DESCRIPTION

Title of Invention: TEMPORARY PROTECTION FILM FOR SEMICONDUCTOR ENCAPSULATION MOLDING, METHOD FOR MANUFACTURING SAME, LEAD FRAME PROVIDED WITH TEMPORARY PROTECTION FILM, TEMPORARILY PROTECTED ENCAPSULATION MOLDING OBJECT, AND METHOD FOR MANUFACTURING SEMICONDUCTOR PACKAGE

Technical Field

[0001] The present disclosure relates to a temporary protective film for semiconductor encapsulation molding and a production method therefor, a lead frame provided with a temporary protective film, a temporarily protected encapsulation molded body, and a method for manufacturing a semiconductor package.

Background Art

[0002] In a semiconductor package, a structure in which a sealing layer is formed only on a semiconductor element side of a lead frame and the rear surface of the lead frame is exposed may be employed (Patent Literatures 1 and 2). In the manufacturing of the semiconductor package having this structure, in order to prevent a sealing resin from flowing to the rear surface of the lead frame at the time of encapsulation molding, the rear surface of the lead frame may be temporarily protected by bonding a temporary protective film to the rear surface of the lead frame (Patent Literatures 3 and 4). The temporary protective film is peeled off from the lead frame after the sealing layer is formed.

Citation List

Patent Literature

[0003] [Patent Literature 1] Japanese Unexamined Patent Publication No. H5-129473

[Patent Literature 2] Japanese Unexamined Patent Publication No. H10-12773

[Patent Literature 3] International Publication No. 2021/206058

[Patent Literature 4] International Publication No. 2021/206069

Summary of Invention

Technical Problem

[0004] The present disclosure relates to a temporary protective film for semiconductor encapsulation molding, the temporary protective film capable of being bonded to a lead frame and capable of being easily peeled off after receiving a thermal history at a high temperature of about 400°C.

Solution to Problem

[0005] The present disclosure includes the following.

[1]

A temporary protective film for semiconductor encapsulation molding, comprising: a support film; and an adhesive layer provided on one surface or both surfaces of the support film, the temporary protective film being used for temporarily protecting a surface of a lead frame on a side opposite to a semiconductor element during encapsulation molding of forming a sealing layer that seals the semiconductor element mounted on a die pad of the lead frame, wherein

the adhesive layer comprises a thermoplastic resin and a low-molecular-weight component that is a compound having a molecular

weight of less than 1000, and

a total chlorine content in the low-molecular-weight component is 12.5% by mass or more.

[2]

The temporary protective film for semiconductor encapsulation molding according to claim 1, wherein a content of the low-molecular-weight component is 3 parts by mass or more and 20 parts by mass or less with respect to 100 parts by mass of a content of the thermoplastic resin.

[3]

A temporary protective film for semiconductor encapsulation molding, comprising: a support film; and an adhesive layer provided on one surface or both surfaces of the support film, the temporary protective film being used for temporarily protecting a surface of a lead frame on a side opposite to a semiconductor element during encapsulation molding of forming a sealing layer that seals the semiconductor element mounted on a die pad of the lead frame, wherein

the adhesive layer contains a thermoplastic resin and a low-molecular-weight component that is a compound having a molecular weight of less than 1000, and

a total chlorine content in the adhesive layer is 1.11% by mass or more.

[4]

The temporary protective film for semiconductor encapsulation molding according to any one of [1] to [3], wherein the low-molecular-weight component comprises an epoxy compound having one or more

epoxy groups.

[5]

A method for producing a temporary protective film for semiconductor encapsulation molding, the temporary protective film comprising: a support film; and an adhesive layer provided on one surface or both surfaces of the support film, the temporary protective film being used for temporarily protecting a surface of a lead frame on a side opposite to a semiconductor element during encapsulation molding of forming a sealing layer that seals the semiconductor element mounted on a die pad of the lead frame, the method comprising:

preparing a low-molecular-weight component that is a compound having a molecular weight of less than 1000;

mixing the low-molecular-weight component with a thermoplastic resin and a solvent, thereby forming a varnish;

forming a film comprising the varnish on the support film; and

forming the adhesive layer by removing the solvent from the film,

wherein a total chlorine content in the low-molecular-weight component is 12.5% by mass or more.

[6]

A lead frame provided with a temporary protective film, comprising:

a lead frame having a die pad; and

the temporary protective film for semiconductor encapsulation molding according to any one of [1] to [4],

wherein the temporary protective film is bonded to one surface

of the lead frame in a direction in which the adhesive layer of the temporary protective film comes into contact with the lead frame.

[7]

A temporarily protected encapsulation molded body, comprising:

a lead frame having a die pad;

a semiconductor element mounted on the die pad on one surface side of the lead frame;

a sealing layer sealing the semiconductor element; and

the temporary protective film for semiconductor encapsulation molding according to any one of [1] to [4],

wherein the temporary protective film is bonded to a surface of the lead frame on a side opposite to the semiconductor element in a direction in which the adhesive layer of the temporary protective film comes into contact with the lead frame.

[8]

A method for manufacturing a semiconductor package, the method comprising, in the stated order:

bonding the temporary protective film for semiconductor encapsulation molding according to any one of [1] to [4] to one surface of a lead frame having a die pad in a direction in which the adhesive layer of the temporary protective film comes into contact with the lead frame;

mounting a semiconductor element on a surface of the die pad on a side opposite to the temporary protective film;

forming a sealing layer sealing the semiconductor element to obtain a temporarily protected encapsulation molded body having the

lead frame, the semiconductor element, and the sealing layer; and

peeling off the temporary protective film from the encapsulation molded body.

[9]

The method according to [8], wherein the lead frame has a plurality of the die pads, and the semiconductor element is mounted on each of the plurality of the die pads, and

the method further comprises a step of dividing the encapsulation molded body subsequent to peeling off the temporary protective film from the encapsulation molded body, to obtain a semiconductor package having one die pad and the semiconductor element.

Advantageous Effects of Invention

[0006] There can be provided a temporary protective film for semiconductor encapsulation molding, which is capable of being bonded to a lead frame and capable of being easily peeled off after receiving a thermal history at a high temperature of about 400°C.

Brief Description of Drawings

[0007] [FIG. 1] FIG. 1 is a cross-sectional view illustrating an example of a temporary protective film.

