

DESCRIPTION

TITLE OF THE INVENTION: SEALING RESIN SHEET

TECHNICAL FIELD

[0001]

The present invention relates to a sealing resin sheet.

BACKGROUND ART

[0002]

Today, along with the spread of mobile devices such as cellular phones, the degree of demands for miniaturization and high performance of circuit boards used for electronic devices is increasing. In order to cope with such demands, an improvement in packaging density of an electronic component in a multilayer printed wiring board or the like has been attempted. The miniaturization of an electronic component itself and the microfabrication of a wiring or the like have been promoted.

[0003]

An insulating layer or the like of a multilayer printed wiring board is required to have a laminating property capable of filling a fine electronic component and wiring. As a resin composition when such performance is considered, a resin composition for a printed wiring board containing a cyanate ester resin, an epoxy resin, a thermoplastic resin, talc, and silica has been proposed (see Patent Document 1).

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0004]

Patent Document 1: JP-A-2010-202865

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

As measures for improving packaging density of an electronic component, the miniaturization of an electronic component itself, the microfabrication of a wiring or the like, as well as the arrangement of an electronic component have been devised. For example, a technique for a substrate having an electronic component built therein has been developed. The technique embeds an electronic component which has been heretofore mounted on a surface of a substrate to be built in a substrate (within a range in a thickness direction).

[0006]

As a procedure for manufacturing a substrate having an electronic component built therein, the following procedure has been studied: at least one electronic component is disposed in an opening portion formed in a substrate; a sealing resin sheet for sealing is disposed on the substrate so as to cover the opening portion; the sealing resin sheet for sealing is heated

and pressed from an upper surface side of the sealing resin sheet to cause the sealing resin sheet to flow, thereby filling the opening portion of the substrate with the sealing resin sheet; and the sealing resin sheet is finally thermally cured.

According to this procedure, a plurality of opening portions are formed in one substrate, a predetermined number of electronic components are disposed in the opening portions, and the opening portions and the electronic components are embedded with one sealing resin sheet for sealing capable of covering the whole of the substrate, so that a substrate having a plurality of electronic components built in one substrate can be collectively produced.

[0007]

When the manufacturing procedure as described above is considered, the filling property of the opening portion of the substrate, as well as the removability of the sealing resin sheet which can be peeled off and repasted to a correct position when positional displacement occurs in the sealing resin sheet disposed on the substrate are required as required characteristics of the sealing resin sheet for a substrate having an electronic component built therein.

[0008]

In order to improve the filling property (fluidity), it is effective to lower the viscosity of the sealing resin sheet. Examples of a measure for lowering the viscosity include

lowering a content of a filler. When the content of the filler is lowered, the property of an organic component tends to strongly appear. In this case, tackiness (stickiness) due to the organic component appears, which causes deterioration in removability. On the other hand, when the content of the filler is increased, an elastic modulus is increased, which provides an improvement in removability; however, the viscosity of the sealing resin sheet is increased, which causes deterioration in a filling property. As described above, there is a trade-off relationship between the filling property and the removability, and a sealing resin sheet achieving both the filling property and the removability is strongly required.

[0009]

It is an object of the present invention to provide a sealing resin sheet which achieves both filling property and removability.

MEANS FOR SOLVING THE PROBLEMS

[0010]

The present inventors have extensively conducted studies, and resultantly found that the above-mentioned object can be achieved by employing the configuration described below. This finding has led to the completion of the present invention.

[0011]

That is, the present invention relates to a sealing resin

sheet having

a tack force at 25°C of 150 g or less, and

a minimum melt viscosity in a temperature range of 50°C to 150°C of 50 Pa·s or less.

