SPECIFICATION

TITLE OF INVENTION: METHOD FOR MANUFACTURING ELECTRONIC DEVICE AND METHOD FOR MANUFACTURING STAINLESS STEEL SUBSTRATE

TECHNICAL FIELD

[0001]

The present invention relates to a method for manufacturing an electronic device and a method for manufacturing a stainless steel substrate.

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 package is known.

In embedded wafer level ball grid array (eWLB), which is one of manufacturing methods of the fan-out 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 components and the support substrate in the sealing process or the like and needs to be removed from the sealed electronic components together with the support substrate after sealing.

[0003]

Examples of a technique related to a method for manufacturing such a fan-out 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 strength to SUS304 after lamination of equal to or more than 0.5 N/20 mm, and being cured by a stimulus received until completion of the resin sealing process to have a peeling force from a package of equal to or less than 2.0 N/20 mm.

RELATED DOCUMENT

PATENT DOCUMENT

[0005]

Patent Document 1: Japanese Unexamined Patent Publication No. 2011-134811

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0006]

According to the studies by the present inventors, it has been clarified that, when the pressure-sensitive adhesive film is peeled from the support substrate, a peeling failure between the support substrate and the pressure-sensitive adhesive film may occur.

The present invention has been made in view of the above-described circumstances, and provides a method for manufacturing an electronic device, in which heat peelability between a support substrate and a pressure-sensitive adhesive film is improved.

SOLUTION TO PROBLEM

[0007]

The present inventors conducted a thorough investigation in order to solve the above-described problem. As a result, it has been found that, by including a stainless steel substrate having an oxide film on a surface as the support substrate, the heat peelability between the support substrate and the pressure-sensitive adhesive film can be improved, thereby completing the present invention.

[0008]

According to the present invention, the following method

for manufacturing an electronic device and method for manufacturing a stainless steel substrate are provided.

[0009]

[1]

A method for manufacturing an electronic device, including:

a step of preparing a structure including a pressure-sensitive adhesive film including a pressure-sensitive adhesive resin layer (A), a base material layer, and a pressure-sensitive adhesive resin layer (B) in this order, an electronic component on a pressure-sensitive adhesive resin layer (A) side of the pressure-sensitive adhesive film, and a support substrate on a pressure-sensitive adhesive resin layer (B) side of the pressure-sensitive adhesive film; and

a step of peeling the support substrate from the structure by reducing an adhesive strength of the pressure-sensitive adhesive resin layer (B) by a heating treatment,

in which the support substrate includes a stainless steel substrate having an oxide film on a surface.

[2]

The method for manufacturing an electronic device according to [1], in which an oxygen concentration at a surface of the stainless steel substrate by the following (Method 1) is 45 atomic% or more and 75 atomic% or less:

(Method 1)

with respect to the stainless steel substrate, a detected element is specified by a wide scan with a step width of 1.0 eV, a dwell time of 50 milliseconds, a number of integrations of 2,

and a measurement range of 0 to 1100 eV using a device under the following conditions by X-ray photoelectron spectroscopy (ESCA); thereafter, a spectrum for oxygen is obtained by a narrow scan with a step width of 0.1 eV, a dwell time of 300 milliseconds, a number of integrations of 4, and a measurement range of 523 to 543 eV; from the obtained spectrum, after subtracting a background determined by the Shirley method, a concentration of oxygen is calculated from an obtained peak area using a relative sensitivity factor method and is defined as the oxygen concentration,

conditions of the device are as follows:

X-ray source: Mg-Kα radiation

X-ray source output: 15 kV, 10 mA

analysis area: 300 × 700 μm

a neutralizing electron gun for charge compensation being used during analysis.

[3]

The method for manufacturing an electronic device according to [1] or [2], further including, before the step of preparing the structure, a step of heating a raw material stainless steel sheet to obtain the stainless steel substrate.

[4]

The method for manufacturing an electronic device according to [3], in which a heating time in the step of obtaining the stainless steel substrate is 3.0 hours or more.

[5]

The method for manufacturing an electronic device according

to [3] or [4], in which a heating temperature in the step of obtaining the stainless steel substrate is 120°C or higher.

[6]

The method for manufacturing an electronic device according to any one of [1] to [5], in which the stainless steel substrate includes one or more selected from the group consisting of SUS304 and SUS430.

[7]

The method for manufacturing an electronic device according to any one of [1] to [6], in which the pressure-sensitive adhesive resin layer (A) includes one or more selected from the group consisting of (meth)acrylic pressure-sensitive adhesive resins, silicone-based pressure-sensitive adhesive resins, urethane-based pressure-sensitive adhesive resins, olefin-based pressure-sensitive adhesive resins, and styrene-based pressure-sensitive adhesive resins.

[8]

The method for manufacturing an electronic device according to any one of [1] to [7], in which a total content of a gas-generating component and thermally expandable microspheres in the pressure-sensitive adhesive resin layer (A) is 0.1% by mass or less, based on 100% by mass of an entirety of the pressure-sensitive adhesive resin layer (A).

[9]

The method for manufacturing an electronic device according to any one of [1] to [8], in which the pressure-sensitive adhesive resin layer (A) has a thickness of 1 μm or more and 40

μm or less.

[10]

The method for manufacturing an electronic device according to any one of [1] to [9], in which the pressure-sensitive adhesive resin layer (B) includes a layer whose adhesive strength is reduced by heating treatment.

[11]

The method for manufacturing an electronic device according to [10], in which the pressure-sensitive adhesive resin layer (B) includes a thermally expandable pressure-sensitive adhesive.

[12]

The method for manufacturing an electronic device according to [10] or [11], in which the pressure-sensitive adhesive resin layer (B) has an adhesive strength that is reduced by being heated at a temperature higher than 180°C.

[13]

The method for manufacturing an electronic device according to any one of [1] to [12], in which the pressure-sensitive adhesive resin layer (B) includes one or more selected from the group consisting of (meth)acrylic pressure-sensitive adhesive resins, silicone-based pressure-sensitive adhesive resins, urethane-based pressure-sensitive adhesive resins, olefin-based pressure-sensitive adhesive resins, and styrene-based pressure-sensitive adhesive resins.

[14]

The method for manufacturing an electronic device according to any one of [1] to [13], in which the pressure-sensitive

adhesive resin layer (B) has a thickness of 10 μm or more and 100 μm or less.

[15]

The method for manufacturing an electronic device according to any one of [1] to [14], in which the base material layer includes one or more selected from the group consisting of polypropylene, polyethylene terephthalate, polyethylene naphthalate, polyamide, and polyimide.

[16]

The method for manufacturing an electronic device according to any one of [1] to [15], in which the pressure-sensitive adhesive film further includes an intermediate layer (C) at least one location selected from the group consisting of a location between the base material layer and the pressure-sensitive adhesive resin layer (A) and a location between the base material layer and the pressure-sensitive adhesive resin layer (B).

[17]

The method for manufacturing an electronic device according to any one of [1] to [16], further including a step of peeling the pressure-sensitive adhesive film from the electronic component.

[18]

The method for manufacturing an electronic device according to any one of [1] to [17], further including, between the step of preparing the structure and the step of peeling the support substrate from the structure, a step of sealing the electronic

component with a sealing material.

[19]

The method for manufacturing an electronic device according to [18], in which the sealing material includes an epoxy resin-based sealing material.

[20]

The method for manufacturing an electronic device according to any one of [1] to [19], in which the electronic device includes a fan-out package.

[21]

A method for manufacturing a stainless steel substrate, which is used in the method for manufacturing an electronic device according to any one of [1] to [20], the method including a step of obtaining the stainless steel substrate by heating a raw material stainless steel sheet.

