

DESCRIPTION

Title of the Invention SEALABLE RESIN SHEET

TECHNICAL FIELD

[0001]

The present invention relates to a sealable resin sheet, in particular, to a sealable resin sheet for sealing an element.

BACKGROUND ART

[0002]

It has been known to form a cured product from a sealable sheet by press sealing a semiconductor element or electronic component mounted on a board with a sealable sheet containing thermosetting resin, and thereafter curing the thermosetting resin by heating (for example, see Patent document 1 below).

Citation List

Patent Document

[0003]

Patent Document 1 Japanese Unexamined Patent Publication No. 2016-162909

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004]

As electronic devices have been getting more sophisticated in functionality, there is a need to downsize the semiconductor elements or electronic components included therein. With the need, there is another need to increase the dimensional accuracy at the curing of the resin (cured product) that protects the semiconductor elements or electronic components. Specifically, there is a need to reduce an entering amount of the cured product that enters between the semiconductor element or electronic component and the board from a lateral edge of the semiconductor element or electronic component.

[0005]

The present invention provides a sealable resin sheet that can reduce an entering amount of a cured product that enters between an element exemplified by a semiconductor element or an electronic component and the board.

MEANS FOR SOLVING THE PROBLEM

[0006]

The present invention [1] includes a sealable resin sheet for sealing an element, the sealable resin sheet containing thermosetting resin, and further containing a layered silicate compound..

[0007]

The present invention [2] includes the sealable resin sheet described in [1] above, wherein the layered silicate compound is smectite.

[0008]

The present invention [3] includes the sealable resin sheet described in [1] or [2] above, wherein the layered silicate compound has a surface modified by an organic component.

[0009]

The present invention [4] includes the sealable resin sheet described in any one of the above-described [1] to [3] further containing an inorganic filler other than the layered silicate compound at 50 mass% or more and 90 mass% or less.

[0010]

The present invention [5] includes the sealable resin sheet described in any one of the above-described [1] to [4], wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.

EFFECTS OF THE INVENTION

[0011]

The sealable resin sheet of the present invention contains a layered silicate compound. Thus, when the sealable resin sheet is disposed on an element and heated to form a cured product, an entering amount of the cured product that enters between the element and board can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

[FIG. 1] FIG. 1A to FIG. 1D are cross-sectional views illustrating the steps of producing an electronic element package by sealing a plurality of electronic elements with an embodiment of the sealable resin sheet of the present invention. FIG. 1A depicts the step of preparing the sealable resin sheet. FIG. 1B depicts the step of preparing the electronic elements. FIG. 1C

depicts the step of forming a sealing body by pressing the sealable resin sheet. FIG. 1D depicts the step of forming a cured product by heating the sealing body.

[FIG. 2] FIG. 2A to FIG. 2D are cross-sectional views illustrating the step of producing an electronic element package by sealing a plurality of electronic elements with a sealable multi-layer resin sheet including the sealable resin sheet illustrated in FIG. 1A and a second sealable resin sheet. FIG. 2A illustrates the step of preparing the sealable multi-layer resin sheet. FIG. 2B illustrates the step of preparing the electronic elements. FIG. 2C illustrates the step of forming a sealing body by pressing the sealable multi-layer resin sheet. FIG. 2D illustrates the step of forming a cured product by heating the sealing body.

[FIG. 3] FIG. 3A to FIG. 3D illustrate a method of measuring a cured product entering length Y in Examples. FIG. 3A illustrates the step of preparing a sealable multi-layer resin sheet (Step A). FIG. 3B illustrates the step of preparing an electronic element (dummy element) (Step B). FIG. 3C illustrates the step of forming a sealing body by pressing the sealable multi-layer resin sheet (Step C). FIG. 3D illustrates the step of forming a cured product by heating the sealing body (Step D).

DESCRIPTION OF THE EMBODIMENTS

[0013]

An embodiment of the sealable resin sheet of the present invention is described.

[0014]

The sealable resin sheet is a resin sheet used to seal an element and has an approximately plate shape (film shape) extending in a surface direction orthogonal to a thickness direction.

[0015]

The material of the sealable resin sheet contains thermosetting resin and further contains a layered silicate compound. Specifically, the material of the sealable resin sheet is a thermosetting resin composition containing thermosetting resin and a layered silicate compound.

[0016]

Examples of the thermosetting resin include epoxy resin, silicone resin, urethane resin, polyimide resin, urea resin, melamine resin, and unsaturated polyester resin. These can be used alone or in combination of two or more.

[0017]

As the thermosetting resin, preferably, epoxy resin is used. The epoxy resin is prepared as an epoxy resin composition containing a main agent, a curing agent, and a curing accelerator.

[0018]

Examples of the main agent include: bifunctional epoxy resins such as bisphenol A epoxy resin, bisphenol F epoxy resin, modified bisphenol A epoxy resin, modified bisphenol F epoxy resin, and biphenyl epoxy resin; and trifunctional or more of multifunctional epoxy resins such as phenol novolak epoxy resin, cresol novolak epoxy resin, trishydroxyphenyl methane epoxy resin, tetraphenylol ethane epoxy resin, and dicyclopentadiene epoxy resin. These epoxy resins can be used alone or in combination of two or more. As the main agent, preferably, a bifunctional epoxy resin, more preferably, a bisphenol F epoxy resin is used.

[0019]

The lower limit of the epoxy equivalent of the main agent is, for example, 10 g/eq., preferably, 100 g/eq.. The upper limit of the epoxy equivalent of the main agent is, for example, 300 g/eq., preferably, 250 g/eq..

[0020]

The lower limit of the softening point of the main agent is, for example, 50°C, preferably, 70°C, more preferably, 72°C, even more preferably, 75°C. The upper limit of the softening point of the main agent is, for example, 130°C, preferably, 110°C, more preferably, 90°C.

[0021]

When the softening point of the main agent is the above-described lower limit or more, a sealable resin sheet 1 can flow in the step illustrated in FIG. 1C. Thus, the time for the step illustrated in FIG. 1C can be shortened, and a one-side surface in the thickness direction of the sealable resin sheet 1 can be flattened in the step illustrated in FIG. 1C.

