

DESCRIPTION

TITLE OF THE INVENTION: RESIN SHEET FOR SEALING ELECTRONIC
DEVICE AND METHOD OF MANUFACTURING ELECTRONIC DEVICE PACKAGE

TECHNICAL FIELD

[0001]

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

BACKGROUND ART

[0002]

In production of an electronic device package, a procedure is typically adopted in which one or a plurality of electronic devices that are fixed on a substrate, etc. are sealed with a sealing resin and a sealing body is deiced as necessary to form a package for every electronic device. As the sealing resin, a sheet-shaped sealing resin may be used.

[0003]

For example, Patent Document 1 describes that varnish is applied on a film and the coating film is dried to form a resin sheet.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0004]

Patent Document 1: JP-A-2006-19714

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

In the method of producing a resin sheet (solvent application) as in Patent Document 1, a solvent is used to prepare varnish. When the solvent remains in the resin sheet, the solvent is volatilized by heating during thermal curing or solder reflow, and outgas is generated. It is difficult to sufficiently volatilize the solvent from the resin sheet that is produced by solvent application, and it is especially difficult to sufficiently volatilize the solvent from a resin sheet having large thickness.

[0006]

The present invention solves the above-described problem, and an object thereof is to provide a resin sheet which has large thickness and generates decreased amount of outgas.

MEANS FOR SOLVING THE PROBLEMS

[0007]

The present invention relates to a resin sheet for sealing an electronic device, which has a thickness of 100 to 2,000 μm and generates gas in an amount of 500 ppm or less when the resin

sheet is cured at 150°C for 1 hour.

[0008]

Conventionally, it has been difficult to decrease the amount of gas generated when a resin sheet having a thickness falling within the above-described range is cured; however, the amount of outgas generated during curing of the resin sheet of the present invention is decreased, and corrosion and operational failures of the electronic device due to the outgas can be reduced.

[0009]

A cured product that is obtained by curing the resin sheet for sealing an electronic device at 150°C for 1 hour has a 1% weight reduction temperature of preferably 260°C or higher. If the 1% weight reduction temperature is 260°C or higher, the amount of volatile component in the resin sheet is decreased, and the amount of gas (outgas) is decreased which is generated during solder reflow.

[0010]

The amount of gas is preferably 500 ppm or less which is generated when the cured product that is obtained by curing the resin sheet for sealing an electronic device at 150°C for 1 hour is heated from 40°C to 260°C at a rising temperature rate of 10°C/min and then heated at 260°C for 1 minute. The heating condition as a prerequisite of the amount of gas is based on the profile of solder reflow. If the amount of gas is 500 ppm

or less, the amount of gas (outgas) is decreased which is generated during solder reflow.

[0011]

The present invention relates to a method of manufacturing an electronic device package, the method including a lamination step of laminating the resin sheet for sealing an electronic device on one or a plurality of electronic devices so as to cover the electronic devices; and a sealing body formation step of curing the resin sheet for sealing an electronic device to form a sealing body.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a cross-sectional view schematically showing a resin sheet according to one embodiment of the present invention.

Fig. 2A is a view schematically showing one step of a method of manufacturing an electronic device package according to one embodiment of the present invention.

Fig. 2B is a view schematically showing one step of the method of manufacturing an electronic device package according to one embodiment of the present invention.

Fig. 2C is a view schematically showing one step of the method of manufacturing an electronic device package according to one embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0013]

The present invention will be explained in detail with reference to embodiments below; however, the invention is not limited only to these embodiments.

[0014]

[Resin sheet for sealing electronic device]

[0015]

Fig. 1 is a cross-sectional view schematically showing a resin sheet 11 according to one embodiment of the present invention. The resin sheet 11 is typically provided in a form in which the resin sheet 11 is laminated on a support 11a such as a polyethylene terephthalate (PET) film. A release treatment may be performed on the support 11a to easily peel the resin sheet 11.

[0016]

The thickness of the resin sheet 11 is relatively large, and is specifically 100 to 2,000 μm . Conventionally, it has been difficult to decrease the amount of outgas generated from a resin sheet having a thickness falling within the above-described range. However, the amount of outgas generated from the resin sheet 11 is decreased. The thickness of the resin sheet 11 is preferably 150 μm or more. On the other hand, the thickness of the resin sheet 11 is preferably 1,000

μm or less.

[0017]

The amount of gas (outgas) generated when the resin sheet 11 is cured at 150°C for 1 hour is 500 ppm or less, and preferably 300 ppm or less. The amount of outgas is 500 ppm or less, so that the amount of outgas is decreased during curing, and corrosion and operational failures of the electronic device due to the outgas can be reduced. On the other hand, the lower limit of the amount of gas generated when the resin sheet 11 is cured at 150°C for 1 hour is not especially limited, and it is for example 30 ppm or more.