[0012]

In the sealing resin sheet, the tack force at 25°C (hereinafter also simply referred to as a "tack force") is set to 150 g or less, so that good removability can be exhibited. At the same time, the minimum melt viscosity in a temperature range of 50°C to 150°C (hereinafter also simply referred to as a "minimum melt viscosity") is set to 50 Pa·s or less, so that the viscosity of the sealing resin sheet is decreased, which can exhibit an excellent filling property. When the tack force is too large, the sealing resin sheet is less likely to be peeled off from the substrate even if the sealing resin sheet is to be peeled off after the sealing resin sheet is disposed on the substrate. The sealing resin sheet may be damaged. With respect to the minimum melt viscosity, an electronic component is disposed in an opening portion, so that not only the surface structure of the electronic component but also a gap between the inner wall of the opening portion and the electronic component need to be densely filled. When the minimum melt viscosity is too high, the opening portion is insufficiently filled with the sealing resin sheet, so that voids occur in the opening portion, which may cause deterioration in reflow

resistance or the like, to cause deterioration in reliability of a substrate having an electronic component built therein.

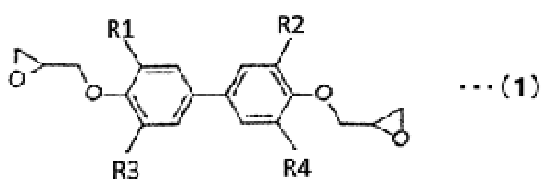
[0013]

The sealing resin sheet preferably includes an inorganic filler having an average particle diameter of 0.1 to 10 μm . The sealing resin sheet preferably includes 65 to 85% by weight of the inorganic filler based on a total solid content of the sealing resin sheet. These constitutions can easily achieve both removability provided by controlling the tack force and a filling property provided by controlling the minimum melt viscosity.

[0014]

The sealing resin sheet preferably includes an epoxy resin represented by chemical formula (1) below:

[Chemical Formula 1]



wherein R1 to R4 are each independently hydrogen or a methyl group; except a case where all of R1 to R4 are hydrogen.

[0015]

Among organic components, there are compounds which have low crystallinity, and do not return to a crystalline state before melting even if the compounds are once thermally melted

and then cooled, resulting in a lower crystalline state. An organic component having low crystallinity may lead to increase in tackiness to cause deterioration in removability. The epoxy resin represented by the chemical formula (1) above (hereinafter also referred to as a "crystalline epoxy resin") as the organic component maintains its crystallinity even after thermal melting, so that an increase in tackiness can be suppressed, which can provide an improvement in removability.

[0016]

The sealing resin sheet includes preferably 5 to 15% by weight of the epoxy resin represented by the chemical formula (1) based on the total solid content of the sealing resin sheet. By setting the content of the crystalline epoxy resin within the above range, removability and filling property can be exhibited at a higher level.

[0017]

In the sealing resin sheet, all of R1 to R4 in the chemical formula (1) are preferably methyl groups. This increases the rigidity of the skeleton of the crystalline epoxy resin and also increases the crystallinity, which can more effectively exhibit a good removability.

[0018]

The sealing resin sheet may be used for sealing an electronic component in a substrate having an electronic component built therein, or for interlayer insulation. The

sealing resin sheet can be suitably applied to a process requiring removability and filling property.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1A is a view schematically showing one step of a method for manufacturing a substrate having an electronic component built therein according to one embodiment of the present invention.

Fig. 1B is a view schematically showing one step of the method for manufacturing a substrate having an electronic component built therein according to one embodiment of the present invention.

Fig. 1C is a view schematically showing one step of the method for manufacturing a substrate having an electronic component built therein according to one embodiment of the present invention.

Fig. 1D is a view schematically showing one step of the method for manufacturing a substrate having an electronic component built therein according to one embodiment of the present invention.

Fig. 1E is a view schematically showing one step of the method for manufacturing a substrate having an electronic component built therein according to one embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0020]

Hereinafter, a polarizing plate according to one embodiment of the present invention will be described with reference to the drawings. However, in part or all of the drawings, parts unnecessary for explanation are omitted, and there are parts shown by magnification or reduction in order to facilitate explanation.

[0021]

<<Sealing Resin Sheet>>

A sealing resin sheet 3 for a substrate having an electronic component built therein (see Fig. 1D) according to one embodiment of the present invention is a sheet-shaped product having a certain thickness, and its planar view shape can be appropriately selected according to a substrate shape such as a circular shape, a rectangular shape, or a square shape. The sealing resin sheet 3 is typically provided in a state where it is laminated on a support (not shown) such as a polyethylene terephthalate (PET) film. The support may be subjected to a mold release treatment in order to easily peel off the sealing resin sheet 3.

