic component device according to one embodiment of the present invention.

[0021]

[Step of preparing laminate]

As shown in Fig. 1, in the method of manufacturing an electronic component device according to the present embodiment,

first, a laminate 20 with a semiconductor chip 23 mounted on a semiconductor wafer 22 is prepared (step A). In Fig. 1, a state is shown where a plurality of semiconductor chips 23 is mounted on the semiconductor wafer 22. However, only one electronic component may be mounted on the body to be mounted in the present invention. A semiconductor wafer on which a circuit is formed can be diced with a known method into pieces to form the semiconductor chip 23. A known apparatus such as a flip-chip bonder or a die bonder can be used to mount the semiconductor chip 23 on the semiconductor wafer 22. The semiconductor chip 23 and the semiconductor wafer 22 are electrically connected to each other through a protrusion electrode such as a bump (not shown in the drawing). The distance between the semiconductor chip 23 and the semiconductor wafer 22 can be appropriately set, and it is generally about 15 to 50 μm. The distance between the semiconductor chip 23 and the semiconductor wafer 22 may be filled with a sealing resin (underfill).

[0022]

[Step of preparing sealing sheet]

In the method of manufacturing an electronic component device according to the present embodiment, as shown in Fig. 2, a sealing sheet 10 is prepared (step B). The sealing sheet 10 may be laminated on a support such as a polyethylene terephthalate (PET) film. In this case, a release treatment may be performed on the support to peel the sealing sheet 10

easily.

[0023]

(Sealing sheet)

The sealing sheet 10 preferably contains an epoxy resin and a phenol resin. This makes it possible to provide a good thermal curing property.

[0024]

The epoxy resin is not especially limited. For example, various kinds of epoxy resins can be used such as a triphenylmethane-type epoxy resin, a cresol novolac-type epoxy resin, a biphenyl-type epoxy resin, a modified bisphenol A-type epoxy resin, a bisphenol A-type epoxy resin, a bisphenol F-type epoxy resin, a modified bisphenol F-type epoxy resin, a dicyclopentadiene-type epoxy resin, a phenol novolac-type epoxy resin, and a phenoxy resin. These epoxy resins may be used alone or in combination of two or more thereof.

[0025]

From the viewpoint of securing the toughness of the epoxy resin after curing and the reactivity of the epoxy resin, epoxy resins are preferable which are solid at normal temperature and have an epoxy equivalent of 150 to 200 and a softening point or melting point of 50 to 130°C. Among these epoxy resins, a triphenylmethane-type epoxy resin, a cresol novolac-type epoxy resin, and a biphenyl-type epoxy resin are more preferable from the viewpoint of reliability.

[0026]

The phenol resin is not especially limited as long as it initiates curing reaction with the epoxy resin. For example, there can be used a phenol novolac resin, a phenolaralkyl resin, a biphenylaralkyl resin, a dicyclopentadiene-type phenol resin, a cresol novolac resin, a resol resin, etc. These phenol resins may be used alone or in combination of two or more thereof.

[0027]

From the viewpoint of the reactivity with the epoxy resin, phenol resins are preferably used which have a hydroxy group equivalent of 70 to 250 and a softening point of 50 to 110°C. Among these phenol resins, a phenol novolac resin is more preferably used from the viewpoint of its high curing reactivity. Further, phenol resins having low moisture absorbability can be also preferably used such as a phenolaralkyl resin and a bisphenylaralkyl resin from the viewpoint of reliability.

[0028]

For the compounding ratio of the phenol resin to the epoxy resin, the epoxy resin and the phenol resin are preferably compounded so that the total amount of the hydroxy group in the phenol resin is 0.7 to 1.5 equivalents, and more preferably 0.9 to 1.2 equivalents, to 1 equivalent of the epoxy group in the epoxy resin.

[0029]

The total content of the epoxy resin and the phenol resin in the sealing sheet 10 is preferably 2.0% by weight or more, and more preferably 3.0% by weight or more. If the content is

2.0% by weight or more, good adhering strength to the electronic component and the body to be mounted can be obtained. The total content of the epoxy resin and the phenol resin in the sealing sheet 10 is preferably 20% by weight or less, and more preferably 10% by weight or less. If the content is 20% by weight or less, moisture absorbability can be decreased.

[0030]

The sealing sheet 10 preferably contains a thermoplastic resin. This makes it possible to provide a handling property when the sealing sheet 10 is uncured and low stress property to the cured product.

