

DESCRIPTION

TAPE FOR ELECTRONIC DEVICE PACKAGING

TECHNICAL FIELD

[0001] The present invention relates to a tape for electronic device packaging. More particularly, the invention relates to a tape for electronic device packaging having a metal layer.

BACKGROUND ART

[0002] In recent years, the demand for thickness reduction and size reduction of electronic equipment such as mobile telephones and laptop computers is ever increasing. Thus, in order to achieve thickness reduction and size reduction of electronic device packages such as semiconductor packages that are mounted on electronic equipment, the number of electrodes in an electronic device or a circuit board is increased, and the pitch is also made narrower. An example of such an electronic device package is a flip chip (FC) mounting package.

[0003] In regard to the flip chip mounting package, as explained above, since the number of electrodes is increased, or the pitch is narrowed, there is a problem of an increase in the amount of heat generation. Thus, as a

heat dissipating structure of a flip chip mounting package, it has been suggested to provide a metal layer on the back surface of an electronic device, with an adhesive layer interposed therebetween (see, for example, Patent Document 1).

[0004] Furthermore, in the flip chip mounting package, there are occasions in which the coefficient of linear expansion of the electronic device is greatly different from the coefficient of linear expansion of the circuit board. In this case, during the process for producing an electron device package, when an intermediate product is heated and cooled, there occur differences in the amount of expansion and the amount of shrinkage between the electronic device and the circuit board. Due to these differences, warpage occurs in the electronic device package. It has been suggested that even for a structure capable of suppressing such warpage, a metal layer should be provided on the back surface of the electronic device, with an adhesive layer interposed therebetween (see, for example, Patent Document 2).

[0005] Furthermore, in regard to the flip chip mounting package, it has also been suggested that a metal layer is provided on the back surface of an electronic device, with an adhesive layer interposed therebetween, and this metal layer is used as a protective layer for laser

marking (see, for example, Patent Document 3).

[0006] In recent years, there are occasions in which three-dimensional mounting is performed by laminating, on a semiconductor chip, another semiconductor chip having the same size. Here, in order to enable lamination of another semiconductor chip having the same size on a semiconductor chip, it is necessary to have a spacer laminated between the two chips. It is because this other semiconductor chip is laminated also on the electrode pad portion in the semiconductor chip. Regarding the spacer described above, it has been suggested to use an adhesive layer-attached metal layer as the spacer mentioned above (see, for example, Patent Document 4). It is described in Patent Document 4 that the spacer is provided by a step of pasting a spacer adhesive sheet having a metal layer provided with an adhesive layer on at least one surface, to a dicing sheet by using the adhesive layer as a pasting surface; a step of dicing the spacer adhesive sheet, and thereby forming a chip-shaped spacer including the adhesive layer; a step of pushing up the spacer using a pin, and detaching the pushed-up spacer from the dicing sheet together with the adhesive layer by means of a pick-up apparatus that is used when semiconductor chips are detached together with an adhesive layer from a dicing sheet; and a step of fixing the spacer to an adherend, with the adhesive layer

interposed therebetween.

CITATION LIST

PATENT DOCUMENT

[0007] Patent Document 1: JP 2007-235022 A

Patent Document 2: JP 5487847 B

Patent Document 3: JP 5419226 B

Patent Document 4: JP 4954569 B

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0008] As described above, the adhesive layer-attached metal layer is useful for various electronic device packages; however, as disclosed in Patent Document 4, it will be convenient if the adhesive layer-attached metal layer can be picked up and fixed to an adherend using an existing apparatus.

[0009] However, since metals have a characteristic that plastic deformation attributed to metal bonding easily occurs, there is a risk that when a metal layer is pushed up with pins of the pick-up process, pin marks may remain. Also, since the adhesive layer laminated on the metal layer is in an uncured state or in a semicured state, the adhesive layer is flexible. Therefore, if pin marks are produced in the metal layer, the adhesive layer also has a

shape conforming to these pin marks. When the adhesive layer is stuck to an adherend in this state, there is a problem that voids may occur and cause package cracks.

[0010] Thus, it is an object of the invention to provide a tape for electronic device packaging, which can suppress the generation of pin marks occurring as a result of deformation of the metal layer caused by the pressure applied by pins of a pick-up apparatus when an adhesive layer-attached metal layer is picked up from a pressure-sensitive adhesive tape, and can suppress the generation of voids between the adhesive layer and an adherend.

MEANS FOR SOLVING PROBLEM

[0011] In order to solve the problems described above, a tape for electronic device packaging according to the invention comprises a pressure-sensitive adhesive tape having a base film and a pressure-sensitive adhesive layer; and a laminate of an adhesive layer and a metal layer provided by laminating on a surface of the pressure-sensitive adhesive layer, the surface being on the opposite side of the base film, in which the metal layer has a tensile strength of 350 MPa or higher.

[0012] In regard to the tape for electronic device packaging, it is preferable that the metal layer contains copper or aluminum.

[0013] In regard to the tape for electronic device packaging, it is preferable that the copper content in the metal layer is 99.95% or less.

[0014] In regard to the tape for electronic device packaging, it is preferable that the metal layer is a copper alloy foil or an aluminum alloy foil.

[0015] In regard to the tape for electronic device packaging, it is preferable that the metal layer is formed from an alloy including copper and one kind or two or more kinds selected from the group consisting of nickel, chromium, zirconium, zinc, tin, titanium, silicon, iron, manganese, magnesium, phosphorus, and cobalt.

[0016] In regard to the tape for electronic device packaging, it is preferable that the metal layer is formed from an alloy including aluminum and one kind or two or more kinds selected from the group consisting of nickel, chromium, zirconium, zinc, tin, magnesium, copper, manganese, titanium, silicon, iron, and cobalt.

[0017] It is also acceptable for the tape for electronic device packaging that the metal layer is formed from stainless steel.

[0018] In regard to the tape for electronic device packaging, it is preferable that the metal layer has a thermal conductivity of 5 W/(m·K) or higher.

[0019] In regard to the tape for electronic device

packaging, it is preferable that the adhesive layer contains (A) an epoxy resin, (B) a curing agent, (C) an acrylic resin or a phenoxy resin, and (D) a surface-treated inorganic filler.

[0020] Furthermore, in regard to the tape for electronic device packaging, it is preferable that the pressure-sensitive adhesive layer contains an acrylic polymer configured to include an acrylic acid ester represented by the formula: $\text{CH}_2=\text{CHCOOR}$ (wherein R represents an alkyl group having 4 to 18 carbon atoms), a hydroxyl group-containing monomer, and an isocyanate compound having a radical reactive carbon-carbon double bond in the molecule.

EFFECT OF THE INVENTION

[0021] According to the invention, when an adhesive layer-attached metal layer is picked up from a pressure-sensitive adhesive tape, pin marks occurring as a result of deformation of the metal layer caused by the pressure of pins of a pick-up apparatus can be suppressed, and the generation of voids between the adhesive layer and an adherend can be suppressed.

BRIEF DESCRIPTION OF DRAWINGS

[0022] Fig. 1 is a cross-sectional view schematically

illustrating the structure of a tape for electronic device packaging according to embodiments of the invention;

Fig. 2(a) is a plan view schematically illustrating the structure of a tape for electronic device packaging according to embodiments of the invention, and Fig. 2(b) is a cross-sectional view of the same structure;

Fig. 3 is a perspective view schematically illustrating the structure of a tape for electronic device packaging according to embodiments of the invention;

Fig. 4 shows explanatory diagrams schematically illustrating a method for producing a tape for electronic device packaging according to embodiments of the invention, while Fig. 4(A) is a cross-sectional view in the longitudinal direction illustrating a process for sticking a metal layer; Fig. 4(B) is a cross-sectional view in the longitudinal direction illustrating a process for sticking an adhesive layer; Fig. 4(C) is a cross-sectional view in the transverse direction illustrating a precutting process; and Fig. 4(D) is a perspective view illustrating a process for removing unnecessary parts;

Fig. 5 shows explanatory diagrams schematically illustrating a method for producing a tape for electronic device packaging according to embodiments of the invention, while Fig. 5(A) is a cross-sectional view in the transverse direction illustrating a process for sticking a pressure-

sensitive adhesive tape; Fig. 5(B) is a cross-sectional view in the transverse direction illustrating a precutting process; and Fig. 5(C) is a cross-sectional view in the transverse direction illustrating a process for removing unnecessary parts;

Fig. 6 is a cross-sectional view schematically illustrating a method of using the tape for electronic device packaging according to embodiments of the invention;

Fig. 7 is a cross-sectional view schematically illustrating a method of using the tape for electronic device packaging according to embodiments of the invention; and

Fig. 8 is a cross-sectional view schematically illustrating the structure of an electronic device package that uses the tape for electronic device packaging according to embodiments of the invention.

MODE(S) FOR CARRYING OUT THE INVENTION

[0023] Embodiments of the invention will be described in detail below.

[0024] Fig. 1 is a cross-sectional view illustrating a tape for electronic device packaging 1 according to an embodiment of the invention. This tape for electronic device packaging 1 has a pressure-sensitive adhesive tape 5 composed of a base film 51 and a pressure-sensitive

adhesive layer 52 provided on the base film 51, and provided on the pressure-sensitive adhesive layer 52 is a laminate of an adhesive layer 4 and a metal layer 3. According to the present embodiment, an adhesive layer 4 and a metal layer 3 provided on the adhesive layer 4 by laminating are provided on the pressure-sensitive adhesive layer 52. The laminate of the adhesive layer 4 and the metal layer 3 includes an embodiment in which the adhesive layer 4 and the metal layer 3 are laminated indirectly, with a primer layer or the like interposed therebetween, in order to improve the adhesiveness between the two.

[0025] In regard to the tape for electronic device packaging 1 of the invention, it is preferable that the pressure-sensitive adhesive tape 5 is cut into a shape corresponding to the shape of a ring frame R (see Fig. 7) as illustrated in Fig. 2 and Fig. 3, and the metal layer 3 and the adhesive layer 4 are also cut correspondingly into a predetermined shape (precut processing). According to the present embodiment, the tape for electronic device packaging 1 is subjected to precut processing.

