

TITLE OF THE INVENTION

SEALABLE SHEET

BACKGROUND OF THE INVENTION

Field of the Invention

[0001]

The present invention relates to a sealable sheet, to be specific, to a sealable sheet for sealing an electronic element.

Description of Related Art

[0002]

Conventionally, it has been known that an electronic element mounted on a board is sealed by a sealable sheet to obtain an electronic element package.

[0003]

As the sealable sheet, for example, a resin sheet in which an outermost layer and an innermost layer are included and the outermost layer contains a thermosetting resin and an inorganic filler has been proposed (ref: for example, Patent Document 1).

Citation List

Patent Document

[0004]

Patent Document 1: Japanese Unexamined Patent Publication No. 2018-103584

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005]

When the electronic element is sealed by heating and pressing the resin sheet, there is a disadvantage that the resin sheet remarkably flows to wet-expand on the board, and the resin sheet protrudes to the outside of the board. Then, the surroundings of the board (for example, a pressing device or the like) is contaminated by the resin sheet.

[0006]

Also, in the electronic element package after sealing, there is a disadvantage that warping occurs because of a difference of materials of the board and the resin sheet after curing.

[0007]

The present invention provides a sealable sheet capable of compatibly achieving suppression of contamination to the surroundings during sealing, and suppression of warping after sealing.

MEANS FOR SOLVING THE PROBLEM

[0008]

The present invention [1] includes a sealing sheet for sealing an electronic element including a first layer and a second layer sequentially toward one side in a thickness direction, the first layer being in contact with the electronic element and the second layer being exposed outwardly when sealing the electronic element, wherein the first layer and the second layer have thermosetting properties, an other-side surface in the thickness direction of the first layer is harder than a one-side surface in the thickness direction of the second layer at 90°C, and an elastic modulus of the second layer after thermal curing is larger than an elastic modulus of the first layer after thermal curing.

[0009]

The present invention [2] includes the sealable sheet described in [1], wherein an elastic modulus of the second layer before thermal curing is smaller than an elastic modulus of the first layer before thermal curing.

[0010]

The present invention [3] includes the sealable sheet described in [1] or [2], wherein the first layer contains a first organic component containing a first thermosetting resin and a first thermoplastic resin, the second layer contains a second organic component containing a second thermosetting resin and a second thermoplastic resin, and a mass ratio of the second thermoplastic resin to the second organic component is smaller than a mass ratio of the first thermoplastic resin to the first organic component.

EFFECT OF THE INVENTION

[0011]

According to the sealable sheet of the present invention, the other-side surface in the thickness direction of the first layer is harder than the one-side surface in the thickness direction of the second layer at 90°C, and the elastic modulus of the second layer after thermal curing is larger than that of the first layer after thermal curing, so that the sealing sheet can compatibly achieve suppression of contamination to the surroundings during sealing, and suppression of warping after sealing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIGS. 1A and 1B show views for illustrating a one embodiment of a sealable sheet of the present invention and a producing method thereof:

FIG. 1A illustrating a cross-sectional view of the sealable sheet and

FIG. 1B illustrating a view of preparing a first layer and a second layer.

FIGS. 2A to 2B show views for illustrating a measurement method of a recessed amount in an iron ball drop test:

FIG. 2A illustrating a view of preparing a sealable sheet and an iron ball and

FIG. 2B illustrating the recessed amount and an enlarged view thereof.

FIGS. 3A to 3C show views for illustrating a method for sealing electronic elements by using the sealable sheet shown in FIG. 1A:

FIG. 3A illustrating a view of preparing an electronic element-mounted board and the sealable sheet,

FIG. 3B illustrating a view of sealing the electronic elements by the sealable sheet to thermally cure a sealing sheet, and

FIG. 3C illustrating a view of obtaining a plurality of electronic element packages.

FIG. 4 shows a plan view at the time of evaluation of contamination in Examples.

FIG. 5 shows a cross-sectional view at the time of evaluation of warping in Examples.

DESCRIPTION OF EMBODIMENTS

[0013]

In FIGS. 1A to 1B and 3A to 3C, the up-down direction on the plane of the sheet is an up-down direction (thickness direction). The upper side on the plane of the sheet is an upper side (one side in the thickness direction), and the lower side on the plane of the sheet is a lower side (the other side in the thickness direction).

[0014]

As shown in FIGS. 1A and 3A, a sealable sheet 1 that is a one embodiment of the present invention is an electronic element sealable sheet for sealing an electronic element 51 with respect to an electronic member including a board 50 and the electronic element 51.

[0015]

The sealable sheet 1 is a component for producing an electronic element package 7 to be described later, and is not the electronic element package 7. The sealable sheet 1 does not include the electronic element 51 and the board 50 that is mounted with the electronic element 51, and to be specific, is an industrially available member whose component alone is circulated.

[0016]

The sealable sheet 1 is not a sealing sheet 8 (ref: FIGS. 3B and 3C) after sealing the electronic element 51, that is, a sheet before sealing the electronic element 51.

[0017]

As shown in FIG. 1A, the sealable sheet 1 has a generally plate shape (film shape) extending in a direction perpendicular to the thickness direction (plane direction).

[0018]

The sealable sheet 1 sequentially includes a first layer 2 and a second layer 3 upwardly. That is, the sealable sheet 1 includes the first layer 2 and the second layer 3 that is disposed on the upper surface of the first layer 2. The sealable sheet 1 preferably consists of only the first layer 2 and the second layer 3.

[0019]

The first layer 2 is a lower layer that forms the lower surface (surface at the other side in the thickness direction) of the sealable sheet 1. The first layer 2 has a generally plate shape extending in the plane direction. As described later, the first layer 2 is a contact layer that is brought into contact with the electronic element 51 when the sealable sheet 1 seals the electronic element 51 (ref: FIG. 3A).

[0020]

A material for the first layer 2 is, for example, a first composition containing a first organic component and a first inorganic filler.

[0021]

The first organic component contains a first thermosetting resin and a first thermoplastic resin.

[0022]

The first thermosetting resin is a resin that is once softened and then melted to flow by heating, and cured by further heating at the time of sealing of the electronic element 51.

[0023]

The first thermosetting resin is in a B-stage state, and not in a C-stage state (that is, a state before complete curing) in the first layer 2 before sealing the electronic element 51.