[22]

The method for manufacturing a stainless steel substrate according to [21], in which an oxygen concentration of a surface of the stainless steel substrate by the following (Method 1) is 45 atomic% or more and 75 atomic% or less:

(Method 1)

with respect to the stainless steel substrate, a detected element is specified by a wide scan with a step width of 1.0 eV, a dwell time of 50 milliseconds, a number of integrations of 2, and a measurement range of 0 to 1100 eV using a device under the following conditions by X-ray photoelectron spectroscopy (ESCA);

thereafter, a spectrum for oxygen is obtained by a narrow scan with a step width of 0.1 eV, a dwell time of 300 milliseconds, a number of integrations of 4, and a measurement range of 523 to 543 eV; from the obtained spectrum, after subtracting a background determined by the Shirley method, a concentration of oxygen is calculated from an obtained peak area using a relative sensitivity factor method and is defined as the oxygen concentration,

conditions of the device are as follows:

X-ray source: Mg-Kα radiation

X-ray source output: 15 kV, 10 mA

analysis area: 300 × 700 μm

a neutralizing electron gun for charge compensation being used during analysis.

[23]

The method for manufacturing a stainless steel substrate according to [21] or [22], in which a heating time in the step of obtaining the stainless steel substrate is 3.0 hours or more.

[24]

The method for manufacturing a stainless steel substrate according to any one of [21] to [23], in which a heating temperature in the step of obtaining the stainless steel substrate is 120°C or higher.

ADVANTAGEOUS EFFECTS OF INVENTION

[0010]

According to the present invention, it is possible to

provide a method for manufacturing an electronic device in which the heat peelability between a support substrate and a pressure-sensitive adhesive film is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

[FIG. 1] A cross-sectional view schematically showing an example of a method for manufacturing an electronic device of an embodiment according to the present invention.

[FIG. 2] A cross-sectional view schematically showing an example of a method for manufacturing an electronic device 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 structure of a pressure-sensitive adhesive film 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]

<Method for Manufacturing Electronic Device>

Hereinafter, the method for manufacturing an electronic device according to the present embodiment will be described.

As shown in FIG. 1, the method for manufacturing an electronic device according to the present embodiment includes a step of preparing a structure 100 including a pressure-sensitive adhesive film 50 including a pressure-sensitive adhesive resin layer (A), a base material layer 10, and a pressure-sensitive adhesive resin layer (B) in this order, an electronic component 70 on a pressure-sensitive adhesive resin layer (A) side of the pressure-sensitive adhesive film 50, and a support substrate 80 on a pressure-sensitive adhesive resin layer (B) side of the pressure-sensitive adhesive film 50; and a step of peeling the support substrate 80 from the structure 100 by reducing an adhesive strength of the pressure-sensitive adhesive resin layer (B) by a heating treatment, in which the support substrate 80 includes a stainless steel substrate having an oxide film on a surface.

[0014]

As described above, it has been found that peeling failure

between the support substrate and the pressure-sensitive adhesive film may occur in a case of peeling the pressure-sensitive adhesive film from the support substrate. In the present invention, by including the stainless steel substrate having an oxide film on the surface as the support substrate, the heat peelability between the support substrate and the pressure-sensitive adhesive film can be improved. The reason for this is not clear, but it is considered that, since the surface of the stainless steel substrate having an oxide film on the surface is in an inert state, the initial adhesive strength with the pressure-sensitive adhesive film and an excessive increase in adhesion due to heating can be suppressed, and as a result, the heat peelability between the support substrate and the pressure-sensitive adhesive film can be improved.

[0015]

Hereinafter, each step of the method for manufacturing an electronic device according to the present embodiment will be described in detail.

[0016]

First, the structure 100 including the pressure-sensitive adhesive film 50 including the pressure-sensitive adhesive resin layer (A), the base material layer 10, and the pressure-sensitive adhesive resin layer (B) in this order, the electronic component 70 on the pressure-sensitive adhesive resin layer (A) side of the pressure-sensitive adhesive film 50, and the support substrate 80 on the pressure-sensitive adhesive resin layer (B) side of the pressure-sensitive adhesive film 50 is prepared.

[0017]

It is possible to manufacture the structure 100, for example, by the following procedure.

First, the pressure-sensitive adhesive film 50 is attached on the support substrate 80 such that the pressure-sensitive adhesive resin layer (B) is on the support substrate 80 side. A protective film called a separator may be attached on the pressure-sensitive adhesive resin layer (B) and it is possible to peel the protective film and attach the exposed surface of the pressure-sensitive adhesive resin layer (B) to the surface of the support substrate 80.

Next, the electronic component 70 is disposed on the pressure-sensitive adhesive resin layer (A) on the other surface of the pressure-sensitive adhesive film 50, which is the surface opposite to the surface to which the support substrate 80 is bonded, whereby the structure 100 can be obtained.

[0018]

The surface of the electronic component 70 may have an uneven structure, for example, by having an electrode.

In addition, the electrodes are, for example, bonded to the electrodes formed on the mounting surface when the electronic device is mounted on the mounting surface, and form an electrical connection between the electronic device and the mounting surface (mounting surface of a printed circuit board 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.

[0019]

The stainless steel substrate of the present embodiment preferably includes one or more selected from the group consisting of an austenitic stainless steel substrate, an austenitic-ferritic stainless steel substrate, a ferritic stainless steel substrate, and a martensitic stainless steel substrate.

The austenitic stainless steel substrate of the present embodiment preferably includes one or more selected from the group consisting of SUS301, SUS301J1, SUS301L, SUS630, SUS631, SUS302, SUSXM15J1, SUS303, SUS303Cu, SUS304, SUS304LN, SUS304N1, SUS304N2, SUS304J1, SUS304J2, SUS305, SUS305J1, SUS309S, SUS310S, SUS312L, SUS836L, SUS890L, SUS315J1, SUS315J2, SUS316, SUS316L, SUS316N, SUS316LN, SUS316J1, SUS316J1L, SUS317, SUS317J1, SUS317L, SUS321, and SUS347.

The austenitic-ferritic stainless steel substrate of the present embodiment preferably includes one or more selected from the group consisting of SUS329J1, SUS329J3L, and SUS329J4L.

The ferritic stainless steel substrate of the present

embodiment preferably includes one or more selected from the group consisting of SUH409, SUH409L, SUS405, SUS410L, SUS429, SUS430, SUS430F, SUS430LX, SUS430J1L, SUS443J1, SUS434, SUS436J1L, SUS436L, SUS444, SUS445J1, SUSXM27, and SUS447J1.

The martensitic stainless steel substrate of the present embodiment preferably includes one or more selected from the group consisting of SUS403, SUS410, SUS410S, SUS410F2, SUS416, SUS420J1, SUS420J2, SUS420F, SUS420F2, SUS440A, SUS440B, SUS440C, SUS440F, and SUS431.

From the viewpoint that the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50 can be further improved, the stainless steel substrate of the present embodiment more preferably includes one or two selected from the group consisting of SUS304 and SUS430.

[0020]

In the method for manufacturing an electronic device of the present embodiment, from the viewpoint that the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50 can be further improved, the oxygen concentration of the surface of the stainless steel substrate by the following (Method 1) is preferably 45 atomic% or more and 75 atomic% or less, more preferably 47 atomic% or more and 70 atomic% or less, still more preferably 49 atomic% or more and 65 atomic% or less, even more preferably 51 atomic% or more and 60 atomic% or less, even still more preferably 52 atomic% or more and 58 atomic% or less, and even further still more preferably 53 atomic% or more and 56 atomic% or less.

[0021]

(Method 1)

With respect to the stainless steel substrate, a detected element is specified by a wide scan with a step width of 1.0 eV, a dwell time of 50 milliseconds, a number of integrations of 2, and a measurement range of 0 to 1100 eV using a device under the following conditions by X-ray photoelectron spectroscopy (ESCA). Thereafter, a spectrum for oxygen is obtained by a narrow scan with a step width of 0.1 eV, a dwell time of 300 milliseconds, a number of integrations of 4, and a measurement range of 523 to 543 eV. From the obtained spectrum, after subtracting a background determined by the Shirley method, a concentration of oxygen is calculated from an obtained peak area using a relative sensitivity factor method and is defined as the oxygen concentration.

Conditions of the device are as follows:

X-ray source: Mg-Kα radiation

X-ray source output: 15 kV, 10 mA

analysis area: 300 × 700 μm

a neutralizing electron gun for charge compensation being used during analysis.