[0022]

The lower limit of the ratio of the main agent in the thermosetting resin composition is, for example, 1 mass%, preferably, 2 mass%. The upper limit of the ratio of the main agent in the thermosetting resin composition is, for example, 30 mass%, preferably, 15 mass%. The lower limit of the ratio of the main agent in the epoxy resin composition is, for example, 30 mass%, preferably, 50 mass%. The upper limit of the ratio of the main agent in the epoxy resin composition is, for example, 80 mass%, preferably, 70 mass%.

[0023]

The curing agent is a latent curing agent that cures the main agent by heating. Examples of the curing agent include phenol resins such as phenol novolak resin. When the curing agent is a phenol resin, a cured product of the phenol resin and main agent has a high heat resistance and a high chemical resistance. Accordingly, the cured product has excellent reliability for sealing.

[0024]

The ratio of the curing agent is set so that the following equivalent ratio holds. Specifically, the lower limit of the total amount of the hydroxyl group in the phenol resin with respect to 1 equivalent of the epoxy group in the main agent is, for example, 0.7 equivalent, preferably, 0.9 equivalent. The upper limit of the total amount of the hydroxyl group in the phenol resin with respect to 1 equivalent of the epoxy group in the main agent is, for example, 1.5 equivalent, preferably, 1.2 equivalent. Specifically, the lower limit of the contained amount of the curing agent with respect to 100 parts by mass of the main agent is, for example, 20 parts by mass, preferably, 40 parts by mass. The upper limit of the contained amount of the curing agent with respect to 100 parts by mass of the main agent is, for example, 80 parts by mass, preferably, 60 parts by mass.

[0025]

The curing accelerator is a catalyst (thermosetting catalyst) that promotes curing of the main agent by heating. Examples of the curing accelerator include organic phosphorus compounds and imidazole compounds such as 2-phenyl-4, 5-dihydroxy methyl imidazole (2PHZ-PW). Preferably, an imidazole compound is used. The lower limit of the contained amount of the curing accelerator with respect to 100 parts by mass of the main agent is, for example, 0.05 parts by mass. The upper limit of the contained amount of the curing accelerator with respect to 100 parts by mass of the main agent is, for example, 5 parts by mass.

[0026]

The lower limit of the content ratio of the thermosetting resin in the thermosetting resin composition (sealable resin sheet) is, for example, 5 mass%, preferably, 15 mass%, more preferably, 17 mass%, even more preferably, 18 mass%. The upper limit of the content ratio of the thermosetting resin in the thermosetting resin composition (sealable resin sheet) is, for example, 30 mass%, preferably, 25 mass%, more preferably, 20 mass%.

[0027]

The layered silicate compound is dispersed into the thermosetting resin (matrix) in the thermosetting resin composition (sealable resin sheet). The layered silicate compound works as a flow adjuster when a sealing body and a cured product (describe below) are formed from the sealable resin sheet. Specifically, the layered silicate compound is a flow reducer used to reduce the fluidity of the cured product when the sealable resin sheet is heated and cured to form the cured product.

[0028]

The layered silicate compound is, for example, silicate salt having a structure (three-dimensional structure) in which layers each two-dimensionally extending (in the surface direction) are laminated in the thickness direction, and referred to as phyllosilicate.

[0029]

Specifically, examples of the layered silicate compound include: smectite such as montmorillonite, beidellite, non-tronite, saponite, hectorite, sauconite, and stevensite; kaolinite; halloysite; talc; and mica. To improve the mixability with the thermosetting resin, preferably, smectite is used as the layered silicate compound. More preferably, montmorillonite is used.

[0030]

The layered silicate compound may be an unmodified product of which surface is not modified. Alternatively, the layered silicate compound may be a modified product of which surface is modified by an organic component. To achieve excellent affinity with the thermosetting resin, preferably, the layered silicate compound has a surface modified by an organic component. Specifically, as the layered silicate compound, organic smectite having a surface modified by an organic component is used. More preferably, organic bentonite having a surface modified by an organic component is used.

[0031]

Examples of the organic component include organic cation (onium ion) such as ammonium, imidazolium, pyridinium, and phosphonium.

[0032]

Examples of the ammonium include dimethyl distearyl ammonium, distearyl ammonium, octadecylammonium, hexylammonium, octylammonium, 2-hexylammonium,

dodecylammonium, and trioctylammonium. Examples of the imidazolium include methyl stearyl imidazolium, distearyl imidazolium, methylhexylimidazolium, dihexylimidazolium, methyloctylimidazolium, dioctylimidazolium, methyldodecylimidazolium, and didodecylimidazolium. Examples of the pyridinium include stearyl pyridinium, hexylpyridinium, octylpyridinium, and dodecylpyridinium. Examples of the phosphonium include dimethyl distearyl phosphonium, distearyl phosphonium, octadecylphosphonium, hexylphosphonium, octylphosphonium, 2-hexylphosphonium, dodecylphosphonium, and trioctylphosphonium. These organic cations can be used alone or in combination of two or more. Preferably, ammonium, more preferably, dimethyl distearyl ammonium is used.

[0033]

As the organic layered silicate compound, preferably, organic smectite having a surface modified by ammonium is used. More preferably, organic bentonite having a surface modified by dimethyl distearyl ammonium is used.

[0034]

The lower limit of the average particle size of the layered silicate compound is, for example, 1 nm, preferably, 5 nm, more preferably, 10 nm. The upper limit of the average particle size of the layered silicate compound is, for example, 100 μm , preferably, 50 μm , more preferably, 10 μm . The average particle size of the layered silicate compound is, for example, obtained as a D50 value (50% accumulation in median diameter) based on the particle size distribution obtained by a particle size distribution measurement method in a laser scattering method.

[0035]

A commercialized product can be used as the layered silicate compound. As an exemplary commercialized product of organic bentonite, the S-Ben series (manufactured by HOJUN.,Co.Ltd.) is used.

[0036]

The lower limit of the content ratio of the layered silicate compound in the thermosetting resin composition (sealable resin sheet) is, for example, 0.1 mass%, preferably, 1 mass%, more preferably, 2 mass%, more preferably, 3 mass%, particularly preferably, 4 mass%. The upper limit of the content ratio of the layered silicate compound in the thermosetting resin composition

(sealable resin sheet) is, for example, 25 mass%, preferably, 10 mass%, more preferably, 9 mass%, even more preferably, 7 mass%, particularly preferably, 6 mass%.