[0022]

A tack force of the sealing resin sheet at 25°C is preferably 150 g or less, more preferably 140 g or less, and

still more preferably 130 g or less. By setting the tack force within the above range, good removability can be achieved. The tack force is preferably as small as possible. From the viewpoint of workability after the sealing resin sheet is disposed on the substrate, a filling property (fluidity) or the like, the tack force is preferably 0 g or more, and more preferably 5 g or more.

[0023]

A minimum melt viscosity of the sealing resin sheet 3 in a temperature range of 50°C to 150°C is preferably 50 Pa•s or less, more preferably 40 Pa•s or less, and still more preferably 30 Pa•s or less. By setting the minimum melt viscosity of the sealing resin sheet 3 within the above range, the filling property of the sealing resin sheet 3 to an opening portion of a substrate can be improved to suppress the occurrence of voids, so that a highly-reliable substrate having an electronic component built therein can be obtained. On the other hand, a too low minimum melt viscosity may make it difficult to maintain the shape of the sheet, or increase the tack force at room temperature. Therefore, the minimum melt viscosity is preferably 1 Pa•s or more, and more preferably 3 Pa•s or more.

[0024]

The sealing resin sheet 3 preferably includes an epoxy resin and a phenol resin. This provides a good thermal curing property.

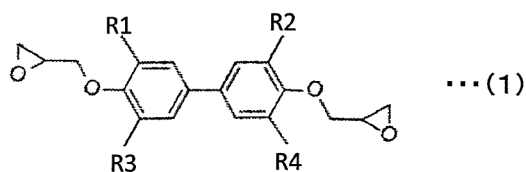
[0025]

The epoxy resin is not particularly limited. Examples of the epoxy resin capable of being used include various kinds of epoxy resins such as a triphenylmethane type epoxy resin, a cresol novolak 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 novolak type epoxy resin, and a phenoxy resin. These epoxy resins may be used alone or in combination of two or more thereof.

[0026]

From the viewpoint of ensuring the toughness of the epoxy resin after being cured and the reactivity of the epoxy resin, an epoxy resin is preferable, which has an epoxy equivalent of 150 to 250 and is solid, at room temperature, having a softening point or melting point of 50 to 130°C. From the viewpoint of reliability, a triphenylmethane type epoxy resin, a cresol novolak type epoxy resin, and a biphenyl type epoxy resin are more preferable. Among these, a biphenyl type epoxy resin is preferable, and a biphenyl type epoxy resin containing an epoxy resin represented by the following chemical formula (1) is particularly preferable:

[Chemical Formula 1]



wherein, R1 to R4 are each independently hydrogen or a methyl group; except the case where all of R1 to R4 are hydrogen.

[0027]

Among organic components, there are compounds which have low crystallinity, and do not return to a crystalline state before melting even if the compounds are once thermally melted and then cooled, resulting in a lower crystalline state. An organic component having low crystallinity may lead to increase in tackiness to cause deterioration in removability. The epoxy resin represented by the chemical formula (1) above as the organic component maintains its crystallinity even after thermal melting, so that an increase in tackiness can be suppressed, which can provide an improvement in removability.

[0028]

The sealing resin sheet includes preferably 5 to 15% by weight, more preferably 8 to 12% by weight of the epoxy resin represented by the chemical formula (1) based on the total solid content of the sealing resin sheet. By setting the content of the crystalline epoxy resin within the above range, removability and filling property can be exhibited at a higher level.

[0029]

In the sealing resin sheet, all of R1 to R4 in the chemical formula (1) are preferably methyl groups. This increases the rigidity of the skeleton of the crystalline epoxy resin and also increases the crystallinity, which can more effectively exhibit a good removability.

[0030]

The phenol resin is not particularly limited as long as it provides a curing reaction between the phenol resin and the epoxy resin. For example, a phenol novolak resin, a phenol aralkyl resin, a biphenyl aralkyl resin, a dicyclopentadiene type phenol resin, a cresol novolac resin, a resole resin and the like are used. These phenol resins may be used alone or in combination of two or more thereof.

