DESCRIPTION

Title of Invention:

COMPOSITION FOR FORMING PRIMER COATING FILM, LAMINATE, METHOD FOR PRODUCING LAMINATE, AND METHOD FOR MANUFACTURING PROCESSED SEMICONDUCTOR SUBSTRATE OR ELECTRONIC DEVICE SUBSTRATE

Technical Field

[0001]

The present invention relates to a composition for forming a primer coating film, a laminate, a method for producing a laminate, and a method for manufacturing a processed semiconductor substrate or electronic device substrate.

Background Art

[0002]

There is a demand for semiconductor integration technology in which semiconductor wafers conventionally integrated in a two-dimensional planar direction are further integrated (laminated) in a three-dimensional direction for the purpose of achieving even higher integration. This three-dimensional lamination is a technology of integrating the wafers into multiple layers while connecting them by a through silicon via (TSV). At the time of multilayer integration, each of the wafers to

be integrated is thinned by polishing the side opposite to the formed circuit surface (that is, the back surface), and the thinned semiconductor wafers are laminated.

[0003]

A semiconductor wafer before thinning (also referred to herein simply as a wafer) is bonded to a support in order to be polished by a polishing apparatus. The adhesion at that time needs to be easily releasable after polishing, and is therefore referred to as temporary adhesion. This temporary adhesion needs to allow easy removal from the support. When a large force is applied for the removal, the thinned semiconductor wafer may be cut or deformed, and therefore, in order to prevent such a situation, the semiconductor wafer is easily removed. On the other hand, it is not preferable for the semiconductor wafer to be detached or displaced due to polishing stress during polishing of the back surface of the semiconductor wafer. Therefore, the performance required for temporary adhesion is to withstand the stress during polishing and to allow easy removal after polishing.

[0004]

As temporary adhesives used for such temporary adhesion, an adhesive containing polydimethylsiloxane (Patent Literature 1), a temporary adhesive containing an epoxy-modified polysiloxane (Patent Literature 2), and the

like have been proposed.

Citation List

Patent Literature

[0005]

Patent Literature 1: WO 2017/221772 A

Patent Literature 2: WO 2018/216732 A

Summary of Invention

Technical Problem

[0006]

As described above, in temporary adhesion between a semiconductor wafer and a support, at the time of temporary adhesion, an adhesive layer formed from a temporary adhesive needs to be difficult to peel from the support or the semiconductor wafer, while when the semiconductor wafer is peeled from the support, the adhesive layer needs to be easily peelable from the support or the semiconductor wafer.

Meanwhile, when the semiconductor wafer is peeled from the support, there are cases where the location where peeling occurs is an interface between the semiconductor wafer and the adhesive layer (this case is also referred to as device peeling (device release)) or an interface between the support and the adhesive layer (this case is also

referred to as carrier peeling (carrier release)).

For example, when peeling is carrier peeling, since the adhesive layer remains (adheres) on the device side of the semiconductor wafer, there are concerns that, compared with the case of device peeling, cleaning of the adhesive layer after peeling takes longer and process time increases, and that the cleaning burden on the device substrate, which is the semiconductor wafer, becomes greater. Therefore, in order not to cause the above-described concerns, device peeling is preferable.

As described above, device peeling is preferable from the viewpoint of reducing residues of the adhesive layer on the device substrate. On the other hand, carrier peeling may be desired for reasons such as the adhesive layer to be used, the types of the respective substrates in contact therewith, or setting conditions in the manufacturing process.

Thus, when the semiconductor wafer is peeled from the support, it is convenient if the location where peeling occurs (peeling interface) can be controlled.

[0007]

The present invention has been made in view of the above circumstances, and an object of the present invention is to provide a laminate including:

a support substrate;

a semiconductor substrate or an electronic device substrate; and

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate,

in which a peeling interface can be controlled when a semiconductor wafer is peeled from the support substrate.

Solution to Problem

[0008]

As a result of intensive studies to solve the above problems, the present inventors have found that the above problems can be solved by providing, between an adhesive layer and a substrate, a primer coating film capable of increasing adhesive strength between the adhesive layer and the substrate, and completed the present invention having the following gist.

[0009]

That is, the present invention includes the following.

[1] A composition for forming a primer coating film for increasing adhesive strength between an adhesive layer and a substrate, the adhesive layer being formed from an adhesive composition containing an adhesive component that cures by a hydrosilylation reaction,

the composition for forming a primer coating film, containing a component contributing to the hydrosilylation reaction.

[2] The composition for forming a primer coating film according to [1], wherein the composition for forming a primer coating film contains, as the component contributing to the hydrosilylation reaction, a component selected from a compound containing platinum, a compound containing an Si-H group, and a compound containing a vinyl group.

[3] The composition for forming a primer coating film according to [1] or [2], wherein the adhesive composition that forms the adhesive layer contains the adhesive component and a release agent component.

[4] The composition for forming a primer coating film according to [3], wherein the release agent component contains a polyorganosiloxane.

[5] The composition for forming a primer coating film according to any one of [1] to [4], wherein the adhesive component that cures by the hydrosilylation reaction contains:

a component (A-1) having an alkenyl group having 2 to 40 carbon atoms, the alkenyl group being bonded to a silicon atom;

a component (A-2) having an Si-H group; and

a platinum group metal-based catalyst (A-3).

[6] A laminate including:

a support substrate;

a semiconductor substrate or an electronic device substrate; and

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate,

wherein a primer coating film is formed on a substrate surface of any one of the semiconductor substrate, the electronic device substrate, and the support substrate, and

the primer coating film is a primer coating film formed from the composition for forming a primer coating film according to any one of [1] to [5].

[7] The laminate according to [6], wherein the primer coating film is formed on a surface of the support substrate.

[8] A method for producing a laminate, the laminate including:

a support substrate;

a semiconductor substrate or an electronic device substrate;

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate; and

a primer coating film formed on a substrate surface of any one of the semiconductor substrate, the electronic device substrate, and the support substrate,

the method including:

a step of forming a primer coating film by applying the composition for forming a primer coating film according to any one of [1] to [5] to a substrate surface of any one of the semiconductor substrate, the electronic device substrate, and the support substrate.

[9] The method for producing a laminate according to [8], further including:

a step of applying an adhesive composition for forming the adhesive layer to a substrate on which the primer coating film is not formed, the substrate being any one of the semiconductor substrate, the electronic device substrate, and the support substrate; and

a step of bonding together the substrate on which the primer coating film is formed and the substrate to which the adhesive composition is applied, and then performing heat treatment to form an adhesive layer between the semiconductor substrate or the electronic device substrate and the support substrate.

[10] The method for producing a laminate according to [9], including:

a step of forming a primer coating film by applying

the composition for forming a primer coating film according to any one of [1] to [5] to a surface of the support substrate;

a step of applying an adhesive composition for forming an adhesive layer to the semiconductor substrate or the electronic device substrate; and

a step of bonding together the support substrate on which the primer coating film is formed and the semiconductor substrate or the electronic device substrate to which the adhesive composition is applied, and then performing heat treatment to form an adhesive layer between the semiconductor substrate or the electronic device substrate and the support substrate.

[11] A method for manufacturing a processed semiconductor substrate or electronic device substrate, the method including:

a fifth step in which the semiconductor substrate or the electronic device substrate of the laminate according to [6] or [7] is processed; and

a sixth step in which the semiconductor substrate or the electronic device substrate processed by the fifth step is separated from the support substrate.

Advantageous Effects of Invention

[0010]

According to the present invention,

it is possible to provide a laminate including:

a support substrate;

a semiconductor substrate or an electronic device substrate; and

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate,

in which a peeling interface can be controlled when a semiconductor wafer is peeled from the support substrate.

Brief Description of Drawings

[0011]

[Fig. 1] Fig. 1 is a schematic cross-sectional view of an example of a laminate.

[Fig. 2] Fig. 2 is a schematic cross-sectional view of another example of a laminate.

[Fig. 3A] Fig. 3A is a schematic cross-sectional view for explaining a method for producing the laminate shown in Fig. 1 (Part 1).

[Fig. 3B] Fig. 3B is a schematic cross-sectional view for explaining a method for producing the laminate shown in Fig. 1 (Part 2).

[Fig. 3C] Fig. 3C is a schematic cross-sectional view for explaining a method for producing the laminate shown in

Fig. 1 (Part 3).

[Fig. 4A] Fig. 4A is a schematic cross-sectional view for explaining a method for producing the laminate shown in Fig. 2 (Part 1).

[Fig. 4B] Fig. 4B is a schematic cross-sectional view for explaining a method for producing the laminate shown in Fig. 2 (Part 2).

[Fig. 4C] Fig. 4C is a schematic cross-sectional view for explaining a method for producing the laminate shown in Fig. 2 (Part 3).

[Fig. 4D] Fig. 4D is a schematic cross-sectional view for explaining a method for producing the laminate shown in Fig. 2 (Part 4).

Mode for Carrying Out the Invention

[0012]

(Laminate)

A laminate of the present invention is a laminate including:

a support substrate;

a semiconductor substrate or an electronic device substrate; and

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate,

in which a primer coating film is formed on a substrate surface of any one of the semiconductor substrate, the electronic device substrate, and the support substrate.

The primer coating film is formed from the composition for forming a primer coating film described below.

The composition for forming a primer coating film is a composition for increasing adhesive strength between an adhesive layer and a substrate, the adhesive layer being formed from an adhesive composition containing an adhesive component that cures by a hydrosilylation reaction, and contains a component contributing to the hydrosilylation reaction.

[0013]

In the present invention, by arranging, in the laminate, a primer layer formed from a composition for forming a primer coating film containing a component contributing to a hydrosilylation reaction, adhesive strength between an adhesive layer and a substrate can be increased, the adhesive layer being formed from an adhesive composition containing an adhesive component that cures by the hydrosilylation reaction. Accordingly, in the laminate having the primer layer, at the time of temporary adhesion, the adhesive layer is less likely to peel from the support

substrate, the semiconductor substrate, or the electronic device substrate, while when the semiconductor substrate or the electronic device substrate is peeled from the support substrate, the adhesive layer can be easily peeled at an interface between a substrate not having the primer coating film and the adhesive layer.

[0014]

In the present invention, "a primer coating film is formed on a substrate surface of any one of a semiconductor substrate, an electronic device substrate, and a support substrate" is specified. Specific aspects for forming the primer coating film include, for example, the following aspects.

(a) In a laminate including a semiconductor substrate and a support substrate, a primer coating film is formed on a surface of the support substrate.

(b) In a laminate including an electronic device substrate and a support substrate, a primer coating film is formed on a surface of the support substrate.

(c) In a laminate including a semiconductor substrate and a support substrate, a primer coating film is formed on a surface of the semiconductor substrate.

(d) In a laminate including an electronic device substrate and a support substrate, a primer coating film is formed on a surface of the electronic device substrate.

[0015]

For example, in the case of the aspect (a) described above, since adhesive strength between the substrate on which the primer coating film is formed and the adhesive layer is increased by the primer coating film, when an attempt is made to peel the semiconductor substrate from the support substrate, peeling occurs at an interface between the substrate on which the primer coating film is not formed and the adhesive layer. That is, in the case of the aspect (a) described above, peeling (device peeling) occurs at an interface between the semiconductor substrate and the adhesive layer.

Similarly, also in the aspect (b) described above, peeling (device peeling) occurs at an interface between the electronic device substrate and the adhesive layer.

On the other hand, in the aspect (c) described above and the aspect (d) described above, peeling (carrier peeling) occurs at an interface between the support substrate and the adhesive layer.

In this manner, the peeling interface can be controlled depending on the substrate in the laminate on which the primer coating film is arranged.

[0016]

In the present invention, as long as the object of controlling the peeling interface can be achieved, the

aspect of the laminate may be either device peeling or carrier peeling.

In the present invention, the substrate on which the primer coating film is arranged can be appropriately selected in consideration of the adhesive layer to be used, the types of the respective substrates in contact therewith, setting conditions in the manufacturing process, and the like.

However, in the following, a case of device peeling in which a primer coating film is formed on a surface of the support substrate will be described as an example.

[0017]

The laminate of the present invention is used for temporary adhesion when processing a semiconductor substrate or an electronic device substrate, and can be suitably used for processing such as thinning of a semiconductor substrate or an electronic device substrate (hereinafter, “semiconductor substrate or electronic device substrate” may also be collectively referred to as “semiconductor substrate or the like”).

While the semiconductor substrate or the like is subjected to processing such as thinning, the semiconductor substrate or the like is supported by the support substrate. On the other hand, after processing of the semiconductor substrate or the like, the semiconductor

substrate or the like and the support substrate are separated.

After the semiconductor substrate or the like and the support substrate are separated, residues of the adhesive layer remaining on the semiconductor substrate, the electronic device substrate, or the support substrate can be removed by, for example, a cleaning agent composition for cleaning the semiconductor substrate or the like.

[0018]

Examples of a more preferred configuration of the laminate of the present invention include a laminate including:

a support substrate;

a primer coating film formed on a surface of the support substrate;

a semiconductor substrate or an electronic device substrate; and

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate having the primer coating film on the surface thereof.

This laminate is a device peeling-type laminate.

[0019]

Each component constituting the laminate will be described below.

[0020]

<Adhesive layer>

The adhesive layer is provided between the support substrate and the semiconductor substrate or the electronic device substrate (semiconductor substrate or the like).

The adhesive layer is in contact with, for example, the semiconductor substrate or the like. In addition, the adhesive layer is also in contact with, for example, the support substrate having a primer coating film formed on a surface thereof.

The adhesive layer is formed from an adhesive composition.

[0021]

The thickness of the adhesive layer included in the laminate of the present invention is not particularly limited, but is usually 5 to 500 μm, preferably 10 μm or more, more preferably 20 μm or more, and still more preferably 30 μm or more from the viewpoint of maintaining the film strength, and is preferably 200 μm or less, more preferably 150 μm or less, still more preferably 120 μm or less, and further preferably 100 μm or less from the viewpoint of avoiding nonuniformity caused by a thick film.

[0022]

A method for forming an adhesive layer from an adhesive composition will be described in detail in the

section describing a method for producing a laminate.

[0023]

<<Adhesive composition>>

The adhesive composition according to the present invention contains an adhesive component that cures by a hydrosilylation reaction.

The adhesive composition according to the present invention preferably contains the adhesive component and a release agent component.

The adhesive composition according to the present invention may contain other components.

[0024]

The release agent component preferably contains a polyorganosiloxane.

The release agent component preferably contains two or more types of release agent component.

[0025]

<<<Adhesive component>>>

The adhesive component is a component that cures by a hydrosilylation reaction.

The component that cures by a hydrosilylation reaction is not particularly limited, but preferably contains a component having an alkenyl group having 2 to 40 carbon atoms, the alkenyl group being bonded to a silicon atom (hereinafter, also referred to as “component (A-1)” in

some cases), a component having an Si-H group (hereinafter, also referred to as "component (A-2)" in some cases), and a platinum group metal-based catalyst (A-3).

