DESCRIPTION

Title of the Invention: CLEANING AGENT COMPOSITION FOR WAFER PROCESSING

Technical Field

[0001] The present disclosure relates to a cleaning agent composition for wafer processing, a cleaning method and a method for producing a semiconductor substrate, both methods using the cleaning agent composition, and an adhesive remover.

Background Art

[0002] The integration density of semiconductor devices has dramatically increased in recent years, and three-dimensional integrated circuit (3DIC) technology is attracting attention. The 3DIC technology allows wafers to be stacked in multiple layers while interconnecting them using, e.g., through-silicon vias (TSVs). For the arrangement of wafers in multiple layers, a wafer having a circuit needs to be thinned by polishing the back surface of the wafer (on which no circuit is formed), and then processed, e.g., to form electrodes on the back surface.

The wafer is temporarily bonded (fixed) to a fixing member (support) with an adhesive before being thinned. After polishing and processing such as electrode formation, the wafer is separated from the fixing member. In this case, the adhesive often remains on the wafer separated from the fixing member, which can cause defects in the subsequent processes. Therefore, a cleaning process is performed to remove the residual adhesive from the wafer.

[0003] Various compositions for removing residues such as adhesives have been developed.

For example, JP 2012-186480 A (Patent Document 1) proposes a cleaning agent for a semiconductor substrate that can remove particles and carbon defects present on the substrate surface. The cleaning agent contains 0.05 to 50% by weight of an organic acid having at least one carboxyl group, 0.01 to 30% by weight of a specific complexing agent, and 0.05 to 50% by weight of a specific organic solvent.

WO 2010/016350 A1 (Patent Document 2) proposes a residue removing liquid composition for removing a resist residue and a metal residue derived from wiring materials. The residue removing liquid composition contains ammonium fluoride, methanesulfonic acid, a specific compound having a carbon-carbon triple bond, a specific water-soluble organic solvent, and water in their respective predetermined amounts.

JP 2023-105258 A (Patent Document 3) proposes a pressure-sensitive adhesive treatment liquid capable of removing a pressure-sensitive adhesive. The pressure-sensitive adhesive treatment liquid contains a liquid having a Hansen solubility parameter value of 25 or less and an alkaline compound. The liquid having a Hansen solubility parameter value of 25 or less contains a mixed solvent of a lower alcohol and an organic solvent other than the lower alcohol. The concentration of the alkaline compound is 0.05 to 20% by weight.

WO 2016/021646 A1 (Patent Document 4) proposes a rework solvent for cleaning an adhesive layer adhering to the debonded semiconductor circuit formation substrate or support substrate. The rework solvent contains at least an amine-based solvent and a specific glycol ether-based solvent.

WO 2022/163350 A1 (Patent Document 5) proposes a composition for a semiconductor device that has excellent residue removal performance. The composition contains an alcohol, an aprotic polar solvent, an azole compound, an alkanolamine, and water.

JP 2022-549372 A (Patent Document 6) proposes a cleaning agent composition for removing a photoresist from a substrate. The cleaning agent composition contains (i) an alkanolamine, (ii) an ether alcohol solvent or an aromatic-containing alcohol, and (iii) a corrosion inhibitor.

JP 2021-158352 (Patent Document 7) proposes a polymer cleaning composition capable of removing an adhesive polymer remaining on a circuitry surface of a wafer during a semiconductor device manufacturing process without causing metal corrosion. The polymer cleaning composition contains a fluorinated alkyl compound, a polar protic solvent, and an amine compound. The amine compound includes an acyclic secondary amine compound or an acyclic amine compound.

JP 2006-63201 A (Patent Document 8) proposes an alkaline cleaning agent for removing, e.g., oils, resins, and particles adhering to electronic components or the like. The alkaline cleaning agent contains an alkaline component and a hydrophilic organic solvent, and has an electrical conductivity of 0.1 to 3.0 mS/cm at 30°C.

Disclosure of the Invention

[0004] An aspect of the present disclosure relates to a cleaning agent composition for wafer processing to remove a wafer processing adhesive remaining on a wafer. The cleaning agent composition contains a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less

carbon atoms (component A) and an organic amine (component B). The component A is a nitrile compound. A Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

[0005] An aspect of the present disclosure relates to a wafer cleaning method to remove a wafer processing adhesive from a wafer to which the adhesive has been attached. The wafer cleaning method includes a cleaning step of cleaning a wafer to which a wafer processing adhesive is attached with the cleaning agent composition for wafer processing of the present disclosure.

[0006] An aspect of the present disclosure relates to a method for producing a semiconductor substrate. The method includes: (1) a step of bonding a wafer to a fixing member with an adhesive; (2) a step of polishing a back surface of the wafer that is opposite to the bonding surface between the wafer and the fixing member; (3) a step of processing the polished surface of the wafer; (4) a step of separating the processed wafer from the fixing member; and (5) a step of removing the adhesive remaining on the separated wafer with a cleaning agent. The cleaning agent is a cleaning agent composition that contains a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B). The component A is a nitrile compound. A Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

[0007] An aspect of the present disclosure relates to an adhesive remover to remove a wafer processing adhesive remaining on a wafer. The adhesive remover contains a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B). The component A is a nitrile compound. A Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

Brief Description of Drawings

[0008] [FIG. 1] FIG. 1 is a flowchart showing each step in an embodiment of a method for producing a semiconductor substrate of the present disclosure.

[FIG. 2] FIG. 2 is a schematic diagram illustrating each step in an embodiment of a method for producing a semiconductor substrate of the present disclosure.

Description of the Invention

[0009] In the 3DIC production process, the wafer that is temporarily bonded (fixed) to the fixing member (support) with an adhesive is polished, and then may be further processed, e.g., to form electrodes at a high temperature of 150°C or more. If the adhesive degrades by heating, it tends to be difficult to remove. Thus, the cleaning agent composition is required to be highly effective in removing (cleaning) a temporary fixing adhesive (wafer processing adhesive) used in wafer processing.

However, the compositions disclosed in Patent Documents 1 to 3 are insufficient to remove the wafer processing adhesive. Moreover, although Patent Document 4 discloses a rework solvent containing monoethanolamine and 1-methyl-2-pyrrolidone (NMP) in the examples, the use of NMP and similar substances in the cleaning agent composition has recently been restricted because of environmental concerns.

[0010] The present disclosure provides a cleaning agent composition for wafer processing that has high ability to remove a wafer processing adhesive, a cleaning method and a method for producing a semiconductor substrate, both methods using the cleaning agent composition, and an adhesive remover.

[0011] The present disclosure can provide a cleaning agent composition for wafer processing that has high ability to remove a wafer processing adhesive, a cleaning method and a method for producing a semiconductor substrate, both methods using the cleaning agent composition, and an adhesive remover.