[0037]

When the content ratio of the layered silicate compound is the upper limit or less, the layered silicate compound can sufficiently be dispersed in the sealable resin sheet. Thus, a sealable resin sheet with a uniform fluidity can be produced.

[0038]

The thermosetting resin composition can further contain an inorganic filler in addition to the layered silicate compound.

[0039]

Examples of the inorganic filler include: a silicate salt compound other than the layered silicate compound such as orthosilicate salt, sorosilicate salt, and inosilicate salt; and a silicon compound (other than the layered silicate compound) such as quartz (silicic acid), silica (anhydrous silicic acid), and silicon nitride. Examples of the inorganic filler further include alumina, aluminum nitride, and boron nitride. These can be used alone or in combination of two or more. Preferably, a silicate salt compound other than the layered silicate compound, more preferably, silica is used.

[0040]

The shape of the inorganic filler particles is not especially limited. Example thereof include an approximately spherical shape, an approximately plate shape, an approximately aciculate shape, and an amorphous shape. Preferably, an approximately spherical shape is used.

[0041]

The upper limit of the average value (average particle size in the case of an approximately spherical shape) of the maximum lengths of the inorganic filler particles is, for example, 50 μm , preferably, 20 μm , more preferably, 10 μm . The lower limit of the average value of the maximum lengths of the inorganic filler particles is, for example, 0.1 μm , preferably, 0.5 μm . The average particle size is, for example, obtained as a D50 value (50% accumulation in median diameter) based on the particle size distribution obtained by a particle size distribution measurement method in a laser scattering method.

[0042]

The inorganic filler can include a first filler and a second filler having an average value of the maximum lengths smaller than the average value of the maximum lengths of the first filler particles.

[0043]

The lower limit of the average value of the maximum lengths of the first filler particles is, for example, 1 μm , preferably, 3 μm . The upper limit of the average value of the maximum lengths of the first filler particles is, for example, 50 μm , preferably, 30 μm .

[0044]

The upper limit of the average value of the maximum lengths of the second filler particles is, for example, 0.9 μm , preferably, 0.8 μm . The lower limit of the average value of the maximum lengths of the second filler particles is, for example, 0.01 μm , preferably, 0.1 μm .

[0045]

The lower limit of the ratio of the average value of the maximum lengths of the first filler particles to the average value of the maximum lengths of the second filler particles is, for example, 2, preferably, 5. The upper limit of the ratio of the average value of the maximum lengths of the first filler particles to the average value of the maximum lengths of the second filler particles is, for example, 50, preferably, 20.

[0046]

The material of the first filler may be the same as or different from that of the second filler.

[0047]

In addition, the inorganic filler may have a surface partially or wholly treated with, for example, a silane coupling agent.

[0048]

The lower limit of the content ratio of the inorganic filler in the thermosetting resin composition (sealable resin sheet) is, for example, 50 mass%, preferably, 55 mass%, more preferably, 60 mass%, even more preferably, 65 mass%. The upper limit of the content ratio of the inorganic filler in the thermosetting resin composition (sealable resin sheet) is, for example, 90 mass%, preferably, 85 mass%, more preferably, 80 mass%, even more preferably, 75 mass%.

[0049]

When the content ratio of the inorganic filler is the above-described lower limit or more, the coefficient of linear thermal expansion of the thermosetting resin composition is improved (reduced). Thus, the reliability of the element can be ensured. When the content ratio of the inorganic filler is the above-described upper limit or less, the hardening and weakening of the thermosetting resin composition can be suppressed, and the reduction in handleability can be suppressed.

[0050]

Particularly, in the embodiment, when the content ratio of the inorganic filler in the thermosetting resin composition (sealable resin sheet) is, for example, 50 mass% or more and 90 mass% or less, i.e., in a high range, the content ratio of the layered silicate compound in the thermosetting resin composition (sealable resin sheet) is, for example, 3 mass% or more and 6 mass% or less, i.e., in a low range.

[0051]

In other words, in the embodiment, even when the content ratio of the inorganic filler is high and the content ratio of the layered silicate compound is low in the thermosetting resin composition (sealable resin sheet), the fluidity of the cured product can effectively be reduced at the forming of the cured product from the sealing body by heating. In this manner, the entering amount of the cured product that enters between the element and board can be reduced.

[0052]

When the content ratio and/or contained amount of the inorganic filler is the above-described lower limit or more, the sealable resin sheet 1 can flow in the step illustrated in FIG. 1C.

[0053]

The lower limit of the contained amount of the layered silicate compound with respect to 100 parts by mass of the inorganic filler is, for example, 1 part by mass, preferably, 2 parts by mass, more preferably, 3 parts by mass, even more preferably, 5 parts by mass. The upper limit of the contained amount of the layered silicate compound with respect to 100 parts by mass of the inorganic filler is, for example, 25 parts by mass, preferably, 20 parts by mass, more preferably, 15 parts by mass, even more preferably, 10 parts by mass.

[0054]

When the inorganic filler includes the first filler and second filler, the lower limit of the content ratio of the first filler in the thermosetting resin composition (sealable resin sheet) is, for example, 30 mass%, preferably, 40 mass% in the thermosetting resin composition. The upper limit of the content ratio of the first filler in the thermosetting resin composition (sealable resin sheet) is, for example, 60 mass%, preferably, 50 mass% in the thermosetting resin composition. The lower limit of the contained amount of the second filler to 100 parts by mass of the first filler is, for example, 30 parts by mass, preferably, 40 parts by mass, more preferably, 50 parts by mass. The upper limit of the contained amount of the second filler to 100 parts by mass of the first filler is, for example, 70 parts by mass, preferably, 60 parts by mass, more preferably, 55 parts by mass.

[0055]

Another additive agent such as thermoplastic resin, a pigment, or a silane coupling agent can be added to the thermosetting resin composition.

[0056]

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 resin (6-nylon, 6,6-nylon, or the like), phenoxy resin, acrylic resin, saturated polyester resin (PET or the like), polyamide imide resin, fluorine resin, and styrene-isobutylene-styrene block copolymer. These thermoplastic resins can be used alone or in combination of two or more.