[0026]

<<<<Component (A-1) and Component (A-2)>>>>

The adhesive composition preferably contains the component (A-1).

The adhesive composition preferably contains the component (A-2).

Hereinafter, the combination of the component (A-1), the component (A-2), and the platinum group metal-based catalyst (A-3) may be referred to as "curing component (A)" or "component (A)".

[0027]

From the viewpoint of suitably obtaining the effects of the present invention, the component (A-1) preferably contains a polyorganosiloxane (a1) having an alkenyl group having 2 to 40 carbon atoms, the alkenyl group being bonded to a silicon atom.

From the viewpoint of suitably obtaining the effects of the present invention, the component (A-2) preferably contains a polyorganosiloxane (a2) having an Si-H group.

Here, the alkenyl group having 2 to 40 carbon atoms may be substituted. Examples of the substituent include a halogen atom, a nitro group, a cyano group, an amino group,

a hydroxy group, a carboxyl group, an aryl group, and a heteroaryl group.

[0028]

In another preferred embodiment, the adhesive composition that cures by a hydrosilylation reaction contains a polysiloxane (A1) containing one or two or more units selected from the group consisting of a siloxane unit (Q unit) represented by SiO_2, a siloxane unit (M unit) represented by $R^1R^2R^3SiO_{1/2}$, a siloxane unit (D unit) represented by $R^4R^5SiO_{2/2}$, and a siloxane unit (T unit) represented by $R^6SiO_{3/2}$, and a platinum group metal-based catalyst (A-3). The polysiloxane (A1) contains a polyorganosiloxane (a1') containing one or two or more units selected from the group consisting of a siloxane unit (Q' unit) represented by SiO_2, a siloxane unit (M' unit) represented by $R^1'R^2'R^3'SiO_{1/2}$, a siloxane unit (D' unit) represented by $R^4'R^5'SiO_{2/2}$, and a siloxane unit (T' unit) represented by $R^6'SiO_{3/2}$, and also containing at least one selected from the group consisting of M' units, D' units, and T' units; and a polyorganosiloxane (a2') containing one or two or more units selected from the group consisting of a siloxane unit (Q'' unit) represented by SiO_2, a siloxane unit (M'' unit) represented by $R^1''R^2''R^3''SiO_{1/2}$, a siloxane unit (D'' unit) represented by $R^4''R^5''SiO_{2/2}$, and a siloxane unit (T'' unit) represented by $R^6''SiO_{3/2}$, and also

containing at least one selected from the group consisting of M'' units, D'' units, and T'' units.

Note that (a1') is an example of (a1), and (a2') is an example of (a2).

[0029]

R^1 to R^6 are groups or atoms bonded to a silicon atom, and R^1 to R^6 each independently represent an alkyl group which may be substituted, an alkenyl group which may be substituted, or a hydrogen atom. Examples of the substituent include a halogen atom, a nitro group, a cyano group, an amino group, a hydroxy group, a carboxyl group, an aryl group, and a heteroaryl group.

[0030]

$R^{1'}$ to $R^{6'}$ are each a group bonded to a silicon atom, and each independently represent an optionally substituted alkyl group or an optionally substituted alkenyl group, but at least one of $R^{1'}$ to $R^{6'}$ is an optionally substituted alkenyl group. Examples of the substituent include a halogen atom, a nitro group, a cyano group, an amino group, a hydroxy group, a carboxyl group, an aryl group, and a heteroaryl group.

[0031]

$R^{1''}$ to $R^{6''}$ are each a group or atom bonded to a silicon atom and each independently represent an optionally substituted alkyl group or a hydrogen atom, but at least

one of $R^{1''}$ to $R^{6''}$ is a hydrogen atom. Examples of the substituent include a halogen atom, a nitro group, a cyano group, an amino group, a hydroxy group, a carboxyl group, an aryl group, and a heteroaryl group.

[0032]

The alkyl group may be linear, branched, or cyclic, but is preferably a linear or branched alkyl group. The number of carbon atoms thereof is not particularly limited, but is usually 1 to 40, preferably 30 or less, more preferably 20 or less, and still more preferably 10 or less.

[0033]

Specific examples of the linear or branched alkyl group which may be substituted include, but are not limited to, a methyl group, an ethyl group, an n-propyl group, an i-propyl group, an n-butyl group, an i-butyl group, an s-butyl group, a tertiary butyl group, an n-pentyl group, a 1-methyl-n-butyl group, a 2-methyl-n-butyl group, a 3-methyl-n-butyl group, a 1,1-dimethyl-n-propyl group, a 1,2-dimethyl-n-propyl group, a 2,2-dimethyl-n-propyl group, a 1-ethyl-n-propyl group, an n-hexyl group, a 1-methyl-n-pentyl group, a 2-methyl-n-pentyl group, a 3-methyl-n-pentyl group, a 4-methyl-n-pentyl group, a 1,1-dimethyl-n-butyl group, a 1,2-dimethyl-n-butyl group, a 1,3-dimethyl-n-butyl group, a 2,2-dimethyl-n-butyl group, a 2,3-

dimethyl-n-butyl group, a 3,3-dimethyl-n-butyl group, a 1-ethyl-n-butyl group, a 2-ethyl-n-butyl group, a 1,1,2-trimethyl-n-propyl group, a 1,2,2-trimethyl-n-propyl group, a 1-ethyl-1-methyl-n-propyl group, and a 1-ethyl-2-methyl-n-propyl group, and the number of carbon atoms thereof is usually 1 to 14, preferably 1 to 10, and more preferably 1 to 6. Among them, a methyl group is particularly preferable.

[0034]

Specific examples of the cyclic alkyl group which may be substituted include, but are not limited to, cycloalkyl groups such as a cyclopropyl group, a cyclobutyl group, a 1-methyl-cyclopropyl group, a 2-methyl-cyclopropyl group, a cyclopentyl group, a 1-methyl-cyclobutyl group, a 2-methyl-cyclobutyl group, a 3-methyl-cyclobutyl group, a 1,2-dimethyl-cyclopropyl group, a 2,3-dimethyl-cyclopropyl group, a 1-ethyl-cyclopropyl group, a 2-ethyl-cyclopropyl group, a cyclohexyl group, a 1-methyl-cyclopentyl group, a 2-methyl-cyclopentyl group, a 3-methyl-cyclopentyl group, a 1-ethyl-cyclobutyl group, a 2-ethyl-cyclobutyl group, a 3-ethyl-cyclobutyl group, a 1,2-dimethyl-cyclobutyl group, a 1,3-dimethyl-cyclobutyl group, a 2,2-dimethyl-cyclobutyl group, a 2,3-dimethyl-cyclobutyl group, a 2,4-dimethyl-cyclobutyl group, a 3,3-dimethyl-cyclobutyl group, a 1-n-propyl-cyclopropyl group, a 2-n-propyl-cyclopropyl group, a

1-i-propyl-cyclopropyl group, a 2-i-propyl-cyclopropyl group, a 1,2,2-trimethyl-cyclopropyl group, a 1,2,3-trimethyl-cyclopropyl group, a 2,2,3-trimethyl-cyclopropyl group, a 1-ethyl-2-methyl-cyclopropyl group, a 2-ethyl-1-methyl-cyclopropyl group, a 2-ethyl-2-methyl-cyclopropyl group, and a 2-ethyl-3-methyl-cyclopropyl group; and bicycloalkyl groups such as a bicyclobutyl group, a bicyclopentyl group, a bicyclohexyl group, a bicycloheptyl group, a bicyclooctyl group, a bicyclononyl group, and a bicyclodecyl group, and the number of carbon atoms thereof is usually 3 to 14, preferably 4 to 10, and more preferably 5 to 6.

[0035]

The alkenyl group may be linear or branched, and the number of carbon atoms thereof is not particularly limited, but is usually 2 to 40, preferably 30 or less, more preferably 20 or less, and still more preferably 10 or less.

[0036]

Specific examples of the linear or branched alkenyl group which may be substituted include, but are not limited to, a vinyl group, an allyl group, a butenyl group, and a pentenyl group, and the number of carbon atoms thereof is usually 2 to 14, preferably 2 to 10, and more preferably 1 to 6. Among them, an ethenyl group and a 2-propenyl group

are particularly preferable.

Specific examples of the cyclic alkenyl group which may be substituted include, but are not limited to, cyclopentenyl and cyclohexenyl, and the number of carbon atoms thereof is usually 4 to 14, preferably 5 to 10, and more preferably 5 to 6.

[0037]

As described above, the polysiloxane (A1) contains a polyorganosiloxane (a1') and a polyorganosiloxane (a2'), and an alkenyl group contained in the polyorganosiloxane (a1') and a hydrogen atom (Si-H group) contained in the polyorganosiloxane (a2') form a crosslinked structure and cure by a hydrosilylation reaction with the platinum group metal-based catalyst (A-3). As a result, a cured film is formed.

[0038]

The polyorganosiloxane (a1') contains one or two or more units selected from the group consisting of Q' units, M' units, D' units, and T' units, and also contains at least one selected from the group consisting of M' units, D' units, and T' units. As the polyorganosiloxane (a1'), two or more polyorganosiloxanes satisfying such conditions may be used in combination.

[0039]

Examples of the preferred combinations of two or more

units selected from the group consisting of Q′ units, M′ units, D′ units, and T′ units include, but are not limited to, (Q′ units and M′ units), (D′ units and M′ units), (T′ units and M′ units), and (Q′ units, T′ units, and M′ units).

[0040]

When the polyorganosiloxane (a1′) contains two or more polyorganosiloxanes, a combination of (Q′ unit and M′ unit) and (D′ unit and M′ unit), a combination of (T′ unit and M′ unit) and (D′ unit and M′ unit), and a combination of (Q′ unit, T′ unit, and M′ unit) and (T′ unit and M′ unit) are preferable, but the combinations are not limited thereto.

[0041]

The polyorganosiloxane (a2′) contains one or two or more units selected from the group consisting of Q′′ units, M′′ units, D′′ units, and T′′ units, and contains at least one selected from the group consisting of M′′ units, D′′ units, and T′′ units. As the polyorganosiloxane (a2′), two or more polyorganosiloxanes satisfying such conditions may be used in combination.

[0042]

Preferred combinations of two or more units selected from the group consisting of Q′′ unit, M′′ unit, D′′ unit, and T′′ unit include, but are not limited to, (M′′ unit and

D'' unit), (Q'' unit and M'' unit), and (Q'' unit, T'' unit, and M'' unit).

[0043]

The polyorganosiloxane (a1') is composed of siloxane units in which alkyl groups and/or alkenyl groups are bonded to silicon atoms thereof, but the proportion of alkenyl groups in the total substituents represented by $R^{1'}$ to $R^{6'}$ is preferably 0.1 to 50.0% by mol and more preferably 0.5 to 30.0% by mol, and the remaining $R^{1'}$ to $R^{6'}$ may be alkyl groups.

[0044]

The polyorganosiloxane (a2') is composed of siloxane units in which alkyl groups and/or hydrogen atoms are bonded to silicon atoms thereof, but the proportion of hydrogen atoms among all the substituents and substituent atoms represented by $R^{1''}$ to $R^{6''}$ is preferably 0.1 to 50.0% by mol and more preferably 10.0 to 40.0% by mol, and the remaining $R^{1''}$ to $R^{6''}$ may be alkyl groups.

[0045]

When the adhesive composition contains (a1) and (a2), in a preferred embodiment of the present invention, the molar ratio of the alkenyl groups contained in the polyorganosiloxane (a1) to the hydrogen atoms constituting the Si-H bond contained in the polyorganosiloxane (a2) is in the range of 1.0:0.5 to 1.0:0.66.

[0046]

The weight-average molecular weight of polysiloxanes such as the polyorganosiloxane (a1) or the polyorganosiloxane (a2) is not particularly limited, and each is typically 500 to 1,000,000, and is preferably 5,000 to 50,000 from the viewpoint of achieving the effects of the present invention with good reproducibility.

In the present invention, the weight-average molecular weight, the number-average molecular weight, and the dispersity of the polyorganosiloxanes can be measured, for example, using a GPC apparatus (EcoSEC, HLC-8320GPC, manufactured by Tosoh Corporation) and a GPC column (TSKgel SuperMultiporeHZ-N and TSKgel SuperMultiporeHZ-H, manufactured by Tosoh Corporation), at a column temperature of 40°C, using tetrahydrofuran as an eluent (elution solvent), at a flow rate (flow velocity) of 0.35 mL/min, and using polystyrene (Shodex from Showa Denko K.K.) as a standard sample.

[0047]

The viscosities of the polyorganosiloxane (a1) and the polyorganosiloxane (a2) are not particularly limited, and are each usually 10 to 1,000,000 (mPa·s), and are preferably 50 to 10,000 (mPa·s) from the viewpoint of achieving the effects of the present invention with good reproducibility. The viscosities of the polyorganosiloxane

(a1) and the polyorganosiloxane (a2) are values measured with an E-type rotational viscometer at 25°C.

[0048]

The polyorganosiloxane (a1) and the polyorganosiloxane (a2) react with each other by a hydrosilylation reaction. Accordingly, the mechanism of curing is different from, for example, a mechanism involving silanol groups, and therefore, neither siloxane needs to contain a silanol group or a functional group that forms a silanol group by hydrolysis, such as an alkyloxy group.

[0049]

<<<<Platinum group metal-based catalyst (A-3)>>>>

The platinum group metal-based catalyst is a platinum-based metal catalyst.

Such a platinum-based metal catalyst is a catalyst for promoting the hydrosilylation reaction between the alkenyl group and the Si-H group.

[0050]

As specific examples of the platinum-based metal catalyst, a catalyst known as a platinum-based compound (platinum or a compound containing platinum) can be used.

Specific examples thereof include platinum fine powder, platinum black, chloroplatinic acid, an alcohol-modified product of chloroplatinic acid, a complex of

chloroplatinic acid and diolefin, a platinum-olefin complex, a platinum-carbonyl complex [platinum bis(acetoacetate), platinum bis(acetylacetonate), or the like], a chloroplatinic acid-alkenylsiloxane complex (chloroplatinic acid-divinyltetramethyldisiloxane complex, chloroplatinic acid-tetravinyltetramethylcyclotetrasiloxane complex, or the like), a platinum-alkenylsiloxane complex (platinum-divinyltetramethyldisiloxane complex, platinum-tetravinyltetramethylcyclotetrasiloxane complex, or the like), and a complex of chloroplatinic acid and acetylene alcohols. Among them, a platinum-alkenylsiloxane complex is particularly preferable because it has a high effect of promoting the hydrosilylation reaction.

These hydrosilylation reaction catalysts may be used alone, or two or more thereof may be used in combination.