[0031]

Examples of the thermoplastic resin include natural rubber, butyl rubber, isoprene rubber, chloroprene rubber, an ethylene-vinylacetate copolymer, an ethylene-acrylic acid copolymer, an ethylene-acrylate copolymer, a polybutadiene resin, a polycarbonate resin, a thermoplastic polyimide resin, polyamide resins such as 6-nylon and 6,6-nylon, a phenoxy resin, an acrylic resin, saturated polyester resins such as PET and PBT, a polyamideimide resin, a fluororesin, and a styrene-isobutylene-styrene block copolymer. These thermoplastic resins may be used alone or in combination of two or more thereof. Among these, a styrene-isobutylene-styrene block copolymer is preferable from the viewpoint of its low stress property and low moisture absorption.

[0032]

The content of the thermoplastic resin in the sealing sheet 10 is preferably 1.0% by weight or more, and more preferably 1.5% by weight. If the content is 1.0% by weight or more, the flexibility can be obtained. The content of the thermoplastic resin in the sealing sheet 10 is preferably 3.5% by weight or less, and more preferably 3% by weight or less. If the content is 3.5% by weight or less, the adhesion with the electronic component and the body to be mounted is good.

[0033]

The sealing sheet 10 preferably contains an inorganic filler.

[0034]

The inorganic filler is not especially limited, and various kinds of conventionally known fillers can be used. Examples thereof include powers of quartz glass, talc, silica (such as fused silica and crystalline silica), alumina, aluminum nitride, silicon nitride, and boron nitride. These may be used alone or in combination of two or more kinds. Among these, silica and alumina are preferable, and silica is more preferable due to the reason that the linear expansion coefficient can be satisfactorily decreased.

[0035]

As silica, silica powers are preferable, and fused silica powers are more preferable. Examples of the fused silica powders include spherical fused silica powders and crushed and fused silica powders. However, spherical fused silica powders

are preferable from the viewpoint of fluidity. Among these, powers having an average particle size of 10 to 30 μm are preferable, and powders having an average particle size of 15 to 25 μm are more preferable.

The average particle size can be obtained, for example, by measurement on a sample that is extracted arbitrarily from the population using a laser diffraction-scattering type particle size distribution measuring apparatus.

[0036]

The content of the inorganic filler in the sealing sheet 10 is preferably 80 to 95% by weight, and more preferably 85 to 90% by weight to the entire sealing sheet 10. If the content of the inorganic filler is 80% by weight or more to the entire sealing sheet 10, a low coefficient of thermal expansion can be obtained to suppress the mechanical damage due to thermal impact. As a result, the long-term reliability can be improved. On the other hand, if the content of the inorganic filler is 95% by weight or less to the entire sealing sheet 10, the flexibility, fluidity, and adhesion become better.

[0037]

The sealing sheet 10 preferably contains a curing accelerator.

[0038]

The curing accelerator is not especially limited as long as it promotes curing of the epoxy resin and the phenol resin, and examples of the curing accelerator include organophosphate

compounds such as triphenylphosphine and tetraphenylphosphonium tetraphenylborate; and imidazole compounds such as 2-phenyl-4,5-dihydroxymethylimidazole and 2-phenyl-4-methyl-5-hydroxymethylimidazole. Among these, 2-phenyl-4,5-dihydroxymethylimidazole is preferable due to the reason that the curing reaction does not rapidly proceed even when the temperature increases during kneading and the sealing sheet 10 can be produced satisfactorily.

[0039]

The content of the curing accelerator is preferably 0.1 to 5 parts by weight to the total 100 parts by weight of the epoxy resin and the phenol resin.

[0040]

The sealing sheet 10 preferably contains a flame retardant component. This makes it possible to reduce an expansion of combustion when the sealing sheet 11 catches fire due to short circuit of the parts or heat generation. Examples of the flame retardant component include various kinds of metal hydroxides such as aluminum hydroxide, magnesium hydroxide, iron hydroxide, calcium hydroxide, tin hydroxide, and composite metal hydroxide; and a phosphazene flame retardant.

[0041]

From the viewpoint of exhibiting flame retardancy even with a small amount, the content of phosphorus element in the phosphazene flame retardant is preferably 12% by weight or more.

