SPECIFICATION

TITLE OF INVENTION: PRESSURE-SENSITIVE ADHESIVE FILM AND METHOD OF MANUFACTURING ELECTRONIC DEVICE

TECHNICAL FIELD

[0001]

The present invention relates to a pressure-sensitive adhesive film and a method of manufacturing an electronic device.

BACKGROUND ART

[0002]

As a technique capable of achieving size reduction and weight reduction of an electronic device (for example, a semiconductor device), a fan-out type package is known.

In an embedded wafer level ball grid array (eWLB), which is one of methods of manufacturing the fan-out type package, a plurality of electronic components such as a semiconductor chip are temporarily fixed on the pressure-sensitive adhesive film attached to the support substrate in a spaced state, and the plurality of electronic components are collectively sealed with a sealing material. Here, the pressure-sensitive adhesive film needs to be fixed to the electronic component and the support substrate in the sealing steps or the like and needs to be removed from the sealed electronic component together with the support substrate after the sealing.

[0003]

Examples of a technique related to a method of manufacturing such a fan-out type package include those described in Patent Document 1 (Japanese Unexamined Patent Publication No. 2011-134811).

[0004]

Patent Document 1 discloses a heat-resistant pressure-sensitive adhesive sheet for manufacturing a semiconductor device, which is used by being attached when resin-sealing a substrate-less semiconductor chip, for the purpose of solving problems such as a chip not being held in position and being displaced from a specified location due to pressure during resin sealing, or a package being damaged due to strong adhesion to a chip surface caused by curing of a sealing material or by heat when peeling a heat-resistant pressure-sensitive adhesive sheet for manufacturing a semiconductor device. The heat-resistant pressure-sensitive adhesive sheet includes a base material layer and a pressure-sensitive adhesive layer, and the pressure-sensitive adhesive layer is a layer having an adhesive force to SUS304 after bonding of 0.5 N/20 mm or more, and being cured by a stimulus received before completion of the resin sealing step so that a peel force from a package becomes 2.0 N/20 mm or less.

RELATED DOCUMENT

PATENT DOCUMENT

[0005]

Patent Document 1: Japanese Unexamined Patent Publication

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0006]

According to the studies by the present inventors, it has been clarified that, for example, the intermediate layer flows due to heating during sealing of an electronic component, and wrinkles are likely to occur in the film.

The present invention has been made in view of the above circumstances, and provides a pressure-sensitive adhesive film and a method of manufacturing an electronic device, in which occurrence of wrinkles during heating can be suppressed.

SOLUTION TO PROBLEM

[0007]

The present inventors conducted a thorough investigation in order to achieve the above-described object. As a result, the present inventors have found that, by setting the storage elastic modulus G’ of the intermediate layer in the pressure-sensitive adhesive film after photocuring to be within a specific numerical range, it is possible to suppress the occurrence of wrinkles during heating, thereby completing the present invention.

[0008]

According to the present invention, a pressure-sensitive adhesive film and a method of manufacturing an electronic device

described below are provided.

[0009]

[1]

A pressure-sensitive adhesive film including:

a pressure-sensitive adhesive resin layer (B);

an intermediate layer (A); and

a base material layer in this order,

in which a storage elastic modulus G' of the intermediate layer (A) according to the following (Method 1) is 4.0 kPa or more and 50.0 kPa or less,

(Method 1)

the intermediate layer (A) is overlapped to have a thickness of 2 mm, and press molding is performed under the following conditions, the obtained press sheet is cut into a circle having a diameter of φ25 mm to obtain a test piece,

<Press conditions>

heating temperature: 100°C, preheating time: 2 minutes,

main pressurization load: 10 MPa, main pressurization time: 2 minutes,

cooling temperature: 20°C, and cooling time: 3 minutes,

next, the obtained test piece is irradiated with UV having a wavelength of 300 to 600 nm using a UV irradiator under a condition of 10,800 mJ/cm^2 to perform photocuring,

thereafter, using a dynamic viscoelasticity measuring apparatus, a photocured test piece is set in the dynamic viscoelasticity measuring apparatus through a parallel-plate attachment having a diameter of 25 mm, a temperature dependence

of dynamic viscoelasticity is measured under conditions of a temperature increase rate of 5 °C/min, a temperature range of 25°C to 120°C, an angular frequency of 6.3 rad/s, and a torsion mode, and the storage elastic modulus G’ of the intermediate layer (A) at 100°C is obtained from the obtained graph.

[2]

The pressure-sensitive adhesive film according to [1], in which the intermediate layer (A) contains one or two or more resins selected from the group consisting of a polyolefin-based resin, an ethylene-carboxylic acid anhydride-based copolymer, an ethylene-epoxy copolymer, an ethylene-(meth)acrylic acid ester copolymer, an ethylene-ethylenically unsaturated acid copolymer, an ethylene-vinyl ester copolymer, a polystyrene-based resin, and a (meth)acrylic resin.

[3]

The pressure-sensitive adhesive film according to [2], in which a melt flow rate (MFR) of the resin in the intermediate layer (A), which is measured under conditions of 190°C and a load of 2,160 g in accordance with JIS K7210:1999, is 0.1 g/10 min or more and 20 g/10 min or less.

[4]

The pressure-sensitive adhesive film according to any one of [1] to [3], in which the intermediate layer (A) contains a photoinitiator.

[5]

The pressure-sensitive adhesive film according to [4], in which the photoinitiator includes one or two or more selected

from the group consisting of benzophenone, a benzophenone derivative, thioxanthone, a thioxanthone derivative, benzoin, a benzoin derivative, α-hydroxyalkylphenones, α-aminoalkylphenols, acylphosphine oxides, alkylphenylglyoxylates, diethoxyacetophenone, oxime esters, a titanocene compound, and an anthraquinone derivative.

[6]

The pressure-sensitive adhesive film according to [5], in which the photoinitiator includes 4-methylbenzophenone.

[7]

The pressure-sensitive adhesive film according to any one of [4] to [6], in which a content of the photoinitiator in the intermediate layer (A) is 0.01 parts by mass or more and 5.0 parts by mass or less in a case where a total amount of resins contained in the intermediate layer (A) is set to 100 parts by mass.

[8]

The pressure-sensitive adhesive film according to any one of [1] to [7], in which the intermediate layer (A) contains a crosslinking agent.

[9]

The pressure-sensitive adhesive film according to [8], in which the crosslinking agent includes one or two or more selected from the group consisting of a divinyl aromatic compound, a cyanurate compound, a diallyl compound, an acrylate compound, a triallyl compound, an oxime compound, and a maleimide compound.

[10]

The pressure-sensitive adhesive film according to [9], in which the crosslinking agent includes triallyl isocyanurate.

[11]

The pressure-sensitive adhesive film according to any one of [8] to [10], in which a content of the crosslinking agent in the intermediate layer (A) is 0.01 parts by mass or more and 5.0 parts by mass or less in a case where a total amount of resins contained in the intermediate layer (A) is set to 100 parts by mass.

[12]

The pressure-sensitive adhesive film according to any one of [1] to [11], in which a thickness of the intermediate layer (A) is 100 μm or more and 1,000 μm or less.

[13]

The pressure-sensitive adhesive film according to any one of [1] to [12], in which the base material layer contains one or two or more selected from the group consisting of polypropylene, polyethylene terephthalate, polyethylene naphthalate, polyamide, and polyimide.

[14]

The pressure-sensitive adhesive film according to any one of [1] to [13], in which a thickness of the base material layer is 10 μm or more and 1,000 μm or less.

[15]

The pressure-sensitive adhesive film according to any one of [1] to [14], in which the pressure-sensitive adhesive resin

layer (B) contains one or two or more selected from the group consisting of a (meth)acrylic pressure-sensitive adhesive resin, a silicone-based pressure-sensitive adhesive resin, a urethane-based pressure-sensitive adhesive resin, an olefin-based pressure-sensitive adhesive resin, and a styrene-based pressure-sensitive adhesive resin.

[16]

The pressure-sensitive adhesive film according to any one of [1] to [15], in which a total content of a gas-generating component and thermally expandable microspheres in the pressure-sensitive adhesive resin layer (B) is 0.1% by mass or less, in a case where an entirety of the pressure-sensitive adhesive resin layer (B) is set to 100% by mass.

[17]

The pressure-sensitive adhesive film according to any one of [1] to [16], in which a thickness of the pressure-sensitive adhesive resin layer (B) is 1 μm or more and 40 μm or less.

[18]

The pressure-sensitive adhesive film according to any one of [1] to [17], further including: a pressure-sensitive adhesive resin layer (C) on a side of the base material layer opposite to the intermediate layer (A).

[19]

The pressure-sensitive adhesive film according to [18], in which the pressure-sensitive adhesive resin layer (C) is a layer in which an adhesive force is reduced by an external stimulus.

[20]

The pressure-sensitive adhesive film according to [19], in which the pressure-sensitive adhesive resin layer (C) contains a heat-expandable pressure-sensitive adhesive.

[21]

The pressure-sensitive adhesive film according to [20], in which the heat-expandable pressure-sensitive adhesive is a pressure-sensitive adhesive whose adhesive force is reduced or lost by heating at a temperature exceeding 150°C.

[22]

The pressure-sensitive adhesive film according to any one of [18] to [21], further including: an unevenness-absorbing resin layer (D) between the base material layer and the pressure-sensitive adhesive resin layer (C).

[23]

The pressure-sensitive adhesive film according to [22], in which a thickness of the unevenness-absorbing resin layer (D) is 10 μm or more and 1,000 μm or less.

[24]

The pressure-sensitive adhesive film according to any one of [1] to [23], in which the pressure-sensitive adhesive film is capable of temporarily fixing an electronic component in a case of sealing the electronic component with a sealing material.

[25]

The pressure-sensitive adhesive film according to [24], in which the electronic component has an uneven structure.

[26]

The pressure-sensitive adhesive film according to [25], in

which the uneven structure of the electronic component includes a bump electrode.

[27]

The pressure-sensitive adhesive film according to [26], in which a height of the bump electrode is 50 μm or more and 500 μm or less.

[28]

A method of manufacturing an electronic device, the method including:

a step (a) of preparing a structure including the pressure-sensitive adhesive film according to any one of [1] to [27] and an electronic component attached to the pressure-sensitive adhesive resin layer (B) of the pressure-sensitive adhesive film;

a step (b) of performing one or two or more treatments selected from the group consisting of light irradiation and a heat treatment on the structure; and

a step (c) of sealing the electronic component with a sealing material.

[29]

The method of manufacturing an electronic device according to [28], in which the sealing material includes an epoxy resin-based sealing material.

[30]

The method of manufacturing an electronic device according to [28] or [29], further including: a step (d) of curing the sealing material by performing one or two or more methods

selected from the group consisting of light irradiation and a heat treatment after the step (c).

[31]

The method of manufacturing an electronic device according to [30], further including: a step (e) of peeling the pressure-sensitive adhesive film from the electronic component after the step (d).

[32]

The method of manufacturing an electronic device according to any one of [28] to [31], in which the electronic device includes a fan-out type package.

ADVANTAGEOUS EFFECTS OF INVENTION

[0010]

According to the present invention, it is possible to provide a pressure-sensitive adhesive film and a method of manufacturing an electronic device, in which occurrence of wrinkles during heating can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

[FIG. 1] A cross-sectional view schematically showing an example of a structure of a pressure-sensitive adhesive film of an embodiment according to the present invention.

[FIG. 2] A cross-sectional view schematically showing an example of a structure of a pressure-sensitive adhesive film of an embodiment according to the present invention.

[FIG. 3] A cross-sectional view schematically showing an example of a structure of a pressure-sensitive adhesive film of an embodiment according to the present invention.

[FIG. 4] A cross-sectional view schematically showing an example of a method of manufacturing an electronic device of an embodiment according to the present invention.

[FIG. 5] A cross-sectional view schematically showing an example of a method of manufacturing an electronic device of an embodiment according to the present invention.

DESCRIPTION OF EMBODIMENTS

[0012]

Hereinafter, an embodiment of the present invention will be described with reference to the drawings.