[0022]

The stainless steel substrate that can be used in the method for manufacturing an electronic device according to the present embodiment can be obtained, for example, by the following manufacturing method.

From the viewpoint of further improving the heat

peelability between the support substrate 80 and the pressure-sensitive adhesive film 50, the method for manufacturing a stainless steel substrate according to the present embodiment preferably includes a step of heating a raw material stainless steel sheet to obtain the stainless steel substrate.

A method of heating the raw material stainless steel sheet is not particularly limited, and for example, a generally known heating treatment method such as an oven, a dryer, a heating roll, or a drying furnace can be used.

[0023]

From the viewpoint of further improving the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50, the method for manufacturing a stainless steel substrate according to the present embodiment preferably includes heating the raw stainless steel sheet until the oxygen concentration of the surface of the stainless steel substrate reaches the above-described numerical value.

That is, in the method for manufacturing a stainless steel substrate according to the present embodiment, from the viewpoint that the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50 can be further improved, the oxygen concentration of the surface of the stainless steel substrate by the following (Method 1) is preferably 45 atomic% or more and 75 atomic% or less, more preferably 47 atomic% or more and 70 atomic% or less, still more preferably 49 atomic% or more and 65 atomic% or less, even more preferably 51 atomic% or more and 60 atomic% or less, even still

more preferably 52 atomic% or more and 58 atomic% or less, and even further still more preferably 53 atomic% or more and 56 atomic% or less.

[0024]

(Method 1)

With respect to the stainless steel substrate, a detected element is specified by a wide scan with a step width of 1.0 eV, a dwell time of 50 milliseconds, a number of integrations of 2, and a measurement range of 0 to 1100 eV using a device under the following conditions by X-ray photoelectron spectroscopy (ESCA). Thereafter, a spectrum for oxygen is obtained by a narrow scan with a step width of 0.1 eV, a dwell time of 300 milliseconds, a number of integrations of 4, and a measurement range of 523 to 543 eV. From the obtained spectrum, after subtracting a background determined by the Shirley method, a concentration of oxygen is calculated from an obtained peak area using a relative sensitivity factor method and is defined as the oxygen concentration.

Conditions of the device are as follows:

X-ray source: Mg-Kα radiation

X-ray source output: 15 kV, 10 mA

analysis area: 300 × 700 μm

a neutralizing electron gun for charge compensation being used during analysis.

[0025]

In the method for manufacturing a stainless steel substrate according to the present embodiment, from the viewpoint of

further improving the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50, the heating time in the step of obtaining the stainless steel substrate is preferably 3.0 hours or more, more preferably 3.5 hours or more, still more preferably 4.0 hours or more, and even more preferably 4.5 hours or more.

The upper limit value of the heating time is not particularly limited, and may be, for example, 144 hours or less, 120 hours or less, 96 hours or less, 72 hours or less, 48 hours or less, 24 hours or less, or 12 hours or less.

In addition, in the method for manufacturing a stainless steel substrate according to the present embodiment, from the viewpoint of further improving the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50, the heating time in the step of obtaining the stainless steel substrate is preferably 3.0 hours or more and 144 hours or less, more preferably 3.0 hours or more and 120 hours or less, still more preferably 3.0 hours or more and 96 hours or less, even more preferably 3.0 hours or more and 72 hours or less, even still more preferably 3.5 hours or more and 48 hours or less, even further still more preferably 4.0 hours or more and 24 hours or less, and even further still more preferably 4.5 hours or more and 12 hours or less.

[0026]

In the method for manufacturing a stainless steel substrate according to the present embodiment, from the viewpoint of further improving the heat peelability between the support

substrate 80 and the pressure-sensitive adhesive film 50, the heating temperature in the step of obtaining the stainless steel substrate is preferably 120°C or higher, more preferably 130°C or higher, still more preferably 140°C or higher, and even more preferably 150°C or higher, and from the viewpoint of manufacturing efficiency, the heating temperature is preferably 500°C or lower, more preferably 450°C or lower, still more preferably 400°C or lower, even more preferably 350°C or lower, even still more preferably 300°C or lower, and even further still more preferably 250°C or lower.

That is, in the method for manufacturing a stainless steel substrate according to the present embodiment, from the viewpoint of further improving the performance balance between the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50 and the manufacturing efficiency, the heating temperature in the step of obtaining the stainless steel substrate is preferably 120°C or higher and 500°C or lower, more preferably 120°C or higher and 450°C or lower, still more preferably 130°C or higher and 400°C or lower, even more preferably 130°C or higher and 350°C or lower, even still more preferably 140°C or higher and 300°C or lower, and even further still more preferably 150°C or higher and 250°C or lower.

[0027]

From the viewpoint of further improving the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50, the method for manufacturing a

stainless steel substrate according to the present embodiment is preferably performed immediately before the structure 100 is prepared by the method for manufacturing an electronic device according to the present embodiment.

That is, from the viewpoint of further improving the heat peelability between the support substrate 80 and the pressure-sensitive adhesive film 50, the method for manufacturing an electronic device according to the present embodiment preferably includes a step of heating the raw material stainless steel sheet to obtain the stainless steel substrate before the step of preparing the structure 100.

Each condition of the method for obtaining the stainless steel substrate in the method for manufacturing an electronic device according to the present embodiment is in accordance with each condition described above as the method for manufacturing a stainless steel substrate according to the present embodiment.

[0028]

Next, the adhesive strength of the pressure-sensitive adhesive resin layer (B) is reduced by a heating treatment to peel the support substrate 80 from the structure 100.

The support substrate 80 can be easily removed from the pressure-sensitive adhesive film 50 by, for example, heating the support substrate 80 to a temperature exceeding 150°C or a temperature exceeding 170°C to reduce the adhesive force of the pressure-sensitive adhesive resin layer (B).

[0029]

As shown in FIG. 2, the method for manufacturing an

electronic device according to the present embodiment preferably further includes a step of sealing the electronic component 70 with a sealing material 60 between the step of preparing the structure 100 and the step of peeling the support substrate 80 from the structure 100.

In the step of sealing the electronic component 70 with the sealing material 60, 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 (B) of the pressure-sensitive adhesive film 50 includes at least one selected from gas-generating components and thermally expandable microspheres, the temperature for sealing with the sealing material 60 is preferably within a range not exceeding the temperature at which gas is generated or the temperature at which the thermally expandable microspheres undergo heat expansion.

[0030]

In the step 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 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.

[0031]

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 of further improving the affinity of the sealing material 60 to the pressure-sensitive adhesive film 50 and enabling the electronic component 70 to be sealed 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 process at a low temperature and low pressure and further suppress the positional displacement of the electronic component 70 in the sealing process, the sealing material is preferably in a liquid state.

[0032]

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

further suppressed.

In addition, from the viewpoint that the positional displacement of the electronic component 70 can be further suppressed, the step of curing the sealing material 60 is preferably performed before the step of peeling the support substrate 80 from the structure 100.

[0033]

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 heating 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 heating 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.

[0034]

In the method for manufacturing an electronic device according to the present embodiment, in a case where the pressure-sensitive adhesive film 50 includes an intermediate layer (C) described later, a step of performing one or more treatments selected from the group consisting of light irradiation and a heating treatment on the structure 100 is preferably performed between the step of preparing the structure 100 and the step of sealing the electronic component 70 with the sealing material 60.

In this step, the intermediate layer (C) is crosslinked by irradiating the intermediate layer (C) in the structure 100 with light or heating the intermediate layer (C) to apply light energy or thermal energy.

[0035]

In a case where the intermediate layer (C) is crosslinked by irradiating the structure 100 with light in the step of performing one or more treatments selected from the group consisting of light irradiation and a heating treatment on the structure 100, the intermediate layer (C) 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 from the light source may include a component having a wavelength of 300 nm or more.