[0042]

The content of the flame retardant component in the sealing sheet 10 is preferably 10% by weight or more, and more preferably 15% by weight or more in the entire organic component (excluding inorganic filler). If the content is 10% by weight or more, the flame retardancy can be obtained satisfactorily. The content of the thermoplastic resin in the sealing sheet 10 is preferably 30% by weight or less, and more preferably 25% by weight or less. If the content is 30% by weight or less, deterioration in the physical properties (deterioration in physical properties such as glass transition temperature and resin strength at high temperature) of the cured product tends to be suppressed.

[0043]

The sealing sheet 10 preferably contains a silane coupling agent. The silane coupling agent is not especially limited, and an example includes 3-glycidoxypropyl trimethoxysilane.

[0044]

The content of the silane coupling agent in the sealing sheet 10 is preferably 0.1 to 3% by weight. If the content is 0.1% by weight or more, the strength of the cured product is sufficiently made high, so that the water absorption can be lowered. If the content is 3% by weight or less, the amount of outgas can be decreased.

[0045]

The sealing sheet 10 preferably contains a pigment. The

pigment is not especially limited, and an example thereof includes carbon black.

[0046]

The content of the pigment in the sealing sheet 10 is preferably 0.1 to 2% by weight. If the content is 0.1% by weight or more, a good marking property can be obtained when marking is performed by laser marking, etc. If the content is 2% by weight or less, the strength of the cured product is sufficiently made high.

[0047]

Other additives besides each component described above can be appropriately compounded in the resin composition as necessary.

[0048]

The minimum melt viscosity of the sealing sheet 10 at 0 to 200°C is preferably 100,000 Pa•s or less, and more preferably 50,000 Pa•s or less. If the minimum melt viscosity of the sealing sheet 10 at 0 to 200°C is 100,000 Pas or less, the embedding property of the semiconductor chip 23 (electronic component) into the sealing sheet 10 can be improved.

The minimum melt viscosity of the sealing sheet 10 at 0 to 200°C is preferably 100 Pa•s or more, and more preferably 1,000 Pa•s or more. If the minimum melt viscosity of the sealing sheet 10 at 0 to 200°C is 100 Pas or more, the sheet shape can be maintained, and the protrusion of the resin can be suppressed.

The minimum melt viscosity of the sealing sheet 10 at 0 to 200°C can be controlled by the addition amounts of the thermoplastic resin, the thermosetting resin, the inorganic filler, etc.

[0049]

The sealing sheet 10 may have a single layered structure or a multilayered structure in which two or more sealing sheets are laminated. However, a single layered structure is preferable due to the reason that there is no possibility of generating interlayer peeling and the uniformity of the sheet thickness is high.

[0050]

The thickness of the sealing sheet 10 is not especially limited; however, it is for example 50 μm to 2,000 μm from the viewpoint of using the sheet as a sealing sheet.

[0051]

The outer circumferential length of the sealing sheet 10 is preferably 500 mm or more, and more preferably 800 mm or more. The upper limit of the outer circumferential length of the sealing sheet 10 is not especially limited; however, it can be for example 3000 mm or less in consideration of practical range. In the present embodiment, the laminate 20 with the semiconductor chip 23 mounted is arranged on the sealing sheet 10 (refer to Fig. 3). Because of that, the space between the sealing sheet 10 and the semiconductor wafer 22 is not closed even when the sealing sheet 10 has a large area with the outer

circumferential length being 500 mm or more. Therefore, when hot press is performed in this state to embed the semiconductor chip 23 into the sealing sheet 10, air in the space escapes outside. As a result, a large area can be collectively sealed while suppressing the generation of voids.

[0052]

The method of manufacturing the sealing sheet 10 is not especially limited; however, preferred examples are a method of preparing a kneaded product of the resin composition for forming the sealing sheet 10 and applying the obtained kneaded product and a method of subjecting the obtained kneaded product to plastic-working to be formed into a sheet shape. This makes it possible to produce the sealing sheet 10 without using a solvent. Therefore, the effects on the electronic component (semiconductor chip 23) from the volatilized solvent can be suppressed.

[0053]

Specifically, each component described later is melted and kneaded with a known kneader such as a mixing roll, a pressure kneader, or an extruder to prepare a kneaded product, and the obtained kneaded product is applied or plastic-worked into a sheet shape. As a kneading condition, the temperature is preferably the softening point or higher of each component described above, and is for example 30 to 150°C. When the thermal curing property of the epoxy resin is considered, the temperature is preferably 40 to 140°C, and more preferably 60

to 120°C. The time is for example 1 to 30 minutes, and preferably 5 to 15 minutes.