[0024]

Examples of the first thermosetting resin include epoxy resin, phenol resin, melamine resin, vinyl ester resin, cyanoester resin, maleimide resin, and silicone resin. These first thermosetting resins can be used alone or in combination of two or more. As the first thermosetting resin, in view of heat resistance or the like, preferably, an epoxy resin and a phenol resin are used, more preferably, an epoxy resin and a phenol resin are used in combination.

[0025]

Examples of the epoxy resin 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. Preferably, a bifunctional epoxy resin is used, more preferably, a bisphenol F epoxy resin is used.

[0026]

An epoxy equivalent of the epoxy resin is, for example, 230 g/eq. or less, preferably 210 g/eq. or less, and for example, 10 g/eq. or more, preferably 50 g/eq. or more.

[0027]

A softening point of the epoxy resin is, for example, 50°C or more, preferably 70°C or more, and for example, 110°C or less, preferably 90°C or less.

[0028]

A ratio of the epoxy resin with respect to the first thermosetting resin is, for example, 40 mass% or more, preferably 60 mass% or more, and for example, 90 mass% or less, preferably 70 mass% or less.

[0029]

The phenol resin is a resin that cures along with the epoxy resin. Examples of the phenol resin include trifunctional or more of multifunctional phenol resins such as phenol novolak resin, cresol novolak resin, phenol aralkyl resin, phenol biphenylene resin, dicyclopentadiene phenol resin, and resol resin. These phenol resins can be used alone or in combination of two or more. Preferably, a phenol novolak resin is used.

[0030]

A hydroxyl equivalent of the phenol resin is, for example, 230 g/eq. or less, preferably 210 g/eq. or less, and for example, 10 g/eq. or more, preferably 50 g/eq. or more.

[0031]

The softening point of the phenol resin is, for example, 40°C or more, preferably 50°C or more, and for example, 90°C or less, preferably 70°C or less.

[0032]

The ratio of the phenol resin with respect to the first thermosetting resin is, for example, 10 mass% or more, preferably 30 mass% or more, and for example, 60 mass% or less, preferably 40 mass% or less.

[0033]

The ratio of the epoxy resin to the phenol resin is adjusted so that the total amount of a hydroxyl group in the phenol resin with respect to 1 equivalent of an epoxy group in the epoxy resin is, for example, 0.7 equivalent or more and 1.5 equivalent or less, preferably 0.9 equivalent or more and 1.2 equivalent or less.

[0034]

The ratio of the first thermosetting resin with respect to the first organic component is, for example, 10 mass% or more, preferably 20 mass% or more, and for example, 50 mass% or less, preferably 40 mass% or less. The ratio of the first thermosetting resin with respect to the first composition is, for example, 1 mass% or more, preferably 2 mass% or more, and for example, 10 mass% or less, preferably 5 mass% or less.

[0035]

The first thermoplastic resin is a resin that is softened by heating and does not thermally cured.

[0036]

Examples of the first 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. Preferably, an acrylic resin is used.

[0037]

An example of the acrylic resin includes an acrylic polymer obtained by polymerizing a monomer component. The monomer component is one or two or more of alkyl (meth)acrylates having a straight-chain or branched alkyl group. “(Meth)acryl” represents “acryl and/or methacryl”.

[0038]

An example of the alkyl group includes an alkyl group having a carbon number of 1 to 20. Examples thereof 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. Preferably, an alkyl group having a carbon number of 1 to 6 is used.

[0039]

The acrylic polymer may be a copolymer of alkyl (meth)acrylate and another monomer (copolymerizable monomer).

[0040]

Examples of the other monomer (copolymerizable monomer) include glycidyl group-containing monomers such as glycidyl acrylate and glycidyl methacrylate; 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 styrene sulfonic acid, allyl sulfonic acid, 2-(meth)acrylamide-2-methylpropane sulfonic acid, (meth)acrylamidepropane sulfonic acid, sulfopropyl(meth)acrylate, and (meth)acryloyloxynaphthalene sulfonic acid; phosphoric acid group-containing monomers such as 2-hydroxyethylacryloyl phosphate; styrene monomers; and acrylonitriles. These monomers can be used alone or in combination of two or more. Among these, preferably, a carboxyl group-containing monomer is used.

[0041]

A glass transition temperature (T_g) of the first thermoplastic resin is, for example, 30°C or less, preferably 0°C or less, more preferably -5°C or less, and for example, -50°C or more. When T_g is the above-described upper limit or less, the sealable sheet 1 can easily enter space between the plurality of electronic elements 51 at the time of sealing, and the embedding properties are excellent.

[0042]

The glass transition temperature is obtained by a maximum value of a loss tangent ($\tan\delta$) measured by using a dynamic viscoelasticity measuring device (DMA, frequency of 1 Hz, temperature rising rate of 10°C/min).

[0043]

A weight average molecular weight of the first thermoplastic resin is, for example, 100,000 or more, preferably 300,000 or more, and for example, 1,000,000 or less. The weight average molecular weight is calibrated with standard polystyrene based on gel permeation chromatography (GPC).

[0044]

The ratio of the first thermoplastic resin with respect to the first organic component is, for example, 40 mass% or more, preferably 50 mass% or more, more preferably 55 mass% or more, and for example, 90 mass% or less, preferably 80 mass% or less, more preferably 65 mass% or less. The ratio of the first thermoplastic resin with respect to the first composition is, for example, 1 mass% or more, preferably 5 mass% or more, and for example, 30 mass% or less, preferably 20 mass% or less.

[0045]

The first organic component may contain another organic component such as first silane coupling agent in addition to the first thermosetting resin and the first thermoplastic resin. Preferably, the first organic component contains the first silane coupling agent. In this manner, the viscosity of the entire resin is reduced, the resin flowability is improved, and the embedding properties for the electronic element 51 are excellent.

[0046]

Examples of the first silane coupling agent include vinyl group-containing silane coupling agent, epoxy group-containing silane coupling agent, styryl group-containing silane coupling agent, (meth)acryl group-containing silane coupling agent, amino group-containing silane coupling agent, isocyanurate group-containing silane coupling agent, and mercapto group-containing silane coupling agent. Preferably, an epoxy group-containing silane coupling agent is used.