In all drawings, the same constituents are marked with the same reference signs and may not be repeatedly described as appropriate. In addition, the drawings are schematic and do not necessarily correspond to actual dimensional ratios.

In the present specification, a description of “A to B” regarding a numerical range means A or more and B or less, unless otherwise specified. For example, 1% to 5% means 1% or more and 5% or less.

In the specification, “(meth)acrylic” means acrylic, methacrylic, or both acrylic and methacrylic.

[0013]

<Pressure-sensitive adhesive film>

The pressure-sensitive adhesive film 50 according to the

present embodiment will be described.

FIG. 1 is a cross-sectional view schematically showing an example of a structure of a pressure-sensitive adhesive film 50 of the embodiment according to the present invention.

[0014]

As shown in FIG. 1, the pressure-sensitive adhesive film 50 according to the present embodiment includes a pressure-sensitive adhesive resin layer (B), an intermediate layer (A), and a base material layer 10 in this order.

A storage elastic modulus G’ of the intermediate layer (A) according to the following (Method 1) is 4.0 kPa or more and 50.0 kPa or less.

[0015]

(Method 1)

The intermediate layer (A) is overlapped to have a thickness of 2 mm, and press molding is performed under the following conditions. The obtained press sheet is cut into a circle having a diameter of φ25 mm to obtain a test piece.

<Press conditions>

Heating temperature: 100°C, preheating time: 2 minutes

Main pressurization load: 10 MPa, main pressurization time: 2 minutes

Cooling temperature: 20°C, cooling time: 3 minutes

Next, the obtained test piece is irradiated with UV having a wavelength of 300 to 600 nm using a UV irradiator (for example, manufactured by Ushio Inc., product name: UVX-02528S1AJA02) under a condition of 10,800 mJ/cm^2 to perform

photocuring.

Thereafter, using a dynamic viscoelasticity measuring apparatus, a photocured test piece is set in the dynamic viscoelasticity measuring apparatus through a parallel-plate attachment having a diameter of 25 mm, a temperature dependence of dynamic viscoelasticity is measured under conditions of a temperature increase rate of 5 °C/min, a temperature range of 25°C to 120°C, an angular frequency of 6.3 rad/s, and a torsion mode. The storage elastic modulus G’ of the intermediate layer (A) at 100°C is obtained from the obtained graph.

[0016]

As described above, according to the studies by the present inventors, it has been clarified that the intermediate layer flows due to heating during sealing of an electronic component, and wrinkles are likely to occur in the film. The present inventors have conducted intensive studies to achieve the above object, and have found that, by setting the storage elastic modulus G’ of the intermediate layer in the pressure-sensitive adhesive film after photocuring to be within a specific numerical range, it is possible to suppress the occurrence of wrinkles during heating, thereby completing the present invention. The reason for this is not clear, but it is considered that the elastic modulus at a high temperature is an index indicating that the intermediate layer does not flow due to heat, and as a result, the occurrence of wrinkles during heating can be suppressed.

[0017]

From the viewpoint of further suppressing the occurrence of wrinkles during heating, the storage elastic modulus G' of the intermediate layer (A) in the pressure-sensitive adhesive film 50 of the present embodiment is preferably 4.0 kPa or more and 45.0 kPa or less, more preferably 4.0 kPa or more and 30.0 kPa or less, still more preferably 4.0 kPa or more and 20.0 kPa or less, even more preferably 4.0 kPa or more and 15.0 kPa or less, and even still more preferably 4.0 kPa or more and 12.0 kPa or less.

[0018]

From the viewpoint of the balance between mechanical properties and handleability, the total thickness of the pressure-sensitive adhesive film 50 of the present embodiment is preferably 10 μm or more and 1,500 μm or less, and more preferably 20 μm or more and 1,000 μm or less.

[0019]

Examples of the electronic component 70 include a semiconductor chip such as an IC, an LSI, a discrete, a light emitting diode, or a light receiving element, a semiconductor panel, a semiconductor package, and an optical sensor.

[0020]

The pressure-sensitive adhesive film 50 of the present embodiment is preferably capable of temporarily fixing the electronic component 70 in a case of sealing the electronic component 70 with the sealing material 60.

In this case, the electronic component 70 preferably has an uneven structure 75.

[0021]

Here, the uneven structure 75 of the electronic component 70 preferably includes a bump electrode. In a case where the uneven structure 75 of the electronic component 70 includes a bump electrode, in a case where a height of the bump electrode is denoted by H [μm] and a thickness of the intermediate layer (A) is denoted by d [μm], H/d is preferably 1 or less, more preferably 0.85 or less, and still more preferably 0.7 or less. When H/d is the upper limit value described above or less, it is possible to make the unevenness-absorbing property more favorable while making the thickness of the pressure-sensitive adhesive film 50 thinner.

The lower limit of H/d is not particularly limited, but is, for example, 0.01 or more.

[0022]

In a case where the electronic component 70 of the present embodiment includes a bump electrode, from the viewpoint of further improving the unevenness-absorbing property, a height of the bump electrode is preferably 50 μm or more and 500 μm or less, more preferably 75 μm or more and 450 μm or less, and still more preferably 100 μm or more and 400 μm or less.

[0023]

Next, each layer constituting the pressure-sensitive adhesive film 50 according to the present embodiment will be described.

[0024]

[Base material layer]

The base material layer 10 is a layer provided for the purpose of making the characteristics such as the handleability, mechanical properties, heat resistance, and the like of the pressure-sensitive adhesive film 50 more favorable.

The base material layer 10 is not particularly limited and examples thereof include a resin film.

[0025]

The base material layer 10 preferably contains a thermoplastic resin. The thermoplastic resin constituting the base material layer 10 according to the present embodiment preferably contains one or two or more selected from polyolefins such as polyethylene, polypropylene, poly(4-methyl-1-pentene), and poly(1-butene); polyesters such as polyethylene terephthalate, polybutylene terephthalate, and polyethylene naphthalate; polyamides such as nylon-6, nylon-66, and polymetaxylene adipamide; polyacrylate; polymethacrylate; polyvinyl chloride; polyvinylidene chloride; polyimide; polyetherimide; an ethylene-vinyl acetate copolymer; polyacrylonitrile; polycarbonate; polystyrene; an ionomer; polysulfone; polyethersulfone; and polyphenylene ether.

Among these, from the viewpoint of excellent balance of transparency, mechanical strength, price, and the like, the base material layer 10 preferably contains one or two or more selected from polypropylene, polyethylene terephthalate, polyethylene naphthalate, polyamide, and polyimide, and more preferably contains one or two or more selected from polyethylene terephthalate and polyethylene naphthalate.

[0026]

The base material layer 10 may be a single layer or two or more layers.

In addition, the form of the resin film used to form the base material layer 10 may be a stretched film or a film stretched in the uniaxial or biaxial direction; however, from the viewpoint of improving the mechanical strength of the base material layer 10, a film stretched in the uniaxial or biaxial direction is preferable.

[0027]

From the viewpoint of obtaining good film characteristics, the thickness of the base material layer 10 is preferably 10 μm or more and 1,000 μm or less, more preferably 20 μm or more and 500 μm or less, and still more preferably 30 μm or more and 100 μm or less.

The base material layer 10 may be subjected to a surface treatment in order to improve the adhesion with other layers. Specifically, a corona treatment, a plasma treatment, an undercoating treatment, a primer coating treatment, or the like may be performed.

[0028]

[Intermediate layer (A)]

The intermediate layer (A) is a layer provided on one surface side of the base material layer 10, and is, for example, a layer that imparts conformability and adhesion to the pressure-sensitive adhesive film 50 with respect to a surface on which the uneven structure 75 of the electronic component 70 is

formed.

[0029]

From the viewpoint of improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the thickness of the intermediate layer (A) of the present embodiment is preferably 100 μm or more and 1,000 μm or less, more preferably 150 μm or more and 750 μm or less, still more preferably 200 μm or more and 600 μm or less, and even more preferably 250 μm or more and 500 μm or less.

[0030]

From the viewpoint of improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the intermediate layer (A) of the present embodiment preferably contains a resin, a photoinitiator, and a crosslinking agent.

[0031]

(Resin)

From the viewpoint of improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the

intermediate layer (A) of the present embodiment preferably contains, as a resin, one or two or more resins selected from the group consisting of a polyolefin-based resin, an ethylene-carboxylic acid anhydride-based copolymer, an ethylene-epoxy copolymer, an ethylene-(meth)acrylic acid ester copolymer, an ethylene-ethylenically unsaturated acid copolymer, an ethylene-vinyl ester copolymer, a polystyrene-based resin, and a (meth)acrylic resin, more preferably contains an ethylene-vinyl ester copolymer from the viewpoint of improving the performance balance between the conformability, the adhesion, and the work efficiency during manufacturing of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed, and still more preferably contains an ethylene-vinyl acetate copolymer.

[0032]

The ethylene-vinyl acetate copolymer described above is a copolymer of ethylene and vinyl acetate, and is, for example, a random copolymer.

When the total amount of the constitutional units in the ethylene-vinyl acetate copolymer is set to 100% by mass, the content of the constitutional unit derived from vinyl acetate in the ethylene-vinyl acetate copolymer is preferably 5% by mass or more and 50% by mass or less, more preferably 10% by mass or more and 45% by mass or less, and still more preferably 15% by mass or more and 40% by mass or less. When the content of vinyl acetate is in this range, the pressure-sensitive adhesive film 50 is superior in the balance of flexibility, heat resistance,

transparency, and mechanical properties.

The content of vinyl acetate can be measured in accordance with JIS K 7192:1999.

[0033]

In addition, the ethylene-vinyl acetate copolymer is preferably a binary copolymer formed only of ethylene and vinyl acetate, but, in addition to ethylene and vinyl acetate, for example, one type or two or more types selected from vinyl ester-based monomers such as vinyl formate, vinyl glycolate, vinyl propionate, and vinyl benzoate; acrylic-based monomers such as acrylic acid, methacrylic acid, and ethacrylic acid or salts or alkyl esters thereof; and the like may be included as a copolymerization component. In a case where the ethylene-vinyl acetate copolymer contains a copolymerization component other than ethylene and vinyl acetate, the amount of the copolymerization component other than ethylene and vinyl acetate in the ethylene-vinyl acetate copolymer is preferably 0.5% by mass or more and 5% by mass or less.

[0034]

From the viewpoint of improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles and the chip thickness variation during heating, the melt flow rate (MFR) of the resin in the intermediate layer (A) of the present embodiment, which is measured under conditions of 190°C and a

load of 2,160 g in accordance with JIS K7210:1999, is preferably 0.1 g/10 min or more and 20 g/10 min or less, more preferably 0.5 g/10 min or more and 19 g/10 min or less, still more preferably 1.0 g/10 min or more and 18 g/10 min or less, even more preferably 5.0 g/10 min or more and 17 g/10 min or less, and even still more preferably 10 g/10 min or more and 16 g/10 min or less.

[0035]

When the total amount of the components contained in the intermediate layer (A) is set to 100% by mass, the content of the resin in the intermediate layer (A) of the present embodiment is preferably 90% by mass or more and 100% by mass or less, more preferably 92% by mass or more and 100% by mass or less, still more preferably 94% by mass or more and 100% by mass or less, even more preferably 96% by mass or more and 100% by mass or less, and even still more preferably 97% by mass or more and 100% by mass or less.

[0036]

(Photoinitiator)

From the viewpoint of further improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the intermediate layer (A) of the present embodiment preferably contains a photoinitiator.

[0037]

From the viewpoint of further improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the photoinitiator of the present embodiment preferably includes one or two or more selected from the group consisting of benzophenone, a benzophenone derivative, thioxanthone, a thioxanthone derivative, benzoin, a benzoin derivative, α-hydroxyalkylphenones, α-aminoalkylphenols, acylphosphine oxides, alkylphenylglyoxylates, diethoxyacetophenone, oxime esters, a titanocene compound, and an anthraquinone derivative, more preferably includes one or two or more selected from the group consisting of benzophenone, a benzophenone derivative, and an anthraquinone derivative, and still more preferably includes one or two or more selected from the group consisting of benzophenone and a benzophenone derivative.