[0026] In regard to the tape for electronic device packaging 1 of the invention, as illustrated in Fig. 2 and Fig. 3, a form in which a long base tape 2 has a plurality of laminates formed thereon, each laminate being obtained by laminating a metal layer 3, an adhesive layer 4, and a

pressure-sensitive adhesive tape 5 (label portion 5a) that has been cut into a shape corresponding to the shape of a ring frame R, and the long base tape 2 is wound into a roll form, is preferred. According to the present embodiment, the tape for electronic device packaging 1 is wound into a roll form; however, a form in which the laminates provided on the base tape 2 are cut individually may also be employed.

[0027] In a case in which the tape for electronic device packaging has been subjected to precut processing and is wound into a roll form, as illustrated in Fig. 2 and Fig. 3, the tape for electronic device packaging 1 has a base tape 2. On the base tape 2, a metal layer 3 having a predetermined flat surface shape; an adhesive layer 4 having a predetermined flat surface shape, which is provided on a surface of the metal layer 3 so as to be laminated with the metal layer 3, the surface being on the opposite side of the base tape 2; and a pressure-sensitive adhesive tape 5 that includes a label portion 5a having a predetermined flat surface shape, which is provided so as to cover the adhesive layer 4 and to be in contact with the base tape 2 at the periphery of the adhesive layer 4, and a peripheral portion 5b that surrounds the outer side of the label portion 5a, are provided.

[0028] The label portion 5a has a shape corresponding

to the shape of a ring frame R for dicing. It is preferable that the shape corresponding to the shape of a ring frame R for dicing is a shape approximately the same as the inner side of the ring frame R, which is an analogous shape having a size larger than that of the inner side of the ring frame R. The shape may be not necessarily a circular shape; however, a shape close to a circular shape is preferred, and a circular shape is more preferred. The peripheral portion 5b includes a form that perfectly surrounds the outer side of the label portion 5a, and a form that does not perfectly surrounds the outer side of the label portion as shown in the diagram. It is still acceptable if the peripheral portion 5b is not provided.

[0029] The adhesive layer 4 has a predetermined flat surface shape, and this flat surface shape is a shape smaller than the label portion 5a so that the ring frame R can be stuck onto the peripheral edge of the label portion 5a of the pressure-sensitive adhesive tape 5 and pushed up by a push-up member of a pick-up apparatus (see Fig. 7(C)). It is preferable that the adhesive layer 4 has a shape that is approximately the same as the shape of the label portion 5a, which is an analogous shape having a size smaller than the size of the label portion 5a. The adhesive layer 4 may not be necessarily circular in shape; however, a shape close to a circular shape is preferred, and a circular

shape is more preferred.

[0030] The metal layer 3 has the same shape as that of the adhesive layer 4, and the adhesive layer 4 is laminated on the metal layer 3. Regarding the term lamination as used herein, it is acceptable if a main part is laminated, and although it is not necessarily essential that the metal layer 3 and the adhesive layer 4 have the same size; however, in view of the convenience of production, it is preferable that the metal layer 3 and the adhesive layer 4 have approximately same shapes. The various constituent elements will be described below.

[0031] <Base tape 2>

 The base tape 2 may be constructed from a known separator; however, a base tape that is used for the precut processing of tapes for electronic device packaging can also be used directly. In a case in which a base tape that is used for the precut processing of tapes for electronic device packaging is used directly, since the base tape 2 needs to adhere and retain the metal layer 3 at the time of precut processing, for example, a tape having a resin film and a pressure-sensitive adhesive layer for base tape provided on one surface of the resin film can be suitably used.

[0032] Regarding the material for the resin film that constitutes the base tape 2, known materials can be used,

and examples thereof include polyester (PET, PBT, PEN, PBN, and PTT)-based films, polyolefin (PP and PE)-based films, copolymer (EVA, EEA, and EBA)-based films, and films having enhanced adhesiveness and mechanical strength by partially substituting these materials. Laminates of these films may also be employed. From the viewpoints of heat resistance, smoothness, and easy availability, it is preferable that the material for the resin film that constitutes the base tape 2 is selected from polyethylene terephthalate, polypropylene, and polyethylene.

[0033] The thickness of the resin film that constitutes the base tape 2 is not particularly limited, and may be appropriately set; however, the thickness is preferably 10 to 150 μm .

[0034] Regarding the resin that is used for the pressure-sensitive adhesive layer for the base tape, a chlorinated polypropylene resin, an acrylic resin, a polyester resin, a polyurethane resin, an epoxy resin, and the like, which are known to be used for pressure-sensitive adhesives, can be used; however, an acrylic pressure-sensitive adhesive that employs an acrylic polymer as a base polymer is preferred.

[0035] Examples of the acrylic polymer include acrylic polymers that use one kind or two or more kinds of a (meth)acrylic acid alkyl ester (for example, a linear or

branched alkyl ester having an alkyl group with 1 to 30 carbon atoms, and particularly 4 to 18 carbon atoms, such as a methyl ester, an ethyl ester, a propyl ester, an isopropyl ester, a butyl ester, an isobutyl ester, a s-butyl ester, a t-butyl ester, a pentyl ester, an isopentyl ester, a hexyl ester, a heptyl ester, an octyl ester, a 2-ethylhexyl ester, an isooctyl ester, a nonyl ester, a decyl ester, an isodecyl ester, an undecyl ester, a dodecyl ester, a tridecyl ester, a tetradecyl ester, a hexadecyl ester, an octadecyl ester, or an eicosyl ester); and a (meth)acrylic acid cycloalkyl ester (for example, a cyclopentyl ester or a cyclohexyl ester), as monomer components. Here, the term (meth)acrylic acid ester refers to acrylic acid ester and/or methacrylic acid ester, and the term (meth) as used herein has the same meaning in all cases.

[0036] The acrylic polymer may include a unit corresponding to another monomer component that is copolymerizable with the (meth)acrylic acid alkyl ester or cycloalkyl ester as necessary, for the purpose of modifying the cohesive force, heat resistance and the like of the polymer. Examples of such a monomer component include carboxyl group-containing monomers such as acrylic acid, methacrylic acid, carboxyethyl (meth)acrylate, carboxypentyl (meth)acrylate, itaconic acid, maleic acid,

fumaric acid, and crotonic acid; acid anhydride monomers such as maleic anhydride and itaconic anhydride; hydroxyl group-containing monomers such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxylauryl (meth)acrylate, and (4-hydroxymethylcyclohexyl)methyl (meth)acrylate; sulfonic acid group-containing monomers such as styrenesulfonic acid, allylsulfonic acid, 2-(meth)acrylamido-2-methylpropanesulfonic acid, (meth)acrylamidopropanesulfonic acid, sulfopropyl (meth)acrylate, and (meth)acryloyloxynaphthalenesulfonic acid; phosphoric acid group-containing monomers such as 2-hydroxyethylacryloyl phosphate; acrylamide, and acrylonitrile. These copolymerizable monomer components can be used singly or as mixtures of two or more kinds thereof. The amount of use of these copolymerizable monomers is preferably 40% by weight or less of the total amount of the monomer components.

[0037] Furthermore, since the acrylic polymer is crosslinked, the acrylic polymer may also include a polyfunctional monomer or the like as necessary, as a monomer component for copolymerization. Examples of such a polyfunctional monomer include hexanediol di(meth)acrylate,

(poly)ethylene glycol di(meth)acrylate, (poly)propylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate, pentaerythritol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, pentaerythritol tri(meth)acrylate, dipentaerythritol hexa(meth)acrylate, epoxy (meth)acrylate, polyester (meth)acrylate, and urethane (meth)acrylate.

These polyfunctional monomers can also be used singly or as mixtures of two or more kinds thereof. The amount of use of the polyfunctional monomer is preferably 30% by weight or less of the total amount of the monomer components, from the viewpoint of pressure-sensitive adhesion characteristics and the like.

[0038] Preparation of an acrylic polymer can be carried out by, for example, subjecting one kind of component monomer or a mixture of two or more kinds of component monomers to an appropriate method such as a solution polymerization method, an emulsion polymerization method, a bulk polymerization method, or a suspension polymerization method. It is preferable that the pressure-sensitive adhesive layer for the base tape has a composition with suppressed contents of low molecular weight substances, and from such a viewpoint, it is preferable that an acrylic polymer having a weight average molecular weight of 300,000 or more, and particularly 400,000 to 3,000,000, is used as a main component.

Therefore, the pressure-sensitive adhesive may be selected to be a material of a type that is appropriately crosslinked by an internal crosslinking method or an external crosslinking method.

[0039] Furthermore, in order to enhance the detachability of the pressure-sensitive adhesive tape 5 by controlling the crosslinking density of the pressure-sensitive adhesive layer for the base tape, for example, an adequate method such as a method of performing a crosslinking treatment using an appropriate external crosslinking agent such as a polyfunctional isocyanate-based compound, a polyfunctional epoxy-based compound, a melamine-based compound, a metal salt-based compound, a metal chelate-based compound, an amino resin-based compound or a peroxide, or a method of mixing low molecular weight compounds each having two or more carbon-carbon double bonds and performing a crosslinking treatment by means of irradiation with energy ray or the like, can be employed. In the case of using an external crosslinking agent, the amount of use thereof is appropriately determined based on the balance between the external crosslinking agent and the base polymer to be crosslinked, and based on the use applications as a pressure-sensitive adhesive. Generally, it is preferable that the external crosslinking agent is incorporated in an amount of about 20 parts by weight or

less, and more preferably 0.1 parts by weight to 20 parts by weight, relative to 100 parts by weight of the base polymer.

[0040] The thickness of the pressure-sensitive adhesive layer for the base tape is not particularly limited and can be appropriately determined; however, the thickness is generally about 5 to 200 μm . The pressure-sensitive adhesive layer for the base tape may be composed of a single layer, or may also be composed of a plurality of layers.