[0047]

Examples of the epoxy group-containing silane coupling agent include 2-(3,4-epoxycyclohexyl)ethyl trimethoxy silane, 3-glycidoxypropyl methyl dimethoxy silane, 3-glycidoxypropyl trimethoxy silane, 3-glycidoxypropyl methyl diethoxy silane, and 3-glycidoxypropyl triethoxy silane. Preferably, in view of reactivity, a 3-glycidoxy propyl triethoxy silane is used.

[0048]

The ratio of the first silane coupling agent with respect to the first organic component is, for example, 1 mass% or more, preferably 5 mass% or more, and for example, 20 mass% or less, preferably 15 mass% or less. The ratio of the first silane coupling agent with respect to the first composition is, for example, 0.1 mass% or more, preferably 0.5 mass% or more, and for example, 5 mass% or less, preferably 3 mass% or less.

[0049]

The ratio of the first organic component with respect to the first composition is, for example, 5 mass% or more, preferably 10 mass% or more, and for example, 50 mass% or less, preferably 35 mass% or less, more preferably 20 mass% or less.

[0050]

Examples of the first inorganic filler include quartz glass, talc, silica (fused silica, crystalline silica, or the like), alumina, aluminum nitride, silicon nitride, and boron nitride. These inorganic fillers can be used alone or in combination of two or more. As the inorganic filler, preferably, silica and alumina are used, more preferably, silica is used.

[0051]

A size of the first inorganic filler is not particularly limited, and to be specific, an average particle size thereof is, for example, 0.1 μm or more, preferably 0.2 μm or more, and for example, 20 μm or less, preferably 15 μm or less. The two or more inorganic fillers having a different average particle size can be used in combination. The inorganic filler is, for example, described in Japanese Unexamined Patent Publication No. 2016-162909 or the like.

[0052]

The ratio of the first inorganic filler with respect to the first composition is, for example, 50 mass% or more, preferably 65 mass% or more, more preferably 80 mass% or more, and for example, 95 mass% or less, preferably 90 mass% or less. When the ratio of the first inorganic filler is within the above-described range, the heat resistance reliability can be improved in the electronic element package 7 (described later).

[0053]

The first composition may also contain a curing accelerator and pigment.

[0054]

The curing accelerator is a catalyst (thermosetting catalyst) that promotes curing of the thermosetting resin by heating. Examples thereof include imidazole compounds such as 2-phenyl-4,5-dihydroxy dimethyl imidazole (2PHZ-PW) and 2-phenyl-4-methyl-5-hydroxy methyl imidazole (2P4MHZ); and organic phosphorus compounds. Preferably, an imidazole compound is used. Also, an inclusion compound in which the above-described imidazole compound is used as a guest and hydroxyisophthalate (HIPA) is used as a host is used. The inclusion compound is, for example, described in Japanese Unexamined Patent Publication No. 2012-232994. These curing accelerators can be used alone or in combination of two or more.

[0055]

The ratio of the curing accelerator with respect to 100 parts by mass of the first

thermosetting resin is, for example, 0.1 parts by mass or more, and for example, 5 parts by mass or less.

[0056]

An example of the pigment includes black pigment such as carbon black. The average particle size of the pigment is, for example, 0.001 μm or more and 1 μm or less. These pigment can be used alone or in combination of two or more.

[0057]

The ratio of the pigment with respect to the first composition is, for example, 0.1 mass% or more, and for example, 5 mass% or less.

[0058]

Furthermore, the first composition can contain an additive other than the above-described component at an appropriate ratio.

[0059]

A thickness T1 of the first layer 2 is, for example, 10 μm or more, preferably 50 μm or more, and for example, 200 μm or less, preferably 100 μm or less.

[0060]

The second layer 3 is an upper layer that forms the upper surface (surface at one side in the thickness direction) of the sealable sheet 1. The second layer 3 has a generally plate shape extending in the plane direction. The second layer 3 is disposed on the entire upper surface of the first layer 2. As described later, the second layer 3 is an exposed layer that is exposed outwardly (upwardly) when the sealable sheet 1 seals the electronic element 51. Preferably, the second layer 3 is a non-contact layer that is not in contact with the electronic element 51.

[0061]

A material for the second layer 3 is, for example, a second composition containing a second organic component and a second inorganic filler.

[0062]

The second organic component contains a second thermosetting resin and a second thermoplastic resin.

[0063]

As the second thermosetting resin, the same thermosetting resin as that illustrated in the first thermosetting resin is used. As the second thermosetting resin, preferably, an epoxy resin and a phenol resin are used, to be specific, an epoxy resin and a phenol resin are used in combination.

[0064]

The ratio of the epoxy resin with respect to the second thermosetting resin is, for example, 40 mass% or more, preferably 60 mass% or more, and for example, 90 mass% or less, preferably 70 mass% or less.

[0065]

The ratio of the phenol resin with respect to the second thermosetting resin is, for example, 10 mass% or more, preferably 30 mass% or more, and for example, 60 mass% or less, preferably 40 mass% or less.

[0066]

The ratio of the epoxy resin to the phenol resin is adjusted so that the total amount of the hydroxyl group in the phenol resin with respect to 1 equivalent of the epoxy group in the epoxy resin is, for example, 0.7 equivalent or more and 1.5 equivalent or less, preferably 0.9 equivalent or more and 1.2 equivalent or less.

[0067]

The ratio of the second thermosetting resin with respect to the second organic component is, for example, 60 mass% or more, preferably 70 mass% or more, and for example, 95 mass% or less, preferably 90 mass% or less. The ratio of the second thermosetting resin with respect to the second composition is, for example, 5 mass% or more, preferably 10 mass% or more, and for example, 25 mass% or less, preferably 15 mass% or less.

[0068]

As the second thermoplastic resin, the same thermoplastic resin as that illustrated in the first thermoplastic resin is used. Preferably, an acrylic resin is used.

[0069]

The ratio of the second thermoplastic resin with respect to the second organic component is, for example, 1 mass% or more, preferably 3 mass% or more, more preferably 5 mass% or more, and for example, 40 mass% or less, preferably 30 mass% or less, more preferably 20 mass% or less. The ratio of the second thermoplastic resin with respect to the second composition is, for example, 0.1 mass% or more, preferably 0.5 mass% or more, and for example, 10 mass% or less, preferably 5 mass% or less.

