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(54) **Title:**

PRESSURE-SENSITIVE ADHESIVE SHEET FOR SEMICONDUCTOR WAFER PROCESSING

(57) **Abstract:**

58 PRESSURE-SENSITIVE ADHESIVE SHEET FOR SEMICONDUCTOR WAFER PROCESSING ABSTRACT 5 A pressure-sensitive adhesive sheet for semiconductor wafer processing, having, a radiation-transmissive base resin film, and a pressure-sensitive adhesive layer formed on the base resin film, the pressure-sensitive adhesive layer including a layer using a radiation-curable resin composition containing: 10 (i-2) 100 parts by mass of an acrylic polymer; 1 to 300 parts by mass of a compound (c) having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a weight average molecular weight of 10,000 or less; and 0.1 to 10 parts by mass of a photopolymerization initiator (b) having a weight 15 average molecular weight of less than 1000, as measured by gel permeation chromatography and calculated relative to polystyrene employed as standards. Figure 1

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PRESSURE-SENSITIVE ADHESIVE SHEET FOR SEMICONDUCTOR WAFER PROCESSING

ABSTRACT

5

A pressure-sensitive adhesive sheet for semiconductor wafer processing, having, a radiation-transmissive base resin film, and a pressure-sensitive adhesive layer formed on the base resin film, the pressure-sensitive adhesive layer including a layer using a radiation-curable resin composition containing:

10 (i-2) 100 parts by mass of an acrylic polymer;

(ii) 1 to 300 parts by mass of a compound (c) having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a weight average molecular weight of 10,000 or less; and

(iii) 0.1 to 10 parts by mass of a photopolymerization initiator (b) having a weight

15 average molecular weight of less than 1000, as measured by gel permeation chromatography and calculated relative to polystyrene employed as standards.

Figure 1

DESCRIPTION

PRESSURE-SENSITIVE ADHESIVE SHEET FOR SEMICONDUCTOR WAFER PROCESSING

5

TECHNICAL FIELD

{0001}

The present invention relates to a pressure-sensitive adhesive sheet for semiconductor wafer processing having a radiation-curable pressure-sensitive
10 adhesive layer, which is used when processing a thin semiconductor wafer.

BACKGROUND ART

{0002}

Semiconductor integrated circuits have been hitherto produced by fixing a
15 semiconductor chip having a predetermined circuit pattern is formed, on a die pad with an adhesive. The semiconductor chip used in this case is produced by, for example, the following method of steps.

(1) A high purity silicon single crystal is sliced into semiconductor wafers, and then a predetermined circuit pattern such as IC is formed on the surface of each
20 wafer.

(2) A surface protection tape for protecting the semiconductor wafer circuit surface is affixed to protect the circuit surface thus formed, subsequently the back surface of the wafer is ground using a grinding machine to adjust the thickness of the wafer to be small, such as up to about 100 μm to 600 μm, and thereafter, the
25 surface protection tape is peeled off from the circuit surface.

(3) A dicing sheet is affixed to a ring-shaped dicing frame having a hollow portion which is slightly larger than the diameter of the semiconductor wafer, and the back surface of the wafer that has been ground with a grinding machine is

attached to the pressure-sensitive adhesive layer exposed at the hollow portion of the frame.

(4) Dicing is performed through the reverse side of the surface where the dicing sheet has been affixed (that is, the side where a circuit is formed) to produce semiconductor chips, and a radiation such as ultraviolet radiation is irradiated to reduce the pressure-sensitive adhesive power of the pressure-sensitive adhesive layer of the dicing sheet. The chip is lifted up with a needle from the base material film side of the dicing sheet, and thereby a pickup process is carried out.

{0003}

The dicing sheet used in this step requires a pressure-sensitive adhesive power to the extent that detachment does not occur during the dicing processing. On the other hand, it is required that at the time of pickup after dicing, the semiconductor chip can be detached from the dicing sheet with a low pressure-sensitive adhesive power to the extent that the semiconductor chip can be easily detached, and that contaminants including the pressure-sensitive adhesive is not left on the back surface of the chip.

On the other hand, in recent years, it became the mainstream to obtain thin semiconductor chips having a thickness of 100 μm or less from a large-diameter wafer having a diameter of 300 mm. Thus, it is an important task to find out how to obtain semiconductor chips from this thin wafer without causing any problem.

{0004}

As one of the solutions to this problem, there has been suggested a so-called in-line production apparatus in which the steps (1) to (3) described above are carried out in a continuous type apparatus, or a production method of rapidly carrying out the processes (2) and (3) (see, for example, Patent Literatures 1 and 2). For example, in the in-line production apparatus, the step of grinding the back surface of the wafer in (2) and the step of affixing the dicing sheet to the

back surface of the wafer in (3) are continuously carried out. For this reason, in the in-line production apparatus, damage of the semiconductor wafer or the semiconductor chip can be reduced. In this apparatus, the dicing sheet is affixed before an oxide film is generated at the back surface of the wafer.

5 However, in the conventional dicing sheets having a pressure-sensitive adhesive layer, the step has been carried out such that affixation is achieved before the oxide film is generated at the back surface of the wafer. Accordingly, there is a problem that such a dicing sheet that could be easily detached may not be easily detached in this case, even if the dicing sheet is used similarly in an in-

10 line production apparatus.

Furthermore, in the conventional production processes, the process has been carried out such that the dicing sheet is affixed after an oxide film is produced at the back surface of the wafer. Accordingly, there is a problem that a conventional dicing sheet having a pressure-sensitive adhesive layer, which

15 could be easily detached, is not be easily detached even if the dicing sheet is used similarly in an in-line production apparatus.

{0005}

As another solution, there has been suggested a so-called dicing die bond sheet, in which an adhesive that is used to fix, in advance, a semiconductor

20 chip on a die pad, after being formed into a film form and is laminated on the pressure-sensitive adhesive layer of a dicing tape. When this dicing die bond sheet is used, the dicing die bond sheet can be affixed to the back surface of the wafer similarly to a conventional dicing sheet; however, the adhesive layer is diced together with the pressure-sensitive adhesive layer. Since the adhesive

25 layer has been affixed to this sheet, the strength of the tape as a whole is stronger, and the sheet itself has an effect of enhancing the strength of the thin wafer. For this reason, dicing of a thin wafer can be carried out efficiently. However, after completion of dicing, the adhesive layer is to be left on the back

surface of the semiconductor chip, to occur detachment between the adhesive layer and the pressure-sensitive adhesive layer. Thus, a sheet which uses a particular radiation-curable pressure-sensitive adhesive layer is being used. Recently, the production processes for semiconductor chips have been speeded
5 up by increasing the radiation dose after the dicing step. However, if the radiation dose becomes larger, the amount of heat generation also becomes large, and there is a problem that detachment between the adhesive layer and the pressure-sensitive adhesive layer is made difficult by the heat generated in the radiation-irradiating step after the dicing step.

10

CITATION LIST

PATENT LITERATURES

{0006}

Patent Literature 1: JP-A-2002-343756 ("JP-A" means unexamined published
15 Japanese patent application)

Patent Literature 2: JP-A-2004-40114

SUMMARY OF INVENTION

TECHNICAL PROBLEM

20 {0007}

An object of the present invention is to provide a pressure-sensitive adhesive sheet for semiconductor wafer processing, which can be easily detached after completion of the dicing process even in an apparatus in which a dicing sheet is affixed immediately after the back surface of a wafer, and can
25 reduce the attachment of contaminants.

Another object of the present invention is to provide a pressure-sensitive adhesive sheet for semiconductor wafer processing, which is further provided with an adhesive layer on the pressure-sensitive adhesive layer, so that

detachment between the adhesive layer and the pressure-sensitive adhesive layer can be easily achieved in the pickup process, and thereby a semiconductor chip attached with an adhesive layer can be obtained.

SOLUTION TO PROBLEM

{0008}

The inventors of the present invention conducted a thorough investigation on the objects described above, and as a result, the inventors found that the objects described above can be respectively solved by using either (I) a pressure-sensitive adhesive sheet for semiconductor wafer processing in which a pressure-sensitive adhesive layer is formed on a base resin film, by using a radiation-curable resin composition containing a base resin which includes a particular radiation-curable acrylic polymer as a main component, and a photopolymerization initiator having a particular molecular weight, or (II) a pressure-sensitive adhesive sheet for semiconductor wafer processing in which a radiation polymerizable pressure-sensitive adhesive layer of a resin composition containing a radiation-polymerizable compound and a photopolymerization initiator having a particular molecular weight in an acrylic polymer, is formed. The present invention was achieved based on the finding.

That is, according to the present invention, there is provided the following means:

<1> A pressure-sensitive adhesive sheet for semiconductor wafer processing, having:

a radiation-transmissive base resin film; and

a pressure-sensitive adhesive layer formed on the base resin film, the pressure-sensitive adhesive layer including a layer using a radiation-curable resin composition containing:

(i-1) 100 parts by mass of a base resin including, as a main component, an

acrylic polymer (a) formed by linking a residue having a (meth)acrylic monomer moiety having a radiation-curable carbon-carbon double bond-containing group, to the repeating unit of the main chain; and

(iii) 0.1 to 10 parts by mass of a photopolymerization initiator (b) having a weight
5 average molecular weight of less than 1000 as measured by gel permeation chromatography (hereinafter, referred to as "GPC") by calculating relative to polystyrene employed as standards.

<2> A pressure-sensitive adhesive sheet for semiconductor wafer processing, having:

10 a radiation-transmissive base resin film; and

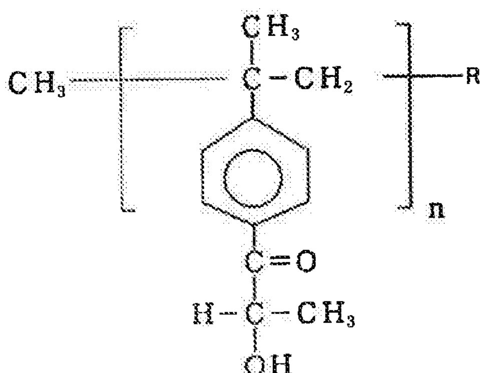
a pressure-sensitive adhesive layer formed on the base resin film, the pressure-sensitive adhesive layer including a layer using a radiation-curable resin composition containing:

(i-2) 100 parts by mass of an acrylic polymer;

15 (ii) 1 to 300 parts by mass of a compound (c) having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a weight average molecular weight of 10,000 or less; and

(iii) 0.1 to 10 parts by mass of a photopolymerization initiator (b) having a weight average molecular weight of less than 1000, as measured by gel permeation
20 chromatography (hereinafter, referred to as "GPC") and calculated relative to polystyrene employed as standards.