[0041] <Pressure-sensitive adhesive tape 5>

 The pressure-sensitive adhesive tape 5 is not particularly limited, and any conventional pressure-sensitive adhesive tape can be used. Regarding the pressure-sensitive adhesive tape 5, for example, a tape with a pressure-sensitive adhesive layer 52 provided on a base film 51 can be suitably used.

[0042] Regarding the base film 51, any conventionally known base film can be used without any particular limitations; however, in the case of using a radiation-curable material as the pressure-sensitive adhesive layer 52 that will be described below, it is preferable to use a material having radiation transmissibility.

[0043] Examples of the material include homopolymers or copolymers of α -olefins, such as polyethylene,

polypropylene, an ethylene-propylene copolymer, polybutene-1, poly-4-methylpentene-1, an ethylene-vinyl acetate copolymer, an ethylene-ethyl acrylate copolymer, an ethylene-methyl acrylate copolymer, an ethylene-acrylic acid copolymer, and an ionomer, or mixtures thereof; thermoplastic elastomers such as polyurethane, a styrene-ethylene-butene or pentene-based copolymer, and a polyamide-polyol copolymer; and mixtures thereof. The base film may be a mixture of two or more materials selected from the group of these materials, or may be a single-layered film or a multilayer film of these materials.

[0044] The thickness of the base film 51 is not particularly limited and may be appropriately set; however, the thickness is preferably 50 to 200 μm .

[0045] In order to enhance the adhesiveness between the base film 51 and the pressure-sensitive adhesive layer 52, the surface of the base film 51 may be subjected to a chemical or physical surface treatment such as a chromic acid treatment, exposure to ozone, exposure to flame, exposure to a high voltage electric shock, or an ionizing radiation treatment.

[0046] According to the present embodiment, the pressure-sensitive adhesive layer 52 is provided directly on the base film 51; however, the pressure-sensitive adhesive layer 52 may be provided indirectly, with a primer

layer for providing adhesiveness, an anchor layer for enhancing the cutting properties at the time of dicing, a stress relaxation layer, an antistatic layer or the like, interposed therebetween.

[0047] The resin that is used for the pressure-sensitive adhesive layer 52 of the pressure-sensitive adhesive tape 5 is not particularly limited, and a chlorinated polypropylene resin, an acrylic resin, a polyester resin, a polyurethane resin, an epoxy resin, and the like, which are known to be used for pressure-sensitive adhesives, can be used. However, an acrylic pressure-sensitive adhesive that uses an acrylic polymer as a base polymer is preferred.

[0048] Examples of the acrylic polymer include acrylic polymers that use one kind or two or more kinds of a (meth)acrylic acid alkyl ester (for example, a linear or branched alkyl ester having an alkyl group with 1 to 30 carbon atoms, and particularly 4 to 18 carbon atoms, such as a methyl ester, an ethyl ester, a propyl ester, an isopropyl ester, a butyl ester, an isobutyl ester, a s-butyl ester, a t-butyl ester, a pentyl ester, an isopentyl ester, a hexyl ester, a heptyl ester, an octyl ester, a 2-ethylhexyl ester, an isooctyl ester, a nonyl ester, a decyl ester, an isodecyl ester, an undecyl ester, a dodecyl ester, a tridecyl ester, a tetradecyl ester, a hexadecyl

ester, an octadecyl ester, or an eicosyl ester); and a (meth)acrylic acid cycloalkyl ester (for example, a cyclopentyl ester or a cyclohexyl ester), as monomer components. Here, the term (meth)acrylic acid ester refers to acrylic acid ester and/or methacrylic acid ester, and the term (meth) as used herein has the same meaning in all cases.

[0049] The acrylic polymer may include a unit corresponding to another monomer component that is copolymerizable with the (meth)acrylic acid alkyl ester or cycloalkyl ester as necessary, for the purpose of modifying the cohesive force, heat resistance and the like of the polymer. Examples of such a monomer component include carboxyl group-containing monomers such as acrylic acid, methacrylic acid, carboxyethyl (meth)acrylate, carboxypentyl (meth)acrylate, itaconic acid, maleic acid, fumaric acid, and crotonic acid; acid anhydride monomers such as maleic anhydride and itaconic anhydride; hydroxyl group-containing monomers such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxylauryl (meth)acrylate, and (4-hydroxymethylcyclohexyl)methyl (meth)acrylate; sulfonic acid group-containing monomers such as styrenesulfonic

acid, allylsulfonic acid, 2-(meth)acrylamido-2-methylpropanesulfonic acid, (meth)acrylamidopropanesulfonic acid, sulfopropyl (meth)acrylate, and (meth)acryloyloxynaphthalenesulfonic acid; phosphoric acid group-containing monomers such as 2-hydroxyethylacryloyl phosphate; acrylamide, and acrylonitrile. These copolymerizable monomer components can be used singly or as mixtures of two or more kinds thereof. The amount of use of these copolymerizable monomers is preferably 40% by weight or less of the total amount of the monomer components.

[0050] Furthermore, since the acrylic polymer is crosslinked, the acrylic polymer may also include a polyfunctional monomer or the like as necessary, as a monomer component for copolymerization. Examples of such a polyfunctional monomer include hexanediol di(meth)acrylate, (poly)ethylene glycol di(meth)acrylate, (poly)propylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate, pentaerythritol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, pentaerythritol tri(meth)acrylate, dipentaerythritol hexa(meth)acrylate, epoxy (meth)acrylate, polyester (meth)acrylate, and urethane (meth)acrylate. These polyfunctional monomers can also be used singly or as mixtures of two or more kinds thereof. The amount of use of the polyfunctional monomer is preferably 30% by weight

or less of the total amount of the monomer components, from the viewpoint of pressure-sensitive adhesion characteristics and the like.

[0051] Preparation of the acrylic polymer can be carried out by, for example, applying an appropriate method such as a solution polymerization method, an emulsion polymerization method, a bulk polymerization method or a suspension polymerization method to one kind of component monomer or a mixture of two or more kinds of component monomers. In regard to the pressure-sensitive adhesive layer, a composition with suppressed inclusion of low molecular weight substances is preferred from the viewpoint of preventing contamination of wafers, and from this point of view, it is preferable to use an acrylic polymer having a weight average molecular weight of 300,000 or more, and particularly 400,000 to 3,000,000, as a main component. Therefore, the pressure-sensitive adhesive can be of an appropriately crosslinked type based on an internal crosslinking method, an external crosslinking method or the like.

[0052] Furthermore, in order to enhance the pick-up properties by controlling the crosslinking density of the pressure-sensitive adhesive layer 52, for example, an adequate method such as a method of performing a crosslinking treatment using an appropriate external

crosslinking agent such as a polyfunctional isocyanate-based compound, a polyfunctional epoxy-based compound, a melamine-based compound, a metal salt-based compound, a metal chelate-based compound, an amino resin-based compound, or a peroxide; or a method of mixing low molecular weight compounds each having two or more carbon-carbon double bonds, and performing a crosslinking treatment by irradiation with energy rays or the like, can be employed. In the case of using an external crosslinking agent, the amount of use thereof is appropriately determined based on the balance between the crosslinking agent and the base polymer to be crosslinked, and also based on the use applications as a pressure-sensitive adhesive. Generally, it is preferable that the external crosslinking agent is incorporated in an amount of about 20 parts by weight or less, and more preferably 0.1 parts by weight to 20 parts by weight, with respect to 100 parts by weight of the base polymer. For the pressure-sensitive adhesive, if necessary, various additives such as a tackifier and an aging preventing agent may also be used in addition to the components described above, from the viewpoint of preventing deterioration or the like.

[0053] As the pressure-sensitive adhesive that constitutes the pressure-sensitive adhesive layer 52, a radiation-curable pressure-sensitive adhesive is suitable.

An example of the radiation-curable pressure-sensitive adhesive may be an addition type radiation-curable pressure-sensitive adhesive obtained by incorporating a radiation-curable monomer component or a radiation-curable oligomer component to the pressure-sensitive adhesive described above.

[0054] Examples of the radiation-curable monomer component to be incorporated include urethane (meth)acrylate, trimethylolpropane tri(meth)acrylate, tetramethylolmethane tetra(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, dipentaerythritol monohydroxypenta(meth)acrylate, dipentaerythritol hexa(meth)acrylate, and 1,4-butanediol di(meth)acrylate. These monomer components can be used singly or in combination of two or more kinds thereof.

[0055] Furthermore, examples of the radiation-curable oligomer component include various oligomers such as urethane-based, polyether-based, polyester-based, polycarbonate-based, and polybutadiene-based oligomers, and an oligomer having a molecular weight in the range of about 100 to 30,000 is suitable. Regarding the amount of incorporation of the radiation-curable monomer component or oligomer component, an amount that can lower the pressure-sensitive adhesive force of the pressure-sensitive adhesive layer can be appropriately determined depending on the kind

of the pressure-sensitive adhesive layer. Generally, the amount of incorporation is, for example, 5 parts by weight to 500 parts by weight, and preferably about 70 parts by weight to 150 parts by weight, with respect to 100 parts by weight of the base polymer such as the acrylic polymer that constitutes the pressure-sensitive adhesive.

[0056] Regarding the radiation-curable pressure-sensitive adhesive, there may also be mentioned an intrinsic type radiation-curable pressure-sensitive adhesive obtained by using a polymer having a carbon-carbon double bond in a side chain or the main chain of the polymer or at the main chain terminals as the base polymer, in addition to the addition type radiation-curable pressure-sensitive adhesive. An intrinsic type radiation-curable pressure-sensitive adhesive does not need to contain an oligomer component and the like, which are low molecular weight components, or do not include many oligomer components and the like. Therefore, a pressure-sensitive adhesive layer having a stable layer structure can be formed, without allowing oligomer components and the like to migrate around in the pressure-sensitive adhesive over time, and this is preferable.

[0057] Regarding the base polymer having a carbon-carbon double bond, any polymer having a carbon-carbon double bond and having pressure-sensitive adhesiveness can

be used without any particular limitations. It is preferable that such a base polymer has an acrylic polymer as the basic skeleton. Examples of the acrylic polymer basic skeleton include the acrylic polymers listed above as examples.