[0051]

The alkenylsiloxane used in the platinum-alkenylsiloxane complex is not particularly limited, and examples thereof include 1,3-divinyl-1,1,3,3-tetramethyldisiloxane; 1,3,5,7-tetramethyl-1,3,5,7-tetravinylcyclotetrasiloxane; alkenylsiloxane oligomers in which some of the methyl groups of these alkenylsiloxanes are substituted with ethyl groups, phenyl groups, or the like; and alkenylsiloxane oligomers in which the vinyl groups of these alkenylsiloxanes are substituted with allyl

groups, hexenyl groups, or the like. In particular, 1,3-divinyl-1,1,3,3-tetramethyldisiloxane is preferable since the platinum-alkenylsiloxane complex to be produced has good stability.

[0052]

The content of the platinum group metal-based catalyst (A-3) in the adhesive composition is not particularly limited, and is, for example, in the range of 0.1 to 50.0 ppm based on the total mass of the component (A-1) and the component (A-2).

[0053]

<<<<Polymerization inhibitor>>>>

The adhesive component may contain a polymerization inhibitor for the purpose of suppressing the progress of the hydrosilylation reaction.

The polymerization inhibitor is not particularly limited as long as it can suppress the progress of the hydrosilylation reaction, and specific examples thereof include alkynyl alcohols such as 1-ethynyl-1-cyclohexanol and 1,1-diphenyl-2-propyn-1-ol.

The amount of the polymerization inhibitor is not particularly limited, but is usually 1,000.0 ppm or more with respect to, for example, the total amount of the polyorganosiloxane (a1) and the polyorganosiloxane (a2) from the viewpoint of obtaining the effect, and is 10,000.0

ppm or less from the viewpoint of preventing excessive suppression of the hydrosilylation reaction.

[0054]

<<<Release agent component>>>

The release agent component is not particularly limited, but is preferably a polyorganosiloxane from the viewpoint of more suitably obtaining the effects of the present invention.

The polyorganosiloxane as the release agent component usually does not react with the adhesive component.

For example, the polyorganosiloxane as the release agent component is a component that does not undergo a hydrosilylation reaction.

[0055]

The polyorganosiloxane is not particularly limited, and examples thereof include a polydimethylsiloxane, an epoxy group-containing polyorganosiloxane, a phenyl group-containing polyorganosiloxane, and a carbinol-modified polyorganosiloxane.

[0056]

The two or more types of release agent components preferably include two or more types of polyorganosiloxanes from the viewpoint of more suitably obtaining the effects of the present invention.

The two types in the two or more types of

polyorganosiloxanes mean, for example, a combination of polydimethylsiloxane and an epoxy group-containing polyorganosiloxane, a combination of polydimethylsiloxane and a phenyl group-containing polyorganosiloxane, and a combination of a phenyl group-containing polyorganosiloxane and an epoxy group-containing polyorganosiloxane, and do not refer to, for example, a combination of two epoxy group-containing polyorganosiloxanes having different molecular weights, viscosities, types of epoxy groups, or the like.

[0057]

Examples of the two types among the two or more types of release agent components include the following combinations.

· A combination of polydimethylsiloxane and an epoxy group-containing polyorganosiloxane

· A combination of polydimethylsiloxane and a phenyl group-containing polyorganosiloxane

· A combination of polydimethylsiloxane and a carbinol-modified polyorganosiloxane

· A combination of an epoxy group-containing polyorganosiloxane and a phenyl group-containing polyorganosiloxane

· A combination of an epoxy group-containing polyorganosiloxane and a carbinol-modified

polyorganosiloxane

· A combination of a phenyl group-containing polyorganosiloxane and a carbinol-modified polyorganosiloxane

Among these combinations, the combination of polydimethylsiloxane and an epoxy group-containing polyorganosiloxane is preferable as a combination from which the effect of the present invention is most easily obtained.

[0058]

<<<<Polydimethylsiloxane>>>>

The polydimethylsiloxane contained in the adhesive composition is not particularly limited.

The polydimethylsiloxane is a component that does not undergo a hydrosilylation reaction.

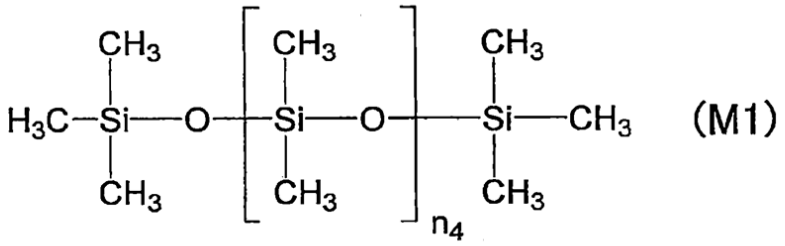
The “polydimethylsiloxane” in the present invention is an unmodified polyorganosiloxane and is a polyorganosiloxane having a methyl group as an organic group bonded to a silicon atom, unlike epoxy group-containing polydimethylsiloxane, phenyl group-containing polydimethylsiloxane, and the like.

[0059]

Specific examples of the polydimethylsiloxane include, but are not limited to, those represented by Formula (M1).

[0060]

[Chem. 1]



(M1)

(n_4 represents the number of repeating units, and is a positive integer.)

[0061]

The weight-average molecular weight of the polydimethylsiloxane is not particularly limited, but is usually 100,000 to 2,000,000, and is preferably 200,000 to 1,200,000, and more preferably 300,000 to 900,000 from the viewpoint of achieving the effects of the present invention with good reproducibility. In addition, the dispersity is not particularly limited, but is usually 1.0 to 10.0, and is preferably 1.5 to 5.0, and more preferably 2.0 to 3.0 from the viewpoint of, for example, achieving suitable release with good reproducibility. Note that the weight-average molecular weight and the dispersity can be measured by the above-described method related to the polyorganosiloxane as the adhesive component.

The viscosity of the polydimethylsiloxane is not particularly limited, but is usually 1,000 to 2,000,000

mm^2/s. Note that the value of the viscosity of the polydimethylsiloxane is expressed as kinematic viscosity, and centistokes (cSt)=mm^2/s. The value can also be determined by dividing the viscosity (mPa·s) by the density (g/cm^3). That is, the value can be determined from the viscosity measured with an E-type rotational viscometer at 25°C and the density, and can be calculated from the equation: kinematic viscosity (mm^2/s)=viscosity (mPa·s)/density (g/cm^3).

[0062]

<<<<Epoxy group-containing polyorganosiloxane>>>>

The epoxy group-containing polyorganosiloxane contained in the adhesive composition is not particularly limited.

The epoxy group-containing polyorganosiloxane is a component that does not undergo a hydrosilylation reaction.

[0063]

Examples of the epoxy group-containing polyorganosiloxane include those containing a siloxane unit (D^{10} unit) represented by $R^{11}R^{12}SiO_{2/2}$.

[0064]

R^{11} is a group bonded to a silicon atom and represents an alkyl group, and R^{12} is a group bonded to a silicon atom and represents an epoxy group or an organic group containing an epoxy group. Specific examples of the

alkyl group include the above-described examples.

The epoxy group in the organic group containing an epoxy group may be an independent epoxy group that is not fused to another ring, or may be an epoxy group forming a fused ring with another ring, such as a 1,2-epoxycyclohexyl group.

Specific examples of the organic group containing an epoxy group include, but are not limited to, 3-glycidoxypropyl and 2-(3,4-epoxycyclohexyl)ethyl.

In the present invention, a preferred example of the epoxy group-containing polyorganosiloxane is an epoxy group-containing polydimethylsiloxane, but the epoxy group-containing polyorganosiloxane is not limited thereto.

[0065]

The epoxy group-containing polyorganosiloxane contains the above-described siloxane unit (D^{10} unit), but may contain, in addition to the D^{10} unit, Q units, M units, and/or T units.

In a preferred embodiment of the present invention, specific examples of the epoxy group-containing polyorganosiloxane include a polyorganosiloxane composed only of D^{10} units, a polyorganosiloxane containing D^{10} units and Q units, a polyorganosiloxane containing D^{10} units and M units, a polyorganosiloxane containing D^{10} units and T units, a polyorganosiloxane containing D^{10} units, Q units,

and M units, a polyorganosiloxane containing D^{10} units, M units, and T units, and a polyorganosiloxane containing D^{10} units, Q units, M units, and T units.

[0066]

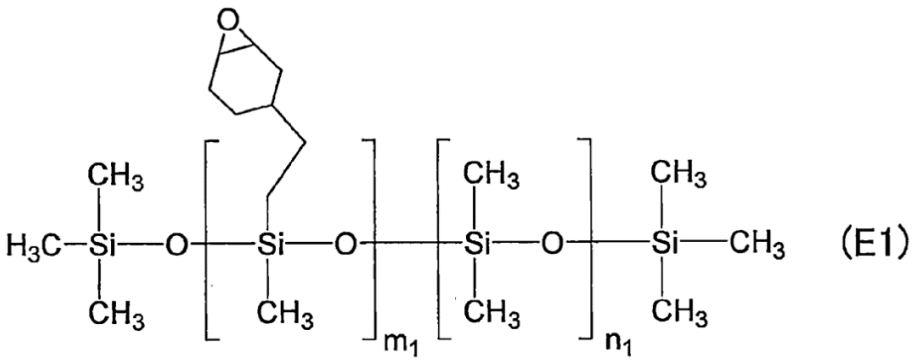
The epoxy group-containing polyorganosiloxane is preferably an epoxy group-containing polydimethylsiloxane having an epoxy value of 0.1 to 5. In addition, the weight-average molecular weight is not particularly limited, but is usually from 1,500 to 500,000, and is preferably 100,000 or less from the viewpoint of suppressing precipitation in the composition.

[0067]

Specific examples of the epoxy group-containing polyorganosiloxane include, but are not limited to, those represented by Formulas (E1) to (E3).

[0068]

[Chem. 2]



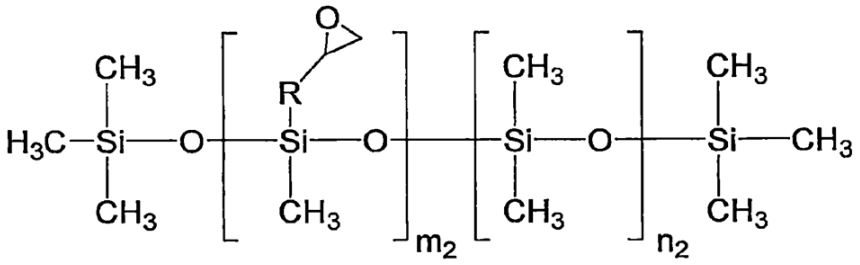
(E1)

(m_1 and n_1 represent the numbers of respective

repeating units, and are positive integers.)

[0069]

[Chem. 3]

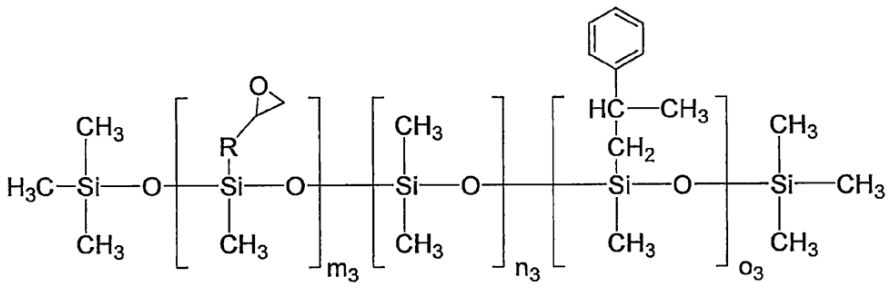


(E2)

(m_2 and n_2 represent the numbers of the respective repeating units and are positive integers, and R is an alkylene group having 1 to 10 carbon atoms which may be interrupted by at least one of an oxygen atom and an unsaturated bond (for example, a carbon-carbon double bond, a carbon-carbon triple bond, or -N=N-).)

[0070]

[Chem. 4]



(E3)

(m_3, n_3, and o_3 represent the numbers of the respective repeating units and are positive integers, and R is an alkylene group having 1 to 10 carbon atoms which may be interrupted by at least one of an oxygen atom and an

unsaturated bond (for example, a carbon-carbon double bond, a carbon-carbon triple bond, or -N=N-).)

[0071]

In the above general formula, when m_1, m_2, m_3, and o_3 are 2 or more, these repeating units may be arranged adjacent to each other to form a block, or may be randomly arranged.

[0072]

Note that the polyorganosiloxane represented by Formula (E3) has an epoxy group and a phenyl group and is thus an epoxy group-containing polyorganosiloxane and is also a phenyl group-containing polyorganosiloxane. Note that the epoxy group-containing polyorganosiloxane may or may not have a phenyl group.

[0073]

The weight-average molecular weight of the epoxy group-containing polyorganosiloxane is not particularly limited, but is usually 100,000 to 2,000,000, and is preferably 200,000 to 1,200,000, more preferably 300,000 to 900,000 from the viewpoint of achieving the effects of the present invention with good reproducibility. In addition, the dispersity is not particularly limited, but is usually 1.0 to 10.0, and is preferably 1.5 to 5.0, and more preferably 2.0 to 3.0 from the viewpoint of, for example, achieving suitable release with good reproducibility. Note

that the weight-average molecular weight and the dispersity can be measured by the above-described method related to the polyorganosiloxane as the adhesive component.

The viscosity of the epoxy group-containing polyorganosiloxane is not particularly limited, but is usually 1,000 to 2,000,000 mm^2/s. Note that the value of the viscosity of the epoxy group-containing polyorganosiloxane is expressed as kinematic viscosity, and centistokes (cSt)=mm^2/s. The value can also be determined by dividing the viscosity (mPa·s) by the density (g/cm^3). That is, the value can be determined from the viscosity measured with an E-type rotational viscometer at 25°C and the density, and can be calculated from the equation: kinematic viscosity (mm^2/s)=viscosity (mPa·s)/density (g/cm^3).

[0074]

<<<<Phenyl group-containing polyorganosiloxane>>>>

Examples of the phenyl group-containing polyorganosiloxane include those containing a siloxane unit (D^{30} unit) represented by $R^{31}R^{32}SiO_{2/2}$.

[0075]

R^{31} is a group bonded to a silicon atom and represents a phenyl group or an alkyl group, and R^{32} is a group bonded to a silicon atom and represents a phenyl group. Specific examples of the alkyl group include the

above-described examples, but a methyl group is preferable.

[0076]

The phenyl group-containing polyorganosiloxane contains the above-described siloxane unit (D^{30} unit), but may contain, in addition to the D^{30} unit, Q units, M units, and/or T units.

[0077]

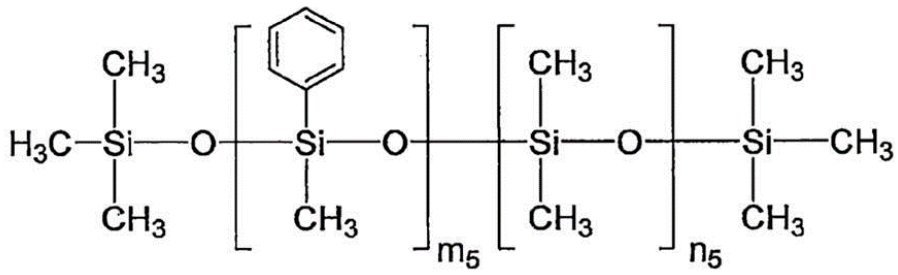
In a preferred embodiment, specific examples of the phenyl group-containing polyorganosiloxane include a polyorganosiloxane composed only of D^{30} units, a polyorganosiloxane containing D^{30} units and Q units, a polyorganosiloxane containing D^{30} units and M units, a polyorganosiloxane containing D^{30} units and T units, a polyorganosiloxane containing D^{30} units, Q units, and M units, a polyorganosiloxane containing D^{30} units, M units, and T units, and a polyorganosiloxane containing D^{30} units, Q units, M units, and T units.