[0038]

The benzophenone and the benzophenone derivative of the present embodiment preferably include one or two or more selected from the group consisting of benzophenone, 4-phenylbenzophenone, 4-phenoxybenzophenone, 4,4-bis(diethylamino)benzophenone, methyl o-benzoylbenzoate, 4-methylbenzophenone, and 2,4,6-trimethylbenzophenone.

Among these, from the viewpoint of further improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the

surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the photoinitiator of the present embodiment more preferably includes 4-methylbenzophenone.

[0039]

The anthraquinone derivative of the present embodiment preferably includes one or two or more selected from the group consisting of 2-methylanthraquinone, 2-ethylanthraquinone, 2-t-butylanthraquinone, and 1-chloroanthraquinone.

[0040]

From the viewpoint of further improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the content of the photoinitiator in the intermediate layer (A) of the present embodiment is preferably 0.01 parts by mass or more and 5.0 parts by mass or less, more preferably 0.05 parts by mass or more and 4.0 parts by mass or less, still more preferably 0.10 parts by mass or more and 3.0 parts by mass or less, even more preferably 0.30 parts by mass or more and 2.0 parts by mass or less, and even still more preferably 0.40 parts by mass or more and 1.5 parts by mass or less, with respect to 100 parts by mass of the total amount of the resin contained in the intermediate layer (A).

[0041]

(Crosslinking agent)

From the viewpoint of further improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the intermediate layer (A) of the present embodiment preferably contains a crosslinking agent.

[0042]

From the viewpoint of further improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the crosslinking agent of the present embodiment preferably includes one or two or more selected from the group consisting of a divinyl aromatic compound, a cyanurate compound, a diallyl compound, an acrylate compound, a triallyl compound, an oxime compound, and a maleimide compound, and more preferably includes a cyanurate compound.

[0043]

The divinyl aromatic compound of the present embodiment preferably includes one or two or more selected from the group consisting of divinylbenzene and di-i-propenylbenzene.

The cyanurate compound of the present embodiment preferably includes one or two or more selected from the group consisting of triallyl cyanurate and triallyl isocyanurate.

The diallyl compound of the present embodiment preferably

includes diallyl phthalate.

The triallyl compound of the present embodiment preferably includes pentaerythritol triallyl ether.

The acrylate compound of the present embodiment preferably includes one or two or more selected from the group consisting of diethylene glycol diacrylate, triethylene glycol diacrylate, dipropylene glycol diacrylate, tripropylene glycol diacrylate, trimethylolpropane tri(meth)acrylate, ditrimethylolpropane tetra(meth)acrylate, tetramethylolmethane tetra(meth)acrylate, and tetramethylolmethane tetra(meth)acrylate.

The oxime compound of the present embodiment preferably includes one or two or more selected from the group consisting of p-quinonedioxime and p-p’-dibenzoylquinonedioxime.

The maleimide compound of the present embodiment preferably includes m-phenylenedimaleimide.

[0044]

Among these, from the viewpoint of further improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the crosslinking agent of the present embodiment preferably includes one or two or more selected from the group consisting of triallyl cyanurate, triallyl isocyanurate, trimethylolpropane tri(meth)acrylate, and ditrimethylolpropane tetra(meth)acrylate, more preferably includes one or two or more selected from the group consisting

of triallyl cyanurate and triallyl isocyanurate, and still more preferably includes triallyl isocyanurate.

[0045]

From the viewpoint of further improving the performance balance between the conformability and the adhesion of the pressure-sensitive adhesive film 50 with respect to the surface on which the uneven structure 75 of the electronic component 70 is formed while suppressing the occurrence of wrinkles during heating, the content of the crosslinking agent in the intermediate layer (A) of the present embodiment is preferably 0.01 parts by mass or more and 5.0 parts by mass or less, more preferably 0.05 parts by mass or more and 4.0 parts by mass or less, still more preferably 0.10 parts by mass or more and 3.0 parts by mass or less, even more preferably 0.30 parts by mass or more and 2.0 parts by mass or less, and even still more preferably 0.40 parts by mass or more and 1.5 parts by mass or less, with respect to 100 parts by mass of the total amount of the resin contained in the intermediate layer (A).

[0046]

[Pressure-sensitive adhesive resin layer (B)]

The pressure-sensitive adhesive film 50 of the present embodiment includes a pressure-sensitive adhesive resin layer (B) on a side opposite to the base material layer 10 side of the intermediate layer (A).

The pressure-sensitive adhesive resin layer (B) is, for example, a layer for temporarily fixing the electronic component 70 by coming into contact with the surface of the electronic

component 70 in a case of sealing the electronic component 70 with the sealing material 60 in the manufacturing step of the electronic device.

[0047]

The pressure-sensitive adhesive resin layer (B) preferably includes a pressure-sensitive adhesive resin (Ba).

The pressure-sensitive adhesive resin (Ba) preferably includes one or two or more selected from a (meth)acrylic pressure-sensitive adhesive resin (b), a silicone-based pressure-sensitive adhesive resin, a urethane-based pressure-sensitive adhesive resin, an olefin-based pressure-sensitive adhesive resin, and a styrene-based pressure-sensitive adhesive resin.

Among these, from the viewpoint of improving the performance balance between the bump absorbency and the adhesive force, the pressure-sensitive adhesive resin (Ba) preferably includes the (meth)acrylic pressure-sensitive adhesive resin (b).

[0048]

The pressure-sensitive adhesive resin layer (B) can also be a radiation-crosslinkable pressure-sensitive adhesive resin layer capable of reducing the adhesive force by radiation. In a case where the radiation-crosslinkable pressure-sensitive adhesive resin layer is irradiated with radiation, the adhesive force is significantly reduced by crosslinking, and thus the pressure-sensitive adhesive film 50 is easily peeled from the electronic component 70. Examples of the radiation include

ultraviolet rays, electron beams, infrared rays, and the like.

The radiation-crosslinkable pressure-sensitive adhesive resin layer preferably includes an ultraviolet-crosslinkable pressure-sensitive adhesive resin layer.

[0049]

The (meth)acrylic pressure-sensitive adhesive resin (b) used in the pressure-sensitive adhesive resin layer (B) of the present embodiment preferably includes a copolymer including an alkyl (meth)acrylate monomer unit (b1) and a monomer unit (b2) having a functional group capable of reacting with a crosslinking agent.

In the present embodiment, the alkyl (meth)acrylate means an acrylic acid alkyl ester, a methacrylic acid alkyl ester, or a mixture thereof.

[0050]

The (meth)acrylic pressure-sensitive adhesive resin (b) of the present embodiment can be obtained, for example, by copolymerizing a monomer mixture including an alkyl (meth)acrylate monomer and a monomer having a functional group capable of reacting with a crosslinking agent.

[0051]

The alkyl (meth)acrylate monomer of the present embodiment preferably includes an alkyl (meth)acrylate having an alkyl group having about 1 to 12 carbon atoms, and more preferably includes an alkyl (meth)acrylate having an alkyl group having 1 to 8 carbon atoms. The alkyl (meth)acrylate having an alkyl group having about 1 to 12 carbon atoms preferably includes one

or two or more selected from the group consisting of methyl acrylate, methyl methacrylate, ethyl acrylate, ethyl methacrylate, butyl acrylate, butyl methacrylate, 2-ethylhexyl acrylate, and 2-ethylhexyl methacrylate.

In the (meth)acrylic pressure-sensitive adhesive resin (b) of the present embodiment, the content of the alkyl (meth)acrylate monomer unit (b1) is preferably 10% by mass or more and 98.9% by mass or less, more preferably 50% by mass or more and 97% by mass or less, and still more preferably 85% by mass or more and 95% by mass or less, in a case where the total of all monomer units in the (meth)acrylic pressure-sensitive adhesive resin (b) is set to 100% by mass.

[0052]

Examples of the monomer having a functional group capable of reacting with the crosslinking agent of the present embodiment include acrylic acid, methacrylic acid, itaconic acid, mesaconic acid, citraconic acid, fumaric acid, maleic acid, itaconic acid monoalkyl ester, mesaconic acid monoalkyl ester, citraconic acid monoalkyl ester, fumaric acid monoalkyl ester, maleic acid monoalkyl ester, glycidyl acrylate, glycidyl methacrylate, 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, acrylamide, methacrylamide, tert-butylaminoethyl acrylate, tert-butylaminoethyl methacrylate, and the like. The monomer having a functional group capable of reacting with a crosslinking agent of the present embodiment more preferably includes one or two or more selected from the group consisting of acrylic acid, methacrylic acid, 2-hydroxyethyl acrylate, 2-

hydroxyethyl methacrylate, acrylamide, and methacrylamide.

In the (meth)acrylic pressure-sensitive adhesive resin (b) of the present embodiment, the content of the monomer unit (b2) having a functional group capable of reacting with the crosslinking agent is preferably 1% by mass or more and 40% by mass or less, more preferably 1% by mass or more and 20% by mass or less, and still more preferably 1% by mass or more and 10% by mass or less, in a case where the total of all monomer units in the (meth)acrylic pressure-sensitive adhesive resin (b) is set to 100% by mass.

[0053]

The (meth)acrylic pressure-sensitive adhesive resin (b) of the present embodiment may further include a bifunctional monomer unit (b3) or a unit of a specific comonomer having a property as a surfactant (hereinafter, referred to as a polymerizable surfactant), in addition to the alkyl (meth)acrylate monomer unit (b1) and the monomer unit (b2) having a functional group capable of reacting with a crosslinking agent.

The polymerizable surfactant has a property of copolymerizing with the alkyl (meth)acrylate monomer, the monomer having a functional group capable of reacting with a crosslinking agent, and the bifunctional monomer, and acts as emulsifier in a case of emulsion polymerization.

[0054]

The bifunctional monomer of the present embodiment preferably includes one or two or more selected from the group

consisting of allyl methacrylate, allyl acrylate, divinylbenzene, vinyl methacrylate, vinyl acrylate, trimethylolpropane tri(meth)acrylate, pentaerythritol tri(meth)acrylate, dipentaerythritol hexa(meth)acrylate, tetraethylene glycol di(meth)acrylate, and a bifunctional monomer having diacrylate or dimethacrylate at both terminals and having a main chain structure of a propylene glycol type (for example, manufactured by NOF CORPORATION, product names; PDP-200, PDP-400, ADP-200, and ADP-400), a tetramethylene glycol type (for example, manufactured by NOF CORPORATION, product names; ADT-250 and ADT-850), or a mixed type thereof (for example, manufactured by NOF CORPORATION, product names: ADET-1800 and ADPT-4000).

[0055]

In the (meth)acrylic pressure-sensitive adhesive resin (b) according to the present embodiment, a content of the bifunctional monomer unit (b3) is preferably 0.1% by mass or more and 30% by mass or less, more preferably 0.1% by mass or more and 20% by mass or less, still more preferably 0.1% by mass or more and 15% by mass or less, and even more preferably 0.1% by mass or more and 5% by mass or less, in a case where the total of all the monomer units in the (meth)acrylic pressure-sensitive adhesive resin (b) is set to 100% by mass.

[0056]

The polymerizable surfactant of the present embodiment preferably includes one or two or more selected from the group consisting of a polymerizable surfactant obtained by introducing

a polymerizable 1-propenyl group into a benzene ring of polyoxyethylene nonylphenyl ether (manufactured by DKS Co., Ltd.; product name: Aqualon RN-10, RN-20, RN-30, RN-50, and the like), a polymerizable surfactant obtained by introducing a polymerizable 1-propenyl group into a benzene ring of an ammonium salt of a sulfuric acid ester of polyoxyethylene nonylphenyl ether (manufactured by DKS Co., Ltd.; product name: Aqualon HS-10, HS-20, HS-1025, and the like), and a sulfosuccinic acid diester-based surfactant (manufactured by Kao Corporation; product name: LATEMUL S-120A, S-180A, and the like) having a polymerizable double bond in the molecule.

