TITLE OF THE INVENTION

SEALABLE SHEET AND PRODUCING METHOD OF ELECTRONIC ELEMENT DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

[0001]

The present invention relates to a sealable sheet and a method for producing an electronic element device, to be more specific, to a method for producing an electronic element device and a sealable sheet used therein.

Description of Related Art

[0002]

Conventionally, a method in which an electronic device mounted on a one-side surface of a board is sealed by an electronic device sealable sheet to produce an electronic device package has been known (ref: for example, Japanese Unexamined Patent Publication No. 2015-179829).

[0003]

In this method, the electronic device sealable sheet embeds the electronic device so as to be in contact with a one-side surface and side surfaces of the electronic device, and a one-side surface around the electronic device in the board, thereby sealing the electronic device.

SUMMARY OF THE INVENTION

[0004]

It has been required that the peeling of the electronic device from the board is suppressed, and the electronic device package having excellent reliability is produced.

[0005]

In the electronic device package, a sealing resin sheet that is a cured body of the electronic device sealable sheet is required to have shape stability.

[0006]

The present invention provides a sealable sheet that is capable of suppressing the peeling of an electronic element from a board and forming a sealing layer having excellent shape stability, and a method for producing an electronic element device.

[0007]

The present invention (1) includes a sealable sheet used to form a sealing layer sealing an electronic element mounted on a one-side surface in a thickness direction of a board to face thereto, the sealing layer being in contact with the one-side surface in the thickness direction which does not faces the electronic element in the board, wherein the product (T × E' [N/mm]) of

a thickness T [mm] of the sealable sheet and a tensile storage elastic modulus E' [N/mm^2] at 25°C of the sealing layer is 3,000 [N/mm] or more and 5,000 [N/mm] or less.

[0008]

[1] The thickness T of the sealable sheet is thick and the tensile storage elastic modulus E' at 25°C of the sealing layer is high, so that when the above-described product is above 5,000 [N/mm], in a case where the sealable sheet is pressed toward the electronic element to be used so as to form the sealing layer, an internal stress occurs in the thick sealable sheet, and the internal stress remains without being relaxed by the hard sealing layer after curing. Thus, the peeling of the electronic element and the sealing layer from the board occurs.

[0009]

Also, in a case where even when the thickness T of the sealable sheet is not thick to the degree of the above-described [1], the tensile storage elastic modulus E' at 25°C of the sealing layer is excessively high, so that the above-described product is above 5,000 [N/mm], or in a case where even when the tensile storage elastic modulus E' at 25°C of the sealing layer is not high to the degree of [1], the thickness T of the sealable sheet is excessively thick, so that the above-described product is above 5,000 [N/mm], the peeling of the electronic element and the sealing layer from the board occurs in the same manner as that described above.

[0010]

However, in the present invention, the above-described product is 5,000 [N/mm] or less, so that in a case where the sealable sheet is pressed toward the electronic element to be used so as to form the sealing layer, even when the internal stress is produced in the sealable sheet, the internal stress can be relaxed by the sealing layer after curing. Thus, the peeling of the electronic element and the sealing layer from the board can be suppressed.

[0011]

Also, [2] In a case where the thickness T of the sealable sheet is thin and the tensile storage elastic modulus E' at 25°C of the sealing layer is low, so that the above-described product is below 3,000 [N/mm], when the sealable sheet is pressed toward the electronic element to be used so as to form the sealing layer, the thin sealable sheet easily flows toward the outside of the electronic element, and it is difficult for the soft sealing layer after curing to retain a desired shape.

[0012]

Meanwhile, in a case where even when the thickness T of the sealable sheet is not thin to the degree of the above-described [2], the tensile storage elastic modulus E' at 25°C of the

sealing layer is excessively low, so that the above-described product is below 3,000 [N/mm], or in a case where even when the tensile storage elastic modulus E' at 25°C of the sealing layer is not low to the degree of [2], the thickness T of the sealable sheet is excessively thin, so that the above-described product is below 3,000 [N/mm], it is difficult for the sealing layer to retain a desired shape in the same manner as that described above.

[0013]

However, in the present invention, the above-described product is 3,000 [N/mm] or more, so that in a case where the sealable sheet is pressed toward the electronic element to be used so as to form the sealing layer, the sealing layer can retain a desired shape. Thus, the shape stability of the sealing layer is excellent.

[0014]

As a result, according to the sealable sheet of the present invention, the sealing layer having excellent shape stability can be formed, while the peeling of the electronic element and the sealing layer from the board can be suppressed.

[0015]

The present invention (2) includes the sealable sheet described in (1), wherein the thickness T of the sealable sheet is 0.25 [mm] or more and below 0.50 [mm].

[0016]

The thickness T of the sealable sheet is 0.25 [mm] or more, so that the above-described product (T × E' [N/mm]) can be surely set to the above-described lower limit or more.

[0017]

Meanwhile, there is usually a limit in a predetermined thickness in the electronic element device, and when the thickness is above the limit, the electronic element device may not be used as a product.

[0018]

However, the thickness T of the sealable sheet is below 0.50 [mm], so that the application of the above-described nonuse limit caused by excessive thickening of the sealing layer can be suppressed. Thus, the electronic element device can be produced as an excellent product that passes the thickness limit.

[0019]

When the thickness T of the electronic element sealable sheet is below 0.50 [mm], the product can be surely set to the above-described upper limit or less.

[0020]

The present invention (3) includes a method for producing an electronic element device sealing an electronic element by using the sealable sheet described in (1) or (2).

[0021]

In the producing method, the electronic element mounted on the board can be surely sealed by the sealing layer by using the above-described sealable sheet. As a result, the electronic element device including the board, the electronic element, and the sealing layer and having excellent reliability can be produced.

[0022]

According to the sealable sheet of the present invention, the sealing layer having excellent shape stability can be formed, while the peeling of the electronic element and the sealing layer from the board can be suppressed.

[0023]

According to the method for producing an electronic element device of the present invention, the electronic element device having excellent reliability can be produced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

FIG. 1 shows a cross-sectional view of an electronic element sealable sheet that is one embodiment of a sealable sheet of the present invention.

FIG. 2 shows a step of dicing a board and a sealing layer around an electronic element by sealing the electronic element by using the electronic element sealable sheet shown in FIG. 1 to produce an electronic element device.