[0070]

Preferably, a mass ratio A2 of the second thermoplastic resin with respect to the second organic component is smaller than a mass ratio A1 of the first thermoplastic resin with respect to the first organic component. To be specific, a difference (A1 - A2) of the mass ratio of these is,

for example, 25 mass% or more, preferably 40 mass% or more, and for example, 60 mass% or less, preferably 50 mass% or less. When the above-described difference is within the above-described range, the lower surface of the first layer 2 can be furthermore surely harder than the upper surface of the second layer 3, and an elastic modulus of the second layer 3 after thermal curing can be larger than that of the first layer 2 after thermal curing.

[0071]

The second organic component may contain another organic component such as second silane coupling agent in addition to the second thermosetting resin and the second thermoplastic resin. Preferably, the second organic component contains the second silane coupling agent. In this manner, the viscosity of the entire resin is reduced, the resin flowability is improved, and the embedding properties for the electronic element 51 are excellent.

[0072]

As the second silane coupling agent, the same silane coupling agent as that illustrated in the first silane coupling agent is used. Preferably, an epoxy group-containing silane coupling agent is used.

[0073]

The ratio of the second silane coupling agent with respect to the second organic component is, for example, 1 mass% or more, preferably 5 mass% or more, and for example, 20 mass% or less, preferably 15 mass% or less. The ratio of the second silane coupling agent with respect to the second composition is, for example, 0.1 mass% or more, preferably 0.5 mass% or more, and for example, 5 mass% or less, preferably 3 mass% or less.

[0074]

The ratio of the second organic component with respect to the second composition is, for example, 5 mass% or more, preferably 10 mass% or more, and for example, 50 mass% or less, preferably 35 mass% or less, more preferably 20 mass% or less.

[0075]

As the second inorganic filler, the same inorganic filler as that illustrated in the first inorganic filler is used. Preferably, silica is used.

[0076]

The ratio of the second inorganic filler with respect to the second composition is, for example, 50 mass% or more, preferably 65 mass% or more, more preferably 80 mass% or more, and for example, 95 mass% or less, preferably 90 mass% or less. When the ratio of the second inorganic filler is within the above-described range, the heat resistance reliability can be

improved in the electronic element package 7 (described later).

[0077]

The ratio $[C2/C1]$ of a ratio C2 (mass%) of the second inorganic filler with respect to the second composition to a ratio C1 (mass%) of the first inorganic filler with respect to the first composition is, for example, 0.5 or more, preferably 0.8 or more, and for example, 2.0 or less, preferably 1.3 or less. When the above-described ratio is within the above-described range, a crack on the interface between the first layer 2 and the second layer 3 can be suppressed in the electronic element package 7 (described later).

[0078]

The second composition may also contain the curing accelerator, the pigment, or the like illustrated in the first composition at an appropriate ratio.

[0079]

A thickness T2 of the second layer 3 is, for example, 50 μm or more, preferably 100 μm or more, more preferably 150 μm or more, and for example, 1000 μm or less, preferably 500 μm or less, more preferably 300 μm or less.

[0080]

The ratio $(T2/T1)$ of the thickness T2 of the second layer 3 with respect to the thickness T1 of the first layer 2 is, for example, 1 or more, preferably 1.5 or more, more preferably 2 or more, and for example, 10 or less, preferably 5 or less, more preferably 4 or less. When the above-described ratio is within the above-described range, the protrusion can be furthermore surely suppressed.

[0081]

In the sealable sheet 1, the lower surface (the other-side surface in the thickness direction) of the first layer 2 is harder than the upper surface (one-side surface in the thickness direction) of the second layer 3 at 90°C. That is, the upper surface of the second layer 3 is softer than the lower surface of the first layer 2 at 90°C. In other words, the lower surface of the first layer 2 is not easily recessed compared to the upper surface of the second layer 3 at 90°C.

[0082]

To be specific, as shown in an iron ball drop test of FIG. 2A, the sealable sheet 1 is disposed on a heating table 10 so that the first layer 2 is positioned at the upper side, the sealable sheet 1 is heated at 90°C, and subsequently, an iron ball 11 is dropped on the surface (lower surface) of the first layer 2. At this time, as shown in FIG. 2B, a recessed amount (depth) formed on the surface of the first layer 2 is defined as D1. In the same manner, the sealable

sheet 1 is disposed on the heating table 10 so that the second layer 3 is positioned at the upper side, the sealable sheet 1 is heated at 90°C, and subsequently, the iron ball 11 is dropped on the surface (upper surface) of the second layer 3. At this time, a recessed amount (depth) formed on the surface of the second layer 3 is defined as D2. In this case, the recessed amount D1 of the first layer 2 is smaller than the recessed amount D2 of the second layer 3. That is, $D1 < D2$ is satisfied.

[0083]

To be specific, the recessed amount D1 in the iron ball drop test is, for example, below 80 μm , preferably 65 μm or less, and for example, 10 μm or more, preferably 30 μm or more.

[0084]

The recessed amount D2 in the iron ball drop test is, for example, 80 μm or more, preferably 100 μm or more, and for example, 200 μm or less, preferably 160 μm or less.

[0085]

As the size of the iron ball, a diameter thereof is 18 mm and a weight thereof is 21.7 g. A drop height is 10 cm. The details are described in Examples.

[0086]

When the first layer 2 is harder than the second layer 3 at 90°C, in a case where the sealable sheet 1 is heated and the electronic element 51 is sealed, the protrusion of the sealable sheet 1 can be suppressed. Accordingly, the contamination of the surroundings of the electronic element package 7 can be suppressed.

[0087]

In the sealable sheet 1, the elastic modulus of the second layer 3 (that is, the elastic modulus of the second layer 3 before thermal curing) is preferably smaller than the elastic modulus of the first layer 2 (that is, the elastic modulus of the first layer 2 before thermal curing).

[0088]

The elastic modulus of the second layer 3 is, for example, below 3.0×10^{-3} GPa, preferably 2.5×10^{-3} GPa or less, and for example, 1.0×10^{-5} GPa or more, preferably 1.0×10^{-4} GPa or more.