The amount of gas generated when the resin sheet 11 is cured at 150°C for 1 hour can be measured with the method described in the examples.

[0018]

The 1% weight reduction temperature of a cured product that is obtained by curing the resin sheet 11 at 150°C for 1 hour is preferably 260°C or higher, and preferably 300°C or higher. When the 1% weight reduction temperature is 260°C or higher, the amount of volatile component in the resin sheet 11 is decreased, and the amount of gas (outgas) is decreased which is generated during solder reflow. The upper limit of the 1% weight reduction temperature of the cured product that is obtained by curing the resin sheet 11 is not especially limited, and it is for example 500°C or lower.

The 1% weight reduction temperature of the cured product that is obtained by curing the resin sheet 11 at 150°C for 1 hour can be measured with the method described in the examples.

[0019]

The amount of gas is preferably 500 ppm or less which is generated when the cured product that is obtained by curing the resin sheet 11 at 150°C for 1 hour is heated from 40°C to 260°C at a rising temperature rate of 10°C/min and then heated at 260°C for 1 minute. The heating condition as a prerequisite of the amount of gas is based on the profile of solder reflow. If the amount of gas is 500 ppm or less, the amount of gas (outgas) is decreased which is generated during solder reflow. The lower limit of the amount of gas is not especially limited; however, it is 30 ppm or more.

The amount of gas which is generated when the cured product that is obtained by curing the resin sheet 11 at 150°C for 1 hour is heated from 40°C to 260°C at a rising temperature rate of 10°C/min and then heated at 260°C for 1 minute can be measured with the method described in the examples.

[0020]

The method of manufacturing the resin sheet 11 is not especially limited; however, preferred is a method of preparing a kneaded product of components described later and subjecting the obtained kneaded product to plastic processing to form the kneaded product into a sheet shape. This makes it possible to

produce the resin sheet 11 without using a solvent. Therefore, the amount of outgas can be decreased. In order to produce the resin sheet 11 having large thickness by solvent application, it is necessary to laminate a plurality of resin sheets produced by solvent application. However, with the method described above, the resin sheet 11 can be produced without lamination (the resin sheet 11 can be produced at once). Therefore, there is no possibility of interlayer peeling. The uniformity of the sheet thickness can be also improved. Because the surface area is small compared to the case of lamination, reduced moisture absorption can be achieved. As a result, the amount of outgas can be decreased.

[0021]

Specifically, components described later (for example, an epoxy resin, a phenol resin, a thermoplastic resin, an inorganic filler, a curing accelerator, etc.) are melt-kneaded with a known kneader such as a mixing roll, a pressure kneader, or an extruder to prepare a kneaded product, and the obtained kneaded product is subjected to plastic processing to form the kneaded product into a sheet shape. For the kneading condition, the temperature is preferably the softening point or higher of each component described above, and it is for example 30 to 150°C. If the thermosetting property of the epoxy resin is considered, the temperature is preferably 40 to 140°C, and more preferably 60 to 120°C. The time is for example 1 to 30 minute(s), and

preferably 5 to 15 minutes.

[0022]

The kneading is preferably performed under a reduced pressure condition (under a reduced pressure atmosphere). This makes it possible to remove gas, and to prevent gas from entering into the kneaded product. As a result, the amount of outgas can be decreased. The pressure under the reduced pressure condition is preferably 0.1 kg/cm^2 or less, and more preferably 0.05 kg/cm^2 or less. If the pressure is 0.1 kg/cm^2 or less, the amount of outgas can be suitably decreased. The lower limit of the pressure under reduced pressure is not especially limited; however, it is $1 \times 10^{-4} \text{ kg/cm}^2$ or more.

[0023]

The kneaded product after melt-kneading is preferably subjected to plastic processing in a high temperature state without being cooled. The plastic processing is not especially limited, and examples thereof include a plate pressing method, a T-die extrusion method, a screw-die extrusion method, a rolling method, a roll kneading method, an inflation extrusion method, a co-extrusion method and a calendar molding method. The plastic processing temperature is preferably the softening point or higher of each component described above. If the thermosetting property and moldability of the epoxy resin are considered, the temperature is for example 40 to 150°C , preferably 50 to 140°C , and more preferably 70 to 120°C .

[0024]

The resin sheet 11 may have a single-layered structure or may have a multilayered structure in which two or more resin sheets are laminated; however, a single-layered structure is preferable because there is no possibility of interlayer peeling, good uniformity of the sheet thickness can be obtained, and reduced moisture absorption can be easily obtained.

[0025]

Next, the composition of the resin sheet 11 is explained.

[0026]

The resin sheet 11 preferably contains an epoxy resin and a phenol resin. This provides a good thermosetting property.