[0078]

Specific examples of the phenyl group-containing polyorganosiloxane include, but are not limited to, those represented by Formula (P1) or (P2).

[0079]

[Chem. 5]

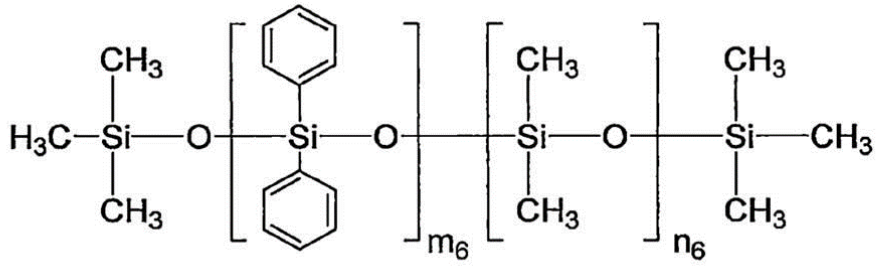


(P1)

(m5 and n5 represent the numbers of respective repeating units, and are positive integers.)

[0080]

[Chem. 6]



(P2)

(m6 and n6 represent the numbers of respective repeating units, and are positive integers.)

[0081]

In the above general formula, when m_5 and m_6 are 2 or more, these repeating units may be arranged adjacent to each other to form a block, or may be randomly arranged.

[0082]

<<<<Carbinol-modified polyorganosiloxane>>>>

The carbinol-modified polyorganosiloxane is not particularly limited.

The carbinol-modified polyorganosiloxane is a

polyorganosiloxane having a hydroxy group directly bonded to a carbon atom. As described above, the carbinol in the "carbinol-modified polyorganosiloxane" is not limited to methanol in a narrow sense, and includes methanol derivatives.

[0083]

The carbinol-modified polyorganosiloxane is, for example, a carbinol-modified polydimethylsiloxane.

[0084]

The number of hydroxy groups directly bonded to a carbon atom in the carbinol-modified polyorganosiloxane is not particularly limited, and may be one or two or more.

[0085]

The carbinol-modified polyorganosiloxane may have a hydroxy group directly bonded to a carbon atom in a side chain, may have a hydroxy group directly bonded to a carbon atom at one end, or may have hydroxy groups directly bonded to a carbon atom at both ends.

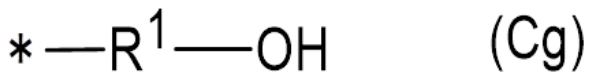
The carbinol-modified polyorganosiloxane preferably has a hydroxy group directly bonded to a carbon atom in a side chain. In this case, even when the content of the carbinol-modified polyorganosiloxane is small, it is possible to impart good releasability to the adhesive layer formed from the adhesive composition.

[0086]

The carbinol-modified polyorganosiloxane has, for example, a group represented by the following Formula (Cg) as a group directly bonded to a silicon atom.

[0087]

[Chem. 7]



(In Formula (Cg), R^1 represents a group having one or more carbon atoms. * represents a bond to a silicon atom. However, the hydroxy group in Formula (Cg) is directly bonded to a carbon atom.)

[0088]

The number of hydroxy groups directly bonded to a carbon atom in the group represented by Formula (Cg) may be one or two or more. Examples of the two or more include two, three, four, and the like.

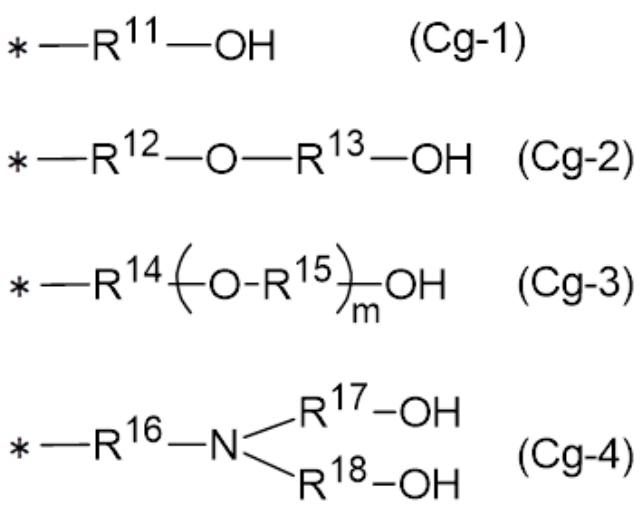
[0089]

The number of carbon atoms in R^1 is not particularly limited, and may be, for example, 1 to 30, 1 to 20, or 1 to 10.

[0090]

Examples of the group represented by Formula (Cg) include groups represented by the following Formulas (Cg-1) to (Cg-4)).

[Chem. 8]



(In Formula (Cg-1), R^{11} represents an alkylene group having 1 to 6 carbon atoms which may be substituted with an alkoxy group having 1 to 3 carbon atoms.

In Formula (Cg-2), R^{12} represents an alkylene group having 1 to 6 carbon atoms. R^{13} represents an alkylene group having 1 to 6 carbon atoms which may be substituted with an alkoxy group having 1 to 3 carbon atoms or a hydroxy group.

In Formula (Cg-3), R^{14} represents an alkylene group having 1 to 6 carbon atoms. R^{15} represents an alkylene group having 1 to 3 carbon atoms. m represents an integer of 1 to 10.

In Formula (Cg-4), R^{16} to R^{18} each independently represent an alkylene group having 1 to 6 carbon atoms.

In Formula (Cg-1) to Formula (Cg-4), * represents a

bond to a silicon atom.)

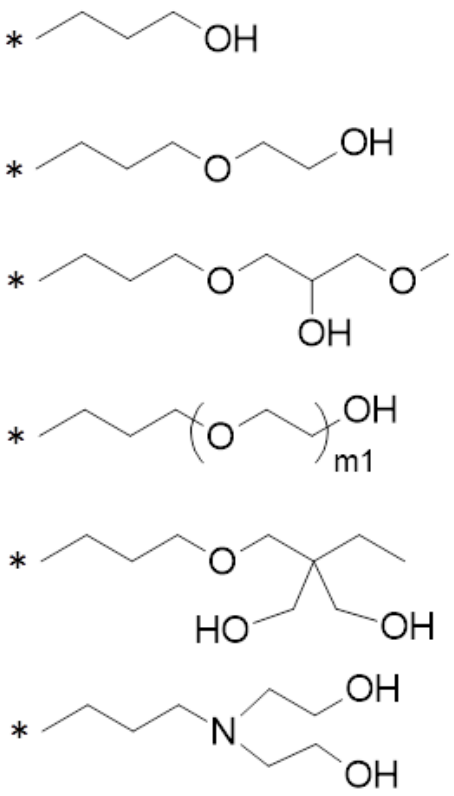
[0091]

The alkylene groups of R^{11} to R^{18} may be linear, branched, or cyclic.

[0092]

Examples of the group represented by Formula (Cg) include the following groups.

[Chem. 9]



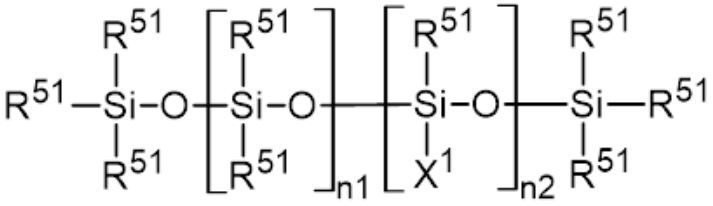
(In the formula, m1 represents an integer of 2 to 10. * represents a bond to a silicon atom.)

[0093]

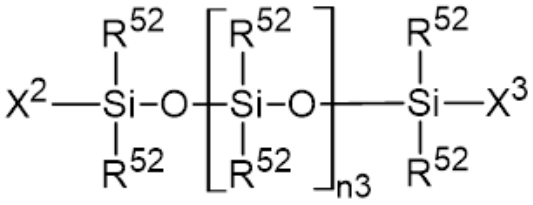
The carbinol-modified polyorganosiloxane is

represented by, for example, the following Formula (CPS-1) or (CPS-2).

[Chem. 10]



(CPS-1)



(CPS-2)

(In Formula (CPS-1), each R^{51} independently represents a hydrocarbon group. X^1 represents the group represented by Formula (Cg). n1 represents an integer of 0 or more. n2 represents an integer of 1 or more.

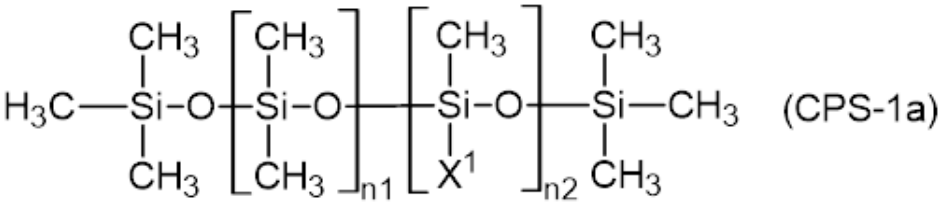
In Formula (CPS-2), each R^{52} independently represents a hydrocarbon group. X^2 represents the group represented by Formula (Cg). X^3 represents a hydrocarbon group or the group represented by Formula (Cg). n3 represents an integer of 0 or more.)

[0094]

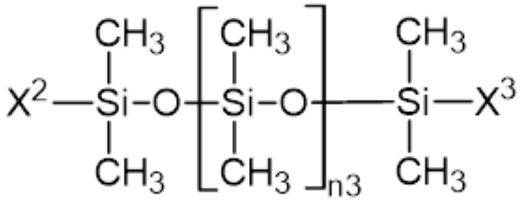
Examples of the hydrocarbon groups in R^{51}, R^{52}, and X^3 include alkyl groups having 1 to 8 carbon atoms. As the alkyl group having 1 to 8 carbon atoms, a methyl group is preferable. That is, the carbinol-modified

polyorganosiloxane is preferably polydimethylsiloxane represented by the following Formula (CPS-1a) or (CPS-2a).

[Chem. 11]



(CPS-1a)



(CPS-2a)

(In Formula (CPS-1a), X^1 represents the group represented by Formula (Cg). n1 represents an integer of 0 or more. n2 represents an integer of 1 or more.

In Formula (CPS-2a), X^2 represents the group represented by Formula (Cg). X^3 represents a methyl group or the group represented by Formula (Cg). n3 represents an integer of 0 or more.)

[0095]

Note that the carbinol-modified polyorganosiloxane represented by Formula (CPS-1) and the carbinol-modified polydimethylsiloxane represented by Formula (CPS-1a) have a hydroxy group directly bonded to a carbon atom in a side chain.

The carbinol-modified polyorganosiloxane represented

by Formula (CPS-2) and the carbinol-modified polydimethylsiloxane represented by Formula (CPS-2a) have a hydroxy group(s) directly bonded to a carbon atom at one terminal or both terminals.

[0096]

Note that when n2 is 2 or more in the carbinol-modified polyorganosiloxane represented by Formula (CPS-1), siloxane units represented by $-Si(R^{51})(X^{1})-O-$ may be arranged adjacent to each other to form a block, or may be randomly arranged.

In addition, when n2 is 2 or more in the carbinol-modified polydimethylsiloxane represented by Formula (CPS-1a), siloxane units represented by $-Si(CH_3)(X^{1})-O-$ may be arranged adjacent to each other to form a block, or may be randomly arranged.

[0097]

The weight-average molecular weight of the carbinol-modified polyorganosiloxane is not particularly limited, but is usually 500 to 1,000,000, and is preferably 5,000 to 50,000 from the viewpoint of achieving the effects of the present invention with good reproducibility. In addition, the dispersity is not particularly limited, but is usually 1.0 to 10.0, and is preferably 1.5 to 5.0, and more preferably 2.0 to 3.0 from the viewpoint of, for example, achieving suitable release with good reproducibility.

The viscosity of the carbinol-modified polyorganosiloxane is not particularly limited, but is usually 100 to 200,000 mm^2/s. Note that the value of the viscosity of the polydimethylsiloxane is expressed as kinematic viscosity, and centistokes (cSt)=mm^2/s. The value can also be determined by dividing the viscosity (mPa·s) by the density (g/cm^3). That is, the value can be determined from the viscosity measured with an E-type rotational viscometer at 25°C and the density, and can be calculated from the equation: kinematic viscosity (mm^2/s)=viscosity (mPa·s)/density (g/cm^3).

[0098]

The polyorganosiloxane as the release agent component (B) may be a commercially available product or a synthesized product.

Examples of commercially available polyorganosiloxanes include, but are not limited to, WACKERSILICONE FLUID AK series (AK50, AK 350, AK 1000, AK 10000, AK 1000000) and GENIOPLAST GUM, which are products manufactured by Wacker Chemie AG, dimethyl silicone oil (KF-96L, KF-96A, KF-96, KF-96H, KF-69, KF-965, KF-968) and cyclic dimethyl silicone oil (KF-995), manufactured by Shin-Etsu Chemical Co., Ltd.; epoxy group-containing polyorganosiloxane manufactured by Gelest, Inc. (trade names: CMS-227, ECMS-327, EMS-622), epoxy group-containing

polyorganosiloxane manufactured by Shin-Etsu Chemical Co., Ltd. (KF-101, KF-1001, KF-1005, X-22-343), epoxy group-containing polyorganosiloxane (DOWSIL BY16-839, DOWSIL8413, DOWSIL8411) manufactured by Dow Toray Co., Ltd.; and phenyl group-containing polyorganosiloxane (PMM-1043, PMM-1025, PDM-0421, PDM-0821) manufactured by Gelest, Inc., phenyl group-containing polyorganosiloxane (KF50-3000CS) manufactured by Shin-Etsu Chemical Co., Ltd., and phenyl group-containing polyorganosiloxane (TSF431, TSF433) manufactured by Momentive Performance Materials, Inc.

[0099]

In addition, examples of commercially available carbinol-modified polyorganosiloxanes include KF6000, KF6001, KF6002, KF6003, X-22-4039, and X-22-4015 manufactured by Shin-Etsu Silicone Co., Ltd.; DMS-C15, DMS-C16, DMS-C21, DMS-C23, DBE-C25, DBE-C22, DMS-CA21, DMS-CS26, CMS-221, CMS-222, CMS-832, CMS-626, MCR-C12, MCR-C18, MCR-C22, MCS-C11, MCS-C13, MCR-C61, MCR-C62, and MCR-C63 manufactured by Gelest, Inc.; and DOWSIL BY 16-201, DOWSIL SF 8427 Fluid, and DOWSIL SF 8428 Fluid manufactured by Dow Toray Co., Ltd.