[0089]

The elastic modulus of the first layer 2 is, for example, 3.0×10^{-3} GPa or more, preferably 4.0×10^{-3} GPa or more, and for example, 1.0×10^{-1} GPa or less, preferably 1.0×10^{-2} GPa or less.

[0090]

The ratio (the second layer/the first layer) of the elastic modulus of the second layer 3 with respect to that of the first layer 2 is, for example, below 1.0, preferably 0.8 or less, and for example, 0.1 or more, preferably 0.3 or more.

[0091]

The elastic modulus is a push-in elastic modulus, and is measured by, for example, carrying out a push-in test with respect to the surface of each of the layers (the first layer or the second layer) at room temperature (25°C). To be specific, an ultra-fine hardness tester is used. The details are described in Examples.

[0092]

In the sealable sheet 1, when the elastic modulus of the second layer 3 is smaller than that of the first layer 2, the protrusion of the sealable sheet 1 can be furthermore suppressed.

[0093]

As shown in FIG. 1B, to produce the sealable sheet 1, the first layer 2 and the second layer 3 are prepared.

[0094]

For example, the first composition is dissolved and/or dispersed in a solvent (for example, methyl ethyl ketone, toluene, ethyl acetate, or the like), so that a first varnish is prepared. The prepared first varnish is applied to a first peeling sheet 4 shown by a phantom line to be dried. In this manner, the first layer 2 is prepared in a state of being supported by the first peeling sheet 4.

[0095]

The second composition is dissolved and/or dispersed in a solvent, so that a second varnish is prepared. The prepared second varnish is applied to a second peeling sheet 5 shown by the phantom line to be dried. In this manner, the second layer 3 is prepared in a state of being supported by the second peeling sheet 5.

[0096]

Also, the first layer 2 and/or the second layer 3 can be prepared by kneading and extruding without preparing the varnish.

[0097]

The first thermosetting resin in the first layer 2 and the second thermosetting resin in the second layer 3 are, for example, in a B-stage state.

[0098]

Thereafter, the first layer 2 is attached to the second layer 3.

[0099]

Next, a method for producing the electronic element package 7 by sealing the electronic element 51 by using the sealable sheet 1 is described with reference to FIGS. 3A to 3C. The electronic element 51, the electronic element package 7, and the producing method thereof are also described in Japanese Unexamined Patent Publication No. 2016-162909.

[0100]

As shown in FIG. 3A, first, the electronic elements 51 are prepared.

[0101]

The electronic element 51 has a generally flat plate shape extending in the plane direction. The electronic element 51 is not particularly limited, and various electronic elements are used. Examples thereof include hollow electronic element and semiconductor element. The plurality of electronic elements 51 are mounted on the upper surface of the board 50 so as to face thereto. The plurality of electronic elements 51 are, for example, flip-chip mounted on the board 50. In this case, electrodes (not shown) provided on the lower surfaces of the plurality of electronic elements 51 are electrically connected to terminals (not shown) provided on the upper surface of the board 50. Also, the electronic elements 51 may be die-bonded via an adhesive layer (die-bonding film or the like) that is not shown.

[0102]

To prepare the electronic element 51, an electronic element-mounted board 55 that includes the electronic element 51 and the board 50 mounted with the electronic element 51 is prepared.

[0103]

The board 50 is, for example, a print wiring board or the like. The board 50 has a generally flat plate shape extending in the plane direction. The board 50 has a size including the plurality of electronic elements 51 when viewed from the top. The board 50 has a terminal (not shown) that is electrically connected to the electronic element 51 on the upper surface thereof. The board 50 consists of, for example, a ceramic plate, a glass epoxy plate, or the like.

[0104]

Next, the sealable sheet 1 is prepared.

[0105]

The size of the sealable sheet 1 is adjusted so as to be capable of collectively sealing the plurality of electronic elements 51, that is, the sealable sheet 1 has a size entirely including the plurality of electronic elements 51 when projected in the thickness direction.

[0106]

As shown in FIG. 3B, next, the electronic elements 51 are sealed by the sealable sheet 1.

[0107]

The electronic elements 51 are, for example, sealed by the sealable sheet 1 by using a flat plate press 97 including a lower plate 98 and an upper plate 99 shown by the phantom line of FIG. 3B.

[0108]

The electronic element-mounted board 55 is disposed on the lower plate 98. To be specific, the lower surface of the board 50 is disposed on the upper surface of the lower plate 98.

[0109]

Subsequently, the sealable sheet 1 is disposed on the electronic element-mounted board 55. To be specific, the first layer 2 is brought into contact with the upper surfaces of the plurality of electronic elements 51. Meanwhile, the second layer 3 is positioned at the upper side. At this time, when the first peeling sheet 4 supports the first layer 2, the first peeling sheet 4 is beforehand peeled from the first layer 2.

[0110]

Next, the upper plate 99 is pushed down toward the sealable sheet 1. At the same time, the sealable sheet 1 is heated by a heat source (not shown) provided in the lower plate 98 and the upper plate 99.

[0111]

A heating temperature is, for example, 40°C or more, preferably 60°C or more, and for example, 100°C or less, preferably 95°C or less. The pressure is, for example, 0.05 MPa or more, preferably 0.1 MPa or more, and for example, 10 MPa or less, preferably 5 MPa or less. The pressing time is, for example, 0.3 minutes or more, preferably 0.5 minutes or more, and for example, 10 minutes or less, preferably 5 minutes or less.

[0112]

In the thermal pressing, a roll press or the like is also used other than the flat plate press 97 (phantom line of FIG. 3B).

[0113]

When the sealable sheet 1 is thermally pressed, the sealable sheet 1 is softened and embeds the plurality of electronic elements 51. In other words, the plurality of electronic elements 51 are embedded in the sealable sheet 1.

[0114]

To be more specific, the first layer 2 covers the upper surfaces and the side surfaces of the electronic elements 51, and the upper surface that is not overlapped with the electronic elements 51 in the board 50 when projected in the thickness direction. That is, the first layer 2 is plastically deformed corresponding to the outer shape of the electronic element 51.

[0115]

Meanwhile, the lower surface of the second layer 3 is deformed corresponding to the deformation of the first layer 2, and the upper surface of the second layer 3 is pressed by the upper plate 99, so that the upper surface retains a flat shape.