[0027]

The epoxy resin is not particularly limited, and examples thereof include triphenyl methane type epoxy resin, cresol novolak type epoxy resin, biphenyl type epoxy resin, modified bisphenol A type epoxy resin, bisphenol A type epoxy resin, bisphenol F type epoxy resin, modified bisphenol F type epoxy resin, dicyclopentadiene type epoxy resin, phenol novolak type epoxy resin, phenoxy resin, and other various epoxy resins. These epoxy resins may be used alone or in combination of two or more thereof.

[0028]

The epoxy resin is preferably an epoxy resin which is in a solid form at room temperature, and has an epoxy equivalent

of 150 to 250 and a softening point or melting point of 50°C to 130°C in order to certainly attain a desired toughness after curing and reactivity. Particularly preferred are triphenylmethane type epoxy resin, cresol novolak type epoxy resin, and biphenyl type epoxy resin from the viewpoint of the reliability.

[0029]

The phenol resin is not particularly limited as far as the resin causes a curing reaction with the epoxy resin. Examples thereof include phenol novolak resin, phenol aralkyl resin, biphenyl aralkyl resin, dicyclopentadiene type phenolic resin, cresol novolak resin, and resol resin. These phenolic resins may be used alone or in combination of two or more thereof.

[0030]

The phenol resin is preferably a resin having a hydroxyl equivalent of 70 to 250 and a softening point of 50°C to 110°C from the viewpoint of the reactivity thereof with the epoxy resin. The phenol resin is in particular preferably phenol novolak resin because the resin is high in curing reactivity. Moreover, from the viewpoint of the reliability, the phenol resin is a low-hygroscopicity phenolic resin such as phenol aralkyl resin, or biphenyl aralkyl resin can be preferably used.

[0031]

Regarding the blend ratio between the epoxy resin and the phenol resin, the entire amount of the hydroxyl groups in the

phenol resin is preferably from 0.7 to 1.5 equivalents, more preferably 0.9 to 1.2 equivalents per equivalent of epoxy groups in the epoxy resin from the viewpoint of the curing reactivity therebetween.

[0032]

The total content of the epoxy resin and the phenol resin in the resin sheet 11 is preferably 2.0% by weight or more, and more preferably 3.0% by weight or more. If the total content is 2.0% by weight or more, the adhering strength of the resin sheet 11 to the electronic device, the substrate, etc. can be suitably obtained. The total content of the epoxy resin and the phenol resin in the resin sheet 11 is preferably 20% by weight or less, and more preferably 10% by weight or less. If the total content is 20% by weight or less, the moisture absorption can be kept low.

[0033]

The resin sheet 11 preferably contains a thermoplastic resin. This makes it possible to provide a handling property when the resin sheet 11 is uncured and a low stress property to the cured product.

[0034]

Examples of the thermoplastic resin include natural rubber, butyl rubber, isoprene rubber, chloroprene rubber, an ethylene-vinylacetate copolymer, an ethylene-acrylic acid copolymer, an ethylene-acrylate copolymer, a polybutadiene

resin, a polycarbonate resin, a thermoplastic polyimide resin, polyamide resins such as 6-nylon and 6,6-nylon, a phenoxy resin, an acrylic resin, saturated polyester resins such as PET and PBT, a polyamideimide resin, a fluoro resin, and a styrene-isobutylene-styrene block copolymer. These thermoplastic resins may be used alone or in combination of two or more thereof. Among these, styrene-isobutylene-styrene block copolymer is preferable from the viewpoint of its low stress property and low moisture absorption.

[0035]

The content of the thermoplastic resin in the resin sheet 11 is preferably 1.0% by weight or more, and more preferably 1.5% by weight or more. If the content is 1.0% by weight or more, flexibility can be obtained. The content of the thermoplastic resin in the resin sheet 11 is preferably 3.5% by weight or less, and more preferably 3% by weight or less. If the content is 3.5% by weight or less, the adhesion with the electronic device and the substrate can be improved.

[0036]

The resin sheet 11 preferably contains an inorganic filler.

[0037]

The inorganic filler is not especially limited, and various kinds of conventionally known fillers can be used. Examples thereof include powders of quartz glass, talc, silica

(fused silica, crystalline silica, etc.), alumina, aluminum nitride, silicon nitride, and boron nitride. These may be used alone or in combination of two or more thereof. Among these, silica and alumina are preferable, and silica is more preferable because the coefficient of linear expansion can be satisfactorily decreased.

[0038]

As silica, silica powers are preferable, and fused silica powers are more preferable. Examples of the fused silica powders include spherical fused silica powders and crushed and fused silica powders. However, spherical fused silica powders are especially preferably used from the viewpoint of fluidity. Among these, powers having an average particle size of 10 to 30 μm are preferable, and powders having an average particle size of 15 to 25 μm are more preferable.

For example, the average particle size can be obtained by measurement on a sample that is extracted arbitrarily from the population using a laser diffraction-scattering type particle size distribution measuring apparatus.

