

SHEET FOR SEALING ELECTRONIC DEVICE
AND
METHOD FOR MANUFACTURING ELECTRONIC DEVICE PACKAGE

BACKGROUND OF THE INVENTION

Field of the Invention

[0001]

The present invention relates to a sheet for sealing an electronic device and a method for manufacturing an electronic device package.

Description of the Related Art

[0002]

As a method for manufacturing an electronic device package, there has been known a method for sealing one or more electronic devices (for example, semiconductor chips) fixed to a substrate or the like with a sealing resin, and then dicing the resultant sealed body into a package for an electronic device unit. As such a sealing resin, for example, a thermosetting resin sheet is known (see, for example, Patent Document 1).

Prior Art Document

Patent Document

[0003]

SUMMARY OF THE INVENTION

[0004]

When electronic devices are manufactured by the electronic device package manufacturing method as described above, it is preferable to laser-mark a sealing resin to make it possible to distinguish the resultant sealed bodies or electronic device packages from each other. However, a laser-marked portion may have poor visibility since the sealing resin is a member for attaining sealing.

[0005]

In light of the problem described above, the present invention has been made. It is an object of the present invention to provide a sheet for sealing an electronic device having a laser-marked portion having excellent visibility, and a method for manufacturing an electronic device package using the sheet for sealing.

[0006]

The inventors have found out that the problem can be solved by adopting a structure described below. Thus, the present invention has been achieved.

[0007]

That is, a sheet for sealing an electronic device according to the present invention includes:

a first surface having a surface roughness Ra of 0.3 μm or more; and

a second surface having a surface roughness Ra of 0.1 μm or less.

[0008]

Since the constitution includes the first surface having a surface roughness Ra of 0.3 μm or more, contrast between a laser-marked portion and a portion which is not laser-marked is likely to be provided by laser-marking the first surface. As a result, the laser-marked portion has excellent visibility.

Laser marking may be carried out after thermal curing. However, when the surface roughness Ra before thermal curing is 0.3 μm or more, the surface roughness is equal to or greater than a prescribed value even after thermal curing. Therefore, when the surface roughness Ra before thermal curing is 0.3 μm or more, the laser-marked portion has excellent visibility.

Since the second surface has a surface roughness Ra of 0.1 μm or less, voids can be prevented from occurring in a pasted surface when the second surface is pasted on an adherend.

[0009]

In the constitution, the first surface preferably has a surface roughness Ra after thermal curing of 0.3 μm or more.

[0010]

When the first surface has a surface roughness Ra after thermal curing of 0.3 μm or more, the laser-marked portion has

more excellent visibility.

[0011]

A method for manufacturing an electronic device package according to the present invention, the method comprising the steps of:

preparing a laminated body having an adherend and an electronic device fixed on the adherend with a bump interposed therebetween;

preparing the sheet for sealing an electronic device;

disposing the sheet for sealing an electronic device on the electronic device of the laminated body so that the second surface of the sheet for sealing an electronic device and the electronic device are brought into contact with each other;

embedding the electronic device into the sheet for sealing an electronic device by heat pressing; and

thermally curing the sheet for sealing an electronic device after the embedding step to obtain a sealed body.

[0012]

Since the sheet for sealing an electronic device is used according to the constitution, contrast between a laser-marked portion and a portion which is not laser-marked is likely to be provided by laser-marking the first surface. As a result, the laser-marked portion has excellent visibility.

Since the second surface having a surface roughness Ra of 0.1 μm or less is pasted on the electronic device or the

adherend, voids can be prevented from occurring in a pasted surface.

[0013]

In the constitution, the first surface preferably has a surface roughness Ra of 0.3 μm or more after the step of obtaining the sealed body.

[0014]

When the first surface has a surface roughness Ra of 0.3 μm or more after the step of obtaining the sealed body, the laser-marked portion has more excellent visibility.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a schematic sectional view showing a sheet for sealing an electronic device according to an embodiment of the present invention;

Fig. 2 is a schematic sectional view for describing a method for producing an electronic device package according to an embodiment of the present invention;

Fig. 3 is a schematic sectional view for describing a method for producing an electronic device package according to an embodiment of the present invention;

Fig. 4 is a schematic sectional view for describing a method for producing an electronic device package according to an embodiment of the present invention;

Fig. 5 is a schematic sectional view for describing a method for producing an electronic device package according to an embodiment of the present invention;

Fig. 6 is a schematic sectional view for describing a method for producing an electronic device package according to an embodiment of the present invention; and

Fig. 7 is a schematic sectional view for describing a method for producing an electronic device package according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016]

Embodiments of the present invention will be described below with reference to the drawings. However, the present invention is not limited to these embodiments.

[0017]

Fig. 1 is a schematic sectional view of a sheet for sealing an electronic device according to the present embodiment. As shown in Fig. 1, a sheet for sealing an electronic device 11 (hereinafter, referred to as a "sealing sheet 11") according to the present embodiment has a first surface 11a and a second surface 11b. The second surface 11b is a surface opposite to the first surface 11a. In detail, the first surface 11a is described in paragraph "Method for Manufacturing Electronic Device Package", but the first surface 11a is a laser-marked

surface. The second surface 11b is a surface into which an electronic device is embedded, and is a surface pasted on an adherend.

[0018]

The first surface 11a has a surface roughness Ra of 0.3 μm or more, preferably 0.8 μm or more, and more preferably 1.0 μm or more. Since the first surface 11a has a surface roughness Ra of 0.5 μm or more, contrast between a laser-marked portion and a portion which is not laser-marked is likely to be provided by laser-marking the first surface 11a. As a result, the laser-marked portion has excellent visibility.

Laser marking may be carried out after thermal curing. However, when the surface roughness Ra before thermal curing is 0.3 μm or more, the surface roughness is equal to or greater than a prescribed value even after thermal curing. Therefore, when the surface roughness Ra before thermal curing is 0.3 μm or more, the laser-marked portion has excellent visibility.

From the viewpoint of appearance properties, the first surface 11a has a surface roughness Ra of preferably 3.0 μm or less, and more preferably 2.0 μm or less.

[0019]

The second surface 11b has a surface roughness Ra of 0.1 μm or less, preferably 0.08 μm or less, and more preferably 0.05 μm or less. Since the second surface 11b has a surface roughness Ra of 0.1 μm or less, voids can be prevented from occurring in

a pasted surface when the second surface 11b is pasted on an adherend.

The surface roughness Ra of the second surface 11b is preferably smaller, but the surface roughness Ra is 0.01 μm or more, for example.

[0020]

A method for measuring the surface roughness Ra is on the basis of a method described in Examples.