[0012] The present disclosure is based on the findings that the wafer processing adhesive (also simply referred to as an "adhesive" below) can be efficiently removed by using a cleaning agent composition that contains a nitrile compound, i.e., an aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B), in which a Hansen solubility parameter value of a mixed solvent of the component A and the component B falls within a predetermined range.

[0013] In one aspect, the present disclosure relates to a cleaning agent composition for wafer processing (also referred to as a "cleaning agent composition of the present disclosure" below) to remove a wafer processing adhesive remaining on a wafer. The cleaning agent composition of the present disclosure contains a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B). The component A is a nitrile compound. A Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

[0014] In one or more embodiments, the present disclosure provides a cleaning agent composition with excellent wafer processing adhesive removal performance. The use of the cleaning agent composition of the present disclosure can produce a high-quality semiconductor substrate with a high yield.

[0015] The details of the mechanism of the effects of the present disclosure are not fully clear, but can be assumed as follows.

According to the cleaning agent composition of the present disclosure, the nitrile compound, i.e., the aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) penetrates into the adhesive remaining on the wafer and allows the adhesive to swell, so that stress may be exerted on the adhesive surface sticking to the wafer, thereby facilitating the stripping of the adhesive. When a predetermined amount of organic amine (component B) is used alone, it would not easily penetrate into the adhesive. In the cleaning agent composition of the present disclosure, the organic amine (component B) is used in combination with the nitrile compound (component A), and the Hansen solubility parameter value of the mixed solvent of the component A and the component B is set to 20.0 or more and 26.0 or less. This configuration can help the cleaning agent composition penetrate into the adhesive and make it easy to strip the adhesive off the substrate due to the stress created by dissolution or swelling of the adhesive.

However, the present disclosure should not be interpreted solely by the above mechanism.

[0016] In one or more embodiments, the cleaning agent composition of the present disclosure may be used to remove an adhesive from a wafer to which the adhesive has been attached. In one or more embodiments, the cleaning agent composition of the present disclosure is an adhesive remover (also referred to as an "adhesive remover of the present disclosure" below) to remove a wafer processing adhesive remaining on a wafer. In one or more embodiments, the adhesive remover of the present disclosure contains a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B). The component A is a nitrile compound. A Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

In one or more embodiments, the cleaning agent composition or the adhesive remover of the present disclosure may be used to remove an adhesive remaining on a wafer that has

been previously bonded to a fixing member with the adhesive and then separated from the fixing member.

The wafer may be, e.g., a semiconductor substrate. Examples of the semiconductor substrate include wafers, e.g., silicon wafer, germanium wafer, gallium-arsenide wafer, gallium-phosphide wafer, and gallium-arsenide-aluminum wafer. In one or more embodiments, the wafer may be, e.g., a substrate having pads and/or lands that serve as connections for bonding and mounting.

The wafer processing adhesive may be, e.g., an adhesive that can join the wafer to the fixing member, has sufficient durability to withstand the polishing step and the processing step, and enables the wafer to be easily separated from the fixing member in the separation step. The wafer processing adhesive may be, e.g., at least one selected from the group consisting of acrylic adhesive, urethane adhesive, silicone adhesive, novolac adhesive, and polyimide adhesive.

[0017] [Nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A)]

The nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (also referred to as a "component A" below) contained in the cleaning agent composition of the present disclosure may be one type or a combination of two or more types.

[0018] The carbon number of the component A is 2 or more and 10 or less, preferably 2 or more and 9 or less, and more preferably 2 or more and 8 or less from the viewpoint of improving the wafer processing adhesive removal performance.

[0019] The Hansen solubility parameter value of the component A is preferably 26.0 or less, more preferably 25.5 or less, even more preferably 25.0 or less, and still more preferably 24.5 or less from the viewpoint of improving the wafer processing adhesive removal performance. From the same viewpoint, the Hansen solubility parameter value of the component A is preferably 20.0 or more, more preferably 20.5 or more, and even more preferably 21.0 or more.

In the present disclosure, the Hansen solubility parameter (also referred to as "HSP" below) is a value used to predict the solubility of a substance, which was developed by Charles M. Hansen in 1967. The parameter is based on the idea that "two substances with similar intermolecular interactions will easily dissolve in each other." The HSP consists of the following three parameters (unit: $MPa^{0.5}$).

δd: Energy from dispersion forces between molecules

δp: Energy from dipole interactions between molecules

δh: Energy from hydrogen bonds between molecules

Detailed explanations can be found in, e.g., *CHEMICAL INDUSTRY*, No. 3, 2010 (Chemical Industry, Co., Ltd.), and the Hansen solubility parameters of various substances can be obtained by using PC software, e.g., "HSPiP: Hansen Solubility Parameters in Practice." The HSP can also be determined by a method as described in Examples.

[0020] From the viewpoint of improving the wafer processing adhesive removal performance, the component A is a nitrile compound and may be, e.g., at least one selected from the group consisting of benzonitrile, phenylacetonitrile, and acetonitrile.

[0021] The content of the component A in the cleaning agent composition of the present disclosure is preferably 50.0% by mass or more, more preferably 60.0% by mass or more, and even more preferably 70.0% by mass or more from the viewpoint of penetration of the cleaning agent composition into the wafer processing adhesive. From the same viewpoint, the content of the component A is preferably 99.9% by mass or less, more preferably 95.0% by mass or less, and even more preferably 90.0% by mass or less. More specifically, the content of the component A is preferably 50.0% by mass or more and 99.9% by mass or less, more preferably 60.0% by mass or more and 95.0% by mass or less, and even more preferably 70.0% by mass or more and 90.0% by mass or less. When the component A is a combination of two or more types, the content of the component A is the total content of the two or more types.

[0022] In the present disclosure, the "content of each component in the cleaning agent composition" may be the amount of each component at the time of cleaning, i.e., at the time the cleaning agent composition starts to be used for cleaning.

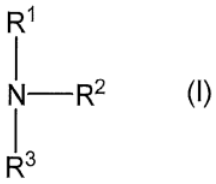
In one or more embodiments, the content of each component in the cleaning agent composition of the present disclosure may be considered as the blending amount of each component in the cleaning agent composition of the present disclosure.

[0023] (Component B: organic amine)

The organic amine (also referred to as a "component B" below) contained in the cleaning agent composition of the present disclosure may be one type or a combination of two or more types.

From the viewpoint of improving the wafer processing adhesive removal performance, the component B may be, e.g., a compound represented by the following formula (I).

[Chemical Formula 1]



(I)

In the formula (I), R^1 represents a linear alkanol group having 2 or more and 4 or less carbon atoms, R^2 represents a linear alkanol group having 2 or more and 4 or less carbon atoms, a methyl group, or a hydrogen atom, and R^3 represents a methyl group or a hydrogen atom.