[0058] The method for introducing a carbon-carbon double bond into an acrylic polymer is not particularly limited, and various methods can be employed. However, it is easy to introduce a carbon-carbon double bond into a polymer side chain, in view of molecular design. For example, a method of copolymerizing in advance a monomer having a functional group into an acrylic polymer, and then subjecting the copolymerization product to a condensation or addition reaction with a compound having a carbon-carbon double bond and a functional group that is capable of reacting with the aforementioned functional group, while maintaining the radiation-curability of the carbon-carbon double bond, may be employed.

[0059] Examples of combinations of these functional groups include a combination of a carboxylic acid group and an epoxy group, a combination of a carboxylic acid group and an aziridyl group, and a combination of a hydroxyl group and an isocyanate group. Among these combinations of functional groups, a combination of a hydroxyl group and an isocyanate group is suitable, from the viewpoint of the

ease of tracing the reaction. As long as a combination which allows production of the acrylic polymer having a carbon-carbon double bond by the combination of these functional groups is employed, the functional group may be on any side of the acrylic polymer and the compound. However, in the preferred combination described above, it is suitable that the acrylic polymer has a hydroxyl group, and the compound has an isocyanate group. In this case, examples of the isocyanate compound having a carbon-carbon double bond include methacryloyl isocyanate, 2-methacryloyloxyethyl isocyanate, and m-isopropenyl- α,α -dimethylbenzyl isocyanate. Furthermore, as the acrylic polymer, acrylic polymers copolymerized with the hydroxyl group-containing monomers described above or ether-based compounds such as 2-hydroxyethyl vinyl ether, 4-hydroxybutyl vinyl ether, and diethylene glycol monovinyl ether, are used.

[0060] Regarding the intrinsic type radiation-curable pressure-sensitive adhesive, the base polymer having a carbon-carbon double bond (particularly, an acrylic polymer) can be used alone; however, a photopolymerizable compound such as the radiation-curable monomer component or oligomer component described above may also be incorporated to the extent that the characteristics are not deteriorated. The amount of incorporation of the

photopolymerizable compound is usually within the range of 30 parts by weight or less, and preferably within the range of 0 to 10 parts by weight, with respect to 100 parts by weight of the base polymer.

[0061] It is preferable that a photopolymerization initiator is incorporated into the radiation-curable pressure-sensitive adhesive, in a case in which the pressure-sensitive adhesive is cured by ultraviolet radiation or the like.

[0062] Among the acrylic polymers described above, particularly acrylic polymer A, which is configured to include an acrylic acid ester represented by the formula: $\text{CH}_2=\text{CHCOOR}$ (wherein R represents an alkyl group having 4 to 18 carbon atoms), a hydroxyl group-containing monomer, and an isocyanate compound having a radical reactive carbon-carbon double bond in the molecule, is preferred.

[0063] If the alkyl group of the acrylic acid alkyl ester has fewer than 4 carbon atoms, the acrylic acid alkyl ester has high polarity and excessively large peeling force, and the pick-up properties may be deteriorated. On the other hand, if the alkyl group of the acrylic acid alkyl ester has more than 18 carbon atoms, the glass transition temperature of the pressure-sensitive adhesive layer 52 becomes too high, thereby the adhesion characteristics at normal temperature are deteriorated, and

as a result, detachment of the metal layer 3 may occur at the time of dicing or expansion.

[0064] The acrylic polymer A may also include a unit corresponding to another monomer component, if necessary.

[0065] For the acrylic polymer A, an isocyanate compound having a radical reactive carbon-carbon double bond is used. That is, it is preferable that the acrylic polymer has a configuration in which a double bond-containing isocyanate compound is added, by an addition reaction, to a polymer obtained from a monomer composition of the acrylic acid ester or the hydroxyl group-containing monomer. Therefore, it is preferable that the acrylic polymer has a radical reactive carbon-carbon double bond in the molecular structure. Thereby, an active energy ray-curable pressure-sensitive adhesive layer (ultraviolet-curable pressure-sensitive adhesive layer or the like) that is cured when irradiated with active energy ray (ultraviolet radiation or the like) can be provided, and the peeling force between the metal layer 3 and the pressure-sensitive adhesive layer can be reduced.

[0066] Examples of the double bond-containing isocyanate compound include methacryloyl isocyanate, acryloyl isocyanate, 2-methacryloyloxyethyl isocyanate, 2-acryloyloxyethyl isocyanate, and m-isopropenyl- α,α -dimethylbenzyl isocyanate. The double bond-containing

isocyanate compounds can be used singly or in combination of two or more kind thereof.

[0067] Furthermore, in the active energy ray-curable pressure-sensitive adhesive, an external crosslinking agent can be appropriately used in order to adjust the pressure-sensitive adhesive force before the irradiation with active energy ray, or the pressure-sensitive adhesive force after the irradiation with active energy ray. Regarding a specific means for an external crosslinking method, a method of adding a so-called crosslinking agent such as a polyisocyanate compound, an epoxy compound, an aziridine compound, or a melamine-based crosslinking agent, and causing the pressure-sensitive adhesive to react, may be used. In the case of using an external crosslinking agent, the amount of use of the agent is appropriately determined on the basis of the balance between the crosslinking agent and the base polymer to be crosslinked, and on the basis of the use applications as the pressure-sensitive adhesive. The amount of use of the external crosslinking agent is generally 20 parts by weight or less (preferably 0.1 parts by weight to 10 parts by weight) with respect to 100 parts by weight of the base polymer. Furthermore, if necessary, various conventionally known additives such as a tackifier, an aging preventing agent and a foaming agent, may also be incorporated into the active energy ray-curable pressure-

sensitive adhesive, in addition to the components described above.

[0068] The thickness of the pressure-sensitive adhesive layer 52 is not particularly limited and can be appropriately determined; however, the thickness is generally about 5 to 200 μm . The pressure-sensitive adhesive layer 52 may be composed of a single layer, or may be composed of multiple layers.

[0069] <Metal layer 3>

 The metal that constitutes the metal layer 3 is not particularly limited as long as the tensile strength of the metal layer 3 is 350 MPa or higher, and it is preferable that the metal layer 3 includes at least one selected from the group consisting of, for example, stainless steel, aluminum, iron, titanium, tin, nickel and copper, from the viewpoint of heat dissipation properties and from the viewpoint of preventing warpage in the electronic device package 8. Among these, from the viewpoint of obtaining a heat dissipation effect with high thermal conductivity, it is particularly preferable that the metal layer 3 includes copper. Furthermore, from the viewpoint of preventing warpage in the electronic device package 8, it is particularly preferable that the metal layer 3 includes aluminum.

[0070] It is preferable that the metal layer 3 is

formed from an alloy including copper and one kind or two or more kinds selected from the group consisting of nickel, chromium, zirconium, zinc, tin, titanium, silicon, iron, manganese, magnesium, phosphorus and cobalt. When the metal layer 3 is formed from a copper alloy, it is preferable that the percentage content of copper is 99.95% or less. Furthermore, the metal layer 3 may also be formed from an alloy including aluminum and one kind or two or more kinds selected from the group consisting of nickel, chromium, zirconium, zinc, tin, magnesium, copper, manganese, titanium, silicon, iron, and cobalt. It is also preferable that the metal layer 3 is formed from stainless steel. Stainless steel contains iron as a main component, and also contains chromium. In stainless steel, the content of iron is 50% or more, and the content of chromium is 10.5% or more, and more preferably 11% or more. By having the metal layer 3 constructed from such a copper alloy, an aluminum alloy, or stainless steel, the tensile strength can be increased.

[0071] If the tensile strength of the metal layer 3 is 350 MPa or higher, when the adhesive layer-attached metal layer is picked up from the pressure-sensitive adhesive tape, the generation of pin marks occurring as a result of deformation of the metal layer caused by the pressure applied by pins of a pick-up apparatus when an adhesive

layer-attached metal layer is picked up from a pressure-sensitive adhesive tape, can be suppressed. There is no upper limit in particular for the tensile strength of the metal layer 3; however, from the viewpoint of thin film processability, the tensile strength is preferably 1,000 MPa or lower. The tensile strength of the metal layer 3 is a value measured at 25°C according to JIS Z 2241.

[0072] It is preferable that the metal layer 3 has a thermal conductivity of 5 W/(m·K) or higher. When the thermal conductivity is 5 W/(m·K) or higher, the metal layer has superior heat dissipation properties than a sealant material. When the thermal conductivity is 85 W/(m·K) or higher, the metal layer has superior heat dissipation properties than a wafer, and this is more preferable.

[0073] The thickness of the metal layer 3 is 5 μm or more and less than 200 μm. When the thickness is adjusted to be 5 μm or more, pin marks occurring as a result of deformation of the metal layer caused by the pressure of pins of a pick-up apparatus can be suppressed. Also, when the thickness is less than 200 μm, the winding processing is facilitated.

[0074] As such a metal layer 3, a metal foil can be used.

[0075] <Adhesive layer 4>

The adhesive layer 4 is a layer obtained by processing an adhesive into a film in advance.

[0076] The adhesive layer 4 is formed from at least a thermosetting resin, and it is preferable that the adhesive layer is formed from at least a thermosetting resin and a thermoplastic resin.

[0077] Examples of the thermoplastic resin include natural rubber, butyl rubber, isoprene rubber, chloroprene rubber, an ethylene-vinyl acetate copolymer, an ethylene-acrylic acid copolymer, an ethylene-acrylic acid ester copolymer, a polybutadiene resin, a polycarbonate resin, a thermoplastic polyimide resin, a polyamide resin such as 6-nylon or 6,6-nylon, a phenoxy resin, an acrylic resin, a saturated polyester resin such as PET (polyethylene terephthalate) or PBT (polybutylene terephthalate), a polyamideimide resin, and a fluororesin. The thermoplastic resins can be used singly, or two or more kinds thereof can be used in combination. Among these thermoplastic resins, an acrylic resin is particularly preferred from the viewpoint of having less ionic impurities and having excellent stress relaxation performance; and a phenoxy resin is particularly preferred from the viewpoint of achieving a balance between flexibility and strength and having high toughness, because the resins make it easier to secure reliability of semiconductor elements from the

respective viewpoints.