[0116]

At this time, the first layer 2 is hard, so that the first layer 2 does not excessively wet-expand in the board 50 and does not easily flow to the outside of the board 50, that is, to the lower plate 98. Therefore, the first layer 2 does not easily reach the lower plate 98 and the side surfaces or the lower surface of the board 50, so that the contamination of the surroundings is suppressed.

[0117]

Thereafter, the sealable sheet 1 is cured by heating. To be more specific, the first thermosetting resin contained in the first layer 2 and the second thermosetting resin contained in the second layer 3 are thermally cured (completely cured, brought into a C-stage state).

[0118]

After the sealing and the curing, the sheet that seals the electronic element 51 is no longer the sealable sheet 1, and is the sealing sheet 8. The sealing sheet 8 is not a flat plate shape, and has a recessed portion that has an opening downwardly corresponding to the electronic element 51.

[0119]

In the sealing sheet member 8, the first thermosetting resin and the second thermosetting resin are in a C-stage state.

[0120]

When the second peeling sheet 5 supports the second layer 3 before thermal curing of the sealable sheet 1, the second peeling sheet 5 is peeled from the second layer 3. Or, the second peeling sheet 5 can be also peeled from the second layer 3 before sealing of the electronic element 51 by the sealable sheet 1.

[0121]

The heating temperature (curing temperature) is, for example, 100°C or more, preferably

120°C or more, and for example, 200°C or less, preferably 180°C or less. The heating time is, for example, 10 minutes or more, preferably 30 minutes or more, and for example, 180 minutes or less, preferably 120 minutes or less.

[0122]

To thermally cure the sealable sheet 1, the sealable sheet 1, the electronic element 51, and the board 50 are taken out from the flat plate press 97 to be then put into, for example, a heating furnace or the like. Or, the sealable sheet 1 can be also thermally cured by using a heat source provided in the flat plate press 97 without taking out the sealable sheet 1, the electronic element 51, and the board 50 from the flat plate press 97.

[0123]

Thereafter, a mark is imparted (marking is carried out) to the upper surface of the second layer 3 that is positioned on the plurality of electronic elements 51 by laser irradiation or the like as needed. The mark includes information (product information, lot number, or the like) on the electronic element package 7 to be described next.

[0124]

In the sealing sheet 8 (the sealable sheet 1 after thermal curing), the elastic modulus of the second layer 3 (that is, the elastic modulus of the second layer 3 after thermal curing) is larger than the elastic modulus of the first layer 2 (that is, the elastic modulus of the first layer 2 after thermal curing).

[0125]

The elastic modulus of the second layer 3 after thermal curing is, for example, 1.0 GPa or more, preferably 2.0 GPa or more, and for example, 100 GPa or less, preferably 10 GPa or less.

[0126]

The elastic modulus of the first layer 2 after thermal curing is, for example, below 1.0 GPa, preferably 0.5 GPa or less, and for example, 0.01 GPa or more, preferably 0.1 GPa or more.

[0127]

The ratio (the second layer/the first layer) of the elastic modulus of the second layer 3 with respect to that of the first layer 2 is, for example, above 1.0, preferably 5.0 or more, and for example, 20 or less, preferably 15 or less.

[0128]

In the sealing sheet 8, when the elastic modulus of the second layer 3 is larger than that of the first layer 2, the warping of the electronic element package 7 can be suppressed.

[0129]

The second layer 3 has a relatively high elastic modulus, so that the marking of the electronic element package 7 is easy. Furthermore, the grinding for reducing a size of the package can be easily carried out, and the abrasion of a grinding stone can be also reduced.

[0130]

As shown in FIG. 3C, thereafter, the sealing sheets 8 between the plurality of electronic elements 51 are, for example, cut by dicing, and the electronic elements 51 and the boards 50 are singulated. In this manner, the electronic element package 7 including the one sealing sheet 8, the one electronic element 51, and the one board 50 is produced.

[0131]

Thereafter, the electronic element package 7 is mounted on another board.

[0132]

In the sealable sheet 1 (sheet before forming the sealing sheet 8) shown in FIG. 1A, the lower surface of the first layer 2 is harder than the upper surface of the second layer 3 at 90°C. Thus, when the sealable sheet 1 is heated and the electronic element 51 is sealed, the first layer 2 that is relatively hard is brought into contact with the electronic element 51 and the board 50, so that the sealable sheet 1 does not easily wet-expand. Thus, the protrusion of the sealable sheet 1 can be suppressed. Accordingly, the contamination of the surroundings of the electronic element package 7 can be suppressed. That is, the low contamination properties are excellent. Furthermore, the first layer 2 does not easily protrude in a state of sealing (before curing and dicing) shown in FIG. 3B, so that the deformation of the end portion of the second layer 3 can be suppressed, and the yield of the electronic element package 7 can be improved.

[0133]

In the sealable sheet 1, the elastic modulus of the second layer 3 after thermal curing is larger than that of the first layer 2 after thermal curing. Thus, the warping of the electronic element package 7 can be suppressed. That is, the electronic element package 7 includes the board 50 and the second layer 3, and the first layer 2 is sandwiched between the board 50 and the second layer 3. Thus, when the electronic element package 7 is left at high temperature, the electronic element package 7 has a sandwich structure of the board 50 (for example, a ceramic board) and the second layer 3 both having a relatively high elastic modulus, so that the occurrence of the warping of the electronic element package 7 can be suppressed. Furthermore, the laser marking properties with respect to the second layer 3 are excellent. Also, a dimensional change is small, so that the reliability in a thermal cycle test or the like is excellent.

[0134]

In the sealable sheet 1, when the elastic modulus of the second layer 3 before thermal curing is smaller than that of the first layer 2 before thermal curing, the protrusion of the sealable sheet 1 can be furthermore suppressed. Furthermore, the plastic deformation of the second layer 3 (upper layer) is possible, so that the influence of the unevenness on the upper surface of the electronic element 51 can be reduced, and as a result, the upper surface of the electronic element package 7 can be flat.