[0021]

The surface roughness Ra of the first surface 11a can be controlled by the surface roughness of a separator 11c when the separator 11c is laminated on the first surface 11a, for example. When the sealing sheet 11 contains an inorganic filler, the surface roughness Ra of the first surface 11a can be controlled by the content and particle diameter (average particle diameter) of the inorganic filler.

Similarly, the surface roughness Ra of the second surface 11b can be controlled by the surface roughness of a separator 11d when the separator 11d is laminated on the second surface 11b, for example. When the sealing sheet 11 contains an inorganic filler, the surface roughness Ra of the second surface 11b can be controlled by the content and particle diameter (average particle diameter) of the inorganic filler.

[0022]

The separator 11c is laminated on the first surface 11a.

The surface roughness Ra of the separator 11c on the first surface 11a side is preferably 0.5 μm or more, and more preferably 1.0 μm or more. The surface shape of the separator 11c is transferred to the first surface 11a to some extent. Therefore, when the surface roughness Ra of the separator 11c on the first surface 11a side is 0.5 μm or more, the surface roughness of the first surface 11a is easily set to 0.3 μm or more when the sealing sheet 11 is manufactured. From the viewpoint of the appearance of the sealing sheet 11 to be manufactured, the surface roughness Ra of the separator 11c on the first surface 11a side is preferably 3.0 μm or less, and more preferably 2.0 μm or less.

[0023]

The separator 11d is laminated on the second surface 11b. The surface roughness Ra of the separator 11d on the second surface 11b side is preferably 0.1 μm or less, and more preferably 0.05 μm or less. The surface shape of the separator 11d is transferred to the second surface 11b to some extent. Therefore, when the surface roughness Ra of the separator 11d on the second surface 11b side is 0.1 μm or less, the surface roughness of the second surface 11b is easily set to 0.1 μm or less when the sealing sheet 11 is manufactured. The surface roughness Ra of the separator 11d on the second surface 11b side is preferably smaller, but it is 0.01 μm or more, for example.

[0024]

Examples of the materials of the separator 11c and separator 11d include, but are not particularly limited to, polyethylene terephthalate (PET), polymethylpentene, polyethylene, and polypropylene.

[0025]

In order to provide easy peeling, the surfaces of the separator 11c and separator 11d brought into contact with the sealing sheet 11 may be subjected to mold release processing. For example, the surfaces may be coated with a parting agent such as a silicone-based release agent, a fluorine-based release agent, or a long-chain alkyl acrylate-based release agent.

[0026]

In the present embodiment, the case where the separator is laminated on each of the surfaces of the sheet for sealing an electronic device is described, but the sheet for sealing an electronic device of the present invention is not limited to this example as long as the sheet for sealing an electronic device has a first surface having a surface roughness Ra of 0.3 μm or more and a second surface having a surface roughness Ra of 0.1 μm or less. For example, the separator may be laminated on neither of the first surface and the second surface. The separator may be laminated on only the first surface, and the separator may not be laminated on the second surface. The separator may be laminated on only the second surface, and the

separator may not be laminated on the first surface.

[0027]

The sealing sheet 11 preferably contains an epoxy resin and a phenol resin. This case gives a good thermosetting performance to the sheet.

[0028]

The epoxy resin is not particularly limited. The resin may be an epoxy resin that may be of various types, examples thereof including triphenylmethane type epoxy resin, cresol novolak type epoxy resin, biphenyl type epoxy resin, modified bisphenol A type epoxy resin, bisphenol A type epoxy resin, bisphenol F type epoxy resin, modified bisphenol F type epoxy resin, dicyclopentadiene type epoxy resin, phenol novolak type epoxy resin, and phenoxy resin. These epoxy resins may be singly or in any combination of two or more thereof.

[0029]

In order for the epoxy resin to ensure toughness after set, and ensure reactivity, the epoxy resin is preferably a resin having an epoxy equivalent of 150 to 250 and a softening point or melting point of 50 to 130°C to be in a solid form at any ordinary temperature. Of the above-mentioned examples, bisphenol F type epoxy resin, bisphenol A type epoxy resin, biphenyl type epoxy resin and others are more preferred from the viewpoint of shapability and reliability.

[0030]

The phenol resin is not particularly limited as far as the resin is a phenol resin which is combined with the epoxy resin to cause a setting reaction between the two resins. Examples thereof include phenol novolak resin, phenol aralkyl resin, biphenyl aralkyl resin, dicyclopentadiene type phenol resin, cresol novolak resin and resol resin. These phenol resins may be used singly or in any combination of two or more thereof.

[0031]

The phenol resin is preferably a resin having a hydroxyl equivalent of 70 to 250 and a softening point of 50 to 110°C from the viewpoint of reactivity with the epoxy resin. Of the above-mentioned examples, phenol novolak resin is preferred since the resin is high in setting reactivity and is inexpensive. From the viewpoint of reliability, preferred is also a phenol resin low in hygroscopicity, such as phenol aralkyl resin or biphenyl aralkyl resin.

[0032]

About the blend ratio between the epoxy resin and the phenol resin, the phenol resin is blended with the epoxy resin to set the total amount of hydroxyl groups in the phenol resin into the range of 0.9 to 1.2 equivalents per equivalent of epoxy groups in the epoxy resin.

[0033]

The lower limit of the total content by percentage of the

epoxy resin and the phenol resin in the sealing sheet 11 is preferably 5.0% by weight, more preferably 7.0% by weight. When the lower limit is 5.0% by weight, the sealing sheet can satisfactorily gain adhering strength to an electronic device, an adherend and others. In the meantime, the upper limit of the total content by percentage is preferably 25% by weight, more preferably 20% by weight. When the lower limit is 25% by weight, the sealing sheet can be decreased in hygroscopicity.

[0034]

The sealing sheet 11 preferably contains a thermoplastic resin. This case makes it possible to improve the sealing sheet in heat resistance, flexibility, and strength.

[0035]

Examples of the thermoplastic resin include natural rubber, butyl rubber, isoprene rubber, chloroprene rubber, ethylene/vinyl acetate copolymer, ethylene/acrylic acid copolymer, ethylene/acrylate copolymer, polybutadiene resin, polycarbonate resin, thermoplastic polyimide resin, polyamide resins such as 6-nylon and 6,6-nylon, phenoxy resin, acrylic resin, saturated polyester resins such as PET and PBT, polyamideimide resin, fluororesin, and styrene/isobutylene/styrene block copolymer. These thermoplastic resins may be used singly or in any combination of two or more thereof. Of these resins, acrylic resin is preferred since the resin causes the sealing sheet to gain

flexibility easily, and is good in dispersibility in the epoxy resin.