[0057]

To improve the dispersibility with the main agent, preferably, an acrylic resin is used as the thermoplastic resin.

[0058]

Examples of the acrylic resin include a carboxyl group-containing (meth)acrylate copolymer (preferably, carboxyl group-containing acrylate copolymer) obtained by polymerizing a monomer component containing an alkyl (meth)acrylate having a straight-chain or branched alkyl group and another monomer (copolymerizable monomer).

[0059]

Examples of the alkyl group include an alkyl group having a carbon number of 1 to 6 such as methyl, ethyl, propyl, isopropyl, n-butyl, t-butyl, isobutyl, pentyl, and hexyl.

[0060]

Examples of the other monomer include carboxyl group-containing monomers such as acrylic acid, methacrylic acid, carboxyethyl acrylate, carboxypentyl acrylate, itaconic acid, maleic acid, fumaric acid, and crotonic acid.

[0061]

The lower limit of the weight average molecular weight of the thermoplastic resin is, for example, 100,000, preferably 300,000. The upper limit of the weight average molecular weight of the thermoplastic resin is, for example, 1,000,000, preferably 900,000. The weight average molecular weight is calibrated with standard polystyrene based on gel permeation chromatography (GPC).

[0062]

The ratio (solid content ratio) of the thermoplastic resin is adjusted so as not to block the thermal curing of the thermosetting resin. Specifically, the lower limit of the ratio (solid content ratio) of the thermoplastic resin in the thermosetting resin composition is, for example, 1 mass% or more, preferably 2 mass% or more. The upper limit of the ratio (solid content ratio) of the thermoplastic resin in the thermosetting resin composition is, for example, 10 mass%, preferably, 5 mass%.

[0063]

The thermoplastic resin may be prepared by being diluted with an appropriate solvent.

[0064]

Examples of the pigment include black pigments such as carbon black. The lower limit of the particle size of the pigment is, for example, 0.001 μm . The upper limit of the particle size of the pigment is, for example, 1 μm . The lower limit of the ratio of the pigment to the thermosetting resin composition is, for example, 0.1 mass%. The particle size of the pigment is an arithmetic average particle size obtained by observing the pigment with an electron microscope. The upper limit of the ratio of the pigment to the thermosetting resin composition is, for example, 2 mass%.

[0065]

Examples of the silane coupling agent include a silane coupling agent containing an epoxy group. Examples of the silane coupling agent containing an epoxy group include: 3-glycidoxy dialkyl dialkoxysilanes such as 3-glycidoxy propyl methyl dimethoxy silane and 3-glycidoxy propyl methyl diethoxy silane; and 3-glycidoxy alkyl trialkoxysilanes such as 3-glycidoxy propyl trimethoxy silane and 3-glycidoxy propyl triethoxy silane. Preferably, a 3-glycidoxy alkyl trialkoxysilane is used. The lower limit of the content ratio of the silane coupling agent in the thermosetting resin composition is, for example, 0.1 mass%, preferably, 1 mass%. The upper limit of the content ratio of the silane coupling agent in the thermosetting resin composition is, for example, 10 mass%, preferably, 5 mass%.

[0066]

To produce the sealable resin sheet, the thermosetting resin composition is prepared by blending the above-described components in the above-described ratios. Preferably, the above-described components are sufficiently stirred to uniformly disperse the layered silicate compound and the inorganic filler blended as necessary into the thermosetting resin composition.

[0067]

As necessary, a solvent (for example, ketone such as methyl ethyl ketone) is further blended, thereby preparing a varnish. Thereafter, the varnish is applied to a peeling sheet not illustrated and then dried by heating, thereby producing a sealable resin sheet having a sheet shape.

Alternatively, without preparing a varnish, the sealable resin sheet can be formed from the thermosetting resin composition by kneading extrusion.

[0068]

The formed sealable resin sheet is B stage (a semi-cured state), and specifically in a state before C stage. In short, the formed sealable resin sheet is in a state before being completely cured.

The sealable resin sheet is formed as a B-stage sheet from the thermosetting resin composition in A stage by heating in the above-described drying or by heating in the kneading extrusion.

[0069]

The lower limit of the thickness of the sealable resin sheet is, for example, 10 μm , preferably, 25 μm , more preferably, 50 μm . The upper limit of the thickness of the sealable resin sheet is, for example, 3000 μm , preferably, 1000 μm , more preferably, 500 μm , even more preferably, 300 μm .

[0070]

Next, a method of producing an electronic element package 51 by sealing electronic elements as exemplary elements with the sealable resin sheet is described with reference to FIG. 1A to FIG. 1D.

[0071]

In this method, as illustrated in FIG. 1A, first, a sealable resin sheet 1 is prepared. The sealable resin sheet 1 has a one-side surface and the other-side surface in thickness direction, which face each other in the thickness direction.

[0072]

As illustrated in FIG. 1B, an electronic element 21 is separately be prepared.

[0073]

The electronic element 21 includes an electronic component. For example, a plurality of electronic elements 21 is mounted on a board 22. The plurality of electronic elements 21 and board 22 are included together with bumps 23 on an element mounting board 24. In short, the element mounting board 24 includes the plurality of electronic elements 21, the board 22, and the bumps 23.

[0074]

The board 22 has an approximately flat plate shape extending in the surface direction. A one-side surface 25 in the thickness direction of the board 22 is provided with terminals (not illustrated) electrically connected to electrodes (not illustrated) of the electronic elements 21.

[0075]

Each of the electronic elements 21 has an approximately flat board shape (chip shape) extending in the surface direction. The electronic elements 21 are disposed with a space therebetween in the surface direction. The other-side surfaces 28 in the thickness direction of the electronic elements 2 are parallel to the one-side surface 25 in the thickness direction of the board 22. The other-side surface 28 in the thickness direction of each of the electronic elements 21 is provided with an electrode (not illustrated). The electrodes of the electronic elements 21 are electrically connected to the terminals of the board 22 via the bumps 23 described next. The other-side surfaces 28 in the thickness direction of the electronic elements 21 are separated from the one-side surface 25 in the thickness direction of the board 22 with gaps (spaces) 26 therebetween.