[FIG. 2] FIG. 2 is a cross-sectional view illustrating an example of a temporary protective film.

[FIG. 3] FIG. 3 is a cross-sectional view illustrating an example of a method for manufacturing a semiconductor device.

[FIG. 4] FIG. 4 is a cross-sectional view illustrating an example of a method for manufacturing a semiconductor device.

[FIG. 5] FIG. 5 is a cross-sectional view illustrating an example

of a semiconductor device.

[FIG. 6] FIG. 6 is a perspective view illustrating an example of a reel body.

[FIG. 7] FIG. 7 is a front view illustrating an example of a package body.

[FIG. 8] FIG. 8 is a front view illustrating an example of a packed product.

Description of Embodiments

[0008] The present invention is not limited to the following examples. Upper limit values and lower limit values in the numerical range described in the present specification can be arbitrarily combined. Values described in Examples can also be used as upper limit values or lower limit values in the numerical range.

[0009] Temporary protective film

FIG. 1 is a cross-sectional view illustrating an example of a temporary protective film. A temporary protective film 10 illustrated in FIG. 1 is composed of a support film 1 and an adhesive layer 2 provided on one surface of the support film 1. An adhesive layer may be formed on both surfaces of the support film 1. FIG. 2 is also a cross-sectional view illustrating an example of a temporary protective film. A temporary protective film 10' of FIG. 2 has the support film 1, the adhesive layer 2 provided on one main surface of the support film 1, and a non-adhesive layer 3 provided on the other main surface of the support film 1. Each of these temporary protective films can be used as a temporary protective film for semiconductor encapsulation molding for temporarily protecting a lead frame during encapsulation molding by bonding the temporary

protective film to a rear surface of the lead frame (a surface on a side opposite to a surface on which a semiconductor element is mounted) in an encapsulation molding step of forming a sealing layer that seals the semiconductor element mounted on a die pad of the lead frame.

[0010] The adhesive layer 2 contains a thermoplastic resin and a low-molecular-weight component. The thermoplastic resin is composed of a polymer having a molecular weight of 1000 or more. The low-molecular-weight component is composed of a compound having a molecular weight of less than 1000.

[0011] The thermoplastic resin in the adhesive layer 2 may be at least one selected from the group consisting of an aromatic polyether amideimide, an aromatic polyether imide, an aromatic polyether amide, an aromatic polyamide, an aromatic polyester, an aromatic polyimide, an aromatic polyamideimide, an aromatic polyether, and an aromatic polyester imide. From the viewpoint of heat resistance and adhesiveness, the thermoplastic resin may be at least one selected from the group consisting of an aromatic polyether amideimide, an aromatic polyether imide, and an aromatic polyether amide, and may be an aromatic polyether amideimide.

[0012] The aromatic polyether amideimide is a polycondensate formed from an acid component containing an aromatic tricarboxylic acid or a reactive derivative thereof and an amine component containing an aromatic diamine, and can be a polycondensate in which at least one of an aromatic tricarboxylic acid and an aromatic diamine contains a compound having a plurality of aromatic groups and an oxy group (-O-) that bonds aromatic groups to each other. The aromatic polyether imide

is a polycondensate formed from an acid component containing an aromatic tetracarboxylic acid or a reactive derivative thereof and an amine component containing an aromatic diamine, and can be a polycondensate in which at least one of an aromatic tetracarboxylic acid and an aromatic diamine contains a compound having a plurality of aromatic groups and an oxy that bonds aromatic groups to each other. The aromatic polyether amide is a polycondensate formed from an acid component containing an aromatic dicarboxylic acid or a reactive derivative thereof and an amine component containing an aromatic diamine, and can be a polycondensate in which at least one of an aromatic dicarboxylic acid and an aromatic diamine contains a compound having a plurality of aromatic groups and an oxy that bonds aromatic groups to each other. The reactive derivative of a carboxylic acid may be, for example, an acid anhydride or an acid chloride.

[0013] The aromatic polyether amideimide and the aromatic polyamideimide may contain a constitutional unit derived from trimellitic acid or a reactive derivative thereof. The aromatic polyimide and the aromatic polyether imide may contain a constitutional unit derived from pyromellitic acid, polynuclear aromatic tetracarboxylic acid, or reactive derivatives thereof. Examples of the polynuclear aromatic tetracarboxylic acid include bisphenol A bistrimellitate and oxydiphthalic acid. The aromatic polyamide may contain a constitutional unit derived from terephthalic acid, isophthalic acid, or reactive derivatives thereof.

[0014] The aromatic polyether amideimide, the aromatic polyether imide, and the aromatic polyether amide may contain, for example, a

constitutional unit derived from an aromatic diamine having an oxy group, selected from 2,2-bis[4-(4-aminophenoxy)phenyl]propane, bis[4-(4-aminophenoxy)phenyl]sulfone, 4,4'-diaminodiphenyl ether, bis[4-(4-aminophenoxy)phenyl]ether, and 2,2-bis[4-(4-aminophenoxy)]hexafluoropropane. The aromatic polyether amideimide, the aromatic polyether imide, and the aromatic polyether amide may further contain a constitutional unit derived from another diamine selected from an aromatic diamine not having an oxy group (for example, 4,4'-methylenebis(2-isopropylaniline)), siloxane diamine (for example, 1,3-bis(3-aminopropyl)tetramethyldisiloxane), and α,ω-diaminoalkane (for example, 1,12-diaminododecane or 1,6-diaminohexane).