[0031]

From the viewpoint of reactivity between the phenol resin and the epoxy resin, a phenol resin having a hydroxyl group equivalent of 70 to 250 and a softening point of 50 to 110°C is preferably used. Among these, from the viewpoint of high curing reactivity, a phenol novolac resin can be suitably used. From the viewpoint of reliability, low moisture-absorption materials such as a phenol aralkyl resin and a biphenyl aralkyl resin can also be suitably used.

[0032]

From the viewpoint of curing reactivity, a blending ratio

of the epoxy resin and the phenol resin is preferably such that the total of the hydroxy group in the phenol resin is 0.7 to 1.5 equivalents, and more preferably 0.9 to 1.2 equivalents, based on 1 equivalent of the epoxy group in the epoxy resin.

[0033]

A lower limit of the total content of the epoxy resin and phenol resin in the sealing resin sheet is preferably 10% by weight or more, and more preferably 12% by weight or more. When the total content is 10% by weight or more, a good adhering force to electronic devices, substrates or the like is obtained. On the other hand, an upper limit of the total content is preferably 30% by weight or less, and more preferably 28% by weight or less. When the total content is 30% by weight or less, the moisture absorbability of the sealing resin sheet can be reduced.

[0034]

The sealing resin sheet 3 may include a thermoplastic resin as long as the sealing resin sheet 3 satisfies solvent resistance.

[0035]

The sealing resin sheet preferably includes an inorganic filler. A shape of the inorganic filler is not particularly limited, and may be any shape such as a spherical shape (including an ellipsoid shape), a polyhedral shape, a polygonal column shape, or an irregular shape. From the viewpoint of achievement of a high filling state in the vicinity of a hollow

structure and moderate fluidity, a spherical shape is preferable.

[0036]

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

[0037]

As silica, a silica powder is preferable, and a molten silica powder is more preferable. Examples of the molten silica powder include a spherical molten silica powder and a crushed molten silica powder, but a spherical molten silica powder is preferable from the viewpoint of fluidity.

[0038]

An average particle diameter of the inorganic filler to be used is preferably in a range of 0.1 to 10 μm , and more preferably in a range of 0.5 to 5 μm . The average particle diameter can be derived by measuring a sample arbitrarily extracted from a population with a laser diffraction scattering type particle size distribution measuring device. When the

average particle diameter of the inorganic filler is too small, the viscosity of the sealing resin sheet tends to be increased to cause deterioration in filling property, or the tack force tends to be increased. When the average particle diameter is too large, filling of a gap in the opening portion of the substrate may be insufficient.

[0039]

The sealing resin sheet preferably includes 65 to 85% by weight, more preferably 70 to 83% by weight of the inorganic filler based on the total solid content of the sealing resin sheet. By setting the content of the inorganic filler within the above range, both removability provided by controlling the tack force and a filling property provided by controlling the minimum melt viscosity can be easily achieved.

[0040]

The sealing resin sheet 3 preferably includes a curing accelerator.

[0041]

The curing accelerator is not particularly limited as long as it promotes curing of the epoxy resin and the phenol resin. Examples of the curing accelerator include organophosphorus 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, because the curing reaction does not rapidly proceed even when the temperature increases during kneading and the sealing resin sheet 3 can be satisfactorily produced.

[0042]

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

[0043]

The sealing resin sheet 3 preferably includes a flame retardant component. This makes it possible to reduce expansion of combustion when the sealing resin sheet 3 catches fire due to short circuit or heat generation of the parts. As the flame retardant component, various metal hydroxides such as aluminum hydroxide, magnesium hydroxide, iron hydroxide, calcium hydroxide, tin hydroxide, and composite metal hydroxide; a phosphazene flame retardant or the like may be used.

[0044]

The sealing resin sheet 3 preferably includes a silane coupling agent. The silane coupling agent is not particularly limited, and examples thereof include 3-glycidoxypropyl trimethoxysilane.

