

[Name of Document] Description
[Title of Invention] PRESSURE SENSITIVE ADHESIVE SHEET
FOR WORK PROCESSING AND METHOD OF MANUFACTURING THE SAME
[Technical Field]

5 [0001]

 The present invention relates to a pressure sensitive
 adhesive sheet for work processing and a method of
 manufacturing the same and preferably to a pressure
 sensitive adhesive sheet for work processing which is
10 attached to a workpiece having recesses on its surface and
 a method of manufacturing the same.

[Background Art]

 [0002]

 In recent years, semiconductor devices have been
15 manufactured using a mounting method called a face-down
 scheme (flip-chip scheme). The face-down scheme uses
 semiconductor chips formed with protrusions, also called
 bumps, to ensure electrical conduction. The protrusions of
 each semiconductor chip are formed at the circuit surface
20 side and connected to a substrate. The surface of the
 semiconductor chip opposite to the circuit surface is
 formed with a protection film of a cured resin layer for
 protecting the semiconductor chip. Such semiconductor
 chips can be obtained through forming protrusions as the
25 above on one surface of a semiconductor wafer while
 laminating a protection film on the other surface and then
 dicing the semiconductor wafer.

 [0003]

 Semiconductor chips may also be manufactured using a
30 wire bonding scheme. This scheme includes wire-bonding a
 plurality of semiconductor chips placed on a substrate,
 subsequently sealing the semiconductor chips together using
 a curable resin to form a sealing resin layer, and then

dicing the sealing resin layer with the semiconductor chips into individual pieces.

[0004]

In the dicing as the above, a dicing sheet may
5 ordinarily be used, which includes a pressure sensitive
adhesive layer composed of an energy ray-curable pressure
sensitive adhesive. In this case, the surface of the
dicing sheet at the pressure sensitive adhesive layer side
is attached to an object to be diced and, thereafter, the
10 dicing of the object is performed on the dicing sheet.
Then, the pressure sensitive adhesive layer is irradiated
with energy rays to cure the pressure sensitive adhesive
layer, thereby reducing the adhesive strength of the dicing
sheet. This allows cut pieces obtained by the dicing to be
15 readily picked up from the dicing sheet.

[0005]

As is known in the art, the dicing sheet may be
electrostatically charged when conveyed and used. Such
electrostatic charge may cause damage of the semiconductor
20 chips and the like and erroneous operation of the dicing
apparatus and the like. The dicing sheet may therefore be
provided with an antistatic function to prevent the
electrostatic charge. For example, Patent Literature 1
discloses including an antistatic in a pressure sensitive
25 adhesive that constitutes the pressure sensitive adhesive
layer (paragraph 0021 of Patent Literature 1). Patent
Literature 2 discloses using a film that contains an
antistatic, as the base film (paragraph 0029 of Patent
Literature 2). A dicing sheet has also been developed in
30 which an antistatic layer containing an antistatic is
provided between the base film and the pressure sensitive
adhesive layer.

[Prior Art Literature]

[Patent Literature]

[0006]

[Patent Literature 1] JP2002-256234A

[Patent Literature 2] JP5414953B

5 [Summary of the Invention]

[Problems to be solved by the Invention]

[0007]

The above-described protection film and sealing resin layer may be formed with their surfaces on which
10 information items such as characters are printed by laser printing. In such cases, the surfaces of the protection film and sealing resin layer are formed with fine recesses due to irradiation with laser light. In recent years, pressure sensitive adhesive sheets for work processing,
15 such as the above-described dicing sheets, may be used for processing glass plates and glass chips. In such cases, the surfaces of glass plates and glass chips may have been formed with fine recesses, such as cut grooves.

[0008]

20 When pressure sensitive adhesive sheets for work processing are used for workpieces having fine recesses on the surfaces, however, the problem of adhesive residue may readily occur. This will be specifically described. When using a pressure sensitive adhesive sheet for work
25 processing, the surface of the pressure sensitive adhesive sheet for work processing at the pressure sensitive adhesive layer side is attached to the surface of a workpiece on which recesses exist, predetermined processing is performed for the workpiece on the pressure sensitive
30 adhesive sheet for work processing, and then the pressure sensitive adhesive sheet for work processing and the workpiece are separated from each other. During this separation, the pressure sensitive adhesive which

constitutes the pressure sensitive adhesive layer of the pressure sensitive adhesive sheet for work processing may readily remain on the surface of the workpiece which has been attached to the pressure sensitive adhesive sheet for work processing.

[0009]

In particular, the above-described adhesive residue may readily occur when the pressure sensitive adhesive layer of the pressure sensitive adhesive sheet for work processing is made of an energy ray-curable pressure sensitive adhesive and the pressure sensitive adhesive layer is cured by irradiation with energy rays prior to the separation of the workpiece and when the pressure sensitive adhesive sheet for work processing includes a conductive layer, such as the previously-described antistatic layer, which contains a conductive material.