[0076]

The lower limit of the interval (thickness-direction length) between the adjacent electronic elements 21 is, for example, 50 μm , preferably, 100 μm , more preferably, 200 μm . The upper limit of the interval between the adjacent electronic elements 21 is, for example, 10 mm, preferably, 5 mm, more preferably, 1 mm. When the interval between the adjacent electronic elements 21 is the above-described upper limit or less, the board 22 can mount more electronic elements 21. Thus, the space can be saved.

[0077]

The bumps 23 electrically connect the electrodes (not illustrated) of the electronic elements 21 to the terminals on the board 22, respectively. The bumps 23 are disposed between the electrodes of the electronic elements 21 and the terminals on the board 22. Examples of the material of the bumps 23 include metals such as a solder and gold. The bump 23 has a thickness corresponding to the thickness (height) of the gap 26. The thickness of the bump 23 is appropriately set, depending on the use or purpose of the element mounting board 24.

[0078]

Next, as illustrated in FIG. 1B, the sealable resin sheet 1 is disposed on the plurality of electronic elements 21. Specifically, the other-side surface in the thickness direction of the sealable resin sheet 1 is brought into contact with the one-side surfaces in the thickness direction of the electronic elements 21.

[0079]

Next, as illustrated in FIG. 1C, the sealable resin sheet 1 and the element mounting board 24 are pressed. Preferably, the sealable resin sheet 1 and element mounting board 24 are heat-pressed.

[0080]

For example, a press 27 having two flat plates presses the sealable resin sheet 1 and element mounting board 24, sandwiching them in the thickness direction. The flat plates of the press 27 include, for example, a heat source not illustrated.

[0081]

The conditions for the press (for example, pressure, time, and temperature) are not especially limited. The conditions allowing the sealable resin sheet 1 to enter between the electronic elements 21 and preventing the element mounting board 24 from being damaged are selected.

More specifically, the conditions for the press are set so that the sealable resin sheet 1 can flow and enter between the adjacent electronic elements 21, cover the side peripheral surface of each of the electronic elements 21, and be in contact with the one-side surface 25 in the thickness direction of the board 22 that does not overlap the electronic elements 21 in the plan view.

[0082]

Specifically, the lower limit of the pressure of the press is, for example, 0.05 MPa, preferably, 0.1 MPa. The upper limit of the pressure of the press is, for example, 10 MPa, preferably, 5 MPa. The lower limit of the time of the press is, for example, 0.3 minutes, preferably, 0.5 minutes. The upper limit of the time of the press is, for example, 10 minutes, preferably, 5 minutes.

[0083]

Specifically, the lower limit of the heating temperature is, for example, 40°C, preferably, 60°C. The upper limit of the heating temperature is, for example, 100°C, preferably, 95°C.

[0084]

When the sealable resin sheet 1 is pressed, the sealable resin sheet 1 plastically deforms corresponding in the outer shape of the electronic elements 21. The other-side surface in the thickness direction of the sealable resin sheet 1 deforms into a shape corresponding to the thickness-direction one-side surfaces and side peripheral surfaces of the electronic elements 21.

[0085]

The sealable resin sheet 1 plastically deforms while maintaining B stage.

[0086]

In this manner, the sealable resin sheet 1 covers the side peripheral surface of each of the electronic elements 21, and is in contact with the one-side surface 25 in the thickness direction of the board 22 that does not overlap the electronic elements 21 in the plan view.

[0087]

In this manner, a sealing body 31 sealing the electronic elements 21 is formed (produced) from the sealable resin sheet 1. A one-side surface in the thickness direction of the sealing body 31 is a flat surface.

[0088]

At that time, the sealing body 31 is allowed to slightly enter the gap 26 (between the electronic elements 21 and board 22). Specifically, the sealing body 31 is allowed to have a sealing body entering length X in which the sealing body 31 enters the gap 26 based on a side edge of the electronic element 21 (see FIG. 3C).

[0089]

Thereafter, as illustrated in FIG. 1D, the sealing body 31 is heated, thereby forming a cured product 41 from the sealing body 31.

[0090]

Specifically, the sealing body 31 and element mounting board 24 are taken out of the press 27. Subsequently, the sealing body 31 and element mounting board 24 are heated under atmospheric pressure in a dryer.

[0091]

The lower limit of the heating temperature (curing temperature) is, for example, 100°C, preferably, 120°C. The upper limit of the heating temperature (curing temperature) is, for example, 200°C, preferably, 180°C. The lower limit of the heating time is, for example, 10 minutes, preferably, 30 minutes. The upper limit of the heating time is, for example, 180 minutes, preferably, 120 minutes.

[0092]

The above-described heating of the sealing body 31 forms the cured product 41 in C stage (completely cured) from the sealing body 31. A one-side surface in the thickness direction of the cured product 41 is an exposed surface.

[0093]

An edge of the sealing body 31 allowed to slightly enter the gap is further allowed to slightly enter the inside of the gap 26 and become the cured product 41 therein. The degree of the entry is suppressed as much as possible. Specifically, the cured product 41 is allowed to have a value $(Y - X)$, i.e., the difference when the sealing body entering length X is subtracted from a cured product entering length Y (see FIG. 3D) in which the cured product 41 enters the gap 26 based on the side edge of the electronic elements 21.

[0094]

The sealable resin sheet 1 contains the layered silicate compound. Thus, when the cured product 41 as illustrated in FIG. 1D is formed by disposing the sealable resin sheet 1 on the electronic element 21 and heating the sealable resin sheet 1 (sealing body 31), the entering amount of the cured product 41 that enters the gap 26 between the electronic element 21 and board 22 can be reduced.

[0095]

Even when the sealable resin sheet 1 further contains the inorganic filler other than the layered silicate compound at a high ratio i.e., 50 mass% or more and 85 mass% or less and the content ratio of the layered silicate compound is 3 mass% or more and 6 mass% or less, i.e, at a low ratio, the entering amount of the cured product 41 that enters the gap 26 can effectively be reduced.

[0096]

Specifically, the sealing body entering length Y (see FIG. 3D) described in detail in Examples can be reduced.

[0097]

As illustrated in FIG. 2A to FIG. 2D, a sealable multi-layer resin sheet 11, which includes the sealable resin sheet 1 and a second sealable resin sheet 12 sequentially at one side in the thickness direction, seals the electronic elements 21. Subsequently, the cured product 41 can be formed.