[0054]

The kneading is preferably performed under a reduced pressure condition (under reduced pressure atmosphere). This makes it possible to remove gas, and to prevent invasion of gas into the kneaded product. The pressure under the reduced pressure condition is preferably 0.1 kg/cm^2 or less, and more preferably 0.05 kg/cm^2 or less. The lower limit of the pressure under reduced pressure is not especially limited; however, it is 1×10^{-4} kg/cm^2 or more.

[0055]

When the kneaded product is applied to form the sealing sheet 10, the kneaded product after being melt-kneaded is preferably applied while it is at high temperature without being cooled. The application method is not especially limited, and examples thereof include bar coating, knife coating, and slot-die coating. The application temperature is preferably the softening point or higher of each component described above. When the thermal curing property and molding property of the epoxy resin are considered, the temperature is for example 40 to 150°C, preferably 50 to 140°C, and more preferably 70 to 120°C.

[0056]

When forming the sealing sheet 10 by plastic-working the kneaded product, the kneaded product after melt-kneaded is preferably subjected to plastic-working while it is at high

temperature without being cooled. The plastic-working process is not especially limited, and examples thereof include flat plate pressing, T-die extrusion, screw-die extrusion, rolling, roll kneading, inflation extrusion, coextrusion, and calendar molding. The temperature for plastic-working is preferably the softening point or higher of each component described above. When the thermal curing property and molding property of the epoxy resin are considered, the temperature is for example 40 to 150°C, preferably 50 to 140°C, and more preferably 70 to 120°C.

[0057]

The resin, etc. for forming the sealing sheet 10 may be dissolved and dispersed in an appropriate solvent to prepare varnish. This varnish may be applied to obtain the sealing sheet 10.

[0058]

[Step of arranging sealing sheet and laminate]

After the step (step A) of preparing the laminate and a step (step B) of preparing the sealing sheet, as shown in Fig. 3, the sealing sheet 10 is arranged on a lower heating plate 32 and the laminate 20 is arranged on the sealing sheet 10 with a surface on which the semiconductor chip 23 is mounted facing downward (step C). In this step C, the sealing sheet 10 may be first arranged on the heating plate 32, and after that, the laminate 20 may be arranged on the sealing sheet 10. The laminate 20 may be first laminated on the sealing sheet 10, and after that, a laminate in which the sealing sheet 10 and the

laminate 20 are laminated may be arranged on the lower heating plate 32.

[0059]

[Step of embedding electronic component into sealing sheet]

After the step C, as shown in Fig. 4, hot press is performed with the lower heating plate 32 and an upper heating plate 34 to embed the semiconductor chip 23 (electronic component) into the sealing sheet 10 (step D). The sealing sheet 10 functions as a sealing resin for protecting the semiconductor chip 23 and the elements attached to the chip from the external environment. This provides a structure 26 in which the semiconductor chip 23 that is mounted on the semiconductor wafer 22 is embedded into the sealing sheet 10.

[0060]

For the hot pressing condition when the semiconductor chip 23 is embedded into the sealing sheet 10, the temperature is for example 40 to 100°C, and preferably 50 to 90°C; the pressure is for example 0.1 to 10 MPa, and preferably 0.5 to 0.8 MPa; and the duration is for example 0.3 to 10 minutes, and preferably 0.5 to 5 minutes. This makes it possible to provide an electronic component device in which the semiconductor chip 23 is embedded in the sealing sheet 10. In consideration of improvement of the tackiness and followability of the sealing sheet 10 to the semiconductor chip 23 and the semiconductor wafer 22, pressing is preferably performed under a reduced pressure condition.

For the reduced pressure condition, the pressure is for example 0.1 to 5 kPa, and preferably 0.1 to 100 Pa; and the reduced pressure maintaining time (time from start of reducing pressure to start of pressing) is for example 5 to 600 seconds, and preferably 10 to 300 seconds.

[0061]

[Thermal curing step]

Next, a thermal curing process is performed on the sealing sheet 10 to form an electronic component device 28 (refer to Fig. 5). Specifically, the structure 26 in which the semiconductor chip 23 that is mounted on the semiconductor wafer 22 is embedded into the sealing sheet 10 is entirely heated to obtain a sealing body 28.