[0078] The acrylic resin is not particularly limited, and a polymer containing, as components, one kind or two or more kinds of acrylic acid or methacrylic acid esters each having a linear or branched alkyl group having 30 or fewer carbon atoms (preferably 1 to 18 carbon atoms) may be used. That is, according to the invention, the acrylic resin is meant to also include a methacrylic resin in a broad sense. Examples of the alkyl group include a methyl group, an ethyl group, a propyl group, an isopropyl group, a n-butyl group, a t-butyl group, an isobutyl group, a pentyl group, an isopentyl group, a hexyl group, a heptyl group, a 2-ethylhexyl group, an octyl group, an isooctyl group, a nonyl group, an isononyl group, a decyl group, an isodecyl group, an undecyl group, a dodecyl group (lauryl group), a tridecyl group, a tetradecyl group, a stearyl group, and an octadecyl group.

[0079] Furthermore, the other monomer for forming the acrylic resin (monomer other than an alkyl ester of acrylic acid or methacrylic acid with an alkyl group having 30 or fewer carbon atoms) is not particularly limited, and examples include carboxyl group-containing monomers such as acrylic acid, methacrylic acid, carboxyethyl acrylate, carboxypentyl acrylate, itaconic acid, maleic acid, fumaric acid, and crotonic acid; acid anhydride monomers such as

maleic anhydride and itaconic anhydride; hydroxyl group-containing monomers such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxylauryl (meth)acrylate, or (4-hydroxymethylcyclohexyl)-methyl acrylate; sulfonic acid group-containing monomers such as styrenesulfonic acid, allylsulfonic acid, 2-(meth)acrylamido-2-methylpropanesulfonic acid, (meth)acrylamidopropanesulfonic acid, sulfopropyl (meth)acrylate, or (meth)acryloyloxynaphthalenesulfonic acid; or phosphoric acid group-containing monomers such as 2-hydroxyethylacryloyl phosphate. Meanwhile, the term (meth)acrylic acid refers to acrylic acid and/or methacrylic acid, and the term (meth) of the invention means the same in all cases.

[0080] Examples of the thermosetting resin include, in addition to an epoxy resin and a phenolic resin, an amino resin, an unsaturated polyester resin, a polyurethane resin, a silicone resin, and a thermosetting polyimide resin. The thermosetting resins can be used singly or in combination of two or more kinds thereof. Regarding the thermosetting resin, an epoxy resin having a smaller content of ionic impurities that corrode semiconductor

elements is particularly suitable. Furthermore, a phenolic resin can be suitably used as a curing agent for an epoxy resin.

[0081] The epoxy resin is not particularly limited, and for example, bifunctional epoxy resins or polyfunctional epoxy resins, such as a bisphenol A type epoxy resin, a bisphenol F type epoxy resin, a bisphenol S type epoxy resin, a brominated bisphenol A type epoxy resin, a hydrogenated bisphenol A type epoxy resin, a bisphenol AF type epoxy resin, a biphenyl type epoxy resin, a naphthalene type epoxy resin, a fluorene type epoxy resin, a phenol-novolac type epoxy resin, an orthocresol-novolac type epoxy resin, a trishydroxyphenylmethane type epoxy resin, and a tetraphenylolthane type epoxy resin; or epoxy resins such as a hydantoin type epoxy resin, a trisglycidyl isocyanurate type epoxy resin, or a glycidylamine type epoxy resin, can be used.

[0082] As the epoxy resin, among the examples, a novolac type epoxy resin, a biphenyl type epoxy resin, a trishydroxyphenylmethane type epoxy resin, and a tetraphenylolthane type epoxy resin are particularly preferred. It is because these epoxy resins are highly reactive with phenolic resins as curing agents, and have excellent heat resistance or the like.

[0083] The phenolic resin acts as a curing agent for

an epoxy resin, and examples thereof include novolac type phenolic resins such as a phenol novolac resin, a phenol aralkyl resin, a cresol novolac resin, a tert-butylphenol novolac resin, and a nonylphenol novolac resin; resol type phenolic resins; and polyoxystyrene such as polyparaoxystyrene. The phenolic resins can be used singly or in combination of two or more kinds thereof. Among these phenolic resins, a phenol novolac resin and a phenol aralkyl resin are particularly preferred. It is because the connection reliability of semiconductor devices can be enhanced.

[0084] In regard to the mixing ratio between the epoxy resin and the phenolic resin, it is suitable to mix the epoxy resin with the phenolic resin such that the amount of hydroxyl groups in the phenolic resin per equivalent of epoxy groups in the epoxy resin component would be, for example, 0.5 equivalents to 2.0 equivalents, and more suitably 0.8 equivalents to 1.2 equivalents. That is, if the mixing ratio of the two components is not in the range described above, the curing reaction does not proceed sufficiently, and the characteristics of the epoxy resin cured product are easily deteriorated.

[0085] A thermosetting accelerating catalyst for the epoxy resin and the phenolic resin may also be used. The thermosetting accelerating catalyst is not particularly

limited, and can be appropriately selected for use from among known thermosetting accelerating catalysts. The thermosetting accelerating catalysts can be used singly or in combination of two or more kinds thereof. As the thermosetting accelerating catalyst, for example, an amine-based curing accelerating agent, a phosphorus-based curing accelerating agent, an imidazole-based curing accelerating agent, a boron-based curing accelerating agent, and a phosphorus-boron-based curing accelerating agent can be used.

[0086] Regarding the curing agent for an epoxy resin, it is preferable to use a phenolic resin as explained above; however, known curing agents such as imidazoles, amines, and acid anhydrides can also be used.

[0087] It is important that the adhesive layer 4 has adhesiveness (stickiness) to an adherend 9 such as an electronic device. Thus, in order to crosslink the adhesive layer 4 in advance to some extent, a polyfunctional compound that reacts with a functional group at the molecular chain terminal of a polymer or the like may be added to the adhesive layer as a crosslinking agent. Thereby, the adhesion characteristics at high temperature can be enhanced, and an improvement of heat resistance can be attempted.

[0088] Regarding the crosslinking agent, any known

crosslinking agent can be used without any particular limitations. Specific examples thereof include an isocyanate-based crosslinking agent, an epoxy-based crosslinking agent, a melamine-based crosslinking agent, a peroxide-base crosslinking agent, a urea-based crosslinking agent, a metal alkoxide-based crosslinking agent, a metal chelate-based crosslinking agent, a metal salt-based crosslinking agent, a carbodiimide-based crosslinking agent, an oxazoline-based crosslinking agent, an aziridine-based crosslinking agent, and an amine-based crosslinking agent. As the crosslinking agent, an isocyanate-based crosslinking agent or an epoxy-based crosslinking agent is suitable. The crosslinking agents can be used singly or in combination of two or more kinds thereof.

[0089] According to the invention, it is also possible to apply a crosslinking treatment by irradiation with an electron beam, ultraviolet radiation or the like, instead of using a crosslinking agent or simultaneously with the use of a crosslinking agent.

[0090] If necessary, other additives can be incorporated as appropriate into the adhesive layer 4. Examples of the other additives include a filler, a flame retardant, a silane coupling agent, an ion trapping agent, an extending agent, an aging preventing agent, an oxidation preventing agent, and a surfactant.

[0091] The filler may be any one of an inorganic filler and an organic filler; however, an inorganic filler is suitable. By incorporating a filler such as an inorganic filler, enhancement of thermal conductivity of the adhesive layer 4, regulation of the elastic modulus, and the like can be promoted. Examples of the inorganic filler include ceramics such as silica, clay, gypsum, calcium carbonate, barium sulfate, alumina, beryllium oxide, silicon carbide, aluminum nitride, and silicon nitride; metals such as aluminum, copper, silver, gold, nickel, chromium, lead, tin, zinc, palladium, and solder, or alloys; and various inorganic powders formed from carbon and the like. The fillers can be used singly or in combination of two or more kinds thereof. Regarding the filler, among them, silica or alumina is suitable, and as the silica, fused silica is particularly suitable. The average particle size of the inorganic filler is preferably in the range of 0.001 μm to 80 μm . The average particle size of the inorganic filler can be measured using, for example, a laser diffraction type particle size distribution analyzer.

[0092] The amount of incorporation of the filler (particularly, inorganic filler) is preferably 98% by weight or less (0% by weight to 98% by weight) with respect to the organic resin components. Particularly, in the case

of silica, the amount of incorporation is suitably 0% by weight to 70% by weight, and in the case of a functional inorganic filler for thermal conduction or electrical conduction, the amount of incorporation is suitably 10% by weight to 98% by weight.

[0093] Examples of the flame retardant include antimony trioxide, antimony pentoxide, and a brominated epoxy resin. The flame retardants can be used singly or in combination of two or more kinds thereof. Examples of the silane coupling agent include β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane, γ -glycidoxypropyltrimethoxysilane, and γ -glycidoxypropylmethyldiethoxysilane. The silane coupling agents can be used singly or in combination of two or more kinds thereof. Examples of the ion trapping agent include hydrotalcites and bismuth hydroxide. The ion trapping agents can be used singly or in combination of two or more kinds thereof.

[0094] It is particularly preferable, from the viewpoints of adhesiveness and reliability, that the adhesive layer 4 contains (A) an epoxy resin, (B) a curing agent, (C) an acrylic resin or a phenoxy resin, and (D) a surface-treated inorganic filler.

[0095] By using the (A) epoxy resin, high adhesiveness, water resistance and heat resistance are

obtained. As the epoxy resin, the above-mentioned known epoxy resins can be used. Regarding the (B) curing agent, any known curing agent can be used.