In the formula (I), R^1 is preferably a linear alkanol group having 2 or 3 carbon atoms from the viewpoint of improving the wafer processing adhesive removal performance. From the same viewpoint, R^2 is preferably a hydrogen atom. From the same viewpoint, R^3 is preferably a hydrogen atom.

[0024] In one or more embodiments, the component B may be any organic amine that would be combined with the component A to form a mixed solvent with a Hansen solubility parameter value (HSP) of 20.0 or more and 26.0 or less. The Hansen solubility parameter value of the component B is not particularly limited.

[0025] From the viewpoint of improving the wafer processing adhesive removal performance, the component B is preferably an alkanolamine (amino alcohol). The alkanolamine may be, e.g., at least one selected from the group consisting of N-methylmonoethanolamine, N-ethylmonoethanolamine, diethanolamine, N-dimethylmonoethanolamine, N-methyldiethanolamine, N-diethylmonoethanolamine, N-ethyldiethanolamine, N-(β-aminoethyl)ethanolamine, N-(β-aminoethyl)diethanolamine, monoethanolamine, and 2-(methylamino)ethanol. Among these, the alkanolamine is preferably at least one selected from the group consisting of monoethanolamine, N-methyldiethanolamine, and 2-(methylamino)ethanolamine, more preferably at least one selected from the group consisting of monoethanolamine and 2-(methylamino)ethanolamine, and even more preferably contains monoethanolamine.

[0026] The content of the component B in the cleaning agent composition of the present disclosure is preferably 0.1% by mass or more, more preferably 5.0% by mass or more, and even more preferably 10.0% by mass or more from the viewpoint of improving the wafer processing adhesive removal performance. From the same viewpoint, the content of the component B is preferably 50.0% by mass or less, more preferably 40.0% by mass or less, and even more preferably 30.0% by mass or less. More specifically, the content of the component B is preferably

0.1% by mass or more and 50.0% by mass or less, more preferably 5.0% by mass or more and 40.0% by mass or less, and even more preferably 10.0% by mass or more and 30.0% by mass or less. When the component B is a combination of two or more types, the content of the component B is the total content of the two or more types.

[0027] The mass ratio B/A (the content of the component B/the content of the component A) of the component B to the component A in the cleaning agent composition of the present disclosure is preferably 0.001 or more, more preferably 0.01 or more, and even more preferably 0.1 or more from the viewpoint of improving the wafer processing adhesive removal performance. From the same viewpoint, the mass ratio B/A is preferably 1 or less, more preferably 0.7 or less, and even more preferably 0.5 or less. More specifically, the mass ratio B/A is preferably 0.001 or more and 1 or less, more preferably 0.01 or more and 0.7 or less, and even more preferably 0.1 or more and 0.5 or less.

[0028] The total content of the component A and the component B in the cleaning agent composition of the present disclosure is preferably 50.1% by mass or more, more preferably 65% by mass or more, even more preferably 80% by mass or more, still more preferably 95% by mass or more, and yet more preferably 98% by mass or more from the viewpoint of improving the wafer processing adhesive removal performance. The total content of the component A and the component B may be 100% by mass from the viewpoint of improving the wafer processing adhesive removal performance.

[0029] (Hansen solubility parameter value of mixed solvent)

The Hansen solubility parameter value (HSP) of the mixed solvent of the component A and the component B is 20.0 or more, preferably 20.5 or more, and more preferably 21.0 or more from the viewpoint of improving the wafer processing adhesive removal performance. From the same viewpoint, the Hansen solubility parameter value of the mixed solvent of the component A and the component B is 26.0 or less, preferably 25.5 or less, more preferably 25.0 or less, and even more preferably 24.5 or less. More specifically, the Hansen solubility parameter value of the mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less, preferably 20.5 or more and 25.5 or less, and more preferably 21.0 or more and 24.5 or less. The HSP value of the mixed solvent may be determined by a method as described in Examples.

[0030] [Water (component C)]

In one or more embodiments, the cleaning agent composition of the present disclosure contains no water or may have a water content of 5% by mass or less. In one or more

embodiments, examples of water (also referred to as a "component C" below) include ion-exchanged water, RO water, distilled water, pure water, and ultrapure water.

When the cleaning agent composition of the present disclosure contains water (component C), the content of the component C in the cleaning agent composition may be the remainder obtained by subtracting the component A, the component B, and optional components as will be described later from the amount of the cleaning agent composition. Specifically, the content of the component C in the cleaning agent composition is preferably 5% by mass or less, more preferably 3% by mass or less, even more preferably 1% by mass or less, and still more preferably 0% by mass (i.e., the component C is not contained) from the viewpoint of improving the adhesive removal performance.

[0031] [Other components]

The cleaning agent composition of the present disclosure may further contain water (component C) or other components as needed in addition to the components A and B. The other components include, e.g., any components that would be used for usual cleaning agents. Examples of the other components include solvents other than the component A, alkali agents other than the component B, surfactants, chelating agents, thickening agents, dispersing agents, rust inhibitors, metal corrosion inhibitors, polymer compounds, solubilizing agents, antioxidants, preservatives, antifoaming agents, and antibacterial agents.

It is preferable that the optional components other than the components A and B (i.e., the component C and the other components) do not significantly affect the Hansen solubility parameter value of the mixed solvent of the component A and the component B.

[0032] In one or more embodiments, the cleaning agent composition of the present disclosure may contain substantially no organic acid having at least one carboxyl group. For example, the content of the organic acid having at least one carboxyl group in the cleaning agent composition is preferably less than 0.05% by mass, more preferably 0.01% by mass or less, and even more preferably 0% by mass (i.e., the organic acid having at least one carboxyl group is not contained).

In one or more embodiments, the cleaning agent composition of the present disclosure may contain substantially no ammonium fluoride. For example, the content of the ammonium fluoride in the cleaning agent composition is preferably less than 0.005% by mass, more preferably 0.001% by mass or less, and even more preferably 0% by mass (i.e., the ammonium fluoride is not contained).

In one or more embodiments, the cleaning agent composition of the present disclosure may contain substantially no methanesulfonic acid. For example, the content of the methanesulfonic acid in the cleaning agent composition is more preferably 0% by mass (i.e., the methanesulfonic acid is not contained).

In one or more embodiments, the cleaning agent composition of the present disclosure may contain substantially no alkali metal or alkaline earth metal hydroxide, carbonate, or metal alkoxide. For example, the content of the alkali metal or alkaline earth metal hydroxide, carbonate, or metal alkoxide in the cleaning agent composition is preferably less than 0.001% by mass, and more preferably 0% by mass (i.e., the alkali metal or alkaline earth metal hydroxide, carbonate, or metal alkoxide is not contained).

In one or more embodiments, the cleaning agent composition of the present disclosure may contain substantially no azole compound. For example, the content of the azole compound in the cleaning agent composition is preferably less than 0.1% by mass, and more preferably 0% by mass (i.e., the azole compound is not contained).