FIGS. 3A and 3B show views illustrating steps of producing an electronic element device from an electronic element-mounted board including one electronic element:

FIG. 3A illustrating a step of preparing an electronic element-mounted board including one electronic element, and

FIG. 3B illustrating a step of dicing the board and the sealing layer around the electronic element in the electronic element device.

FIGS. 4A and 4B show cross-sectional views of Comparative Examples 1 to 4:

FIG. 4A illustrating a step of preparing a thin electronic element sealable sheet, and

FIG. 4B illustrating a step of sealing the electronic element by using the electronic element sealable sheet shown in FIG. 4A to produce an electronic element device.

FIGS. 5A and 5B show cross-sectional views of Comparative Examples 5 to 8:

FIG. 5A illustrating a step of preparing a thick electronic element sealable sheet, and

FIG. 5B illustrating a step of sealing the electronic element by using the electronic element sealable sheet shown in FIG. 5A to produce an electronic element device.

FIG. 6 shows a graph illustrating a relationship between a thickness T of an electronic element sealable sheet, and the product (T × E') of the thickness T [mm] of the electronic element sealable sheet 1 and the tensile storage elastic modulus E' of the sealing layer.

DETAILED DESCRIPTION OF THE INVENTION

[0025]

An electronic element sealable sheet that is one embodiment of a sealable sheet of the present invention is described with reference to FIGS. 1 and 2.

[0026]

As shown in FIGS. 1 and 2, an electronic element sealable sheet 1 is used in the production of an electronic element device (electronic element package) 3. As shown in FIG. 2, though described later, the electronic element device 3 includes a board 2, electronic elements 4, and a sealing layer 5.

[0027]

The electronic element sealable sheet 1 shown in FIG. 1 is not the sealing layer 5 (ref: FIG. 2) after sealing the electronic elements 4, that is, is a precursor sheet (preferably, a curable sheet) before sealing the electronic elements 4 for forming the sealing layer 5.

[0028]

As shown in FIG. 1, the electronic element sealable sheet 1 has a generally plate shape (film shape) extending in a direction perpendicular to a thickness direction (plane direction). The electronic element sealable sheet 1 has a first sheet surface 6 that is a one-side surface in the thickness direction and a second sheet surface 7 that is the other-side surface in the thickness direction. The first sheet surface 6 and the second sheet surface 7 are plane surfaces (flat surfaces) that are parallel to each other.

[0029]

When the electronic element sealable sheet 1 seals the electronic elements 4 (ref: FIG. 2), for example, the first sheet surface 6 retains its flat (plane) shape, ensures a gap with the second sheet surface 7 in the thickness direction, and gives a predetermined thickness thereto.

[0030]

Although the details are described later, when the electronic element sealable sheet 1 seals the electronic elements 4, the second sheet surface 7 is a contact surface that is in contact with both surfaces of at least a first element surface 8 (described later) in the electronic element 4, and

a first board surface 11 (described later) that does not face the electronic element 4 in the board 2.

[0031]

A material for the electronic element sealable sheet 1 is not particularly limited as long as a thickness T of the electronic element sealable sheet 1 and a tensile storage elastic modulus E' of the thickness T and the sealing layer 5 satisfy a range to be described later. An example of the material for the electronic element sealable sheet 1 includes a sealing composition.

[0032]

The sealing composition is, for example, a curable composition containing a thermosetting component.

[0033]

The thermosetting component is a component that is once softened by heating at the time of sealing the electronic element 4, and furthermore, is melted and flows to be cured by further heating.

[0034]

The thermosetting component is in a B-stage state (semi-cured state), and not in a C-stage state (that is, a state before complete curing) in the electronic element sealable sheet 1. The B-stage state is a state between an A-stage state in which the thermosetting component is liquid and a C-stage state in which the thermosetting component is completely cured, and a state where the curing and gelation thereof slightly progress, and the compressive elastic modulus thereof is smaller than that of the C-stage state.

[0035]

The thermosetting component contains, for example, a main agent, a curing agent, and a curing accelerator.

[0036]

Examples of the main agent include epoxy resin, phenol resin, melamine resin, vinyl ester resin, cyanoester resin, maleimide resin, and silicone resin. As the main agent, in view of heat resistance or the like, preferably, an epoxy resin is used. When the main agent is the epoxy resin, the thermosetting component, along with the curing agent (epoxy curing agent) and the curing accelerator (epoxy curing accelerator) to be described later, constitutes an epoxy thermosetting component.

[0037]

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.

[0038]

Preferably, a bifunctional epoxy resin is used alone, and to be specific, a bisphenol F epoxy resin is used alone.

[0039]

The epoxy equivalent of the epoxy resin is, for example, 10 g/eq. or more, preferably 100 g/eq. or more, and for example, 300 g/eq. or less, preferably 250 g/eq. or less.

[0040]

The softening point of the main agent (preferably, 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.

[0041]

The ratio of the main agent (preferably, epoxy resin) in the sealing composition is, for example, 1 mass% or more, preferably 2 mass% or more, and for example, 30 mass% or less, preferably 10 mass% or less. The ratio of the main agent (preferably, epoxy resin) in the thermosetting component is, for example, 50 mass% or more, preferably 60 mass% or more, and for example, 90 mass% or less, preferably 10 mass% or less.

[0042]

The curing agent (preferably, epoxy resin curing agent) is a component that cures the above-described main agent by heating. Examples of the curing agent include phenol resins such as phenol novolak resin.

[0043]

As the ratio of the curing agent, when the main agent is the epoxy resin and the curing agent is the phenol resin, 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 adjusted to be, for example, 0.7 equivalent or more, preferably 0.9 equivalent or more, and for example, 1.5 equivalent or less, preferably 1.2 equivalent or less. To be specific, the mixed amount of the curing agent with respect to 100 parts by mass of the main agent is, for example, 30 parts by mass or more, preferably 50 parts by mass or more, and for example, 75 parts by mass or less, preferably 60 parts by mass or less.

[0044]

The curing accelerator is a catalyst (thermosetting catalyst) (preferably, epoxy resin curing accelerator) that promotes curing of the main agent by heating, and examples thereof 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 mixed amount of the curing accelerator with respect to 100 parts by mass of the main agent is, for example, 0.05 parts by mass or more and for example, 5 parts by mass or less.