[0096] The (C) acrylic resin has high toughness while achieving a good balance between flexibility and strength. A preferable acrylic resin is a crosslinkable functional group-containing (meth)acrylic copolymer obtained by polymerizing a monomer having an epoxy group, a glycidyl group, an alcoholic hydroxyl group, a phenolic hydroxyl group, or a carboxyl group as a crosslinkable functional group, the acrylic copolymer having a Tg (glass transition temperature) of -50°C to 50°C. Furthermore, if the acrylic resin contains acrylonitrile or the like and exhibits rubber characteristics, superior toughness is obtained.

The phenoxy resin has a long molecular chain and has a structure similar to the structure of an epoxy resin. Since a phenoxy resin acts as a flexible material in a composition having a high crosslinking density and imparts high toughness, a composition having high strength and high toughness is obtained. A preferred phenoxy resin is a phenoxy resin having a main skeleton of bisphenol A type; however, in addition to that, commercially available phenoxy resins such as a bisphenol F type phenoxy resin, a bisphenol A/F mixed type phenoxy resin, and a brominated phenoxy resin are also preferable.

[0097] Regarding the (D) surface-treated inorganic filler, an inorganic filler that has been surface-treated with a coupling agent may be used. As the inorganic filler, the above-mentioned known inorganic fillers can be used; however, preferred examples include silica and alumina. When the inorganic filler is surface-treated with a coupling agent, the inorganic filler acquires satisfactory dispersibility. Accordingly, excellent fluidity is obtained, and therefore, the adhesive force to the metal layer 3 can be increased. Also, since the inorganic filler can be filled at a high density, the water absorption ratio can be lowered, and the moisture resistance can be increased.

[0098] For example, the surface treatment of an inorganic filler with a silane coupling agent is carried out according to a known method, by dispersing the inorganic filler in a silane coupling agent solution, thereby causing the hydroxyl groups present at the surface of the inorganic filler to react with silanol groups produced as a result of hydrolysis of hydrolyzable groups such as alkoxy groups of the silane coupling agent, and producing Si-O-Si bonds on the surface of the inorganic filler.

[0099] The thickness of the adhesive layer 4 is not particularly limited; however, usually, from the viewpoint

of handleability, the thickness is preferably 3 μm or more, more preferably 5 μm or more, and from the viewpoint of contributing to thickness reduction of the semiconductor package, the thickness is preferably 150 μm or less, and more preferably 100 μm or less. The adhesive layer 4 may be composed of a single layer, or may be composed of multiple layers.

[0100] Furthermore, it is preferable that the adhesive layer 4 has a peeling force (23°C, peeling strength: 180°, linear velocity: 300 mm/min) of 0.3 N or more against the metal layer 3 in the B-stage (uncured state or semicured state). If the peeling force is less than 0.3 N, there is a risk that detachment may occur between the adhesive layer 4 and the metal layer 3 at the time of division into individual chips (dicing).

[0101] It is preferable that the water absorption ratio of the adhesive layer 4 is 1.5 vol% or less. The method for measuring the water absorption ratio is as follows. That is, an adhesive layer 4 (film-like adhesive) having a size of 50 × 50 mm is used as a sample, and the sample is dried for 3 hours at 120°C in a vacuum dryer and is left to cool naturally in a desiccator. Subsequently, the dry mass is measured and is designated as M1. The sample is immersed in distilled water for 24 hours at room temperature, and after the sample is taken out, the sample

surface is wiped with a filter paper. The sample is immediately weighed, and the weight is designated as M2. The water absorption ratio is calculated by the following Formula (1).

$$\text{Water absorption ratio (vol\%)} = [(M2 - M1)/(M1/d)] \times 100 \quad (1)$$

wherein d represents the density of the film.

If the water absorption ratio is higher than 1.5 vol%, there is a risk that package cracks may occur at the time of solder reflow due to the absorbed moisture.

[0102] It is preferable that the saturation moisture absorption ratio of the adhesive layer 4 is 1.0 vol% or less. The method for measuring the saturation moisture absorption ratio is as follows. That is, a circular-shaped adhesive layer 4 (film-like adhesive) having a diameter of 100 mm is used as a sample, and the sample is dried for 3 hours at 120°C in a vacuum dryer and is left to cool naturally in a desiccator. Subsequently, the dry mass is measured and is designated as M1. The sample is humidified for 168 hours in a constant temperature constant humidity chamber at 85°C and 85%RH, and after the sample is taken out, the sample is immediately weighed, and the weight is designated as M2. The saturation moisture absorption ratio is calculated by the following Formula (2).

$$\text{Saturation moisture absorption ratio (vol\%)} = [(M2 -$$

$$M1)/(M1/d)] \times 100 \quad (2)$$

wherein d represents the density of the film.

If the saturation moisture absorption ratio is higher than 1.0 vol%, the value of vapor pressure increases as a result of moisture absorption at the time of reflow, and there is a risk that satisfactory reflow characteristics may not be obtained.

[0103] It is preferable that the residual volatile matter content of the adhesive layer 4 is 3.0 wt% or less. The method for measuring the residual volatile matter content is as follows. That is, an adhesive layer 4 (film-like adhesive) having a size of 50 × 50 mm is used as a sample, and the initial mass of the sample is measured and designated as M1. The sample is heated for 2 hours at 200°C in a hot air circulation constant temperature chamber, subsequently the sample is weighed, and the weight is designated as M2. The residual volatile matter content is calculated by the following Formula (3).

$$\text{Residual volatile matter content (wt\%)} = [(M2 - M1)/M1] \times 100 \quad (3)$$

If the residual volatile matter content is higher than 3.0 wt%, the solvent is volatilized by the heating during packaging, and there is a risk that voids may occur in the interior of the adhesive layer 4, and package cracks may occur.

[0104] It is preferable that the ratio of the coefficient of linear expansion of the metal layer 3 with respect to the coefficient of linear expansion of the adhesive layer 4 (linear expansion coefficient of metal layer 3/linear expansion coefficient of adhesive layer 4) is 0.2 or higher. If this ratio is less than 0.2, detachment between the metal layer 3 and the adhesive layer 4 is likely to occur, and there is a risk that package cracks may occur at the time of packaging, and reliability may be lowered.

[0105] Next, a method for producing a tape for electronic device packaging 1 according to the present embodiment will be described. First, a long metal layer 3 is prepared. As the metal layer 3, a commercially available metal foil may be used. Next, as illustrated in Fig. 4(A), the metal layer 3 is stuck onto the pressure-sensitive adhesive surface of a long base tape 2 using a sticking roller r or the like.

[0106] Separately, a long film-like adhesive layer 4 is formed. The adhesive layer 4 can be formed by utilizing a conventionally used method of preparing a resin composition and forming a film-like layer. Specifically, for example, a method of forming the adhesive layer 4 by applying the resin composition on an appropriate separator (release paper or the like), and drying the resin

composition (in a case in which thermal curing or the like is needed, the resin composition is subjected to a heating treatment as necessary and dried), may be used. The resin composition may be a solution or a dispersion liquid.

[0107] Next, as illustrated in Fig. 4(B), the adhesive layer 4 that has been detached from the separator is stuck onto the metal layer 3 that is stuck onto the base tape 2, using a sticking roller r or the like.

[0108] In the description given above, it is described that the metal layer 3 is stuck onto the base tape 2, and then the adhesive layer 4 is stuck onto the metal layer 3. However, it is still acceptable that the adhesive layer 4 is stuck onto the metal layer 3, and then the surface on the metal layer 3 side is stuck onto the base tape 2.

[0109] Subsequently, as illustrated in Fig. 4(C), the adhesive layer 4 and the metal layer 3 are precut into a predetermined shape (here, a circular shape) using a press-cutting blade or the like, and as illustrated in Fig. 4(D), unnecessary parts 6 at the periphery are detached from the base tape 2 and removed. At this time, the adhesive layer 4 and the metal layer 3 may be individually divided in advance into a predetermined size such as a size corresponding to that of the semiconductor chip C, using a lattice-shaped press-cutting blade having a circular-shaped outer frame.

[0110] The method of forming a metal layer 3 and an adhesive layer 4 having a predetermined shape on the base tape 2 is not limited to the method described above. A long metal layer 3 is stuck onto a long base tape 2, the assembly is punched into a predetermined shape, unnecessary parts 6 are removed, and then the adhesive layer 4 that has been formed into a predetermined shape may be stuck onto the metal layer 3 having a predetermined shape.

Alternatively, a metal layer 3 and an adhesive layer 4 that have been respectively formed into a predetermined shape in advance may be stuck onto the base tape 2. However, from the viewpoint of convenience of the production process, it is preferable that the assembly is produced by a process illustrated in Figs. 4(A) to 4(D) as described above.

[0111] Also, separately, a pressure-sensitive adhesive tape 5 is produced. The base film can be formed by a conventionally known film-forming method. Examples of the film-forming method include a calender film-forming method, a method of casting in an organic solvent, an inflation extrusion method in a sealed system, a T-die extrusion method, a co-extrusion method, and a dry lamination method. Next, a pressure-sensitive adhesive composition is applied on a base film and dried (by heating and crosslinking as necessary), and thus a pressure-sensitive adhesive layer is formed. Examples of the application method include roll

coating, screen coating, and gravure coating. The pressure-sensitive adhesive layer may be formed on the base film by applying the pressure-sensitive adhesive composition directly on the base film. Alternately, after the pressure-sensitive adhesive layer is formed by applying the pressure-sensitive adhesive composition on a release paper that has been release-treated on the surface or the like, the pressure-sensitive adhesive layer may be transferred onto a base film. Thereby, a pressure-sensitive adhesive tape 5 having a pressure-sensitive adhesive layer formed on a base film is produced.

[0112] Subsequently, as illustrated in Fig. 5(A), the pressure-sensitive adhesive tape 5 is laminated on the assembly of the metal layer 3 and the adhesive layer 4 that has a predetermined shape and is provided on the base tape 2, such that the surface on the adhesive layer 4 side is brought into contact with the surface on the pressure-sensitive adhesive layer 52 side of the pressure-sensitive adhesive tape 5.

