

DESCRIPTION

TITLE OF THE INVENTION: METHOD FOR MANUFACTURING ELECTRONIC COMPONENT DEVICE, LAMINATED SHEET, AND ELECTRONIC COMPONENT DEVICE

TECHNICAL FIELD

[0001]

The present invention relates to a method for manufacturing an electronic component device, a laminated sheet used in the method for manufacturing an electronic component device, and an electronic component device.

BACKGROUND ART

[0002]

Conventionally, a sealing sheet that is used to seal a semiconductor element has been known.

[0003]

Patent Document 1 discloses a sealing sheet for a semiconductor element in which a resin composition layer made of an epoxy resin composition containing specified components is formed on a surface of a base made of a metal foil. In Patent Document 1, it is described that a sealing sheet for a semiconductor element that is mounted on a suction head is press-bonded to a semiconductor element that is arranged in a mold, the sealing sheet for a semiconductor element is heated

by using a heater that is built in the suction head to heat and melt the resin composition layer, subsequently, the resin composition layer is thermally cured and released from the mold to resin-seal one lateral surface of the semiconductor element with a sealing resin layer, and a semiconductor device including a metal foil on the surface of the sealing resin layer can be obtained.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0004]

Patent Document 1: JP-A-2000-174045

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

In an electronic component device such as a semiconductor device, it is desired that there is no cracking or chipping of the resin that seals a semiconductor element.

[0006]

The present invention has been made in consideration of the above-described problems, and an object thereof is to provide a method for manufacturing an electronic component device that is capable of suppressing the generation of cracking and chipping of the resin that seals an electronic component,

and a laminated sheet. Another object thereof is to provide an electronic component device that is capable of suppressing the generation of cracking and chipping of the resin that seals electronic components.

MEANS FOR SOLVING THE PROBLEMS

[0007]

The present inventors found that the above-described problems can be solved by adopting the following configuration, and completed the present invention.

[0008]

That is, the present invention provides a method for manufacturing an electronic component device, including: a step A of providing a laminate in which an electronic component is mounted onto a body to be Mounted, a step B of providing a laminated sheet having a sealing sheet for sealing an electronic component and a functional layer made of a different material from that of the sealing sheet, a step C of arranging the laminate on a heating plate with a surface on which the electronic component is mounted facing up and arranging the laminated sheet on the surface of the laminate on which the electronic component is mounted with a sealing sheet surface facing down, and a step D of heat-pressing the laminated sheet to embed the electronic component into the sealing sheet and seal the electronic component after the step C; wherein at least a part of the lateral

surface of the functional layer is covered with a resin constituting the sealing sheet after the step D.

[0009]

The method for manufacturing an electronic component device according to the present invention includes the step D of heat-pressing the laminated sheet to embed the electronic component into the sealing sheet and seal the electronic component, and at least a part of the lateral surface of the functional layer is covered with a resin constituting the sealing sheet after the step D. In the resin that seals electronic components, cracking and chipping are easily generated in the corner portions of the sealing sheet. However, cracking and chipping in the corner portions of the sealing sheet can be suppressed in the method for manufacturing an electronic component device according to the present invention since at least a part of the lateral surface of the functional layer is covered with a resin constituting the sealing sheet.

[0010]

In the above-described configuration, when the thickness of the functional layer is defined as "h" and the thickness of the portion of the functional layer that is covered with the resin is defined as "d," the thickness d after the step D is preferably $[0.01 \times h]$ or more and $[0.99 \times h]$ or less. If the thickness d after the step D is $[0.01 \times h]$ or more, cracking and chipping in the corner portions of the sealing sheet can

be more suitably suppressed. If the thickness d after the step D is $[0.99 \times h]$ or less, contamination of the manufacturing devices (for example, the upper heating plate) caused by the resin can be prevented.

[0011]

In the above-described configuration, the minimum melt viscosity of the sealing sheet at 0°C to 200°C is preferably $100,000 \text{ Pa}\cdot\text{s}$ or less. If the minimum melt viscosity of the sealing sheet at 0°C to 200°C is $100,000 \text{ Pa}\cdot\text{s}$ or less, the melt viscosity at heat-pressing is $100,000 \text{ Pa}\cdot\text{s}$ or less. As a result, a structure can be easily formed in which at least a part of the lateral surface of the functional layer is covered with the resin constituting the sealing sheet.