[0100]

The content of the release agent component in the adhesive composition is not particularly limited, but is preferably 0.01 mass% or more, more preferably 0.05 mass%

or more, and particularly preferably 0.10 mass% or more based on the nonvolatile matter of the adhesive composition from the viewpoint of suitably obtaining the effects of the present invention. The upper limit is not particularly limited, but is, for example, preferably 30 mass% or less, more preferably 25 mass% or less, and particularly preferably 20 mass% or less.

The nonvolatile matter in the adhesive composition refers to a component other than the solvent in the adhesive composition.

[0101]

When the adhesive composition contains a polydimethylsiloxane, the content of the polydimethylsiloxane in the adhesive composition is not particularly limited, but is preferably 0.5 mass% to 30 mass%, more preferably 1 mass% to 10 mass%, and particularly preferably 2 mass% to 8 mass% with respect to the adhesive component from the viewpoint of suitably obtaining the effect of the present invention.

Note that the adhesive component here does not include a solvent.

[0102]

When the adhesive composition contains the epoxy group-containing polyorganosiloxane, the content of the epoxy group-containing polyorganosiloxane in the adhesive

composition is not particularly limited, but is preferably 0.05 mass% to 30 mass%, more preferably 0.1 mass% to 5 mass%, and particularly preferably 0.2 mass% to 3 mass% with respect to the adhesive component from the viewpoint of suitably obtaining the effect of the present invention.

Note that the adhesive component here does not include a solvent.

[0103]

When the adhesive composition contains the polydimethylsiloxane and the epoxy group-containing polyorganosiloxane, the mass ratio (B-1:B-2) between the polydimethylsiloxane (B-1) and the epoxy group-containing polyorganosiloxane (B-2) is not particularly limited, but is preferably 20:1 to 1:10, more preferably 15:1 to 1:7.5, and particularly preferably 15:1 to 5:1 from the viewpoint of suitably obtaining the effect of the present invention.

[0104]

In the adhesive composition, the total ratio of the polydimethylsiloxane and the epoxy group-containing polyorganosiloxane to the adhesive component is not particularly limited, but is preferably 1 mass% to 30 mass%, preferably 2 mass% to 10 mass%, and particularly preferably 3 mass% to 8 mass% from the viewpoint of suitably obtaining the effect of the present invention.

Note that the adhesive component here does not

include a solvent.

[0105]

<<<Solvent>>>

The adhesive composition may contain a solvent for the purpose of adjusting the viscosity and the like. Specific examples thereof include aliphatic hydrocarbons, aromatic hydrocarbons, and ketones, but are not limited thereto.

More specific examples thereof include, but are not limited to, hexane, heptane, octane, nonane, decane, undecane, dodecane, isododecane, menthane, limonene, toluene, xylene, mesitylene, cumene, MIBK (methyl isobutyl ketone), butyl acetate, diisobutyl ketone, 2-octanone, 2-nonanone, and 5-nonanone. Such solvents can be used alone or in combination with two or more thereof.

[0106]

When the adhesive composition contains a solvent, the content thereof is appropriately determined in consideration of the desired viscosity of the composition, the coating method to be employed, the thickness of the film to be produced, and the like, but is, for example, in a range of about 10 to 90 mass% with respect to the entire composition.

[0107]

The viscosity of the adhesive composition used in the

present invention is not particularly limited, but, at 25°C, is usually 500 to 20,000 mPa·s, and preferably 1,000 to 10,000 mPa·s.

[0108]

An example of the adhesive composition used in the present invention can be manufactured by mixing the adhesive component (A), the release agent component (B), and the solvent.

The mixing order is not particularly limited, and examples of a method by which the adhesive composition can be produced easily and with good reproducibility include, but are not limited to, a method in which the adhesive component (A) and the release agent component (B) are dissolved in the solvent, and a method in which the adhesive component (A) and a part of the release agent component (B) are dissolved in the solvent, the remainder is dissolved in a solvent, and the resulting solutions are mixed. When the adhesive composition is prepared, the components may be heated as appropriate, as long as the components are not decomposed or altered.

In the present invention, for the purpose of removing foreign matter, a solvent, a solution, or the like to be used may be filtered using a filter or the like during the production of the adhesive composition or after mixing all the components.

[0109]

<Primer coating film>

The primer coating film is formed on a surface of a substrate located on a side opposite to the side where a peeling interface is desired to be generated, with respect to the adhesive layer.

Here, the substrate on which the primer coating film is formed may be either the support substrate or the semiconductor substrate or the electronic device substrate (semiconductor substrate or the like).

When interfacial peeling is desired to be generated at an interface between the semiconductor substrate or the electronic device substrate (semiconductor substrate or the like) and the adhesive layer (in the case of device peeling), the primer coating film is formed on a surface of the support substrate.

On the other hand, when interfacial peeling is desired to be generated at an interface between the support substrate and the adhesive layer (in the case of carrier peeling), the primer coating film is formed on a surface of the semiconductor substrate or the electronic device substrate (semiconductor substrate or the like).

[0110]

The primer coating film is provided in order to increase adhesive strength between a substrate and an

adhesive layer formed from an adhesive composition containing an adhesive component that cures by a hydrosilylation reaction.

[0111]

The primer coating film is formed from a composition for forming a primer coating film.

[0112]

<<Composition for forming primer coating film>>

The composition for forming a primer coating film according to the present invention contains a component that further promotes a hydrosilylation reaction used when forming an adhesive layer, that is, a component contributing to the hydrosilylation reaction.

Since the composition for forming a primer coating film has a function of increasing adhesive strength between a substrate having a primer coating film on a surface thereof and an adhesive layer, in the present specification, the composition for forming a primer coating film is also referred to as an adhesion aid composition.

[0113]

Examples of the component contributing to the hydrosilylation reaction include a component selected from a compound containing platinum, a compound containing an Si-H group, and a compound containing a vinyl group.

[0114]

Examples of the compound containing platinum include a platinum group metal or a compound containing a platinum group metal.

The compound containing platinum may be, for example, a supported hydrosilylation catalyst including a solid carrier having a platinum group metal on a surface thereof. Examples of the supported catalyst include, but are not limited to, platinum-supported carbon, palladium-supported carbon, ruthenium-supported carbon, rhodium-supported carbon, platinum-supported silica, palladium-supported silica, platinum-supported alumina, palladium-supported alumina, and ruthenium-supported alumina.

[0115]

The compound containing platinum may be, for example, a photoactivatable hydrosilylation catalyst capable of initiating curing by irradiation and/or heating. The photoactivatable hydrosilylation catalyst refers to, for example, in particular, any hydrosilylation catalyst capable of catalyzing a hydrosilylation reaction by exposure to radiation having a wavelength of 150 to 800 nanometers (nm). The suitability of a specific photoactivatable hydrosilylation catalyst for use in the composition of the present invention can be readily determined by routine experimentation.

[0116]

Specific examples of the above photoactivatable hydrosilylation catalyst include, but are not limited to, platinum(II) β-diketonate complexes such as platinum(II) bis(2,4-pentanedioate), platinum(II) bis(2,4-hexanedioate), platinum(II) bis(2,4-heptanedioate), platinum(II) bis(1-phenyl-1,3-butanedioate), platinum(II) bis(1,3-diphenyl-1,3-propanedioate), and platinum(II) bis(1,1,1,5,5,5-hexafluoro-2,4-pentanedioate); (h-cyclopentadienyl)trialkylplatinum complexes, such as (Cp)trimethylplatinum, (Cp)ethyldimethylplatinum, (Cp)triethylplatinum, (chloro-Cp)trimethylplatinum, and (trimethylsilyl-Cp)trimethylplatinum, in which Cp represents cyclopentadienyl; triazene oxide-transition metal complexes such as $[Pt[C_6H_5NNNOCH_3]_4$, $Pt[p\text{-}CN\text{-}C_6H_4NNNOC_6H_{11}]_4$, $Pt[p\text{-}H_3COC_6H_4NNNOC_6H_{11}]_4$, $Pt[p\text{-}CH_3(CH_2)_x\text{-}C_6H_4NNNOCH_3]_4$, 1,5-cyclooctadiene $Pt[p\text{-}CN\text{-}C_6H_4NNNOC_6H_{11}]_2$, 1,5-cyclooctadiene $Pt[p\text{-}CH_3O\text{-}C_6H_4NNNOCH_3]_2$, $[(C_6H_5)_3P]_3Rh[p\text{-}CN\text{-}C_6H_4NNNOC_6H_{11}]$, and $Pd[p\text{-}CH_3(CH_2)_x\text{-}C_6H_4NNNOCH_3]_2$ [in the formula x is 1, 3, 5, 11, or 17]; and (h-diolefin)(σ-aryl)platinum complexes such as (h^4-1,5-cyclooctadienyl)diphenylplatinum, (h^4-1,3,5,7-cyclooctatetraenyl)diphenylplatinum, (h^4-2,5-norboradienyl)diphenylplatinum, (h^4-1,5-cyclooctadienyl)bis-(4-dimethylaminophenyl)platinum, (h^4-1,5-cyclooctadienyl)bis-(4-acetylphenyl)platinum, and (h^4-

1,5-cyclooctadienyl)bis-(4-trifluoromethylphenyl)platinum. Generally, the photoactivatable hydrosilylation catalyst is a Pt(II) β-diketonate complex, and more generally, the catalyst is platinum(II) bis(2,4-pentanedioate).

[0117]

The compound containing an Si-H group is not particularly limited as long as it contains an Si-H group, and examples thereof include a compound having a weight-average molecular weight (Mw) of 100 or more and 400,000 or less. In addition, a compound containing two or more Si-H groups in one molecule is preferable.

The compound containing an Si-H group may be a linear-type compound or a cyclic-type compound, and for example, in consideration of solubility in a solvent, a cyclic-type compound is preferable.

[0118]

The compound containing a vinyl group is not particularly limited as long as it contains a vinyl group, and examples thereof include a compound having a weight-average molecular weight (Mw) of 100 or more and 400,000 or less. In addition, a compound containing two or more vinyl groups in one molecule is preferable.

[0119]

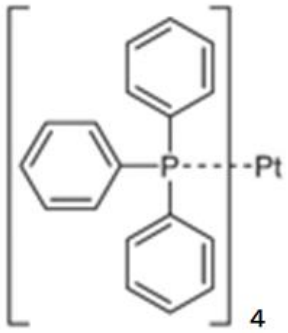
The compound containing platinum, the compound containing an Si-H group, and the compound containing a

vinyl group may be, for example, the adhesive component described in the section <<<Adhesive component>>> of <<Adhesive composition>> above.

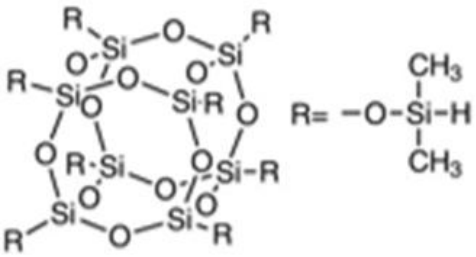
[0120]

Preferred embodiments of the component contributing to the hydrosilylation reaction include compounds containing platinum and compounds containing an Si-H group, which are also used in the following Examples and are represented by, for example, the following Formula (X-1) to the following Formula (X-4). However, the component is not limited thereto.

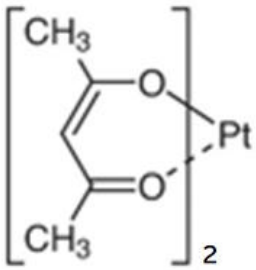
[Chem. 12]



(X-1)

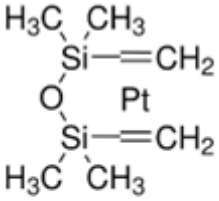


(X-2)



(X-3)

[Chem. 13]



(X-4)

[0121]

The composition for forming a primer coating film can be produced, for example, by mixing a component contributing to the hydrosilylation reaction and a solvent.

As the solvent, for example, propylene glycol monomethyl ether, propylene glycol monomethyl ether acetate, or the like is used.

[0122]

The method for forming a primer coating film from the composition for forming a primer coating film is not particularly limited, and examples thereof include a method of applying the composition for forming a primer coating film to form a primer coating film.

The method for applying the composition for forming a primer coating film is not particularly limited, but is usually a spin coating method.

[0123]

<Support substrate>

The support substrate is not particularly limited as long as it is a member capable of supporting the semiconductor substrate when the semiconductor substrate is processed. Examples thereof include a glass support substrate and a silicon support substrate.

[0124]

The shape of the support substrate is not

particularly limited, but examples thereof include a disk shape. The disk-shaped support substrate does not need to have a completely circular surface shape, and for example, the outer periphery of the support substrate may have a straight portion called an orientation flat or may have a cut called a notch.

The thickness of the disk-shaped support substrate may be appropriately determined depending on the size of the semiconductor substrate and the like, and is not particularly limited, but is, for example, 500 to 1,000 μm.

The diameter of the disk-shaped support substrate may be appropriately determined depending on the size of the semiconductor substrate and the like, and is not particularly limited, but is, for example, 100 to 1,000 mm.

[0125]

An example of the support substrate is a glass wafer having a diameter of about 300 mm and a thickness of about 700 μm.

[0126]

When peeling is performed by light irradiation in the laminate, a substrate that is light-transmissive to the light used is used as the support substrate, for example.

[0127]

<Semiconductor substrate or electronic device substrate>

<<Semiconductor substrate>>

The main material constituting the entire semiconductor substrate is not particularly limited as long as the material is used for this type of application, but examples thereof include silicon, silicon carbide, a compound semiconductor, and a glass substrate with an organic resin.

The shape of the semiconductor substrate is not particularly limited, but is, for example, a disk shape. The disk-shaped semiconductor substrate does not need to have a completely circular surface, and for example, the outer periphery of the semiconductor substrate may have a straight portion called an orientation flat or may have a cut called a notch.

The thickness of the disk-shaped semiconductor substrate may be appropriately determined depending on the purpose of use of the semiconductor substrate and the like, and is not particularly limited, but is, for example, 500 to 1,000 μm.

The diameter of the disk-shaped semiconductor substrate may be appropriately determined depending on the purpose of use of the semiconductor substrate and the like, and is not particularly limited, but is, for example, 100 to 1,000 mm.

[0128]

The semiconductor substrate may have a bump. The bump is a protruding terminal.

In the laminate, when the semiconductor substrate has a bump, the semiconductor substrate has the bump on the support substrate side.

In the semiconductor substrate, the bump is usually formed on a surface on which a circuit is formed. The circuit may be a single layer or a multilayer. The shape of the circuit is not particularly limited.

In the semiconductor substrate, a surface (back surface) opposite to the surface having the bump is a surface to be processed.

The material, size, shape, structure, and density of the bump of the semiconductor substrate are not particularly limited.