<3> The pressure-sensitive adhesive sheet for semiconductor wafer processing as described in the above item <1> or <2>, wherein the photopolymerization initiator (b) is at least one kind initiator selected from the
25 group consisting of 1-hydroxy-cyclohexylphenyl-ketone, 2,2-dimethoxy-1,2-diphenylethane-1-one, 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropane-1-one, and an oligomer represented by formula (1):



Formula (1)

wherein R represents an alkyl group; and n represents an integer.

<4> The pressure-sensitive adhesive sheet for semiconductor wafer processing as described in the above item <3>, wherein the oligomer represented by the formula (1) has a degree of polymerization of n = 2 to 4.

<5> The pressure-sensitive adhesive sheet for semiconductor wafer processing as described in the above item <1>, <3> or <4>, wherein the (a) polymer containing, as a constituent unit, an acrylic monomer having a radiation-polymerizable carbon-carbon double bond-containing group in the repeating unit of the main chain, has an iodine value of 1 to 50.

<6> The pressure-sensitive adhesive sheet for semiconductor wafer processing as described in any one of the items <1> to <5>, wherein an adhesive layer is further provided on the pressure-sensitive adhesive layer of the pressure-sensitive adhesive sheet for semiconductor wafer processing as described in any one of the items <1> to <5>.

ADVANTAGEOUS EFFECTS OF INVENTION

{0009}

By using the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention, when the pressure-sensitive adhesive sheet is used in an apparatus for affixing a dicing sheet immediately after the back

surface of the wafer, the pressure-sensitive adhesive sheet can be easily detached after completion of the dicing step, and the amount of contaminants left can be markedly reduced.

Furthermore, when the pressure-sensitive adhesive sheet for
5 semiconductor wafer processing of the present invention, in which an adhesive layer is further provided on the pressure-sensitive adhesive layer, is used, the adhesive layer and the pressure-sensitive adhesive layer can be easily detached in the pickup step, and a semiconductor chip with the adhesive layer can be obtained.

10 {0010}

Other and further features and advantages of the invention will be more apparent from the following description, optionally referring to the accompanying drawings.

15 BRIEF DESCRIPTION OF THE DRAWINGS

{0011}

{Fig. 1}

Fig. 1 is a schematic cross-sectional view showing an embodiment of the pressure-sensitive adhesive sheet for semiconductor wafer processing of the
20 present invention.

{Fig. 2}

Fig. 2 is a schematic cross-sectional view showing another embodiment of the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention.

25

MODE FOR CARRYING OUT THE INVENTION

{0012}

A preferred pressure-sensitive adhesive sheet for semiconductor wafer

processing of the present invention will be described with reference to the attached drawings.

Fig. 1 is a schematic cross-sectional view showing a preferred embodiment of the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention, which includes a base resin film 1 and a pressure-sensitive adhesive layer 2 formed on the base resin film 1. Further, Fig. 2 is a schematic cross-sectional diagram showing another preferred embodiment of the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention. In Fig. 2, there is a base resin film 1, a pressure-sensitive adhesive layer 2 is formed on the base resin film 1, and an adhesive layer 3 is further formed.

{0013}

The pressure-sensitive adhesive layer according to the present invention is composed of a radiation-curable resin composition in which a specific amount of a radiation-polymerizable compound and a specific amount of a particular photopolymerization initiator are incorporated in the base resin. By using the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention, after completion of the dicing step, a radiation is conducted through the radiation-transmissive base resin film side that will be described below, and as a result the pressure-sensitive adhesive power of the pressure-sensitive adhesive layer is reduced. Thereby, the step of picking up semiconductor chips is made possible without any problem. As illustrated in Fig. 2, also similarly in the case of the pressure-sensitive adhesive sheet for semiconductor wafer processing in which an adhesive layer is formed on the pressure-sensitive adhesive layer, a radiation is conducted through the radiation-transmissive base resin film side that will be described below, and thus the pressure-sensitive adhesive power of the pressure-sensitive adhesive layer is reduced. In this case, a semiconductor with an adhesive layer chip is obtained

by causing detachment at the interface between the adhesive layer and the pressure-sensitive adhesive layer, and the semiconductor chip can be fixed on a die pad as it is.

{0014}

5 The pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention illustrated in Fig. 1 can be detached without any problem in the pickup step after the irradiation of a radiation, even in the case where after completion of the grinding of the back surface of the semiconductor wafer, the pressure-sensitive adhesive sheet is quickly affixed to the back surface.

10 The surface of the semiconductor wafer immediately after completion of grinding is such that a naturally oxidized film is not formed at all over the surface, and the surface generated is an active one where non-oxidized active atoms exist. Even in this case, the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention can be detached without any problem after

15 irradiation of a radiation, and the attachment of contaminants that are attributable to the pressure-sensitive adhesive components can be markedly reduced.

Furthermore, the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention in which an adhesive layer is further provided on a pressure-sensitive adhesive layer as illustrated in Fig. 2, does not

20 have the problem that the detachment between the pressure-sensitive adhesive layer and the adhesive layer is made difficult by the heat generated by the irradiation of a radiation after completion of the dicing process.

{0015}

In the sheet for semiconductor wafer processing of the present invention,

25 a layer using a radiation-curable resin composition is formed as the pressure-sensitive adhesive layer on the base resin film that will be described below. The sheet for semiconductor wafer processing of the present invention encompasses the first embodiment and the second embodiment. The respective embodiments

include the sheets for semiconductor wafer processing of the embodiment illustrated in Fig. 1 and the embodiment illustrated in Fig. 2. The base resin of the pressure-sensitive adhesive layer of the sheet for semiconductor wafer processing of the first embodiment includes, as a main component, (i-1) an
5 acrylic polymer (a) in which a residue having a (meth)acrylic monomer moiety having a radiation-curable carbon-carbon double bond-containing group is linked to a repeating unit of the main chain.

{0016}

(Base resin of pressure-sensitive adhesive layer of sheet for semiconductor wafer
10 processing of first embodiment)

The base resin of the radiation-curable resin composition used in the pressure-sensitive adhesive layer of the sheet for semiconductor wafer processing of the first embodiment includes, as a main component, a polymer (a) in which a residue having a (meth)acrylic monomer moiety having a radiation-
15 curable carbon-carbon double bond-containing group is linked to a repeating unit of the main chain. According to the present invention, including the polymer (a) as a main component means that the content proportion in the base resin is 50% to 100% by mass. Furthermore, according to the present invention, the (meth)acrylic monomer is intended to include both an acrylic monomer and a
20 methacrylic monomer.

The polymer (a) may be a polymer produced by any method. For example, a product, obtained by allowing an acrylic based copolymer and/or a methacrylic based copolymer (a1) having a radiation-curable carbon-carbon double bond in the repeating unit of a main chain and having a functional group,
25 to react with a compound (a2) having a functional group that can react with the functional group, may be used. Furthermore, an acrylic copolymer and/or methacrylic copolymer having a functional group is defined as component (a1'), while a compound having a radiation-curable carbon-carbon double bond and

also having a functional group which is capable of reacting with the functional group of (a1') is defined as component (a2'), and these can be allowed to react with each other to obtain a polymer (a).

The foregoing acrylic based copolymer and/or methacrylic based
5 copolymer (a1) having a radiation-curable carbon-carbon double bound in the repeating unit of a main chain and having a functional group may be obtained by, for example, copolymerizing a monomer (a1-1) such as an acrylic acid alkyl ester and/or a methacrylic acid alkyl ester having a radiation-curable carbon-carbon double bond, with a monomer (a1-2) having a functional group.

10 {0017}

Examples of the monomer (a1-1) include (meth)acrylic acid alkyl esters in which the alkyl group of the alkyl ester has 6 to 12 carbon atoms (for example, hexyl acrylate, n-octyl acrylate, isooctyl acrylate, 2-ethylhexyl acrylate, dodecyl acrylate, and decyl acrylate). Further, the examples include (meth)acrylic acid
15 alkyl esters in which the alkyl group of the alkyl ester has 5 or less carbon atoms (for example, pentyl acrylate, n-butyl acrylate, isobutyl acrylate, ethyl acrylate, methyl acrylate, and methacrylates similar to these).

{0018}

As a (meth)acrylic acid alkyl ester having a larger number of carbon
20 atoms carried by the alkyl group of the alkyl ester is used as the monomer (a1-1), the glass transition temperature tends to be lowered. Accordingly, a polymer (a) having a desired glass transition temperature can be obtained by appropriately selecting the number of carbon atoms for the alkyl group of the alkyl ester of the monomer (a1-1).

25 Furthermore, for the purpose of enhancing the compatibility with other components or various performances in addition to the glass transition temperature, the polymer (a) can be obtained by adding a low molecular weight compound having a carbon-carbon double bond such as vinyl acetate, styrene or

acrylonitrile to the monomer (a1-1). The incorporation amount of such a low molecular weight compound is preferably set to 5% by mass or less of the amount of the monomer (a1-1).

{0019}

5 Examples of the functional group which the monomer (a1-2) has, include a carboxyl group, a hydroxyl group, an amino group, a cyclic acid anhydride group, an epoxy group, and an isocyanate group. Specific examples of the monomer (a1-2) include acrylic acid, methacrylic acid, cinnamic acid, itaconic acid, fumaric acid, phthalic acid, 2-hydroxyalkyl acrylates, 2-hydroxyalkyl 10 methacrylates, glycol monoacrylates, glycol monomethacrylates, N-methylol acrylamide, N-methylol methacrylamide, allyl alcohol, N-alkylaminoethyl acrylates, N-alkylaminoethyl methacrylates, acrylamides, methacrylamides, maleic anhydride, itaconic anhydride, fumaric anhydride, phthalic anhydride, glycidyl acrylate, glycidyl methacrylate, allyl glycidyl ether, and polyisocyanate 15 compounds in which isocyanate groups are partially urethanated with a monomer having a hydroxyl group or carboxyl group and a radiation-curable carbon-carbon double bond.

{0020}

When the functional group of the component (a2) is a carboxyl group or a 20 cyclic acid anhydride group, examples of the functional group carried by the component (a1) include a hydroxyl group, an epoxy group, and an isocyanate group. Further, when the functional group of the component (a2) is a hydroxyl group, examples of the functional group carried by the component (a1) include a cyclic acid anhydride group, an isocyanate group, and the like. When the 25 functional group of the component (a2) is an amino group, the functional group carried by the component (a1) may be an epoxy group, an isocyanate group or the like. When the functional group of the component (a2) is an epoxy group, examples of the functional group carried by the component (a1) include a

carboxyl group, a cyclic acid anhydride group, an amino group, and the like.

Specific examples include the same compounds listed as specific examples of the monomer (a1-2).

{0021}

5 In the reaction between the components (a1) and (a2), the acid value, the hydroxyl group value and the like can be preferably appropriately set to the ranges that will be described below, by allowing unreacted functional groups to remain behind.