[0039]

The content of the inorganic filler in the resin sheet 11 is preferably 70% by volume or more, and more preferably 74% by volume or more. If the content is 70% by volume or more, the coefficient of linear expansion can be designed to be low. On the other hand, the content of the inorganic filler is

preferably 90% by volume or less, and more preferably 85% by volume or less. If the content is 90% by volume or less, flexibility, fluidity, and adhesion can be suitably obtained.

[0040]

The content of the inorganic filler can be also explained by using "% by weight" as a unit. The content of silica is explained typically by using "% by weight" as a unit.

Silica normally has a specific gravity of 2.2 g/cm^3 . Therefore, the preferred range of the content (% by weight) of silica is as follows.

That is, the content of silica in the resin sheet 11 is preferably 81% by weight or more, and more preferably 84% by weight or more. The content of silica in the resin sheet 11 is preferably 94% by weight or less, and more preferably 91% by weight or less.

[0041]

Alumina normally has a specific gravity of 3.9 g/cm^3 . Therefore, the preferred range of the content (% by weight) of alumina is as follows.

That is, the content of alumina in the resin sheet 11 is preferably 88% by weight or more, and more preferably 90% by weight or more. The content of alumina in the resin sheet 11 is preferably 97% by weight or less, and more preferably 95% by weight or less.

[0042]

The resin sheet 11 preferably contains a curing accelerator.

[0043]

The curing accelerator is not especially limited as long as it promotes curing of the epoxy resin and the phenol resin, and examples of the curing accelerator include organophosphate compounds such as triphenylphosphine and tetraphenylphosphonium tetraphenylborate; and imidazole compounds such as 2-phenyl-4,5-dihydroxymethylimidazole and 2-phenyl-4-methyl-5-hydroxymethylimidazole. Among these, 2-phenyl-4,5-dihydroxymethylimidazole is preferable due to the reason that the curing reaction does not rapidly proceed even when the temperature increases during kneading and the resin sheet 11 can be produced satisfactorily.

[0044]

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

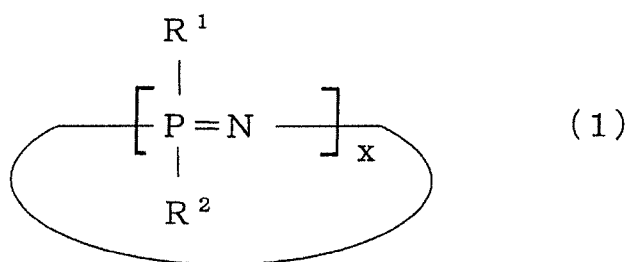
[0045]

The resin sheet 11 preferably contains a flame retardant component. This makes it possible to reduce an expansion of combustion when the resin sheet 11 catches fire due to short circuit of the parts or heat generation. Examples of the flame retardant component include various kinds of metal hydroxides such as aluminum hydroxide, magnesium hydroxide, iron hydroxide,

calcium hydroxide, tin hydroxide, and composite metal hydroxide; and a phosphazene flame retardant. Among these, a phosphazene flame retardant is preferable, and a compound represented by Formula (1) or (2) is preferable because it has excellent flame retardance and excellent strength after curing.

[0046]

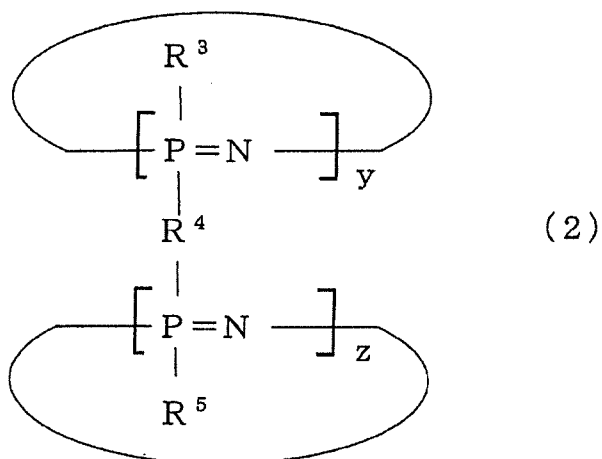
[Formula 1]



wherein, R^1 and R^2 are the same or different from each other, and represent an alkoxy group, a phenoxy group, an amino group, a hydroxy group, an allyl group, or a monovalent organic group having at least one selected from the group consisting of the above-mentioned groups; and x represents an integer of 3 to 25.

[0047]

[Formula 2]



wherein, R^3 and R^5 are the same or different from each other, and represent an alkoxy group, a phenoxy group, an amino group, a hydroxy group, an allyl group, or a monovalent organic group having at least one selected from the group consisting of the above-mentioned groups; R^4 represents a divalent organic group having at least one selected from the group consisting of an alkoxy group, a phenoxy group, an amino group, a hydroxy group and an allyl group; y represents an integer of 3 to 25; and z represents an integer of 3 to 25.