[0062]

For a condition of the thermal curing treatment, the heating temperature is preferably 100°C or higher, and more preferably 120°C or higher. On the other hand, the upper limit of the heating temperature is preferably 200°C or lower, and more preferably 180°C or lower. The heating time is preferably 10 minutes or more, and more preferably 30 minutes or more. On the other hand, the upper limit of the heating time is preferably 180 minutes or less, and more preferably 120 minutes or less. A pressure may be applied as necessary. The pressure is preferably 0.1 MPa or more, and more preferably 0.5 MPa or more. On the other hand, the upper limit of the pressure is preferably 10 MPa or less, and more preferably 5 MPa or less.

[0063]

[Dicing step]

Subsequently, the sealing body 28 may be diced (refer to Fig. 6). This makes it possible to provide an electronic component device 29 for each semiconductor chip 23.

[0064]

[Substrate mounting step]

A rewiring and a bump are formed for the electronic component device 29 (on the surface opposite to the semiconductor chip 23 of the semiconductor wafer 22) as necessary to perform the substrate mounting step of mounting the electronic component device 29 on a separate substrate (not shown in the drawing). The electronic component device 29 can be mounted on the separate substrate by using a known apparatus such as a flip-chip bonder or a die bonder. The substrate mounting step is performed to obtain an FOWLP (Fan-Out Wafer Level Package).

[0065]

According to the method of manufacturing an electronic component device of the present embodiment, the sealing sheet 10 is arranged on the lower heating plate 32, and the laminate 20 is arranged on the sealing sheet 10 with a surface on which the semiconductor chip 23 is mounted facing downward (step C). Since the laminate 20 with the semiconductor chip 23 mounted is arranged on the sealing sheet 10, the space between the sealing sheet 10 and the semiconductor wafer 22 is not closed.

When hot press is performed in this state to embed the semiconductor chip 23 into the sealing sheet 10, air in the space escapes outside. As a result, the generation of voids can be suppressed in the electronic component device 29 to be manufactured.

[0066]

In the above-described embodiment, a case is explained where the semiconductor chip 23 is used as the electronic component of the present invention and the semiconductor wafer 22 is used as the body to be mounted. However, the present invention is not limited to this example, one other than the semiconductor chip may be used as the electronic component. When one other than the semiconductor wafer is used as the body to be mounted, the method of manufacturing an electronic component device described above can be also adopted.

EXAMPLES

[0067]

The preferred examples of this invention will be explained in detail below. However, the materials, the compounding amounts, etc. described in the examples are not intended to be limited thereto in the scope of this invention unless otherwise specified.

[0068]

The components used in the examples will be explained.

Epoxy resin a: YSLV-80XY manufactured by Nippon Steel

Chemical Co., Ltd. (Bisphenol F-type epoxy resin: epoxy equivalent 200 g/eq., softening point 80°C)

Phenol resin a: MEH-7851-SS (phenol resin having biphenylaralkyl skeleton, hydroxy group equivalent 203 g/eq., softening point 67°C)

Inorganic filler a: FB-9454FC manufactured by DENKI KAGAKU KOGYO KABUSHIKI KAISHA (fused spherical silica, average particle size 20 μm)

Curing accelerator a: 2PHZ-PW manufactured by Shikoku Chemicals Corporation
(2-phenyl-4,5-dihydroxymethylimidazole)

Thermoplastic resin a: SIBSTER 072T manufactured by Kaneka Corporation (styrene-isobutylene-styrene block copolymer)

[0069]

(Production of sealing sheet)

Examples 1 and 2 and Comparative Example 1

Each component was compounded according to the compounding ratio described in Table 1, and the mixture was melt-kneaded at 60 to 120°C for 10 minutes under a reduced pressure condition (0.01 kg/cm^2) with a roll kneader to prepare a kneaded product. Then, the obtained kneaded product was applied by slot-die coating at 120°C and formed into a sheet shape to produce a sealing sheet having the thickness shown in Table 1. The outer circumferential length of the sealing sheet of any of the examples and the comparative example was 1,400

mm (350 mm long × 350 mm wide).

[0070]

(Measurement of minimum melt viscosity)

The minimum value of the melt viscosity at 0 to 200°C was defined as the minimum melt viscosity when each sample was measured using a viscoelasticity measuring apparatus ARES (manufactured by Rheometric Scientific, Inc.). The measurement condition was as follows: rising temperature rate of 10°C/min, distortion of 20%, and frequency of 0.1 Hz. The results are shown in Table 1.