The polymer (a) containing, as a constituent unit, a (meth)acrylic
10 monomer having a radiation-curable carbon-carbon double bond-containing group in the repeating unit of the main chain, can be obtained through solution polymerization in various solvents. When carrying out copolymerization reaction by solution polymerization, a ketone-series, ester-series, alcohol-series, or aromatic-series solvent can be used as an organic solvent. A preferable solvent
15 is a usual good solvent for an acrylic-series polymer, which solvent has a boiling point of 60 to 120°C. Examples of the preferable solvent include toluene, ethyl acetate, isopropyl alcohol, benzene, methylcellosolve, ethylcellosolve, acetone, methyl ethyl ketone, and the like. As a polymerization initiator, use may be generally made of a radical generating agent of azobis-series, such as α,α'-
20 azobisisobutyronitrile, and organic peroxide-series, such as benzoylperoxide. At this time, a catalyst, a polymerization inhibitor, and the like can be optionally added, if necessary. In this way, it is possible to obtain a polymer (a) with a desired molecular weight, by controlling a polymerization temperature and a polymerization time. As for the control of the molecular weight, it is preferred to
25 use a mercaptan-series or carbon tetrachloride-series solvent. Additionally, the synthesis of the polymer (a) is not limited to solution polymerization, but it may also be performed in other ways such as bulk polymerization, suspension polymerization, and the like.

{0022}

According to the present invention, the weight average molecular weight of the polymer (a) in which a residue having a (meth)acrylic monomer moiety having a radiation-curable carbon-carbon double bond-containing group is linked
5 to a repeating unit of the main chain, is preferably about 300,000 to about 1,000,000. If the molecular weight is less than 300,000, the cohesive force by irradiation of a radiation becomes lesser, thus a misalignment of elements (chips) may occur easily upon dicing the wafer, and image recognition may be difficult. Further, to prevent this misalignment of elements as much as possible, it is
10 preferable that the molecular weight is 400,000 or more. If the molecular weight is more than 1,000,000, there is a possibility of gelation upon synthesis and coating. The weight average molecular weight of the polymer (a) according to the present invention can be determined by, for example, the following method, as a weight average molecular weight calculated relative to polystyrene
15 standards.

(Measurement conditions for weight average molecular weight)

GPC apparatus: HLC-8120GPC (trade name, manufactured by Tosoh Corporation)

Column: TSK gel SuperHM-H/H4000/H3000/H2000 (trade name, manufactured
20 by Tosoh Corporation)

Flow rate: 0.6 mL/min

Concentration: 0.3 mass%

Injection amount: 20 μL

Column temperature: 40°C

25 Developing solvent: chloroform

{0023}

According to the present invention, the iodine value of the polymer (a) containing, as a constituent unit, an acrylic monomer having a radiation-

polymerizable carbon-carbon double bond-containing group in the main chain is preferably 1 to 50, and more preferably 2 to 30. If the iodine value is less than 1, the degree of crosslinking after the irradiation of a radiation is low, and the peeling force tends to decrease. Therefore, the pickup of chips may not be
5 satisfactorily achieved. If the iodine value exceeds 50, the degree of crosslinking after the irradiation of a radiation is high, curing shrinkage occurs, and the pickup properties of chips deteriorate.

{0024}

When the hydroxyl group value of the polymer (a) is 5 to 100, the
10 pressure-sensitive adhesive power after the irradiation of a radiation is decreased, and thereby the risk of pickup failure can be further reduced, which is preferable. Furthermore, it is preferable that the acid value of the polymer (a) be 0.5 to 30.

Here, the hydroxyl group value and the acid value are meant to refer to the values measured according to JIS K0070. When the hydroxyl group value of
15 the polymer (a) is set to an appropriate range, the fluidity of the pressure-sensitive adhesive layer after the irradiation of a radiation can be adjusted to an appropriate range, and the pressure-sensitive adhesive power after the irradiation of a radiation can be sufficiently decreased. When the acid value of the polymer (a) is set to an appropriate range, the fluidity of the pressure-sensitive adhesive
20 layer after the irradiation of a radiation can be adjusted to an appropriate range, and the tape restorability can be satisfied.

{0025}

In the base resin used in the radiation-curable resin composition that constitutes the pressure-sensitive adhesive layer of the present invention,
25 conventional ingredients can be incorporated to the extent that the purport of the present invention is not impaired. For example, use can be made of rubber-based polymers such as natural rubber and various synthetic rubber; acrylic copolymers such as poly(meth)acrylic acid alkyl esters, (meth)acrylic acid alkyl

esters, and copolymers of a (meth)acrylic acid alkyl ester and another unsaturated monomer capable of copolymerization with the (meth)acrylic acid alkyl ester.

{0026}

5 (Base resin of pressure-sensitive adhesive layer of sheet for semiconductor wafer processing of second embodiment)

The base resin of the radiation-curable resin composition used in the pressure-sensitive adhesive layer of the sheet for semiconductor wafer processing of the second embodiment is an acrylic polymer.

10 The acrylic polymer may be a product produced by using a (meth)acrylic acid ester component as a main monomer component (the percentage by mass in the polymer is more than 50%), and copolymerizing the (meth)acrylic acid ester component with a monomer component capable of copolymerization with the (meth)acrylic acid ester component.

15 {0027}

With regard to the acrylic polymer, examples of the (meth)acrylic acid ester component as the main monomer component include (meth)acrylic acid alkyl esters such as methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, isopropyl (meth)acrylate, butyl (meth)acrylate, isobutyl
20 (meth)acrylate, s-butyl (meth)acrylate, t-butyl (meth)acrylate, pentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, octyl (meth)acrylate, isooctyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, nonyl (meth)acrylate, isononyl (meth)acrylate, decyl (meth)acrylate, isodecyl (meth)acrylate, undecyl (meth)acrylate, dodecyl (meth)acrylate, tridecyl (meth)acrylate, tetradecyl
25 (meth)acrylate, pentadecyl (meth)acrylate, hexadecyl (meth)acrylate, heptadecyl (meth)acrylate, and octadecyl (meth)acrylate; (meth)acrylic acid cycloalkyl esters such as cyclohexyl (meth)acrylate; and (meth)acrylic acid aryl esters such as phenyl (meth)acrylate. The (meth)acrylic acid esters can be used singly or in

combination of two or more kinds.

{0028}

(Curing agent)

In the radiation-curable resin composition that constitutes the pressure-sensitive adhesive layer of the pressure-sensitive adhesive sheets for semiconductor wafer processing of the first embodiment and the second embodiment as described above, conventionally used curing agents such as polyisocyanate compounds, alkyl etherified melamine compounds, epoxy compounds and silane coupling agents can be incorporated. When a curing agent is incorporated into the resin composition, the initial pressure-sensitive adhesive power can be set to any arbitrary value. Among the curing agents, it is preferable to use an isocyanate-based curing agent.

Specifically, as the isocyanate-based curing agent, a polyvalent isocyanate compound, for example, 2,4-tolylene diisocyanate, 2,6-tolylene diisocyanate, 1,3-xylene diisocyanate, 1,4-xylene diisocyanate, diphenylmethane-4,4'-diisocyanate, diphenylmethane-2,4'-diisocyanate, 3-methyldiphenylmethane diisocyanate, hexamethylene diisocyanate, isophorone diisocyanate, dicyclohexylmethane-4,4'-diisocyanate, dicyclohexylmethane-2,4'-diisocyanate, lysine isocyanate or the like is used.

{0029}

(Compound having at least two photopolymerizable carbon-carbon double bonds in molecule and having weight average molecular weight of 10,000 or less)

The radiation-curable resin composition used in the pressure-sensitive adhesive layer of the sheet for semiconductor wafer processing of the second embodiment contains a compound (c) having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a weight average molecular weight of 10,000 or less. As the compound (c), any compound that is capable of being cured by irradiation of a radiation and forming a three-

dimensional network can be used without any particular limitations. This compound is to include an oligomer having a weight average molecular weight of 10,000 or less, and not to include a macromolecular polymer having a weight average molecular weight of more than 100,000. In order to efficiently achieve
5 three-dimensional networking of the pressure-sensitive adhesive layer by the irradiation of a radiation, a compound having a molecular weight of 5,000 or less and having a number of radiation-polymerizable carbon-carbon double bonds in the molecule of 2 to 6 is preferred.

Meanwhile, the weight average molecular weight of the low molecular
10 weight compound having at least two photopolymerizable carbon-carbon double bonds in the molecule according to the present invention means the weight average molecular weight measured by GPC (gel permeation chromatography) under the conditions described below and calculated relative to polystyrene standards.

15

(Measurement conditions for weight average molecular weight)
GPC apparatus: HLC-8120GPC (trade name, manufactured by Tosoh Corporation)
Column: TSK-GEL G2500HHR (trade name, manufactured by Tosoh
20 Corporation)
Flow rate: 1mL/min
Concentration: 0.2 mg/mL
Injection amount: 100 μL
Temperature of thermostat bath: 40°C
25 Mobile phase: chloroform
{0030}

Examples of the radiation-polymerizable compound (c) include trimethylolpropane triacrylate, tetramethylolmethane tetraacrylate, pentaerythritol

triacrylate, pentaerythritol tetraacrylate, dipentaerythritol monohydroxypentaacrylate, dipentaerythritol hexaacrylate, 1,4-butylene glycol diacrylate, 1,6-hexanediol diacrylate, polyethylene glycol diacrylate, an organopolysiloxane composition, a commercially available oligoester acrylate, 5 urethane acrylate, and the like.

{0031}

The compound having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a weight average molecular weight of 10,000 or less may be used singly, or two or more kinds may be used in 10 combination. The incorporation amount is 1 to 300 parts by mass relative to 100 parts by mass of the base resin. The incorporation amount is preferably 30 to 200 parts by mass, and more preferably 50 to 150 parts by mass, relative to 100 parts by mass of the base resin. If this amount is too small, the three-dimensional networking of the pressure-sensitive adhesive layer caused by the 15 irradiation of a radiation is unsatisfactorily achieved, it becomes difficult to detach the pressure-sensitive adhesive sheet for semiconductor wafer process from the wafer, and there is a risk that the wafer may be contaminated. If this amount is too large, the polymerization reaction induced by a radiation proceeds excessively, and curing shrinkage caused by the irradiation of a radiation occurs. 20 As a result, the pressure-sensitive adhesive layer conforms to the surface of the object to be attached and is embedded, and when semiconductor chips are picked up after dicing, the semiconductor chips are not easily picked up. Furthermore, if the amount of the radiation-polymerizable compound is too large, it is difficult to retain the shape of the pressure-sensitive adhesive layer, and there 25 is a problem that the thickness accuracy is deteriorated.