In one or more embodiments, the cleaning agent composition of the present disclosure may contain substantially no fluorinated alkyl compound. For example, the content of the fluorinated alkyl compound in the cleaning agent composition is preferably less than 0.1% by mass, and more preferably 0% by mass (i.e., the fluorinated alkyl compound is not contained).

[0033] [Production method of cleaning agent composition]

In one or more embodiments, the cleaning agent composition of the present disclosure can be produced by blending the component A and the component B, and the optional components (the component C and the other components) as needed, with a known method. For example, the cleaning agent composition of the present disclosure can be produced by blending at least the component A and the component B. Thus, in one aspect, the present disclosure relates to a method for producing a cleaning agent composition that includes a step of blending at least the component A and the component B. In the present disclosure, the term "blend" includes mixing the component A and the component B, and the optional components (the component C and the other components) as needed, simultaneously or in any order. The preferred blending amount of each component for the production method of the cleaning agent composition of the present disclosure may be the same as the preferred content of each component in the cleaning agent composition of the present disclosure, as described above.

[0034] [Workpiece]

A workpiece (also referred to as an "object to be cleaned") may be, e.g., a wafer to which a wafer processing adhesive is attached. In one or more embodiments, the wafer may be, e.g., a semiconductor substrate. Examples of the semiconductor substrate include wafers, e.g., silicon wafer, germanium wafer, gallium-arsenide wafer, gallium-phosphide wafer, and gallium-arsenide-aluminum wafer. In one or more embodiments, the wafer may be, e.g., a substrate having pads and/or lands that serve as connections for bonding and mounting. The pads and lands may be made of metals, e.g., gold, copper, and aluminum.

In one or more embodiments, the wafer to which the adhesive is attached may be, e.g., a wafer that has been previously bonded to a fixing member with the adhesive and then separated from the fixing member. In one or more embodiments, the wafer separated from the fixing member is a substrate having metal pads to which the adhesive is attached. Thus, in one aspect, the present disclosure relates to use of the cleaning agent composition of the present disclosure as a cleaning agent to remove an adhesive remaining on a wafer that has been previously bonded to a fixing member with the adhesive and then separated from the fixing member. In another aspect, the present disclosure relates to use of the adhesive remover of the present disclosure as a remover to remove an adhesive remaining on a wafer that has been previously bonded to a fixing member with the adhesive and then separated from the fixing member. In one or more embodiments, the wafer fixed to the fixing member with the adhesive has undergone a heat treatment. The heat treatment temperature may be, e.g., 200°C or more. In one or more embodiments, the heat treatment may be performed in the processing step, as will be described later.

In one or more embodiments, the wafer to which the adhesive is attached may be, e.g., a substrate to which an adhesive used in the three-dimensional integrated circuit (3DIC) production process is attached. Thus, in one aspect, the present disclosure relates to use of the cleaning agent composition of the present disclosure as a cleaning agent to remove an adhesive used in the three-dimensional integrated circuit production process. In another aspect, the present disclosure relates to use of the adhesive remover of the present disclosure as a remover to remove an adhesive used in the three-dimensional integrated circuit production process.

In one or more embodiments, the wafer to which the adhesive is attached has undergone a heat treatment at 200°C or more. In one or more embodiments, the heat treatment may be performed in the processing step, as will be described later.

[0035] [Production method of semiconductor substrate]

In one aspect, the present disclosure relates to a method for producing a semiconductor substrate (also referred to as a "semiconductor substrate production method of the present disclosure" below). The method includes: (1) a step of bonding a wafer to a fixing member with an adhesive; (2) a step of polishing a surface of the wafer that is opposite to the bonding surface between the wafer and the fixing member; (3) a step of processing the polished surface of the wafer; (4) a step of separating the processed wafer from the fixing member; and (5) a step of removing the adhesive remaining on the separated wafer with a cleaning agent. The cleaning agent is a cleaning agent composition containing a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B). A Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less. In one or more embodiments, the cleaning agent used in the step (5) is the cleaning agent composition of the present disclosure.

[0036] The semiconductor substrate production method of the present disclosure will be described by referring to FIGS. 1 and 2. FIG. 1 is a flowchart showing each step in an embodiment of the semiconductor substrate production method of the present disclosure. FIG. 2 is a schematic diagram illustrating each step in an embodiment of the semiconductor substrate production method of the present disclosure.

[0037] <Step (1): bonding step>

The step (1) is a step (bonding step) of bonding a wafer 3 to a fixing member 1 with an adhesive 2 (step S1). In one or more embodiments, the step (1) includes a step (1-1) of applying the adhesive to the surface of the wafer or the fixing member to form an adhesive layer, and a step (1-2) of bonding the wafer and the fixing member together via the adhesive layer and joining them together by a heat treatment.

[0038] The wafer used in the step (1) may be, e.g., a silicon wafer or a glass wafer with a diameter of 100 to 500 mm and a thickness of 50 to 2,000 μm. In one or more embodiments, the wafer used in the step (1) is a substrate having metal pads.

[0039] The fixing member used in the step (1) is not particularly limited and may be, e.g., a substrate such as a silicon wafer or a glass plate with a diameter of 100 to 500 mm and a thickness of 50 to 20,000 μm.

[0040] The adhesive used in the step (1) may be any adhesive that can join the wafer to the fixing member, has sufficient durability to withstand the polishing step and the processing step, and enables the wafer to be easily separated from the fixing member in the separation step. For

example, the adhesive may be a wafer processing adhesive used in the 3DIC production process. The wafer processing adhesive may be, e.g., at least one adhesive (adhesive composition) selected from the group consisting of acrylic adhesive, urethane adhesive, silicone adhesive, polyimide adhesive, and novolac adhesive. Specifically, the wafer processing adhesive may be, e.g., an adhesive composition described in JP 2021-161196 A.

In one or more embodiments, the adhesive composition used in the step (1) may include at least one selected from the group consisting of acrylic adhesive, urethane adhesive, silicone adhesive, polyimide adhesive, and novolac adhesive as an adhesive component, and may further include, e.g., a platinum metal catalyst, a release agent component, and a solvent.

The viscosity of the adhesive composition used in the step (1) can be adjusted by appropriately changing, e.g., the concentration of the components in the adhesive composition, depending on the coating method, the film thickness, or the like.

[0041] The coating method of the adhesive (adhesive composition) in the step (1-1) is not particularly limited and may be, e.g., a spin coating method.

The thickness of the coating layer (adhesive layer) of the adhesive (adhesive composition) may be, e.g., 5 to 500 μm.

In one or more embodiments, the step (1-1) includes bonding the surface of the wafer having metal pads to the fixing member with the adhesive.

[0042] In the step (1-2), the heat treatment temperature may be, e.g., 80°C or more, and is preferably 300°C or less from the viewpoint of preventing the adhesive from hardening excessively.