[0135]

When the ratio of the second thermoplastic resin with respect to the second organic component is smaller than the ratio of the first thermoplastic resin with respect to the first organic component, the properties of the sealable sheet 1 can be easily adjusted. Furthermore, the ratio of the first thermoplastic resin is high, so that the sealable sheet 1 has excellent flexibility as a sheet, has excellent handling properties at the time of sealing, and can suppress the occurrence of a crack.

Examples

[0136]

Next, the present invention is further described based on Examples and Comparative Examples below. The present invention is however not limited by the following Examples and Comparative Examples. The specific numerical values in mixing ratio (content ratio), property value, and parameter used in the following description can be replaced with upper limit values (numerical values defined as “or less” or “below”) or lower limit values (numerical values defined as “or more” or “above”) of corresponding numerical values in mixing ratio (content ratio), property value, and parameter described in the above-described “DESCRIPTION OF EMBODIMENTS”.

[0137]

Each of the components used in Examples and Comparative Examples is shown in the following.

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

LVR-8210DL: phenol resin (novolak phenol resin), hydroxyl equivalent: 104 g/eq., softening point: 60°C, manufactured by Gunei Chemical Industry Co., Ltd.

HME-2006M: acrylic resin (methyl ethyl ketone solution having 20 mass% of acrylate polymer containing a carboxyl group), weight average molecular weight: about 600,000, Tg: -30°C, manufactured by Negami Chemical Industrial Co., Ltd.

SG-70L: acrylic resin (methyl ethyl ketone solution having 12.5 mass% of acrylate polymer containing a carboxyl group), weight average molecular weight: about 800,000, Tg: -10°C, manufactured by Nagase ChemteX Corporation

KBM-403: epoxy silane coupling agent, 3-glycidoxy propyl trimethoxy silane, manufactured by Shin-Etsu Chemical Co., Ltd.

FB-8SM: silica, average particle size: 6 μm , manufactured by Denka Company Limited

SC220G-SMJ: silica, average particle size: 0.5 μm , manufactured by Admatechs Company Limited

#20: carbon black, average particle size: 50 nm, manufactured by Mitsubishi Chemical Corporation

2PHZ-PW: curing accelerator, imidazole compound (2-phenyl-4,5-dihydroxy dimethyl imidazole), manufactured by SHIKOKU CHEMICALS CORPORATION

[0138]

Example 1

Each of the components was dissolved and dispersed in methyl ethyl ketone in accordance with the mixing formulation (numerical values in Table 1 showing solid content) described in Table 1, so that a first varnish and a second varnish were obtained. The concentration of the solid content of the first varnish was 84 mass%, and the concentration of the solid content of the second varnish was 70 mass%.

[0139]

Each of the first varnish and the second varnish was applied to each of the surfaces of the first peeling sheet 4 and the second peeling sheet 5 to be then dried at 110°C for 5 minutes. In this manner, the first layer 2 having a thickness of 65 μm and the second layer 3 having a thickness of 195 μm were prepared.

[0140]

Thereafter, the first layer 2 was attached to the second layer 3. In this manner, the sealable sheet 1 including the first layer 2 (lower layer) and the second layer 3 (upper layer) was fabricated.

[0141]

Examples 2 to 3 and Comparative Examples 1 to 4

The sealable sheet 1 was fabricated in the same manner as that of Example 1 in accordance with the mixing formulation described in Table 1.

[0142]

(Evaluation)

The following items were evaluated. The results are shown in Table 2.

[0143]

<Measurement of Recessed Amount in Iron Ball Drop Test>

A polyethylene terephthalate (thickness of 38 μm) was disposed on the upper surface and the lower surface of each of the sealable sheets (50 mm $\times$ 50 mm) of Examples and Comparative Examples. Next, the sealable sheet was disposed on a hot plate 10 at 90°C so that the first layer was positioned at the lower side and the second layer was positioned at the upper side. In one minute, the iron ball 11 (diameter of 18 mm, weight of 21.7 g) was dropped from a height of 10 cm onto the upper surface of the sealable sheet. After dropping, the iron ball 11 was left for 5 minutes to be then removed (ref: FIGS. 2A to 2B).

[0144]

The recessed amount D2 of the upper surface of the sealable sheet (surface at the second layer side) was measured by using a 3CCD color confocal microscope (manufactured by Lasertec Corporation, "MC-1000A") under the conditions of confocal mode and a magnification of 5.

[0145]

The recessed amount D1 of the surface at the first layer side was measured in the same manner as that described above, except that the first layer was positioned at the upper side and the second layer was positioned at the lower side.

[0146]

The results are shown in Table 2.

[0147]

<Measurement of Elastic Modulus>

A push-in elastic modulus of the first layer and the second layer of each of the sealable sheets of Examples and Comparative Examples was measured 5 times by using a micro-fine hardness tester under the following conditions, so that an average value was obtained.

[0148]

Each of the sealable sheets of Examples and Comparative Examples was heated under the conditions of 150°C and 1 hour to be completely cured. The push-in elastic modulus of the first layer and the second layer of the sheet after curing (sealing sheet) was obtained in the same manner as that described above. The results are shown in Table 2.

[0149]

Device: “DUH-211”, manufactured by Shimadzu Corporation

Test mode: loading-unloading test

Testing force: 0.5 mN (before curing), 9.8 mN (after curing)

Set depth: 1.0000 μm

Loading rate: 1.0 mN/sec

Data processing: dynamic hardness

Sample size: 1 cm $\times$ 1.5 cm $\times$ thickness of 260 μm

<Evaluation of Suppression (Protruding Suppression) of Contamination>

A glass plate 20 having a size of 100 mm $\times$ 100 mm $\times$ thickness of 1.1 mm was prepared. Each of the sealable sheets 1 (80 mm $\times$ 80 mm $\times$ thickness of 260 μm) of Examples and Comparative Examples was disposed in the center of the glass plate 20 so that the first layer was in contact therewith, and then, these were attached to each other with a vacuum flat plate pressing machine under the conditions of a pressure of 0.1 MPa, 90°C, and one minute.

[0150]

Next, in the attached sealable sheet, a length L_1 and a length L_2 of straight lines connecting the middle points of the facing two sides were measured (ref: FIG. 4). The larger value was defined as A, and a protrusion rate X was calculated by the following formula.