[0045]

A content of the silane coupling agent in the sealing

resin sheet 3 is preferably 0.1 to 3% by weight. When the content is 0.1% by weight or more, the strength of the sealing resin sheet after being cured can be increased, and the water absorption rate of the sealing resin sheet can be reduced. On the other hand, when the content is 3% by weight or less, the occurrence of outgas can be suppressed.

[0046]

The sealing resin sheet 3 preferably includes a pigment. The pigment is not particularly limited, and examples thereof include carbon black.

[0047]

A content of the pigment in the sealing resin sheet 3 is preferably 0.1 to 2% by weight. When the content is 0.1% by weight or more, a good marking property is obtained. On the other hand, when the content is 2% by weight or less, the strength of the sealing resin sheet after being cured can be secured.

[0048]

Besides the above-mentioned respective components, other additives may be appropriately blended into the resin composition, if necessary.

[0049]

<<Method for Manufacturing Sealing Resin Sheet>>

A method for manufacturing the sealing resin sheet 3 is not particularly limited, but the method preferably includes preparing a kneaded product and processing the obtained kneaded

product into a sheet. Specifically, the above-mentioned respective components are melt-kneaded by 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 processed into a sheet. As kneading conditions, a temperature is preferably equal to or higher than the softening point of each of the above-mentioned components, 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. A time is, for example, 1 to 30 minutes, and preferably 5 to 15 minutes.

[0050]

The kneading is preferably performed under a reduced pressure condition (under reduced pressure atmosphere). An upper limit of the pressure under the reduced pressure condition is preferably 0.1 kg/cm² or less, and more preferably 0.05 kg/cm² or less. A lower limit of the pressure under the reduced pressure condition is preferably as low as possible, but it may be 1×10^{-4} kg/cm² or more from the viewpoint of productivity and physical limitation. This makes it possible to prevent mixing of gas into the kneaded product, and to suppress occurrence of pores in the obtained kneaded product.

[0051]

The kneaded product after melt-kneading is preferably processed while it is in a high temperature state without being

cooled. The processing method is not particularly limited, and examples thereof include a flat plate press method, a T die extrusion method, a roll rolling method, a roll kneading method, an inflation extrusion method, a coextrusion method, and a calender molding method. A processing temperature is preferably equal to or higher than the softening point of each of the above components, and is, for example, 40 to 150°C, preferably 50 to 140°C, and more preferably 70 to 120°C when the thermal curing property and moldability of the epoxy resin are considered.

[0052]

A thickness of the sealing resin sheet 3 is not particularly limited, but it is preferably 50 to 700 μm . The thickness within the above range makes it possible to satisfactorily fill the opening portion of the substrate with sealing resin sheet 3. The thinning of the sealing resin sheet makes it possible to reduce an amount of heat generation, so that cure shrinkage hardly occurs. As a result, an amount of package warpage can be reduced, so that a highly-reliable substrate having an electronic component built therein is obtained.

[0053]

The sealing resin sheet 3 may have a single layer structure or a multilayer structure in which two or more sealing resin sheets are laminated; however, a single layer structure

is preferable since it has no risk of interlayer peeling, has high sheet thickness uniformity, and is likely to have lower moisture absorption.

[0054]

As described above, the sealing resin sheet 3 may be used for sealing the electronic component in the substrate having an electronic component built therein, or for interlayer insulation in a multilayer circuit board. Furthermore, the sealing resin sheet 3 can also be used for sealing a surface acoustic wave (SAW) filter; Micro Electro Mechanical Systems (MEMS) such as a pressure sensor and a vibration sensor; IC such as LSI, a semiconductor such as a transistor; a capacitor; a resistor; and a surface mount electronic device such as a CMOS sensor.