The heat treatment time may be, e.g., 30 seconds or more, and is preferably 10 minutes or less from the viewpoint of preventing degradation of the adhesive layer and other components.

The heat treatment may be performed using, e.g., a hot plate or an oven.

The thickness of the adhesive layer after the heat treatment may be, e.g., 5 μm or more and 100 μm or less.

[0043] <Step (2): polishing step>

The step (2) is a step (polishing step) of polishing a surface (back surface) 3a of the wafer 3 that is opposite to the bonding surface between the wafer 3 and the fixing member 1 (step S2).

Examples of the polishing method include mechanical polishing using, e.g., abrasive grains and chemical mechanical polishing.

In the step (2), the thickness of the polished wafer (thinned wafer) is preferably 200 μm or less, and may be, e.g., 50 μm to 200 μm.

[0044] <Step (3): processing step>

The step (3) is a step (processing step) of processing the polished surface (the back surface of the thinned wafer) 3a of the wafer 3 (step S3).

In one or more embodiments, the step (3) may include, e.g., an electrode formation step, a metal wiring formation step, and a protective film formation step. Specifically, examples of the step (3) include conventionally known processing steps, e.g., metal sputtering for forming electrodes, wet etching, resist coating, pattern formation, resist stripping, dry etching, metal plating, silicon etching for forming through-silicon vias (TSVs), and oxide film formation on silicon surface.

In one or more embodiments, the above processing in the step (3) is performed at a high temperature of 150°C or more. The electrode formation such as TSV may include, e.g., a heat treatment at 250°C or more and 350°C or less.

[0045] <Step (4): separation step>

The step (4) is a step (separation step) of separating the processed wafer 3 from the fixing member 1 (step S4).

Examples of the separation method include solvent debonding, laser debonding, and mechanical debonding.

[0046] <Step (5): cleaning step>

The step (5) is a step (cleaning step) of removing the adhesive (adhesive residue) 2a remaining on the separated wafer 3 with a cleaning agent (step S5). In one or more embodiments, the separated wafer is a wafer to which the adhesive is attached (i.e., the workpiece described above). For example, the separated wafer may be a substrate having metal pads to which the adhesive is attached.

In one or more embodiments, the cleaning agent used in the step (5) may be the cleaning agent composition of the present disclosure.

[0047] Examples of the cleaning method (adhesive removal method) in the cleaning step include immersion cleaning and spray cleaning. Thus, in one or more embodiments, the cleaning step is a step of immersing the wafer (workpiece) to which the adhesive is attached in the cleaning agent composition of the present disclosure (immersion cleaning step). From the viewpoint of improving the wafer processing adhesive removal performance, the immersion

cleaning step is preferably a step of immersing the wafer (workpiece) to which the adhesive is attached in the cleaning agent composition at 50°C or more and 100°C or less.

The temperature (cleaning temperature) of the cleaning agent used in the cleaning step or the immersion temperature in the immersion cleaning step is preferably 50°C or more, more preferably 60°C or more, and even more preferably 70°C or more from the viewpoint of improving the wafer processing adhesive removal performance. Furthermore, the cleaning temperature or the immersion temperature is also preferably 100°C or less, more preferably 90°C or less, and even more preferably 80°C or less from the viewpoint of reducing the volatilization and degradation of cleaning agent components. The cleaning time in the cleaning step or the immersion time in the immersion cleaning step is preferably 5 minutes or more, more preferably 10 minutes or more, and even more preferably 15 minutes or more from the viewpoint of improving the wafer processing adhesive removal performance. Furthermore, the cleaning time or the immersion time is also preferably 60 minutes or less, more preferably 40 minutes or less, and even more preferably 20 minutes or less from the viewpoint of productivity. From the viewpoint of facilitating the cleaning power of the cleaning agent composition of the present disclosure, ultrasonic vibrations are preferably applied to the cleaning agent composition in the cleaning step or the immersion cleaning step. For example, the ultrasonic vibrations are preferably in the range of 25 to 50 kHz, and more preferably in the range of 35 to 45 kHz to prevent damage to the wafer.

[0048] In one or more embodiments, the wafer after the cleaning step may be washed with water or rinsed with a rinsing agent and then dried. The rinsing agent may be, e.g., at least one rinsing agent selected from the group consisting of methanol, ethanol, isopropyl alcohol, and propylene glycol monomethyl ether.

[0049] In one or more other embodiments, the step (5) is a step of removing the adhesive remaining on the separated wafer with an adhesive remover. In one or more embodiments, the adhesive remover used in the step (5) may be the adhesive remover of the present disclosure.

Thus, in one or more embodiments, the semiconductor substrate production method of the present disclosure includes: (1) a step of bonding a wafer to a fixing member with an adhesive; (2) a step of polishing a surface of the wafer that is opposite to the bonding surface between the wafer and the fixing member; (3) a step of processing the polished surface of the wafer; (4) a step of separating the processed wafer from the fixing member; and (5) a step of

removing the adhesive remaining on the separated wafer with the adhesive remover of the present disclosure.

[0050] [Wafer cleaning method]

In one aspect, the present disclosure relates to a wafer cleaning method (also referred to as a "cleaning method of the present disclosure" below) to remove a wafer processing adhesive from a wafer (workpiece) to which the adhesive has been attached. The wafer cleaning method includes a cleaning step of cleaning a wafer to which a wafer processing adhesive is attached with the cleaning agent composition for wafer processing of the present disclosure. In one or more embodiments, the cleaning step is a step of removing a wafer processing adhesive remaining on a wafer with the cleaning agent composition of the present disclosure after separating the wafer from the fixing member to which it has been bonded with the wafer processing adhesive. The cleaning method of the present disclosure can efficiently remove the wafer processing adhesive.

[0051] In one or more embodiments, the cleaning method (adhesive removal method) in the cleaning step of the cleaning method of the present disclosure may be the same as the cleaning method (adhesive removal method) in the step (5) of the semiconductor substrate production method of the present disclosure. In one or more embodiments, from the viewpoint of improving the wafer processing adhesive removal performance, the cleaning step of the cleaning method of the present disclosure is preferably a step of immersing the wafer (workpiece) to which the adhesive is attached in the cleaning agent composition at 50°C or more and 100°C or less (immersion cleaning step). In one or more embodiments, the immersion conditions (immersion temperature, immersion time, ultrasonic vibration, etc.) in the immersion cleaning step may be, e.g., the immersion conditions (immersion temperature, immersion time, ultrasonic vibration, etc.) in the immersion cleaning step of the step (5) of the semiconductor substrate production method of the present disclosure, as described above.