In the (meth)acrylic pressure-sensitive adhesive resin (b) according to the present embodiment, a content of the polymerizable surfactant is preferably 0.1% by mass or more and 30% by mass or less, more preferably 0.1% by mass or more and 20% by mass or less, still more preferably 0.1% by mass or more and 15% by mass or less, and even more preferably 0.1% by mass or more and 5% by mass or less, in a case where the total of all the monomer units in the (meth)acrylic pressure-sensitive adhesive resin (b) is set to 100% by mass.

[0057]

The (meth)acrylic pressure-sensitive adhesive resin (b) according to the present embodiment may further include a monomer unit formed of a monomer having a polymerizable double bond such as vinyl acetate, acrylonitrile, or styrene, as necessary.

[0058]

Examples of the polymerization reaction mechanism of the (meth)acrylic pressure-sensitive adhesive resin (b) according to the present embodiment include radical polymerization, anionic polymerization, cationic polymerization, and the like. In consideration of the manufacturing cost of the (meth)acrylic pressure-sensitive adhesive resin (b), the influence of functional groups of the monomer, the influence of ions on the surface of the electronic component, and the like, polymerization by radical polymerization is preferable.

In a case of performing polymerization by a radical polymerization reaction, the (meth)acrylic pressure-sensitive adhesive resin (b) of the present embodiment preferably includes a radical polymerization initiator. The radical polymerization initiator of the present embodiment preferably includes one or two or more selected from the group consisting of organic peroxides such as benzoyl peroxide, di-t-butyl peroxide, dicumyl peroxide, 3,3,5-trimethylhexanoyl peroxide, di-2-ethylhexyl peroxydicarbonate, methyl ethyl ketone peroxide, t-butyl peroxyphthalate, t-butyl peroxybenzoate, di-t-butyl peroxyacetate, t-butyl peroxyisobutyrate, t-butyl peroxy-2-hexanoate, t-butyl peroxy-2-ethylhexanoate, t-butyl peroxy-3,5,5-trimethylhexanoate, acetyl peroxide, isobutyryl peroxide, octanoyl peroxide, t-butyl peroxide, and di-t-amyl peroxide; inorganic peroxides such as ammonium persulfate, potassium persulfate, and sodium persulfate; and azo compounds such as 2,2′-azobisisobutyronitrile, 2,2′-azobis-2-methylbutyronitrile, and 4,4′-azobis-4-cyanovaleric acid.

[0059]

In a case of performing polymerization by an emulsion polymerization method, the (meth)acrylic pressure-sensitive adhesive resin (b) of the present embodiment preferably includes one or two or more selected from the group consisting of water-soluble inorganic peroxides such as ammonium persulfate, potassium persulfate, and sodium persulfate; and azo compounds having a carboxyl group in the molecule, such as 4,4’-azobis-4-cyanovaleric acid, which are also water-soluble. In addition, in consideration of the influence of ions on the surface of the electronic component, the (meth)acrylic pressure-sensitive adhesive resin (b) of the present embodiment more preferably includes ammonium persulfate and/or an azo compound having a carboxyl group in the molecule, such as 4,4’-azobis-4-cyanovaleric acid, and still more preferably includes an azo compound having a carboxyl group in the molecule, such as 4,4’-azobis-4-cyanovaleric acid.

[0060]

From the viewpoint of improving the performance balance between the bump absorbency and the adhesive force, the pressure-sensitive adhesive resin layer (B) of the present embodiment preferably further includes a crosslinking agent (Bb) having two or more crosslinkable functional groups in one molecule, in addition to the pressure-sensitive adhesive resin (Ba).

The crosslinking agent (Bb) having two or more crosslinkable functional groups in one molecule can be used to

adjust the adhesive force and the cohesive force by reacting with the functional groups of the pressure-sensitive adhesive resin (Ba).

The crosslinking agent (Bb) of the present embodiment preferably includes one or two or more selected from the group consisting of epoxy crosslinking agents such as sorbitol polyglycidyl ether, polyglycerol polyglycidyl ether, pentaerythritol polyglycidyl ether, diglycerol polyglycidyl ether, glycerol polyglycidyl ether, neopentyl glycol diglycidyl ether, and resorcinol diglycidyl ether; isocyanate crosslinking agents such as tetramethylene diisocyanate, hexamethylene diisocyanate, a toluene diisocyanate 3-adduct of trimethylolpropane, polyisocyanate, diphenylmethane diisocyanate, and tolylene diisocyanate; aziridine crosslinking agents such as trimethylolpropane-tri-β-aziridinylpropionate, tetramethylolmethane-tri-β-aziridinylpropionate, N,N'-diphenylmethane-4,4'-bis(1-aziridinecarboxyamide), N,N'-hexamethylene-1,6-bis(1-aziridinecarboxyamide), N,N'-toluene-2,4-bis(1-aziridinecarboxyamide), and trimethylolpropane-tri-β-(2-methylaziridine)propionate; tetrafunctional epoxy crosslinking agents such as N,N,N',N'-tetraglycidyl-m-xylenediamine and 1,3-bis(N,N'-diglycidylaminomethyl)cyclohexane; and melamine crosslinking agents such as hexamethoxymethylmelamine.

Among these, from the viewpoint of improving the performance balance between the bump absorbency and the adhesive force, the crosslinking agent (Bb) of the present embodiment

preferably includes one or two or more selected from the group consisting of an epoxy crosslinking agent, an isocyanate crosslinking agent, and an aziridine crosslinking agent.

[0061]

The content of the crosslinking agent (Bb) is usually preferably in a range in which the number of functional groups in the crosslinking agent (Bb) does not exceed the number of functional groups in the pressure-sensitive adhesive resin (Ba). However, in a case where a functional group is newly generated in the crosslinking reaction, in a case where the crosslinking reaction is slow, or the like, the crosslinking agent (Bb) may be contained in excess as necessary.

From the viewpoint of improving the performance balance between the bump absorbency, the heat resistance, and the adhesive force of the pressure-sensitive adhesive resin layer (B), the content of the crosslinking agent (Bb) in the pressure-sensitive adhesive resin layer (B) is preferably 0.1 parts by mass or more and 15 parts by mass or less with respect to 100 parts by mass of the pressure-sensitive adhesive resin (Ba).

[0062]

The pressure-sensitive adhesive resin layer (B) may include additives such as plasticizers and tackifier resins as other components. In a case where the pressure-sensitive adhesive resin layer (B) is a radiation-crosslinkable pressure-sensitive adhesive resin layer, various additives for radiation crosslinking may be contained. From the viewpoint of further suppressing the occurrence of wrinkles during heating while

improving the bump absorbency, the total content of the pressure-sensitive adhesive resin (Ba) and the crosslinking agent (Bb) in the pressure-sensitive adhesive resin layer (B) is preferably 50% by mass or more, more preferably 70% by mass or more, still more preferably 90% by mass or more, and particularly preferably 95% by mass or more in a case where the total amount of the pressure-sensitive adhesive resin layer (B) is set to 100% by mass.

In addition, the upper limit value of the total content of the pressure-sensitive adhesive resin (Ba) and the crosslinking agent (Bb) in the pressure-sensitive adhesive resin layer (B) is not particularly limited, but is, for example, 100% by mass or less.

[0063]

In addition, in the pressure-sensitive adhesive film 50 according to the present embodiment, from the viewpoint of stably holding the electronic component 70 on the pressure-sensitive adhesive resin layer (B) during peeling of the support substrate from the pressure-sensitive adhesive film 50, the total content of the gas-generating component and the thermally expandable microspheres in the pressure-sensitive adhesive resin layer (B) is preferably 0.1% by mass or less, more preferably 0.05% by mass or less, and still more preferably 0.01% by mass or less in a case where the total amount of the pressure-sensitive adhesive resin layer (B) is set to 100% by mass, and it is still more preferable that the pressure-sensitive adhesive resin layer (B) does not contain the gas-generating component

and the thermally expandable microspheres.

[0064]

The pressure-sensitive adhesive resin layer (B) may be a single layer or a multilayer.

The thickness of the pressure-sensitive adhesive resin layer (B) is preferably 1 μm or more and 40 μm or less, more preferably 3 μm or more and 35 μm or less, and still more preferably 5 μm or more and 30 μm or less.

[0065]

The pressure-sensitive adhesive resin layer (B) can be formed, for example, by applying a pressure-sensitive adhesive onto the intermediate layer (A) laminated on the base material layer 10. The pressure-sensitive adhesive may be dissolved in a solvent and coated as a coating solution, coated as an aqueous emulsion, or directly coated as a liquid-like pressure-sensitive adhesive.

Among the above, an aqueous emulsion coating solution is preferable. Examples of aqueous emulsion coating solutions include a coating solution in which the (meth)acrylic pressure-sensitive adhesive resin (b), a silicone-based pressure-sensitive adhesive resin, a urethane-based pressure-sensitive adhesive resin, an olefin-based pressure-sensitive adhesive resin, a styrene-based pressure-sensitive adhesive resin, or the like is dispersed in water.

A pressure-sensitive adhesive coating solution dissolved in an organic solvent may be used. The organic solvent is not particularly limited and may be appropriately selected from

known organic solvents in consideration of solubility and drying time. The organic solvent of the present embodiment preferably includes one or two or more selected from the group consisting of ester-based solvents such as ethyl acetate and methyl acetate; ketone-based solvents such as acetone and MEK; aromatic-based solvents such as benzene, toluene, and ethylbenzene; linear or cyclic aliphatic solvents such as heptane, hexane, and cyclohexane; and alcohol-based solvents such as isopropanol and butanol, and more preferably includes one or two selected from the group consisting of ethyl acetate and toluene.

[0066]

As a method for coating the pressure-sensitive adhesive coating solution, it is possible to adopt a coating method known in the related art, for example, a roll coater method, a reverse roll coater method, a gravure roll method, a bar coating method, a comma coater method, a die coater method, or the like. The drying conditions of the coated pressure-sensitive adhesive are not particularly limited, but in general, it is preferable to perform the drying in a temperature range of equal to or more than 80°C and equal to or less than 200°C for 10 seconds to 10 minutes. More preferably, the drying is performed at 80°C to 170°C for 15 seconds to 5 minutes. In order to sufficiently promote the crosslinking reaction between the crosslinking agent and the pressure-sensitive adhesive, after the drying of the pressure-sensitive adhesive coating solution is completed, heating may be carried out at a temperature of 40°C to 80°C for

approximately 5 to 300 hours.

[0067]

In addition, the pressure-sensitive adhesive resin layer (B) of the present embodiment may be formed by co-extrusion molding in combination with the base material layer 10 and the intermediate layer (A), or may be formed by further laminating a film-like pressure-sensitive adhesive resin layer (B) on a film-like intermediate layer (A) laminated on the film-like base material layer 10. In Examples described later, first, the pressure-sensitive adhesive resin layer (B) is formed on the surface of a separator (release film), and then the pressure-sensitive adhesive resin layer (B) is bonded to another layer to produce a pressure-sensitive adhesive film.

[0068]

[Pressure-sensitive adhesive resin layer (C)]

From the viewpoint that the pressure-sensitive adhesive film 50 can be fixed to the support substrate in a case of sealing the electronic component 70 fixed to the pressure-sensitive adhesive film 50, the pressure-sensitive adhesive film 50 of the present embodiment preferably further includes a pressure-sensitive adhesive resin layer (C) on a side of the base material layer 10 opposite to the intermediate layer (A), as shown in FIG. 2.

[0069]

The pressure-sensitive adhesive resin layer (C) is preferably a layer in which the adhesive force is reduced by an external stimulus. As a result, the pressure-sensitive adhesive

film 50 can be peeled from the support substrate by an external stimulus.

Here, the external stimulus preferably includes one or two or more selected from the group consisting of light irradiation and a heat treatment, and more preferably includes a heat treatment.

[0070]

From the viewpoint of further improving the peelability, the pressure-sensitive adhesive resin layer (C) of the present embodiment preferably contains a heat-expandable pressure-sensitive adhesive.

The heat-expandable pressure-sensitive adhesive of the present embodiment preferably contains a pressure-sensitive adhesive resin (C1) and one or two or more selected from the group consisting of a gas-generating component and thermally expandable microspheres, and more preferably contains a pressure-sensitive adhesive resin (C1) and thermally expandable microspheres.