[0036]

The acrylic resin is not particularly limited, and may be a polymer (acrylic copolymer) made from components including one or more acrylates or methacrylates (each) having a linear or branched alkyl group having 30 or less carbon atoms, particularly, 4 to 18 carbon atoms. Examples of the alkyl group include methyl, ethyl, propyl, isopropyl, n-butyl, t-butyl, isobutyl, amyl, isoamyl, hexyl, heptyl, cyclohexyl, 2-ethylhexyl, octyl, isooctyl, nonyl, isononyl, decyl, isodecyl, undecyl, lauryl, tridecyl, tetradecyl, stearyl, octadecyl, and dodecyl groups.

[0037]

The glass transition temperature (T_g) of the acrylic resin is preferably 50°C or lower, more preferably from -70 to 20°C, even more preferably from -50 to 0°C. By setting the glass transition temperature to 50°C or lower, the sheet can be caused to have flexibility.

[0038]

About the acrylic resin, the weight-average molecular weight is preferably 50000 or more, more preferably from 100000 to 2000000, even more preferably from 300000 to 1600000. When the weight-average molecular weight is 50000 or more, the sealing sheet 11 can be made higher in viscosity and flexibility.

The weight-average molecular weight is a value obtained by making a measurement according to GPC (gel permeation chromatography) and making a calculation in terms of the molecular weight of polystyrene.

[0039]

One or more different monomers that are combined with the (meth)acrylate(s) to produce the polymer are not particularly limited. Examples thereof include carboxyl-group-containing monomers, such as acrylic acid, methacrylic acid, carboxyethyl acrylate, carboxypentyl acrylate, itaconic acid, maleic acid, fumaric acid, and crotonic acid; acid anhydride monomers, such as maleic anhydride, and itaconic anhydride; hydroxyl-group-containing monomers, such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxylauryl (meth)acrylate, and (4-hydroxymethylcyclohexyl)-methyl acrylate; sulfonic-acid-group-containing monomers, such as styrenesulfonic acid, allylsulfonic acid, 2-(meth)acrylamide-2-methylpropanesulfonic acid, (meth)acrylamidepropanesulfonic acid, sulfopropyl (meth)acrylate, and (meth)acryloyloxynaphthalenesulfonic acid; and phosphate-group-containing monomers, such as 2-hydroxyethylacryloyl phosphate. It is particularly

preferred that the different monomer(s) is/include at least one selected from carboxyl-group-containing monomers, glycidyl-group-containing (epoxy-group-containing) monomers, and hydroxyl-group-containing monomers since the different monomer(s) can react with the epoxy resin to heighten the sealing sheet 11 in viscosity.

[0040]

The content by percentage of the thermoplastic resin in the sealing sheet 11 is preferably 0.5% or more by weight, more preferably 1.0% or more by weight. When the content by percentage is 0.5% or more by weight, the sealing sheet can gain softness and flexibility. The content by percentage of the thermoplastic resin in the sealing sheet 11 is preferably 10% or less by weight, more preferably 5% or less by weight. When the content by percentage is 10% or less by weight, the sealing sheet is good in adhesion or bondability to an electronic device or a substrate.

[0041]

The sealing sheet 11 preferably contains an inorganic filler. When the inorganic filler is contained, the surface roughnesses Ra of the first surface 11a and second surface 11b of the sealing sheet 11 can be controlled according to the content and particle diameter (average particle diameter) of the inorganic filler. Particularly, when the separator 11c is laminated on the first surface 11a of the sealing sheet 11, the

surface roughness Ra of the first surface 11a can be controlled by selecting the surface roughness Ra of the separator 11c, and the content and particle diameter of the inorganic filler. When the separator 11d is laminated on the second surface 11b of the sealing sheet 11, the surface roughness Ra of the second surface 11b can be controlled by selecting the surface roughness Ra of the separator 11d, and the content and particle diameter of the inorganic filler.

[0042]

The inorganic filler is not particularly limited, and may be an inorganic filler that may be of various types known in the prior art. Examples thereof include respective powders of quartz glass, talc, silica (such as fused silica or crystalline silica), alumina, aluminum nitride, silicon nitride, and boron nitride. These fillers may be used singly or in any combination of two or more thereof. Silica or alumina is preferred, and silica is more preferred since the filler can satisfactorily decrease the linear expansion coefficient of the sealing sheet 11.

[0043]

The species of silica is preferably silica powder, more preferably fused silica powder. Examples of the fused silica powder include spherical fused silica powder, and crushed fused silica powder. From the viewpoint of fluidity, spherical fused silica powder is preferred.

[0044]

The sealing sheet 11 preferably contains 69 to 86% by volume of the inorganic filler. The content is more preferably 75% by volume or more, and still more preferably 78% by volume or more. When 69 to 86% by volume of the inorganic filler is contained, the thermal expansion coefficient of the sealing sheet 11 can be brought close to that of the electronic device (for example, a SAW chip 13 to be described later). As a result, the warpage of a package can be suppressed. Furthermore, when 69 to 86% by volume of the inorganic filler is contained, the water absorption of the sealing sheet 11 can be decreased.

[0045]

When the inorganic filler is silica, the content by percentage of the inorganic filler can also be described, using the unit of "% by weight". The silica content by percentage in the sealing sheet 11 is preferably from 80 to 92% by weight, more preferably from 85 to 92% by weight.

[0046]

The average particle diameter of the inorganic filler is preferably 50 μm or less, more preferably 0.1 to 20 μm , and particularly preferably 0.5 to 10 μm .

As the inorganic filler, two or more kinds of inorganic fillers having different average particle sizes may be used. When two or more kinds of inorganic fillers having different average particle diameters are used, "the average particle

diameter of the inorganic filler is 50 μm or less" means that the average particle diameter of the whole inorganic filler is 50 μm or less.

When the average particle diameter is 50 μm or less, the surface roughness Ra of the first surface 11a is easily set to 0.3 μm or more, and the surface roughness Ra of the second surface 11b is easily set to 0.1 μm or less.

[0047]

The form of the inorganic filler is not particularly limited, and may be any form such as a spherical (or elliptical), polyhedral, polygonal columnar, flat, or indeterminate form. The form is preferably a spherical form since the filler can attain a highly filled state, and have an appropriate fluidity.

[0048]

It is preferable for the inorganic filler contained in the sealing sheet 11 to have two peaks in a particle size distribution thereof measured by a laser diffraction scattering method. This inorganic filler can be obtained, for example, by mixing two inorganic filler species different from each other in average particle diameter with each other.

The use of the inorganic filler, which has two peaks in the particle size distribution, makes it possible to fill the inorganic filler to have a high density. As a result, the content by percentage of the inorganic filler can be made larger.