[0012]

In the above-described configuration, the sealing sheet and the functional layer preferably have the same shape in planar view, and the length of the outer periphery of the laminated sheet is preferably 500 mm or more. When a plurality of electronic components are sealed with a sealing sheet having a large area, that is, a sealing sheet whose length of outer periphery is 500 mm or more, higher followability of the sealing sheet to the electronic components is desired.

In the present invention, because the laminate exists between the heating plate and the sealing sheet, sufficient followability of the sealing sheet to the electronic components

can be secured even when a plurality of electronic components are sealed with a sealing sheet having a large area, that is, a sealing sheet whose length of outer periphery is 500 mm or more.

The length of the outer periphery of the sealing sheet means the entire length of the outer circumference of the sealing sheet; for example, it means $[(\text{length}) \times 2 + (\text{width}) \times 2]$ when the sealing sheet has a rectangular shape, and it means the length of the entire circumference $[2 \times \pi \times (\text{radius})]$ when the sealing sheet has a circular shape.

[0013]

In the above-described configuration, the sealing sheet preferably contains an epoxy resin, a curing agent, and an inorganic filler. This configuration improves the long-term reliability of the electronic component.

[0014]

The present invention also provides a laminated sheet used in the method for manufacturing an electronic component device.

[0015]

If the laminated sheet is used in the method for manufacturing an electronic component device, at least a part of the lateral surface of the functional layer can be covered with the resin constituting the sealing sheet by the step D. As a result, an electronic component device that is manufactured

by using the laminated sheet is suppressed in cracking and chipping in the corner portions of the sealing sheet.

[0016]

In the above-described configuration, the minimum melt viscosity of the sealing sheet at 0°C to 200°C is preferably 100,000 Pa·s or less. If the minimum melt viscosity of the sealing sheet at 0°C to 200°C is 100,000 Pa·s or less, the melt viscosity at heat-pressing is 100,000 Pa·s or less. As a result, a structure can be easily formed in which at least a part of the lateral surface of the functional layer is covered with the resin constituting the sealing sheet.

[0017]

In the above-described configuration, the sealing sheet and the functional layer preferably have the same shape in planar view, and the length of the outer periphery of the laminated sheet is preferably 500 mm or more. When a plurality of electronic components are sealed with a sealing sheet having a large area, that is, a sealing sheet whose length of outer periphery is 500 mm or more, higher followability of the sealing sheet to the electronic components is desired.

In the present invention, because the laminate exists between the heating plate and the sealing sheet, sufficient followability of the sealing sheet to the electronic components can be secured even when a plurality of electronic components are sealed with a sealing sheet having a large area, that is,

a sealing sheet whose length of outer periphery is 500 mm or more.

[0018]

In the above-described configuration, the sealing sheet preferably contains an epoxy resin, a curing agent, and an inorganic filler. This configuration improves the long-term reliability of the electronic component.

[0019]

The present invention also provides an electronic component device including: a laminate in which an electronic component is mounted onto a body to be Mounted, a sealing sheet in which the electronic component is sealed, and a functional layer that is laminated on a side of the sealing sheet opposite to the electronic component; wherein at least a part of the lateral surface of the functional layer is covered with a resin constituting the sealing sheet.

[0020]

According to the above-described configuration, at least a part of the lateral surface of the functional layer is covered with a resin constituting the sealing sheet. Cracking and chipping are easily generated particularly in the corner portions of the resin for sealing an electronic component. However, the cracking and the chipping of the corner portions of the sealing sheet can be suppressed because at least a part of the lateral surface of the functional layer is covered with

a resin constituting the sealing sheet in the electronic component device according to the present invention.

EFFECT OF THE INVENTION

[0021]

The present invention can provide a method for manufacturing an electronic component device that is capable of suppressing the generation of cracking and chipping of the resin that seals electronic components, and a laminated sheet. The present invention can also provide an electronic component device that is capable of suppressing the generation of cracking and chipping of the resin that seals electronic components.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

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

Figs. 4(a) and 4(b) are schematic cross-sectional views

for explaining the method for 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 for 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 for manufacturing an electronic component device according to one embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0023]

In the following, a embodiment of the present invention will be explained by referring to the drawings; however, the present invention is not limited to the embodiment.