In the cleaning method of the present disclosure, in one or more embodiments, the wafer bonded to the fixing member with the adhesive has undergone a heat treatment preferably at 230°C or more, and more preferably at 270°C or more. The heat treatment at 230°C or more may be performed, e.g., when joining a substrate with a circuit to devices (such as semiconductor chips) and to another substrate with a circuit by using solder or metallic fine particles. In one or more embodiments, the heat treatment may be performed after the processing step of the step (3) and before the step (4).

In one or more embodiments, the workpiece in the cleaning method of the present disclosure may be the wafer that has been subjected to the steps (1) to (4) of the semiconductor substrate production method of the present disclosure.

[0052] In one or more embodiments, the cleaning method of the present disclosure may further include a step of rinsing the wafer after the cleaning step with at least one rinsing agent selected from the group consisting of methanol, ethanol, isopropyl alcohol, and propylene glycol monomethyl ether, and then drying the wafer.

[0053] In one or more other embodiments, the cleaning step of the cleaning method of the present disclosure is a step of removing an adhesive remaining on a wafer with an adhesive remover after separating the wafer from the fixing member to which it has been bonded with the adhesive (removal step). The adhesive remover used in the removal step may be the adhesive remover of the present disclosure.

Thus, in one or more embodiments, the cleaning method of the present disclosure is an adhesive removal method that includes a step of removing an adhesive remaining on a wafer with the adhesive remover of the present disclosure after separating the wafer from the fixing member to which it has been bonded with the adhesive.

[0054] [Kit]

In one aspect, the present disclosure relates to a kit (also referred to as a "kit of the present disclosure" below) used for the cleaning method of the present disclosure or the semiconductor substrate production method of the present disclosure. In one or more embodiments, the kit of the present disclosure is used to produce the cleaning agent composition of the present disclosure. The kit of the present disclosure provides a cleaning agent composition that has high ability to remove a wafer processing adhesive.

An embodiment of the cleaning agent composition of the present disclosure may be either a so-called one-part or two-part cleaning agent composition. The one-part cleaning agent composition is supplied to the market with the components A and B being mixed together. In the case of the two-part cleaning agent composition, the components A and B are mixed at the time of use.

Therefore, in one or more embodiments, the kit of the present disclosure may be, e.g., a kit that includes a solution containing the component A and the component B. The solution may contain the above optional components (the component C and the other components) as

needed. The solution may be diluted with water (component C) or an organic solvent as needed at the time of use.

In one or more embodiments, the kit of the present disclosure may be, e.g., a kit (two-part cleaning agent composition) that includes a solution (first solution) containing the component A and a solution (second solution) containing the component B so that the two solutions are not mixed with each other. The first solution and the second solution are mixed at the time of use. After the first solution and the second solution are mixed together, the mixed solution may be diluted with the component C (water) or an organic solvent as needed. Each of the first solution and the second solution may contain the above optional components as needed.

[0055] The present disclosure further relates to one or more embodiments as follows.

<1>

A cleaning agent composition for wafer processing to remove a wafer processing adhesive remaining on a wafer,

the cleaning agent composition comprising a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B),

wherein the component A is a nitrile compound, and

a Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

<2>

The cleaning agent composition for wafer processing according to <1>, wherein the component A contains at least one selected from the group consisting of benzonitrile, phenylacetonitrile, and acetonitrile.

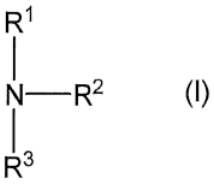
<3>

The cleaning agent composition for wafer processing according to <1> or <2>, wherein a content of the component A is 50.0% by mass or more and 99.9% by mass or less, 60.0% by mass or more and 95.0% by mass or less, or 70.0% by mass or more and 90.0% by mass or less.

<4>

The cleaning agent composition for wafer processing according to any one of <1> to <3>, wherein the component B contains a compound represented by the following formula (I):

[Chemical Formula 2]



(I)

in the formula (I), R^1 represents a linear alkanol group having 2 or more and 4 or less carbon atoms, R^2 represents a linear alkanol group having 2 or more and 4 or less carbon atoms, a methyl group, or a hydrogen atom, and R^3 represents a methyl group or a hydrogen atom.

<5>

The cleaning agent composition for wafer processing according to any one of <1> to <4>, wherein the component B is at least one selected from the group consisting of monoethanolamine and 2-(methylamino)ethanol.

<6>

The cleaning agent composition for wafer processing according to any one of <1> to <5>, wherein a content of the component B is 0.1% by mass or more and 50.0% by mass or less, 5.0% by mass or more and 40.0% by mass or less, or 10.0% by mass or more and 30.0% by mass or less.

<7>

The cleaning agent composition for wafer processing according to any one of <1> to <6>, wherein a mass ratio B/A of the component B to the component A is 0.001 or more and 1 or less, 0.01 or more and 0.7 or less, or 0.1 or more and 0.5 or less.

<8>

The cleaning agent composition for wafer processing according to any one of <1> to <7>, wherein a total content of the component A and the component B is 50.1% by mass or more, 65% by mass or more, 80% by mass or more, 95% by mass or more, 98% by mass or more, or 100% by mass.

<9>

The cleaning agent composition for wafer processing according to any one of <1> to <8>, wherein the solubility parameter value (HSP) of the mixed solvent of the component A and the component B is 20.5 or more and 25.5 or less, or 21.0 or more and 24.5 or less.

<10>

The cleaning agent composition for wafer processing according to any one of <1> to <9>, comprising no water or having a water content of 5% by mass or less, 3% by mass or less, or 1% by mass or less.

<11>

A cleaning agent composition for wafer processing to remove a wafer processing adhesive remaining on a wafer,

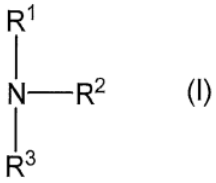
the cleaning agent composition comprising a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B),

wherein the component A is a nitrile compound,

the component A contains at least one selected from the group consisting of benzonitrile, phenylacetonitrile, and acetonitrile,

the component B contains a compound represented by the following formula (I):

[Chemical Formula 3]



(I)

in the formula (I), R^1 represents a linear alkanol group having 2 or more and 4 or less carbon atoms, R^2 represents a linear alkanol group having 2 or more and 4 or less carbon atoms, a methyl group, or a hydrogen atom, and R^3 represents a methyl group or a hydrogen atom,

a mass ratio B/A of the component B to the component A is 0.001 or more and 1 or less,

a total content of the component A and the component B is 50.1% by mass or more, and

a Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

<12>

A wafer cleaning method to remove a wafer processing adhesive from a wafer to which the adhesive has been attached,

the wafer cleaning method comprising a cleaning step of cleaning a wafer to which a wafer processing adhesive is attached with the cleaning agent composition for wafer processing according to any one of <1> to <11>.

<13>

The wafer cleaning method according to <12>, wherein the cleaning step is a step of immersing the wafer to which the adhesive is attached in the cleaning agent composition at 50°C or more and 100°C or less.