[0098]

The sealable multi-layer resin sheet 11 includes the sealable resin sheet 1, and the second sealable resin sheet 12 disposed on the whole of the one-side surface in the thickness direction of the sealable resin sheet 1. Preferably, the sealable multi-layer resin sheet 11 includes only the sealable resin sheet 1 and the second sealable resin sheet 12.

[0099]

The material of the second sealable resin sheet 12 is the same as the material (thermosetting resin composition) of the sealable resin sheet 1, except that the material of the second sealable resin sheet 12 does not contain a layered silicate compound. The lower limit of the ratio of the thickness of the second sealable resin sheet 12 to the thickness of the sealable resin sheet 1 is, for example, 0.5, preferably, 1, more preferably, 2. The upper limit of the ratio of the thickness of

the second sealable resin sheet 12 to the thickness of the sealable resin sheet 1 is, for example, 10, preferably, 5.

[0100]

A method of producing an electronic element cured product package 50 by sealing the plurality of electronic elements 21 with the sealable multi-layer resin sheet 11 and subsequently forming the cured product 41 is described with reference to FIG. 2A to FIG. 2D.

[0101]

As illustrated in FIG. 2A, the sealable multi-layer resin sheet 11 is prepared. Specifically, the sealable resin sheet 1 and the second sealable resin sheet 12 are bonded to each other.

[0102]

As illustrated in FIG. 2B, the plurality of electronic elements 21 mounted on the board 22 is prepared.

[0103]

Subsequently, the sealable multi-layer resin sheet 11 is disposed on the electronic elements 21 so that the other-side surface in the thickness direction of the sealable resin sheet 1 is brought into contact with the one-side surfaces in the thickness direction of the electronic elements 21.

[0104]

As illustrated in FIG. 2C, thereafter, the sealable resin sheet 1 and the element mounting board 24 are pressed.

[0105]

The press makes the sealable resin sheet 1 flow and enter between the adjacent electronic elements 21. On the other hand, the second sealable resin sheet 12 does not contain a layered silicate compound. Thus, when the second sealable resin sheet 12 is pressed, the fluidity of the second sealable resin sheet 12 is not improved and maintained low. Hence, the entry of the second sealable resin sheet 12 between the adjacent electronic elements 21 is suppressed.

[0106]

In this manner, the sealing body 31 sealing the electronic elements 21 is formed from the sealable multi-layer resin sheet 11.

[0107]

When the sealable resin sheet 1 contains the inorganic filler in a ratio of the above-described lower limit or more and the second sealable resin sheet 12 contains the inorganic filler in a ratio of the above-described lower limit or more, the press illustrated in FIG. 2C can make both the sealable resin sheet 1 and second sealable resin sheet 12 flow.

[0108]

At that time, the sealable resin sheet 1 is in contact with the electronic elements 21 while the second sealable resin sheet 12 is located at a side opposite to the electronic elements 21 relative to the sealable resin sheet 1. In other words, an edge of the sealing body 31 that faces the gap 26 is formed from the sealable resin sheet 1. On the other hand, the one-side surface in the thickness direction of the sealing body 31 is formed from the second sealable resin sheet 12.

[0109]

Thereafter, as illustrated in FIG. 2D, the sealing body 31 is heated, thereby forming the cured product 41 from the sealing body 31.

[0110]

The sealable multi-layer resin sheet 11 includes the above-described sealable resin sheet 1. Thus, the entering amount of the cured product 41 that enters the gap 26 can be reduced.

[0111]

This sealable multi-layer resin sheet 11 can also have the same operations and effects as those of the above-described sealable resin sheet 1.

[0112]

In particular, when the sealable resin sheet 1 and the second sealable resin sheet 12 contain a main agent of epoxy resin having a softening point of 50°C or more and 130°C or less, the sealable resin sheet 1 and the second sealable resin sheet 12 can flow in the step illustrated in FIG. 2C. Thus, the time for the step illustrated in FIG. 2C can be shortened, and a one-side surface in the thickness direction of the second sealable resin sheet 12 can be flattened in the step illustrated in FIG. 2C.

[0113]

Furthermore, when the sealable resin sheet 1 and the second sealable resin sheet 12 contain phenol resin as a curing agent together with the main agent of epoxy resin, the cured product 41

has a high heat resistance and a high chemical resistance. Accordingly, the cured product 41 has excellent reliability for sealing.

[0114]

In the step illustrated in FIG. 2C, the second sealable resin sheet 12 receives the pressing force and is fluidized. Thus, the one-side surface in the thickness direction of the second sealable resin sheet 12 is flattened. As described above, in the step illustrated in FIG. 2C, the sealable resin sheet 1 receives the pressing force, is softened and flows together with the second sealable resin sheet 12 in the sealable multi-layer resin sheet 11. Then, the sealable multi-layer resin sheet 11 deforms, following the outer shapes of the electronic elements 21. In the step illustrated in FIG. 2C, the sealable resin sheet 1 is allowed to slightly enter the gap 26.

[0115]

In the step illustrated in FIG. 2D, the flow of the sealable resin sheet 1 is suppressed based on the reduction in complex viscosity η^* with the rise in temperature. Thus, an excessive entry of the sealable resin sheet 1 to the gap 26 is suppressed. In other words, the cured product 41 that is the cured sealable multi-layer resin sheet 11 including the sealable resin sheet 1 can reduce the cured product entering length Y.

[0116]

Variations

In each of the variations described below, the same members and steps as the above-described embodiment are given the same numerical references and the descriptions thereof are omitted. Further, each of the variations has the same operations and effects as those of the embodiment unless especially described otherwise. The embodiment and variations can appropriately be combined.

[0117]

In the embodiment, the one-layer sealable resin sheet 1 seals the electronic elements 21. Although not illustrated, however, (a laminate sheet of) a plurality of the sealable resin sheets 1 can seal the electronic elements 21.

[0118]

Alternatively, the second sealable resin sheet 12 in the sealable multi-layer resin sheet 11 can have a plurality of layers.

[0119]

As an example of the element, the electronic elements 21 separated from the one-side surface 25 in the thickness direction of the board 22 with the gap 26 therebetween is described. Then, the electronic elements 21 are sealed with the sealable resin sheet 1. However, although not illustrated, for example, electronic elements 21 in contact with the one-side surface 25 in the thickness direction of the board 22 can be used. Then, the electronic elements 21 can be sealed with the sealable resin sheet 1 as well.