[0024]

The method for manufacturing an electronic component device according to the present embodiment includes: a step A of providing a laminate in which an electronic component is mounted onto a body to be Mounted, a step B of providing a laminated sheet having a sealing sheet for sealing an electronic component and a functional layer made of a different material from that of the sealing sheet, a step C of arranging the laminate on a heating plate with a surface on which the electronic component is mounted facing up and arranging the laminated sheet

on the surface of the laminate on which the electronic component is mounted with a sealing sheet surface facing down, and a step D of heat-pressing the laminated sheet to embed the electronic component into the sealing sheet and seal the electronic component after the step C; and at least a part of the lateral surface of the functional layer is covered with a resin constituting the sealing sheet after the step D.

[0025]

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.

[0026]

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

[0027]

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.

[0028]

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.

[0029]

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. Fig. 4(b) is a partial enlarged view of Fig. 4(a).

[0030]

[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 plurality of semiconductor chips 23 mounted on a semiconductor wafer 22 is prepared (step A). In Fig. 1, a plurality of semiconductor chips 23 are mounted onto a semiconductor wafer 22; however, the number of the electronic components that are mounted onto the body to be Mounted may be one 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 bump 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).

[0031]

[Step of providing laminated sheet]

In the method for manufacturing an electronic component device according to the present embodiment, as shown in Fig. 2, a laminated sheet 8 having a sealing sheet 10 for sealing an electronic component and a functional layer 12 made of a different material from that of the sealing sheet 10 is provided (step B). The laminated sheet 8 may be provided in a form in which it is laminated on a support such as a polyethylene terephthalate (PET) film with the sealing sheet 10 side as a pasting surface. In this case, the support may be subjected to a release treatment in order to easily peel the sealing sheet 10.

[0032]

The case is explained in the present embodiment in which the laminated sheet has a two-layer structure in which the sealing sheet 10 and the functional layer 12 are laminated. However, the laminated sheet in the present invention is not

limited to this example as long as it has a sealing sheet and a functional layer, and other layers may be further laminated.

[0033]

(Sealing sheet)

The sealing sheet 10 preferably contains an epoxy resin and a phenol resin as a curing agent. This provides a good thermal curing property.

[0034]

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.

[0035]

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.

[0036]

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.

[0037]

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.

[0038]

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.

[0039]

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.

[0040]

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.

[0041]

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.

[0042]

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.

[0043]

The sealing sheet 10 preferably contains an inorganic filler.

[0044]

The inorganic filler is not especially limited, and various kinds of conventionally known fillers can be used. Examples thereof include powders 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.

[0045]

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.

[0046]

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 with respect to the entire sealing sheet 10, 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.

[0047]

The sealing sheet 10 preferably contains a curing accelerator.

[0048]

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.

[0049]

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.

[0050]

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.

[0051]

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.

[0052]

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.

[0053]

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.

[0054]

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.

[0055]

The sealing sheet 10 preferably contains a pigment. The pigment is not especially limited, and an example thereof includes carbon black.

[0056]

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.

[0057]

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

[0058]

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. When the minimum melt viscosity of the sealing sheet at 0°C to 200°C is 100,000 Pa·s or less, the melt viscosity at heat-pressing is 100,000 Pa·s or less. As a result,

a structure can be easily formed in which at least a part of the lateral surface of the functional layer is covered with the resin constituting the sealing sheet. The minimum melt viscosity of the sealing sheet 10 at 0°C to 200°C can be controlled by the amount of the thermoplastic resin added. The minimum melt viscosity of the sealing sheet 10 at 0 to 200°C is preferably 1,000 Pa·s or more, more preferably 10,000 Pa·s or more. If the minimum melt viscosity of the sealing sheet 10 at 0 to 200°C is 1,000 Pa·s or more, the outer circumferential part (part where no electronic component is located directly underneath) of the sealing sheet 10 is suppressed from hanging down when the sealing sheet 10 is arranged on the laminate 20, and the sealing sheet 10 can be suppressed from being pressed in the state in which air is trapped between the sealing sheet and the mounted substrate. As a result, voids are not easily generated in the electronic component device that is obtained after pressing. 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.

[0059]

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.

[0060]

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.

[0061]

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.

[0062]

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.

[0063]

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/cm² or less, and more preferably 0.05 kg/cm² or less. The lower limit of the pressure under reduced pressure is not especially limited; however, it is 1×10^{-4} kg/cm² or more.