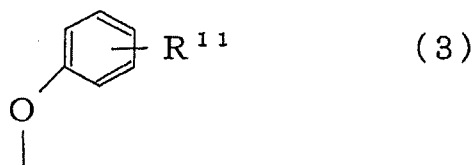
[0048]

Examples of the alkoxy group of R^1 and R^2 include a methoxy group, an ethoxy group, a n-propoxy group, an isopropoxy group, a n-butoxy group and a t-butoxy group. Among these, an alkoxy group having 4 to 10 carbon atoms is preferable.

[0049]

An example of the phenoxy group of R^1 and R^2 includes a group represented by Formula (3).

[Formula 3]



wherein, R¹¹ represents hydrogen, a hydroxy group, an alkyl group, an alkoxy group, a glycidyl group, or a monovalent organic group having at least one selected from the group consisting of the above-mentioned groups.

[0050]

Examples of the alkyl group of R¹¹ include a methyl group, an ethyl group, a n-propyl group, an isopropyl group, a n-butyl group, an iso-butyl group, a sec-butyl group, a tert-butyl group, a pentyl group, a hexyl group, a heptyl group, a 2-ethylhexyl group, an octyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group, a tridecyl group, a tetradecyl group, a pentadecyl group and an octadecyl group. Examples of the alkoxy group of R¹¹ include the same groups as the alkoxy group of R¹ and R².

[0051]

A phenoxy group is preferable, and a group represented by Formula (3) is more preferable as R¹ and R² de to the reason that flame retardancy and strength after curing is suitably obtained.

[0052]

x represents an integer of 3 to 25; however, x is

preferably 3 to 10, and more preferably 3 and 4 due to the reason that flame retardancy and strength after curing is suitably obtained.

[0053]

In Formula (2), examples of the alkoxy group of R^3 and R^5 include a methoxy group, an ethoxy group, a n-propoxy group, an isopropoxy group, a n-butoxy group and a t-butoxy group. Among these, an alkoxy group having 4 to 10 carbon atoms is preferable.

[0054]

An example of the phenoxy group of R^3 and R^5 includes a group represented by Formula (3).

[0055]

The monovalent organic group of R^3 and R^5 having at least one selected from the group consisting of the alkoxy group, the phenoxy group, the amino group, the hydroxy group and the allyl group is not especially limited.

[0056]

A phenoxy group is preferable, and a group represented by Formula (3) is more preferable as R^3 and R^5 due to the reason that flame retardancy and strength after curing is suitably obtained.

[0057]

Examples of the alkoxy group which the divalent organic group of R^4 has include a methoxy group, an ethoxy group, a

n-propoxy group, an isopropoxy group, a n-butoxy group and a t-butoxy group. Among these, an alkoxy group having 4 to 10 carbon atoms is preferable.

[0058]

An example of the phenoxy group which the divalent organic group of R^4 has includes a group represented by Formula (3).

[0059]

y represents an integer of 3 to 25; however, y is preferably 3 to 10 due to the reason that flame retardancy and strength after curing is suitably obtained.

[0060]

z represents an integer of 3 to 25; however, z is preferably 3 to 10 due to the reason that flame retardancy and strength after curing is suitably obtained.

[0061]

The content rate of phosphorus element in the phosphazene flame retardant is preferably 12% by weight or more from the viewpoint of exhibiting flame retardant effect even in a small amount.

[0062]

The content of the flame retardant component is preferably 10% by weight or more, and more preferably 15% by weight or more in 100% by weight of the organic component (entire components excluding inorganic filler). If the content is 10% by weight or more, the flame retardance can be obtained

satisfactorily. The content of the flame retardant component is preferably 30% by weight or less, and more preferably 25% by weight or less. If the content is 30% by weight or less, deterioration in physical properties (specifically, deterioration in physical properties such as glass transition temperature and resin strength at high temperature) of the cured product tends to be suppressed.

[0063]

The resin sheet 11 preferably contains a silane coupling agent. The silane coupling agent is not especially limited, and an example thereof includes 3-glycidoxypopyl trimethoxysilane.

[0064]

The content of the silane coupling agent in the resin sheet 11 is preferably 0.1 to 3% by weight. If the content is 0.1% by weight or more, the strength of the cured product is sufficiently made high, and the water absorption can be lowered. If the content is 3% by weight or less, the amount of outgas can be suppressed.

[0065]

The resin sheet 11 preferably contains a pigment. The pigment is not especially limited, and an example thereof includes carbon black.

[0066]

The content of the pigment in the resin sheet 11 is

preferably 0.1 to 2% by weight. If the content is 0.1% by weight or more, a good marking property can be obtained. If the content is 2% by weight or less, the strength of the cured product is sufficiently made high.

[0067]

Other additives besides each component described above can be appropriately compounded in the resin composition as necessary.