[0055]

<<Method for Manufacturing Substrate Having Electronic Component Built Therein>>

Figs. 1A to 1E are views schematically showing one step of a method for manufacturing a substrate having an electronic component built therein according to one embodiment of the present invention. A procedure for manufacturing a substrate having an electronic component built therein is not particularly limited, and the following procedure can be suitably adopted: at least one electronic component 2 is disposed in an opening portion O formed in a substrate 1; a

sealing resin sheet 3 is disposed on the substrate 1 so as to cover the opening portion O; the sealing resin sheet 3 is heated and pressed from an upper surface side of the sealing resin sheet 3 to cause the sealing resin sheet 3 to flow, thereby filling the opening portion O of the substrate 1 with the sealing resin sheet 3; and the sealing resin sheet 3 is thermally cured.

[0056]

(Substrate Preparing Step)

The substrate 1 (see Fig. 1A) is not particularly limited, and examples thereof include a metal substrate such as a copper substrate, a (multilayer) printed wiring substrate, a ceramic substrate, and a silicon substrate.

[0057]

(Opening Portion Forming Step)

Next, the opening portion O is formed in the substrate 1 (see Fig. 1B). The method for forming the opening portion O is not particularly limited, and examples thereof include etching, laser processing, and punching processing. The number of the opening portions to be formed in one substrate is not also particularly limited, and may be appropriately changed according to the intended design of the substrate having an electronic component built therein.

[0058]

(Electronic Component Disposing Step)

As shown in Fig. 1C, at least one electronic component

2 is disposed in the opening portion O formed in the substrate 1. The electronic component is not limited at all. Any electronic component such as a semiconductor chip, a capacitor, a sensor device, a light emitting element, or a vibration element can be used. In Fig. 1C, one electronic component 2 is disposed in one opening portion O, but the number of the electronic components to be disposed in one opening portion is not limited to one, and may be appropriately changed according to the intended design of the substrate having an electronic component built therein.

[0059]

(Filling Step)

In the filling step, as shown in Figs. 1D and 1E, the sealing resin sheet 3 is laminated on the substrate 1 so as to cover the opening portion O, and the sealing resin sheet 3 is then heated and pressed from the upper surface side of the sealing resin sheet 3 to cause the sealing resin sheet 3 to flow, thereby filling the opening portion O of the substrate 1 with the sealing resin sheet 3, and the sealing resin sheet 3 is then thermally cured.

[0060]

As conditions for heating and pressing the sealing resin sheet 3 to fill the opening portion O, a temperature is, for example, 50 to 100°C, and preferably 60 to 90°C; a pressure is, for example, 0.1 to 3.0 MPa, and preferably 0.5 to 2.5 MPa; and

a time is, for example, 5 to 120 minutes, and preferably 10 to 60 minutes. When improvements in the tackiness and followability of the sealing resin sheet 3 to an inner wall of the opening portion 0 and the electronic component 2 are considered, the pressing is preferably performed under a reduced pressure condition (for example, -90 to -100 kPaG as a gauge pressure).

[0061]

After embedding of the opening portion is completed, the sealing resin sheet 3 is subjected to a thermal curing treatment. As conditions for the thermal curing treatment, a heating temperature is preferably 100°C or higher, and more preferably 120°C or higher. On the other hand, an upper limit of the heating temperature is preferably 200°C or less, and more preferably 190°C or less. A heating time is preferably 5 minutes or more, and more preferably 10 minutes or more. On the other hand, an upper limit of the heating time is preferably 120 minutes or less, and more preferably 60 minutes or less. A pressure may be applied if necessary; and the pressure is preferably 0.5 MPa or more, and more preferably 1.0 MPa or more. On the other hand, an upper limit of the pressure is preferably 5.0 MPa or less, and more preferably 3.0 MPa or less. This provides a substrate 10 having an electronic component built therein in which the electronic component 2 is embedded in the substrate 1.

EXAMPLES

[0062]

Hereinafter, preferred examples of the present invention will be demonstratively described in detail. However, regarding materials, blend amounts and the like described in examples are not intended to limit the scope of the present invention only to these unless there is a particularly limited description.

[0063]

Components used in examples will be described.

Epoxy resin 1: YX4000H (biphenyl type epoxy resin, epoxy equivalent: 190 g/eq.) manufactured by Mitsubishi Chemical Corporation

Epoxy resin 2: YSLV-80 XY (bisphenol F type epoxy resin, epoxy equivalent: 200 g/eq.) manufactured by Nippon Steel Chemical Co., Ltd.