Examples of the bump include a ball bump, a printed bump, a stud bump, and a plated bump.

Usually, the height, radius, and pitch of the bump are appropriately determined from the conditions of a bump height of approximately 1 to 200 μm, a bump radius of 1 to 200 μm, and a bump pitch of 1 to 500 μm.

Examples of the material of the bump include low melting point solder, high melting point solder, tin, indium, gold, silver, and copper. The bump may contain only a single component or may contain a plurality of

components. More specific examples thereof include alloy plating mainly containing Sn, such as SnAg bumps, SnBi bumps, Sn bumps, and AuSn bumps.

In addition, the bump may have a laminated structure including a metal layer made of at least one of these components.

[0129]

An example of the semiconductor substrate is a silicon wafer having a diameter of about 300 mm and a thickness of about 770 μm.

[0130]

<<Electronic device substrate>>

The electronic device substrate refers to a substrate having an electronic device, and in the present invention refers to, for example, a substrate composed of a layer in which a plurality of semiconductor chip substrates are embedded in a sealing resin, that is, a substrate composed of a plurality of semiconductor chip substrates and the sealing resin disposed between the semiconductor chip substrates.

Here, the “electronic device” means a member constituting at least a part of an electronic component. The electronic device is not particularly limited, and can be one in which various mechanical structures and circuits are formed on the surface of a semiconductor substrate.

The electronic device is preferably a composite of a member made of metal or a semiconductor and a resin that seals or insulates the member. The electronic device may be one in which a rewiring layer, which will be described below, and/or a semiconductor element or other elements are sealed or insulated with a sealing material or an insulating material, and may have a single-layer or multi-layer structure.

[0131]

<Layer configuration of laminate>

Hereinafter, an example of the configuration of the laminate will be described with reference to the drawings.

Fig. 1 shows a schematic cross-sectional view of an example of the laminate.

The laminate of Fig. 1 includes a semiconductor substrate 1, an adhesive layer 2, and a support substrate 4 in this order. That is, the adhesive layer 2 is provided between the semiconductor substrate 1 and the support substrate 4. A primer coating film 3 is formed on a surface of the support substrate 4.

The laminate of Fig. 1 is a device peeling-type laminate.

[0132]

Fig. 2 shows a schematic cross-sectional view of another example of the laminate.

The laminate of Fig. 2 includes a support substrate 24, an adhesive layer 22, and an electronic device substrate 26 in this order.

The electronic device substrate 26 includes a plurality of semiconductor chip substrates 21 and a sealing resin 25, which is a sealing material disposed between the semiconductor chip substrates 21.

The adhesive layer 22 is provided between the electronic device substrate 26 and the support substrate 24. A primer coating film 23 is formed on a surface of the support substrate 24.

The laminate of Fig. 2 is a device peeling-type laminate.

[0133]

(Method for producing laminate)

A method for producing a laminate of the present invention is a method for producing a laminate, the laminate including:

a support substrate;

a semiconductor substrate or an electronic device substrate;

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate; and

a primer coating film formed on a substrate surface

of any one of the semiconductor substrate, the electronic device substrate, and the support substrate,

the method including a step of forming a primer coating film by applying the above-described composition for forming a primer coating film to a substrate surface of any one of the semiconductor substrate, the electronic device substrate, and the support substrate.

In addition, the method for producing a laminate of the present invention may be a production method further including:

a step of applying an adhesive composition for forming the adhesive layer to a substrate on which the primer coating film is not formed, the substrate being any one of the semiconductor substrate, the electronic device substrate, and the support substrate; and

a step of bonding together the substrate on which the primer coating film is formed and the substrate to which the adhesive composition is applied, and then performing heat treatment to form an adhesive layer between the semiconductor substrate or the electronic device substrate and the support substrate.

[0134]

In addition, in consideration that the laminate is particularly a device peeling-type laminate, the method for producing a laminate of the present invention is preferably

a production method including:

a step of forming a primer coating film by applying the above-described composition for forming a primer coating film to a surface of a support substrate;

a step of applying an adhesive composition for forming an adhesive layer to a semiconductor substrate or an electronic device substrate; and

a step of bonding together the support substrate on which the primer coating film is formed and the semiconductor substrate or the electronic device substrate to which the adhesive composition is applied, and then performing heat treatment to form an adhesive layer between the semiconductor substrate or the electronic device substrate and the support substrate.

[0135]

The method for producing a laminate will be described below using the laminate shown in Fig. 1 as an example.

An example of the laminate of the present invention can be produced, for example, by a method including the following first to fourth steps.

First step: a step of applying a composition for forming a primer coating film onto a support substrate to form a primer coating film on a surface of the support substrate

Second step: a step of applying an adhesive

composition onto a semiconductor substrate to form an adhesive coating layer (and, as necessary, further heating the adhesive coating layer to form an adhesive layer)

Third step: a step of placing the support substrate having the primer coating film disposed on a surface thereof on the adhesive coating layer or the adhesive layer, and bonding together the support substrate having the primer coating film disposed on the surface thereof and the semiconductor substrate via the adhesive coating layer or the adhesive layer while performing at least one of heat treatment and reduced-pressure treatment

Fourth step: a step of curing the adhesive coating layer by post-heating treatment to form an adhesive layer

[0136]

The method for applying the composition for forming a primer coating film is not particularly limited, but is usually a spin coating method.

The spin coating conditions are, for example, 1,000 rpm for 60 seconds.

[0137]

The method for applying the adhesive composition is not particularly limited, but is usually a spin coating method. A method for separately forming a coating film by a spin coating method or the like, forming a sheet-like coating film, and attaching the sheet-like coating film as

an adhesive coating layer can be adopted.

The heating temperature of the applied adhesive composition varies depending on the type and amount of the adhesive component contained in the adhesive composition, whether or not a solvent is contained, the boiling point of the solvent to be used, the desired thickness of the adhesive layer, and the like, and thus cannot be generally determined, but the heating temperature is usually 80 to 150°C, and the heating time is usually 30 seconds to 5 minutes.

When the adhesive composition contains a solvent, the applied adhesive composition is usually heated.

The film thickness of an adhesive coating layer obtained by applying an adhesive composition and heating the adhesive composition, as necessary, is usually about 5 to 500 μm, and finally, is appropriately determined to fall within the above-described range of the thickness of the adhesive layer.

[0138]

In the present invention, the laminate of the present invention can be obtained by applying a load in the thickness direction of the semiconductor substrate and the support substrate while performing heat treatment or reduced-pressure treatment, or both, and then performing post-heating treatment. The treatment conditions to be

adopted, among heat treatment, reduced-pressure treatment, and a combination of both, are appropriately determined taking into consideration various factors such as the type of adhesive composition, the film thickness, and the desired adhesive strength.

[0139]

The temperature of the heat treatment is usually appropriately determined from the range of 20 to 160°C from the viewpoint of removing the solvent from the composition and the like. In particular, from the viewpoint of suppressing or avoiding excessive curing and unnecessary alteration of the adhesive component (A), the heating temperature is preferably 150°C or lower, and more preferably 130°C or lower, and the heating time is appropriately determined depending on the heating temperature and the type of adhesive, but, from the viewpoint of reliably exhibiting suitable adhesion, is usually 30 seconds or longer, and preferably 1 minute or longer, and, from the viewpoint of suppressing alteration of the adhesive layer and other members, is usually 10 minutes or shorter, and preferably 5 minutes or shorter.

[0140]

In the reduced-pressure treatment, the adhesive coating layers in contact with each other may be exposed to a pressure of 10 to 10,000 Pa. The time for the reduced-

pressure treatment is usually 1 to 30 minutes.

[0141]

The load in the thickness direction of the semiconductor substrate and the support substrate is not particularly limited as long as the load does not adversely affect the semiconductor substrate, the support substrate, and the layers therebetween, and can bring them into close contact with each other, but is usually within the range of 10 to 50,000 N.

[0142]

The temperature of the post-heating is preferably 120°C or higher from the viewpoint of achieving a sufficient curing rate and the like, and is preferably 260°C or lower from the viewpoint of preventing alteration of the substrates and the respective layers, and the like.

The post-heating time is usually 1 minute or more, and preferably 5 minutes or more from the viewpoint of achieving suitable bonding of the substrates and layers constituting the laminate, and is usually 180 minutes or less, and preferably 120 minutes or less from the viewpoint of suppressing or avoiding adverse effects on each layer due to excessive heating, and the like.

The heating can be performed using a hot plate, an oven, or the like. When post-heating is performed using a hot plate, heating may be performed with either the

semiconductor substrate or the support substrate of the laminate facing downward. Preferably, the post-heating is performed with the semiconductor substrate facing downward from the viewpoint of achieving suitable peeling with excellent reproducibility.

One object of the post-heating treatment is to achieve an adhesive layer that is a more suitable self-supporting film, and, in particular, to suitably achieve curing by a hydrosilylation reaction.

[0143]

Figs. 3A to 3C are views illustrating one embodiment for producing the laminate shown in Fig. 1.

First, a laminate in which the primer coating film 3 is formed on the support substrate 4 is prepared (Fig. 3A). This laminate can be obtained, for example, by applying the composition for forming a primer coating film onto the support substrate 4 by spin coating.

Next, a laminate in which the adhesive coating layer 2a is formed on the semiconductor substrate 1 is prepared (Fig. 3B). This laminate can be obtained, for example, by applying the adhesive composition onto the semiconductor substrate 1 and heating the adhesive composition.

Next, the laminate composed of the support substrate 4 having the primer coating film 3 formed on a surface thereof shown in Fig. 3A and the laminate composed of the

semiconductor substrate 1 having the adhesive coating layer 2a shown in Fig. 3B are bonded together such that the adhesive coating layer 2a is in contact with the support substrate 4 via the primer coating film 3. Then, after applying a load in the thickness direction of the semiconductor substrate 1 and the support substrate 4 under reduced pressure, a heating device (not shown; hot plate) is disposed on a surface of the semiconductor substrate 1 opposite to the surface in contact with the adhesive coating layer 2a, and the adhesive coating layer 2a is heated and cured by the heating device to be converted into the adhesive layer 2 (Fig. 3C).

The laminate shown in Fig. 1 is obtained by the steps shown in Figs. 3A to 3C.

[0144]

In addition, the method for producing the laminate will be described below using the laminate shown in Fig. 2 as an example.

An example of the laminate of the present invention can be produced, for example, by a method including the following first (D) to fifth (D) steps.

First (D) step: a step of applying a composition for forming a primer coating film onto a support substrate to form a primer coating film on a surface of the support substrate

Second (D) step: a step of applying an adhesive composition onto a semiconductor chip substrate to form an adhesive coating layer (and, as necessary, further heating the adhesive coating layer to form an adhesive layer)

Third (D) step: a step of placing the support substrate having the primer coating film disposed on a surface thereof on the adhesive coating layer or the adhesive layer, and bonding together the support substrate having the primer coating film disposed on the surface thereof and the semiconductor chip substrate via the adhesive coating layer or the adhesive layer while performing at least one of heat treatment and reduced-pressure treatment

Fourth (D) step: a step of curing the adhesive coating layer by post-heating treatment to form an adhesive layer

Fifth (D) step: a step of sealing the semiconductor chip substrate fixed on the adhesive layer using a sealing resin

[0145]

Figs. 4A to 4D are views for explaining one embodiment for producing the laminate shown in Fig. 2.

First, a laminate in which the primer coating film 23 is formed on the support substrate 24 is prepared (Fig. 4A). This laminate can be obtained, for example, by

applying the composition for forming a primer coating film onto the support substrate 24 by spin coating.

Next, a laminate in which the adhesive coating layer 22a is formed on the semiconductor chip substrate 21 is prepared (Fig. 4B). This laminate can be obtained, for example, by applying the adhesive composition onto the semiconductor chip substrate 21 and heating the adhesive composition. At this time, the adhesive coating layer 22a may be heated to form the adhesive layer 22.

Next, the laminate composed of the support substrate 24 having the primer coating film 23 formed on a surface thereof shown in Fig. 4A and the laminate composed of the semiconductor chip substrate 21 having the adhesive coating layer 22a shown in Fig. 4B are bonded together such that the adhesive coating layer 22a is in contact with the support substrate 24 via the primer coating film 23. Then, after applying a load in the thickness direction of the semiconductor chip substrate 21 and the support substrate 24 under reduced pressure, a heating device (not shown; hot plate) is disposed on a surface of the semiconductor chip substrate 21 opposite to the surface in contact with the adhesive coating layer 22a, and the adhesive coating layer 22a is heated and cured by the heating device to be converted into the adhesive layer 22 (Fig. 4C).

Next, as shown in Fig. 4D, the semiconductor chip

substrate 21 fixed on the adhesive layer 22 is sealed using the sealing resin 25. In Fig. 4D, a plurality of semiconductor chip substrates 21 temporarily bonded onto the support substrate 24 via the adhesive layer 22 are sealed with the sealing resin 25. The electronic device substrate 26 having the semiconductor chip substrates 21 and the sealing resin 25 disposed between the semiconductor chip substrates 21 is formed on the adhesive layer 22, and thus, the electronic device substrate 26 is a base material layer in which a plurality of semiconductor chip substrates are embedded in a sealing resin.

The laminate shown in Fig. 2 is obtained by the steps shown in Figs. 4A to 4D.

[0146]

<Sealing step>

The semiconductor chip substrate 21 is sealed using a sealing material.

As the sealing material for sealing the semiconductor chip substrate 21, a member capable of insulating or sealing a member made of metal or a semiconductor is used.

In the present invention, for example, a resin composition (sealing resin) is used as the sealing material. The type of the sealing resin is not particularly limited as long as the sealing resin can seal and/or insulate metal or a semiconductor, and for example,

an epoxy-based resin or a silicone-based resin is preferably used.

The sealing material may contain, in addition to the resin component, other components such as a filler. Examples of the filler include spherical silica particles.

In the sealing step, for example, the sealing resin heated to 130 to 170°C is supplied onto the adhesive layer 22 to cover the semiconductor chip substrate 21 while maintaining a high viscosity state, and is compression-molded to form a layer formed of the sealing resin 25 on the adhesive layer 22. At this time, the temperature condition is, for example, 130 to 170°C. In addition, the pressure applied to the semiconductor chip substrate 21 is, for example, 50 to 500 N/cm^2.

[0147]

(Method for manufacturing processed semiconductor substrate or electronic device substrate)

When the laminate according to the present invention is used, a method for manufacturing a processed semiconductor substrate or a method for manufacturing a processed electronic device substrate can be provided.

A method for manufacturing a processed semiconductor substrate or electronic device substrate of the present invention is characterized by including:

a fifth step in which the semiconductor substrate or

electronic device substrate (semiconductor substrate or the like) in the laminate of the present invention is processed; and

a sixth step in which the semiconductor substrate or the electronic device substrate (semiconductor substrate or the like) processed by the fifth step and the support substrate in the laminate are separated.