[0068]

The resin sheet 11 is used to seal an electronic device such as a SAW (Surface Acoustic Wave) filter; MEMS (Micro Electro Mechanical Systems) such as a pressure sensor and a vibration sensor; semiconductors such as an IC (Integrated Circuit) including an LSI, and a transistor; a capacitor; and a resistor. Among these, the resin sheet 11 can be suitably used for sealing an electronic device (specifically, an SAW filter and MEMS) that requires hollow sealing, and can be especially suitably used for sealing a SAW filter.

[0069]

The sealing method is not especially limited. An example thereof includes a method of laminating the resin sheet 11 that is not cured on a substrate so that the resin sheet 11 covers an electronic device on the substrate and curing the resin sheet 11 to seal the electronic device. The substrate is not especially limited, and examples thereof include a printed

circuit board, a ceramic substrate, a silicon substrate, and a metal substrate.

[0070]

[Method of manufacturing electronic device package]

Each of Figs. 2A to 2C is a view schematically showing one step of a method of manufacturing an electronic device package according to one embodiment of the present invention. In the present embodiment, hollow sealing is performed on a SAW filter 13 that is mounted on a printed circuit board 12 by using the resin sheet 11 to produce an electronic device package.

[0071]

(SAW filter mounted substrate preparing step)

In the SAW filter mounted substrate preparing step, the printed circuit board 12 is prepared on which a plurality of the SAW filters 13 are mounted (refer to Fig. 2A). A piezoelectric crystal in which a prescribed comb-shaped electrode is formed is diced into individual pieces with a known method to form the SAW filter 13. The SAW filter 13 can be mounted on the printed circuit board 12 with a known apparatus such as a flip-chip bonder or a die bonder. The SAW filter 13 is electrically connected to the printed circuit board 12 through a bump electrode 13a such as a bump. A hollow part 14 is maintained between the SAW filter 13 and the printed circuit board 12 so as not to inhibit propagation of a surface acoustic wave on the surface of the SAW filter. The distance between

the SAW filter 13 and the printed circuit board 12 can be appropriately set, and is generally about 15 to 50 μm .

[0072]

(Sealing step)

In the sealing step, the resin sheet 11 is laminated on the printed circuit board 12 so that the resin sheet 11 covers the SAW filter 13 to perform resin sealing on the SAW filter 13 with the resin sheet 11 (refer to Fig. 2B). The resin sheet 11 functions as a sealing resin for protecting the SAW filter 13 and the elements attached to the filter from the external environment.

[0073]

The method of laminating the resin sheet 11 on the printed circuit board 12 is not especially limited, and a known method can be used such as hot press or laminator. For the hot pressing condition, the temperature is for example 40 to 100°C, and preferably 50 to 90°C; the pressure is for example 0.1 to 10 MPa, and preferably 0.5 to 8 MPa; and the duration is for example 0.3 to 10 minutes, and preferably 0.5 to 5 minutes. In consideration of improvement of the tackiness and followability of the resin sheet 11 to the SAW filter 13 and the printed circuit board 12, pressing is preferably performed under a reduced pressure condition (for example 0.1 to 5 kPa).

[0074]

(Sealing body forming step)

In the sealing body forming step, the resin sheet 11 is subjected to a thermal curing treatment to form a sealing body 15 (refer to Fig. 2B).

[0075]

For a condition of the thermal curing treatment, the heating temperature is preferably 100°C or higher, and more preferably 120°C or higher. On the other hand, the upper limit of the heating temperature is preferably 200°C or lower, and more preferably 180°C or lower. The heating time is preferably 10 minutes or more, and more preferably 30 minutes or more. On the other hand, the upper limit of the heating time is preferably 180 minutes or less, and more preferably 120 minutes or less. A pressure may be applied as necessary. The pressure is preferably 0.1 MPa or more, and more preferably 0.5 MPa or more. On the other hand, the upper limit of the pressure is preferably 10 MPa or less, and more preferably 5 MPa or less.

[0076]

(Dicing step)

Subsequently, the sealing body 15 may be diced (refer to Fig. 2C). This makes it possible to provide an electronic device package 18 for each SAW filter 13.

[0077]

(Substrate mounting step)

A rewiring and a bump are formed for the electronic device package 18 as necessary to perform the substrate mounting step

of mounting the electronic device package 18 to a separate substrate (not shown in the drawing). The electronic device package 18 can be mounted to the substrate by using a known apparatus such as a flip-chip bonder or a die bonder.

EXAMPLES

[0078]

The preferred examples of this invention will be explained in detail below. However, the materials, the compounding amounts, etc. described in the examples are not intended to be limited only thereto in the scope of this invention unless otherwise specified.

[0079]

The components used in the examples will be explained.