Epoxy resin 3: Epikote 828 (epoxy equivalent: 190 g/eq.) manufactured by Mitsubishi Chemical Corporation

Phenol resin 1: MEH-7500-3S (hydroxyl group equivalent: 103 g/eq.) manufactured by Meiwa Plastic Industries, Ltd.

Phenol resin 2: MEH-7851-SS (phenol resin having a biphenyl aralkyl skeleton, hydroxyl group equivalent: 203 g/eq.) manufactured by Meiwa Plastic Industries, Ltd.

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

Kaneka Corporation

Inorganic filler 1: FB-5SDC (molten spherical silica, average particle diameter 5 μm) manufactured by Denka Company Limited

Inorganic filler 2: FB-9454FC (molten spherical silica, average particle diameter 17 μm) manufactured by Denka Company Limited

Inorganic filler 3: SO-25R (molten spherical silica, average particle diameter 0.5 μm) manufactured by Admatechs Company Limited

Carbon black: #20 manufactured by Mitsubishi Chemical Corporation

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

Silane coupling agent: KBM-403
(3-glycidoxypropyltrimethoxysilane) manufactured by Shin-Etsu Chemical Co., Ltd.

[0064]

[Examples 1 to 4 and Comparative Examples 1 to 3]

In accordance with blending ratios described in Table 1, respective components were blended to obtain a blended product, and the blended product was melted and kneaded through a roll kneader at 60 to 120°C under a reduced pressure (0.01 kg/cm²) for 10 minutes to prepare a kneaded product. Next, the obtained

kneaded product was formed into a sheet (100 mm × 100 mm) by a flat plate press method to produce a sealing resin sheet having a thickness of 200 μm.

[0065]

<Evaluation>

Regarding the produced sealing resin sheet, the following items were evaluated. The results are shown in Table 1.

[0066]

(Minimum Melt Viscosity)

Five circular shape sheets each having a diameter of 25 mm that were punched out from the sealing resin sheet were laminated to produce a cylindrical measurement sample having a diameter of 25 mm and a thickness of 1 mm. Regarding the minimum melt viscosity of the measurement sample, when a viscosity change was pursued with a viscoelasticity measuring apparatus "ARES" manufactured by Rheometric Scientific (measurement conditions: measuring temperature range of 50 to 150°C, temperature increase rate of 10°C/minute, frequency of 1 Hz, strain amount of 10%), the minimum value of the viscosity was measured.

[0067]

(Tack Force)

A circular shape sheet having a diameter of 25 mm obtained by punching out from each of uncured sealing resin sheets was used as a measuring sample (diameter: 25 mm, thickness: 200 μm).

RSA3 (manufactured by TA Instruments) was used as an evaluation apparatus, and a load was measured when an upper plate was apart from a sample sandwiched between the upper plate (diameter: 8 mm) and a lower plate (diameter: 25 mm) of a parallel plate compression geometry (manufactured by TA Instruments). The measured value was used as a tack force. Specifically, a double-sided tape was pasted on one surface of the measurement sample, and the tape surface was pasted on the lower plate of the jig. In this state, the sample was held for 5 minutes in order to stabilize the sample ambient temperature at 25°C, and the upper plate was brought close to the measurement sample so that the upper plate was in slightly contact with the sample. Thereafter, the upper plate was further pressed against the measurement sample. When a load of 100 N was applied to the upper plate, the movement of the upper plate was reversed so that the upper plate was apart from the measurement sample. The maximum load (adhesive force) when the upper plate was apart from the measurement sample was taken as the tack force.

[0068]

(Removability)

Under the condition of room temperature (25°C), each of the sealing resin sheets was disposed on an SUS plate having a size of 100 × 100 mm and a thickness of 0.5 mm in a state where the separator was peeled off, and was allowed to stand for 3 minutes. Then, the case where the sealing resin sheet could

be peeled off from the SUS plate again without causing the breaking, cracking, or residue of the sealing resin sheet was evaluated as "O", and the case where the breaking, cracking, or residue of the sealing resin sheet was caused was evaluated as "X".