[0045]

The sealing composition can contain additives such as inorganic filler, thermoplastic component, pigment, and silane coupling agent in addition to the above-described thermosetting component.

[0046]

The inorganic filler is inorganic particles for improving the strength of the sealing layer 5 (described later) and imparting excellent toughness thereto. Examples of a material for the inorganic filler include inorganic compounds such as silica glass, talc, silica, alumina, aluminum nitride, silicon nitride, and boron nitride. These can be used alone or in combination of two or more. Preferably, silica is used.

[0047]

The shape of the inorganic filler is not particularly limited, and examples of the shape thereof include generally sphere shape, generally plate shape, generally needle shape, and amorphous shape. Preferably, a generally sphere shape is used.

[0048]

An average value (in the case of a generally sphere shape, average particle size) M of the maximum length of the inorganic filler is, for example, 50 μm or less, preferably 20 μm or less, more preferably 10 μm or less, and for example, 0.1 μm or more, preferably 0.5 μm or more. The average particle size M 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.

[0049]

The inorganic filler can include a first filler and a second filler having an average value M2 of the maximum length that is smaller than an average value M1 of the maximum length of the first filler.

[0050]

The average value (in the case of a generally sphere shape, average particle size) M1 of the maximum length of the first filler is, for example, 1 μm or more, preferably 3 μm or more, and for example, 50 μm or less, preferably 30 μm or less.

[0051]

The average value (in the case of a generally sphere shape, average particle size) M2 of the maximum length of the second filler is, for example, below 1 μm, preferably 0.8 μm or less, and for example, 0.01 μm or more, preferably 0.1 μm or more.

[0052]

The ratio (M1/M2) of the average value of the maximum length of the first filler to the average value of the maximum length of the second filler is, for example, 2 or more, preferably 5 or more, and for example, 50 or less, preferably 20 or less.

[0053]

The material for the first filler and that for the second filler may be the same or different from each other.

[0054]

Furthermore, the surface of the inorganic filler may be partially or entirely subjected to surface treatment by a silane coupling agent or the like.

[0055]

When the inorganic filler contains the above-described first filler and second filler, the ratio of the first filler in the sealing composition is, for example, 40 mass% or more, preferably above 50 mass%, and for example, 80 mass% or less, preferably 70 mass% or less, more preferably 60 mass% or less. The mixed amount of the second filler with respect to 100 parts by mass of the first filler is, for example, 40 parts by mass or more, preferably 50 parts by mass or more, and for example, 70 parts by mass or less, preferably 60 parts by mass or less.

[0056]

The ratio of the inorganic filler in the sealing composition is, for example, 50 mass% or more, preferably 65 mass% or more, more preferably 70 mass% or more, further more preferably 75 mass% or more, and for example, 95 mass% or less, preferably 90 mass% or less.

[0057]

A thermoplastic component is a component for improving the flexibility of the electronic element sealable sheet 1 at the time of sealing the electronic element 4. An example of the thermoplastic component includes a thermoplastic resin.

[0058]

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.

[0059]

As the thermoplastic resin, preferably, in view of improvement of the dispersibility with the main agent (preferably, epoxy resin), an acrylic resin is used.

[0060]

An example of the acrylic resin includes 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).

[0061]

An example of the alkyl group includes 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.

[0062]

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.

[0063]

The weight average molecular weight of the thermoplastic component is, for example, 100,000 or more, preferably 300,000 or more, and for example, 1,000,000 or less, preferably 900,000 or less. The weight average molecular weight is calibrated with standard polystyrene based on gel permeation chromatography (GPC).

[0064]

The ratio (solid content ratio) of the thermoplastic component is adjusted so as not to block the thermal curing of the sealing composition, and to be specific, the ratio (solid content ratio) of the thermoplastic component with respect to the sealing 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. The thermoplastic component may be prepared by being diluted with an appropriate

solvent.

[0065]

Examples of the pigment include black pigments such as carbon black. The average particle size of the pigment is, for example, 0.001 μm or more and for example, 1 μm or less. The ratio of the pigment with respect to the sealing composition is, for example, 0.1 mass% or more, and for example, 2 mass% or less.

[0066]

An example of the silane coupling agent includes a silane coupling agent containing an epoxy group. Examples of the silane coupling agent containing an epoxy group include 3-glycidoxy dialkyl dialkoxy silanes such as 3-glycidoxy propyl methyl dimethoxy silane and 3-glycidoxy propyl methyl diethoxy silane and 3-glycidoxy alkyl trialkoxy silanes such as 3-glycidoxy propyl trimethoxy silane and 3-glycidoxy propyl triethoxy silane. Preferably, a 3-glycidoxy alkyl trialkoxy silane is used. The mixing ratio of the silane coupling agent with respect to 100 parts by mass of the inorganic filler is, for example, 0.1 parts by mass or more, preferably 1 part by mass or more, and for example, 10 parts by mass or less, preferably 5 parts by mass or less.

[0067]

The thickness T of the electronic element sealable sheet 1 is, for example, 0.25 mm or more, preferably 0.27 mm or more. To be specific, the thickness T of the electronic element sealable sheet 1 is a distance (average length) between the first sheet surface 6 and the second sheet surface 7.

[0068]

When the thickness T of the electronic element sealable sheet 1 is above the above-described lower limit, the electronic element sealable sheet 1 can be used as a thick product having excellent sealing properties of the electronic element 4.

[0069]

Meanwhile, the thickness T of the electronic element sealable sheet 1 is, for example, below 0.50 mm, preferably 0.45 mm or less, more preferably 0.40 mm or less.

[0070]

When the thickness T of the electronic element sealable sheet 1 is above the above-described lower limit and is below the above-described upper limit, the product (T × E' [N/mm]) of the thickness T [mm] of the electronic element sealable sheet 1 and the tensile storage elastic modulus E' [N/mm^2] at 25°C of the sealing layer 5 to be described later can be

surely set in a range to be described later.