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

[0036]

In a case where the intermediate layer (C) is crosslinked by heating in the step of performing one or more treatments selected from the group consisting of light irradiation and a heating treatment on the structure 100, a crosslinking method of the intermediate layer (C) by heating is not limited, but preferred examples thereof include thermal crosslinking with an oven, thermal crosslinking with a hot plate, and thermal crosslinking with infrared irradiation. In a case of thermal crosslinking, the heating temperature is, for example, 100°C to 150°C, and the heating 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.

[0037]

As shown in FIG. 2, the method for manufacturing an electronic device according to the present embodiment preferably further includes a step of peeling the pressure-sensitive adhesive film 50 from the electronic component 70. 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 strength on the surface of the pressure-sensitive adhesive film 50, or the like.

The step of peeling the pressure-sensitive adhesive film 50 from the electronic component 70 is preferably performed after the step of peeling the support substrate 80 from the structure 100.

[0038]

<Pressure-Sensitive Adhesive Film>

Next, each layer constituting the pressure-sensitive adhesive film 50 that can be used in the method for manufacturing an electronic device according to the present embodiment will be described.

As shown in FIG. 3, the pressure-sensitive adhesive film 50 that can be used in the method for manufacturing an electronic device according to the present embodiment is a pressure-sensitive adhesive film 50 including a pressure-sensitive adhesive resin layer (A), a base material layer 10, and a pressure-sensitive adhesive resin layer (B) in this order.

[0039]

(Base Material Layer)

The base material layer 10 is a layer provided for the purpose of making the characteristics such as the handling, 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.

[0040]

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 includes one or more selected from the group consisting of 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 polymetaxylylene 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 includes one or more selected from the group consisting of polypropylene, polyethylene terephthalate, polyethylene naphthalate, polyamide, and

polyimide, and more preferably includes one or more selected from the group consisting of polyethylene terephthalate and polyethylene naphthalate.

[0041]

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.

[0042]

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.

[0043]

[Pressure-Sensitive Adhesive Resin Layer (A)]

From the viewpoint of being able to suppress the positional displacement of the electronic component 70, the pressure-

sensitive adhesive film 50 of the present embodiment includes a pressure-sensitive adhesive resin layer (A) on one surface of the base material layer 10.

The pressure-sensitive adhesive resin layer (A) is, for example, a layer for contacting the surface of the electronic component to temporarily fix the electronic component when the electronic component is sealed with a sealing material in the electronic device manufacturing process.

[0044]

The pressure-sensitive adhesive resin layer (A) preferably includes a pressure-sensitive adhesive resin (Aa).

The pressure-sensitive adhesive resin (Aa) preferably includes one or more selected from a (meth)acrylic pressure-sensitive adhesive resin (a), 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 being able to improve the performance balance of the suppression of the positional displacement of the electronic component 70 and the adhesive strength, the pressure-sensitive adhesive resin (Aa) preferably includes a (meth)acrylic pressure-sensitive adhesive resin (a).

[0045]

The pressure-sensitive adhesive resin layer (A) can also be a radiation-crosslinkable pressure-sensitive adhesive resin layer capable of reducing the adhesive strength by radiation. In a case where the radiation-crosslinkable pressure-sensitive

adhesive resin layer is irradiated with radiation, the adhesive strength 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.

[0046]

The (meth)acrylic pressure-sensitive adhesive resin (a) used in the pressure-sensitive adhesive resin layer (A) of the present embodiment preferably includes a copolymer including an alkyl (meth)acrylate monomer unit (a1) and a monomer unit (a2) 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.

[0047]

The (meth)acrylic pressure-sensitive adhesive resin (a) 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.

[0048]

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 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 (a) of the present embodiment, when the total of all monomer units in the (meth)acrylic pressure-sensitive adhesive resin (a) is set to 100% by mass, the content of the alkyl (meth)acrylate monomer unit (a1) 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.

[0049]

Preferred 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, monoalkyl itaconate, monoalkyl mesaconate, monoalkyl citraconate, monoalkyl fumarate, monoalkyl maleate, 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 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 (a) of the present embodiment, when the total of all monomer units in the (meth)acrylic pressure-sensitive adhesive resin (a) is set to 100% by mass, the content of the monomer unit (a2) having a functional group capable of reacting with a 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.

[0050]

The (meth)acrylic pressure-sensitive adhesive resin (a) of the present embodiment may further include, in addition to the alkyl (meth)acrylate monomer unit (a1) and the monomer unit (a2) having a functional group capable of reacting with a crosslinking agent, one or both of a bifunctional monomer unit (a3) and a unit derived from a specific comonomer having properties as a surfactant (hereinafter referred to as a polymerizable surfactant).

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 has an action as an emulsifier in a case of emulsion polymerization.

[0051]

The bifunctional monomer of the present embodiment preferably includes one 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 in which both terminals are diacrylate or dimethacrylate and the structure of the main chain is selected from the group consisting of a propylene glycol type (for example, manufactured by NOF CORPORATION, product name; PDP-200, PDP-400, ADP-200, and ADP-400), a tetramethylene glycol type (for example, manufactured by NOF CORPORATION, product name; ADT-250 and ADT-850), and a mixed type thereof (for example, manufactured by NOF CORPORATION, product name; ADET-1800 and ADPT-4000).

[0052]

In the (meth)acrylic pressure-sensitive adhesive resin (a) according to the present embodiment, a content of the bifunctional monomer unit (a3) 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 (a) is set to 100% by mass.

[0053]

The polymerizable surfactant of the present embodiment preferably includes one 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 (a) 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 (a) is set to 100% by mass.

[0054]

The (meth)acrylic pressure-sensitive adhesive resin (a) 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.

[0055]

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

In a case of polymerization by a radical polymerization reaction, the (meth)acrylic pressure-sensitive adhesive resin (a) of the present embodiment preferably includes a radical polymerization initiator. The radical polymerization initiator of the present embodiment preferably includes one or more selected from the group consisting of organic peroxides such as benzoyl peroxide, di-tert-butyl peroxide, dicumyl peroxide, 3,3,5-trimethylhexanoyl peroxide, di(2-ethylhexyl) peroxydicarbonate, methyl ethyl ketone peroxide, tert-butyl peroxyphthalate, tert-butyl peroxybenzoate, di-tert-butyl peroxyacetate, tert-butyl peroxyisobutyrate, tert-butyl peroxy-2-hexanoate, tert-butyl peroxy-2-ethylhexanoate, tert-butyl peroxy-3,5,5-trimethylhexanoate, acetyl peroxide, isobutyryl

peroxide, octanoyl peroxide, tert-butyl peroxide, and di-tert-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).

[0056]

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

[0057]

From the viewpoint of improving the performance balance between suppression of positional displacement of the electronic component 70 and adhesive strength, the pressure-sensitive adhesive resin layer (A) of the present embodiment preferably further includes, in addition to the pressure-sensitive adhesive

resin (Aa), a crosslinking agent (Ab) having two or more crosslinkable functional groups in one molecule.

The crosslinking agent (Ab) having two or more crosslinkable functional groups in one molecule can be used to adjust the adhesive strength and the cohesive force by reacting with the functional group of the pressure-sensitive adhesive resin (Aa).

The crosslinking agent (Ab) of the present embodiment preferably includes one 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 trimethylolpropane-toluene diisocyanate triadduct, 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-aziridinecarboxamide), N,N'-hexamethylene-1,6-bis(1-aziridinecarboxamide), N,N'-toluene-2,4-bis(1-aziridinecarboxamide), and trimethylolpropane-tri-β-(2-methylaziridine)propionate; tetrafunctional epoxy crosslinking agents such as N,N,N',N'-tetraglycidyl-m-xylylenediamine 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 of the suppression of the positional displacement of the electronic component 70 and the adhesive strength, the crosslinking agent (Ab) of the present embodiment preferably includes one or more selected from the group consisting of an epoxy crosslinking agent, an isocyanate crosslinking agent, and an aziridine crosslinking agent.

[0058]

The content of the crosslinking agent (Ab) is preferably in a range in which the number of functional groups in the crosslinking agent (Ab) does not become larger than the number of functional groups in the pressure-sensitive adhesive resin (Aa). However, in a case where a functional group is newly generated in the crosslinking reaction, a case where the crosslinking reaction is slow, or the like, the content may be excessive as necessary.