[0113] Next, as illustrated in Fig. 5(B), the pressure-sensitive adhesive tape 5 is precut into a predetermined shape using a press-cutting blade or the like, and as illustrated in Fig. 5(C), unnecessary parts 7 at the periphery are detached from the base tape 2 and removed. Thus, a tape for electronic device packaging 1 is

produced. Subsequently, the base tape 2 that has been used for precut processing is detached, and a known separator may be pasted to the pressure-sensitive adhesive layer 52 of the pressure-sensitive adhesive tape 5.

[0114] <Method of use>

Next, the method for producing an electronic device package 8 using the tape for electronic device packaging 1 of the present embodiment will be described with reference to Fig. 6 to Fig. 8. The present embodiment will be described by taking a semiconductor chip C that is flip-chip connected on an adherend 9, as an example of the electronic device package 8.

[0115] [Semiconductor wafer W mounting step]

First, a separate dicing tape D that is similar to the pressure-sensitive adhesive tape 5 of the tape for electronic device packaging 1 of the invention is prepared, and a semiconductor wafer W is stuck onto the center on the dicing tape D as illustrated in Fig. 6(A). This is adhered and retained to be fixed (semiconductor wafer W mounting step), and a ring frame R is stuck to the peripheral edge of the dicing tape D. At this time, the dicing tape D is stuck to the back surface of the semiconductor wafer W. The back surface of the semiconductor wafer W means the surface on the opposite side of the circuit surface (also referred to as non-circuit surface, non-electrode-formed

surface, or the like). The sticking method is not particularly limited; however, a method by heating and pressure-bonding is preferred. Pressure bonding is usually carried out by pressing with a pressing means such as a pressure-bonding roll.

[0116] [Semiconductor wafer W dicing step]

Next, dicing of the semiconductor wafer W is performed as illustrated in Fig. 6(B). Thereby, the semiconductor wafer W is individually divided (subdivided) by cutting the wafer into a predetermined size, and thus semiconductor chips C are produced. Dicing is carried out according to a conventional method, for example, from the circuit surface side of the semiconductor wafer W. In the present step, for example, a cutting method called full-cut, by which incisions are inserted to reach the pressure-sensitive adhesive tape 5, can be employed. The dicing apparatus that is used for the present step is not particularly limited, and any conventionally known apparatus can be used. In the case of implementing expansion of the dicing tape D, the expansion can be carried out using a conventionally known expanding apparatus.

[0117] [Semiconductor chip C pick-up step]

As illustrated in Fig. 6(C), picking up of the semiconductor chips C is performed, and thus the

semiconductor chips C are detached from the dicing tape D. The method for picking up is not particularly limited, and various conventionally known methods can be employed. For example, a method of placing the dicing tape D bonded together with a semiconductor chip C and a ring frame R on a stage S of a pick-up apparatus, with the base film side facing downward; lifting a hollow cylinder-shaped pressure member T while the ring frame R is fixed, so as to expand the dicing tape D; pushing up the individual semiconductor chips C in this state by means of pins N from the base film side of the dicing tape D; and picking up the pushed semiconductor chips C using a pick-up apparatus, may be employed.

[0118] [Flip-chip connection step]

The semiconductor chips C thus picked up are fixed to an adherend 9 such as a substrate by a flip-chip bonding method (flip-chip mounting method) as illustrated in Fig. 6(D). Specifically, the semiconductor chips C are fixed to the adherend 9 by a conventional method, in a state in which the circuit surface (also called a surface, a circuit pattern-formed surface, an electrode-formed surface, or the like) of a semiconductor chip C faces the adherend 16. For example, first, a flux is attached to bumps 10, which are connection parts that are formed on the circuit surface side of the semiconductor chips C. Next, the bumps 10 of

the semiconductor chips C are contacted with a conductor material 11 (solder or the like) for bonding, which is adhered to a connection pad of the adherend 9, and then the bumps 10 and the conductor material 11 are melted while being pressed. Thereby, electrical conduction between the semiconductor chips C and the adherend 9 is secured, and the semiconductor chips C can be fixed to the adherend 9 (flip-chip bonding process). At this time, voids are formed between the semiconductor chips C and the adherend 9, and the distance of voids is generally about 30 μm to 300 μm . The flux remaining on the facing surfaces of the semiconductor chips C and the adherend 9 or in the gaps therebetween is washed and removed.

[0119] As the adherend 9, various substrates such as a lead frame and a circuit board (wiring circuit board or the like) can be used. The material for such a substrate is not particularly limited; however, a ceramic substrate or a plastic substrate may be used. Examples of the plastic substrate include an epoxy substrate, a bismaleimide triazine substrate and a polyimide substrate. Also, a chip-on-chip structure can be obtained by using another semiconductor chip as the adherend 9, and flip-chip connecting the semiconductor chip C thereon.

[0120] Next, as illustrated in Fig. 7(A), the base tape 2 of the tape for electronic device packaging 1

according to the present embodiment is detached, the metal layer 3 and the pressure-sensitive adhesive layer 52 of the pressure-sensitive adhesive tape 5 are exposed. The peripheral edge of the pressure-sensitive adhesive layer 52 is fixed to the ring frame R.

[0121] Next, as illustrated in Fig. 7(B), the metal layer 3 and the adhesive layer 4 are cut into a size corresponding to the size of the semiconductor chip C and are divided. Cutting can be carried out by a process similar to the semiconductor wafer W dicing step described above. In a case in which the precut processing of dividing the metal layer 3 and the adhesive layer 4 in advance has been carried out, the present step is not implemented.

[0122] Next, as will be illustrated in Fig. 7(C) the individually divided metal layer 3 and the adhesive layer 4 are picked up and then detached from the pressure-sensitive adhesive tape 5. Picking up can be carried out by a process similar to the semiconductor chip C pick-up step described above.

[0123] Next, the adhesive layer 4 side of the metal layer 3 and the adhesive layer 4 thus picked up is stuck to the back surface of a semiconductor chip C that has been flip-chip connected, as illustrated in Fig. 8.

Subsequently, the periphery of the metal layer 3-attached

semiconductor chip C and the gap between the semiconductor chip C and the adherend 9 are filled with a sealant material (sealant resin or the like), and thus assembly is encapsulated. Encapsulation is carried out by a conventional method. At this time, since the metal layer 3 is provided on the back surface of the semiconductor chip C, the warpage occurring due to the difference between the coefficient of thermal expansion of the semiconductor chip C and the coefficient of thermal expansion of the adherend 9 in the flip-chip bonding process is canceled by the difference between the coefficient of thermal expansion of the semiconductor chip C and the coefficient of thermal expansion of the metal layer 3. Furthermore, since the metal layer 3 is provided on the back surface of the semiconductor chip C, the heat generated at the time of being used as an electronic device is dissipated through the metal layer 3.

[0124] Meanwhile, in the description given above, a package structure in which the metal layer 3 is provided directly on the back surface of a semiconductor chip C, with the adhesive layer 4 interposed therebetween, and the metal layer 3 is encapsulated together with the semiconductor chip C, has been described. However, it is still acceptable that after the semiconductor chip C is encapsulated, the metal layer 3 is provided on the top

surface of the encapsulated body by means of the adhesive layer 4. Since the electronic device package 8 undergoes warpage even at the time of encapsulation, the warpage at the time of encapsulation can be canceled by providing the metal layer 3 on the top surface of the encapsulated body.

[0125] In the description given above, a semiconductor chip C that is flip-chip connected onto an adherend 9 has been described as an example of the electronic device package 8. However, the invention is not intended to be limited to this, and for example, in regard to an electronic device package structure in which different semiconductor chips having the same size are laminated on a semiconductor chip, the metal layer 3 may be provided on the semiconductor chip on the lower side, with the adhesive layer 4 interposed therebetween, in order to use the metal layer 3 of the tape for electronic device packaging 1 of the invention as a space between two chips.

[0126] Furthermore, in the present embodiment, the pressure-sensitive adhesive layer 52, the adhesive layer 4, and the metal layer 3 are provided in this order; however, it is still acceptable to provide the pressure-sensitive adhesive layer 52, the metal layer 3, and the adhesive layer 4 in this order. In this case, a semiconductor wafer is stuck onto the adhesive layer 4, the semiconductor wafer, the metal layer 3 and the adhesive layer 4 are

diced, and these may be picked up together. However, as described above, it is also possible that the semiconductor wafer, the metal layer 3, and the adhesive layer 4 are separately diced and picked up, the semiconductor chips are flip-chip connected, and then the metal layer 3 can be adhered onto the semiconductor chip by means of the adhesive layer 4. In this case, since the tensile strength of the metal layer 3 is 350 MPa or higher, the metal layer 3 and the adhesive layer 4 can be picked up from the pressure-sensitive adhesive tape 5 without having pin marks generated therein.

[0127] <Examples>

Next, Examples and Comparative Examples will be explained in detail in order to further clarify the effects of the invention; however, the invention is not intended to be limited to these Examples.

[0128] (1) Production of pressure-sensitive adhesive tape

 <Pressure-sensitive adhesive composition (1)>

 As an acrylic copolymer (A1) having a functional group, an acrylic copolymer (a-1) comprising butyl acrylate, 2-ethylhexyl acrylate, 2-hydroxyethyl acrylate and acrylic acid, and having a proportion of 2-ethylhexyl acrylate of 50 mol%, a mass average molecular weight of 650,000, a glass transition temperature of -60°C, a

hydroxyl group value of 25 mg KOH/g, and an acid value of 6 mg KOH/g, was prepared.

[0129] A mixture obtained by adding 8 parts by mass of CORONATE L (manufactured by Tosoh Corp.) as a polyisocyanate to 100 parts by mass of the acrylic copolymer (a-1) was dissolved in ethyl acetate and stirred, and thus a pressure-sensitive adhesive composition (1) was prepared.

[0130] The following was produced as a base film.

<Base film (1)>

Resin beads of an ethylene-methacrylic acid copolymer were melted at 200°C, and the molten product was molded into a long film form having a thickness of 150 μm using an extruder. Thus, a base film (1) was produced. For the ethylene-methacrylic acid copolymer, NUCREL N035C (trade name) manufactured by DuPont-Mitsui Polychemicals Co., Ltd. was used.