[0071]

The shape of the electronic element sealable sheet 1 in a direction perpendicular to the thickness direction (plane direction) is not particularly limited, and the size thereof is set so that the plurality of electronic elements 4 are embedded (sealed), and it can be in contact with the first board surface 11 of the board 2 that is exposed from the plurality of electronic elements 4 (the first board surface 11 around the electronic elements 4). To be specific, the length in the plane direction of the electronic element sealable sheet 1 (when the electronic element sealable sheet 1 is a rectangular shape when viewed from the top, the maximum length of the four sides) is, for example, 1 mm or more, and for example, 500 mm or less.

[0072]

To produce the electronic element sealable sheet 1, first, the sealing composition is prepared. To be specific, the above-described components are blended to be mixed, thereby preparing the sealing composition. Preferably, each of the components described above, and, if necessary, a solvent (ketone, alcohol, or the like) are blended and mixed, thereby preparing a varnish. Thereafter, the varnish is applied to a peeling sheet that is not shown to be dried, thereby obtaining the electronic element sealable sheet 1. Also, the electronic element sealable sheet 1 can be formed from the sealing composition by kneading and extruding without preparing the varnish.

[0073]

In this manner, the electronic element sealable sheet 1 can be formed as one layer from the sealing composition.

[0074]

The electronic element sealable sheet 1 is, for example, in a B-stage state when it contains the thermosetting component.

[0075]

(Producing Method of Electronic Element Device)

Next, a method for producing the electronic element device 3 by using the electronic element sealable sheet 1 is described.

[0076]

The producing method includes a preparing step (ref: FIG. 1) of preparing the electronic element sealable sheet 1 and the electronic elements 4 and a sealing step (ref: FIG. 2) of sealing the electronic elements 4 by using the electronic element sealable sheet 1 to form the sealing

layer 5.

[0077]

(Preparing Step)

As shown in FIG. 1, in the preparing step, the above-described electronic element sealable sheet 1 (preferably, the electronic element sealable sheet 1 in a B-stage state) is prepared. Separately, as shown by a phantom line of FIG. 1, in the preparing step, the electronic elements 4 that are mounted on the board 2 are prepared.

[0078]

The plurality of electronic elements 4 are disposed at spaced intervals to each other in the first board surface 11 (described later) of the board 2. Each of the plurality of electronic elements 4 has a generally flat plate shape extending in the plane direction. To be specific, each of the plurality of electronic elements 4 continuously includes the first element surface 8, a second element surface 9, and an element peripheral side surface 10.

[0079]

The first element surface 8 and the second element surface 9 are spaced apart from each other in the thickness direction, and flat surfaces that are parallel to each other.

[0080]

The element peripheral side surface 10 connects the peripheral end edge of the first element surface 8 to that of the second element surface 9 in the thickness direction. The element peripheral side surface 10 extends in the thickness direction, and to be more specific, the element peripheral side surface 10 is in perpendicular to the plane direction.

[0081]

The electronic element 4 is not particularly limited, and various electronic elements are used. Examples thereof include hollow electronic elements and semiconductor elements. The plurality of electronic elements 4 are mounted so as to face the first board surface 11 of the board 2. To be specific, the plurality of electronic elements 4 are flip-chip mounted on the board 2. In this case, electrodes (not shown) that are provided on the second element surfaces 9 of the plurality of electronic elements 4 are electrically connected to terminals (not shown) that are provided on the first board surface 11 of the board 2. Also, die bonding may be applied to the board 2 of the electronic elements 4 via an adhesive layer (die bonding film or the like) that is not shown.

[0082]

A material for the electronic element 4 is not particularly limited, and examples thereof

include hard materials such as silicon.

[0083]

A thickness t2 of the electronic element 4 is, for example, 0.05 mm or more, preferably 0.10 mm or more, and for example, 0.5 mm or less, preferably 0.4 mm or less, more preferably 0.3 mm or less. The thickness t2 of the electronic element 4 is a distance between the first element surface 8 and the second element surface 9.

[0084]

When the thickness t2 of the electronic element 4 is the above-described upper limit or less, the application of the limit of the thickness of the electronic element device 3 can be suppressed in advance.

[0085]

Meanwhile, when the thickness t2 of the electronic element 4 is the above-described lower limit or more, the area in which the element peripheral side surface 10 of the electronic element 4 is in contact with the sealing layer 5 is sufficiently ensured, and the sealing properties of the sealing layer 5 can be improved.

[0086]

The length in the plane direction of the electronic element 4 (when the electronic element 4 is a rectangular shape when viewed from the top, the maximum length of the four sides) is not particularly limited as long as a length (consequently, the area) in which the electronic element 4 is fixed to the first board surface 11 of the board 2 is ensured. The length in the plane direction of the electronic element 4 is, for example, 0.01 mm or more, preferably 0.1 mm or more, and for example, 10 mm or less, preferably 1 mm or less.

[0087]

A gap between the electronic elements 4 that are next to each other is not particularly limited as long as the electronic element sealable sheet 1 fills the gap and the electronic elements 4 can be in contact with the first board surface 11 of the board 2. The gap between the electronic elements 4 that are next to each other is, for example, 0.01 mm or more, preferably 0.1 mm or more, and for example, 10 mm or less, preferably 1 mm or less.

[0088]

Along with the electronic elements 4, the board 2 is provided in an electronic element-mounted board 13. That is, the electronic element-mounted board 13 includes the plurality of electronic elements 4 and the board 2 that is mounted with the plurality of electronic elements 4. Preferably, the electronic element-mounted board 13 consists of only the plurality

of electronic elements 4 and the board 2.

[0089]

The board 2 has a generally flat plate shape extending in the plane direction. The board 2 has a size that surrounds the plurality of electronic elements 4 when viewed from the top. The board 2 includes the first board surface 11 that is a one-side surface in the thickness direction, and a second board surface 12 that is the other-side surface in the thickness direction.

[0090]

The first board surface 11 is exposed toward the one side in the thickness direction. The terminals (not shown) that are subjected to flip-chip mounting with the electronic elements 4 are provided on the first board surface 11.

[0091]

The second board surface 12 is a flat surface that is parallel with the first board surface 11.

[0092]

A material for the board 2 is not particularly limited, and examples thereof include resins, ceramics (alumina or the like), and metals. Preferably, in view of ensuring low linear expansion coefficient, ceramics are used.

[0093]

A thickness t3 of the board 2 is not particularly limited, and for example, 10 μm or more, and for example, 1,000 μm or less, preferably 500 μm or less.