[0015] In the aromatic polyether amideimide, the aromatic polyether imide, and the aromatic polyether amide, the ratio of the constitutional unit derived from an aromatic diamine having an oxy group may be 40 to 100 mol% or 50 to 97 mol% on the basis of the total amount of the constitutional unit derived from the diamine component. In the aromatic polyether imide, the aromatic polyether amideimide, and the aromatic polyether amide, the ratio of the constitutional unit derived from an aromatic diamine having an oxy group may be 60 to 89 mol% or 68 to 82 mol%, the ratio of the constitutional unit derived from siloxane diamine may be 1 to 10 mol% or 3 to 7 mol%, and the ratio of the constitutional unit derived from α,ω-diaminoalkane may be 10 to 30 mol% or 15 to 25 mol%, on the basis of the total amount of the constitutional unit derived from the diamine component. In the aromatic polyether imide, the aromatic polyether amideimide, and the aromatic

polyether amide, the ratio of the constitutional unit derived from an aromatic diamine having an oxy group may be 90 to 99 mol% or 93 to 97 mol% and the ratio of the constitutional unit derived from siloxane diamine may be 1 to 10 mol% or 3 to 7 mol%, on the basis of the total amount of the constitutional unit derived from the diamine component. In the aromatic polyether imide, the aromatic polyether amideimide, and the aromatic polyether amide, the ratio of the constitutional unit derived from an aromatic diamine having an oxy group may be 40 to 70 mol% or 45 to 60 mol% and the ratio of the constitutional unit derived from an aromatic diamine not having an oxy group may be 30 to 60 mol% or 40 to 55 mol%, on the basis of the total amount of the constitutional unit derived from the diamine component.

[0016] An adhesive layer containing a thermoplastic resin and a low-molecular-weight component tends to easily decrease in adhesiveness to a lead frame by thermal treatment. Furthermore, according to the finding of the present inventor, when the amount of a component containing chlorine atoms contained in the low-molecular-weight component is large, there is a tendency that the adhesiveness of the adhesive layer 2 after thermal treatment to the lead frame is reduced. That is, the peelability of the adhesive layer 2 from the lead frame is further improved. It is inferred that the component containing chlorine atoms volatilizes as a gas component such as hydrogen chloride at a high temperature, and the volatilized gas component contributes to the reduction in adhesiveness of the adhesive layer to the lead frame. From these viewpoints, the total chlorine content of the low-molecular-weight component may be 12.5% by mass or more, and may be 12.5% by mass

or more and 30% by mass or less. The total chlorine content of the low-molecular-weight component may be 13.0% by mass or more, 13.5% by mass or more, 13.8% by mass or more, 14.0% by mass or more, 14.5% by mass or more, 15.0% by mass or more, 15.5% by mass or more, 16.0% by mass or more, 16.5% by mass or more, 17.0% by mass or more, 17.5% by mass or more, 18.0% by mass or more, 18.5% by mass or more, or 19.0% by mass or more. The total chlorine content of the additive may be 25% by mass or less, 24% by mass or less, 23% by mass or less, 22% by mass or less, 21% by mass or less, or 20% by mass or less.

[0017] In the present specification, the total chlorine content of the low-molecular-weight component means the proportion of the mass of chlorine atoms based on the total mass of the low-molecular-weight component. The total chlorine content of the low-molecular-weight component is measured, for example, by a method including liberating chlorine atoms contained in the low-molecular-weight component as chloride ions and quantifying the amount of the liberated chloride ions by potentiometric titration using silver nitrate. Such measurement is performed, for example, in accordance with the method described in JIS K-7243-3. Alternatively, the total chlorine content may be measured by ion chromatography. In that case, the total chlorine content is measured, for example, by a method including combusting the low-molecular-weight component, collecting chlorine atoms in the combustion gas formed by the combustion into a sample, and analyzing the sample by ion chromatography.

[0018] The low-molecular-weight component may contain chlorine

atoms in an amount such that the total chlorine content falls within the above-described predetermined range. At least a part of the chlorine atoms in the additive may be covalently bonded to other atoms in the compound of the low-molecular-weight component.

[0019] At least a part of the low-molecular-weight compounds constituting the low-molecular-weight component may be an epoxy compound having one or more epoxy groups (or glycidyl ether groups) and a molecular weight of less than 1000. Specific examples of such an epoxy compound include a sorbitol polyglycidyl ether and a polyethylene glycol diglycidyl ether. The sorbitol polyglycidyl ether is a compound having a sorbitol residue and two or more glycidyl ether groups bonded thereto, and may be a mixture of two or more kinds of components each having a different number of glycidyl ether groups. The epoxy equivalent of the sorbitol polyglycidyl ether may be, for example, 150 to 200 g/eq. The proportion of the epoxy compound may be 50% by mass or more, 60% by mass or more, 70% by mass or more, 80% by mass or more, 90% by mass or more, 95% by mass or more, 96% by mass or more, 97% by mass or more, 98% by mass or more, or 99% by mass or more, and may be 100% by mass or less, on the basis of the mass of the low-molecular-weight component. The proportion of the epoxy compound may be 50% by mass or more and 100% by mass or less on the basis of the mass of the low-molecular-weight component. In particular, the proportion of the sorbitol polyglycidyl ether may be within these ranges.

[0020] When the low-molecular-weight component contains an epoxy compound, the low-molecular-weight component may contain, as a

component containing chlorine atoms, epichlorohydrin, a chlorohydrin compound derived from epichlorohydrin, or both of these. A part of the epoxy compound (for example, sorbitol polyglycidyl ether) may have a chlorohydrin group.

[0021] The content of the low-molecular-weight component may be 3 parts by mass or more and 30 parts by mass or less with respect to 100 parts by mass of the content of the thermoplastic resin, from the viewpoint of peelability from the lead frame after receiving a thermal history at 400°C. The content of the low-molecular-weight component may be 4 parts by mass or more, 5 parts by mass or more, or 6 parts by mass or more, and may be 25 parts by mass or less, 20 parts by mass or less, 15 parts by mass or less, or 10 parts by mass or less, with respect to 100 parts by mass of the content of the thermoplastic resin. From the same viewpoint, the content of the epoxy compound or the sorbitol polyglycidyl ether may be 3 parts by mass or more and 30 parts by mass or less, and may be 4 parts by mass or more, 5 parts by mass or more, or 6 parts by mass or more, and may be 25 parts by mass or less, 20 parts by mass or less, 15 parts by mass or less, or 10 parts by mass or less, with respect to 100 parts by mass of the content of the thermoplastic resin.