<Pressure-sensitive adhesive tape (1)>

[0131] The pressure-sensitive adhesive composition (1) was applied on a release liner formed from a release-treated polyethylene terephthalate film so as to obtain a thickness after drying of 10 μm , and the composition was dried for 3 minutes at 110°C to obtain a pressure-sensitive adhesive layer. Subsequently, the pressure-sensitive adhesive layer was bonded with the base film (1), and thus

a pressure-sensitive adhesive tape (1) was produced.

[0132] (2) Production of adhesive layer

<Adhesive layer (1)>

28 parts by mass of a bisphenol A type phenoxy resin (manufactured by Nippon Steel & Sumikin Chemical Co., Ltd., trade name "YP-50S", Mw 60,000, Tg 84°C), 55 parts by mass of a solid bisphenol A type epoxy resin (manufactured by Nippon Steel & Sumikin Chemical Co., Ltd., trade name "YD-011", Mw 1,000, epoxy equivalent 450), 49 parts by mass of a liquid bisphenol A type epoxy resin (manufactured by Nippon Steel & Sumikin Chemical Co., Ltd., trade name "YD-128", Mw 400, epoxy equivalent 190), 9 parts by mass of imidazole (manufactured by Shikoku Chemicals Corp., trade name "2PHZ-PW") as a curing agent, and 74 parts by mass of a silica filler (manufactured by Admatechs Co., Ltd., trade name "SO-C2", average particle size 0.5 μm) were dissolved or dispersed in methyl ethyl ketone, and thus an adhesive composition solution was prepared. This adhesive composition solution was applied on a release-treated film (release liner) formed from a silicone release-treated polyethylene terephthalate film having a thickness of 50 μm , and then the composition was dried for 5 minutes at 130°C. Thereby, an adhesive layer (1) having a thickness of 20 μm was produced.

[0133] The following was prepared as the metal layer.

<Metal layer (1)>

Rolled copper foil (manufactured by UACJ Corp., tough pitch copper foil, thickness: 18 μm , tensile strength: 450 MPa, 391 W/m $\cdot$ K)

<Metal layer (2)>

C18040 (manufactured by UACJ Corp., copper alloy foil, thickness: 18 μm , tensile strength 658 MPa, 322 W/m $\cdot$ K)

<Metal layer (3)>

Sample A (aluminum alloy foil, thickness: 20 μm , tensile strength: 356 MPa, 110 W/m $\cdot$ K)

<Metal layer (4)>

SUS304 (manufactured by Nippon Steel & Sumikin Materials Co., Ltd., stainless steel foil, thickness: 20 μm , tensile strength: 1225 MPa, 16.3 W/m $\cdot$ K)

<Metal layer (5)>

F0-WS (manufactured by Furukawa Electric Co., Ltd., copper foil, thickness: 18 μm , tensile strength: 310 MPa, 378 W/m $\cdot$ K)

<Metal layer (6)>

1085 (manufactured by UACJ Corp., aluminum foil, thickness: 20 μm , tensile strength: 180 MPa, 221 W/m $\cdot$ K)

[0134] <Sample A>

An aluminum alloy containing 0.27% by mass of Si, 0.31% by mass of Fe, 0.02% by mass of Cu, 1.1% by mass of

Mn, 0.51% by mass of Mg, and 0.01% by mass of Ti, with the balance being Al, was melted and subjected to ingot casting by a semi-continuous casting method. An ingot thus obtained was subjected to a homogenization treatment for 5 hours at a temperature of 480°C, and then hot rolling was performed at a temperature in the range of 450°C to 260°C. Thus, a hot rolled plate having a thickness of 3 mm was obtained. The hot-rolled plate was subjected to cold rolling to obtain a thickness of 0.5 mm, and then the resultant was subjected to an intermediate heat treatment of maintaining the plate for 1 minute at a temperature of 400°C using a rapid heating furnace and cooling at a cooling rate of 20°C/s. After the intermediate heat treatment, cold rolling was repeated, and thus an aluminum alloy foil having a thickness of 20 μm was obtained.

[0135] (5) Production of tape for electronic device packaging

<Example 1>

The adhesive layer (1) formed on the release liner and the metal layer (1) as described above were bonded together under the conditions of a bonding angle of 120°, a pressure of 0.2 MPa, and a velocity of 10 mm/s, and thus a single-sided adhesive film was produced. The pressure-sensitive adhesive tape (1) was precut into a circular shape so that the pressure-sensitive adhesive tape could be

stuck onto a ring frame, and the single-sided adhesive film was precut into a circular shape that was smaller than the pressure-sensitive adhesive tape (1). The adhesive layer (1) side exposed by peeling the release-treated film from the single-sided adhesive film and the pressure-sensitive adhesive layer of the pressure-sensitive adhesive tape (1) were bonded together such that the pressure-sensitive adhesive layer at the periphery of the single-sided adhesive film would be exposed. Thus, a tape for electronic device packaging of Example 1 as illustrated in Fig. 1 was produced.

[0136] <Examples 2 to 4 and Comparative Examples 1 and 2>

Tapes for electronic device packaging of Examples 2 to 4 and Comparative Examples 1 and 2 were produced by a technique similar to that of Example 1, except that the combinations of the pressure-sensitive adhesive tape, the adhesive composition, and the metal layer as described in Table 1 were employed.

[0137] The tapes for electronic device packaging according to Examples 1 to 4 and Comparative Examples 1 and 2 were subjected to the following evaluations. The results are presented in Table 1.

[0138] (Suppression of pin marks)

The metal layer and the adhesive layer of the tape

for electronic device packaging of each of the various samples of Examples and Comparative Examples were diced so as to produce individual samples having a size of 5 mm × 5 mm. Subsequently, the pressure-sensitive adhesive layer was irradiated with ultraviolet radiation at 200 mJ/cm² using an air-cooled high-pressure mercury lamp (80 W/cm, distance of radiation 10 cm), through the base film side. For 100 individual samples at the center of the tape for electronic device packaging, a pick-up test was performed using a dice picker apparatus (trade name "CAP-300II") manufactured by Canon Machinery, Inc., and the presence or absence of pin marks in the metal layer was checked. A sample in which pin marks could not be seen by visual inspection in the picked-up metal layer was considered as a successful sample, and the success ratio for pin mark suppression was calculated. Based on the calculation results, a sample having a success ratio of 90% or higher was rated as O as a good product, and a sample having a success ratio of lower than 90% was rated as X as a defective product. The evaluation results are presented in Table 1.

	Example 1	Example 2	Example 3	Example 4	Comparative Example 1	Comparative Example 2
Pressure-sensitive adhesive tape	(1)	(1)	(1)	(1)	(1)	(1)
Adhesive layer	(1)	(1)	(1)	(1)	(1)	(1)
Metal layer	(1)	(2)	(3)	(4)	(5)	(6)
Tensile strength [Mpa]	450	658	356	1225	310	180
Thermal conductivity [W/mK]	391	322	110	16.3	378	221
Pin mark suppression	○	○	○	○	×	×

[0140] As shown in Table 1, regarding the tapes for electronic device packaging according to Examples 1 to 4, the tensile strength of the metal layers was 356 MPa or higher, which was 350 MPa or higher as defined in the claims. Therefore, satisfactory results were obtained for the evaluation of pin mark suppression.

[0141] In contrast, regarding the tapes for electronic device packaging according to Comparative Examples 1 and 2, since the tensile strength of the metal layer was lower than 350 MPa, poor results were obtained for the evaluation of pin mark suppression.

EXPLANATIONS OF LETTERS OR NUMERALS

[0142] 1: Tape for electronic device packaging

2: Base tape

3: Metal layer

4: Adhesive layer

5: Pressure-sensitive adhesive tape

5a: Label portion

5b: Peripheral portion

CLAIMS

1. A tape for electronic device packaging, comprising:
a pressure-sensitive adhesive tape having a base film and a pressure-sensitive adhesive layer; and
a laminate of an adhesive layer and a metal layer provided by laminating on a surface of the pressure-sensitive adhesive layer, the surface being on the opposite side of the base film,
wherein the metal layer has a tensile strength of 350 MPa or higher.
2. The tape for electronic device packaging according to claim 1, wherein the metal layer contains copper or aluminum.
3. The tape for electronic device packaging according to claim 1 or 2, wherein the metal layer has a copper content of 99.95% or less.
4. The tape for electronic device packaging according to any one of claims 1 to 3, wherein the metal layer is a copper alloy foil or an aluminum alloy foil.
5. The tape for electronic device packaging according to any one of claims 1 to 4, wherein the metal layer comprises an alloy including copper and one kind or two or more kinds selected from the group consisting of nickel, chromium, zirconium, zinc, tin, titanium, silicon, iron, manganese,

magnesium, phosphorus, and cobalt.

6. The tape for electronic device packaging according to any one of claims 1 to 4, wherein the metal layer comprises an alloy including aluminum and one kind or two or more kinds selected from the group consisting of nickel, chromium, zirconium, zinc, tin, magnesium, copper, manganese, titanium, silicon, iron, and cobalt.

7. The tape for electronic device packaging according to any one of claims 1 to 4, wherein the metal layer comprises stainless steel.

8. The tape for electronic device packaging according to any one of claims 1 to 7, wherein the metal layer has a thermal conductivity of 5 W/(m·K) or higher.

9. The tape for electronic device packaging according to any one of claims 1 to 8, wherein the adhesive layer contains (A) an epoxy resin, (B) a curing agent, (C) an acrylic resin or a phenoxy resin, and (D) a surface-treated inorganic filler.

10. The tape for electronic device packaging according to any one of claims 1 to 9, wherein the pressure-sensitive adhesive layer contains an acrylic polymer configured to include an acrylic acid ester represented by the formula: $\text{CH}_2=\text{CHCOOR}$ (wherein R represents an alkyl group having 4 to

18 carbon atoms), a hydroxyl group-containing monomer, and an isocyanate compound having a radical reactive carbon-carbon double bond in the molecule.