The two peaks are not particularly limited. It is preferred that larger-particle-diameter one of the two peaks is present in a range in which the particle diameter is from 3 to 30 μm while the other, which is smaller in particle diameter, is present in a range in which that is from 0.1 to 1 μm . When the particle diameters of the peaks are in the respective numerical ranges, the content by percentage of the inorganic filler can be made still larger.

Specifically, through the following process, the particle size distribution is obtained:

(a) The sealing sheet 11 is put into a crucible, and the crucible is intensely heated at 700°C in the air atmosphere for 2 hours to be incinerated.

(b) The resultant ash content is dispersed in pure water; the ash-dispersed water is subjected to ultrasonic treatment for 10 minutes; and then the (volume-reference) particle size distribution of the filler is obtained, using a laser diffraction scattering type particle size distribution measuring instrument ("LS 13 320" in a wet manner, manufactured by Beckman Coulter, Inc.).

In the composition of the sealing sheet 11, the compositions other than the inorganic filler are organic components, so that substantially the whole of the organic components is lost by the intensely heating treatment. Thus, the measurement is made under a condition that the resultant

ash content is regarded as the inorganic filler. The calculation of the average particle diameter is also made simultaneously with the analysis of the particle size distribution.

[0049]

It is preferred in the sealing sheet 11 that the inorganic filler is beforehand surface-treated with the silane coupling agent.

[0050]

The silane coupling agent is not particularly limited as far as the agent is a compound which has a methacryloxy group or acryloxy group and which is a compound with which an inorganic filler can be surface-treated. Specific examples of the silane coupling agent include

3-methacryloxypropylmethyldimethoxysilane,

3-methacryloxypropyltrimethoxysilane,

3-methacryloxypropylmethyldiethoxysilane,

3-methacryloxypropyltriethoxysilane,

methacryloxyoctyltrimethoxysilane, and

methacryloxyoctyltriethoxysilane. Of these examples,

3-methacryloxypropyltrimethoxysilane is preferred from the viewpoint of reactivity and costs.

[0051]

When the surface of the inorganic filler is treated with the silane coupling agent, an outgas (for example, methanol)

is generated. Thus, at a stage before the sealing sheet 11 is produced, the inorganic filler is beforehand surface-treated with the silane coupling agent. This treatment makes it possible to exclude any outgas to some extent at this stage. As a result, when the sealing sheet 11 is produced, the outgas volume confined inside the sealing sheet can be controlled into a low level so that the generation of voids can be decreased. [0052]

When the sealing sheet 11 contains the inorganic filler surface-treated beforehand with the compound having a methacryloxy group or acryloxy group as the silane coupling agent, it is preferred that the inorganic filler is beforehand surface-treated with the silane coupling agent in an amount of 0.5 to 2 parts by weight for 100 parts by weight of the inorganic filler. When the inorganic filler is subjected to a surface treatment using the silane coupling agent, the viscosity of the sealing sheet 11 can be suppressed from becoming too high. When the amount of the silane coupling agent is increased, the generated amount of outgas is also increased. Therefore, even if the inorganic filler is previously subjected to a surface treatment, the performance of the sealing sheet 11 is deteriorated by the outgas generated when the sealing sheet 11 is produced. On the other hand, when the amount of the silane coupling agent is decreased, the viscosity may be too high. Thus, when the inorganic filler is beforehand surface-treated

with the silane coupling agent in an amount of 0.5 to 2 parts by weight for 100 parts by weight of the inorganic filler, the sealing sheet can be appropriately lowered in viscosity and can be further restrained from being lowered in performance by the outgas.

[0053]

When the sealing sheet 11 contains the inorganic filler surface-treated beforehand with the compound having a methacryloxy group or acryloxy group as the silane coupling agent and further the inorganic filler is an inorganic filler containing two inorganic filler species different from each other in average particle diameter, it is preferred that at least a species smaller in average particle diameter, out of the two filler species, is beforehand surface-treated with the silane coupling agent. Since the inorganic filler species smaller in average particle diameter is large in specific surface area, the rise in viscosity can be further restrained.

When the used inorganic filler is a mixture obtained by mixing two inorganic filler species different from each other in average particle diameter with each other, it is more preferred that both of a species smaller in average particle diameter out of the two species and the other, which is larger in average particle diameter, are beforehand surface-treated with the silane coupling agent. In this case, the rise in the viscosity can be further restrained.

[0054]

The sealing sheet 11 preferably contains a curing promoter.

[0055]

The curing promoter is not particularly limited as far as the promoter causes the curing or setting of the epoxy resin and the phenol resin to advance. Examples thereof include organic phosphorus-containing compounds such as triphenylphosphine, and tetraphenylphosphonium tetraphenyl borate; and imidazole compounds such as 2-phenyl-4,5-dihydroxymethylimidazole, and 2-phenyl-4-methyl-5-hydroxymethylimidazole. Of these examples, imidazole compounds are preferred since the compounds are good in reactivity to heighten the Tg of the cured product easily. Among the imidazole compounds, 2-phenyl-4-methyl-5-hydroxymethyl imidazole is preferable since a viscosity increase during thermal curing can be accelerated.

[0056]

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

[0057]

The sealing sheet 11 may contain a flame retardant, as required. This case makes it possible to decline burning

expansion when the sheet catches fire by a short circuit or heat-generation of the member concerned. Examples of the flame retardant include various metal hydroxides such as aluminum hydroxide, magnesium hydroxide, iron hydroxide, calcium hydroxide, tin hydroxide, and complex metal hydroxides; and phosphazene flame retardants.

[0058]

The sealing sheet 11 preferably contains a pigment. The pigment is not particularly limited, and may be, for example, carbon black.

[0059]

The content by percentage of the pigment in the sealing sheet 11 is preferably from 0.1 to 2% by weight. When the content by percentage is 0.1% or more by weight, the sheet gains a good marking performance. When the content by percentage is 2% or less by weight, the sealing sheet can ensure strength after cured.

[0060]

An additional additive other than the above-mentioned individual components may be appropriately blended into the resin composition, as required.

[0061]

The thickness of the sealing sheet 11 is not particularly limited, and may be, for example, from 100 to 2000 μm . When the thickness is in this range, an electronic device can be

satisfactorily sealed with the sheet.

[0062]

The sealing sheet 11 may have a single layer structure, or may have a multilayer structure in which a plurality of layers having different compositions are laminated.