[0094]

(Sealing Step)

In the sealing step, as shown by arrows of FIG. 1, and FIG. 2, next, the electronic elements 4 are sealed by using the electronic element sealable sheet 1.

[0095]

For example, the electronic element sealable sheet 1 is hot pressed with respect to the electronic element-mounted board 13. The temperature, the time, and the pressure of the hot pressing are not particularly limited. The electronic element sealable sheet 1 (in particular, the second sheet surface 7) is deformed by the hot pressing.

[0096]

Then, the second sheet surface 7 of the electronic element sealable sheet 1 is brought into contact with the first element surfaces 8 and the element peripheral side surfaces 10 of the electronic elements 4, and the first board surface 11 around the electronic elements 4 in the board 2, so that the electronic element sealable sheet 1 embeds the electronic elements 4.

[0097]

After the above-described hot pressing, when the material for the electronic element sealable sheet 1 contains the thermosetting component, and the electronic element sealable sheet 1 is in a B-stage state, the electronic element sealable sheet 1 is heated to be completely cured (brought into a C-stage state). In this manner, the sealing layer 5 is formed from the electronic element sealable sheet 1.

[0098]

As shown by bold lines of FIG. 2, thereafter, in the electronic element device 3, the board 2 and the sealing layer 5 around the electronic elements 4 are diced. For example, a dicing tape 14 shown by phantom lines is disposed on the second board surface 12 of the board 2, and thereafter, the board 2 and the sealing layer 5 between the electronic elements 4 that are next to each other are cut along the plane direction with a dicing saw (not shown). In addition, the board 2 and the sealing layer 5 at the outside of the electronic elements 4 are cut along the plane direction (that is, trimmed).

[0099]

In this manner, the electronic element device 3 including the board 2, the one electronic element 4, and the sealing layer 5 is obtained. The electronic element device 3 preferably consists of only the board 2, the electronic element 4, and the sealing layer 5.

[0100]

In the electronic element device 3, the communication of the electronic elements 4 with the outside is blocked by the board 2 and the sealing layer 5. That is, the electronic elements 4 are shielded with respect to the outside. In other words, the plurality of electronic elements 4 are sealed by the sealing layer 5.

[0101]

As shown (by the phantom line) in FIG. 2, the sealing layer 5 includes a first sealing surface 15, a second sealing surface 16, and a sealing peripheral side surface 21.

[0102]

The first sealing surface 15 is formed of the first sheet surface 6 of the electronic element sealable sheet 1. The first sealing surface 15 is a flat surface along the plane direction.

[0103]

The second sealing surface 16 is formed of the second sheet surface 7 of the electronic element sealable sheet 1, and has a generally U-shape (generally hat shape) having an opening toward the other side in the thickness direction when viewed in cross section. To be specific,

the second sealing surface 16 continuously includes an element contact surface 17 in contact with the electronic elements 4 and a board contact surface 18 in contact with the board 2.

[0104]

The element contact surface 17 is in contact (tight contact) with both surfaces of the first element surface 8 and the element peripheral side surface 10 of the electronic element 4. That is, the element contact surface 17 has a shape corresponding to the electronic element 4. To be more specific, the element contact surface 17 continuously includes a third sealing surface 19 in contact with the first element surface 8, and a fourth sealing surface 20 in contact with the element peripheral side surface 10.

[0105]

The third sealing surface 19 has the same shape as that of the first element surface 8 of the electronic element 4 when viewed from the top.

[0106]

The fourth sealing surface 20 is the inner-side surface extending from the peripheral end edge of the third sealing surface 19 toward the other side in the thickness direction. The fourth sealing surface 20 has the same shape as that of the element peripheral side surface 10 of the electronic element 4 when viewed from the side.

[0107]

The board contact surface 18 is continuous to the other end edge in the thickness direction of the fourth sealing surface 20, and has a shape extending from the other end edge in the thickness direction of the fourth sealing surface 20 toward the outer side in the plane direction. The board contact surface 18 is in contact (tight contact) with the first board surface 11 around the electronic elements 4 in the board 2. Thus, the board contact surface 18 has the same flat surface shape as that of the first board surface 11 around the electronic elements 4 in the board 2.

[0108]

The sealing peripheral side surface 21 is a peripheral surface that connects the peripheral end edge of the first sealing surface 15 to that of the second sealing surface 16 (the board contact surface 18). The sealing peripheral side surface 21 has a shape extending in the thickness direction. The angle made between the sealing peripheral side surface 21 and the first sealing side surface 15 is, for example, 60 degrees or more, preferably 80 degrees or more, and for example, 120 degrees or less, preferably 100 degrees or less, most preferably 90 degrees (right angle).

[0109]

A thickness t1 of the sealing layer 5 is a thickness of a portion in contact with the first element surface 8 in the thickness direction of the electronic element 4, that is, the minimum thickness of the sealing layer 5, and is, for example, 0.15 mm or more, preferably 0.17 mm or more, more preferably 0.19 mm or more, further more preferably 0.20 mm or more, and for example, 0.50 mm or less, preferably 0.40 mm or less, more preferably 0.35 mm or less. The above-described thickness t1 of the sealing layer 5 is a distance between the first sealing surface 15 and the third sealing surface 19 in the thickness direction.

[0110]

When the thickness t1 of the sealing layer 5 is the above-described lower limit or more, the sealing of the electronic element 4 by the sealing layer 5 can be surely achieved. To be specific, the damage or a defect of the sealing layer 5 in contact with the first element surface 8 in the thickness direction of the electronic element 4 can be suppressed, and thus, the sealing properties of the sealing layer 5 can be improved.

[0111]

When the thickness t1 of the sealing layer 5 is the above-described upper limit or less, the excessive thickening of the electronic element device 3 can be suppressed, and the application of the limit of the thickness of the electronic element device 3 can be suppressed in advance (prevented). Also, the peripheral end portion of the first sealing surface 15 of the sealing layer 5 can have a desired shape.

[0112]

The maximum thickness of the sealing layer 5 is the total sum (= t1 + t2) of the above-described minimum thickness t1 and the thickness t2 of the electronic element 4, and to be specific, a distance between the first sealing surface 15 and the board contact surface 18 in the thickness direction. The maximum thickness of the sealing layer 5 is also the length in the thickness direction of the sealing peripheral side surface 21. The maximum thickness of the sealing layer 5 is, for example, 0.30 mm or more, preferably 0.35 mm or more, and for example, below 0.50 mm, preferably 0.45 mm or less.