[0022] For the same reason as described above, the total chlorine content in the adhesive layer 2 may also be related to the peelability from the lead frame after receiving a thermal history at 400°C. From this viewpoint, the total chlorine content in the adhesive layer 2 may be 1.11% by mass or more, and may be 1.11% by mass or more and 3.00% by mass or less, on the basis of the mass of the adhesive layer 2. The

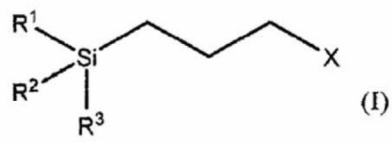
total chlorine content in the adhesive layer 2 may be 1.15% by mass or more, 1.20% by mass or more, 1.25% by mass or more, 1.30% by mass or more, 1.35% by mass or more, 1.40% by mass or more, 1.45% by mass or more, 1.50% by mass or more, 1.55% by mass or more, 1.60% by mass or more, 1.65% by mass or more, or 1.70% by mass or more, and may be 2.90% by mass or less, 2.80% by mass or less, 2.70% by mass or less, 2.60% by mass or less, 2.50% by mass or less, 2.40% by mass or less, 2.30% by mass or less, 2.20% by mass or less, 2.10% by mass or less, 2.00% by mass or less, 1.90% by mass or less, 1.80% by mass or less, or 1.75% by mass or less, on the basis of the mass of the adhesive layer 2. When the low-molecular-weight component contains a component containing chlorine atoms, the total chlorine content in the adhesive layer 2 can be adjusted within a predetermined range by the content of the low-molecular-weight component.

[0023] The total chlorine content in the adhesive layer 2 can be measured by the same method as the total chlorine content in the low-molecular-weight component. The total chlorine content calculated by the following formula from the total chlorine content in the low-molecular-weight component and the content (parts by mass) of the low-molecular-weight component with respect to 100 parts by mass of the content of the thermoplastic resin may be within the above-described range.

Total chlorine content in adhesive layer [% by mass] = {(content of low-molecular-weight component [parts by mass]) × (total chlorine content in low-molecular-weight component [% by mass])} / (total parts by mass of adhesive layer containing 100 parts by mass of thermoplastic resin)

[0024] The adhesive layer 2 may further contain one or more kinds of coupling agents. The coupling agent may be a silane coupling agent. The silane coupling agent may be a compound represented by Formula (I) below:

[Chem. 1]



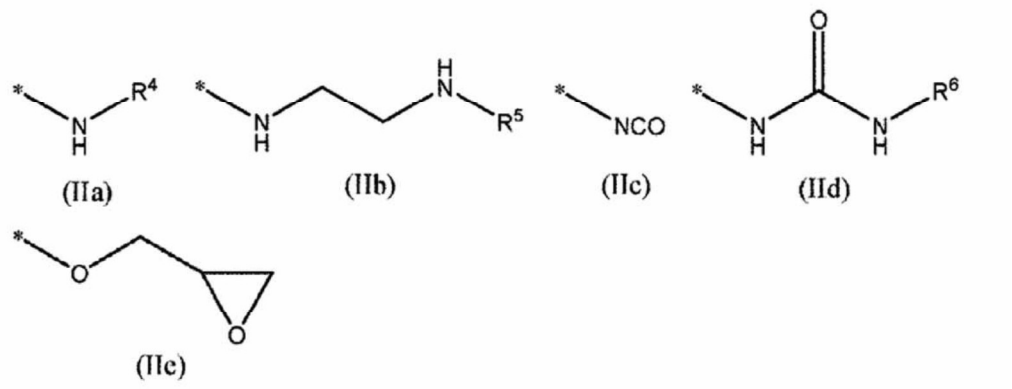
(I)

In Formula (I), R^1, R^2, and R^3 each independently represent an alkoxy group having 1 to 3 carbon atoms, an alkyl group having 1 to 6 carbon atoms, or an aryl group having 6 to 12 carbon atoms, and X represents a group containing a reactive functional group.

[0025] Examples of the alkoxy group having 1 to 3 carbon atoms for R^1, R^2, or R^3 include a methoxy group, an ethoxy group, and a propoxy group. Examples of the alkyl group having 1 to 6 carbon atoms for R^1, R^2, or R^3 include a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, an isobutyl group, a tert-butyl group, a pentyl group, and a hexyl group. Examples of the aryl group having 6 to 12 carbon atoms for R^1, R^2, or R^3 include a phenyl group, a tolyl group, a xylyl group, and a naphthyl group.

[0026] The reactive functional group of X may be, for example, an amino group, an isocyanate group, an amide group, or an epoxy group. X may be a group represented by Formula (IIa), (IIb), (IIc), (IId), or (IIe) below:

[Chem. 2]



In these formulae, R^4, R^5, and R^6 represent an alkyl group having 1 to 6 carbon atoms, an aryl group having 6 to 12 carbon atoms, or a hydrogen atom. "*" represents a binding site to a carbon atom. R^4, R^5, and R^6 may be an alkyl group having 1 to 6 carbon atoms selected from a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, an isobutyl group, a tert-butyl group, a pentyl group, and a hexyl group, or an aryl group having 6 to 12 carbon atoms selected from a phenyl group, a tolyl group, a xylyl group, and a naphthyl group.

[0027] Examples of the silane coupling agent in which X is the group represented by Formula (IIa) include 3-aminopropyltrimethoxysilane, 3-aminopropylmethyldimethoxysilane, 3-aminopropyltriethoxysilane, 3-aminopropylmethyldiethoxysilane, 3-phenylaminopropyltrimethoxysilane, 3-phenylaminopropyltriethoxysilane, 3-phenylaminopropylmethyldimethoxysilane, 3-phenylaminopropylmethyldiethoxysilane, 3-methylaminopropyltrimethoxysilane, 3-methylaminopropyltriethoxysilane, 3-ethylaminopropyltrimethoxysilane, and 3-ethylaminopropyltriethoxysilane.

[0028] Examples of the silane coupling agent in which X is the group represented by Formula (IIb) include 3-(2-aminoethyl)-3-aminopropyltrimethoxysilane, 3-(2-aminoethyl)-3-aminopropylmethyldimethoxysilane, 3-(2-aminoethyl)-3-aminopropyltriethoxysilane, 3-(2-aminoethyl)-3-aminopropylmethyldiethoxysilane, 3-(2-phenylaminoethyl)-3-aminopropyltrimethoxysilane, 3-(2-phenylaminoethyl)-3-aminopropyltriethoxysilane, 3-(2-phenylaminoethyl)-3-aminopropylmethyldimethoxysilane, 3-(2-methylaminoethyl)-3-aminopropyltrimethoxysilane, 3-(2-methylaminoethyl)-3-aminopropyltriethoxysilane, 3-(2-ethylaminoethyl)-3-aminopropyltrimethoxysilane, and N-(2-ethylaminoethyl)-3-aminopropyltriethoxysilane.