[0063]

[Method for Manufacturing Sheet for Sealing Electronic Device]

The sealing sheet 11 can be formed by dissolving and dispersing a resin for forming the sealing sheet 11, or the like in a suitable solvent to prepare a varnish, applying the varnish at a prescribed thickness onto the separator 11c or the separator 11d to form a coating film, and thereafter drying the coating film under a prescribed condition. Examples of the applying method include, but are not particularly limited to, roll coating, screen coating, and gravure coating. The drying is carried out at a drying temperature of 70 to 160°C and a drying time of 1 to 30 minutes, for example, as a drying condition. Then, the other separator is pasted.

As another method, the varnish may be applied onto a support to form a coating film, and then the coating film may be dried in the above-described drying condition to form the sealing sheet 11. Then, the sealing sheet 11 is pasted on the separator 11c or the separator 11d together with the support. Then, the support is peeled off, and the other separator is pasted. When the sealing sheet 11 particularly contains a

thermoplastic resin (acrylic resin), an epoxy resin, and a phenol resin, all the resins are dissolved in a solvent to produce a solution, and the solution is applied and dried. Examples of the solvent include methyl ethyl ketone, ethyl acetate, and toluene.

The sealing sheet 11 may be produced by kneading extrusion. Examples of the production method according to the kneading extrusion include a method of melt-kneading components for forming the sealing sheet 11 in a known kneading machine such as a mixing roll, a pressure kneader, or an extruder to prepare a kneaded product, and subjecting the obtained kneaded product to plastic processing to form a sheet product.

Specifically, the kneaded product after melt-kneading is extrusion-molded while it is kept at a high temperature without being cooled, whereby the sealing sheet can be formed. The extrusion method for this purpose is not particularly limited, and examples thereof include a T die extrusion method, a rolling method, a roll kneading method, a co-extrusion method, and a calender molding method. The extrusion temperature is preferably equal to or higher than the softening points of the components described above. The extrusion temperature is, for example, 40 to 150°C, preferably 50 to 140°C, and more preferably 70 to 120°C in consideration of the thermal curability and moldability of the epoxy resin. In this way, the sealing sheet 11 can be formed.

[0064]

[Method for Manufacturing Electronic Device Package]

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

preparing a laminated body having an adherend and an electronic device fixed on the adherend with a bump interposed therebetween;

preparing a sheet for sealing an electronic device;

disposing the sheet for sealing an electronic device on the electronic device of the laminated body so that the second surface of the sheet for sealing an electronic device and the electronic device are brought into contact with each other;

embedding the electronic device into the sheet for sealing an electronic device by heat pressing; and

thermally curing the sheet for sealing an electronic device after the embedding step to obtain a sealed body.

[0065]

Examples of the adherend include, but are not particularly limited to, a printed wiring substrate, a ceramic substrate, a silicon substrate, and a metal substrate.

Examples of the electronic devices include electronic devices each having a hollow structure (hollow electronic devices) such as sensors, MEMS (micro electro mechanical systems), and SAW (surface acoustic wave) filters;

semiconductor elements such as semiconductor chips, ICs (integrated circuits), and transistors; capacitors; and resistors.

[0066]

Hereinafter, the case where the electronic device package of the present invention is a hollow electronic device package will be described. The hollow electronic device package means an electronic device package in which a hollow part is present between an electronic device and an adherend. However, the electronic device package of the present invention is not limited to the hollow electronic device package. The electronic device package of the present invention may be an electronic device package in which a space between the electronic device and the adherend is filled with a resin or the like, and a hollow part is not present.

Specifically, in an embodiment to be described later, the case where a SAW chip 13 mounted on a printed wiring substrate 12 is subjected to hollow sealing by a sealing sheet 11 to produce a hollow package will be described. The SAW chips 13 are each a chip having a surface acoustic waver (SAW) filter. That is, in the present embodiment, a case where the electronic device of the present invention is a chip having a surface acoustic wave (SAW) filter will be described.

[0067]

Figs. 2 to 7 are schematic sectional views for describing

a method for producing an electronic device package according to an embodiment of the present invention.

[0068]

(Step of Providing Laminate)

In the method for producing an electronic device package according to the present embodiment, first, a laminate 15 is provided, which includes a printed circuit board 12 and a plurality of SAW chips 13 (SAW filters 13) mounted on the printed circuit board 12 (see Fig. 2). The SAW chips 13 can be formed by dicing a piezoelectric crystal on which predetermined comb-shaped electrodes are formed, in a known manner, to be made into individual pieces. In order to mount the SAW chips 13 onto the printed wiring substrate 12, a flip chip bonder, a die bonder or any other known machine is usable. The SAW chips 13 are electrically connected to the printed wiring substrate 12 through bumps 13a. Between each of the SAW chips 13, and the printed wiring substrate 12, a hollow region 14 is maintained not to hinder the transmission of surface acoustic waves in the front surface of the SAW filter. The distance between the SAW chip 13 and the printed wiring substrate 12 (the width of the hollow region) can be appropriately set, and is generally from about 10 to 100 μm .

[0069]

(Step of Providing Sheet for Sealing Electronic Device)

In the method for producing an electronic device package

according to the present embodiment, a sealing sheet 11 (see Fig. 1) is provided.

[0070]

(Step of Disposing Sheet for Sealing Electronic Device)

Next, as shown in Fig. 3, the laminate 15 is disposed on a lower heating plate 22 with the surface on which the SAW chips 13 are fixed facing up, and the sealing sheet 11 is disposed on the surfaces of the SAW chips 13. In this case, when a separator 11d is laminated on a second surface 11b of the sealing sheet 11, the separator 11d is peeled off, and the second surface 11b of the sealing sheet 11 is then disposed to be brought into contact with the SAW chip 13. In this step, the laminate 15 may be first disposed on the lower heating plate 22, followed by disposing the sealing sheet 11 on the laminate 15.

Alternatively, the sealing sheet 11 may be first laminated on the laminate 15, followed by disposing a laminated product of the laminate 15 and the sealing sheet 11 on the lower heating plate 22.

[0071]

(Step of Embedding Electronic Device into Sheet for Sealing Electronic Device)

Next, as shown in Fig. 4, heat pressing is carried out with a lower heating plate 22 and an upper heating plate 24 to embed a SAW chip 13 into the sealing sheet 11. The lower heating plate 22 and the upper heating plate 24 may be those of a

flat-plate press. The sealing sheet 11 functions as a sealing resin for protecting the SAW chip 13 and elements associated with the SAW chip 13 from the external environment.