In this way, the method for manufacturing a processed semiconductor substrate of the present invention includes the following fifth step and the following sixth step. The method for manufacturing a processed electronic device substrate may further include the following seventh step.

Fifth step: a step of processing the semiconductor substrate or electronic device substrate (semiconductor substrate or the like) in the laminate of the present invention

Sixth step: a step of separating the semiconductor substrate or electronic device substrate (semiconductor substrate or the like) processed by the fifth step from the support substrate

Seventh step: a step of cleaning the processed semiconductor substrate or electronic device substrate after the sixth step

[0148]

The processing performed on the semiconductor

substrate or electronic device substrate (semiconductor substrate or the like) in the fifth step is, for example, processing of a side of a wafer opposite to a circuit surface, and examples thereof include thinning of the wafer by polishing a back surface of the wafer. Thereafter, for example, a through-silicon via (TSV) or the like is formed, and the thinned wafer is then released from the support substrate to form a laminate of wafers which are three-dimensionally mounted. In addition, for example, before or after that, a wafer back surface electrode and the like are also formed. In wafer thinning and the TSV process, heat of approximately 250 to 350°C is applied while the wafer is bonded to the support substrate. The laminate of the present invention, including its adhesive layer, ordinarily has heat resistance to that load.

The processing is not limited to the above-described processing, and includes, for example, implementation of a process of mounting a semiconductor component in a case where the support substrate is temporarily bonded in order to support a base material for mounting the semiconductor component.

[0149]

In particular, when the laminate is a laminate having an electronic device substrate, examples of the processing performed on the electronic device substrate in the fifth

step include a grinding step and a wiring layer forming step described below.

[0150]

<Grinding step>

The grinding step is a step of grinding a resin portion of the layer of the sealing resin 25 in the electronic device substrate 26 so that a part of the semiconductor chip substrate 21 is exposed.

[0151]

<Wiring layer forming step>

The wiring layer forming step is a step of forming a wiring layer on the exposed semiconductor chip substrate 21 after the grinding step.

The wiring layer is also called a redistribution layer (RDL), and is a thin-film wiring body constituting wiring connected to a substrate, and may have a single-layer or multi-layer structure. The wiring layer may be, but is not limited to, one in which wiring is formed of a conductor (for example, metals such as aluminum, copper, titanium, nickel, gold, and silver, and alloys such as a silver-tin alloy) between dielectrics (for example, silicon oxide (SiO_x) or a photosensitive resin such as photosensitive epoxy).

Examples of the method for forming the wiring layer include the following methods.

First, a dielectric layer of silicon oxide (SiO_x), a photosensitive resin, or the like is formed on the layer of the sealing resin 25. The dielectric layer made of silicon oxide can be formed by, for example, a sputtering method, a vacuum vapor deposition method, or the like. The dielectric layer made of a photosensitive resin can be formed by applying a photosensitive resin onto the layer of the sealing resin 25 by a method such as spin coating, dipping, roller blade, spray coating, or slit coating.

Subsequently, wiring is formed on the dielectric layer with a conductor such as metal. As a method for forming the wiring, for example, known semiconductor process techniques such as lithography processing such as photolithography (resist lithography) or etching processing can be used. Examples of such lithography processing include lithography processing using a positive resist material and lithography processing using a negative resist material.

[0152]

In the sixth step, the method for separating (peeling) the semiconductor substrate or electronic device substrate and the support substrate (semiconductor substrate or the like) from each other is not particularly limited.

Examples thereof include a method of mechanically

peeling using equipment having a sharp portion (a so-called debonder). Specifically, for example, after the sharp portion is inserted between the semiconductor substrate or electronic device substrate (semiconductor substrate or the like) and the support substrate, the semiconductor substrate or electronic device substrate (semiconductor substrate or the like) and the support substrate are separated.

[0153]

The substrate can be cleaned by spraying a cleaning agent composition onto a surface of at least one of the separated semiconductor substrate or electronic device substrate (semiconductor substrate or the like) and the support substrate, or by immersing the separated semiconductor substrate or electronic device substrate (semiconductor substrate or the like) or support substrate in a cleaning agent composition.

In addition, the surface of the processed semiconductor substrate or the like may be cleaned using a removal tape or the like.

As an example of cleaning the substrate, after the sixth step, a seventh step of cleaning the processed semiconductor substrate or the like may be performed.

Examples of the cleaning agent composition used for cleaning include the following.

[0154]

The cleaning agent composition usually contains a solvent.

Examples of the solvent include lactones, ketones, polyhydric alcohols, compounds having an ester bond, derivatives of polyhydric alcohols, cyclic ethers, esters, and aromatic organic solvents.

Examples of the lactones include γ-butyrolactone.

Examples of the ketones include acetone, methyl ethyl ketone, cyclohexanone, methyl-n-pentyl ketone, methyl isopentyl ketone, and 2-heptanone.

Examples of the polyhydric alcohols include ethylene glycol, diethylene glycol, propylene glycol, and dipropylene glycol.

Examples of the compound having an ester bond include ethylene glycol monoacetate, diethylene glycol monoacetate, propylene glycol monoacetate, and dipropylene glycol monoacetate.

Examples of the derivatives of polyhydric alcohols include monoalkyl ethers such as monomethyl ether, monoethyl ether, monopropyl ether, and monobutyl ether of the polyhydric alcohols or the compounds having an ester bond, or compounds having an ether bond such as monophenyl ether. Among them, propylene glycol monomethyl ether acetate (PGMEA) and propylene glycol monomethyl ether

(PGME) are preferable.

Examples of the cyclic ethers include dioxane.

Examples of the esters include methyl lactate, ethyl lactate (EL), methyl acetate, ethyl acetate, butyl acetate, methyl pyruvate, ethyl pyruvate, methyl methoxypropionate, and ethyl ethoxypropionate.

Examples of the aromatic organic solvents include anisole, ethyl benzyl ether, cresyl methyl ether, diphenyl ether, dibenzyl ether, phenetole, butyl phenyl ether, ethylbenzene, diethylbenzene, pentylbenzene, isopropylbenzene, toluene, xylene, cymene, and mesitylene.

These can be used alone or in combination with two or more thereof.

Among them, propylene glycol monomethyl ether acetate (PGMEA), propylene glycol monomethyl ether (PGME), cyclohexanone, and ethyl lactate (EL) are preferable.

[0155]

In addition, a mixed solvent obtained by mixing PGMEA and a polar solvent is also preferable. The blending ratio (mass ratio) may be appropriately determined in consideration of compatibility between PGMEA and the polar solvent or the like, and is preferably in the range of 1:9 to 9:1, more preferably 2:8 to 8:2.

For example, when EL is blended as the polar solvent, the mass ratio of PGMEA:EL is preferably 1:9 to 9:1, more

preferably 2:8 to 8:2. In addition, when PGME is blended as the polar solvent, the mass ratio of PGMEA:PGME is preferably 1:9 to 9:1, more preferably 2:8 to 8:2, still more preferably 3:7 to 7:3. In addition, when PGME and cyclohexanone are blended as the polar solvent, the mass ratio of PGMEA:(PGME + cyclohexanone) is preferably 1:9 to 9:1, more preferably 2:8 to 8:2, still more preferably 3:7 to 7:3.

[0156]

The cleaning agent composition may contain or may not contain a salt, but it is preferable that the cleaning agent composition does not contain a salt from the viewpoint of enhancing versatility in processing a semiconductor substrate using a laminate, and suppressing cost.

[0157]

An example of the case where the cleaning agent composition contains a salt includes a cleaning agent composition containing a quaternary ammonium salt and a solvent.

The quaternary ammonium salt is composed of a quaternary ammonium cation and an anion, and is not particularly limited as long as the quaternary ammonium salt is used for this type of application.

Such quaternary ammonium cations typically include

tetra(hydrocarbon)ammonium cations. On the other hand, examples of an anion paired therewith include, but are not limited to, a hydroxide ion (OH^-); a halogen ion such as a fluoride ion (F^-), a chloride ion (Cl^-), a bromide ion (Br^-), and an iodide ion (I^-); a tetrafluoroborate ion (BF_4^-); and a hexafluorophosphate ion (PF_6^-).

[0158]

The quaternary ammonium salt is preferably a halogen-containing quaternary ammonium salt, and more preferably a fluorine-containing quaternary ammonium salt.

In the quaternary ammonium salt, the halogen atom may be contained in the cation or the anion, and is preferably contained in the anion.

[0159]

In a preferred embodiment, the fluorine-containing quaternary ammonium salt is tetra(hydrocarbon)ammonium fluoride.

Specific examples of the hydrocarbon group in tetra(hydrocarbon)ammonium fluoride include an alkyl group having 1 to 20 carbon atoms, an alkenyl group having 2 to 20 carbon atoms, an alkynyl group having 2 to 20 carbon atoms, and an aryl group having 6 to 20 carbon atoms.

In a more preferred embodiment, the tetra(hydrocarbon)ammonium fluoride includes tetraalkylammonium fluoride.

Specific examples of tetraalkylammonium fluoride include, but are not limited to, tetramethylammonium fluoride, tetraethylammonium fluoride, tetrapropylammonium fluoride, and tetrabutylammonium fluoride. Among them, tetrabutylammonium fluoride is preferable.

[0160]

As the quaternary ammonium salt such as tetra(hydrocarbon)ammonium fluoride, a hydrate may be used. In addition, the quaternary ammonium salts such as tetra(hydrocarbon)ammonium fluoride may be used alone or in combination of two or more thereof.

The amount of the quaternary ammonium salt is not particularly limited as long as the quaternary ammonium salt dissolves in the solvent contained in the cleaning agent composition, but is usually 0.1 to 30 mass% with respect to the cleaning agent composition.

[0161]

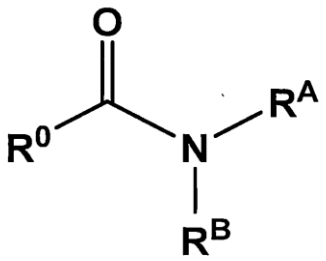
When the cleaning agent composition contains a salt, the solvent to be used in combination is not particularly limited as long as the solvent is used for this type of application and dissolves a salt such as a quaternary ammonium salt, but from the viewpoint of obtaining a cleaning agent composition having excellent cleanability with good reproducibility, from the viewpoint of obtaining a cleaning agent composition having excellent uniformity by

satisfactorily dissolving a salt such as a quaternary ammonium salt, and the like, the cleaning agent composition preferably contains one or two or more amide-based solvents.

[0162]

Suitable examples of the amide-based solvents include an acid amide derivative represented by Formula (Z).

[Chem. 14]



(Z)

[0163]

In the formula, R^0 represents an ethyl group, a propyl group or an isopropyl group, and is preferably an ethyl group or an isopropyl group, and more preferably an ethyl group. R^A and R^B each independently represent an alkyl group having 1 to 4 carbon atoms. The alkyl group having 1 to 4 carbon atoms may be linear, branched, or cyclic, and specific examples thereof include a methyl group, an ethyl group, a propyl group, an isopropyl group, a cyclopropyl group, an n-butyl group, an isobutyl group, an s-butyl group, a t-butyl group, and a cyclobutyl group. Among them, R^A and R^B are each preferably a methyl group or

an ethyl group, more preferably both are methyl groups or ethyl groups, and still more preferably both are methyl groups.

[0164]

Examples of the acid amide derivative represented by Formula (Z) include N,N-dimethylpropionamide, N,N-diethylpropionamide, N-ethyl-N-methylpropionamide, N,N-dimethylbutyramide, N,N-diethylbutyramide, N-ethyl-N-methylbutyramide, N,N-dimethylisobutyramide, N,N-diethylisobutyramide, and N-ethyl-N-methylisobutyramide. Among them, N,N-dimethylpropionamide and N,N-dimethylisobutylamide are particularly preferable, and N,N-dimethylpropionamide is more preferable.

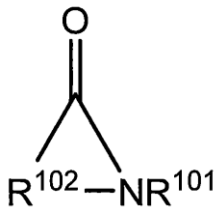
[0165]

The acid amide derivative represented by Formula (Z) may be synthesized by a substitution reaction between a corresponding carboxylic acid ester and an amine, or a commercially available product may be used.

[0166]

Other preferred examples of the amide-based solvents include a lactam compound represented by Formula (Y).

[Chem. 15]



(Y)

[0167]

In Formula (Y), R^{101} represents a hydrogen atom or an alkyl group having 1 to 6 carbon atoms, and R^{102} represents an alkylene group having 1 to 6 carbon atoms. Specific examples of the alkyl group having 1 to 6 carbon atoms include a methyl group, an ethyl group, an n-propyl group, and an n-butyl group, and specific examples of the alkylene group having 1 to 6 carbon atoms include, but are not limited to, a methylene group, an ethylene group, a trimethylene group, a tetramethylene group, a pentamethylene group, and a hexamethylene group.

[0168]

Specific examples of the lactam compound represented by Formula (Y) include an α-lactam compound, a β-lactam compound, a γ-lactam compound, and a δ-lactam compound, and these compounds can be used alone or in combination of two or more thereof.

[0169]

In a preferred embodiment, the lactam compound represented by Formula (Y) contains 1-alkyl-2-pyrrolidone (N-alkyl-γ-butyrolactam), in a more preferred embodiment,

contains N-methylpyrrolidone (NMP) or N-ethylpyrrolidone (NEP), and in a still more preferred embodiment, contains N-methylpyrrolidone (NMP).

[0170]

The cleaning agent composition used in the present invention may contain water as a solvent, but usually, only an organic solvent is intended to be used as the solvent from the viewpoint of avoiding corrosion of the substrates and the like. In this case, it is not denied that water of hydration of the salt or trace amounts of water contained in the organic solvent are included in the cleaning agent composition. The water content of the cleaning agent composition used in the present invention is usually 5 mass% or less.

[0171]

The constituent elements and method elements relating to the above-described steps of the method for manufacturing a processed semiconductor substrate or electronic device substrate (semiconductor substrate or the like) of the present invention may be variously modified without departing from the gist of the present invention.

The method for manufacturing a processed semiconductor substrate or electronic device substrate (semiconductor substrate or the like) of the present invention may include steps other than the above-described

steps.

[0172]

(Composition for forming primer coating film)

The composition for forming a primer coating film of the present invention is a composition for forming a primer coating film for increasing adhesive strength between a substrate and an adhesive layer formed from an adhesive composition containing an adhesive component that cures by a hydrosilylation reaction, and is a composition containing a component contributing to the hydrosilylation reaction. Details thereof are as described in the section <<Composition for Forming Primer Coating Film>> under <Primer Coating Film> in (Laminate) above.

The adhesive layer, which is the target whose adhesion to a substrate is enhanced via the composition for forming a primer coating film, is as described in the section <Adhesive Layer> in (Laminate) above.

Examples

[0173]

Hereinafter, the present invention will be described more specifically with reference to Examples, but the present invention is not limited to the following Examples. The apparatuses used were as follows.