From the viewpoint of improving the performance balance of the suppression of the positional displacement of the electronic component 70, the heat resistance, and the adhesive strength of the pressure-sensitive adhesive resin layer (A), the content of the crosslinking agent (Ab) in the pressure-sensitive adhesive resin layer (A) 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 (Aa).

[0059]

The pressure-sensitive adhesive resin layer (A) may include additives such as plasticizers and tackifying resins as other

components. In a case where the pressure-sensitive adhesive resin layer (A) is a radiation-crosslinkable pressure-sensitive adhesive resin layer, various additives for radiation cross-linking may be included. From the viewpoint of being able to suppress the positional displacement of the electronic component 70, the total content of the pressure-sensitive adhesive resin (Aa) and the crosslinking agent (Ab) in the pressure-sensitive adhesive resin layer (A) is preferably 50% by mass or more, more preferably 60% by mass or more, still more preferably 70% by mass or more, and even still more preferably 80% by mass or more, in a case where the total of the pressure-sensitive adhesive resin layer (A) is set to 100% by mass.

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

[0060]

In addition, in the pressure-sensitive adhesive film 50 of the present embodiment, from the viewpoint of being able to stably hold the electronic component 70 on the pressure-sensitive adhesive resin layer (A) in a case where the support substrate 80 is peeled 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 (A) 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 of the pressure-sensitive adhesive resin layer (A) is set to 100% by mass, and it is still more preferable that the pressure-sensitive adhesive resin layer (A) does not include the gas-generating component and the thermally expandable microspheres.

[0061]

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

The thickness of the pressure-sensitive adhesive resin layer (A) 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.

[0062]

It is possible to form the pressure-sensitive adhesive resin layer (A), for example, by coating a pressure-sensitive adhesive 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 (a), 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 more selected from the group consisting of ester-based solvents such as ethyl acetate and methyl acetate; ketone-based solvents such as acetone and methyl ethyl ketone (MEK); aromatic 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 more selected from the group consisting of ethyl acetate and toluene.

[0063]

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 80°C to 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 40°C to 80°C for approximately 5 to 300 hours.

[0064]

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

[0065]

[Pressure-Sensitive Adhesive Resin Layer (B)]

From the viewpoint of being able to suppress the positional displacement of the electronic component 70, the pressure-sensitive adhesive film 50 of the present embodiment includes a pressure-sensitive adhesive resin layer (B) on the side opposite to the pressure-sensitive adhesive resin layer (A) side of the base material layer 10.

The pressure-sensitive adhesive resin layer (B) is, for example, a layer for fixing the pressure-sensitive adhesive film 50 to the support substrate 80 in a case where the electronic component is sealed with a sealing material in the electronic device manufacturing process.

[0066]

The pressure-sensitive adhesive resin layer (B) preferably includes a layer in which adhesive strength is reduced by an external stimulus. As a result, the pressure-sensitive adhesive film 50 can be peeled off from the support substrate 80 by an external stimulus.

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

[0067]

From the viewpoint of further improving the peelability, the pressure-sensitive adhesive resin layer (B) of the present embodiment preferably includes a thermally expandable pressure-sensitive adhesive.

The thermally expandable pressure-sensitive adhesive of the present embodiment preferably includes a pressure-sensitive adhesive resin (B1) and one or more selected from the group consisting of a gas-generating component and thermally expandable microspheres, and more preferably includes a pressure-sensitive adhesive resin (B1) and thermally expandable microspheres.

[0068]

In the pressure-sensitive adhesive resin layer (B) according to the present embodiment, the adhesive strength is reduced or is lost by heating at a temperature of preferably higher than 180°C, more preferably a temperature of 185°C or

higher, still more preferably a temperature of 190°C or higher, even more preferably a temperature of 195°C or higher, even still more preferably a temperature of 200°C or higher, even further preferably a temperature of 205°C or higher, and even further preferably a temperature of 210°C or higher.

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

Here, it is possible to evaluate the reduction or loss of the adhesive strength by heating at a temperature over 180°C, for example, by the peeling strength from a stainless-steel plate, measured after attaching the pressure-sensitive adhesive resin layer (B) side to the stainless-steel plate, performing a heating treatment at 120°C for one hour, and then heating at a temperature over 180°C for two minutes. The specific heating temperature when heating at a temperature exceeding 180°C is set to a temperature exceeding the temperature at which gas is generated or the temperature at which thermally expandable microspheres undergo heat expansion and is set as appropriate depending on the type of gas to be generated or the type of thermally expandable microspheres. In the present embodiment, loss of adhesive strength means, for example, a case where the 180° peeling strength measured under conditions of 23°C and a tensile speed of 300 mm/min is less than 0.5 N/25 mm.

[0069]

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, examples of the gas-generating component that can be used include inorganic foaming agents such as ammonium carbonate, ammonium hydrogen carbonate, sodium hydrogen carbonate, ammonium nitrite, sodium borohydride, and various azides; and organic foaming agents such as water; chlorofluoroalkane-based compounds such as trichloromonofluoromethane and dichloromonofluoromethane; azo-based compounds such as azobisisobutyronitrile, azodicarbonamide, and barium azodicarboxylate; hydrazine-based compounds such as p-toluenesulfonyl hydrazide, diphenylsulfone-3,3'-disulfonyl hydrazide, 4,4'-oxybis(benzenesulfonyl hydrazide), and allylbis(sulfonyl hydrazide); semicarbazide-based compounds such as p-toluenesulfonyl semicarbazide and 4,4'-oxybis(benzenesulfonyl semicarbazide); triazole-based compounds such as 5-morpholyl-1,2,3,4-thiatriazole; and N-nitroso-based compounds such as N,N'-dinitrosopentamethylenetetramine and N,N'-dimethyl-N,N’-dinitrosoterephthalamide. The gas-generating component may be mixed with the pressure-sensitive adhesive resin (B1) or may be directly bonded to the pressure-sensitive adhesive resin (B1).

[0070]

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.

[0071]

The total content of the gas-generating component and the thermally expandable microspheres in the pressure-sensitive adhesive resin layer (B) 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 (B1) in the pressure-sensitive adhesive resin layer (B), from the viewpoint of further improving the heat peelability.

It is preferable that the temperature at which the gas is generated or the temperature at which the thermally expandable microspheres are thermally expanded is designed to be a temperature higher than 150°C.

[0072]

The pressure-sensitive adhesive resin (B1) of the present embodiment preferably includes one 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 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 peelability; and still more preferably includes a (meth)acrylic pressure-sensitive adhesive resin, from the viewpoint of facilitating adjustment of adhesive strength.

As the (meth)acrylic pressure-sensitive adhesive resin that can be used in the pressure-sensitive adhesive resin (B1) of the present embodiment, for example, the above-described (meth)acrylic pressure-sensitive adhesive resin (a) can be used.

[0073]

The pressure-sensitive adhesive resin layer (B) according to the present embodiment preferably further includes a crosslinking agent (B2) having two or more crosslinkable

functional groups in one molecule, in addition to the pressure-sensitive adhesive resin (B1).

The crosslinking agent (B2) having two or more crosslinkable functional groups in one molecule is used to react with the functional groups of the pressure-sensitive adhesive resin (B1) and adjust the adhesive strength and cohesive force.

The crosslinking agent (B2) of the present embodiment preferably includes one 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 trimethylolpropane-toluene diisocyanate triadduct, 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-aziridinecarboxamide), N,N'-hexamethylene-1,6-bis(1-aziridinecarboxamide), N,N'-toluene-2,4-bis(1-aziridinecarboxamide), and trimethylolpropane-tri-β-(2-methylaziridine)propionate; tetrafunctional epoxy crosslinking agents such as N,N,N',N'-tetraglycidyl-m-xylylenediamine and 1,3-bis(N,N-diglycidylaminomethyl)cyclohexane; and melamine crosslinking agents such as hexamethoxymethylmelamine; and more preferably includes, from the viewpoint of further improving the

performance balance between adhesive strength and peelability, one or more selected from the group consisting of epoxy crosslinking agents, isocyanate crosslinking agents, and aziridine crosslinking agents.