[0064]

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.

[0065]

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.

[0066]

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.

[0067]

(Functional layer)

The functional layer 8 has a function of suppressing the cracking and chipping of the corner portions of the sealing sheet 10 when the semiconductor chip 23 is sealed with the sealing sheet 10, and a function of preventing warpage after sealing.

[0068]

A metal foil and a plastic plate can be suitably used as the material constituting the functional layer 8. Examples of the metal include a 42 nickel-iron alloy (42 alloy), stainless steel such as SUS304, copper, aluminum, and nickel. Among these, copper is preferable from a viewpoint of improving heat dissipation.

[0069]

Examples of the material of the plastic plate include olefin resins such as polyethylene (PE), polypropylene (PP) and an ethylene-propylene copolymer; copolymers having ethylene as a monomer component such as an ethylene-vinyl acetate copolymer (EVA), an ionomer resin, an ethylene-(meth)acrylic acid copolymer and an ethylene-(meth)acrylic acid ester (random or alternate) copolymer; polyesters such as polyethylene terephthalate (PET), polyethylene naphthalate (PEN) and polybutylene terephthalate (PBT); an acrylic resin; polyvinylchloride (PVC); polyurethane; polycarbonate; polyphenylene sulfide (PPS); amide resins such as polyamide (nylon) and fully aromatic polyamide (aramid); polyether ether ketone (PEEK); polyimide; polyether imide; polyvinylidene chloride; an acrylonitrile-butadiene-styrene copolymer (ABS); a cellulose resin; a silicone resin; and a fluoro resin.

[0070]

The thickness of the functional layer 8 is preferably 50 μm to 5,000 μm , and more preferably 100 μm to 1,000 μm . When

the thickness of the functional layer 8 is 50 μm or more, the warpage after sealing can be relaxed, and when the thickness is 5,000 μm or less, the heat can be easily transferred to the sealing sheet at pressing, and the embedding property of electronic components can be improved.

[0071]

In the laminated sheet 8, the sealing sheet 10 and the functional layer 7 preferably have the same shape in planar view, and the length of the outer periphery of the laminated sheet 8 is preferably 500 mm or more, and more preferably 800 mm or more. The upper limit of the length of the outer periphery of the laminated sheet 8 is not especially limited, and for example, it can be set at 300 mm or less as a practical range. When a plurality of semiconductor chips 23 are sealed with a sealing sheet 10 having a large area, that is, a sealing sheet whose length of outer periphery is 500 mm or more, higher followability of the sealing sheet 10 to the semiconductor chips 23 is desired. In the present embodiment, as will be described later, because a laminate 20 exists between a lower heating plate 32 and the sealing sheet 10, sufficient followability of the sealing sheet 10 to the semiconductor chips 23 can be secured even when a plurality of semiconductor chips 23 are sealed with a sealing sheet 10 having a large area, that is, a sealing sheet whose length of outer periphery is 500 mm or more.

[0072]

The laminated sheet 8 can be obtained by laminating the sealing sheet 10 and the functional layer 8. The lamination method is not especially limited, and examples thereof include a method of separately making the sealing sheet 10 and the functional layer 8 and pasting these together by press-bonding or the like, and a method of applying a kneaded product or the like to form the sealing sheet onto the functional layer 8.

[0073]

[Step of arranging laminated sheet and laminate]

After the step of providing the laminate (step A) and the step of providing the laminated sheet (step B), the laminate 20 is arranged on the lower heating plate 32 with a surface on which the semiconductor chips 23 are mounted facing up and the laminated sheet 8 is arranged on the surface of the laminate 20 on which the semiconductor chips 23 are mounted with the sealing sheet 10 surface facing down (step C) as shown in Fig. 3. In the step C, it is possible to arrange the laminate 20 on the lower heating plate 32 first, and then arrange the laminated sheet 8 on the laminate 20, or arrange the laminated sheet 8 on the laminate 20 first, and then arrange a laminated article of the laminate 20 and the laminated sheet 8 on the lower heating plate 32.

[0074]

[Step of embedding electronic component into sealing sheet]

After the step C, as shown in Fig. 4(a), 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.

[0075]

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.