{0032}

(Photopolymerization initiator)

In radiation-curable resin composition constituting the pressure-sensitive

adhesive layer of the pressure-sensitive adhesive sheets for semiconductor wafer processing of the first embodiment and the second embodiment, a photopolymerization initiator having a weight average molecular weight as measured by gel permeation chromatography (hereinafter, referred to as "GPC")
5 and calculated relative to polystyrene standards, of less than 1,000 is used. According to the present invention, the weight average molecular weight of the photopolymerization initiator is intended to refer to the value measured by GPC under the conditions described below.

10 (Measurement conditions for weight average molecular weight)
GPC apparatus: LCVP series manufactured by SHIMADZU CORPORATION
Column: OligoPore 300 × 7.5 (trade name, manufactured by Polymer Laboratories)
Flow rate: 1 mL/min
15 Concentration: 1 mg/mL
Injection amount: 50 μL
Column temperature: 40°C
Developing solvent: chloroform
{0033}
20 A photopolymerization initiator generates a radical when irradiated with a radiation such as light or ultraviolet radiation. Thereby, the photopolymerization initiator accelerates the curing reaction of the polymer (a) containing, as a constituent unit, a (meth)acrylic monomer having a radiation-curable carbon-carbon double bond-containing group in a repeating unit of the main chain, which
25 is included in the pressure-sensitive adhesive layer, or accelerates the curing reaction of the compound having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a weight average molecular weight of 10,000 or less, which is included in the pressure-sensitive adhesive layer. If the

weight average molecular weight of the photopolymerization initiator as measured by GPC and calculated relative to polystyrene standards is too large, there is a problem with the dispersion of the photopolymerization initiator into the pressure-sensitive adhesive layer, and the movement of the radical generated therein may not be easily carried out rapidly. Thus, the curing reaction may not be efficiently carried out. In this case, it is necessary to irradiate a radiation at a high dose that is more than necessary, and the heat thus generated makes it difficult to effectively decrease the adhesiveness between the pressure-sensitive adhesive layer and the object to be attached.

The phenomenon in that case will be explained with reference to the attached drawings. As illustrated in Fig. 1, in the case of a pressure-sensitive adhesive sheet for semiconductor wafer processing 10 in which a pressure-sensitive adhesive layer 2 is formed on a base resin film 1, the pickup process for semiconductor chips is impeded. Furthermore, as illustrated in Fig. 2, in the case of a pressure-sensitive adhesive sheet for semiconductor wafer processing 20 in which a pressure-sensitive adhesive layer 2 is provided on a base resin film 1, and an adhesive layer 3 is further formed thereon, it is difficult to achieve the detachment between the adhesive layer 3 and the pressure-sensitive adhesive layer 2 smoothly.

The upper limit of the weight average molecular weight of the photopolymerization initiator measured by GPC and calculated relative to polystyrene standards is preferably 800, and more preferably 600.

{0034}

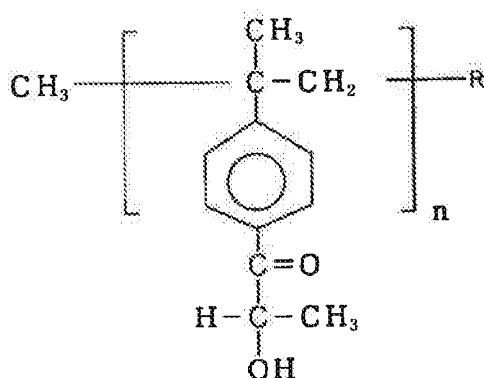
There are no particular limitations on the lower limit of the weight average molecular weight of the photopolymerization initiator as measured by GPC and calculated relative to polystyrene standards, but the weight average molecular weight is preferably 200 or greater. If the molecular weight is small, the compound is likely to sublime, and migration from the pressure-sensitive

adhesive layer to a non-adhesive layer becomes significant, so that the wafer can be easily contaminated. Furthermore, the heat resistance of the pressure-sensitive adhesive layer deteriorates, and the pressure-sensitive adhesive layer is susceptible to degradation in the drying step after application on the base
5 material during the production. Therefore, the pressure-sensitive adhesive layer may not exhibit a stabilized curing reaction.

{0035}

Examples of the photopolymerization initiator include benzophenone, 4,4-bis(diethylamino)benzophenone, 2,4,6-trimethylbenzophenone, 4-
10 phenylbenzophenone, t-butylanthraquinone, 2-ethylanthraquinone, diethoxyacetophenone, 2-hydroxy-2-methyl-1-phenylpropan-1-one, 2,2-dimethoxy-1,2-diphenylethan-1-one, 1-hydroxycyclohexyl phenyl ketone, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzoin isobutyl ether, 2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropan-1-one, 2-benzyl-2-
15 dimethylamino-1-(4-morpholinophenyl)-butanone-1, diethylthioxanthone, isopropylthioxanthone, 2,4,6-trimethylbenzoyldiphenylphosphine oxide, bis(2,4,6-trimethylbenzoyl)-phenylphosphine oxide, 2-hydroxy-1-{4-[4-(2-hydroxy-2-methylpropionyl)benzyl]phenyl}-2-methylpropan-1-one, 2-(dimethylamino)-2-[(4-methylphenyl)methyl]-1-[4-(4-morpholinyl)phenyl]-1-butanone, and an oligomer
20 represented by the following formula (1).

{0036}



Formula (1)

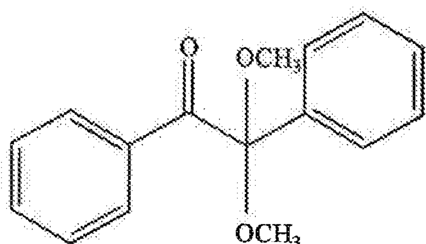
Herein, R represents an alkyl group, and n represents an integer.

{0037}

Among the photopolymerization initiators described above, excellent photopolymerization initiators which do not easily sublime and do not easily allow the occurrence of contaminant residues, include 2,2-dimethoxy-1,2-diphenylethan-1-one (molecular weight 260), 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropan-1-one (molecular weight 280), and 1-hydroxycyclohexyl phenyl ketone (molecular weight 205).

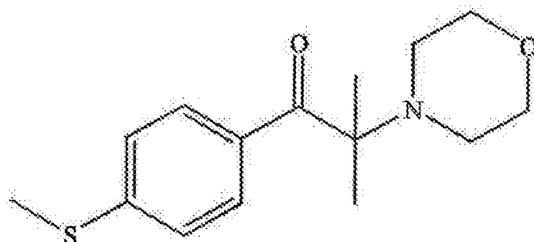
The oligomer of the formula (1) is preferably an oligomer having a degree of polymerization of n = 2 to 4 (molecular weight: 400 to 700), and more preferably an oligomer having a degree of polymerization of n = 2 to 3 (molecular weight: 400 to 500).

{0038}



2,2-dimethoxy-1,2-diphenylethane-1-one

{0039}



2-methyl-1-(4-methylthiophenyl)-2-morpholinopropane-1-one

{0040}

The photopolymerization initiator is incorporated in an amount of 0.1 to 10 part(s) by mass relative to 100 parts by mass of the base resin in the radiation-
5 curable resin composition that constitutes the pressure-sensitive adhesive layer of the pressure-sensitive adhesive sheet for semiconductor wafer processing of the first embodiment. Preferably, the photopolymerization initiator is preferably incorporated in an amount of 1 to 10 part(s) by mass, and more preferably 2 to 7 parts by mass, relative to 100 parts by mass of the base resin. In the radiation-
10 curable resin composition that constitutes the pressure-sensitive adhesive layer of the pressure-sensitive adhesive sheet for semiconductor wafer processing of the second embodiment, the photopolymerization initiator is incorporated in an amount of 0.1 to 10 part(s) by mass relative to 100 parts by mass of the acrylic polymer. Preferably, the photopolymerization initiator is preferably incorporated
15 in an amount of 1 to 10 part(s) by mass, and more preferably 2 to 7 parts by mass, relative to 100 parts by mass of the acrylic polymer.

If the amount of the photopolymerization initiator is too small, the three-dimensional networking of the pressure-sensitive adhesive layer induced by the irradiation of a radiation occurs insufficiently, and the pressure-sensitive adhesive
20 layer may not be easily detached from the adhesive layer, or causes contamination of the semiconductor chip. Furthermore, if the amount of the photopolymerization initiator is too large, an effect appropriate for the purpose may not be obtained, and also, there is a risk that this photopolymerization initiator may remain on the wafer.

25 If necessary, two or more kinds of the photopolymerization initiators described above may be used in combination. It is desirable that the weight average molecular weights measured by GPC of the photopolymerization initiators used be respectively less than 1,000. Furthermore, an amine

compound such as triethylamine, tetraethylpentaamine, or dimethylaminoethanol; or a thioxanthone-based photopolymerization initiator can be used in combination as a photopolymerization promoter.

{0041}

5 The radiation-curable resin composition may contain a tackifier, a pressure-sensitive adhesiveness adjusting agent, a surfactant, other modifying agents, or conventionally used components as necessary, in order to adjust the pressure-sensitive adhesive power to semiconductor wafers. However, since a surfactant or a compound exhibiting interfacial activity may contaminate 10 semiconductor wafers, if used, the surfactant or the compound is preferably used at the minimum level.

{0042}

According to the present invention, a pressure-sensitive adhesive sheet for semiconductor wafer processing in which a pressure-sensitive adhesive 15 layer is composed of a layer using a radiation-polymerizable resin composition, can be produced by directly applying a radiation-polymerizable resin composition containing the base resin described above, a compound having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a weight average molecular weight of 10,000 or less, a particular 20 photopolymerization initiator, and optionally a crosslinking agent and other additive components, on a base resin film and drying the resin composition by heating, or applying the radiation-polymerizable resin composition first on a paper in which a silicone has been applied on the paper surface, drying the resin composition, and then transferring the resin composition layer onto a base resin 25 film.

There are no particular limitations on the thickness of the pressure-sensitive adhesive layer. Usually, the pressure-sensitive adhesive layer is formed such that the thickness of the pressure-sensitive adhesive layer is usually

5 to 100 μm, and thus a pressure-sensitive adhesive sheet for semiconductor wafer processing is produced in the form of a sheet, a tape or the like.

As the radiation, alpha-rays, gamma-rays, an electron beam, ultraviolet radiation, and the like can be used, and there are no particular limitations as long as the radiation is capable of decreasing the pressure-sensitive adhesive power by curing the pressure-sensitive adhesive layer. An electron beam and ultraviolet radiation are preferred, and when a photopolymerization initiator is used, ultraviolet radiation is more preferred.

{0043}

As the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention, as illustrated in Fig. 2, a pressure-sensitive adhesive layer 2 may be provided on a base resin film 1, and an adhesive layer 3 may be further formed thereon. There are no particular limitations on the method of forming a pressure-sensitive adhesive layer and then an adhesive layer on the base resin film, and the pressure-sensitive adhesive layer may be laminated on the base resin film, and the adhesive layer may be laminated on the pressure-sensitive adhesive layer, according to conventional methods.