[0113]

The ratio ([t1 + t2]/t1) of the maximum thickness (t1 + t2) of the sealing layer 5 to the minimum thickness t1 of the sealing layer 5 is, for example, 1.4 or more, preferably 1.7 or more, and for example, 2.2 or less, preferably 2.0 or less.

[0114]

The ratio ([t1 + t2]/T) of the maximum thickness (t1 + t2) of the sealing layer 5 to the

thickness T of the electronic element sealable sheet 1 is, for example, 0.8 or more, preferably 1.0 or more, and for example, 1.6 or less, preferably 1.4 or less.

[0115]

A length L in the plane direction of the board contact surface 18 of the sealing layer 5, as the shortest distance, is, for example, 0.01 mm or more, preferably 0.02 mm or more, and for example, 1.0 mm or less, preferably 0.5 mm or less. The length L of the board contact surface 18 is the shortest distance L from the peripheral end edge of the second element surface 9 of the electronic element 4 to the other end edge in the thickness direction of the sealing peripheral side surface 21, and also the contact length L in which the board contact surface 18 is in contact with the first board surface 11 of the board 2 at the time of proceeding from the other end edge in the thickness direction of the fourth sealing surface 20 toward the outer side in the plane direction. Also, the length L of the board contact surface 18 is the shortest distance between the sealing peripheral side surface 21 and the element peripheral side surface 10 that are next to each other, when each of the sealing layer 5 and the electronic element 4 has a generally rectangular shape when viewed from the top, and each of the four sealing peripheral side surfaces 21 of the sealing layer 5 is parallel with each of the four element peripheral side surfaces 10 of the electronic element 4 when viewed from the top.

[0116]

The tensile storage elastic modulus E' at 25°C of the sealing layer 5 is, for example, 5,000 [N/mm^2] or more, preferably 9,000 [N/mm^2] or more, more preferably 10,000 [N/mm^2] or more, further more preferably 13,000 [N/mm^2] or more, and for example, 20,000 [N/mm^2] or less, preferably 15,000 [N/mm^2] or less, more preferably 14,000 [N/mm^2] or less. The details of the tensile storage elastic modulus E' at 25°C of the sealing layer 5 are described in Examples to be described later.

[0117]

The product (T × E' [N/mm]) of the thickness T of the electronic element sealable sheet 1 shown in FIG. 1 and the tensile storage elastic modulus E' at 25°C of the sealing layer 5 shown in FIG. 2 is 3,000 [N/mm] or more. The above-described product is preferably 3,300 [N/mm] or more, more preferably 3,500 [N/mm] or more, further more preferably 3,700 [N/mm] or more, particularly preferably 3,900 [N/mm] or more, most preferably 4,000 [N/mm] or more, moreover 4,300 [N/mm] or more. When the above-described product is below the above-described lower limit, though the details are described later, the sealing layer 5 cannot retain a desired shape, and the shape stability of the sealing layer 5 is lowered.

[0118]

Meanwhile, the product is 5,000 [N/mm] or less. The above-described product is preferably 4,850 [N/mm] or less, more preferably 4,500 [N/mm] or less. When the product is above the above-described upper limit, though the details are described later, the peeling of the electronic element 4 and the sealing layer 5 from the board 2 cannot be suppressed.

[0119]

A thickness T0 of the electronic element device 3 is, in view of limit of the use of the electronic element device 3, for example, 1.0 mm or less, and in view of production of the thinner electronic element device 3, preferably 0.8 mm or less, and for example, 0.3 mm or more, preferably 0.5 mm or more. The thickness T0 of the electronic element device 3 is the total sum (= t1 + t2 + t3) of the thickness t1 of the sealing layer 5, the thickness t2 of the electronic element 4, and the thickness t3 of the board 2, and a length (distance) in the thickness direction between the second board surface 12 of the board 2 and the first sealing surface 15 of the sealing layer 5.

[0120]

[1] The thickness T of the electronic element sealable sheet 1 is thick and the tensile storage elastic modulus E' at 25°C of the sealing layer 5 is high, so that when the above-described product is above 5,000 [N/mm], in a case where the electronic element sealable sheet 1 is pressed toward the electronic element 4 to be used so as to form the sealing layer 5, an internal stress occurs in the thick electronic element sealable sheet 1, and the internal stress remains without being relaxed by the hard sealing layer 5 after curing. Thus, the peeling of the electronic element 4 and the sealing layer 5 from the board 2 occurs.

[0121]

Also, in a case where even when the thickness T of the electronic element sealable sheet 1 is not thick to the degree of the above-described [1], the tensile storage elastic modulus E' at 25°C of the sealing layer 5 is excessively high, so that the above-described product is above 5,000 [N/mm], or in a case where even when the tensile storage elastic modulus E' at 25°C of the sealing layer 5 is not high to the degree of [1], the thickness T of the electronic element sealable sheet 1 is excessively thick, so that the above-described product is above 5,000 [N/mm], the peeling of the electronic element 4 and the sealing layer 5 from the board 2 occurs in the same manner as that described above.

[0122]

However, in the electronic element sealable sheet 1, the above-described product is 5,000

[N/mm] or less, so that in a case where the electronic element sealable sheet 1 is pressed toward the electronic element 4 to be used so as to form the sealing layer 5, even when the internal stress is produced in the electronic element sealable sheet 1, the internal stress can be relaxed by the sealing layer 5 after curing. Thus, the peeling of the electronic element 4 and the sealing layer 5 from the board 2 can be suppressed.

[0123]

Also, [2] In a case where the thickness T of the electronic element sealable sheet 1 is thin and the tensile storage elastic modulus E' at 25°C of the sealing layer 5 is low, so that the above-described product is below 3,000 [N/mm], when the electronic element sealable sheet 1 is pressed toward the electronic element 4 to be used so as to form the sealing layer 5, the thin electronic element sealable sheet 1 easily flows toward the outside of the electronic element 4, and it is difficult for the soft sealing layer 5 after curing to retain a desired shape.