<14>

A method for producing a semiconductor substrate, comprising:

(1) a step of bonding a wafer to a fixing member with an adhesive;

(2) a step of polishing a back surface of the wafer that is opposite to the bonding surface between the wafer and the fixing member;

(3) a step of processing the polished surface of the wafer;

(4) a step of separating the processed wafer from the fixing member; and

(5) a step of removing the adhesive remaining on the separated wafer with a cleaning agent,

wherein the cleaning agent is a cleaning agent composition that contains a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B), the component A is a nitrile compound, and a Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

<15>

The method for producing a semiconductor substrate according to <14>, wherein a content of the component A in the cleaning agent composition is 50.0% by mass or more and 99.9% by mass or less.

<16>

An adhesive remover to remove a wafer processing adhesive remaining on a wafer,

the adhesive remover comprising a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B),

wherein the component A is a nitrile compound, and

a Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

Examples

[0056] Hereinafter, the present disclosure will be described in detail by way of examples. However, the present disclosure is not limited to the following examples.

[0057] 1. Preparation of cleaning agent compositions of Examples 1 to 8 and Comparative Examples 1 to 6

Cleaning agent compositions of Examples 1 to 8 and Comparative Examples 1 to 6 were each prepared by blending the components in their respective amounts (% by mass, active content) as shown in Table 1, and stirring and mixing them together.

[0058] The following components were used in the preparation of the cleaning agent compositions of Examples 1 to 8 and Comparative Examples 1 to 6.

(Nitrogen-containing aprotic polar solvent)

Benzonitrile [manufactured by FUJIFILM Wako Pure Chemical Corporation]

<δd = 18.8, δp = 12.0, δh = 3.3>

Phenylacetonitrile [manufactured by Tokyo Chemical Industry Co., Ltd.]

<δd = 19.5, δp = 12.3, δh = 3.8>

Acetonitrile [manufactured by FUJIFILM Wako Pure Chemical Corporation]

<δd = 15.3, δp = 18.0, δh = 6.1>

1-methyl-2-pyrrolidone [manufactured by Mitsubishi Chemical Corporation]

<δd = 18.0, δp = 12.3, δh = 7.2>

(Aprotic solvent)

Dimethyl sulfoxide [manufactured by FUJIFILM Wako Pure Chemical Corporation]

<δd = 18.4, δp = 16.4, δh = 10.2>

γ-butyrolactone [manufactured by FUJIFILM Wako Pure Chemical Corporation]

<δd = 18.0, δp = 16.6, δh = 7.4>

(Organic amine)

Monoethanolamine [manufactured by NIPPON SHOKUBAI CO., LTD.]

<δd = 17.0, δp = 15.5, δh = 21.0>

2-(methylamino)ethanol [amino alcohol MMA, manufactured by NIPPON NYUKAZAI CO., LTD.]

<δd = 16.8, δp = 8.7, δh =16.4>

N-methyldiethanolamine [amino alcohol MDA, manufactured by NIPPON NYUKAZAI CO., LTD.]

<δd = 16.8, δp = 8.3, δh = 17.6>

[0059] [Hansen solubility parameter value]

Table 1 shows the Hansen solubility parameter value (HSP) of the mixed solvent of the nitrogen-containing aprotic polar solvent and the organic amine. The HSP value was calculated by the following formulas.

[Mathematical Formula 1]

$$HSP = \sqrt{(\delta d)^2 + (\delta p)^2 + (\delta h)^2} \qquad \text{(Formula 1)}$$

$$\delta d = \delta d1\varphi 1 + \delta d2\varphi 2 \cdots$$

$$\delta p = \delta p1\varphi 1 + \delta p2\varphi 2 \cdots \qquad \text{(Formula 2)}$$

$$\delta h = \delta h1\varphi 1 + \delta h2\varphi 2 \cdots$$

In the formula (1), δd, δp, and δh are compound-specific parameters, where δd represents the energy from dispersion forces between molecules, δp represents the energy from dipole interactions between molecules, and δh represents the energy from hydrogen bonds between molecules.

When the mixed solvent contains two or more components, each parameter (δd, δp, δh) can be calculated as a weighted average indicated by the formula (2). The δd, δp, and δh values for the mixed solvent calculated by the formula (2) are substituted into the formula (1) to determine the HSP value of the mixed solvent.

In the formula (2), φ1 and φ2 are the volume fractions of each compound.

[0060] 2. Evaluation of cleaning agent compositions of Examples 1 to 8 and Comparative Examples 1 to 6

The cleaning agent compositions thus prepared in Examples 1 to 8 and Comparative Examples 1 to 6 were evaluated as follows.

[0061] [Evaluation of cleaning performance (adhesive removal performance)]

(Test piece)

A Si substrate (wafer) having an adhesive (adhesive layer) was cut into 2 cm × 2 cm squares and used as test pieces.

The adhesive was a polyimide adhesive.

The adhesive layer was formed in the following manner. The entire surface of the Si substrate (wafer) was uniformly coated with the adhesive, which was then heat-treated at 80°C for 5 minutes and further heat-treated at 250°C for 5 minutes. The thickness of the adhesive layer after the heat treatment was 30 μm.

(Cleaning test)

First, 50 mL of the cleaning agent composition of each of Examples 1 to 8 and Comparative Examples 1 to 6 was placed in a 100 mL beaker and heated to 50°C. Then, the test piece was immersed in the cleaning agent composition at 50°C for 15 minutes. The test piece was taken out of the cleaning agent composition, rinsed with a rinsing agent (isopropyl alcohol, IPA, manufactured by FUJIFILM Wako Pure Chemical Corporation) at room temperature for 30 seconds, and then dried with air.

(Evaluation of cleaning performance)

Each of the cleaned and dried test pieces was visually inspected for any adhesive residue. Then, the surface of the test piece after the cleaning test was analyzed using X-ray photoelectron spectroscopy (ESCA) (PHI Quantera SXM, manufactured by ULVAC-PHI, Inc.) to calculate a carbon/silicon ratio (C 1s/Si 2p). The carbon/silicon ratio was expressed as a relative value, provided that the carbon/silicon ratio of a Si substrate (mirror wafer) having no adhesive was set to 100. Table 1 shows the results. The smaller the relative value, the better the cleaning performance.

In Comparative Examples 3 and 6, since the adhesive residue was visually observed on the Si substrate (wafer), the residue evaluation by ESCA was not performed and marked with "×" in Table 1.

[0062] [Evaluation of damage to Al substrate]

(Test piece)

To evaluate the damage to Al electrodes that would be formed on a Si substrate, a pure Al substrate of 20 mm × 50 mm (thickness: 0.8 mm) was used as a test piece.