[0074]

The content of the crosslinking agent (B2) in the pressure-sensitive adhesive resin layer (B) is preferably in a range in which the number of functional groups in the crosslinking agent (B2) does not become larger than the number of functional groups in the pressure-sensitive adhesive resin (B1). However, in a case where a functional group is newly generated in the crosslinking reaction, a case where the crosslinking reaction is slow, or the like, the content may be excessive as necessary.

From the viewpoint of further improving the performance balance of the adhesive strength, the peelability, and the storage stability, the content of the crosslinking agent (B2) in the pressure-sensitive adhesive resin layer (B) 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 part 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 (B1).

[0075]

From the viewpoint of further improving the adhesive strength, the pressure-sensitive adhesive resin layer (B) according to the present embodiment preferably contains a

tackifying resin in addition to the pressure-sensitive adhesive resin (B1). In a case where the pressure-sensitive adhesive resin layer (B) contains the tackifying resin, it is easy to adjust the adhesiveness to the support substrate 80 in the vicinity of room temperature. A tackifying resin having a softening point of 100°C or higher is preferable. Specific examples of the tackifying resin include rosin-based resins such as rosin-based derivatives subjected to treatment such as esterification; terpene-based resins such as α-pinene-based resins, β-pinene-based resins, dipentene-based resins, and terpene-phenol-based resins; natural rosins such as gum-based rosin, wood-based rosin, and tall oil-based rosin; petroleum resins obtained by hydrogenating, disproportionating, polymerizing, or maleating these natural rosins; coumarone-indene resins; and the like.

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

[0076]

From the viewpoint of further improving the adhesiveness to the support substrate 80 during work, the content of the tackifying resin in the pressure-sensitive adhesive resin layer (B) 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 (B1).

[0077]

The pressure-sensitive adhesive resin layer (B) may include additives such as plasticizers as other components. The lower limit value of the total content of the pressure-sensitive adhesive resin (B1), the crosslinking agent (B2), the tackifying resin, the gas-generating component, and the thermally expandable microspheres 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 even still more preferably 95% by mass or more, in a case where the total of the pressure-sensitive adhesive resin layer (B) is set to 100% by mass.

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

[0078]

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

From the viewpoint of further improving the performance balance of handleability, adhesiveness, and peelability of the pressure-sensitive adhesive film 50, the thickness of the pressure-sensitive adhesive resin layer (B) is preferably 10 μm or more and 100 μm or less, more preferably 15 μm or more and 90 μm or less, still more preferably 20 μm or more and 80 μm or

less, and even still more preferably 25 μm or more and 70 μm or less.

[0079]

[Intermediate Layer (C)]

From the viewpoint of being able to suppress the positional displacement of the electronic component 70 and being able to improve the performance balance of the followability and the adhesiveness of the pressure-sensitive adhesive film 50 to the electronic component 70 and the support substrate 80, as shown in FIG. 4, the pressure-sensitive adhesive film 50 of the present embodiment preferably further includes an intermediate layer (C) at least one location selected from the group consisting of a location between the base material layer 10 and the pressure-sensitive adhesive resin layer (A) and a location between the base material layer 10 and the pressure-sensitive adhesive resin layer (B), and more preferably further includes an intermediate layer (C) between the base material layer 10 and the pressure-sensitive adhesive resin layer (B).

The intermediate layer (C) of the present embodiment is, for example, a layer for imparting, to the pressure-sensitive adhesive film 50, followability and adhesiveness to the electronic component 70 and the support substrate 80.

[0080]

The intermediate layer (C) of the present embodiment preferably includes a thermoplastic resin (C1). The thermoplastic resin (C1) of the present embodiment preferably includes one or more selected from the group consisting of a

polyolefin-based resin, an ethylene-carboxylic anhydride 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, and more preferably includes a (meth)acrylic resin from the viewpoint of further improving peelability.

As the (meth)acrylic resin that can be used in the thermoplastic resin (C1) of the present embodiment, for example, the above-described (meth)acrylic pressure-sensitive adhesive resin (a) can be used.

[0081]

The intermediate layer (C) of the present embodiment preferably further includes a crosslinking agent (C2) having two or more crosslinkable functional groups in one molecule, in addition to the thermoplastic resin (C1).

The crosslinking agent (C2) having two or more crosslinkable functional groups in one molecule is used to adjust the adhesive strength and the cohesive force by reacting with the functional group of the thermoplastic resin (C1).

The crosslinking agent (C2) of the present embodiment preferably includes one 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 trimethylolpropane-toluene diisocyanate triadduct, 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-aziridinecarboxamide), N,N'-hexamethylene-1,6-bis(1-aziridinecarboxamide), N,N'-toluene-2,4-bis(1-aziridinecarboxamide), and trimethylolpropane-tri-β-(2-methylaziridine)propionate; tetrafunctional epoxy crosslinking agents such as N,N,N',N'-tetraglycidyl-m-xylylenediamine and 1,3-bis(N,N-diglycidylaminomethyl)cyclohexane; and melamine crosslinking agents such as hexamethoxymethylmelamine; and more preferably includes, from the viewpoint of further improving the performance balance between adhesive strength and peelability, one or more selected from the group consisting of epoxy crosslinking agents, isocyanate crosslinking agents, and aziridine crosslinking agents.

[0082]

The content of the crosslinking agent (C2) in the intermediate layer (C) of the present embodiment 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 thermoplastic resin (C1). However, in a case where a functional group is newly generated in the crosslinking reaction, a case where the crosslinking reaction is slow, or the like, the content may be excessive as necessary.

From the viewpoint of further improving the performance balance of the adhesive strength, the peelability, and the storage stability, the content of the crosslinking agent (C2) in the intermediate layer (C) of the present embodiment 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 part 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 thermoplastic resin (C1).

[0083]

From the viewpoint of further improving the adhesive strength, the intermediate layer (C) of the present embodiment preferably includes a tackifying resin in addition to the thermoplastic resin (C1). By containing the tackifying resin in the intermediate layer (C), it is easy to adjust the adhesiveness to the support substrate 80 in the vicinity of room temperature. A tackifying resin having a softening point of 100°C or higher is preferable. Specific examples of the tackifying resin include rosin-based resins such as rosin-based derivatives subjected to treatment such as esterification; terpene-based resins such as α-pinene-based resins, β-pinene-based resins, dipentene-based resins, and terpene-phenol-based resins; natural rosins such as gum-based rosin, wood-based rosin, and tall oil-based rosin; petroleum resins obtained by hydrogenating, disproportionating, polymerizing, or maleating these natural rosins; coumarone-indene resins; and the like.

Among these tackifying resins, the intermediate layer (C) according to the present embodiment preferably contains a tackifying resin having a softening point in a range of 100°C to 160°C, and more preferably contains a tackifying resin having a softening point in a range of 120°C to 150°C.

[0084]

From the viewpoint of further improving the adhesiveness to the support substrate 80 during work, the content of the tackifying resin in the intermediate layer (C) of the present embodiment 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 3 parts by mass or more and 10 parts by mass or less, with respect to 100 parts by mass of the thermoplastic resin (C1).

[0085]

The intermediate layer (C) of the present embodiment may include an additive such as a plasticizer as other components. The total content of the thermoplastic resin (C1), the crosslinking agent (C2), the tackifying resin, the gas-generating component, and the thermally expandable microspheres in the intermediate layer (C) of the present embodiment 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 of the intermediate 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.

[0086]

From the viewpoint of improving the unevenness absorbing property of the pressure-sensitive adhesive film 50, the thickness of the intermediate layer (C) of the present embodiment is preferably 1 μm or more and 500 μm or less, more preferably 5 μm or more and 300 μm or less, and still more preferably 10 μm or more and 100 μm or less.

[0087]

[Other Layers]

The pressure-sensitive adhesive film 50 according to the present embodiment may further include, 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.