[0174]

[Apparatus]

(1) Stirrer A: Planetary centrifugal mixer ARE-500, manufactured by THINKY Corporation

(2) Stirrer B: Mix Rotor VMR-5R, AS ONE Corporation

(3) Stirrer C: Three-One Motor BLW-600, Shinto Scientific Co., Ltd.

(4) Spin coating apparatus: Coater, manufactured by APOGEE Corporation

(5) Measurement of complex viscosity: Rheometer MCR-302, manufactured by Anton Paar GmbH

(6) Vacuum bonding apparatus: auto bonder, manufactured by SUSS MicroTec SE

(7) Peeling apparatus Y: auto debonder, manufactured by SUSS MicroTec SE

[0175]

[1] Preparation of composition for forming primer coating film (adhesion aid composition)

[Preparation Example 1-1]

To a 100 mL glass container with a lid, 0.01 g of tetrakis(triphenylphosphine)platinum represented by the following Formula (X-1) (manufactured by Tokyo Chemical Industry Co., Ltd.), 49.995 g of propylene glycol monomethyl ether, and 49.995 g of propylene glycol monomethyl ether acetate were added, and the mixture was stirred with a stirrer A for 5 minutes to obtain a composition for forming a primer coating film (hereinafter,

also referred to as an adhesion aid composition).

[0176]

[Preparation Example 1-2]

To a 100 mL glass container with a lid, 0.01 g of octakis(dimethylsilyloxy)octasilsesquioxane represented by the following Formula (X-2) (manufactured by Tokyo Chemical Industry Co., Ltd.) and 99.99 g of propylene glycol monomethyl ether acetate were added, and the mixture was stirred with a stirrer A for 5 minutes to obtain an adhesion aid composition.

[0177]

[Preparation Example 1-3]

To a 100 mL glass container with a lid, 0.01 g of bis(2,4-pentanedionato)platinum represented by the following Formula (X-3) (manufactured by Tokyo Chemical Industry Co., Ltd.), 49.995 g of p-menthane, and 49.995 g of propylene glycol monomethyl ether acetate were added, and the mixture was stirred with a stirrer A for 5 minutes to obtain an adhesion aid composition.

[0178]

[Preparation Example 1-4]

To a 100 mL glass container with a lid, 0.01 g of a platinum(0)-1,3-divinyl-1,1,3,3-tetramethyldisiloxane complex solution represented by the following Formula (X-4) (manufactured by Sigma-Aldrich) and 99.99 g of p-menthane

were added, and the mixture was stirred with a stirrer A for 5 minutes to obtain an adhesion aid composition.

[0179]

[Preparation Example 1-5]

To a 100 mL glass container with a lid, 0.01 g of [bicyclo[2.2.1]hept-5-en-2-yl]triethoxysilane represented by the following Formula (XR-1) (Gelest Inc.) and 99.99 g of propylene glycol monomethyl ether acetate were added, and the mixture was stirred with a stirrer A for 5 minutes to obtain an adhesion aid composition.

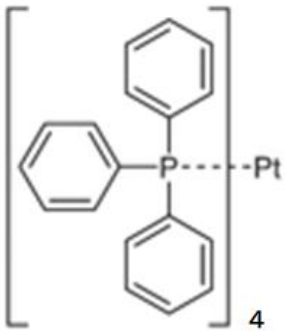
[0180]

[Preparation Example 1-6]

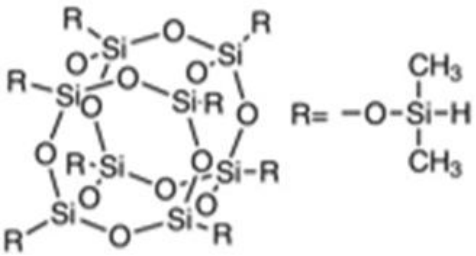
To a 100 mL glass container with a lid, 0.1 g of [bicyclo[2.2.1]hept-5-en-2-yl]triethoxysilane (Gelest Inc.) and 99.9 g of propylene glycol monomethyl ether acetate were added, and the mixture was stirred with a stirrer A for 5 minutes to obtain an adhesion aid composition.

[0181]

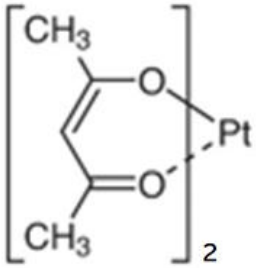
[Chem. 16]



(X-1)



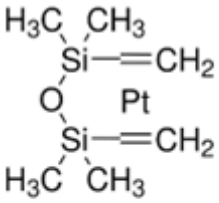
(X-2)



(X-3)

[0182]

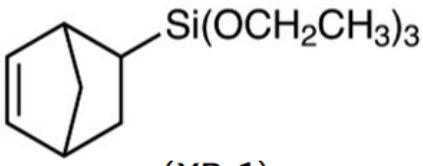
[Chem. 17]



(X-4)

[0183]

[Chem. 18]



(XR-1)

[0184]

[2] Preparation of adhesive composition

[Preparation Example 2-1]

To a 50 mL glass container with a lid, 1.67 g of 1,1-

diphenyl-2-propyn-1-ol (manufactured by Tokyo Chemical Industry Co., Ltd.) and 1.67 g of 1-ethynyl-1-cyclohexanol (manufactured by Wacker Chemie AG) were added, and the mixture was stirred with a stirrer A for 5 minutes to obtain a mixture (I).

Next, to a 200 mL glass container with a lid, 47.84 g of polyorganosiloxane (complex viscosity: 6,000 Pa·s, weight-average molecular weight: 642,000 (dispersity: 2.6), trade name: GENIOPLAST GUM, manufactured by Wacker Chemie AG), 100.18 g of Si-H group-containing linear polydimethylsiloxane having a viscosity of 100 mPa·s (manufactured by Wacker Chemie AG), and 9.77 g of p-menthane (manufactured by Nippon Terpene Chemicals, Inc.) were added, and the mixture was stirred with a stirrer A until the mixture became uniform to obtain a mixture (II).

Subsequently, to a 1 L plastic container with a lid, 921.14 g of a p-menthane solution of a vinyl group-containing MQ resin (concentration: 81.2 mass%, manufactured by Wacker Chemie AG) and 0.2 g of a platinum catalyst (manufactured by Wacker Chemie AG) were added, and the mixture was stirred using a stirrer B until the mixture became uniform to obtain a mixture (III).

Next, to a 1 L plastic container with a lid, 1.67 g of the mixture (I), 157.67 g of a solution separately obtained by mixing a vinyl group-containing MQ resin

(manufactured by Wacker Chemie AG), a vinyl group-containing linear polydimethylsiloxane having a viscosity of 200 mPa·s (manufactured by Wacker Chemie AG), and an Si-H group-containing linear polydimethylsiloxane having a viscosity of 100 mPa·s (manufactured by Wacker Chemie AG) at a ratio of 51.6:38.9:9.5, and 131.49 g of the mixture (II) were added, and the mixture was stirred using a stirrer B until the mixture became uniform.

To this, 614.23 g of the mixture (III), 7.97 g of an epoxy-modified silicone oil (trade name: X-22-343, manufactured by Shin-Etsu Chemical Co., Ltd.), and 21.72 g of p-menthane (manufactured by Nippon Terpene Chemicals, Inc.) were added, and the mixture was stirred using a stirrer B until the mixture became uniform.

Finally, the obtained mixture was filtered through a 300-mesh nylon filter to obtain an adhesive composition.

[0185]

[3] Production of laminate

[Example 1-1]

The adhesion aid composition obtained in Preparation Example 1-1 was spin-coated onto a 300 mm silicon wafer (thickness: 775 μm) as a carrier-side substrate at a rotation speed of 1,500 rpm for 60 seconds, to form a primer coating film (also referred to as an adhesion aid coating film) on the silicon wafer serving as a support

substrate.

On the other hand, the adhesive composition obtained in Preparation Example 2-1 was spin-coated onto a 300 mm silicon wafer (thickness: 775 μm) as a device-side substrate so that the film thickness in the finally obtained laminate would be 50 μm, to form an adhesive coating layer on the silicon wafer serving as a semiconductor substrate.

Then, using a bonding apparatus, the support substrate on which the adhesion aid coating film was formed and the semiconductor substrate on which the adhesive coating layer was formed were bonded together so as to sandwich the adhesion aid coating film and the adhesive coating layer, and then heat treatment was performed at 130°C for 5 minutes and at 200°C for 5 minutes to produce a laminate. The bonding was performed at a temperature of 23°C and a reduced pressure of 1,000 Pa while applying a load of 30 N.

[0186]

[Example 1-2]

A laminate was obtained in the same manner as in Example 1-1, except that the adhesion aid composition obtained in Preparation Example 1-2 was used instead of the adhesion aid composition obtained in Preparation Example 1-1.

[0187]

[Example 1-3]

A laminate was obtained in the same manner as in Example 1-1, except that the adhesion aid composition obtained in Preparation Example 1-3 was used instead of the adhesion aid composition obtained in Preparation Example 1-1.

[0188]

[Example 1-4]

A laminate was obtained in the same manner as in Example 1-1, except that the adhesion aid composition obtained in Preparation Example 1-4 was used instead of the adhesion aid composition obtained in Preparation Example 1-1.

[0189]

[Comparative Example 1-1]

A laminate was obtained in the same manner as in Example 1-1, except that the adhesion aid composition obtained in Preparation Example 1-5 was used instead of the adhesion aid composition obtained in Preparation Example 1-1.

[0190]

[Comparative Example 1-2]

A laminate was obtained in the same manner as in Example 1-1, except that the adhesion aid composition

obtained in Preparation Example 1-6 was used instead of the adhesion aid composition obtained in Preparation Example 1-1.

[0191]

[Comparative Example 1-3]

A laminate was obtained in the same manner as in Example 1-1, except that the adhesion aid composition obtained in Preparation Example 1-1 was not used, and a support substrate having no adhesion aid coating layer formed thereon was used as the carrier-side substrate.

[0192]

[4] Evaluation of adhesion

Using the obtained laminates, the state of residue after peeling was checked. Specifically, after the support substrate and the semiconductor substrate were peeled using a peeling apparatus Y, the presence or absence of a film on the wafer on the carrier side (support substrate side) and on the wafer on the device side (semiconductor substrate side) was checked. As a result, for the laminates of Examples 1-1, 1-2, 1-3, and 1-4, no film was observed on the wafer on the device side, and the film of the adhesive layer remained on the wafer on the carrier side. In contrast, for the laminates of Comparative Examples 1-1, 1-2, and 1-3, the film of the adhesive layer was observed on the wafer on the device side.

Thus, it was confirmed that, when the composition for forming a primer coating film (adhesion aid composition) of the present invention was used, the adhesive strength of the adhesive composition was improved, interfacial peeling occurred on the device side (semiconductor substrate side) opposite to the support substrate whose surface was coated with the composition for forming a primer coating film (adhesion aid composition), and the film of the adhesive composition remained on the support substrate side coated with the composition for forming a primer coating film (adhesion aid composition) after peeling of the laminate.

[0193]

From the above results, by selecting whether to dispose the primer coating film on the support substrate side or on the semiconductor substrate or electronic device substrate side, it is possible to control the location of peeling (peeling interface) when peeling the support substrate from the semiconductor substrate or electronic device substrate.

Reference Signs List

[0194]

1 Semiconductor substrate

2 Adhesive layer

2a Adhesive coating layer

3 Primer coating film

4 Support substrate

21 Semiconductor chip substrate

22 Adhesive layer

22a Adhesive coating layer

23 Primer coating film

24 Support substrate

25 Sealing resin

26 Electronic device substrate

CLAIMS

[claim 1]

A composition for forming a primer coating film for increasing adhesive strength between an adhesive layer and a substrate, the adhesive layer being formed from an adhesive composition containing an adhesive component that cures by a hydrosilylation reaction,

the composition for forming a primer coating film, comprising a component contributing to the hydrosilylation reaction.

[claim 2]

The composition for forming a primer coating film according to claim 1, wherein the composition for forming a primer coating film contains, as the component contributing to the hydrosilylation reaction, a component selected from a compound containing platinum, a compound containing an Si-H group, and a compound containing a vinyl group.

[claim 3]

The composition for forming a primer coating film according to claim 1, wherein the adhesive composition that forms the adhesive layer contains the adhesive component and a release agent component.

[claim 4]

The composition for forming a primer coating film according to claim 3, wherein the release agent component

contains a polyorganosiloxane.

[claim 5]

The composition for forming a primer coating film according to claim 1, wherein the adhesive component that cures by the hydrosilylation reaction contains:

a component (A-1) having an alkenyl group having 2 to 40 carbon atoms, the alkenyl group being bonded to a silicon atom;

a component (A-2) having an Si-H group; and

a platinum group metal-based catalyst (A-3).

[claim 6]

A laminate comprising:

a support substrate;

a semiconductor substrate or an electronic device substrate; and

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate,

wherein a primer coating film is formed on a substrate surface of any one of the semiconductor substrate, the electronic device substrate, and the support substrate, and

the primer coating film is a primer coating film formed from the composition for forming a primer coating film according to any one of claims 1 to 5.

[claim 7]

The laminate according to claim 6, wherein the primer coating film is formed on a surface of the support substrate.

[claim 8]

A method for producing a laminate, the laminate including:

a support substrate;

a semiconductor substrate or an electronic device substrate;

an adhesive layer provided between the semiconductor substrate or the electronic device substrate and the support substrate; and

a primer coating film formed on a substrate surface of any one of the semiconductor substrate, the electronic device substrate, and the support substrate,

the method comprising:

a step of forming a primer coating film by applying the composition for forming a primer coating film according to any one of claims 1 to 5 to a substrate surface of any one of the semiconductor substrate, the electronic device substrate, and the support substrate.

[claim 9]

The method for producing a laminate according to claim 8, further comprising:

a step of applying an adhesive composition for forming the adhesive layer to a substrate on which the primer coating film is not formed, the substrate being any one of the semiconductor substrate, the electronic device substrate, and the support substrate; and

a step of bonding together the substrate on which the primer coating film is formed and the substrate to which the adhesive composition is applied, and then performing heat treatment to form an adhesive layer between the semiconductor substrate or the electronic device substrate and the support substrate.

[claim 10]

The method for producing a laminate according to claim 9, comprising:

a step of forming a primer coating film by applying the composition for forming a primer coating film according to any one of claims 1 to 5 to a surface of the support substrate;

a step of applying an adhesive composition for forming an adhesive layer to the semiconductor substrate or the electronic device substrate; and

a step of bonding together the support substrate on which the primer coating film is formed and the semiconductor substrate or the electronic device substrate to which the adhesive composition is applied, and then

performing heat treatment to form an adhesive layer between the semiconductor substrate or the electronic device substrate and the support substrate.

[claim 11]

A method for manufacturing a processed semiconductor substrate or electronic device substrate, the method comprising:

a fifth step in which the semiconductor substrate or the electronic device substrate of the laminate according to claim 6 is processed; and

a sixth step in which the semiconductor substrate or the electronic device substrate processed by the fifth step is separated from the support substrate.