Epoxy resin 1: YSLV-80XY manufactured by Nippon Steel Chemical Co., Ltd. (bisphenol F-type epoxy resin: epoxy equivalent 200 g/eq., softening point 80°C)

Epoxy resin 2: EPPN-501HY manufactured by Nippon Kayaku Co., Ltd. (triphenylmethane type epoxy resin)

Epoxy resin 3: YL980 manufactured by Mitsubishi Chemical Corporation (bisphenol A-type epoxy resin)

Phenol resin 1: MEH-7851-SS manufactured by Meiwa Plastic Industries, Ltd. (phenol resin having biphenylaralkyl skeleton, hydroxyl group equivalent 203 g/eq., softening point 67°C)

Phenol resin 2: ND564 manufactured by Showa Highpolymer

Co., Ltd.

Thermoplastic resin 1: SIBSTER 072T manufactured by Kaneka Corporation (styrene-isobutylene-styrene block copolymer)

Thermoplastic resin 2: SG-P3 manufactured by Nagase Chemtex Corporation

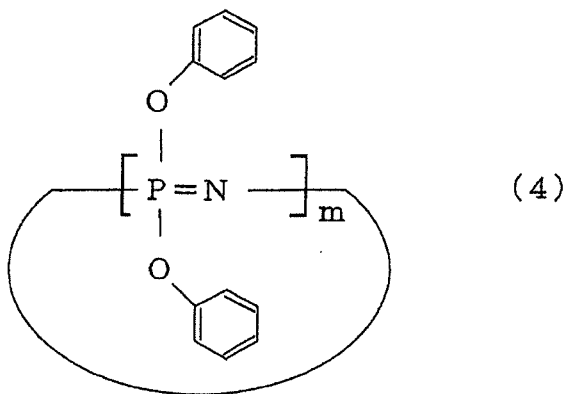
Inorganic filler: FB-9454FC manufactured by DENKI KAGAKU KOGYO KABUSHIKI KAISHA (fused spherical silica, average particle size 20 μm)

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

Carbon black: #20 manufactured by Mitsubishi Chemical Corporation

Flame retardant: FP-100 manufactured by FUSHIMI Pharmaceutical Co., Ltd. (phosphazene flame retardant: compound represented by Formula (4))

[Formula 4]



wherein, m represents an integer of 3 or 4.

Curing accelerator 1: 2PHZ-PW manufactured by Shikoku Chemicals Corporation

(2-phenyl-4,5-dihydroxymethylimidazole)

Curing accelerator 2: TPP-MK manufactured by Hokko Chemical Industry Co., Ltd. (tetraphenylphosphonium tetra-p-tolylborate)

[0080]

Examples 1 to 3

Each of the components was compounded according to the compounding ratio described in Table 1, and the components were melt-kneaded at 60 to 120°C for 10 minutes under a reduced pressure condition (0.01 kg/cm²) with a biaxial kneader to prepare a kneaded product. Next, the obtained kneaded product was formed into a sheet shape by flat plate pressing to produce resin sheets each having a thickness shown in Table 1. Each of the obtained resin sheet was pasted to a separator.

[0081]

The following evaluations were performed using the obtained resin sheets. The results are shown in Table 1.

[0082]

[Amount of outgas]

A sample of 1 cm × 1 cm × 200 μm in thickness was cut out from the non-cured resin sheet, and the separator attached to

the sample was peeled. The sample was placed in a vial bottle to measure its weight. After that, the sample was heated under condition of at 150°C for 1 hour using a head space sampler (HSS). One ml of the heated gas was injected into 6890GC-MS manufactured by Agilen Technology to measure the amount of outgas.

[0083]

[1% weight reduction temperature of cured product]

The separator was peeled from the non-cured resin sheet, and the resin sheet was cured at 150°C for 1 hour under heat. About 8 mg of a sample was cut out from the cured product. The sample was heated from room temperature to 500°C at 10°C/min with TG/DTA 220 manufactured by SII Nano Technology Inc. in the air at a gas flow of 200 mg/min to be subjected to weight analysis.

[0084]

[Amount of outgas generated from cured product]

A sample of 1 cm × 1 cm × 200 μm in thickness was cut out from the non-cured resin sheet, and the separator attached to the sample was peeled. The sample was cured at 150°C for 1 hour under heat. The cured product was placed in a vial bottle to measure its weight. After that, the cured product was heated using a head space sampler (HSS) (heating condition: the temperature was increased from 40°C to 260°C at a temperature rising rate of 10°C/min, and then it was kept at 260°C for 1

minute). One ml of the heated gas was injected into 6890GC-MS manufactured by Agilen Technology to measure the amount of outgas.

[0085]

Comparative Examples 1 and 2

Each of the components was compounded according to the compounding ratio described in Table 1, and methylethylketone that is the same amount as the total amount of the components was added thereto to prepare a varnish. The obtained varnish was applied with a comma coater onto the release-treated surface of a polyester film A (MRF-50 manufactured by Mitsubishi Polyester Film Inc.) having a thickness of 50 μm , and then dried so that the thickness of the varnish became 50 μm after drying. Then, the release-treated surface of a polyester film B (MRF-38 manufactured by Mitsubishi Polyester Film Inc.) having a thickness of 38 μm was pasted to the varnish after drying to prepare a thin resin sheet.