[0088]

The method for manufacturing the electronic device according to the present embodiment can be preferably used for manufacturing an electronic device including a fan-out package. That is, the electronic device obtained by the method for manufacturing the electronic device according to the present embodiment includes a fan-out package. In the fan-out package, since the terminals can be spread to the outside of the chip (fan out), the fan-out 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.

[0089]

The embodiments of 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.

[0090]

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

[0091]

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

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

[0092]

<Raw Material Component>

(Resin Emulsion 1)

Using 0.5 parts by mass of ammonium persulfate as a polymerization initiator, 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, trade name: BLEMMER

ADT-250), and 2 parts by mass of an aqueous solution of ammonium polyoxyethylene nonylpropenylphenyl ether sulfate (manufactured by DKS Co. Ltd., trade name: AQUALON HS-1025) were emulsion-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% by mass was obtained.

[0093]

(Resin Emulsion 2)

Using 0.5 parts by mass of 4,4’-azobis(4-cyanovaleric acid) (manufactured by Otsuka Chemical Co., Ltd., product name: ACVA) as a polymerization initiator, 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 ammonium polyoxyethylene nonylpropenylphenyl ether sulfate (manufactured by DKS Co., Ltd., product name: AQUALON HS-1025) were emulsion-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% by mass was obtained.

[0094]

(Resin Solution 1)

0.536 parts by mass of tert-butyl peroxy-2-ethylhexanoate

(manufactured by NOF Corporation, trade name: PERBUTYL O (registered trademark)) as a polymerization initiator, 34.9 parts by weight of 2-ethylhexyl acrylate, 41 parts by mass of n-butyl acrylate, 14.7 parts by mass of ethyl acrylate, and 9.4 parts by mass of 2-hydroxyethyl methacrylate were charged into a mixed solvent containing ethyl acetate and toluene, and solution polymerization was performed at 83°C to 87°C for 11 hours with stirring, thereby obtaining an acrylic resin solution (resin solution 1) having a solid content concentration of 45% by mass.

[0095]

(Pressure-Sensitive Adhesive Coating Solution A for forming pressure-sensitive adhesive resin layer (A))

42.6 parts by mass of resin emulsion 1, 57.4 parts by mass of 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 pressure-sensitive adhesive coating solution A.

[0096]

(Pressure-Sensitive Adhesive Coating Solution B for forming pressure-sensitive adhesive resin layer (B))

100 parts by mass of resin solution 1, 2.25 parts by weight (5 parts by mass 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., trade name: PENSEL D-125), 1.2 parts by mass (2.7 parts by

mass with respect to 100 parts by mass of the pressure-sensitive adhesive resin) of an isocyanate-based crosslinking agent (manufactured by Mitsui Chemicals, Inc., trade name: OLESTER P49-75S), and 6.75 parts by mass (15 parts by mass with respect to 100 parts by mass of the pressure-sensitive adhesive resin) of thermally expandable microspheres (manufactured by Sekisui Chemical Co., Ltd., trade name: ADVANCELL EM-503) were mixed, and the solid content concentration was adjusted to 30% with ethyl acetate to prepare pressure-sensitive adhesive coating solution B.

[0097]

<Manufacture of Pressure-Sensitive Adhesive Film>

First, the pressure-sensitive adhesive coating solution B for forming a pressure-sensitive adhesive resin layer (B) was applied onto a silicone release-treated separator and dried at 120°C for 3 minutes to form a resin film B having a thickness of 47 μm. Then, this resin film B was bonded to the second surface of a polyethylene terephthalate film (manufactured by Toray Industries, Inc., product name: LUMIRROR S10, thickness: 38 μm, double-sided corona-treated product) which was a base material layer, to obtain a pressure-sensitive adhesive resin layer (B).

In addition, the pressure-sensitive adhesive coating solution A for forming a pressure-sensitive adhesive resin layer (A) was applied onto a silicone release-treated separator and dried at 120°C for 3 minutes to form a resin film A having a thickness of 13 μm. This resin film A was bonded to the first surface (surface on the side opposite to the surface on which

the pressure-sensitive adhesive resin layer (B) of the base material layer was provided) of the base material layer. As a result, a pressure-sensitive adhesive resin layer (A) was obtained.

As described above, a pressure-sensitive adhesive film including a pressure-sensitive adhesive resin layer (A), a base material layer, and a 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.

[0098]

<Treatment of Stainless Steel Substrate>

(Example 1)

A SUS430 having a size of 300 cm × 300 cm × thickness of 1.5 mm was fired at 230°C for 8.0 hours to obtain a stainless steel substrate in which a surface was oxidized.

[0099]

(Example 2)

A stainless steel substrate in which a surface was oxidized was obtained in the same manner as in Example 1, except that the firing conditions of Example 1 were changed to 190°C and 5.0 hours.

[0100]

(Example 3)

A stainless steel substrate in which a surface was oxidized was obtained in the same manner as in Example 1, except that the firing conditions of Example 1 were changed to 150°C and 8.0

hours.

[0101]

(Example 4)

A stainless steel substrate in which a surface was oxidized was obtained in the same manner as in Example 1, except that the SUS430 of Example 1 was changed to SUS304.

[0102]

(Comparative Example 1)

The SUS430 used in Example 1 was used as it was without being fired.

[0103]

(Comparative Example 2)

A stainless steel substrate in which a surface was oxidized was obtained in the same manner as in Example 1, except that the firing conditions of Example 1 were changed to 100°C and 16.0 hours.

[0104]

<Evaluation>

[Oxygen concentration (X-ray photoelectron spectroscopy (ESCA))]

A detected element was specified by a wide scan with a step width of 1.0 eV, a dwell time of 50 milliseconds, a number of integrations of 2, and a measurement range of 0 to 1100 eV under the conditions shown in Table 1 using a device under the following conditions by X-ray photoelectron spectroscopy (ESCA) for the stainless steel substrate. Thereafter, a spectrum was acquired by a narrow scan with the conditions shown in Table 1

for the specified oxygen. From the obtained spectrum, after subtracting a background determined by the Shirley method, concentrations of the detected elements were calculated from an obtained peak area using a relative sensitivity factor method and were defined as the oxygen concentration.

Conditions of the device are as follows:

Device: X-ray photoelectron spectroscopy device (ESCA3400, manufactured by Shimadzu Corporation)

X-ray source: Mg-Kα radiation

X-ray source output: 15 kV, 10 mA

analysis area: 300 × 700 μm

a neutralizing electron gun for charge compensation being used during analysis.

[0105]

[Table 1]

Table 1

		Step Width [eV]	Dwell Time [ms]	Number of Integrations [times]	Measurement Range Start [eV]	Measurement Range End [eV]
Wide Scan		1.0	50	2	1100.00	0.00
Narrow Scan	O 1s	0.1	300	4	543.00	526.00

[0106]

[Heat Peelability]

The pressure-sensitive adhesive resin layer (B) side of the pressure-sensitive adhesive film was attached to the stainless steel substrate of each of Examples and Comparative Examples under conditions of a temperature of 25°C, a pressure of 0.5 MPa, and an attachment speed of 10 mm/sec to obtain a structure. Thereafter, the structure was heated under conditions of 150°C

for 1 hour, and then allowed to stand at 25°C for 1 hour.

Next, using a debonder (manufactured by DYNATEC Co., Ltd., DT-SDB2050), the pressure-sensitive adhesive film was peeled from the stainless steel substrate under conditions including a Bottom chuck temperature of 170°C, a Top chuck temperature of 200°C, and a peeling time of 60 seconds. Thereafter, the heat peelability was evaluated according to the following standard. The results are shown in Table 2.

A: The pressure-sensitive adhesive film could be peeled from the stainless steel substrate.

B: A part of the pressure-sensitive adhesive resin layer (B) remained on the stainless steel substrate, or the pressure-sensitive adhesive film could not be peeled from the stainless steel substrate.