[0151]

$$X [\%] = (A [\text{mm}] / 80 [\text{mm}]) \times 100$$

A case where X was 100% or more and 105% or less was evaluated as “Excellent”, a case where X was above 105% and 110% or less was evaluated as “Good”, and a case where X was above 110% was evaluated as “Bad”. The results are shown in Table 2.

[0152]

<Evaluation of Suppression of Warping>

A ceramic plate 30 having a size of 100 mm $\times$ 100 mm $\times$ thickness of 200 μm was prepared. Each of the sealable sheets 1 (80 mm $\times$ 80 mm $\times$ thickness of 260 μm) of Examples and Comparative Examples was disposed in the center of the ceramic plate 30 so that the first layer was in contact therewith, and then, these were attached to each other with a vacuum flat plate pressing machine under the conditions of a pressure of 0.1 MPa, 90°C, and one minute. In this manner, a laminate 31 was obtained.

[0153]

Next, the laminate 31 was disposed in a dryer at 150°C for one hour, so that the sealable sheet was completely cured, and the sealing sheet 8 was obtained. Thereafter, the laminate 31

was brought back to the room temperature to be disposed on a horizontal table 32. The average value of the height between the four corners of the ceramic plate 30 and the horizontal table 32 was measured as a warping amount (ref: FIG. 5).

[0154]

A case where the warping amount was 5 mm or less was evaluated as “Excellent”, and a case where the warping amount was above 5 mm was evaluated as “Bad”.

[0155]

[Table 1]

Table 1]																
	Material	Trade Name	Ex. 1		Ex. 2		Ex. 3		Comparative Ex. 1		Comparative Ex. 2		Comparative Ex. 3		Comparative Ex. 4	
			Second Layer (Upper Layer)	First Layer (Lower Layer)	Second Layer (Upper Layer)	First Layer (Lower Layer)	Second Layer (Upper Layer)	First Layer (Lower Layer)	Second Layer (Upper Layer)	First Layer (Lower Layer)	Second Layer (Upper Layer)	First Layer (Lower Layer)	Second Layer (Upper Layer)	First Layer (Lower Layer)	Second Layer (Upper Layer)	First Layer (Lower Layer)
Organic Component	Thermosetting Resin	Epoxy Resin	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84
		Phenol Resin	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		Acrylic Polymer	0.56	5.57	0.17	0.00	0.56	0.00	0.00	0.56	1.41	1.41	0.00	0.17	2.80	0.00
		Acrylic Polymer	0.00	0.00	0.00	5.57	0.00	9.67	0.00	0.00	0.00	0.00	3.50	0.00	0.00	3.50
Inorganic Filler	Silane Coupling Agent	Containing Glycidyl Group	0.33	0.81	0.29	0.81	0.33	1.21	0.81	0.33	0.41	0.41	0.29	0.55	0.61	0.61
		Silica	14.26	35.27	12.59	35.27	14.26	52.45	35.27	14.26	17.79	17.79	26.57	23.65	26.57	26.57
		Silica	7.68	18.99	6.78	18.99	7.68	28.24	18.99	7.68	9.58	9.58	14.31	6.78	12.74	14.31
Curing Accelerator	Imidazole-Type		0.03	0.06	0.02	0.06	0.03	0.10	0.06	0.03	0.03	0.03	0.05	0.02	0.04	0.05
Pigment	Carbon Black		0.12	0.29	0.10	0.29	0.12	0.43	0.29	0.12	0.14	0.14	0.22	0.10	0.19	0.22
		Total Amount (wt parts)	25.81	63.84	22.79	63.84	25.81	94.93	63.84	25.81	32.20	32.20	48.09	22.79	42.81	48.09
		Amount of Acrylic Polymer to Organic Component (wt%)	15.11	60.42	5.04	60.42	15.11	70.49	60.41	15.11	30.21	30.21	50.35	5.04	45.29	50.36
		Amount of Filler to Total Amount of Composition (wt%)	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00

[Table 2]

[Table 2]

		Ex. 1	Ex. 2	Ex. 3	Comparative Ex. 1	Comparative Ex. 2	Comparative Ex. 3	Comparative Ex. 4
Recessed Amount (μm)	Second Layer (Upper Layer) D2	106	149	149	47	43	32	48
	First Layer (Lower Layer) D1	52	60	60	70	43	53	28
Push-in Elastic Modulus after Curing [GPa]	Second Layer (Upper Layer)	2.6	2.9	2.6	0.28	2.05	0.45	0.38
	First Layer (Lower Layer)	0.28	0.28	0.22	2.6	2.05	2.9	0.45
Push-in Elastic Modulus before Curing [GPa]	Second Layer (Upper Layer)	0.00225	0.0021	0.00225	0.004123	0.00243	0.003254	0.003417
	First Layer (Lower Layer)	0.004123	0.004123	0.00122	0.00225	0.00243	0.0021	0.003254
Evaluation	Suppression of Contamination	Excellent	Excellent	Good	Bad	Bad	Bad	Bad
	Suppression of Warping	Excellent	Excellent	Excellent	Bad	Bad	Bad	Bad

Description of Reference Numerals

[0156]

- 1 Sealable sheet
- 2 First layer
- 3 Second layer
- 8 Sealing sheet member
- 50 Board
- 51 Electronic element

WHAT IS CLAIMED IS:

1. A sealable sheet for sealing an electronic element, comprising:
 - a first layer and a second layer sequentially toward one side in a thickness direction, the first layer being in contact with the electronic element and the second layer being exposed outwardly when sealing the electronic element, wherein
 - the first layer and the second layer have thermosetting properties,
 - an other-side surface in the thickness direction of the first layer is harder than a one-side surface in the thickness direction of the second layer at 90°C, and
 - an elastic modulus of the second layer after thermal curing is larger than an elastic modulus of the first layer after thermal curing.
2. The sealable sheet according to claim 1, wherein
 - an elastic modulus of the second layer before thermal curing is smaller than an elastic modulus of the first layer before thermal curing.
3. The sealable sheet according to claim 1 or 2, wherein
 - the first layer contains a first organic component containing a first thermosetting resin and a first thermoplastic resin,
 - the second layer contains a second organic component containing a second thermosetting resin and a second thermoplastic resin, and
 - a mass ratio of the second thermoplastic resin to the second organic component is smaller than a mass ratio of the first thermoplastic resin to the first organic component.