[0071]

The heat-expandable pressure-sensitive adhesive in the pressure-sensitive adhesive resin layer (C) of the present embodiment is preferably a pressure-sensitive adhesive whose adhesive force is reduced or lost by heating at a temperature exceeding 150°C, more preferably at a temperature of 160°C or higher, still more preferably at a temperature of 170°C or higher, even more preferably at a temperature of 180°C or higher, even still more preferably at a temperature of 190°C or

higher, even further still more preferably at a temperature of 200°C or higher, and even further still more preferably at a temperature of 210°C or higher. That is, the pressure-sensitive adhesive resin layer (C) of the present embodiment is preferably a layer whose adhesive force is reduced or lost by heating at a temperature exceeding 150°C, more preferably at a temperature of 160°C or higher, still more preferably at a temperature of 170°C or higher, even more preferably at a temperature of 180°C or higher, even still more preferably at a temperature of 190°C or higher, even further still more preferably at a temperature of 200°C or higher, and even further still more preferably at a temperature of 210°C or higher.

Such a pressure-sensitive adhesive resin layer (C) can be obtained by selecting the type of the gas-generating component or the thermally expandable microspheres in the pressure-sensitive adhesive resin layer (C).

Here, it is possible to evaluate the reduction or loss of the adhesive force by heating at a temperature exceeding 150°C, for example, based on the peel strength from a stainless steel plate, measured after attaching the pressure-sensitive adhesive resin layer (C) side to the stainless steel plate, performing a heat treatment at 120°C for one hour, and then heating at a temperature exceeding 150°C for two minutes. The specific heating temperature when heating at a temperature exceeding 150°C is set to a temperature higher than the temperature at which gas is generated or the temperature at which thermally expandable microspheres thermally expand and is set as

appropriate depending on the type of gas generated or the type of the thermally expandable microspheres. In the present embodiment, loss of adhesive force means, for example, a case where the 180° peel strength measured under conditions of 23°C and a tensile speed of 300 mm/min is less than 0.5 N/25 mm.

[0072]

As the gas-generating component, for example, it is possible to use an azo compound, an azide compound, a Meldrum's acid derivative, or the like. In addition, as the gas-generating component, for example, it is also possible to use inorganic foaming agents such as ammonium carbonate, ammonium hydrogen carbonate, sodium hydrogen carbonate, ammonium nitrite, sodium borohydride, and various azides, and water; chlorofluoroalkane-based compounds such as trichloromonofluoromethane and dichloromonofluoromethane; azo-based compounds such as azobisisobutyronitrile, azodicarbonamide, and barium azodicarboxylate; hydrazine-based compounds such as paratoluenesulfonyl hydrazide, diphenylsulfone-3,3'-disulfonylhydrazide, 4,4'-oxybis(benzenesulfonyl hydrazide) and allylbis(sulfonylhydrazide); semicarbazide-based compounds such as p-toluylenesulfonyl semicarbazide, and 4,4'-oxybis(benzenesulfonyl semicarbazide); triazole-based compounds such as 5-morpholyl-1,2,3,4-thiatriazole; organic foaming agents such as N-nitroso compounds such as N,N'-dinitrosopentamethylenetetramine, and N,N'-dimethyl-N,N'-dinitrosoterephthalamide, and the like. The gas-generating

component may be mixed with the pressure-sensitive adhesive resin (C1) or may be directly bonded to the pressure-sensitive adhesive resin (C1).

[0073]

As the thermally expandable microspheres, for example, a foaming agent that is microencapsulated can be used. Examples of such thermally expandable microspheres include microspheres in which a substance that is easily gasified and expanded by heating such as isobutane, propane, and pentane is sealed in a shell having elasticity, or the like. Examples of the material forming the shell include vinylidene chloride-acrylonitrile copolymer, polyvinyl alcohol, polyvinyl butyral, polymethyl methacrylate, polyacrylonitrile, polyvinylidene chloride, polysulfone, and the like. It is possible to manufacture thermally expandable microspheres by, for example, a coacervation method, an interfacial polymerization method, or the like.

[0074]

From the viewpoint of further improving the heat peelability, a total content of the gas-generating component and the thermally expandable microspheres in the pressure-sensitive adhesive resin layer (C) is preferably 1 part by mass or more, more preferably 3 parts by mass or more, still more preferably 5 parts by mass or more, even more preferably 7 parts by mass or more, even still more preferably 11 parts by mass or more, even further preferably 12 parts by mass or more, and even further preferably 14 parts by mass or more, and is preferably 150 parts

by mass or less, more preferably 100 parts by mass or less, still more preferably 50 parts by mass or less, even more preferably 25 parts by mass or less, even still more preferably 20 parts by mass or less, and even further preferably 18 parts by mass or less, with respect to 100 parts by mass of the pressure-sensitive adhesive resin (C1) in the pressure-sensitive adhesive resin layer (C).

In addition, from the viewpoint of further improving the heat peelability, a total content of the gas-generating component and the thermally expandable microspheres in the pressure-sensitive adhesive resin layer (C) is preferably 1 part by mass or more and 150 parts by mass or less, more preferably 3 parts by mass or more and 150 parts by mass or less, still more preferably 5 parts by mass or more and 100 parts by mass or less, even more preferably 7 parts by mass or more and 50 parts by mass or less, even still more preferably 11 parts by mass or more and 25 parts by mass or less, even further preferably 12 parts by mass or more and 20 parts by mass or less, and even further preferably 14 parts by mass or more and 18 parts by mass or less, with respect to 100 parts by mass of the pressure-sensitive adhesive resin (C1) in the pressure-sensitive adhesive resin layer (C).

It is preferable that the temperature at which gas is generated or the temperature at which the thermally expandable microspheres thermally expand be designed to exceed 150°C.

[0075]

The pressure-sensitive adhesive resin (C1) of the present

embodiment preferably includes one or two or more selected from the group consisting of a (meth)acrylic pressure-sensitive adhesive resin, a silicone-based pressure-sensitive adhesive resin, a urethane-based pressure-sensitive adhesive resin, an olefin-based pressure-sensitive adhesive resin, a polyester-based pressure-sensitive adhesive resin, a polyamide-based pressure-sensitive adhesive resin, a fluorine-based pressure-sensitive adhesive resin, and a styrene-based pressure-sensitive adhesive resin, more preferably includes one or two or more selected from the group consisting of a (meth)acrylic pressure-sensitive adhesive resin, a silicone-based pressure-sensitive adhesive resin, a urethane-based pressure-sensitive adhesive resin, an olefin-based pressure-sensitive adhesive resin, and a styrene-based pressure-sensitive adhesive resin from the viewpoint of further improving the peelability, and still more preferably includes a (meth)acrylic pressure-sensitive adhesive resin from the viewpoint of easily adjusting the adhesive force.

[0076]

The pressure-sensitive adhesive resin layer (C) according to the present embodiment preferably further includes a crosslinking agent (C2) having two or more crosslinkable functional groups in one molecule, in addition to the pressure-sensitive adhesive resin (C1).

The crosslinking agent (C2) having two or more crosslinkable functional groups in one molecule is used to react with the functional groups of the pressure-sensitive adhesive resin (C1) and adjust the adhesive force and cohesive force.

The crosslinking agent (C2) of the present embodiment preferably includes one or two or more selected from the group consisting of epoxy crosslinking agents such as sorbitol polyglycidyl ether, polyglycerol polyglycidyl ether, pentaerythritol polyglycidyl ether, diglycerol polyglycidyl ether, glycerol polyglycidyl ether, neopentyl glycol diglycidyl ether, and resorcinol diglycidyl ether; isocyanate crosslinking agents such as tetramethylene diisocyanate, hexamethylene diisocyanate, a toluene diisocyanate 3-adduct of trimethylolpropane, polyisocyanate, diphenylmethane diisocyanate, and tolylene diisocyanate; aziridine crosslinking agents such as trimethylolpropane-tri-β-aziridinylpropionate, tetramethylolmethane-tri-β-aziridinylpropionate, N,N'-diphenylmethane-4,4'-bis(1-aziridinecarboxyamide), N,N'-hexamethylene-1,6-bis(1-aziridinecarboxyamide), N,N'-toluene-2,4-bis(1-aziridinecarboxyamide), and trimethylolpropane-tri-β-(2-methylaziridine)propionate; tetrafunctional epoxy crosslinking agents such as N,N,N',N'-tetraglycidyl-m-xylenediamine and 1,3-bis(N,N'-diglycidylaminomethyl)cyclohexane; and melamine crosslinking agents such as hexamethoxymethylmelamine; and from the viewpoint of further improving the performance balance of the adhesive force and the peelability, more preferably includes one or two or more selected from the group consisting of an epoxy crosslinking agent, an isocyanate crosslinking agent, and an aziridine crosslinking agent.

[0077]

A content of the crosslinking agent (C2) in the pressure-sensitive adhesive resin layer (C) is preferably in a range in which the number of functional groups in the crosslinking agent (C2) does not become larger than the number of functional groups in the pressure-sensitive adhesive resin (C1). However, in a case where a functional group is newly generated in the crosslinking reaction, in a case where the crosslinking reaction is slow, or the like, the crosslinking agent (C2) may be contained in excess as necessary.

From the viewpoint of further improving the performance balance between the adhesive force, the peelability, and the storage stability, the lower limit value of the content of the crosslinking agent (C2) in the pressure-sensitive adhesive resin layer (C) is preferably 0.1 parts by mass or more and 10.0 parts by mass or less, more preferably 0.5 parts by mass or more and 8.0 parts by mass or less, still more preferably 1.0 parts by mass or more and 6.0 parts by mass or less, and even still more preferably 2.0 parts by mass or more and 4.0 parts by mass or less with respect to 100 parts by mass of the pressure-sensitive adhesive resin (C1).

[0078]

From the viewpoint of further improving the adhesive force, the pressure-sensitive adhesive resin layer (C) according to the present embodiment preferably contains a tackifier resin in addition to the pressure-sensitive adhesive resin (C1). By containing the tackifier resin in the pressure-sensitive adhesive resin layer (C), it is easy to adjust the adhesion to

the support substrate at a temperature near room temperature. As the tackifier resin, a tackifier resin having a softening point of 100°C or higher is preferable. Specific examples of tackifier resins include rosin-based resins such as rosin-based derivatives subjected to a treatment such as esterification; terpene-based resins such as α-pinene-based, β-pinene-based, dipentene-based, and terpene phenol-based resins; natural rosin such as gum-based, wood-based, and tall oil-based; petroleum resins obtained by hydrogenating, disproportionating, polymerizing, or maleating the natural rosin; and coumarone-indene resins.

Among these tackifier resins, the pressure-sensitive adhesive resin layer (C) according to the present embodiment preferably contains a tackifier resin having a softening point in a range of 100°C or higher and 160°C or lower, and more preferably contains a tackifier resin having a softening point in a range of 120°C or higher and 150°C or lower.

[0079]

From the viewpoint of further improving the adhesion to the support substrate during work, the content of the tackifier resin in the pressure-sensitive adhesive resin layer (C) is preferably 1 part by mass or more and 100 parts by mass or less, more preferably 2 parts by mass or more and 50 parts by mass or less, still more preferably 3 parts by mass or more and 30 parts by mass or less, and even still more preferably 5 parts by mass or more and 10 parts by mass or less with respect to 100 parts by mass of the pressure-sensitive adhesive resin (C1).

[0080]

The pressure-sensitive adhesive resin layer (C) may include additives such as plasticizers as other components. The lower limit value of the total content of the pressure-sensitive adhesive resin (C1), the crosslinking agent (C2), the tackifier resin, the gas-generating component, and the thermally expandable microspheres in the pressure-sensitive adhesive resin layer (C) is preferably 50% by mass or more, more preferably 70% by mass or more, still more preferably 90% by mass or more, and even still more preferably 95% by mass or more in a case where the total amount of the pressure-sensitive adhesive resin layer (C) is set to 100% by mass.

The upper limit value thereof is not particularly limited, but is, for example, 100% by mass or less.

[0081]

The pressure-sensitive adhesive resin layer (C) may be a single layer or a multilayer.