[0107]

[Table 2]

Table 2

	Stainless Steel	Firing Conditions		Heat Peelability
		Firing Temperature [°C]	Firing Time [hours]	
Example 1	SUS430	230	8.0	A
Example 2	SUS430	190	5.0	A
Example 3	SUS430	150	8.0	A
Example 4	SUS304	230	8.0	A
Comparative Example 1	SUS430	Not fired	Not fired	B
Comparative Example 2	SUS430	100	16.0	B

[0108]

As in each of the Examples, by including a stainless steel substrate having an oxide film on a surface as the support substrate, the heat peelability between the support substrate

and the pressure-sensitive adhesive film could be improved. On the other hand, as in the Comparative Example, the stainless steel substrate having no oxide film on the surface had poor heat peelability.

It was confirmed that the oxygen concentration of the surface of SUS430 of Example 1 was 54 atomic%, and an oxide film was formed on the surface.

[0109]

Priority is claimed on Japanese Patent Application No. 2024-047205, filed March 22, 2024, the entire disclosure of which is incorporated herein by reference.

REFERENCE SIGNS LIST

[0110]

A pressure-sensitive adhesive resin layer

B pressure-sensitive adhesive resin layer

C intermediate layer

10 base material layer

50 pressure-sensitive adhesive film

60 sealing material

70 electronic component

80 support substrate

100 structure

200 electronic device

CLAIMS

1. A method for manufacturing an electronic device, comprising:

a step of preparing a structure including a pressure-sensitive adhesive film including a pressure-sensitive adhesive resin layer (A), a base material layer, and a pressure-sensitive adhesive resin layer (B) in this order, an electronic component on a pressure-sensitive adhesive resin layer (A) side of the pressure-sensitive adhesive film, and a support substrate on a pressure-sensitive adhesive resin layer (B) side of the pressure-sensitive adhesive film; and

a step of peeling the support substrate from the structure by reducing an adhesive strength of the pressure-sensitive adhesive resin layer (B) by a heating treatment,

wherein the support substrate includes a stainless steel substrate having an oxide film on a surface.

2. The method for manufacturing an electronic device according to Claim 1,

wherein an oxygen concentration at a surface of the stainless steel substrate by the following (Method 1) is 45 atomic% or more and 75 atomic% or less:

(Method 1)

with respect to the stainless steel substrate, a detected element is specified by a wide scan with a step width of 1.0 eV, a dwell time of 50 milliseconds, a number of integrations of 2, and a measurement range of 0 to 1100 eV using a device under the

following conditions by X-ray photoelectron spectroscopy (ESCA); thereafter, a spectrum for oxygen is obtained by a narrow scan with a step width of 0.1 eV, a dwell time of 300 milliseconds, a number of integrations of 4, and a measurement range of 523 to 543 eV; from the obtained spectrum, after subtracting a background determined by the Shirley method, a concentration of oxygen is calculated from an obtained peak area using a relative sensitivity factor method and is defined as the oxygen concentration,

conditions of the device are as follows:

X-ray source: Mg-Kα radiation

X-ray source output: 15 kV, 10 mA

analysis area: 300 × 700 μm

a neutralizing electron gun for charge compensation being used during analysis.

3. The method for manufacturing an electronic device according to Claim 1 or 2, further comprising,

before the step of preparing the structure, a step of heating a raw material stainless steel sheet to obtain the stainless steel substrate.

4. The method for manufacturing an electronic device according to Claim 3,

wherein a heating time in the step of obtaining the stainless steel substrate is 3.0 hours or more.

5. The method for manufacturing an electronic device according to Claim 3 or 4,

wherein a heating temperature in the step of obtaining the stainless steel substrate is 120°C or higher.

6. The method for manufacturing an electronic device according to any one of Claims 1 to 5,

wherein the stainless steel substrate includes one or two selected from the group consisting of SUS304 and SUS430.

7. The method for manufacturing an electronic device according to any one of Claims 1 to 6,

wherein the pressure-sensitive adhesive resin layer (A) includes one or more selected from the group consisting of (meth)acrylic pressure-sensitive adhesive resins, silicone-based pressure-sensitive adhesive resins, urethane-based pressure-sensitive adhesive resins, olefin-based pressure-sensitive adhesive resins, and styrene-based pressure-sensitive adhesive resins.

8. The method for manufacturing an electronic device according to any one of Claims 1 to 7,

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

9. The method for manufacturing an electronic device according to any one of Claims 1 to 8,

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

10. The method for manufacturing an electronic device according to any one of Claims 1 to 9,

wherein the pressure-sensitive adhesive resin layer (B) includes a layer whose adhesive strength is reduced by heating treatment.

11. The method for manufacturing an electronic device according to Claim 10,

wherein the pressure-sensitive adhesive resin layer (B) includes a thermally expandable pressure-sensitive adhesive.

12. The method for manufacturing an electronic device according to Claim 10 or 11,

wherein the pressure-sensitive adhesive resin layer (B) has an adhesive strength that is reduced by being heated at a temperature higher than 180°C.

13. The method for manufacturing an electronic device according to any one of Claims 1 to 12,

wherein the pressure-sensitive adhesive resin layer (B) includes one or more selected from the group consisting of

(meth)acrylic pressure-sensitive adhesive resins, silicone-based pressure-sensitive adhesive resins, urethane-based pressure-sensitive adhesive resins, olefin-based pressure-sensitive adhesive resins, and styrene-based pressure-sensitive adhesive resins.

14. The method for manufacturing an electronic device according to any one of Claims 1 to 13,

wherein the pressure-sensitive adhesive resin layer (B) has a thickness of 10 μm or more and 100 μm or less.

15. The method for manufacturing an electronic device according to any one of Claims 1 to 14,

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

16. The method for manufacturing an electronic device according to any one of Claims 1 to 15,

wherein the pressure-sensitive adhesive film further includes an intermediate layer (C) at least one location selected from the group consisting of a location between the base material layer and the pressure-sensitive adhesive resin layer (A) and a location between the base material layer and the pressure-sensitive adhesive resin layer (B).

17. The method for manufacturing an electronic device according to any one of Claims 1 to 16, further comprising

a step of peeling the pressure-sensitive adhesive film from the electronic component.

18. The method for manufacturing an electronic device according to any one of Claims 1 to 17, further comprising

between the step of preparing the structure and the step of peeling the support substrate from the structure, a step of sealing the electronic component with a sealing material.

19. The method for manufacturing an electronic device according to Claim 18,

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

20. The method for manufacturing an electronic device according to any one of Claims 1 to 19,

wherein the electronic device includes a fan-out package.

21. A method for manufacturing a stainless steel substrate, which is used in the method for manufacturing an electronic device according to any one of Claims 1 to 20,

the method comprising a step of obtaining the stainless steel substrate by heating a raw material stainless steel sheet.

22. The method for manufacturing a stainless steel substrate

according to Claim 21,

wherein an oxygen concentration of a surface of the stainless steel substrate by the following (Method 1) is 45 atomic% or more and 75 atomic% or less:

(Method 1)

with respect to the stainless steel substrate, a detected element is specified by a wide scan with a step width of 1.0 eV, a dwell time of 50 milliseconds, a number of integrations of 2, and a measurement range of 0 to 1100 eV using a device under the following conditions by X-ray photoelectron spectroscopy (ESCA); thereafter, a spectrum for oxygen is obtained by a narrow scan with a step width of 0.1 eV, a dwell time of 300 milliseconds, a number of integrations of 4, and a measurement range of 523 to 543 eV; from the obtained spectrum, after subtracting a background determined by the Shirley method, a concentration of oxygen is calculated from an obtained peak area using a relative sensitivity factor method and is defined as the oxygen concentration,

conditions of the device are as follows:

X-ray source: Mg-Kα radiation

X-ray source output: 15 kV, 10 mA

analysis area: 300 × 700 μm

a neutralizing electron gun for charge compensation being used during analysis.

23. The method for manufacturing a stainless steel substrate according to Claim 21 or 22,

wherein a heating time in the step of obtaining the stainless steel substrate is 3.0 hours or more.

24. The method for manufacturing a stainless steel substrate according to any one of Claims 21 to 23,

wherein a heating temperature in the step of obtaining the stainless steel substrate is 120°C or higher.