[0072]

Specifically, the heat pressing conditions when the SAW chip 13 is embedded into the sealing sheet 11 are different according to the viscosity of the sealing sheet 11, or the like. The temperature is preferably 40 to 150°C, and more preferably 60 to 120°C. The pressure is, for example, 0.1 to 10 MPa, and preferably 0.2 to 5 MPa. The time is, for example, 0.3 to 10 minutes, and preferably 0.5 to 5 minutes. Examples of the heat pressing method include parallel flat-plate pressing and roll pressing. Of these, the parallel flat-plate pressing is preferable. By setting the heat pressing condition to be within the numerical value range, the SAW chip 13 can be more suitably embedded into the sealing sheet 11. Since the surface roughness Ra of the second surface 11d of the sealing sheet 11 is 0.1 μm or less, voids can be prevented from occurring at an interface between the sealing sheet 11 and the SAW chip 13 or the printed wiring substrate 12.

[0073]

In view of improvements in the tackiness and followability of the sealing sheet 11 to the SAW chips 13 and the printed circuit board 12, pressing under decompression conditions is preferable.

As the decompression conditions, the pressure is 0.1 to 5 kPa, for example, and preferably 0.1 to 100 Pa; and the decompression retention time (time from the start of decompression to the start of pressing) is 5 to 600 seconds, for example, and preferably 10 to 300 seconds.

[0074]

(Separator Peeling-Off Step)

Next, when a separator 11c is laminated on a first surface 11a of the sealing sheet 11, the separator 11c is peeled off (see Fig. 5).

[0075]

(Step of Carrying Out Thermal Curing to Obtain Sealed Body)

Next, the sealing sheet 11 is thermally cured to obtain a sealed body 25. Since the surface roughness Ra before thermal curing of the first surface 11a of the sealing sheet 11 is 0.3 μm or more, the first surface 11a of the sealing sheet 11 has a surface roughness of a prescribed value or more even after thermal curing. Specifically, the surface roughness Ra after thermal curing is 0.3 μm or more, for example.

In particular, in the present embodiment, the separator 11c is peeled off, and thermal curing is then carried out. During thermal curing, an organic component is slightly contracted to provide a slight decrease in the thickness of the sealing sheet 11 (thickness depending on the organic component). Therefore, the surface shape of the inorganic filler dispersed

in the organic component slightly appears on the first surface 11a. As a result, the surface roughness Ra of the first surface 11a after thermal curing is affected by also the presence of the inorganic filler. Therefore, the surface of the first surface 11a can be more suitably roughed, and the visibility of a portion laser-marked by a laser marking step can be further improved.

[0076]

Specifically, the conditions for the thermal curing treatment is different according to the viscosity and constituent material of the sealing sheet 11. The heating temperature is preferably 100°C or more, and more preferably 120°C or more. The upper limit of the heating temperature is preferably 200°C, more preferably 180°C. The heating period is preferably 10 minutes or longer, more preferably 30 minutes or longer. The upper limit of the heating period is preferably 180 minutes, more preferably 120 minutes. As required, the workpiece may be pressurized. The pressure therefor is preferably 0.1 MPa or more, more preferably 0.5 MPa or more. The upper limit of the pressure is preferably 10 MPa, more preferably 5 MPa. By setting the condition of the thermal curing treatment to be within the numerical value range, the surface roughness Ra after thermal curing of the first surface 11a can be set to a prescribed value or more.

[0077]

(Laser Marking Step)

Next, as shown in Fig. 6, the sealing sheet 11 is laser-marked using a laser 30 for laser marking. Since the first surface 11a has a surface roughness Ra having a prescribed value or more, the laser-marked portion has excellent visibility. Before carrying out laser marking, a thin film may be formed on the first surface 11a by sputtering using silicon-nickel as target. The formation of the thin film provides a further improvement in visibility of the laser-marked portion.

[0078]

Conditions for the laser marking are not particularly limited. It is possible to radiate a laser [wavelength: 532 nm] onto the sealing sheet 11 at an intensity of 0.3 to 2.0 W. Examples thereof include a method for carrying out radiation so that the processing depth (depth) in this case is set to 2 μm or more. The upper limit of the processing depth is not particularly limited, and may be selected from, for example, the range of 2 to 25 μm . The upper limit is preferably 3 μm or more (3 to 20 μm), and more preferably 5 μm or more (5 to 15 μm). By setting the laser-marking conditions to be within the numerical range, the visibility of the laser-marked portion can be further improved.

[0079]

The laser workability of the sealing sheet 11 can be

controlled in accordance with the kind and content of the constituent resin component, the kind and content of the colorant, the kind and content of the crosslinking agent, and those of the filler, or the like.

[0080]

A spot which is to be laser-marked in the sealing sheet 11 is not particularly limited. The spot may be just above the SAW chip 13, or above SAW-chip-13-not-disposed positions (for example, the outer circumferential portion of the sealing sheet 11). Information marked by the laser marking may be character information or figure information or the like capable of distinguishing the sealed body from any other sealed body, or may be character information or figure information or the like capable of distinguishing the electronic devices from each other inside the single sealed body 25. This makes it possible to cause the sealing sheet 11 to have mutual distinguishability between the sealed body 25 and any other sealed body, or mutual distinguishability between a plurality of SAW chips 13 (electronic devices) inside the sealed body 25.

[0081]

When only one SAW filter 13 as the electronic device is sealed, the sealed body 25 can be produced as one electronic device package. When a plurality of SAW filters 13 are collectively sealed, the SAW filters 13 are divided into each filter, and thereby the SAW filter can be produced as one

electronic device package. That is, when a plurality of SAW filters 13 are collectively sealed as in the present embodiment, the following constitution may be further performed.

[0082]

(Dicing Step)

The sealed body 25 may be diced after the laser marking step (see Fig. 6). Thereby, an electronic device package 18 (hollow electronic device package) for the SAW chip 13 unit can be obtained.

[0083]

(Substrate Mounting Step)

As required, a substrate mounting step may be carried out in which a bump is formed on the electronic device package 18, and the electronic device package 18 is mounted onto a different substrate (not illustrated). For the mounting of the electronic device package 18 onto the substrate, a known apparatus such as a flip-chip bonder or a die bonder can be used.

[0084]

In the above-described embodiment, the case where the separator 11c is peeled off and thermal curing is then carried out has been described. However, the present invention is not limited to this example, and the separator laminated on the first surface may be peeled off after thermal curing.

In this case, the separator is laminated on the first surface during thermal curing. Therefore, an interface

tension acts between the separator and the organic component of the sealing sheet. When the organic component close to the separator is contracted, the organic component is drawn to the separator side from the other portion by the contraction. As a result, the surface shape of the inorganic filler dispersed in the organic component does not appear on the first surface 11a as compared with the case of the above-described embodiment (when the separator 11c is peeled, and thermal curing is then carried out). That is, this case is excellent in that the case can provide a surface roughness further depending on the shape of the separator.