[0120]

As an example of the element, the electronic elements 21 are described. However, a semiconductor element can be used as well.

Examples

[0121]

Hereinafter, with reference to Preparation Examples, Comparative Preparation Example, Examples, and Comparative Example, the present invention is more specifically described. The present invention is not limited to Preparation Examples, Comparative Preparation Example, Examples, and Comparative Example in any manner. The specific numeral values used in the description below, such as mixing ratios (contents), physical property values, and parameters can be replaced with the corresponding mixing ratios (contents), physical property values, parameters in the above-described "DESCRIPTION OF EMBODIMENTS", including the upper limit values (numeral values defined with "or less", and "less than") or the lower limit values (numeral values defined with "or more", and "more than").

[0122]

The components used in Preparation Examples and Comparative Preparation Example are described as follows.

[0123]

Layered silicate compound: S-BEN NX manufactured by HOJUN Co., Ltd. (organic bentonite having a surface modified by dimethyl distearyl ammonium)

Main agent: YSLV-80XY manufactured by the new Nippon Steel Chemical Co., Ltd. (bisphenol F type epoxy resin, high-molecular-weight epoxy resin, epoxy equivalent of 200 g/eq., softening point of 80°C)

Curing agent: LVR- 8210DL manufactured by Gunei Chemical Industry Co., Ltd. (novolac-type phenol resin, latent curing agent, hydroxyl group equivalent: 104 g/eq., softening point: 60°C)

Curing accelerator: 2PHZ-PW manufactured by SHIKOKU CHEMICALS CORPORATION (2-phenyl-4,5-dihydroxymethylimidazole)

Acryl resin: HME-2006M manufactured by Negami Chemical Industrial Co.,Ltd., a carboxyl group-containing acrylic acid ester copolymer (acrylic polymer), weight-average molecular weight: 600,000, glass-transition temperature (T_g): -35°C, methyl ethyl ketone solution with a 20 mass% solid content concentration

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

First filler: FB-8SM (spherical molten silica powder (inorganic filler), average particle size of 7.0 μm)

Second filler: an inorganic filler made of SC220G-SMJ manufactured by Admatechs Company Limited (average particle size of 0.5 μm) having a surface finished with 3-methacryloxypropyl trimethoxysilane (manufactured by Shin-Etsu Chemical Co., Ltd. product name: KBM- 503). Inorganic particles having a surface finished with 1 part by mass of a silane coupling agent with respect to 100 parts by mass of the inorganic filler.

Carbon black: #20 manufactured by Mitsubishi Chemical Corporation., particle size of 50 nm
[0124]

Preparation Example 1 to Preparation Example 6 and Comparative Preparation Example 1

A varnish of a thermosetting resin composition was prepared in conformity with the blending formula described in Table 1. The varnish was applied on a surface of a peeling sheet, and then dried at 120°C for 2 minutes, thereby producing a sealable resin sheet 1 with a thickness of 65 μm. The sealable resin sheet 1 was in B stage.

[0125]

Preparation Example 7

A varnish of a thermosetting resin composition was prepared in conformity with the blending formula described in Table 2. The varnish was applied on a surface of a peeling sheet, and then dried at 120°C for 2 minutes, thereby producing a second sealable resin sheet 12 with a thickness of 195 μm. The second sealable resin sheet 12 was in B stage.

[0126]

Examples 1 to 6 and Comparative Example 1

In each of the combinations of Preparation Examples shown in Table 3, the sealable resin sheet and the second sealable resin sheet were adhered to each other, thereby producing a sealable multi-layer resin sheet with a thickness of 260 μm .

[0127]

Evaluation

Steps A to E were carried out. Then, the cured product entering length Y was measured.

[0128]

Step A: As illustrated in FIG. 3A, a sample sheet 61 with a longitudinal length of 10 mm, a lateral length of 10 mm, and a thickness of 260 μm was prepared from the sealable multi-layer resin sheet 11 of each of Examples and Comparative Example.

[0129]

Step B: As illustrated in FIG. 3B, a dummy element mounting board 74 was prepared by mounting a dummy element 71 with a longitudinal length of 3 mm, a lateral length of 3 mm, and a thickness of 200 μm on a glass board 72 through bumps 23.

[0130]

Step C: As illustrated in FIG. 3C, the sample sheet 61 sealed the dummy element 71 on the dummy element mounting board 74 by vacuum flat-plate press at a temperature of 65°C, a pressure of 0.1 MPa, a degree of vacuum of 1.6 kPa, and for a press time of 1 minute, thereby forming a sealing body 31 from the sample sheet 61.

[0131]

Step D: As illustrated in FIG. 3D, the sealing body 31 was heat-cured by heating at 150°C under atmospheric pressure for 1 hour, thereby forming a cured product 41 from the sealing body 31.

[0132]

Step E: As illustrated in an enlarged drawing of FIG. 3D, the cured product entering length Y in which the cured product 41 entered the gap 26 between the dummy element 71 and the glass board 72 from a side edge 75 was measured based on the side edge 75 of the dummy element 71.

[0133]

By the following criteria, the cured product entering length Y was evaluated. The results are shown in Table 1.

Good: The cured product entering length Y was 0 μm or more and 20 μm or less.

Fair: The cured product entering length Y was more than 20 μm and 30 μm or less, or less than 0 μm and -5 μm or more.

Bad: The cured product entering length Y was more than 30 μm , or, less than -5 μm .

[0134]

In the evaluation, the “minus” means that a space protruding outward from the side edge 75 of the dummy element 71 was formed (see the thick dashed line in FIG. 2D). The absolute value of the “minus” corresponds to a length of the protruding space.