In this case, the pressure-sensitive adhesive sheet for semiconductor wafer processing is affixed on the back surface of a semiconductor wafer after grinding, and then a pressure-sensitive adhesive and an adhesive are simultaneously cut by dicing processing from the circuit-formed surface side of the semiconductor wafer. Then, an adhesive layer-attached semiconductor chip can be obtained. As the adhesive used in the adhesive layer 3, conventional adhesives can be used.

{0044}

As the adhesive layer, a product prepared by forming an adhesive in advance into a film can be used. For example, polyimide resins, polyamide resins, polyether imide resins, polyamideimide resins, polyester resins, polyester

imide resins, phenoxy resins, polysulfone resins, polyether sulfone resins, polyphenylene sulfide resins, polyether ketone resins, chlorinated polypropylene resins, acrylic resins, polyurethane resins, epoxy resins, polyacrylamide resins, melamine resins, and mixtures thereof, which are conventionally used in adhesives, can be used.

Among these, it is particularly preferable to use an epoxy resin, from the viewpoint of having excellent heat resistance after curing. The epoxy resin may be any epoxy resin which is cured and exhibits an adhesive action. In order to secure heat resistance of the adhesive layer by increasing the glass transition temperature (Tg), a polyfunctional epoxy resin may be added. Examples of the polyfunctional epoxy resin include a phenol-novolac type epoxy resin, and a cresol-novolac type epoxy resin. The curing agent for the epoxy resin is not particularly limited as long as it is conventionally used as a curing agent, and examples include amine compounds, polyamides, acid anhydrides, polysulfides, boron trifluoride, and bisphenol A, bisphenol F and bisphenol S, which are compounds having two or more phenolic hydroxyl groups in one molecule.

Particularly, it is preferable to use a phenol-novolac resin or a bisphenol-novolac resin, which are phenolic resins, because the electrolytic corrosion resistance at the time of moisture absorption is excellent. Furthermore, it is preferable to use a curing accelerator together with a curing agent, in view of shortening the time of heat treatment for curing. As the curing accelerator, bases such as various imidazoles, including 2-methylimidazole, 2-ethyl-4-methylimidazole, 1-cyanoethyl-2-phenylimidazole, 1-cyanoethyl-2-phenylimidazolium trimellitate, can be used.

{0045}

Furthermore, in order to strengthen the adhesive power to semiconductor chips or lead frames, it is desirable to add a silane coupling agent or a titanium coupling agent as an additive to the resin or a mixture of resins. Further, a filler

may be added for the purpose of enhancing heat resistance or adjusting fluidity. As such a filler, for example, silica, alumina, and antimony oxide can be used. These fillers can be used by incorporating at any proportion, as long as the maximum particle size is smaller than the thickness of the adhesive layer.

5 {0046}

The thickness of the adhesive layer is not particularly limited, but usually, the thickness is preferably about 5 μm to 100 μm. Furthermore, the adhesive layer may be laminated over the entire surface of the pressure-sensitive adhesive layer of the pressure-sensitive adhesive film. Further, an adhesive layer that 10 has been cut in advance to a shape corresponding to the semiconductor wafer to be bonded (precut) may be laminated on a portion of the pressure-sensitive adhesive layer. In this case, the configuration is such that there is an adhesive layer at the area where the semiconductor wafer is bonded, and at the area where a ring frame for dicing is bonded, the adhesive layer is absent, while there 15 is only the pressure-sensitive adhesive layer of the pressure-sensitive adhesive film. When this configuration is employed, the pressure-sensitive adhesive layer is affixed to the ring frame, and usually, the adhesive layer that is not easily detached from the object to be attached may not be affixed. Therefore, the pressure-sensitive adhesive sheet for semiconductor wafer processing of the 20 present invention can be easily detached from the ring frame after use.

{0047}

Since the pressure-sensitive adhesive sheet for semiconductor wafer processing of the present invention is irradiated with a radiation from the base resin film side at the time of detachment, and the pressure-sensitive adhesive 25 layer is cured, it is necessary that the base resin film be radiation-transmissive. Furthermore, at the time of wafer processing, the pressure-sensitive adhesive sheet for semiconductor wafer processing is subjected to the impact produced by a cutting blade or the like, and to the pressure exerted by washing water or the

like. For this reason, the base resin film needs a strength that can withstand these, and a material and a thickness that are appropriate for these are selected. It is preferable that the surface where the pressure-sensitive adhesive layer of the base resin film is formed, be subjected to various surface treatments, including a
5 corona treatment, in order to make the pressure-sensitive adhesive layer not easily detachable from the base resin film.

{0048}

Examples of materials used for the base resin film include films of polyethylene, polypropylene, ethylene/propylene copolymers, polyvinyl chloride,
10 polyethylene terephthalate, polybutylene terephthalate, ethylene/vinyl acetate copolymers, polybutene-1, poly-4-methylpentene-1, ethylene/ethyl acrylate copolymers, ethylene/methyl acrylate copolymers, ethylene/acrylic acid copolymers, polyurethane, polymethylpentene, polybutadiene or the like.

The thickness of the base resin film is 30 μm to 500 μm, preferably 40 μm
15 to 300 μm, and more preferably 50 μm to 200 μm. If this thickness is too thin, the strength is weakened, and therefore, there may be inconvenience caused by fracture or the like during the semiconductor wafer processing.

On the other hand, if the base resin film is too thick, during the pickup process for semiconductor chips after completion of the dicing processing, the
20 pressure-sensitive adhesive sheet for semiconductor wafer processing may be too rigid and thereby cause impediment to the lifting performed by a needle. Furthermore, after completion of the dicing step and during the expanding process before the pickup process, it may be difficult to sufficiently stretch the pressure-sensitive adhesive sheet for semiconductor wafer processing. For that
25 reason, the intervals between semiconductor chips are small, chip recognizability based on images becomes unsatisfactory, and pickup failure of semiconductor chips occurs.

EXAMPLES

{0049}

The present invention will be described in more detail based on examples given below, but the invention is not meant to be limited by these.

5 {0050}

A. Radiation curability

1. Preparation of radiation-curable resin composition used in pressure-sensitive adhesive layer of pressure-sensitive adhesive tape for semiconductor wafer processing of first embodiment

10 (1) Preparation of polymer in which residue having (meth)acrylic monomer moiety having radiation-curable carbon-carbon double bond-containing group is linked to repeating unit of main chain

An acrylic copolymer was produced by using butyl acrylate (59 mol%), 2-hydroxyethyl acrylate (25 mol%), and acrylic acid (16 mol%). The terminal OH

15 groups of the 2-hydroxyethyl acrylate side chain of this acrylic copolymer were caused to react with the NCO groups of 2-methacryloyloxyethyl isocyanate, and thus a polymer in which a residue having a (meth)acrylic monomer moiety having a radiation-curable carbon-carbon double bond-containing group is linked to a repeating unit of the main chain was obtained. At this time, polymers having

20 different amounts of double bonds ((a1) to (a4)) were obtained by appropriately varying the amount of dropwise addition of 2-isocyanatoethyl methacrylate. The polymers ((a1) to (a4)) thus obtained were all such that the weight average molecular weight was 700,000, and the glass transition temperature was -60°C. In Tables 1-1 to 1-4, the iodine value of the polymer (a1) used in Examples 1-1 to

25 1-9 and 1-11, and Comparative Examples 1-1 to 1-4 and 1-7 was 20. Furthermore, the iodine value of the polymer (a2) used in Example 1-10 was 50, the iodine value of the polymer (a3) used in Example 1-12 was 0.5, and the iodine value of the polymer (a4) used in Example 1-13 was 55.

In the following descriptions, the polymers ((a1) to (a4)) will be described as the polymer (a).

(i) Weight average molecular weight

For the polymer (a), the weight average molecular weight was measured
5 by GPC under the conditions described below.

GPC apparatus: HLC-8120GPC (trade name, manufactured by Tosoh Corporation)

Column: TSK gel SuperHM-H/H4000/H3000/H2000 (trade name, manufactured
10 by Tosoh Corporation)

Flow rate: 0.6 mL/min

Concentration: 0.3 mass%

Injection amount: 20 μL

Column temperature: 40°C

15 Developing solvent: chloroform

(ii) Glass transition temperature

Differential scanning calorimeter (DSC): The glass transition temperature was measured using a differential scanning calorimeter (DSC) (DSC7020 (trade
20 name), manufactured by Seiko Instruments, Inc.), at a rate of temperature increase of 5°C/min.

(iii) Amount of double bonds

The iodine value was determined according to JIS K0070.

25 {0051}

(2) Preparation of radiation-curable resin composition

The radiation-curable resin compositions indicated as Examples and Comparative Examples in Table 1-1 to Table 1-4 were prepared by mixing 100

parts by mass of the polymer (a) obtained in section (1) with the photoinitiators in the amounts, expressed as the number of parts, indicated in Tables 1-1 to 1-4, and with 3 parts by mass of a polyisocyanate compound (manufactured by Nippon Polyurethane Industry Co., Ltd., trade name: COLONATE L) as a curing
5 agent. As the polyethylene glycol unit-containing macromolecular azo polymerization initiator of the photoinitiator used in Comparative Examples 1-1 and 1-7, VPE-0201 (trade name, manufactured by Wako Pure Chemical Industries, Ltd.) was used.

The weight average molecular weight of the photoinitiator was measured
10 by gel permeation chromatography, and the weight average molecular weight was calculated relative to polystyrene standards. The results are presented together in Tables 1-1 to 1-4. For the gel permeation chromatography, an OLIGOPORE 300×7.5 (trade name) manufactured by Polymer Laboratories, Ltd. was used. Chloroform was used as the eluent, and the measurement was
15 carried out at 40°C.

{0052}

2. Preparation of radiation-curable resin composition used in pressure-sensitive adhesive tape for semiconductor wafer processing of second embodiment

(1) Acrylic polymer constituting pressure-sensitive adhesive layer

20 An acrylic copolymer was prepared as the base resin that constitutes the pressure-sensitive adhesive layer, by using 85 parts by mass of n-butyl acrylate, 10 parts by mass of ethyl acrylate, and 5 parts by mass of acrylic acid. The weight average molecular weight of the copolymer was 600,000.

{0053}

25 (2) Compound having at least two photopolymerizable carbon-carbon double bonds in molecule and having weight average molecular weight of 10,000 or less

Were used UN-3320HA (trade name, manufactured by Negami chemical industrial co.,ltd), UN-9000PEP (trade name, manufactured by Negami chemical

industrial co.,ltd), UN-6050PTM (trade name, manufactured by Negami chemical industrial co.,ltd), UN-901T (trade name, manufactured by Negami chemical industrial co.,ltd), and UN-9200A (trade name, manufactured by Negami chemical industrial co.,ltd).