[0124]

Meanwhile, in a case where even when the thickness T of the electronic element sealable sheet 1 is not thin to the degree of the above-described [2], the tensile storage elastic modulus E' at 25°C of the sealing layer 5 is excessively low, so that the above-described product is below 3,000 [N/mm], or in a case where even when the tensile storage elastic modulus E' at 25°C of the sealing layer 5 is not low to the degree of [2], the thickness T of the electronic element sealable sheet 1 is excessively thin, so that the above-described product is below 3,000 [N/mm], it is difficult for the sealing layer 5 to retain a desired shape in the same manner as that described above.

[0125]

However, in the electronic element sealable sheet 1, the above-described product is 3,000 [N/mm] or more, so that in a case where the electronic element sealable sheet 1 is pressed toward the electronic element 4 to be used so as to form the sealing layer 5, the sealing layer 5 can retain a desired shape. Thus, the shape stability of the sealing layer 5 is excellent.

[0126]

As a result, according to the electronic element sealable sheet 1, the sealing layer 5 having excellent shape stability can be formed, while the peeling of the electronic element 4 and the sealing layer 5 from the board 2 can be suppressed.

[0127]

When the thickness T of the electronic element sealable sheet 1 is 0.25 [mm] or more, the above-described product (T × E' [N/mm]) can be surely set to the above-described lower limit or

more.

[0128]

Meanwhile, there is usually a limit in a predetermined thickness in the electronic element device 3, and when the thickness is above the limit, the electronic element device 3 may not be used as a product.

[0129]

However, the thickness T of the electronic element sealable sheet 1 is below 0.50 [mm], so that the application of the above-described nonuse limit caused by excessive thickening of the sealing layer 5 can be suppressed. Thus, the electronic element device 3 can be produced as an excellent product that passes the thickness limit.

[0130]

When the thickness T of the electronic element sealable sheet 1 is below 0.50 [mm], the product can be surely set to the above-described upper limit or less.

[0131]

In the producing method, the electronic element 4 mounted on the board 2 can be surely sealed by the sealing layer 5 by using the above-described electronic element sealable sheet 1. As a result, the electronic element device 3 including the board 2, the electronic element 4, and the sealing layer 5 and having excellent reliability can be produced.

[0132]

Modified Examples

In the following each of the modified examples, the same reference numerals are provided for members and steps corresponding to those of the above-described one embodiment, and their detailed description is omitted. Each of the modified examples can achieve the same function and effect as that of one embodiment unless otherwise specified. Furthermore, one embodiment and each of the modified examples can be also appropriately used in combination.

[0133]

In the one embodiment, as shown in FIG. 1, the electronic element-mounted board 13 includes the plurality of electronic elements 4. However, the number thereof is not particularly limited, and for example, as shown in FIG. 3A, the number thereof may be one. In this case, as shown by the bold line of FIG. 3B, in the electronic element device 3 including the one electronic element 4, the board 2 and the sealing layer 5 around the electronic element 4 are diced, and the size (the length in the plane direction) of the electronic element device 3 when viewed from the top can be adjusted (trimmed).

Examples

[0134]

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 "DETAILED DESCRIPTION OF THE INVENTION".

[0135]

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

[0136]

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

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

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

Curing accelerator: 2PHZ-PW (2-phenyl-4,5-dihydroxy methyl imidazole), manufactured by SHIKOKU CHEMICALS CORPORATION, epoxy resin curing accelerator

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

Carbon black: #20, manufactured by Mitsubishi Chemical Corporation

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

Second filler: inorganic filler obtained by subjecting SC220G-SMJ (average particle size of 0.5 μm) manufactured by Admatechs Company Limited to surface treatment with

3-methacryloxy propyl trimethoxy silane (trade name: KBM-503, manufactured by Shin-Etsu Chemical Co., Ltd.). Filler subjected to surface treatment with 1 part by mass of silane coupling agent with respect to 100 parts by mass of inorganic filler

[0137]

Examples 1 to 6 and Comparative Examples 1 to 8

In accordance with the mixing formulation described in Table 1, the sealing composition was prepared, and as shown in FIG. 1, the electronic element sealable sheet 1 having the thickness T described in Table 1 was produced from the sealing composition.

[0138]

Thereafter, as shown in FIG. 2, the plurality of electronic elements 4 were sealed by the electronic element sealable sheet 1, so that the sealing layer 5 was formed.

[0139]

To be specific, the plurality of electronic elements 4 made of silicon, having a size of 3 mm square, and having the thickness t2 described in Table 1 were prepared to be subjected to die bonding to the first board surface 11 of the board 2 made of alumina, having a size of 50 mm square, and having the thickness t3 of 0.22 mm via a die bonding film (adhesive layer) having a thickness of 20 μm. A gap between the electronic elements 4 that were next to each other was 0.3 mm. In this manner, as shown in FIG. 1, the electronic element-mounted board 13 including the plurality of electronic elements 4 and the board 2 was prepared.

[0140]

Next, the electronic element sealable sheet 1 was disposed at one side in the thickness direction of the electronic element-mounted board 13, and subsequently, the electronic element sealable sheet 1 was vacuum pressed with respect to the electronic element-mounted board 13 under the conditions of 75°C, 60 seconds, and a pressure of 100 kPa, so that the plurality of electronic elements 4 were embedded by the electronic element sealable sheet 1. Thereafter, the electronic element-mounted board 13 and the electronic element sealable sheet 1 were heated at 150°C for 1 hour, so that the electronic element sealable sheet 1 was brought into a C-stage state.

[0141]

Thereafter, as shown by the bold line of FIG. 2, the sealing layer 5 and the board 2 around each of the plurality of electronic elements 4 were diced. In this manner, the electronic element device (electronic element package) 3 including the board 2, the electronic element 4, and the sealing layer 5 was produced. The length (average length) L of the board contact surface 18

was 0.15 mm.

[0142]

(Evaluation)

The following items were evaluated. The results are described in Table 1.

[0143]

(Tensile Storage Elastic Modulus E' of Electronic Element Sealable Sheet and Sealing Layer)

The electronic element sealable sheet 1 was trimmed into a piece having a length of 0.1 cm and a width of 5 cm, thereafter, the trimmed sheet was completely cured, so that a cured sample (corresponding to the sealing layer 5) was obtained. Thereafter, the tensile storage elastic modulus E' at 25°C of the cured sample was obtained.