[0029] Examples of the silane coupling agent in which X is the group represented by Formula (IIc) include 3-isocyanatopropyltrimethoxysilane, 3-isocyanatopropylmethyldimethoxysilane, 3-isocyanatopropyltriethoxysilane, and 3-isocyanatopropylmethyldiethoxysilane.

[0030] Examples of the silane coupling agent in which X is the group represented by Formula (IId) include 3-ureidopropyltrimethoxysilane, 3-ureidopropylmethyldimethoxysilane, 3-ureidopropyltriethoxysilane, 3-ureidopropylmethyldiethoxysilane, 3-(3-phenylureido)propyltriethoxysilane, 3-(3-methylureido)propyltriethoxysilane, 3-(3-ethylureido)propyltriethoxysilane, 3-(3-

propylureido)propyltriethoxysilane, 3-(3-butylureido)propyltriethoxysilane, 3-(3-hexylureido)propyltriethoxysilane, 3-(3-phenylureido)propyltrimethoxysilane, 3-(3-methylureido)propyltrimethoxysilane, 3-(3-ethylureido)propyltrimethoxysilane, 3-(3-propylureido)propyltrimethoxysilane, 3-(3-butylureido)propyltrimethoxysilane, and 3-(3-hexylureido)propyltrimethoxysilane.

[0031] Examples of the silane coupling agent in which X is the group represented by Formula (IIe) include 3-glycidoxypropyltrimethoxysilane, 3-glycidoxypropylmethyldimethoxysilane, 3-glycidoxypropyltriethoxysilane, and 3-glycidoxypropylmethyldiethoxysilane.

[0032] The content of the coupling agent may be 1 to 40 parts by mass with respect to 100 parts by mass of the content of the thermoplastic resin. When the content of the silane coupling agent is 1% by mass or more, there is a tendency that peelability from the lead frame after the thermal treatment is further improved. When the content of the coupling agent is 40% by mass or less, gelation of the varnish for forming the adhesive layer 2, a decrease in viscosity, and the like are less likely to occur, and the temporary protective film can be more easily produced. From the same viewpoint, the content of the coupling agent may be 1 to 35 parts by mass, 2 to 35 parts by mass, 3 to 30 parts by mass, more than 5 parts by mass and 35 parts by mass or less, more than 5 parts by mass

and 30% by mass or less, or more than 5 parts by mass and 20 parts by mass or less, with respect to 100 parts by mass of the content of the thermoplastic resin.

[0033] The adhesive layer 2 may further contain a filler. Examples of the filler include ceramic powder, glass powder, silver powder, copper powder, resin particles, and rubber particles. The content of the filler may be 0 to 30 parts by mass, 1 to 30 parts by mass, or 5 to 15 parts by mass with respect to 100 parts by mass of the content of the thermoplastic resin.

[0034] The total content of the thermoplastic resin, the low-molecular-weight component, and the coupling agent, or the total content of the thermoplastic resin, the low-molecular-weight component, the coupling agent, and the filler in the adhesive layer 2 may be 90 to 100% by mass on the basis of the mass of the adhesive layer 2.

[0035] The thickness of the adhesive layer 2 may be 20 μm or less, 18 μm or less, 16 μm or less, 14 μm or less, 12 μm or less, 10 μm or less, 9 μm or less, or 8 μm or less, from the viewpoint of more easily suppressing the curling of the temporary protective film. The thickness of the adhesive layer 2 may be 1 μm or more, 2 μm or more, 3 μm or more, 4 μm or more, 5 μm or more, 6 μm or more, 7 μm or more, or 8 μm or more. The thickness of the adhesive layer 2 may be 1 μm or more and 20 μm or less.

[0036] The support film 1 may be, for example, a film of at least one polymer selected from the group consisting of an aromatic polyimide, an aromatic polyamide, an aromatic polyamideimide, an aromatic polysulfone, an aromatic polyethersulfone, a polyphenylene sulfide, an

aromatic polyether ketone, a polyarylate, an aromatic polyether ether ketone, and polyethylene naphthalate. The support film 1 may be film-shaped copper, aluminum, stainless steel, or nickel. In a case where the support film 1 is a polymer film, the surface thereof may be surface-treated by methods such as chemical treatments including an alkali treatment and a silane coupling treatment, physical treatments including a sand matte treatment, a plasma treatment, and a corona treatment.

[0037] The thickness of the support film 1 may be, for example, 5 to 100 μm, or 5 to 50 μm. A ratio T_2/T_1 of a thickness T_2 of the adhesive layer to a thickness T_1 of the support film may be 0.5 or less, 0.3 or less, or 0.2 or less.

[0038] The non-adhesive layer 3 is a resin layer that substantially does not have adhesiveness (or pressure-sensitive adhesiveness) to the lead frame at 0 to 270°C. The non-adhesive layer may be a resin layer that is not easily softened at a high temperature, and for example, a resin layer having a high glass transition temperature can function as a non-adhesive layer.

[0039] The resin layer as the non-adhesive layer 3 contains a thermoplastic resin, a thermosetting resin (a cured product), or a resin that is a combination of a thermoplastic resin and a thermosetting resin. The thermoplastic resin may have an amide group, an ester group, an imide group, an oxy group, or a sulfonyl group. The thermosetting resin may be, for example, an epoxy resin, a phenolic resin, or a bismaleimide resin. In a case where the thermoplastic resin and the thermosetting resin are combined, the amount of the thermosetting resin may be 5 to 100 parts by mass or 20 to 70 parts by mass with respect to 100 parts by mass

of the content of the thermoplastic resin.

[0040] The non-adhesive layer 3 may contain a filler (for example, ceramic powder, glass powder, silver powder, copper powder, resin particles, and rubber particles), a coupling agent, and the like. The content of the filler in the non-adhesive layer 3 may be 1 to 30 parts by mass or 5 to 15 parts by mass with respect to 100 parts by mass of the content of the resin. The content of the coupling agent may be 1 to 20 parts by mass or 2 to 15 parts by mass with respect to 100 parts by mass of the content of the resin.