[0135]

[Table 1]

Table 1]

Material of sealable resin sheet					Preparation Example 1	Preparation Example 2	Preparation Example 3	Preparation Example 4	Preparation Example 5	Preparation Example 6	Comparative Preparation Example 1	
Formula for thermosetting resin composition	Layered silicate compound	Organic bentonite (modified by dimethyl distearyl ammonium)	S-Ben NX	(part)	0.43	0.57	0.71	0.86	1	1.43	0	
	Parts of layered silicate compound to 100 parts of inorganic filler			[%]	3	4	5	6	7	10	0	
	Content of layered silicate compound in sealable resin sheet			[%]	4	6	7	9	10	14	0	
	Epoxy resin composition	Main agent	Epoxy resin	YSLV-80XY	(part)	1.8	1.73	1.66	1.59	1.52	1.31	2.01
		Curing agent	Phenol resin	LVR-8210DL	(part)	0.98	0.94	0.9	0.87	0.83	0.712	1.01
		Curing accelerator	Imidazole-type	2PHZ-PW	(part)	0.026	0.025	0.024	0.023	0.022	0.02	0.029
	Ratio of main agent in thermosetting resin composition			[%]	13	12	12	11	11	9	14	
	Ratio of main agent in epoxy resin composition			[%]	64	64	64	64	64	64	66	
	Parts of curing agent to 100 parts of main agent			(part)	54	54	54	55	55	54	50	
	Parts of curing accelerator to 100 parts of main agent			(part)	1.4	1.4	1.4	1.4	1.4	1.5	1.4	
	Content of thermosetting resin in thermosetting resin composition			[%]	20	19	18	17	17	14	21	
	Thermoplastic resin	Acrylic polymer (solid content only)		HME-2006M	(part)	0.79	0.76	0.73	0.7	0.67	0.58	0.87
	Ratio of thermoplastic resin in thermosetting resin composition			[%]	6	5	5	5	5	4	6	
	Silane coupling agent	Glycidyl group-containing		KBM-403	(part)	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Content of silane coupling agent in thermosetting resin composition			[%]	1	1	1	1	1	1	1	1
	Inorganic filler	First filler		FB-8SM	(part)	6.5	6.5	6.5	6.5	6.5	6.5	6.5
		Second filler		SC220G-SMJ	(part)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	Content of inorganic filler			[%]	48	48	49	49	50	52	47	
	Content of first filler in thermosetting resin composition			[%]	45	46	46	45	45	45	46	
	Parts of second filler to 100 parts by mass of first filler			(part)	54	54	54	54	54	54	54	54
	Pigment	Carbon black		#20	(part)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Ratio of pigment to thermosetting resin composition			[%]	1	1	1	1	1	1	1	1

[0136]

[Table 2]

Material of second sealable resin sheet					Preparation Example 7
Formula for thermosetting resin composition	Epoxy resin composition	Main agent	Epoxy resin	YSLV-80XY (part)	1.84
		Curing agent	Phenol resin	LVR-8210DL (part)	1
		Curing accelerator	Imidazole-type	2PHZ-PW (part)	0.02
	Ratio of main agent in thermosetting resin composition				[%] 7
	Ratio of main agent in epoxy resin composition				[%] 64
	Parts of curing agent to 100 parts of main agent				(part) 54
	Parts of curing accelerator to 100 parts of main agent	s			(part) 1.1
	Content of thermosetting resin in thermosetting resin composition				[%] 11
	Thermoplastic resin	Acrylic polymer (solid content only)		HME-2006M (part)	0.17
	Ratio of thermoplastic resin in thermosetting resin composition				[%] 1
	Silane coupling agent	Glycidyl group-containing		KBM-403 (part)	0.35
	Content of silane coupling agent in thermosetting resin composition				[%] 1
	Inorganic filler	First filler		FB-8-SM (part)	15.15
		Second filler		SC220G-SMJ (part)	8.16
	Content of inorganic filler				[%] 81
	Content of first filler in thermosetting resin composition				[%] 57
	Parts of second filler to 100 parts by mass of first filler				(part) 54
	Pigment	Carbon black		#20 (part)	0.1
	Ratio of pigment to thermosetting resin composition				[%] 0

[0137]

[Table 3]

Sealable multi-layer resin sheet	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comparative Example 1
Second sealable resin sheet	Preparation Example7	Preparation Example7	Preparation Example7	Preparation Example7	Preparation Example7	Preparation Example7	Preparation Example7
Sealable resin sheet	Preparation Example1	Preparation Example2	Preparation Example3	Preparation Example4	Preparation Example5	Preparation Example6	Comparative Preparation Example 1
Evaluation of entering amount to gap	Fair	Good	Good	Good	Fair	Fair	Bad

While the illustrative embodiments of the present invention are provided in the above description, such is for illustrative purpose only and it is not to be construed as limiting in any manner. Modification and variation of the present invention that will be obvious to those skilled in the art is to be covered by the following claims.

Industrial Applicability

[0138]

The sealable resin sheet is used to seal an element.

Description of Reference Numerals

[0139]

1 sealable resin sheet

Claims

1. A sealable resin sheet for sealing an element, the sealable resin sheet containing thermosetting resin, and further containing a layered silicate compound.
2. The sealable resin sheet according to Claim 1, wherein the layered silicate compound is smectite.
3. The sealable resin sheet according to Claim 1, wherein the layered silicate compound has a surface modified by an organic component.
4. The sealable resin sheet according to Claim 2, wherein the layered silicate compound has a surface modified by an organic component.
5. The sealable resin sheet according to Claim 1 further containing an inorganic filler other than the layered silicate compound in an amount of 50 mass% or more and 90 mass% or less.
6. The sealable resin sheet according to Claim 2 further containing an inorganic filler other than the layered silicate compound in an amount of 50 mass% or more and 90 mass% or less.
7. The sealable resin sheet according to Claim 3 further containing an inorganic filler other than the layered silicate compound in an amount of 50 mass% or more and 90 mass% or less.
8. The sealable resin sheet according to Claim 4 further containing an inorganic filler other than the layered silicate compound in an amount of 50 mass% or more and 90 mass% or less.
9. The sealable resin sheet according to Claim 1, wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.
10. The sealable resin sheet according to Claim 2, wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.

11. The sealable resin sheet according to Claim 3, wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.
12. The sealable resin sheet according to Claim 4, wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.
13. The sealable resin sheet according to Claim 5, wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.
14. The sealable resin sheet according to Claim 6, wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.
15. The sealable resin sheet according to Claim 7, wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.
16. The sealable resin sheet according to Claim 8, wherein a content ratio of the layered silicate compound is 3 mass% or more and 10 mass% or less.