[0076]

After the step D, that is, after the semiconductor chips 23 (electronic components) are embedded into the sealing sheet 10, at least a part of the lateral surface of the functional layer 8 is covered with a resin constituting the sealing sheet 10 (refer to Fig. 4(b)). Due to the pressure exerted at the time of embedding the semiconductor chips 23 (electronic components) into the sealing sheet 10, a portion of the resin constituting the sealing sheet 10 is pushed out in the direction of the lateral surface, and a portion of the functional layer 8 is embedded into the sealing sheet 10. As a result, the above-described configuration can be obtained.

[0077]

When the thickness of the functional layer 8 after the step D is defined as "h" and the thickness of the portion of the functional layer 8 that is covered with the resin is defined as "d," the thickness d after the step D is preferably $[0.01 \times h]$ or more, more preferably $[0.05 \times h]$ or more. The thickness d after the step D is preferably $[0.99 \times h]$ or less, and more preferably $[0.50 \times h]$ or less. If the thickness d after the step D is $[0.01 \times h]$ or more, cracking and chipping in the corner portions of the sealing sheet can be more suitably suppressed. If the thickness d after the step D is $[0.99 \times h]$ or less, contamination of the manufacturing devices (for example, the

upper heating plate 34) caused by the resin can be prevented. The value of the thickness d after the step D can be controlled by the conditions when the step D is performed (for example, the pressure and the pressurizing time) or the selection of the resin constituting the sealing sheet 10.

[0078]

[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.

[0079]

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.

[0080]

[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.

[0081]

[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).

[0082]

As described above, the method for manufacturing an electronic component device according to the present embodiment includes the step D of heat-pressing the laminated sheet to embed the semiconductor chips 23 into the sealing sheet 10 and seal the semiconductor chips 23, and at least a part of the lateral surface of the functional layer 8 is covered with a resin

constituting the sealing sheet 10 after the step D. In the resin that seals the semiconductor chips 23, cracking and chipping are easily generated particularly in the corner portions of the sealing sheet. However, cracking and chipping in the corner portions of the sealing sheet 10 can be suppressed in the method for manufacturing an electronic component device according to the present embodiment because at least a part of the lateral surface of the functional layer 8 is covered with a resin constituting the sealing sheet 10.

[0083]

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

[0084]

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.

[0085]

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)

[0086]

(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. Each of the sealing sheets of the examples and comparative example has a circular shape, and the diameter and the length of the outer periphery thereof are as shown in Table 1.

[0087]

(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.

[0088]

(Production of laminated sheet)

The functional layer was pasted to each of the sealing sheets of the examples and comparative example to obtain a laminated sheet. The same functional layer was used in each of the examples and comparative example. Specifically, a copper foil having a circular shape and having a thickness of $50 \text{ }\mu\text{m}$ was used. The diameter and the length of the outer

periphery of the functional layer are as shown in Table 1. The sealing sheet and the functional layer were pasted to each other so that the centers thereof matched with each other in planar view.

[0089]

(Provision of substrate on which electronic components are mounted)

A substrate on which electronic components were mounted was provided. A semiconductor wafer having a diameter of 300 mm and a thickness of 700 μm was used as a substrate. A semiconductor chip of a length of 10 mm, a width of 10 mm, and a thickness of 500 μm was used for the electronic component, and 14 semiconductor chips were mounted vertically and horizontally on the substrate with an interval (distance between the end of one electronic component and the end of the adjacent electronic component) of 10 mm. The height of the bump was 50 μm .

[0090]

(Production of sample for evaluation)

The substrate was arranged on the lower heating plate of an instant vacuum laminating apparatus VS008-1515 (manufactured by Mikado Trading Co., Ltd.) with the surface on which the electronic components were mounted facing up, and the laminated sheet was arranged on the substrate with the sealing sheet surface facing down. Then, heat-pressing was performed

under a reduced pressure. The conditions of heat-pressing are shown in Table 1.

After heat-pressing, the laminate was heated in an oven at 150°C for 1 hour, and then, naturally cooled to room temperature (23°C) to make a sample for evaluation.

[0091]

(Measurement of coverage)

The thickness d of the portion of the functional layer that was covered with the resin was measured for each sample by using a measurement microscope system ("CCS-CORE PLUS" manufactured by Innotech Corporation). Then, the coverage was calculated by the following (Formula 1). The [Initial thickness of functional layer] of the examples and comparative example was 50 μm . The results are shown in Table 1.