[0041] The 90-degree peeling strength of the non-adhesive layer 3 with respect to a mold made of brass at 25°C may be less than 5 N/m, or 1 N/m or less. The peeling strength is measured after the non-adhesive layer 3 is pressure-bonded to the mold made of brass at a temperature of 250°C and a pressure of 8 MPa for 10 seconds.

[0042] The thickness of the non-adhesive layer 3 may be, for example, 10 μm or less, 9 μm or less, 8 μm or less, or 7 μm or less. The thickness of the non-adhesive layer may be, for example, 1 μm or more, 2 μm or more, 3 μm or more, 4 μm or more, 5 μm or more, or 6 μm or more. The thickness of the non-adhesive layer is not particularly limited, and may be, for example, 1 to 10 μm or 1 to 8 μm.

[0043] The temporary protective film can be produced, for example, by a method including preparing a low-molecular-weight component, mixing the low-molecular-weight component with a thermoplastic resin and a solvent to thereby form a varnish, forming a film containing the varnish on the support film 1, and forming the adhesive layer by removing the solvent from the film. The film containing the varnish can

be formed, for example, by applying the varnish to the support film. The non-adhesive layer can also be formed by the same method as the adhesive layer.

[0044] Method for manufacturing semiconductor package

A semiconductor package can be manufactured using the temporary protective film illustrated above. The semiconductor package thus manufactured may be, for example, a Non Lead Type Package, which has a lead frame, a semiconductor element mounted thereon, and a sealing layer sealing the semiconductor element on the semiconductor element side of the lead frame, with the rear surface of the lead frame being exposed for external connection. Specific examples thereof include QFN (Quad Flat Non-leaded Package) and SON (Small Outline Non-leaded Package).

[0045] FIGS. 3 and 4 are cross-sectional views illustrating an example of a method for manufacturing a semiconductor package. FIG. 5 is a cross-sectional view illustrating an example of the semiconductor package obtained by the manufacturing method illustrated in FIGS. 3 and 4. Hereinafter, each step will be described with reference to each drawing as necessary.

[0046] The method illustrated in FIG. 3 and FIG. 4 includes, in the stated order: a step of bonding the temporary protective film 10 to a rear surface, which is one surface of a lead frame 11 having a die pad 11a and an inner lead 11b, in a direction in which the adhesive layer of the temporary protective film 10 comes into contact with the lead frame 11; a step of mounting a semiconductor element 14 on a surface of the die pad 11a on a side opposite to the temporary protective film 10; a step of

providing a wire 12 connecting the semiconductor element 14 and the inner lead 11b; a step of forming a sealing layer 13 sealing the semiconductor element 14 and the wire 12 to obtain a temporarily protected encapsulation molded body 20 having the lead frame 11, the semiconductor element 14, and the sealing layer 13; and a step of peeling off the temporary protective film 10 from the encapsulation molded body 20. The temporarily protected encapsulation molded body is composed of the encapsulation molded body 20 and the temporary protective film 10.

[0047] The step of bonding the temporary protective film 10 to the lead frame 11 may include heating and pressurizing the temporary protective film 10 disposed on the lead frame 11. The heating temperature may be 150°C or higher, 180°C or higher, or 200°C or higher, and may be 400°C or lower. The heating temperature may be 150°C or higher and 400°C or lower. The pressure may be 0.5 to 30 MPa, 1 to 20 MPa, or 3 to 15 MPa. The time for heating and pressurizing may be 0.1 to 60 seconds, 1 to 30 seconds, or 3 to 20 seconds.

[0048] The lead frame 11 may be formed from, for example, an iron-based alloy such as Alloy 42, copper, or a copper-based alloy. The lead frame 11 may have a molded body formed from copper or a copper-based alloy and a coating layer of palladium, gold, silver, or the like that covers the surface of the molded body.

[0049] The semiconductor element 14 is usually attached to the die pad 11a through an adhesive (for example, a silver paste). After the semiconductor element 14 is attached to the die pad 11a, reflow connection (Cu Clip connection or the like) may be performed under

conditions of a maximum temperature of 250 to 440°C, or a temperature of 250 to 400°C, for 1 to 30 minutes.

[0050] The wire 12 is not particularly limited, and may be, for example, a gold wire, a copper wire, or a palladium-coated copper wire. For example, the semiconductor element 14 and the inner lead 11b may be joined to the wire 12 by heating at 200 to 260°C or 350 to 260°C for 3 to 60 minutes and utilizing ultrasonic waves and a pressing pressure.

[0051] The sealing layer 13 is formed by encapsulation molding using a sealing material. Through encapsulation molding, the encapsulation molded body 20 having a plurality of semiconductor elements 14 and the sealing layer 13 integrally sealing these semiconductor elements may be obtained. Since the temporary protective film 10 is provided during the encapsulation molding, the sealing material is inhibited from flowing to the rear surface side of the lead frame 11.

[0052] The temperature during the formation of the sealing layer 13 (the temperature of the sealing material) may be 140 to 200°C or 160 to 180°C. The pressure during the formation of the sealing layer may be 6 to 15 MPa or 7 to 10 MPa. The time for the encapsulation molding may be 1 to 5 minutes or 2 to 3 minutes.

[0053] The sealing layer 13 thus formed may be cured by heating as necessary. The heating temperature for curing the sealing layer 13 may be 150 to 200°C or 160 to 180°C. The heating time for curing the sealing layer 13 may be 4 to 7 hours or 5 to 6 hours.

[0054] The sealing material may contain, for example, one or more epoxy resins selected from a cresol novolac epoxy resin, a phenol novolac epoxy resin, a biphenyl diepoxy resin, and a naphthol novolac

epoxy resin. The sealing material may contain a filler, a flame retardant substance such as a bromine compound, a wax component, and the like.

[0055] After the encapsulation molding of forming the sealing layer 13, the temporary protective film 10 is peeled off from the lead frame 11 and the sealing layer 13 of the encapsulation molded body 20 thus obtained. In the case of curing the sealing layer 13, the temporary protective film 10 may be peeled off at any time point before or after curing of the sealing layer 13.

[0056] The temperature at which the temporary protective film 10 is heated in order to peel off the temporary protective film 10 from the encapsulation molded body 20 may be 0 to 250°C, 100 to 200°C, or 150 to 250°C.