[0144]

The details of the measurement device and the measurement conditions are as follows.

[0145]

Measurement device: solid viscoelasticity measurement device (type: RSA-G2, manufactured by TA Instruments.)

Mode: tensile

Scanning temperature: 0 to 260°C

Temperature rising rate: 10°C/min

Frequency: 1 Hz

Distortion: 0.05%

The relationship between the thickness T of the electronic element sealable sheet 1 and the tensile storage elastic modulus E' of the sealing layer 5 is shown in FIG. 6.

[0146]

FIG. 6 shows the line in which the product (T × E' [N/mm]) is 3,000 [N/mm] and the line in which the product (T × E' [N/mm]) is 5,000 [N/mm]. The region sandwiched between those 2 lines shows a range in which the above-described product is 3,000 [N/mm] or more and 5,000 [N/mm] or less. In FIG. 6, the above-described range is shown by applying hatching.

[0147]

(Evaluation of Connecting Strength) (Observation of Peeling)

The following temperature cycle test was carried out as for the electronic element device 3.

[0148]

Temperature: -40°C to 85°C

Total transfer time: 1 minute or less

Total dwell time: 10 minutes or more

Specified temperature reached in: 15 minutes or less

Cycle: 1000 cycles

By using an ultrasonic imaging device [SAT] (manufactured by Hitachi Construction Machinery Finetech, "FineSAT II"), the interface between the board 2 and the electronic element 4, and the interface between the board 2 and the sealing layer 5 were observed and evaluated based on the following criteria.

Excellent: the peeling was not observed in the interface between the board 2 and the electronic element 4, and the peeling was also not observed in the interface between the board 2 and the sealing layer 5.

Good: the peeling was observed in the interface between the board 2 and the electronic element 4. Meanwhile, the peeling was not observed in the interface between the board 2 and the sealing layer 5. Ref: FIGS. 4B and 5B. In FIGS. 4B and 5B, though a space was intentionally depicted between the board 2 and the electronic element 4, practically, in this evaluation example, there was no space and simply, the fixing (adhering) (bonding) of the electronic element 4 to the board 2 came off (was peeled). To easily show the above-described "peeling", the space was depicted.

Bad: the peeling was observed in the interface between the board 2 and the electronic element 4. The peeling was also observed in the interface between the board 2 and the sealing layer 5.

[0149]

Shape of Sealing Layer (Shape Stability)

The shape of the peripheral end edge of the first sealing surface 16 of the sealing layer 5 in the electronic element device 3 was observed with a laser microscope (manufactured by Lasertec Corporation, H300), and the shape stability of the sealing layer 5 was evaluated based on the following criteria.

Excellent: the corner portion (one end portion in the thickness direction) of the peripheral end edge of the first sealing surface 16 of the sealing layer 5 was retained, and the thickness thereof was that as designed.

Bad: the peripheral end edge of the first sealing surface 16 of the sealing layer 5 was round, or the thickness thereof was thinner than that initially designed.

[0150]

[Table 1]

[0151]

Table 1

Formulation of Sealing Composition (parts)		Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4	Ex. 7	Ex. 8	Ex. 9	Ex. 10
Acrylic Resin	ME-2006M	12.6	15.6	9.6	12.6	15.6	9.6	12.6	15.6	9.6	24.1	12.6	15.6	9.6	24.1
Silane Coupling Agent	KBM-403	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Epoxy Resin A	YSLV-80XY	4.2	3.8	4.6	4.2	3.8	4.6	4.2	3.8	4.6	6.2	4.2	3.8	4.6	6.2
Curing Agent	LVR8210DL	2.3	2.1	2.5	2.3	2.1	2.5	2.3	2.1	2.5	3.4	2.3	2.1	2.5	3.4
First Filler	FB-8SM	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	64.0	45.2	45.2	45.2	64.0
Second Filler	SC-220G-SMJ	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0.0	24.4	24.4	24.4	0.0
Carbon Black	#20	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.3	0.3	0.3	0.5
Curing Accelerator	2PHZ-PW	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Solvent	MEK	9.9	7.5	12.3	9.9	7.5	12.3	9.9	7.5	12.3	0.8	9.9	7.5	12.3	0.8
	Tensile Storage Elastic Modulus E' of Sealing Layer (N/mm^2) (25°C)	13800	12100	14000	13800	12100	14000	13800	12100	14000	8500	13800	12100	14000	8500
	Thickness T of Electronic Element Sealable Sheet (mm)	0.28	0.28	0.28	0.35	0.35	0.35	0.2	0.2	0.2	0.3	0.5	0.5	0.6	0.6
	Product (Tensile Storage Elastic Modulus E' × Thickness T) (N/mm)	3864	3388	3920	4830	4235	4900	2760	2420	2800	2550	6900	6050	8400	5100
	Thickness t2 of Electronic Element (mm)	0.2	0.2	0.2	0.2	0.15	0.13	0.2	0.2	0.2	0.3	0.15	0.15	0.18	0.15
	t1 + t2 (mm)	0.39	0.4	0.35	0.46	0.43	0.35	0.3	0.32	0.32	0.49	0.5	0.53	0.62	0.63
Evaluation	Peeling	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	Good	Bad	Good	Good	Good	Good
	Shape of One End Portion in Thickness Direction of First Sealing Surface of Sealing Layer	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Bad	Bad	Bad	Bad	Excellent	Excellent	Excellent	Excellent

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 the scope of the present invention. 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.

WHAT IS CLAIMED IS:

1. A sealable sheet used to form a sealing layer sealing an electronic element mounted on a one-side surface in a thickness direction of a board to face thereto, the sealing layer being in contact with the one-side surface in the thickness direction which does not face the electronic element in the board, wherein

the product (T × E' [N/mm]) of a thickness T [mm] of the sealable sheet and a tensile storage elastic modulus E' [N/mm^2] at 25°C of the sealing layer is 3,000 [N/mm] or more and 5,000 [N/mm] or less, wherein the thickness T of the sealable sheet is 0.25 [mm] or more and below 0.50 [mm], and

a minimum thickness t1 of the sealing layer is 0.15 mm or more and 0.50 mm or less.

2. A method for producing an electronic element device sealing an electronic element by using the sealable sheet according to claim 1.