(Damage evaluation)

The weight of the pure Al substrate was accurately measured in advance with a precision balance. As described in the cleaning test above, the pure Al substrate was immersed in 50 mL of the cleaning agent composition of each of Examples 1 to 8 and Comparative Examples 1 to 6 at 50°C for 15 minutes. Subsequently, the test piece was taken out of the cleaning agent composition, rinsed with a rinsing agent (IPA) at room temperature for 30 seconds, and then dried with air. The weight of the dried Al substrate was accurately measured with a precision balance. The amount of the Al substrate etched was calculated from the weight difference of the substrate before and after it was immersed in the cleaning agent composition, and evaluated based on the following evaluation criteria. The results show that the damage

caused by the cleaning agent compositions of Examples 1 to 8 and Comparative Examples 1 to 6 to the Al substrate was all rated as A.

(Evaluation criteria)

A: The weight difference was less than 0.1 mg (Good: almost no damage was observed).

B: The weight difference was 0.1 mg or more and less than 0.5 mg.

C: The weight difference was 0.5 mg or more (Poor: damage was observed).

[0063] [TABLE 1]

Table 1				Example								Comparative Example					
				1	2	3	4	5	6	7	8	1	2	3	4	5	6
Cleaning agent composition	Nitrogen-containing aprotic solvent	Nitrile compound (component A)	benzonitrile	99	85	70	50			85	85	100					
			phenylacetonitrile					85					100				
			acetonitrile						85					100			
		Compounds other than nitrile compound (non-component A)	1-methyl-2-pyrrolidone												50		
	Aprotic solvent (non-component A)		dimethyl sulfoxide													85	
			γ-butyrolactone														85
	Organic amine (component B)		monoethanolamine	1	15	30	50	15	15	7.5	7.5				50	15	15
			2-(methylamino)ethanol							7.5							
			N-methyldiethanolamine								7.5						
	Total (% by mass)			100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Organic amine/Nitrogen-containing aprotic solvent (mass ratio B/A)			0.01	0.18	0.43	1.00	0.18	0.18	0.18	0.18	0.00	0.00	0.00	1.00	0.18	0.18
	Volume fraction of component A (or non-component A): φ1			0.99	0.85	0.70	0.50	0.85	0.88	0.85	0.85	1.00	1.00	1.00	0.50	0.84	0.84
	Volume fraction of component B: φ2			0.01	0.15	0.30	0.50	0.15	0.12	0.15	0.15	0.00	0.00	0.00	0.50	0.16	0.16
	Hansen solubility parameter value			22.6	23.1	24.0	25.6	23.9	24.8	22.8	22.8	22.5	23.4	24.4	26.4	27.1	26.1
Evaluation	Cleaning performance (adhesive removal performance)		C 1s/Si 2p intensity ratio measured by ESCA (relative value, where intensity ratio of Si substrate without adhesive coating is set to 100)	165	101	118	113	108	117	123	122	175	201	×	179	200	×

[0064] As shown in Table 1, the cleaning agent compositions of Examples 1 to 8 were superior to those of Comparative Examples 1 to 6 in adhesive residue removal performance. As described above, the cleaning agent compositions of Examples 1 to 8 caused almost no damage to the Al substrate, and thus would be considered to reduce damage to the Al electrodes.

Industrial Applicability

[0065] The present disclosure provides a cleaning agent composition that has high ability to remove a wafer processing adhesive. The use of the cleaning agent composition of the present disclosure can improve the productivity of semiconductor substrates.

Description of Reference Numerals

[0066]

1	Fixing member
2	Wafer processing adhesive
2a	Residue of wafer processing adhesive
3	Wafer
3a	Polishing/processing surface of wafer

CLAIMS

[Claim 1] A cleaning agent composition for wafer processing to remove a wafer processing adhesive remaining on a wafer,

the cleaning agent composition comprising a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B),

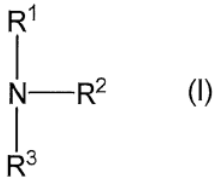
wherein the component A is a nitrile compound, and

a Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

[Claim 2] The cleaning agent composition for wafer processing according to claim 1, wherein a content of the component A is 50.0% by mass or more and 99.9% by mass or less.

[Claim 3] The cleaning agent composition for wafer processing according to claim 1 or 2, wherein the component B contains a compound represented by the following formula (I):

[Chemical Formula 1]



(I)

in the formula (I), R^1 represents a linear alkanol group having 2 or more and 4 or less carbon atoms, R^2 represents a linear alkanol group having 2 or more and 4 or less carbon atoms, a methyl group, or a hydrogen atom, and R^3 represents a methyl group or a hydrogen atom.

[Claim 4] The cleaning agent composition for wafer processing according to any one of claims 1 to 3, wherein the component B is at least one selected from the group consisting of monoethanolamine and 2-(methylamino)ethanol.

[Claim 5] The cleaning agent composition for wafer processing according to any one of claims 1 to 4, wherein a content of the component B is 0.1% by mass or more and 50.0% by mass or less.

[Claim 6] The cleaning agent composition for wafer processing according to any one of claims 1 to 5, wherein a mass ratio B/A of the component B to the component A is 0.001 or more and 1 or less.

[Claim 7] The cleaning agent composition for wafer processing according to any one of claims 1 to 6, comprising no water or having a water content of 5% by mass or less.

[Claim 8] A wafer cleaning method to remove a wafer processing adhesive from a wafer to which the adhesive has been attached,

the wafer cleaning method comprising a cleaning step of cleaning a wafer to which a wafer processing adhesive is attached with the cleaning agent composition for wafer processing according to any one of claims 1 to 7.

[Claim 9] The wafer cleaning method according to claim 8, wherein the cleaning step is a step of immersing the wafer to which the adhesive is attached in the cleaning agent composition at 50°C or more and 100°C or less.

[Claim 10] A method for producing a semiconductor substrate, comprising:

(1) a step of bonding a wafer to a fixing member with an adhesive;

(2) a step of polishing a back surface of the wafer that is opposite to the bonding surface between the wafer and the fixing member;

(3) a step of processing the polished surface of the wafer;

(4) a step of separating the processed wafer from the fixing member; and

(5) a step of removing the adhesive remaining on the separated wafer with a cleaning agent,

wherein the cleaning agent is a cleaning agent composition that contains a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B), the component A is a nitrile compound, and a Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.

[Claim 11] The method for producing a semiconductor substrate according to claim 10, wherein a content of the component A in the cleaning agent composition is 50.0% by mass or more and 99.9% by mass or less.

[Claim 12] An adhesive remover to remove a wafer processing adhesive remaining on a wafer,

the adhesive remover comprising a nitrogen-containing aprotic polar solvent having 2 or more and 10 or less carbon atoms (component A) and an organic amine (component B),

wherein the component A is a nitrile compound, and

a Hansen solubility parameter value of a mixed solvent of the component A and the component B is 20.0 or more and 26.0 or less.