(Formula 1) [Coverage] = d /[Initial thickness of functional layer]

[0092]

(Peelability)

Whether or not the sealing sheet was peeled from the functional layer was observed by using the measurement microscope system ("CCS-CORE PLUS" manufactured by Innotech Corporation). The case in which the sealing sheet was not peeled was evaluated as "O," and the case in which the sealing sheet was peeled was evaluated as "x." When the sealing sheet was not peeled, cracking and chipping in the corner portions

of the sealing sheet can be suppressed by the functional layer.
When the sealing sheet was peeled, it is difficult to suppress the cracking and chipping in the corner portions of the sealing sheet.

[0093]

[Table 1]

			Example 1	Example 2	Comparative Example 1
Formulation 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 Forming Method			Application of Kneaded Product		
Thickness (μm) of Sealing Sheet			600	600	600
Shape of Sealing Sheet			Circular	Circular	Circular
Diameter (mm) of Sealing Sheet			320	320	300
Length (mm) of Outer Periphery of Sealing Sheet			1000	1000	940
Thickness (μm) of Functional Layer			50	50	50
Shape of Functional Layer			Circular	Circular	Circular
Diameter (mm) of Functional Layer			320	320	320
Length (mm) of Outer Periphery of Functional Layer			1000	1000	1000
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 in Decompression			10 Pa	10 Pa	10 Pa
Retention Time of Reduced Pressure			180 seconds	180 seconds	180 seconds
Evaluation	Coverage		10%	0.5%	0%
	Peelability		○	○	×

DESCRIPTION OF REFERENCE SIGNS

[0094]

- 8 Laminated Sheet
- 10 Sealing sheet
- 12 Functional Layer
- 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 for manufacturing a semiconductor device, comprising:

a step A of providing a laminate in which an electronic component is mounted onto a body to be Mounted,

a step B of providing a laminated sheet having a sealing sheet for sealing an electronic component and a functional layer made of a different material from that of the sealing sheet,

a step C of arranging the laminate on a heating plate with a surface on which the electronic component is mounted facing up and arranging the laminated sheet on the surface of the laminate on which the electronic component is mounted with a sealing sheet surface facing down, and

a step D of heat-pressing the laminated sheet to embed the electronic component into the sealing sheet and seal the electronic component after the step C; wherein

at least a part of the lateral surface of the functional layer is covered with a resin constituting the sealing sheet after the step D.

2. The method for manufacturing a semiconductor device according to claim 1, wherein

when the thickness of the functional layer is defined as "h" and the thickness of the portion of the functional layer

that is covered with the resin is defined as "d," the thickness d after the step D is $[0.01 \times h]$ or more and $[0.99 \times h]$ or less.

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

4. The method for manufacturing an electronic component device according to any one of claims 1 to 3, wherein the sealing sheet and the functional layer have the same shape in planar view, and the length of an outer periphery of the laminated sheet is 500 mm or more.

5. The method for manufacturing an electronic component device according to any one of claims 1 to 4, wherein the sealing sheet contains an epoxy resin, a curing agent, and an inorganic filler.

6. A laminated sheet used in the method for manufacturing an electronic component device according to any one of claims 1 to 5.

7. The laminated sheet according to claim 6, wherein the minimum melt viscosity of the sealing sheet at 0°C to 200°C is

100,000 Pa·s or less.

8. The laminated sheet according to claim 6 or 7, wherein the sealing sheet and the functional layer have the same shape in planar view, and the length of an outer periphery of the laminated sheet is 500 mm or more.

9. The laminated sheet according to any one of claims 6 to 8, wherein the sealing sheet contains an epoxy resin, a curing agent, and an inorganic filler.

10. An electronic component device comprising:

a laminate in which an electronic component is mounted onto a body to be Mounted,

a sealing sheet in which the electronic component is sealed, and

a functional layer that is laminated on a side of the sealing sheet opposite to the electronic component; wherein

at least a part of a lateral surface of the functional layer is covered with a resin constituting the sealing sheet.

11. The electronic component device according to claim 10, wherein

when the thickness of the functional layer is defined as "h" and the thickness of the portion of the functional layer

that is covered with the resin is defined as "d," the thickness
d is $[0.01 \times h]$ or more and $[0.99 \times h]$ or less.