5 The weight average molecular weight calculated relative to polystyrene standards and the amount of double bonds of the compound used were measured according to the following method. The results are as described below.

UN-3320HA (trade name, manufactured by Negami chemical industrial co.,ltd):
10 1500 (Amount of double bonds: 6)

UN-3320HC (trade name, manufactured by Negami chemical industrial co.,ltd): 1500 (Amount of double bonds: 6)

UN-9000PEP (trade name, manufactured by Negami chemical industrial co.,ltd): 5000 (Amount of double bonds: 2)

15 UN-6050PTM (trade name, manufactured by Negami chemical industrial co.,ltd): 6000 (Amount of double bonds: 2)

UN-901T (trade name, manufactured by Negami chemical industrial co.,ltd): 4000 (Amount of double bonds: 9)

UN-9200A (trade name, manufactured by Negami chemical industrial co.,ltd):
20 11500 (Amount of double bonds: 2)

(Measurement conditions for weight average molecular weight)

GPC apparatus: HLC-8120GPC (trade name, manufactured by Tosoh Corporation)

25 Column: TSK-GEL G2500HHR (trade name, manufactured by Tosoh Corporation)

Flow rate: 1mL/min

Concentration: 0.2 mg/mL

Injection amount: 100 μL

Temperature of thermostat bath: 40°C

Mobile phase: chloroform

5 (Method for measuring amount of double bonds)

Amount of double bonds

The iodine value was determined according to JIS K0070, and the amount of double bonds was calculated from the iodine value.

{0054}

10 (3) Preparation of radiation-curable resin composition

The radiation-curable resin compositions indicated as Examples and Comparative Examples in Table 2-1 to Table 2-4 were prepared by mixing 100 parts by mass of the base resin of section (1) with the compound having at least two photopolymerizable carbon-carbon double bonds in the molecule and having 15 a weight average molecular weight of 10,000 or less, and the photoinitiator described in section (2) in the amounts, expressed as the number of parts, indicated in Tables 2-1 to 2-4, and with 3 parts by mass of a polyisocyanate compound (manufactured by Nippon Polyurethane Industry Co., Ltd., trade name: COLONATE L) as a curing agent. As the polyethylene glycol unit-containing 20 macromolecular azo polymerization initiator of the photoinitiator used in Comparative Examples 2-1 and 2-6, VPE-0201 (trade name, manufactured by Wako Pure Chemical Industries, Ltd.) was used.

The weight average molecular weight of the photoinitiator was measured by gel permeation chromatography, and the weight average molecular weight 25 was calculated relative to polystyrene standards. The results are presented together in Table 2-1 to Table 2-4. For the gel permeation chromatography, an OLIGOPORE 300×7.5 (trade name) manufactured by Polymer Laboratories, Ltd. was used. Chloroform was used as the eluent, and the measurement was

carried out at 40°C.

{0055}

B. Production of pressure-sensitive adhesive sheet for semiconductor wafer processing (I)

5 A base resin film having a thickness of 100 μm was produced by a T-die method, using an EMMA resin (manufactured by Sumitomo Chemical Co, Ltd., trade name: ACRIFT WD201). On this base resin film, the radiation-curable resin compositions described in Examples 1-1 to 1-10, 1-12 to 1-13, and 2-1 to 2-10, Comparative Examples 1-1 to 1-4, and 2-1 to 2-5 was respectively applied
10 and appropriately cured. Thereby, pressure-sensitive adhesive sheets for semiconductor wafer processing, each of which had a pressure-sensitive adhesive layer having a thickness after drying of 10 μm and had the configuration illustrated in Fig. 1, were obtained.

{0056}

15 3. Production of pressure-sensitive adhesive sheet for semiconductor wafer processing (II)

(1) Preparation of adhesive composition constituting adhesive layer

Cyclohexanone was added to a composition containing 50 parts by mass of a cresol-novolac type epoxy resin as an epoxy resin, 50 parts by weight of a
20 phenolic resin, 3 parts by mass of γ-mercaptopropyltrimethoxysilane and 5 parts by mass of γ-ureidopropyltriethoxysilane as silane coupling agents, and 30 parts by weight of spherical silica as a filler, and the mixture was stirred and mixed. The mixture was further kneaded for 90 minutes using a bead mill.

To the composition described above, 300 parts by mass of an acrylic
25 rubber (weight average molecular weight: 150,000) and 1 part by mass of 1-cyanoethyl-2-phenylimidazole as a curing accelerator were added, and the mixture was stirred and mixed, and was degassed under vacuum. Thus, an adhesive composition was obtained.

{0057}

(2) Production of pressure-sensitive adhesive sheet for semiconductor wafer processing

The adhesive composition obtained in section (1) was applied on a
5 release-treated polyethylene terephthalate film (release film) having a thickness of 35 μm, and the coated film was heated and dried for 5 minutes at 140°C. Thus, an adhesive sheet in the B stage state having a thickness of 20 μm, in which an adhesive layer was formed on the release film, was obtained.

Subsequently, a pressure-sensitive adhesive sheet for semiconductor
10 wafer processing having the structure illustrated in Fig. 1 was obtained, in which a pressure-sensitive adhesive layer was formed by on a base resin film by using one of the radiation-polymerizable resin compositions described in Example 1-11 and Comparative Example 1-7 in Table 1-4, by the same method as the method described in the section 2. Production of pressure-sensitive adhesive sheet for
15 semiconductor wafer processing (I) described above. This pressure-sensitive adhesive layer and the adhesive layer of the adhesive sheet produced by the method described above were laminated to face each other. Thus, pressure-sensitive adhesive sheets (Example 1-11 and Comparative Example 1-7) in which a release film was laminated on the pressure-sensitive adhesive sheet for
20 semiconductor wafer processing having the configuration illustrated in Fig. 2, were obtained.

Separately, a pressure-sensitive adhesive sheet for semiconductor wafer processing having the structure illustrated in Fig. 1 was obtained, in which a pressure-sensitive adhesive layer was formed on a base resin film by using one
25 of the radiation-polymerizable resin compositions described in Examples 2-11 to 2-15, and Comparative Examples 2-6 and 2-7 in Table 2-4, by the same method as the method described in the section 2. Production of pressure-sensitive adhesive sheet for semiconductor wafer processing (I) described above. This

pressure-sensitive adhesive layer and the adhesive layer of the adhesive sheet produced by the method described above were laminated to face each other. Thus, pressure-sensitive adhesive sheets (Examples 2-11 to 2-15 and Comparative Examples 2-6 and 2-7) in which a release film was laminated on the
5 pressure-sensitive adhesive sheet for semiconductor wafer processing having the configuration illustrated in Fig. 2, were obtained.

In the following tests, the release film was peeled off, the pressure-sensitive adhesive sheet was affixed to a semiconductor wafer, and evaluations were carried out.

10 {0058}

4. Performance test

Dicing was performed under the following conditions, and thereafter, evaluations for pickup properties and chip contaminability were carried out.

(Dicing conditions)

15 (1) Pressure-sensitive adhesive sheet for semiconductor wafer processing of configuration of Fig. 1

In Examples 1-1 to 1-10, 1-12, 1-13, and 2-1 to 2-10, and Comparative Examples 1-1 to 1-4 and 2-1 to 2-5, 30 μm of the back surface of a silicon wafer was biaxially ground using a "DFD-840" manufactured by Disco Corp., and then
20 the silicon wafer was ground to a final thickness of 100 μm. The grinding conditions at that time were as follows.

Uniaxial: 350 grindstone (speed of rotation: 4,800 rpm, down speed: P1: 3.0 μm/sec, P2: 2.0 μm/sec)

Biaxial: #2000 grindstone (speed of rotation: 5,500 rpm, down speed: P1:
25 0.8 μm/sec, P2: 0.6 μm/sec)

{0059}

Within 5 minutes after the grinding of the back surface, the pressure-sensitive adhesive sheet for semiconductor wafer processing of the configuration

of Fig. 1 was bonded and fixed to a 8-inch ring frame, and a 8-inch silicon wafer having a thickness of 100 μm was affixed to the pressure-sensitive adhesive sheet for semiconductor wafer processing while being in a bonded and fixed state. The silicon wafer was subjected to full cut dicing to a chip size of 5 mm × 5 mm
5 using a dicing apparatus, DAD340 (trade name), manufactured by Disco Corp. The cutting depth of the blade from the surface of the pressure-sensitive adhesive sheet for semiconductor wafer processing at this time was set to 30 μm in the case of the pressure-sensitive adhesive sheet of the configuration illustrated in Fig. 1.

10 {0060}

(2) Pressure-sensitive adhesive sheet for semiconductor wafer processing of configuration of Fig. 2

In Examples 1-11 and 2-11 to 2-15, and Comparative Examples 1-7, 2-6 and 2-7, the pressure-sensitive adhesive sheet for semiconductor wafer
15 processing of the configuration of Fig. 2 was affixed to a 8-inch silicon wafer having a thickness of 100 μm for 20 seconds at 70°C, and then the silicon wafer was subjected to dicing under the following conditions using a DFD6340 manufactured by Disco Corp.

Dicing blade (thin type rotary grindstone): 1st time: 27HEEE manufactured
20 by Disco Corp., 2nd time: 27HEDD manufactured by Disco Corp.

Speed of blade rotation: 35,000 rpm

Blade feed rate: 50 mm/s

Chip size: 5 mm × 5 mm

Cutting depth:

25 1st time: 50 μm to silicon wafer

2nd time: 40 μm to pressure-sensitive adhesive sheet for semiconductor wafer processing (thickness of base resin film: 100 μm, thickness of pressure-sensitive adhesive layer: 10 μm, thickness of adhesive layer: 20 μm)

{0061}

4-1. Pickup test

Each of the pressure-sensitive adhesive sheets for semiconductor wafer processing of Examples 1-1 to 1-10, 1-12, 1-13, and 2-1 to 2-10, Comparative Examples 1-1 to 1-4, and 2-1 to 2-5, Examples 1-11 and 2-11 to 2-15, and Comparative Examples 1-7, 2-6, and 2-7 was subjected to dicing under the conditions illustrated in the sections 4.(1) and 4.(2), and then was irradiated with ultraviolet radiation using an ultraviolet irradiator equipped with a high pressure mercury lamp, such that the amount of irradiation through the base resin film side of the pressure-sensitive adhesive sheet for semiconductor wafer processing would be 200 mJ/cm^2. Thereafter, the wafer was expanded at an expansion stroke of 5 mm using a CPS-6820 (trade name) manufactured by Canon Machinery, Inc., and a pickup was carried out in the same condition. The pickup was carried out using a lift pin having a tip diameter of R250. Evaluations were carried out on the following evaluation items.