From the viewpoint of further improving the performance balance between the pressure-sensitive adhesiveness and the peelability, a thickness of the pressure-sensitive adhesive resin layer (C) is preferably 10 μm or more, more preferably 15 μm or more, still more preferably 20 μm or more, and even more preferably 25 μm or more, and from the viewpoint of improving the handleability of the pressure-sensitive adhesive film 50, it is preferably 100 μm or less, more preferably 80 μm or less, and still more preferably 50 μm or less.

In addition, from the viewpoint of further improving the

performance balance between the pressure-sensitive adhesiveness, the peelability, and the handleability of the pressure-sensitive adhesive film 50, a thickness of the pressure-sensitive adhesive resin layer (C) is preferably 10 μm or more and 100 μm or less, more preferably 15 μm or more and 100 μm or less, still more preferably 20 μm or more and 80 μm or less, and even more preferably 25 μm or more and 50 μm or less.

[0082]

[Unevenness-absorbing resin layer (D)]

As shown in FIG. 3, the pressure-sensitive adhesive film 50 of the present embodiment preferably further includes an unevenness-absorbing resin layer (D) between the base material layer 10 and the pressure-sensitive adhesive resin layer (C).

[0083]

The unevenness-absorbing resin layer (D) preferably contains a thermoplastic resin, more preferably contains one or two or more selected from the group consisting of a polyolefin-based resin, a polystyrene-based resin, a (meth)acrylic resin, a urethane resin, a silicone resin, a polyester resin, a polyamide resin, and a fluorine-based resin, and still more preferably contains one or two or more selected from the group consisting of a polyolefin-based resin, a polystyrene-based resin, and a (meth)acrylic resin.

[0084]

From the viewpoint of improving the unevenness-absorbing property of the pressure-sensitive adhesive film 50, a thickness of the unevenness-absorbing resin layer (D) is preferably 10 μm

or more and 1,000 μm or less, more preferably 17 μm or more and 500 μm or less, and still more preferably 15 μm or more and 100 μm or less.

[0085]

[Other layers]

The pressure-sensitive adhesive film 50 according to the present embodiment may further be provided with, for example, an easy-adhesion layer or the like between each layer in a range in which the effects of the present embodiment are not impaired.

[0086]

[Method of manufacturing electronic device]

The method of manufacturing the electronic device according to the present embodiment will be described with reference to the drawings. FIGS. 4 and 5 are cross-sectional views schematically showing a method of manufacturing an electronic device according to the embodiment of the present invention.

The method of manufacturing an electronic device of the present embodiment preferably includes a step (a) of preparing a structure 100 including the pressure-sensitive adhesive film 50 and an electronic component 70 attached to the pressure-sensitive adhesive resin layer (B) of the pressure-sensitive adhesive film 50; a step (b) of performing one or two or more treatments selected from the group consisting of light irradiation and a heat treatment on the structure 100; and a step (c) of sealing the electronic component 70 with a sealing material 60.

[0087]

First, as the step (a), the structure 100 including the pressure-sensitive adhesive film 50 and the electronic component 70 attached to the pressure-sensitive adhesive resin layer (B) of the pressure-sensitive adhesive film 50 is prepared.

[0088]

Such a structure 100 can be obtained by disposing the electronic component 70 on the pressure-sensitive adhesive resin layer (B) of the pressure-sensitive adhesive film 50.

[0089]

The surface of the electronic component 70 has the uneven structure 75, for example, by having electrodes.

In addition, the electrodes are, for example, bonded with respect to the electrodes formed on the mounting surface when the electronic device is mounted on the mounting surface, so as to form an electrical connection between the electronic device and the mounting surface (mounting surface of a printed substrate or the like).

Examples of electrodes include bump electrodes such as ball bumps, printing bumps, stud bumps, plating bumps, pillar bumps, and the like. That is, the electrode is usually a protruding electrode. These bump electrodes may be used alone or in combination of two or more kinds thereof.

In addition, the type of the metal forming the bump electrode is not particularly limited and examples thereof include silver, gold, copper, tin, lead, bismuth, alloys thereof, and the like. These types of metal may be used alone or in combination of two or more kinds thereof.

[0090]

Here, the structure 100 preferably further includes a support substrate attached to the pressure-sensitive adhesive resin layer (C) of the pressure-sensitive adhesive film 50.

[0091]

The structure 100 further including the support substrate can be produced, for example, by the following procedure.

First, the pressure-sensitive adhesive film 50 is attached to the support substrate such that the pressure-sensitive adhesive resin layer (C) is on the support substrate side. A protective film referred to as a separator may be attached to the pressure-sensitive adhesive resin layer (C), and the protective film can be peeled off to attach the exposed surface of the pressure-sensitive adhesive resin layer (C) to the surface of the support substrate.

As the support substrate, for example, it is possible to use a quartz substrate, a glass substrate, a SUS substrate, or the like.

[0092]

Thereafter, the electronic component 70 is disposed on the pressure-sensitive adhesive resin layer (B) of the pressure-sensitive adhesive film 50 by the same procedure as described above, whereby the structure 100 can be obtained.

[0093]

Next, as the step (b), one or two or more treatments selected from the group consisting of light irradiation and a heat treatment are performed on the structure 100. In this

step, the intermediate layer (A) is crosslinked by irradiating the intermediate layer (A) in the structure 100 with light or heating the intermediate layer (A) to impart light energy or thermal energy.

[0094]

In a case where the intermediate layer (A) is crosslinked by irradiation with light in the step (b), the intermediate layer (A) is preferably irradiated with light such as ultraviolet rays. The light source used in this case is not particularly limited, but a light source capable of irradiating ultraviolet rays including a wavelength component capable of exciting a photoinitiator is preferably used, and a light source capable of irradiating ultraviolet rays including a component having a wavelength of less than 300 nm is more preferably used. Examples of such a light source include a high-pressure mercury lamp, a low-pressure mercury lamp, a metal halide lamp, and a super UV lamp. The light emitted by the above-described light source may include a component having a wavelength of 300 nm or more.

In the case of ultraviolet crosslinking, for example, the intermediate layer (A) can be crosslinked by irradiating the intermediate layer (A) with ultraviolet light having a main wavelength of 365 nm at an irradiation intensity of 10 to 350 mW/cm^2 under the condition of an ultraviolet light dose of 100 to 20,000 mJ/cm^2 in an environment of 0°C to 60°C using a high-pressure mercury lamp.

[0095]

In a case where the intermediate layer (A) is crosslinked by heating in the step (b), the crosslinking method by heating the intermediate layer (A) is not limited, and preferred examples thereof include thermal crosslinking by an oven, thermal crosslinking by a hot plate, and thermal crosslinking by infrared irradiation. In a case of thermal crosslinking, the heating temperature is, for example, 100°C to 150°C, and the heat treatment time is, for example, 10 to 180 minutes. The heating temperature is preferably not higher than a temperature at which a gas is generated or a temperature at which thermally expandable microspheres are thermally expanded.

[0096]

Thereafter, the electronic component 70 is sealed with the sealing material 60 in the step (c).

The electronic component 70 is sealed by covering the electronic component 70 with the sealing material 60. Here, in a case where the pressure-sensitive adhesive resin layer (C) of the pressure-sensitive adhesive film 50 contains at least one selected from a gas-generating component and thermally expandable microspheres, the temperature at which the sealing material 60 is sealed is preferably in a range that does not exceed the temperature at which gas is generated or the temperature at which the thermally expandable microspheres thermally expand.

[0097]

In the step (c) of sealing the electronic component 70 with the sealing material 60, a plurality of the electronic

components 70 may be collectively sealed with the sealing material 60, or may be individually sealed.

As a method of individually coating each of the plurality of electronic components 70 with the sealing material 60, it is preferable to use one or two or more methods selected from the group consisting of a 3D printer method, a spray method, a screen printing method, and an ink jet method, and it is more preferable to use the 3D printer method.

[0098]

As the sealing material 60, a known sealing material can be used as long as the sealing material has high insulating properties, but from the viewpoint that the affinity of the sealing material 60 to the pressure-sensitive adhesive film 50 is further improved and the electronic component 70 can be sealed even more uniformly, the sealing material 60 preferably includes an epoxy resin-based sealing material.

As such an epoxy resin-based sealing material, for example, it is possible to use the T693/R4000 series, the T693/R1000 series, the T693/R5000 series, and the like, manufactured by Nagase ChemteX Corporation.

The sealing material 60 may be in a solid state or a liquid state, but from the viewpoint of being able to perform the sealing step at a low temperature and a low pressure and further suppressing the displacement of the electronic component 70 in the sealing step, the sealing material 60 is preferably in a liquid state.

[0099]

In addition, from the viewpoint of further suppressing the displacement of the electronic component 70, a thickness of the sealing material 60 after the coating of the electronic component 70 is preferably 1.0 μm or more and 2000.0 μm or less, more preferably 1.5 μm or more and 2000.0 μm or less, still more preferably 5.0 μm or more and 2000.0 μm or less, even more preferably 10.0 μm or more and 1500.0 μm or less, even still more preferably 30.0 μm or more and 1500.0 μm or less, even further preferably 50.0 μm or more and 1000.0 μm or less, even further preferably 100.0 μm or more and 1000.0 μm or less, even further preferably 200.0 μm or more and 500.0 μm or less, and even further preferably 300.0 μm or more and 500.0 μm or less.

[0100]

From the viewpoint of further improving the work efficiency of the step of sealing the electronic component 70 with the sealing material 60 and further suppressing the displacement of the electronic component 70, a sealing temperature in the step of sealing the electronic component 70 with the sealing material 60 is preferably 10°C or higher and 100°C or lower, more preferably 10°C or higher and 90°C or lower, still more preferably 15°C or higher and 80°C or lower, and even more preferably 20°C or higher and 70°C or lower.

The sealing temperature in the present embodiment refers to a set temperature in a device used for sealing the electronic component 70.

[0101]

In addition, from the viewpoint of improving the

reliability of the electronic device and further suppressing the displacement of the electronic component 70, a sealing pressure in the step of sealing the electronic component 70 with the sealing material 60 is preferably 30 kPa or higher and 150 kPa or lower, more preferably 50 kPa or higher and 150 kPa or lower, still more preferably 70 kPa or higher and 130 kPa or lower, and even more preferably 90 kPa or higher and 110 kPa or lower. In addition, the sealing pressure in the step of sealing the electronic component 70 with the sealing material 60 is still more preferably normal pressure.

The sealing pressure in the present embodiment refers to a set pressure in a device used for sealing the electronic component 70.

[0102]

The method of manufacturing an electronic device according to the present embodiment preferably further includes a step (d) of curing the sealing material 60 by performing one or two or more methods selected from the group consisting of light irradiation and a heat treatment after the step (c). As a result, the electronic component 70 can be fixed, and the displacement of the electronic component 70 can be further suppressed.

[0103]

The method of curing the sealing material 60 by light irradiation is preferably a method of curing the sealing material 60 by crosslinking the sealing material 60 by irradiating the sealing material 60 with light such as

ultraviolet rays. As the light source used in this case, it is preferable to use a light source capable of emitting ultraviolet rays including a wavelength component capable of exciting a photoinitiator, and it is more preferable to use a light source capable of emitting ultraviolet rays including a component having a wavelength of less than 300 nm.

The method of curing the sealing material 60 by the heat treatment is preferably a method of curing the sealing material 60 by thermal crosslinking with an oven, thermal crosslinking with a hot plate, thermal crosslinking with infrared irradiation, or the like. In a case of thermal crosslinking, the heating temperature is, for example, 100°C or higher and 150°C or lower, and the heat treatment time is, for example, 10 to 180 minutes. The heating temperature is preferably a temperature not exceeding a temperature at which the gas is generated in the pressure-sensitive adhesive film 50 or a temperature at which the thermally expandable microspheres are thermally expanded.

[0104]

The method of manufacturing an electronic device according to the present embodiment preferably further includes a step (e) of peeling the pressure-sensitive adhesive film 50 from the electronic component 70 after the step (d). An electronic device 200 is obtained by this step.