[0071]

(Preparation of substrate with electronic component mounted)

A substrate with an electronic component mounted was prepared. A semiconductor wafer having a diameter of 300 mm and a thickness of 700 μm was used for the substrate. For the electronic component, a semiconductor chip having a length of 10 mm, a width of 10 mm, and a thickness of 500 μm was used. Fourteen pieces × fourteen pieces of semiconductor chips were mounted vertically and horizontally on the substrate in 10 mm intervals (distance between edge of one electronic component and edge of the adjacent electronic component). The height of the bump was 50 μm.

[0072]

(Production of evaluation sample)

For Examples 1 and 2, the sealing sheet was arranged on the lower heating plate of an instantaneous vacuum laminating

apparatus VS008-1515 (manufactured by Mikado Technos Co., Ltd.), and the substrate was arranged on top of the sealing sheet with a surface on which the electronic component is mounted facing downward. After that, hot press was performed under reduced pressure.

For Comparative Example 1, the substrate was arranged on the lower heating plate of an instantaneous vacuum laminating apparatus VS008-1515 (manufactured by Mikado Technos Co., Ltd.) with a surface on which the electronic component is mounted facing downward, and the sealing sheet was arranged on top of the substrate. After that, hot press was performed under reduced pressure. The hot pressing conditions are shown in Table 1.

After hot pressing, the laminate was heated in an oven at 150°C for 1 hour. After that, it was naturally cooled to room temperature (23°C) to produce an evaluation sample.

[0073]

(Void evaluation)

Whether or not each sample had voids with a diameter of 1 mm or more was checked by using Scanning Acoustic Tomograph (SAT). When the sample had voids with a diameter of 1 mm or more, it was determined as "O", and when the sample did not have voids with a diameter of 1 mm or more, it was determined as "x". SAT FS200 II manufactured by Hitachi, Ltd. was used as the SAT. The results are shown in Table 1.

[0074]

(Evaluation of embedding property)

Each sample was polished by using an automatic polishing apparatus (AutoMet 250 and EcoMet 250 manufactured by BUEHLER), and the cross section of each sample was observed. Fig. 7 is a schematic front view for explaining a method of evaluating an embedding property in examples. The evaluation was performed from the cross-section observation by marking the case as "○" when a gap distance Z from the edge of the chip (refer to Fig. 7) is less than 200 μm, and the case as "△" when the distance Z is 200 μm or more and less than 500 μm, and the case as "×" when the distance Z is 500 μm or more. The results are shown in Table 1.

[0075]

[Table 1]

			Example 1	Example 2	Comparative Example 1
Compounding Ratio of Kneaded Product (% by weight)	Epoxy Resin	a	4.00%	3.00%	4.00%
	Phenol Resin	a	4.00%	3.00%	4.00%
	Inorganic Filler	a	88.0%	88.0%	88.0%
	Curing Accelerator	a	0.10%	0.10%	0.10%
	Thermoplastic Resin	a	3.90%	5.90%	3.90%
Film Formation			Application of Kneaded Product		
Thickness (μm)			600	600	600
Arrangement of Sealing Sheet			Bottom	Bottom	Top
Minimum Melt Viscosity [Pa•s]			20,000	110,000	20,000
Pressing Pressure			0.6 MPa	11 MPa	0.6 MPa
Pressing Time			60 Seconds	60 Seconds	60 Seconds
Pressing Temperature			90°C	90°C	90°C
Pressure at Reducing			10 Pa	10 Pa	10 Pa
Reduced Pressure Maintaining Time			30 Seconds	30 Seconds	30 Seconds
Evaluation	Evaluation of voids		○	○	×
	Evaluation of Embedding Property		○	△	○

DESCRIPTION OF REFERENCE SIGNS

[0076]

10 Sealing Sheet

20 Laminate

22 Semiconductor Wafer (Body to be Mounted)

23 Semiconductor Chip (Electronic Component)

28 Electronic Component Device

32 Lower Heating Plate

CLAIMS

1. A method of manufacturing an electronic component device, comprising:

a step A of preparing a laminate with an electronic component mounted on a body to be mounted;

a step B of preparing a sealing sheet;

a step C of arranging the sealing sheet on a heating plate and arranging the laminate on the sealing sheet with a surface on which the electronic component is mounted facing downward; and

a step D of performing hot press to embed the electronic component into the sealing sheet after the step C.

2. The method of manufacturing an electronic component device according to claim 1, wherein the sealing sheet has a minimum melt viscosity at 0 to 200°C of 100,000 Pa·s or less.

3. The method of manufacturing an electronic component device according to claim 1 or 2, wherein the sealing sheet has an outer circumferential length of 500 mm or more.