{0062}

(1) Pickup properties

Chips were actually picked up, and it was evaluated whether the step of a. lifting a chip up without any problem, b. attaching a circular collet to the chip, and c. mounting the chip on a lead frame, can all be carried out without any problems. The evaluation was carried out by picking 200 chips up from an 8-inch wafer, and investigating how many chips out of them could be picked up. It was regarded as acceptable if 180 chips or more could be picked up out of 200 chips. The number of successfully picked chips is shown in Tables 1-1 to 2-4.

{0063}

(2) Chip contaminability

Chip contaminability was evaluated by the following method, with regard to the pressure-sensitive adhesive sheet for semiconductor wafer processing of

the configuration of Fig. 1 (Examples 1-1 to 1-10, 1-12, 1-13, and 2-1 to 2-10, and Comparative Examples 1-1 to 1-4, and 2-1 to 2-5).

(2)-1 Visual inspection

When the chipping properties described above were evaluated, the chips
5 were detached and visually inspected. It was regarded as acceptable if there was no iridescent gloss due to the affixation of a pressure-sensitive adhesive or attachment of contaminants on the back surface of the wafer. A chip that was acceptable was rated as ○; a chip that exhibited the occurrence of slight gloss but at a level without any problems for practical use, was rated as △; and a chip
10 that had a pressure-sensitive adhesive was regarded as unacceptable and was indicated as ×.

(2)-2 Foreign material test

A pressure-sensitive adhesive sheet for semiconductor wafer processing was affixed to a mirror surface-finished silicon wafer (6 inches) whose front
15 surface has been cleaned, the silicon wafer was left to stand for 24 hours, and then the sheet was detached. The number of foreign materials that remained on the wafer surface where the sheet had been affixed was measured using a laser surface inspection apparatus (SURFSCAN 6420 (trade name, manufactured by KLA Tencor Corp.)). The results thus obtained were judged based on the
20 evaluation criteria shown below. Among these, ◉ and ○ were considered acceptable, Δ was considered to be at a level without any problems for practical use, and × was considered unacceptable. These results are presented in the table.

◉: Fewer than 20

25 ○: Equal to or more than 20 and fewer than 90

Δ: Equal to or more than 90 and fewer than 200

×: Equal to or more than 200

{0064}

(3) Detachability between pressure-sensitive adhesive layer and adhesive layer

A silicon wafer having a diameter of 5 inches was mounted on a hot plate heated to 80°C. After it was confirmed that the surface temperature of the silicon wafer reached 80°C, the pressure-sensitive adhesive sheet for semiconductor wafer processing of the configuration of Fig. 2 (Examples 1-11 and 2-11 to 2-15, and Comparative Examples 1-7, 2-6, and 2-7) was affixed thereon for approximately 10 seconds. Subsequently, the hot plate was removed, and the surface temperature of the silicon wafer to which the pressure-sensitive adhesive sheet for semiconductor wafer processing was affixed, was lowered to room temperature.

Thereafter, the silicon wafer was irradiated with ultraviolet radiation using an ultraviolet irradiator equipped with a high pressure mercury lamp, such that the amount of irradiation through the base resin film side of the pressure-sensitive adhesive sheet for semiconductor wafer processing would be 200 mJ/cm^2. Thereafter, the peeling force of the pressure-sensitive adhesive sheet for semiconductor wafer processing after ultraviolet irradiation with respect to the silicon wafer was measured according to JIS-0237. The measurement conditions were set to 90° peeling and a peeling rate of 50 mm/min. A sample with a peeling force of 0.5 N/25 mm or less was regarded as acceptable, was rated as ○.

{0065}

Table 1-1

		Ex 1-1	Ex 1-2	Ex 1-3	Ex 1-4	Ex 1-5	Ex 1-6
Photopoly-merization Initiator	Kind	DMDPEO *1	2-Methyl-1-(4-methylthiophenyl)-2-morpholinopropane-1-one	Oligo{2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl]} propanone n=2-3	Oligo{2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl]} propanone n=2-3	1-Hydroxy-cyclohexyl phenyl ketone	2-Hydroxy-2-methyl-1-phenylethane-1-one
	Mw	260	280	400-500	400-500	205	165
	Incorporation amount	5	5	5	3.5	5	5
Incorporation amount of polymer (a)		100	100	100	100	100	100
Iodine value of polymer (a)		20	20	20	20	20	20
Number of successfully picked chip/number of total chip		200/200	200/200	200/200	200/200	200/200	180/200
Chip contamination	Visual inspection	○	○	○	○	○	Δ
	Foreign material test	○	○	◉	◉	○	Δ

"Ex" means Example according to the present invention.

Mw: weight average molecular weight

*1 DMDPEO: 2,2-dimethoxy-1,2-diphenylethane-1-one

{0066}

Table 1-2

		Ex 1-7	Ex 1-8	Ex 1-9	Ex 1-10	Ex 1-12	Ex 1-13
Photopoly-merization Initiator	Kind	DMDPEO *1	DMDPEO *1	DMDPEO *1	DMDPEO *1	DMDPEO *1	DMDPEO *1
	Mw	260	260	260	260	260	260
	Incorporation amount	1	10	5	5	5	5
Incorporation amount of polymer (a)		100	100	100	100	100	100
Iodine value of polymer (a)		20	20	20	50	0.5	55
Number of successfully picked chip/number of total chip		200/200	200/200	200/200	200/200	180/200	180/200
Chip contamination	Visual inspection	○	○	○	○	○	○
	Foreign material test	○	○	○	○	○	○

"Ex" means Example according to the present invention.

Mw: weight average molecular weight

*1 DMDPEO: 2,2-dimethoxy-1,2-diphenylethane-1-one

{0067}

Table 1-3

		C Ex 1-1	C Ex 1-2	C Ex 1-3	C Ex 1-4
Photopoly-merization Initiator	Kind	Polyethylene glycol unit-containing macromolecular azo polymerization initiator	DMDPEO *1	DMDPEO *1	DMDPEO *1
	Mw	2000	260	260	260
	Amount	5	0.05	0.05	11
Incorporation amount of polymer (a)		100	100	100	100
Iodine value of polymer (a)		20	20	20	20
Number of successfully picked chip/number of total chip		100/200	50/200	150/200	200/200
Chip contamination	Visual inspection	○	○	○	×
	Foreign material test	○	○	○	×

"C Ex" means Comparative Example.

Mw: weight average molecular weight

*1 DMDPEO: 2,2-dimethoxy-1,2-diphenylethane-1-one

{0068}

Table 1-4

			Ex 1-11	C Ex 1-7
Pressure-sensitive adhesive layer	Photopoly-merization Initiator	Kind	DMDPEO *1	Polyethylene glycol unit-containing macromolecular azo polymerization initiator
		Mw	260	2000
		Amount	5	5
	Incorporation amount of polymer (a)		100	100
	Iodine value of polymer (a)		20	20
Adhesive layer			Epoxy-series	Epoxy-series
Number of successfully picked chip/number of total chip			200/200	100/200
Detachability between pressure-sensitive adhesive layer and adhesive layer			○	○

"Ex" means Example according to the present invention, and "C Ex" means Comparative Example.

Mw: weight average molecular weight

*1 DMDPEO: 2,2-dimethoxy-1,2-diphenylethane-1-one

{0069}

Table 2-1

		Ex 2-1	Ex 2-2	Ex 2-3	Ex 2-4	Ex 2-5	Ex 2-6
Photopolymerization Initiator	Kind	DMDPEO *1	2-Methyl-1-(4-methylthiophenyl)-2-morpholinopropane-1-one	Oligo{2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl]} propanone n=2-3	Oligo{2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl]} propanone n=2-3	1-Hydroxy-cyclohexyl phenyl ketone	2-Hydroxy-2-methyl-1-phenylethane-1-one
	Mw	260	280	400-500	400-500	205	165
	Incorporation amount	5	5	5	3.5	5	5
Acrylic-series base resin		100	100	100	100	100	100
Compound *2	Kind	UN-3320HA	UN-3320HA	UN-3320HA	UN-3320HA	UN-3320HA	UN-3320HA
	Incorporation amount	100	100	100	100	100	100
Number of successfully picked chip/number of total chip		200/200	200/200	200/200	200/200	200/200	200/200
Chip contamination	Visual inspection	○	○	○	○	○	Δ
	Foreign material test	○	○	◉	◉	○	Δ

"Ex" means Example according to the present invention.

Mw: weight average molecular weight

*1 DMDPEO: 2,2-dimethoxy-1,2-diphenylethane-1-one

*2: Low molecular weight compound having at least two photopolymerizable carbon-carbon double bonds in the molecule

{0070}

Table 2-2

		Ex 2-7	Ex 2-8	Ex 2-9	Ex 2-10
Photopoly-merization Initiator	Kind	DMDPEO *1	DMDPEO *1	DMDPEO *1	DMDPEO *1
	Mw	260	260	260	260
	Incorporation amount	1	10	5	5
Acrylic-series base resin		100	100	100	100
Compound *2	Kind	UN-3320HA	UN-3320HA	UN-3320HA	UN-3320HA
	Incorporation amount	100	100	1	300
Number of successfully picked chip/number of total chip		200/200	200/200	200/200	200/200
Chip contamination	Visual inspection	○	○	○	○
	Foreign material test	○	○	○	○

"Ex" means Example according to the present invention.

Mw: weight average molecular weight

*1 DMDPEO: 2,2-dimethoxy-1,2-diphenylethane-1-one

*2: Low molecular weight compound having at least two photopolymerizable carbon-carbon double bonds in the molecule

{0071}

Table 2-3

		C Ex 2-1	C Ex 2-2	C Ex 2-3	C Ex 2-4	C Ex 2-5
Photopoly-merization Initiator	Kind	Polyethylene glycol unit-containing macromolecular azo polymerization initiator	DMDPEO *1	DMDPEO *1	DMDPEO *1	DMDPEO *1
	Mw	2000	260	260	260	260
	Incorporation amount	5	0.05	11	5	5
Acrylic-series base resin		100	100	100	100	100
Compound*	Kind	UN-3320HA	UN-3320HA	UN-3320HA	UN-3320HA	UN-3320HA
	Incorporation amount	100	100	100	0.5	310
Number of successfully picked chip/number of total chip		100/200	50/200	200/200	100/200	150/200
Chip contamination	Visual inspection	○	○	×	○	○
	Foreign material test	○	○	×	○	○

"C Ex" means Comparative Example.