[0069]

(Resin Filling Property)

A pattern (opening portion) of 10 mm × 8 mm was formed in a copper plate of 150 mm × 150 mm (thickness: 500 μm) by etching. A sealing resin sheet was placed on the patterned copper plate, and subjected to vacuum-pressing at 100 kN and 100°C for 30 seconds to fill the pattern (opening portion) with the resin. Thereafter, the front and back surfaces of the pattern (opening portion) were observed with an optical microscope (20 times). The case where no void occurred, or the maximum diameter of the void was 1 μm or less was evaluated as "O". The case where the maximum diameter of the void was more than 1 μm was evaluated as "X".

[0070]

[Table 1]

	Example 1	Example 2	Example 3	Example 4	Comparative Example 1	Comparative Example 2	Comparative Example 3
Epoxy resin 1	100	100	100	100	-	-	-
Epoxy resin 2	-	-	-	-	100	50	-
Epoxy resin 3	-	-	-	-	-	50	100
Phenol resin 1	70	70	-	-	-	45	46
Phenol resin 2	-	-	130	135	105	-	-
Thermoplastic resin	-	-	-	-	90	-	-
Inorganic filler 1	845	1070	1160	1460	-	574	870
Inorganic filler 2	-	-	-	-	2620	-	-
Inorganic filler 3	-	-	-	-	-	152	230
Carbon	2	1.7	2.8	3.5	9	2	1.5
Curing accelerator	1.7	2.5	2.3	2.5	3.5	1.5	3
Silane coupling agent	2.6	3.2	3.5	4.5	1	1	1
Minimum melt viscosity [Pa•s]	8	41	12	49	500	50	300
Tack force [g]	120	74	38	5	15	300	170
Removability	○	○	○	○	○	×	×
Resin filling property	○	○	○	○	×	○	×

[0071]

As can be seen from Table 1, in the sealing resin sheets of Examples 1 to 4, both removability and resin filling property were excellent. On the other hand, in Comparative Examples 1 to 3, one or both of removability and resin filling property was poor.

DESCRIPTION OF REFERENCE SIGNS

[0072]

1 Substrate

2 Electronic component

3 Sealing resin sheet

10 Substrate having an electronic component built therein

CLAIMS

1. A sealing resin sheet having a tack force at 25°C of 150 g or less, and

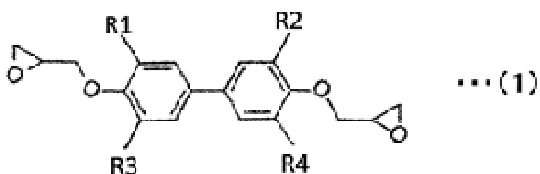
a minimum melt viscosity in a temperature range of 50°C to 150°C of 50 Pa·s or less.

2. The sealing resin sheet according to claim 1, wherein the sealing resin sheet comprises an inorganic filler having an average particle diameter of 0.1 to 10 μm .

3. The sealing resin sheet according to claim 2, wherein the sealing resin sheet comprises 65 to 85% by weight of the inorganic filler based on a total solid content of the sealing resin sheet.

4. The sealing resin sheet according to any one of claims 1 to 3, wherein the sealing resin sheet comprises an epoxy resin represented by chemical formula (1) below:

[Chemical Formula 1]



wherein R1 to R4 are each independently hydrogen or a methyl

group; except a case where all of R1 to R4 are hydrogen.

5. The sealing resin sheet according to claim 4, wherein the sealing resin sheet comprises 5 to 15% by weight of the epoxy resin represented by the chemical formula (1) based on the total solid content of the sealing resin sheet.

6. The sealing resin sheet according to claim 4 or 5, wherein all of R1 to R4 in the chemical formula (1) are methyl groups.

7. The sealing resin sheet according to any one of claims 1 to 6, wherein the sealing resin sheet is used for sealing an electronic component in a substrate having an electronic component built therein.

8. The sealing resin sheet according to any one of claims 1 to 6, wherein the sealing resin sheet is used for interlayer insulation.