After that, four thin resin sheets were laminated by using a roll laminator while appropriately peeling the polyester films A and B to prepare a resin sheet having a thickness of 200 μm .

[0086]

The following evaluations were conducted using the obtained resin sheets. The results are shown in Table 1.

[0087]

[Table 1]

		Example 1	Example 2	Example 3	Comparative Example 1	Comparative Example 2
Compounding Ratio (parts by weight)	Epoxy Resin 1	3.3	3.3	3.3	-	3.3
	Epoxy Resin 2	-	-	-	4.3	-
	Epoxy Resin 3	-	-	-	4.3	-
	Phenol Resin 1	3.5	3.5	3.5	-	3.5
	Phenol Resin 2	-	-	-	5.2	-
	Thermoplastic Resin 1	3.0	3.0	3.0	-	3.0
	Thermoplastic Resin 2	-	-	-	14.4	-
	Inorganic Filler	88.0	88.0	88.0	70.6	88.0
	Silane Coupling Agent	0.3	0.3	0.3	-	0.3
	Carbon Black	0.3	0.3	0.3	0.3	0.3
	Flame Retardant	1.5	1.5	1.5	-	1.5
	Curing Accelerator 1	0.1	0.1	0.1	-	0.1
	Curing Accelerator 2	-	-	-	0.9	-
Total		100.0	100.0	100.0	100.0	100.0
Manufacturing Method		Kneading	Kneading	Kneading	Solvent Coating	Solvent Coating
Sheet Thickness (μm)		200	500	1000	200	200
Content (% by volume) of Inorganic Filler in Resin Sheet		80	80	80	57	80
Evaluation	Amount of Outgas (ppm)	230	230	240	650	1400
	1% Weight Reduction Temperature (°C) of Cured Product	381	380	383	245	240
	Amount of Outgas Generated from Cured Product (ppm)	60	70	85	590	700

DESCRIPTION OF REFERENCE SIGNS

[0088]

- 11 Resin Sheet
- 11a Support
- 13 SAW Filter
- 15 Sealing Body
- 18 Electronic Device Package

CLAIMS

1. A resin sheet for sealing an electronic device,
which has a thickness of 100 to 2,000 μm and generates gas
5 in an amount of 500 ppm or less when the resin sheet is
cured at 150°C for 1 hour,

wherein a cured product that is obtained by curing the
resin sheet at 150°C for 1 hour has a 1% weight reduction
temperature of 260°C or higher.

10

2. A resin sheet for sealing an electronic device,
which has a thickness of 100 to 2,000 μm and generates gas
in an amount of 500 ppm or less when the resin sheet is
cured at 150°C for 1 hour,

15 wherein an amount of gas is 500 ppm or less which is
generated when a cured product that is obtained by curing
the resin sheet at 150°C for 1 hour is heated from 40°C to
260°C at a rising temperature rate of 10°C/min and then
heated at 260°C for 1 minute.

20

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

a lamination step of laminating the resin sheet for
sealing an electronic device according to claim 1 or 2 on
25 one or a plurality of electronic devices so as to cover the
electronic devices; and

a sealing body formation step of curing the resin
sheet for sealing an electronic device to form a sealing
body.

4. A method of manufacturing a resin sheet for sealing an electronic device, the method comprising:

5 kneading an epoxy resin, a phenol resin, a thermoplastic resin, an inorganic filler and a curing accelerator to prepare a kneaded product,

subjecting the kneaded product to plastic processing to form the kneaded product into a sheet shape,

10 wherein the resin sheet has a thickness of 100 to 2,000 μm and generates gas in an amount of 500 ppm or less when the resin sheet is cured at 150°C for 1 hour,

wherein a cured product that is obtained by curing the resin sheet at 150°C for 1 hour has a 1% weight reduction temperature of 260°C or higher.

15

5. A method of manufacturing a resin sheet for sealing an electronic device, the method comprising:

20 kneading an epoxy resin, a phenol resin, a thermoplastic resin, an inorganic filler and a curing accelerator to prepare a kneaded product,

subjecting the kneaded product to plastic processing to form the kneaded product into a sheet shape,

25 wherein the resin sheet has a thickness of 100 to 2,000 μm and generates gas in an amount of 500 ppm or less when the resin sheet is cured at 150°C for 1 hour,

wherein an amount of gas is 500 ppm or less which is generated when a cured product that is obtained by curing the resin sheet at 150°C for 1 hour is heated from 40°C to

260°C at a rising temperature rate of 10°C/min and then heated at 260°C for 1 minute.