[0085]

The case where the electronic device is embedded by the parallel plate pressing, using the sheet for sealing an electronic device has been described in the above-described embodiment, but the present invention is not limited to this example. A laminated product including an electronic device and a sheet for sealing a hollow electronic device may be sealed by a mold releasing film in a vacuum chamber in a vacuum state, followed by introducing a gas having pressure equal to or higher than atmospheric pressure into the chamber, to embed the electronic device into the sheet for sealing an electronic device. Specifically, an electronic device may be embedded into a sheet for sealing an electronic device by a method described in JP-A-2013-52424.

[0086]

The case where laser marking is carried out after the sheet for sealing an electronic device is thermally cured has been described in the above-described embodiment. However, the present invention is not limited to this example, and thermal curing may be carried out after laser marking is carried out. Specifically, the separator located on the first surface side may be peeled off, followed by laser-marking the first surface, and then carrying out thermal curing. The first surface may be laser-marked in a state where the separator located on the first surface side is laminated as it is, followed by peeling off the separator located on the first surface side, and then carrying out thermal curing. The first surface may be laser-marked in a state where the separator located on the first surface side is laminated as it is, followed by carrying out thermal curing, and then peeling off the separator located on the first surface side. In these cases, the laser-marked portion has good visibility since the surface roughness Ra of the first surface before thermal curing is 0.3 μm or more.

Examples

[0087]

Hereinafter, preferred working examples of the present invention will be demonstrated in detail. However, materials, blend amounts and others that are described in the examples do

not limit the scope of this invention as far as the claims do not include a restricted recitation thereabout.

[0088]

Components and kind of separator used in the examples are described as follows.

[0089]

(Components for sealing sheet)

Epoxy resin: a product, YSLV-80 XY (bisphenol F type epoxy resin), manufactured by Nippon Steel Chemical Co., Ltd.; epoxy equivalent: 200 g/eq., and softening point: 80°C

Phenol resin: a product, LVR 8210 DL (novolak type phenol resin), manufactured by Gunee Chemical Industry Co., Ltd.; hydroxyl equivalent: 104 g/eq., and softening point: 60°C

Thermoplastic resin: a product, HME-2006 M (carboxyl-group-containing acrylate copolymer), manufactured by Negami Chemical Industrial Co., Ltd.; weight-average molecular weight: about 600000, and glass transition temperature (T_g): -35°C

Inorganic filler A: the product FB-5SDC (surface-treated with no agent; average particle diameter: 5 μm), manufactured by Denki Kagaku Kogyo K.K.

Inorganic filler B: a filler obtained by surface-treating a product, SO-25R (average particle diameter: 0.5 μm), manufactured by Admatechs Co., Ltd. with 3-methacryloxypropyltrimethoxysilane (product name: KBM-503,

manufactured by Shin-Etsu Chemical Co., Ltd.), the amount of the silane coupling agent being 1 part by weight for 100 parts by weight of the inorganic filler B

Inorganic filler C: the product FB-9454F (surface-treated with no agent; average particle diameter: 20 μm), manufactured by Denki Kagaku Kogyo K.K.

Carbon black: #20, manufactured by Mitsubishi Chemical Corp.

Curing promoter: a product, 2P4MHZ-PW (2-phenyl-4-hydroxymethyl-5-methylimidazole), manufactured by Shikoku Chemicals Corp.

[0090]

(Kind of Separator)

TPX A: manufactured by Mitsui Chemicals Tohcello, Inc.: X-88BMT4, double-sided embossing type (concavo-convex small surface)

TPX B: manufactured by Mitsui Chemicals Tohcello, Inc.: X-88BMT4, double-sided embossing type (concavo-convex large surface)

PET A: manufactured by Fujico Co., Ltd.: 50-X42

PET B: manufactured by Teijin Limited: U70

PET C: manufactured by Mitsubishi Plastics, Inc.: MRA38

[0091]

[Production of Sealing Sheet with Separator Provided on Each of Both Surfaces according to each of Examples and Comparative

Examples]

According to the blending ratios of the sealing sheet described in Table 1, components were dissolved and dispersed in methyl ethyl ketone as a solvent to obtain a varnish having a concentration of 85% by weight. The varnish was applied onto a separator located on the first surface side, and then dried at 110°C for 5 minutes. This was defined as a sheet X.

The varnish was applied onto a separator located on the second surface side, and then dried at 110°C for 5 minutes. This was defined as a sheet Y. The three same sheets Y were produced. The separator located on the first surface side, and the separator located on the second surface side were shown in Table 1. Thereby, 55- μ m-thick sheets (sheet X, sheet Y) were obtained. The four sheets were laminated to produce a 220- μ m-thick sheet. A specific method for laminating four layers is as follows.

(1) A sheet X laminated on a separator located on a first surface side and a sheet Y laminated on a separator located on a second surface side are pasted on each other to produce a laminated body Z1.

(2) Two sheets Y laminated on the separator located on the second surface side are pasted on each other to produce a laminated body Z2.

(3) The separator located on the second surface side is peeled from the laminated body Z1, and the separator located on the second surface side is peeled off from the laminated body

Z2.

(4) The sheet surfaces exposed by the operation of the above (3) were pasted on each other to obtain a sealing sheet having a four-layer structure having a separator provided on each of the surfaces.

[0092]

(Measurement of Surface Roughness of Separator)

The surface roughness (Ra) of each of the separators used in each of Examples and Comparative Examples was measured using a confocal microscope manufactured by Lasertec (OPTELICS H300) on the basis of JIS B 0601. The magnifying power under conditions for the measurement was set to 50 magnifications. A value obtained by multiplying measured data by a median filter was obtained as a measured value. The measurement was made five times for each of the sealing sheets while a spot thereof to be measured was changed. The average of the resultant values was defined as the surface roughness (Ra) of the sheet. This was defined as a surface roughness Ra of each of the separators. The results are shown in Table 1 described below.

[0093]

(Measurement of Surface Roughness of Sealing Sheet before Thermal Curing)

The surface roughnesses (Ra) of the first surface and second surface before thermal curing of the sealing sheet according to each of Examples and Comparative Examples were

measured using a confocal microscope manufactured by Lasertec (OPTELICS H300) on the basis of JIS B 0601. The measurement conditions were made to be the same as those when the surface roughness of the separator was measured. Specifically, the separator located on the first surface side was peeled off from the sealing sheet with a separator provided on each of both surfaces produced above, and the surface roughness (Ra) of the first surface was then measured. From the sealing sheet with a separator provided on each of both surfaces produced above, the separator located on the second surface side was peeled off, and the surface roughness (Ra) of the second surface was then measured. The results are shown in Table 1.