Examples of the method for peeling the pressure-sensitive adhesive film 50 from the electronic component 70 include a mechanical peeling method, a method of peeling after reducing

the adhesive force on the surface of the pressure-sensitive adhesive film 50, or the like.

[0105]

(Other steps)

The method of manufacturing an electronic device according to the present embodiment may further include, between the step (c) and the step (d), a step of peeling the support substrate from the structure 100 by reducing the adhesive force of the pressure-sensitive adhesive resin layer (C) by a heat treatment.

After sealing the electronic component 70, for example, it is possible to easily remove the support substrate from the pressure-sensitive adhesive film 50 by heating to a temperature exceeding 180°C to reduce the adhesive force of the pressure-sensitive adhesive resin layer (C).

[0106]

The pressure-sensitive adhesive film 50 according to the present embodiment can be preferably used for manufacturing an electronic device including a fan-out type package. That is, the electronic device obtained by the method of manufacturing the electronic device according to the present embodiment includes a fan-out type package. In the fan-out type package, since the terminals can be spread to the outside of the chip (fan out), the fan-out type package can be adopted even in an application in which the number of terminals is larger than the chip area. In addition, since the package substrate is not required, thinning is also possible.

[0107]

The embodiments according to the present invention have been described above. However, these are examples of the present invention, and various configurations other than the above can also be adopted.

[0108]

In addition, the present invention is not limited to the above-described embodiments, and modifications, improvements, and the like within a range where the object of the present invention can be achieved are included in the present invention.

Examples

[0109]

Hereinafter, the present invention will be specifically described using Examples, but the present invention is not limited thereto.

[0110]

Details of the method of producing the pressure-sensitive adhesive film are as follows.

[0111]

<Raw material component>

(Resin emulsion 1)

As a polymerization initiator, 0.5 parts by mass of ammonium peroxydisulfate was used, and 63 parts by mass of 2-ethylhexyl acrylate, 21 parts by mass of butyl acrylate, 9 parts by mass of methyl methacrylate, 3 parts by mass of 2-hydroxyethyl methacrylate, 2 parts by mass of methacrylic acid, 1 part by mass of acrylamide, 1 part by mass of polytetramethylene glycol diacrylate (manufactured by NOF

Corporation, product name: BLEMMER ADT-250), and 2 parts by mass of an aqueous solution of polyoxyethylene nonylpropenylphenyl ether ammonium sulfate (manufactured by DKS Co., Ltd., product name: Aqualon HS-1025) were emulsified and polymerized in deionized water at 70°C for 8 hours.

After the polymerization was completed, the pH was adjusted to 7 with ammonia water.

As a result, a (meth)acrylic resin emulsion 1 having a solid content concentration of 56.5% was obtained.

[0112]

(Resin emulsion 2)

As a polymerization initiator, 0.5 parts by mass of 4,4’-azobis-4-cyanovaleric acid (manufactured by Otsuka Chemical Co., Ltd., product name: ACVA) was used, and 74 parts by mass of butyl acrylate, 14 parts by mass of methyl methacrylate, 9 parts by mass of 2-hydroxyethyl methacrylate, 2 parts by mass of methacrylic acid, 1 part by mass of acrylamide, and 3 parts by mass of an aqueous solution of polyoxyethylene nonylpropenyl phenyl ether ammonium sulfate (manufactured by DKS Co., Ltd., product name: Aqualon HS-1025) were emulsified and polymerized in deionized water at 70°C for 8 hours.

After the polymerization was completed, the pH was adjusted to 7 with ammonia water.

As a result, a (meth)acrylic resin emulsion 2 having a solid content concentration of 42.5% was obtained.

[0113]

(Resin solution 1)

49 parts by mass of ethyl acrylate, 20 parts by mass of 2-ethylhexyl acrylate, 21 parts by mass of methyl acrylate, 10 parts by mass of glycidyl methacrylate, and 0.5 parts by mass (in terms of solid contents) of a benzoyl peroxide-based polymerization initiator as a polymerization initiator were reacted in 65 parts by mass of toluene and 50 parts by mass of ethyl acetate at 80°C for 10 hours. After the reaction was completed, the obtained solution was cooled, and 25 parts by mass of xylene, 5 parts by mass of acrylic acid, and 0.5 parts by mass of tetradecyl dimethylbenzyl ammonium chloride were added to the cooled solution, and reacted at 85°C for 32 hours while blowing air, thereby obtaining a (meth)acrylic resin solution having a solid content concentration of 45% by mass (resin solution 1).

[0114]

(Main resin)

Main resin 1: ethylene-vinyl acetate copolymer (manufactured by Dow-Mitsui Polychemicals Co., Ltd., product name: EVAFLEX (registered trademark) V523, vinyl acetate content: 20% by mass, density: 960 kg/m^3, melt flow rate (190°C): 15 g/10 min)

Main resin 2: ethylene-vinyl acetate copolymer (manufactured by Dow-Mitsui Polychemicals Co., Ltd., product name: EVAFLEX (registered trademark) EV150, vinyl acetate content: 33% by mass, density: 960 kg/m^3, melt flow rate (190°C): 30 g/10 min)

(Crosslinking agent)

Crosslinking agent 1: cyanurate compound (manufactured by Mitsubishi Chemical Corporation, triallyl isocyanurate, product name: TAIC (trademark))

(Photoinitiator)

Photoinitiator 1: benzophenone derivative (manufactured by SHUANG-BANG INDUSTRIAL CORPORATION, 4-methylbenzophenone, product name: SB-PI712)

[0115]

(Resin composition A for forming intermediate layer (A))

Each component was mixed using a tumbler mixer at the blending amount (unit: parts by mass) shown in Table 1 to prepare a resin composition A of each of Examples and Comparative Examples.

[0116]

(Pressure-sensitive adhesive coating solution B1 for forming pressure-sensitive adhesive resin layer (B))

100 parts by mass of the resin emulsion 1, 0.4 parts by mass of dimethylethanolamine, 5 parts by mass of an epoxy compound (manufactured by Nagase ChemteX Corporation, product name: EX-1610) as a crosslinking agent, 13 parts by mass of diethylene glycol monobutyl ether, and 20 parts by mass of H_2O were mixed to prepare a pressure-sensitive adhesive coating solution B1.

[0117]

(Pressure-sensitive adhesive coating solution B2 for forming pressure-sensitive adhesive resin layer (B))

100 parts by mass of the resin emulsion 2, 0.4 parts by

mass of dimethylethanolamine, 5 parts by mass of an epoxy compound (manufactured by Nagase ChemteX Corporation, product name: EX-1610) as a crosslinking agent, 13 parts by mass of diethylene glycol monobutyl ether, and 20 parts by mass of H_2O were mixed to prepare a pressure-sensitive adhesive coating solution B2.

[0118]

(Pressure-sensitive adhesive coating solution C for forming pressure-sensitive adhesive resin layer (C))

100 parts by mass of the resin solution 1, 2.4 parts by mass (5.3 parts by mass in terms of solid content with respect to 100 parts by mass of the pressure-sensitive adhesive resin) of a polymerized rosin ester-based tackifier (manufactured by Arakawa Chemical Industries, Ltd., product name: PENSEL D-125), 1.3 parts by mass (2.9 parts by mass in terms of solid content with respect to 100 parts by mass of the pressure-sensitive adhesive resin) of an isocyanate crosslinking agent (manufactured by Mitsui Chemicals, Inc., product name: OLESTER P49-75S), and 7.1 parts by mass (15.8 parts by mass in terms of solid content with respect to 100 parts by mass of the pressure-sensitive adhesive resin) of thermally expandable microspheres (manufactured by Sekisui Chemical Co., Ltd., product name: ADVANCELL EM-503) were mixed, and 37 parts by mass of toluene and 37 parts by mass of ethyl acetate were added thereto to prepare a pressure-sensitive adhesive coating solution C.

[0119]

<Manufacture of pressure-sensitive adhesive film>

First, the resin composition A was molded using a single-screw extruder to obtain a resin film A having a thickness of 350 μm. The resin film A was bonded to a first surface of a polyethylene terephthalate film (manufactured by Toray Industries, Inc., product name: LUMIRROR S10, thickness: 38 μm, double-sided corona-treated product) as a base material layer. As a result, an intermediate layer (A) was obtained.

Thereafter, the pressure-sensitive adhesive coating solution C was applied onto a silicone release-treated separator and dried at 100°C for 3 minutes to obtain a resin film C having a thickness of 27 μm. Then, the resin film C was bonded to a second surface (a surface of the base material layer opposite to the surface on which the intermediate layer (A) was provided) of the base material layer to form a pressure-sensitive adhesive resin layer (C).

Further, similarly, the pressure-sensitive adhesive coating solution B1 or B2 was applied onto a separator and dried at 120°C for 3 minutes to obtain a resin film B having a thickness of 6 μm. The resin film B was laminated on the intermediate layer (A). As a result, a pressure-sensitive adhesive resin layer (B) was obtained. The pressure-sensitive adhesive coating solutions used in each of Examples and Comparative Examples are as shown in Table 1.

As described above, a pressure-sensitive adhesive film including the pressure-sensitive adhesive resin layer (C), the base material layer, the intermediate layer (A), and the pressure-sensitive adhesive resin layer (B) in this order was

obtained.

The obtained pressure-sensitive adhesive film was heated at 60°C for 5 days.

[0120]

<Evaluation>

(1) Storage elastic modulus G’ of intermediate layer after photocuring

The intermediate layer (A) obtained in each of Examples and Comparative Examples was overlapped to have a thickness of 2 mm, and press molding was performed under the following conditions. The obtained press sheet was cut into a circle with a diameter of 25 mm to obtain a test piece.

<Press conditions>

Heating temperature: 100°C, preheating time: 2 minutes

Main pressurization load: 10 MPa, main pressurization time: 2 minutes

Cooling temperature: 20°C, cooling time: 3 minutes

Next, the obtained test piece was irradiated with UV having a wavelength of 300 to 600 nm using a UV irradiator (manufactured by Ushio Inc., product name: UVX-02528S1AJA02) under a condition of 10,800 mJ/cm^2 to perform photocuring.

Thereafter, the photocured test piece was set in a dynamic viscoelasticity measuring apparatus through a parallel-plate attachment having a diameter of 25 mm using the dynamic viscoelasticity measuring apparatus, and a temperature dependence of dynamic viscoelasticity was measured under conditions of a temperature increase rate of 5 °C/min, a

temperature range of 25°C to 120°C, an angular frequency of 6.3 rad/s, and a torsion mode. The storage elastic modulus G' of the intermediate layer (A) at 100°C was obtained from the obtained graph. The results are listed in Table 1.

[0121]

(2) Evaluation of mold wrinkle

The pressure-sensitive adhesive resin layer (C) side of the pressure-sensitive adhesive film (10 cm in length × 10 cm in width) obtained in each of Examples and Comparative Examples was adhered to a stainless steel plate.

Next, the pressure-sensitive adhesive film adhered to the stainless steel plate was irradiated with UV having a wavelength of 300 to 600 nm using a UV irradiator (manufactured by Ushio Inc., product name: UVX-02528S1AJA02) under a condition of 10,800 mJ/cm^2. In this case, the UV was emitted from the pressure-sensitive adhesive resin layer (B) side to crosslink (cure) the intermediate layer (A).

[0122]

Next, 20 g of a liquid epoxy resin-based sealing material (manufactured by Nagase ChemteX Corporation, product name: R4212-2C) was placed on a central portion of the pressure-sensitive adhesive resin layer (B), and a mold cut into a circle having a diameter of 8 cm and a thickness of 2 mm was used to cure the liquid epoxy resin-based sealing material using a small press machine under conditions of a curing pressure of 10 MPa and a curing temperature of 120°C, thereby performing mold molding.

After the molding, the cured product of the epoxy resin-based sealing material was peeled from the pressure-sensitive adhesive film.

For the obtained cured product of the epoxy resin-based sealing material, surface unevenness of a surface in contact with the tape was observed using a 3D laser scanning confocal microscope (manufactured by KEYENCE CORPORATION, product name: VK-X1000), and the mold wrinkle was evaluated according to the following standard. The results are listed in Table 1.