Mw: weight average molecular weight

*1 DMDPEO: 2,2-dimethoxy-1,2-diphenylethane-1-one

*2: Low molecular weight compound having at least two photopolymerizable carbon-carbon double bonds in the molecule

{0072}

Table 2-4

		Ex 2-11	Ex 2-12	Ex 2-13	Ex 2-14	Ex 2-15	C Ex 2-6	C Ex 2-7
Photopolymerization Initiator	Kind	DMDPEO *1	DMDPEO *1	DMDPEO *1	DMDPEO *1	DMDPEO *1	Polyethylene glycol unit-containing macromolecular azo polymerization initiator	DMDPEO *1
	Mw	260	260	260	260	260	2000	260
	Incorporation amount	5	5	5	5	5	5	5
Acrylic-series base resin		100	100	100	100	100	100	100
Compound *2	Kind	UN-3320HA	UN-9000PEP	UN-3320HC	UN-6050PTM	UN-901T	UN-3320HA	UN-9200A
	Incorporation amount	100	100	100	100	100	100	100
Adhesive layer		Epoxy-Series	Epoxy-series	Epoxy-series	Epoxy-series	Epoxy-series	Epoxy-series	Epoxy-series
Number of successfully picked chip/number of total chip		200/200	200/200	200/200	195/200	190/200	100/200	100/200
Detachability between pressure-sensitive adhesive layer and adhesive layer		○	○	○	○	○	○	○

"Ex" means Example according to the present invention, and "C Ex" means Comparative Example.

Mw: weight average molecular weight

*1 DMDPEO: 2,2-dimethoxy-1,2-diphenylethane-1-one

*2: Low molecular weight compound having at least two photopolymerizable carbon-carbon double bonds in the molecule

{0073}

5. Pressure-sensitive adhesive tape for semiconductor wafer processing of first embodiment

As can be seen from Tables 1-1 to 1-3, in the Examples in which the pressure-sensitive adhesive sheets for semiconductor wafer processing of the configuration illustrated in Fig. 1 were evaluated, 180 or more semiconductor chips out of 200 chips could be picked up, less chip contamination or foreign material remains were observed, and semiconductor chips could be effectively picked up. In Example 1-6, chip contamination and foreign material remains were slightly observed, but at a level without any problems for practical use.

Furthermore, in the case of the pressure-sensitive adhesive sheet for semiconductor wafer processing in which the pressure-sensitive adhesive layer was constructed using a polymer (a) having an iodine value of 0.5 as the base resin, 180 semiconductor chips out of 200 chips could be picked up, and the pressure-sensitive adhesive sheet exhibited characteristics at an acceptable level.

On the contrary, when a polyethylene glycol unit-containing macromolecular azo polymerization initiator was used as the photopolymerization initiator (Comparative Example 1-1), the photoinitiator was not dissolved sufficiently uniformly, and the movement of generated radicals was not sufficiently smooth. As a result, only a half portion of the 200 chips could be picked up.

Further, when the amount of the photopolymerization initiator was reduced to be less than 0.1 parts by mass (Comparative Examples 1-2 and 1-3), there was a problem with the pickup properties due to insufficient supply of radicals by the initiator. When the amount of the photopolymerization initiator was increased to be more than 10 parts by mass (Comparative Example 1-4), chip contamination occurred due to the sublimation of unreacted reactants.

{0074}

Furthermore, as can be seen from Table 1-4, in Example 1-11 in which

the pressure-sensitive adhesive sheet for semiconductor wafer processing of the configuration illustrated in Fig. 2 was evaluated, interfacial detachment between the pressure-sensitive adhesive layer and the adhesive layer occurred smoothly, and all of the 200 semiconductor chips could be picked up.

5 On the contrary, in Comparative Example 1-7, interfacial detachment between the pressure-sensitive adhesive layer and the adhesive layer did not occur smoothly, and only 100 semiconductor chips out of 200 chips could be picked up.

{0075}

10 5. Pressure-sensitive adhesive tape for semiconductor wafer processing of second embodiment

As can be seen from Tables 2-1 to 2-3, in the Examples in which the pressure-sensitive adhesive sheets for semiconductor wafer processing of the configuration illustrated in Fig. 1 were evaluated, all semiconductor chips of 200
15 chips could be picked up, less chip contamination or foreign material remains were observed, and semiconductor chips could be effectively picked up. In Example 2-6, chip contamination and foreign material remains were slightly observed, but at a level without any problems for practical use.

On the contrary, when a polyethylene glycol unit-containing
20 macromolecular azo polymerization initiator was used as the photopolymerization initiator (Comparative Example 2-1), the photoinitiator was not dissolved sufficiently uniformly, and the movement of generated radicals was not sufficiently smooth. As a result, only a half portion of the 200 chips could be picked up.

Further, when the amount of the photopolymerization initiator was
25 reduced to be less than 0.1 part by mass (Comparative Example 2-2), there was a problem with the pickup properties due to insufficient supply of radicals by the initiator. When the amount of the photopolymerization initiator was increased to be more than 10 parts by mass (Comparative Example 2-3), chip contamination

occurred due to the sublimation of unreacted reactants.

When the incorporation amount of the compound having at least two photopolymerizable carbon-carbon double bonds in the molecule was reduced to be less than 1 part by mass (Comparative Example 2-4), the pickup properties deteriorated. On the contrary, when the incorporation amount of the radiation-polymerizable compound was larger than 300 parts by mass (Comparative Example 2-5), curing shrinkage occurred in the pressure-sensitive adhesive layer, and the pressure-sensitive adhesive closely adhered to the back surface of the chip, so that deterioration of the pickup properties was observed.

{0076}

Furthermore, as can be seen from Table 2-4, in Examples 2-11 to 2-15 in which the pressure-sensitive adhesive sheet for semiconductor wafer processing of the configuration illustrated in Fig. 2 was evaluated, interfacial detachment between the pressure-sensitive adhesive layer and the adhesive layer occurred smoothly, and all of the 200 semiconductor chips could be picked up.

On the contrary, in Comparative Example 2-6 in which a photopolymerization initiator having a large weight average molecular weight was used, interfacial detachment between the pressure-sensitive adhesive layer and the adhesive layer did not occur smoothly, and only 100 semiconductor chips out of 200 chips could be picked up.

Further, in Comparative Example 2-7 in which a compound having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a weight average molecular weight of 11,500 was used, only 100 semiconductor chips out of 200 chips could be picked up, as in the case of Comparative Example 2-6.

{0077}

Having described our invention as related to the present embodiments, it is our intention that the invention not be limited by any of the details of the

description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

{0078}

This application claims priority on Patent Application No. 2010-84447 filed
5 in Japan on March 31, 2010, and Patent Application No. 2010-84531 filed in Japan on March 31, 2010, each of which is entirely herein incorporated by reference.

REFERENCE SIGNS LIST

10 {0079}

1 Base resin film

2 Pressure-sensitive adhesive layer

3 Adhesive layer

10 and 20 Pressure-sensitive adhesive sheets

15

CLAIMS

{Claim 1}

A pressure-sensitive adhesive sheet for semiconductor wafer processing,
5 comprising:

a radiation-transmissive base resin film; and

a pressure-sensitive adhesive layer formed on the base resin film, the pressure-sensitive adhesive layer including a layer using a radiation-curable resin composition containing:

10 (i-1) 100 parts by mass of a base resin including, as a main component, an acrylic polymer (a) formed by linking a residue having a (meth)acrylic monomer moiety having a radiation-curable carbon-carbon double bond-containing group, to the repeating unit of the main chain; and

(iii) 0.1 to 10 parts by mass of a photopolymerization initiator (b) having a weight
15 average molecular weight of less than 1000 as measured by gel permeation chromatography (hereinafter, referred to as "GPC") by calculating relative to polystyrene employed as standards.

{Claim 2}

20 A pressure-sensitive adhesive sheet for semiconductor wafer processing, comprising:

a radiation-transmissive base resin film; and

a pressure-sensitive adhesive layer formed on the base resin film, the pressure-sensitive adhesive layer including a layer using a radiation-curable resin
25 composition containing:

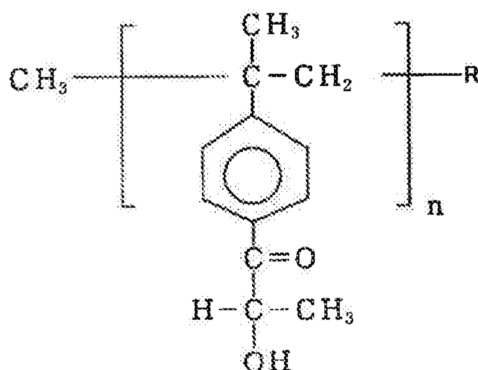
(i-2) 100 parts by mass of an acrylic polymer;

(ii) 1 to 300 parts by mass of a compound (c) having at least two photopolymerizable carbon-carbon double bonds in the molecule and having a

weight average molecular weight of 10,000 or less; and
(iii) 0.1 to 10 parts by mass of a photopolymerization initiator (b) having a weight average molecular weight of less than 1000, as measured by gel permeation chromatography (hereinafter, referred to as "GPC") and calculated relative to
5 polystyrene employed as standards.

{Claim 3}

The pressure-sensitive adhesive sheet for semiconductor wafer processing according to Claim 1 or 2, wherein the photopolymerization initiator
10 (b) is at least one selected from the group consisting of 1-hydroxy-cyclohexylphenyl-ketone, 2,2-dimethoxy-1,2-diphenylethane-1-one, 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropane-1-one, and an oligomer represented by formula (1):



15 Formula (1)

wherein R represents an alkyl group, and n represents an integer.

{Claim 4}

The pressure-sensitive adhesive sheet for semiconductor wafer
20 processing according to Claim 3, wherein the oligomer represented by the formula (1) has a degree of polymerization of n = 2 to 4.

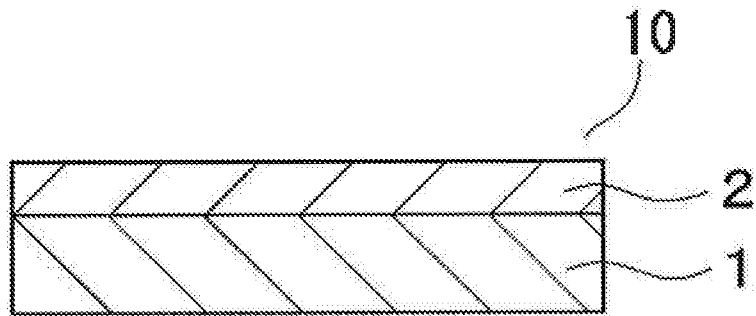
{Claim 5}

The pressure-sensitive adhesive sheet for semiconductor wafer processing according to Claim 1, 3 or 4, wherein the (a) polymer containing, as a constituent unit, an acrylic monomer having a radiation-polymerizable carbon-
5 carbon double bond-containing group in the repeating unit of the main chain, has an iodine value of 1 to 50.

{Claim 6}

The pressure-sensitive adhesive sheet for semiconductor wafer
10 processing according to any one of Claims 1 to 5, wherein an adhesive layer is further provided on the pressure-sensitive adhesive layer of the pressure-sensitive adhesive sheet for semiconductor wafer processing according to any one of Claims 1 to 5.

{Fig. 1}



{Fig. 2}