[0094]

(Measurement of Surface Roughness of First Surface of Sealing Sheet after Thermal Curing)

The surface roughness (Ra) after thermal curing of the sealing sheet according to each of Examples and Comparative Examples was measured using a confocal microscope manufactured by Lasertec (OPTELICS H300) on the basis of JIS B 0601. The measurement conditions were made to be the same as those when the surface roughness of the separator was measured.

Specifically, the following two kinds of cases were measured.

Measuring Method A: the sealing sheet was thermally cured in the state of the sealing sheet with a separator provided on

each of both surfaces, followed by peeling off the separator located on the first surface side and measuring the surface roughness Ra of the first surface of the sealing sheet.

Measuring Method B: the separator located on the first surface side was peeled from the sealing sheet with a separator provided on each of both surfaces, and the sealing sheet was then thermally cured. Then, the surface roughness Ra of the first surface of the sealing sheet was measured.

The thermal curing conditions were set to 150°C and 1 hour in both the measuring method A and the measuring method B. The results are shown in Table 1.

[0095]

(Evaluation of Laser Markability)

The laser markability after thermal curing of the sealing sheet according to each of Examples and Comparative Examples was evaluated as follows.

- Evaluation Method A

The sealing sheet was thermally cured in the state of the sealing sheet with a separator provided on each of both surfaces produced in each of Examples and Comparative Examples, and the separator located on the first surface side was then peeled off. Next, a laser printer (trade name "MD-S9900", manufactured by KEYENCE CORPORATION) was used to laser-print an image on the first surface under the following radiation conditions.

<Radiation Conditions for Laser Printing>

Laser wavelength: 532 nm

Laser power: 1.2 W

Frequency: 32 kHz

An instrument, with a name of CA-DDW8, manufactured by KEYENCE CORPORATION was used to radiate oblique illuminating-rays onto the laser-printed first surface from all directions to the first surface and then a CCD camera (device name: CV-0350) (manufactured by KEYENCE CORPORATION) was used to take in the reflected light rays. The luminosity of the taken-in reflected rays was measured using an instrument with a name of CV-5000 manufactured by KEYENCE CORPORATION. The luminosity was measured about each of the laser-printed region and the non-printed region. Luminosity is a value obtained relatively when the luminance of white is defined as 100% and that of black is defined as 0%. In the present specification, the luminosity is defined as a value measured using the instrument with the name of CV-5000 manufactured by KEYENCE CORPORATION. The difference in luminosity between the laser-printed region and the non-printed region is defined as the contrast (%). When the contrast was 40% or more, the sealing sheet was judged to be good; or when the contrast was less than 40%, the sealing sheet was judged to be poor. The results are shown in Table 1.

- Evaluation Method B

From the sealing sheet with a separator provided on each

of both surfaces produced in each of Examples and Comparative Examples, the separator located on the first surface side was peeled off, and the sealing sheet was then thermally cured. Next, the first surface was laser-printed. The radiation conditions for laser printing were made to be the same as those of the evaluation method A. Laser markability was evaluated as with the evaluation method A. The results are shown in the following Table 1.

The thermal curing conditions were set to 150°C and 1 hour in both the evaluation method A and the evaluation method B. The results are shown in Table 1.

[0096]

[Table 1]

	Example 1	Example 2	Example 3	Example 4	Example 5	Comparative Example 1	Comparative Example 2
	2.1	2.0	1.9	1.9	1.9	1.9	1.9
Epoxy resin							
Phenol resin	1.2	1.1	1.0	1.0	1.0	1.0	1.0
Thermoplastic resin	16.0	15.2	14.4	14.4	14.4	14.4	14.4
Inorganic filler A (No surface treatment; average particle diameter: 5 μm)	56.0	56.7	57.4	57.4	-	57.4	-
Inorganic filler B (Surface treatment filler; average particle diameter: 0.5 μm)	24.0	24.3	24.6	24.6	-	24.6	-
Inorganic filler C (No surface treatment; average particle diameter: 20 μm)	-	-	-	-	82.0	-	82.0
Carbon black	0.6	0.6	0.5	0.5	0.5	0.5	0.5
Curing accelerator	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total (part by weight)	100	100	100	100	100	100	100
Thickness of sheet (μm)	220	220	220	220	220	220	220
Content of inorganic filler in sheet (% by weight)	80	81	82	82	82	82	82
TPX A	1.47	-	-	-	-	-	-
TPX B	-	2.41	-	-	-	-	-
PET A	-	-	0.35	-	-	-	-
PET B	-	-	-	0.64	0.64	-	-
PET C	-	-	-	-	-	0.03	0.03
PET C	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Surface roughness Ra of separator located on second surface side (μm)							
Surface roughness Ra of first surface of sealing sheet before thermal curing (μm)	0.3	0.65	0.30	0.40	0.6	0.086	0.12
Surface roughness Ra of second surface of sealing sheet	0.086	0.086	0.086	0.086	0.091	0.086	0.091

before thermal curing (μm)										
Surface roughness Ra of first surface of sealing sheet after thermal curing (μm)	Measuring method A: the case where thermal curing is carried out after separator is peeled off	0.43	0.75	0.43	0.65	0.83	0.12	0.15		
	Measuring method B: the case where separator is peeled off after thermal curing	0.3	0.65	0.30	0.40	0.6	0.086	0.12		
Evaluation of laser markability	Evaluation method A: the case where thermal curing is carried out after separator is peeled off	○	○	○	○	○	×	×		
	Evaluation method B: the case where separator is peeled off after thermal curing	○	○	○	○	○	×	×		

What is claimed is:

1. A sheet for sealing an electronic device, comprising:
a first surface having a surface roughness Ra of 0.3 μm
or more; and

a second surface having a surface roughness Ra of 0.1 μm
or less.

2. The sheet for sealing an electronic device according
to claim 1,

wherein the first surface has a surface roughness Ra after
thermal curing of 0.3 μm or more.

3. A method for manufacturing an electronic device
package, the method comprising the steps of:

preparing a laminated body having an adherend and an
electronic device fixed on the adherend with a bump interposed
therebetween;

preparing the sheet for sealing an electronic device
according to claim 1;

disposing the sheet for sealing an electronic device on
the electronic device of the laminated body so that the second
surface of the sheet for sealing an electronic device and the
electronic device are brought into contact with each other;

embedding the electronic device into the sheet for
sealing an electronic device by heat pressing; and

thermally curing the sheet for sealing an electronic device after the embedding step to obtain a sealed body.

4. The method for manufacturing an electronic device package according to claim 3,

wherein the first surface has a surface roughness Ra of 0.3 μm or more after the step of obtaining the sealed body.