[0057] After the temporary protective film 10 is peeled off from the lead frame 11, in a case where a part of the adhesive layer remains on the lead frame 11 and the sealing layer 13, the remaining adhesive layer may be removed. The remaining adhesive layer may be removed by mechanical brushing or a solvent. The solvent may be, for example, N-methyl-2-pyrrolidone, dimethylacetamide, diethylene glycol dimethyl ether, tetrahydrofuran, cyclohexanone, methyl ethyl ketone, or dimethylformamide.

[0058] In a case where the lead frame has a plurality of patterns each having a die pad and an inner lead, as necessary, a plurality of semiconductor packages 100 of FIG. 5 each having one semiconductor element can be obtained by dividing the encapsulation molded body 20. That is, in a case where the lead frame 11 has a plurality of the die pads 11a and the semiconductor element 14 is mounted on each of the

plurality of the die pads 11a, the manufacturing method according to an embodiment may further include a step of dividing the encapsulation molded body 20 to obtain the semiconductor package 100 having one die pad 11a and the semiconductor element 14, after peeling off the temporary protective film 10 (or 10') from the encapsulation molded body 20.

[0059] An elongated temporary protective film may be wound around a core, and a semiconductor package may be manufactured while the temporary protective film is unwound from the obtained reel body. The reel body in this case has a core and the temporary protective film according to the above-described embodiment wound around the core.

[0060] FIG. 6 is a perspective view illustrating an example of a reel body. A reel body 30 illustrated in FIG. 6 includes a core 31, the temporary protective film 10 wound around the core 31, and a side plate 32. The width (length in a direction orthogonally intersecting the winding direction) of the core 31 and the temporary protective film 10 may be 0.001 cm or more, 0.005 cm or more, or 0.008 cm or more, and may be 0.03 cm or less. The width (length in the direction orthogonally intersecting the winding direction) of the core 31 and the temporary protective film 10 may be, for example, 0.001 cm or more and 0.03 cm or less, 0.005 cm and 0.03 cm or less, or 0.008 cm or more and 0.03 cm or less.

[0061] The temporary protective film may be provided as a package body in which the reel body is accommodated in a packaging bag. FIG. 7 illustrates an example of a package body. As illustrated in FIG. 7, a package body 50 includes the reel body 30 and a packaging bag 40

accommodating the reel body 30. The reel body 30 is usually individually accommodated in a packaging bag; however, a plurality of (for example, two or three) reel bodies 30 may be accommodated in one packaging bag 40.

[0062] The packaging bag 40 may be formed from a resin film. The packaging bag 40 may be formed from a composite film that is a resin film having an aluminum layer. Specific examples of the packaging bag 40 include an aluminum-coated plastic bag. Examples of the material for the resin film include plastics such as polyethylene, polyester, vinyl chloride, and polyethylene terephthalate. The reel body 30 may be, for example, accommodated in a packaging bag in a vacuum-packed state. The package body 50 is not limited to a vacuum-packed product.

[0063] In the packaging bag 40, a desiccant may be accommodated together with the reel body 30. Examples of the desiccant include silica gel. The package body 50 may further have a cushioning material which wraps the packaging bag 40 accommodating the reel body 30.

[0064] The package body 50 may be provided as a packed product accommodated in a packing box. FIG. 8 illustrates an example of a packed product. As illustrated in FIG. 8, a packed product 70 includes the package body 50 and a packing box 60 accommodating the package body 50. In the packing box 60, one or a plurality of the package bodies 50 are accommodated. As the packing box 60, for example, corrugated cardboard can be used.

[0065] A semiconductor device manufactured using the temporary protective film according to the present disclosure is excellent in terms of higher density, smaller area, reduced thickness, and the like, and can

be suitably utilized, for example, in electronic devices such as mobile telephones, smart phones, personal computers, and tablets.

Examples

[0066] The present invention is not limited to the following examples.

1. Low-molecular-weight component

The following products of sorbitol polyglycidyl ether (manufactured by Nagase ChemteX Corporation) were used as the low-molecular-weight component.

EX-622 (total chlorine content: 19.4% by mass)

EX-612 (total chlorine content: 13.8% by mass)

EX-614B (total chlorine content: 10.1% by mass)

EX-614 (total chlorine content: 11.3% by mass)

[0067] 2. Production of temporary protective film

Temporary protective films of Examples or Comparative Examples each having an adhesive layer containing each component at the compounding ratio (parts by mass) shown in Table 1 were produced by the following procedure. Table 1 also shows the total chlorine content in the adhesive layer calculated from the total chlorine content in each low-molecular-weight component and the content of the low-molecular-weight component.

An aromatic polyether amideimide that is a polycondensate formed from 270.9 g (0.63 mol) of 2,2-bis[4-(4-aminophenoxy)phenyl]propane, 67.0 g (0.27 mol) of 1,3-bis(3-aminopropyl)-tetramethyldisiloxane, and 187.3 g (0.89 mol) of trimellitic anhydride chloride was prepared. One hundred parts by mass of this aromatic polyether amideimide, 10 parts by mass of the low-

molecular-weight component, and 3 parts by mass of a silane coupling agent (3-glycidoxypropyltrimethoxysilane, manufactured by Dow Corning Toray Silicone Co., Ltd., trade name: SH6040) were dissolved in N-methylpyrrolidone to obtain a varnish for forming an adhesive layer.

The obtained varnish was applied onto one surface of a support film. As the support film, a polyimide film (thickness: 25 μm, manufactured by UBE Corporation, trade name: UPILEX SGA) having a chemically treated surface was used. The coating film on the support film was dried by heating at 100°C for 10 minutes and at 200°C for 10 minutes to form an adhesive layer having a thickness of 2 μm, thereby obtaining a temporary protective film having the support film and the adhesive layer.

[0068] 3. Peeling strength

(1) Before thermal treatment

The temporary protective film was bonded to a copper plate under the conditions of a temperature of 235°C, a pressure of 6 MPa, and a time of 10 seconds in a direction in which the adhesive layer was in contact with the copper plate. Next, the 90-degree peeling strength between the adhesive layer and the copper plate at 200°C was measured under the condition of a peeling speed of 300 mm per minute.