A: unevenness in which a difference in height between the recessed portion and the protruding portion is 0 μm or more and less than 5 μm is repeatedly generated, or unevenness is not generated.

B: unevenness in which a difference in height between the recessed portion and the protruding portion is 5 μm or more is repeatedly generated.

[0123]

(3) Evaluation of chip thickness variation

First, the pressure-sensitive adhesive resin layer (C) side of the pressure-sensitive adhesive film obtained in each of Examples and Comparative Examples was adhered to a slide glass having a length of 76 mm, a width of 26 mm, and a thickness of 1 mm.

Next, a silicon chip having a pattern of 3.5 mm × 3.5 mm was used as the electronic component, and the electronic component and the pressure-sensitive adhesive resin layer (B) of the pressure-sensitive adhesive film were brought into close

contact with each other under conditions of a mounting pressure of 2 N (per chip area), a mounting time of 1 second, and a mounting temperature of 75°C using a pick-up mounter, thereby obtaining a structure.

After the mounting, the periphery of the chip of the obtained structure was observed with an optical microscope (MX61L, manufactured by Olympus Corporation), and the chip thickness variation was evaluated according to the following standard. The results are listed in Table 1.

A: No shadow derived from the thickness variation was observed around the chip.

B: A shadow derived from the thickness variation was observed around the chip.

[0124]

(4) Bump absorbency

The pressure-sensitive adhesive resin layer (B) side of the pressure-sensitive adhesive film obtained in each of Examples and Comparative Examples was attached to an 8-inch bumped wafer (solder bump, bump height: 140 μm, bump diameter: 230 μm, bump pitch: 360 μm) using a protective tape applicator (DR3000II, manufactured by Nitto Seiki Co., Ltd.) (table temperature: 75°C, lamination pressure: 0.4 MPa, lamination speed: 2 mm/s). The obtained pressure-sensitive adhesive film-attached wafer was observed with an optical microscope (MX61L, manufactured by Olympus Corporation), and the bump absorption diameter of the pressure-sensitive adhesive film was measured from a portion where floating was observed by an image measurement mode, and

the bump absorbency was evaluated according to the following standard. The results are listed in Table 1.

A: The bump absorption diameter was less than 300 μm.

B: The bump absorption diameter was 300 μm or more.

[0125]

Table 1

		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comparative Example 1	Comparative Example 2
Composition of intermediate layer (A)	Main resin 1	100	100	100			100	100	100
	Main resin 2				100	100			
	Crosslinking agent 1	1.0	0.8	0.5	1.0	0.5	1.0	0.3	0.0
	Photoinitiator 1	1.0	0.8	0.5	1.0	0.5	1.0	0.3	0.0
Pressure-sensitive adhesive coating solution used for pressure-sensitive adhesive resin layer (B)		B1	B1	B1	B1	B1	B2	B1	B1
Evaluation	Storage elastic modulus G' of intermediate layer after photocuring [kPa]	10.0	7.7	4.9	5.1	4.2	10.0	3.7	2.0
	Mold wrinkle	A	A	A	A	A	A	B	B
	Chip thickness variation	A	A	A	B	B	A	A	A
	Bump absorbency	A	A	A	A	A	B	A	A

[0126]

As in each of Examples, by setting the storage elastic modulus G’ of the intermediate layer in the pressure-sensitive adhesive film after photocuring to be within a specific numerical range, the occurrence of wrinkles during heating could be suppressed.

[0127]

Priority is claimed on Japanese Patent Application No. 2024-043485, filed March 19, 2024, the entire disclosure of which is incorporated herein by reference.

REFERENCE SIGNS LIST

[0128]

A intermediate layer

B pressure-sensitive adhesive resin layer

C pressure-sensitive adhesive resin layer

D unevenness-absorbing resin layer

10 base material layer

50 pressure-sensitive adhesive film

60 sealing material

70 electronic component

75 uneven structure

100 structure

200 electronic device

CLAIMS

1. A pressure-sensitive adhesive film comprising:

a pressure-sensitive adhesive resin layer (B);

an intermediate layer (A); and

a base material layer in this order,

wherein a storage elastic modulus G’ of the intermediate layer (A) according to the following (Method 1) is 4.0 kPa or more and 50.0 kPa or less,

(Method 1)

the intermediate layer (A) is overlapped to have a thickness of 2 mm, and press molding is performed under the following conditions, the obtained press sheet is cut into a circle having a diameter of φ25 mm to obtain a test piece,

<Press conditions>

heating temperature: 100°C, preheating time: 2 minutes,

main pressurization load: 10 MPa, main pressurization time: 2 minutes,

cooling temperature: 20°C, and cooling time: 3 minutes,

next, the obtained test piece is irradiated with UV having a wavelength of 300 to 600 nm using a UV irradiator under a condition of 10,800 mJ/cm^2 to perform photocuring,

thereafter, using a dynamic viscoelasticity measuring apparatus, a photocured test piece is set in the dynamic viscoelasticity measuring apparatus through a parallel-plate attachment having a diameter of 25 mm, a temperature dependence of dynamic viscoelasticity is measured under conditions of a

temperature increase rate of 5 °C/min, a temperature range of 25°C to 120°C, an angular frequency of 6.3 rad/s, and a torsion mode, and the storage elastic modulus G’ of the intermediate layer (A) at 100°C is obtained from the obtained graph.

2. The pressure-sensitive adhesive film according to Claim 1,

wherein the intermediate layer (A) contains one or two or more resins selected from the group consisting of a polyolefin-based resin, an ethylene-carboxylic acid anhydride-based copolymer, an ethylene-epoxy copolymer, an ethylene-(meth)acrylic acid ester copolymer, an ethylene-ethylenically unsaturated acid copolymer, an ethylene-vinyl ester copolymer, a polystyrene-based resin, and a (meth)acrylic resin.

3. The pressure-sensitive adhesive film according to Claim 2,

wherein a melt flow rate (MFR) of the resin in the intermediate layer (A), which is measured under conditions of 190°C and a load of 2,160 g in accordance with JIS K7210:1999, is 0.1 g/10 min or more and 20 g/10 min or less.

4. The pressure-sensitive adhesive film according to any one of Claims 1 to 3,

wherein the intermediate layer (A) contains a photoinitiator.

5. The pressure-sensitive adhesive film according to Claim 4,

wherein the photoinitiator includes one or two or more

selected from the group consisting of benzophenone, a benzophenone derivative, thioxanthone, a thioxanthone derivative, benzoin, a benzoin derivative, α-hydroxyalkylphenones, α-aminoalkylphenols, acylphosphine oxides, alkylphenylglyoxylates, diethoxyacetophenone, oxime esters, a titanocene compound, and an anthraquinone derivative.

6. The pressure-sensitive adhesive film according to Claim 5, wherein the photoinitiator includes 4-methylbenzophenone.

7. The pressure-sensitive adhesive film according to any one of Claims 4 to 6,

wherein a content of the photoinitiator in the intermediate layer (A) is 0.01 parts by mass or more and 5.0 parts by mass or less in a case where a total amount of resins contained in the intermediate layer (A) is set to 100 parts by mass.

8. The pressure-sensitive adhesive film according to any one of Claims 1 to 7,

wherein the intermediate layer (A) contains a crosslinking agent.

9. The pressure-sensitive adhesive film according to Claim 8,

wherein the crosslinking agent includes one or two or more selected from the group consisting of a divinyl aromatic compound, a cyanurate compound, a diallyl compound, an acrylate compound, a triallyl compound, an oxime compound, and a

maleimide compound.

10. The pressure-sensitive adhesive film according to Claim 9, wherein the crosslinking agent includes triallyl isocyanurate.

11. The pressure-sensitive adhesive film according to any one of Claims 8 to 10,

wherein a content of the crosslinking agent in the intermediate layer (A) is 0.01 parts by mass or more and 5.0 parts by mass or less in a case where a total amount of resins contained in the intermediate layer (A) is set to 100 parts by mass.

12. The pressure-sensitive adhesive film according to any one of Claims 1 to 11,

wherein a thickness of the intermediate layer (A) is 100 μm or more and 1,000 μm or less.

13. The pressure-sensitive adhesive film according to any one of Claims 1 to 12,

wherein the base material layer contains one or two or more selected from the group consisting of polypropylene, polyethylene terephthalate, polyethylene naphthalate, polyamide, and polyimide.

14. The pressure-sensitive adhesive film according to any one of

Claims 1 to 13,

wherein a thickness of the base material layer is 10 μm or more and 1,000 μm or less.

15. The pressure-sensitive adhesive film according to any one of Claims 1 to 14,

wherein the pressure-sensitive adhesive resin layer (B) contains one or two or more selected from the group consisting of a (meth)acrylic pressure-sensitive adhesive resin, a silicone-based pressure-sensitive adhesive resin, a urethane-based pressure-sensitive adhesive resin, an olefin-based pressure-sensitive adhesive resin, and a styrene-based pressure-sensitive adhesive resin.

16. The pressure-sensitive adhesive film according to any one of Claims 1 to 15,

wherein a total content of a gas-generating component and thermally expandable microspheres in the pressure-sensitive adhesive resin layer (B) is 0.1% by mass or less, in a case where an entirety of the pressure-sensitive adhesive resin layer (B) is set to 100% by mass.

17. The pressure-sensitive adhesive film according to any one of Claims 1 to 16,

wherein a thickness of the pressure-sensitive adhesive resin layer (B) is 1 μm or more and 40 μm or less.

18. The pressure-sensitive adhesive film according to any one of Claims 1 to 17, further comprising:

a pressure-sensitive adhesive resin layer (C) on a side of the base material layer opposite to the intermediate layer (A).

19. The pressure-sensitive adhesive film according to Claim 18,

wherein the pressure-sensitive adhesive resin layer (C) is a layer in which an adhesive force is reduced by an external stimulus.

20. The pressure-sensitive adhesive film according to Claim 19,

wherein the pressure-sensitive adhesive resin layer (C) contains a heat-expandable pressure-sensitive adhesive.

21. The pressure-sensitive adhesive film according to Claim 20,

wherein the heat-expandable pressure-sensitive adhesive is a pressure-sensitive adhesive whose adhesive force is reduced or lost by heating at a temperature exceeding 150°C.

22. The pressure-sensitive adhesive film according to any one of Claims 18 to 21, further comprising:

an unevenness-absorbing resin layer (D) between the base material layer and the pressure-sensitive adhesive resin layer (C).

23. The pressure-sensitive adhesive film according to Claim 22,

wherein a thickness of the unevenness-absorbing resin layer

(D) is 10 μm or more and 1,000 μm or less.

24. The pressure-sensitive adhesive film according to any one of Claims 1 to 23,

wherein the pressure-sensitive adhesive film is capable of temporarily fixing an electronic component in a case of sealing the electronic component with a sealing material.

25. The pressure-sensitive adhesive film according to Claim 24,

wherein the electronic component has an uneven structure.

26. The pressure-sensitive adhesive film according to Claim 25,

wherein the uneven structure of the electronic component includes a bump electrode.

27. The pressure-sensitive adhesive film according to Claim 26,

wherein a height of the bump electrode is 50 μm or more and 500 μm or less.

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

a step (a) of preparing a structure including the pressure-sensitive adhesive film according to any one of Claims 1 to 27 and an electronic component attached to the pressure-sensitive adhesive resin layer (B) of the pressure-sensitive adhesive film;

a step (b) of performing one or two or more treatments

selected from the group consisting of light irradiation and a heat treatment on the structure; and

a step (c) of sealing the electronic component with a sealing material.

29. The method of manufacturing an electronic device according to Claim 28,

wherein the sealing material includes an epoxy resin-based sealing material.

30. The method of manufacturing an electronic device according to Claim 28 or 29, further comprising:

a step (d) of curing the sealing material by performing one or two or more methods selected from the group consisting of light irradiation and a heat treatment after the step (c).

31. The method of manufacturing an electronic device according to Claim 30, further comprising:

a step (e) of peeling the pressure-sensitive adhesive film from the electronic component after the step (d).

32. The method of manufacturing an electronic device according to any one of Claims 28 to 31,

wherein the electronic device includes a fan-out type package.