(2) After thermal treatment

The temporary protective film was bonded to a copper plate under the conditions of a temperature of 235°C, a pressure of 6 MPa, and a time of 10 seconds in a direction in which the adhesive layer was in contact with the copper plate. Next, the copper plate and the temporary

protective film bonded thereto were heated in an oven at 180°C for 1 hour. Thereafter, the copper plate and the temporary protective film taken out from the oven were subjected to a thermal treatment under the conditions of heating at a heating rate of 2°C/second up to a maximum temperature of 400°C under a nitrogen atmosphere and holding at 400°C for 1 second. After the thermal treatment, the 90-degree peeling strength between the adhesive layer and the copper plate at 200°C was measured under the condition of a peeling speed of 300 mm per minute.

[0069] [Table 1]

		Example 1	Example 2	Comparative Example 1	Comparative Example 2
Aromatic polyether amideimide		100	100	100	100
Low-molecular-weight component	EX-622 (19.4% by mass)	10	-	-	-
	EX-612 (13.8% by mass)	-	10	-	-
	EX-614B (10.1% by	-	-	10	-
	EX-614 (11.3% by mass)	-	-	-	10
Silane coupling agent		3	3	3	3
Adhesive layer	Total chlorine content [% by mass]	1.72	1.22	0.89	1.00
Peeling strength [N/m] Peeling temperature: 200°C	Before thermal treatment	140	149	145	153
	After thermal treatment	34	39	50	51

[0070] The evaluation results are shown in Table 1. It was confirmed that the temporary protective films of Examples 1 and 2 can be appropriately bonded to a lead frame and can be peeled off even more easily after receiving a thermal history at a high temperature of about 400°C.

Reference Signs List

[0071] 1: support film, 2: adhesive layer, 3: non-adhesive layer, 10, 10': temporary protective film, 11: lead frame, 11a: die pad, 11b: inner lead, 12: wire, 13: sealing layer, 14: semiconductor element, 20: encapsulation molded body, 30: reel body, 31: core, 32: side plate, 40: packaging bag, 50: package body, 60: packing box, 70: packed product, 100: semiconductor package.

CLAIMS

[Claim 1]

A temporary protective film for semiconductor encapsulation molding, comprising: a support film; and an adhesive layer provided on one surface or both surfaces of the support film, the temporary protective film being used for temporarily protecting a surface of a lead frame on a side opposite to a semiconductor element during encapsulation molding of forming a sealing layer that seals the semiconductor element mounted on a die pad of the lead frame, wherein

the adhesive layer comprises a thermoplastic resin and a low-molecular-weight component that is a compound having a molecular weight of less than 1000, and

a total chlorine content in the low-molecular-weight component is 12.5% by mass or more.

[Claim 2]

The temporary protective film for semiconductor encapsulation molding according to claim 1, wherein a content of the low-molecular-weight component is 3 parts by mass or more and 20 parts by mass or less with respect to 100 parts by mass of a content of the thermoplastic resin.

[Claim 3]

A temporary protective film for semiconductor encapsulation molding, comprising: a support film; and an adhesive layer provided on one surface or both surfaces of the support film, the temporary protective film being used for temporarily protecting a surface of a lead frame on a side opposite to a semiconductor element during encapsulation molding

of forming a sealing layer that seals the semiconductor element mounted on a die pad of the lead frame, wherein

the adhesive layer contains a thermoplastic resin and a low-molecular-weight component that is a compound having a molecular weight of less than 1000, and

a total chlorine content in the adhesive layer is 1.11% by mass or more.

[Claim 4]

The temporary protective film for semiconductor encapsulation molding according to any one of claims 1 to 3, wherein the low-molecular-weight component comprises an epoxy compound having one or more epoxy groups.

[Claim 5]

A method for producing a temporary protective film for semiconductor encapsulation molding, the temporary protective film comprising: a support film; and an adhesive layer provided on one surface or both surfaces of the support film, the temporary protective film being used for temporarily protecting a surface of a lead frame on a side opposite to a semiconductor element during encapsulation molding of forming a sealing layer that seals the semiconductor element mounted on a die pad of the lead frame, the method comprising:

preparing a low-molecular-weight component that is a compound having a molecular weight of less than 1000;

mixing the low-molecular-weight component with a thermoplastic resin and a solvent, thereby forming a varnish;

forming a film comprising the varnish on the support film; and

forming the adhesive layer by removing the solvent from the film,

wherein a total chlorine content in the low-molecular-weight component is 12.5% by mass or more.

[Claim 6]

A lead frame provided with a temporary protective film, comprising:

a lead frame having a die pad; and

the temporary protective film for semiconductor encapsulation molding according to any one of claims 1 to 3,

wherein the temporary protective film is bonded to one surface of the lead frame in a direction in which the adhesive layer of the temporary protective film comes into contact with the lead frame.

[Claim 7]

A temporarily protected encapsulation molded body, comprising:

a lead frame having a die pad;

a semiconductor element mounted on the die pad on one surface side of the lead frame;

a sealing layer sealing the semiconductor element; and

the temporary protective film for semiconductor encapsulation molding according to any one of claims 1 to 3,

wherein the temporary protective film is bonded to a surface of the lead frame on a side opposite to the semiconductor element in a direction in which the adhesive layer of the temporary protective film comes into contact with the lead frame.

[Claim 8]

A method for manufacturing a semiconductor package, the method comprising, in the stated order:

bonding the temporary protective film for semiconductor encapsulation molding according to any one of claims 1 to 3 to one surface of a lead frame having a die pad in a direction in which the adhesive layer of the temporary protective film comes into contact with the lead frame;

mounting a semiconductor element on a surface of the die pad on a side opposite to the temporary protective film;

forming a sealing layer sealing the semiconductor element to obtain a temporarily protected encapsulation molded body having the lead frame, the semiconductor element, and the sealing layer; and

peeling off the temporary protective film from the encapsulation molded body.

[Claim 9]

The method according to claim 8, wherein the lead frame has a plurality of the die pads, and the semiconductor element is mounted on each of the plurality of the die pads, and

the method further comprises a step of dividing the encapsulation molded body subsequent to peeling off the temporary protective film from the encapsulation molded body, to obtain a semiconductor package having one die pad and the semiconductor element.