[0010]

According to a first aspect of the present invention, there is provided a pressure sensitive adhesive sheet for work processing which includes a conductive layer and a pressure sensitive adhesive layer composed of an energy ray-curable pressure sensitive adhesive but which is nevertheless suppressed in the adhesive residue on a workpiece having recesses on its surface. Another object of the present invention is to provide a method of manufacturing the pressure sensitive adhesive sheet for work processing.

[Means for solving the Problems]

[0011]

According to a first aspect of the present invention, there is provided a pressure sensitive adhesive sheet for work processing, comprising: a base material; a conductive layer laminated at one side of the base material; and a

pressure sensitive adhesive layer laminated on a surface of the conductive layer opposite to the base material, the pressure sensitive adhesive layer being composed of an energy ray-curable pressure sensitive adhesive, the pressure sensitive adhesive sheet having an interlaminar strength of 17 N/25 mm or more, the interlaminar strength being measured as a peel strength when, after a surface of the pressure sensitive adhesive sheet at the pressure sensitive adhesive layer side is fixed to a support and the pressure sensitive adhesive layer is irradiated with energy rays, a laminate of the base material and the conductive layer is peeled off from the pressure sensitive adhesive layer at a peeling speed of 300 mm/min and at 180°.

[0012]

In the pressure sensitive adhesive sheet for work processing according to the first aspect, the above interlaminar strength is within the previously-described range thereby to suppress the occurrence of delamination at the interface between the conductive layer and the pressure sensitive adhesive layer when the pressure sensitive adhesive layer is irradiated with energy rays and thereafter the pressure sensitive adhesive sheet for work processing and the workpiece are separated from each other. As a result, even when fine recesses exist on the surface of the workpiece, the pressure sensitive adhesive which constitutes the pressure sensitive adhesive layer is suppressed from remaining on the surface of the workpiece to be separated. Thus, the pressure sensitive adhesive sheet for work processing includes the conductive layer and the pressure sensitive adhesive layer composed of an energy ray-curable pressure sensitive adhesive, but is nevertheless well suppressed in the adhesive residue on the workpiece.

[0013]

In an embodiment, the pressure sensitive adhesive sheet before being irradiated with energy rays may preferably have a holding power of 1.0 mm or less as an amount of displacement of the pressure sensitive adhesive sheet after 70,000 seconds, wherein the holding power is measured in accordance with JIS Z0237: 2009.

[0014]

Disclosed herein is a pressure sensitive adhesive sheet that may preferably be manufactured through laminating the conductive layer at one side of the base material, then performing electron beam irradiation and plasma treatment for a surface of the conductive layer opposite to the base material, and subsequently laminating the pressure sensitive adhesive layer on the surface of the conductive layer.

[0015]

In an embodiment, a surface of the pressure sensitive adhesive layer opposite to the conductive layer may preferably be attached to a workpiece having recesses on its surface, wherein the surface of the pressure sensitive adhesive layer is attached to the surface of the workpiece on which the recesses exist.

[0016]

In an embodiment, the recesses of the workpiece may preferably have a width of 1 μm or more and 100 μm or less and a depth of 1 μm or more and 50 μm or less in a cross-sectional view.

[0017]

According to a second aspect of the present invention, there is provided a method of manufacturing the above pressure sensitive adhesive sheet for work processing, the method comprising: a step of laminating the conductive

layer at one side of the base material; a step of performing electron beam irradiation for a surface of the conductive layer opposite to the base material; a step of performing plasma treatment for the surface of the conductive layer opposite to the base material; and a step of laminating the pressure sensitive adhesive layer on the surface of the conductive layer for which the electron beam irradiation and the plasma treatment are performed .

[0018]

In the above aspect, the step of performing electron beam irradiation may preferably be performed prior to the step of performing plasma treatment

[Advantageous Effect of the Invention]

[0019]

The pressure sensitive adhesive sheet for work processing according to embodiments of the present invention includes the conductive layer and the pressure sensitive adhesive layer composed of an energy ray-curable pressure sensitive adhesive, but is nevertheless suppressed in the adhesive residue on a workpiece having recesses on its surface. Moreover, the method of manufacturing the pressure sensitive adhesive sheet for work processing according to embodiments of the present invention can be used to manufacture such a pressure sensitive adhesive sheet for work processing.

[Brief Description of Drawing(s)]

[0020]

FIG. 1 is a cross-sectional view of a pressure sensitive adhesive sheet for work processing according to

an embodiment of the present invention.

[Embodiments for Carrying out the Invention]

[0021]

Embodiments of the present invention will be described
5 hereinafter.

FIG. 1 illustrates a cross-sectional view of a pressure sensitive adhesive sheet for work processing 1 according to an embodiment of the present invention. The pressure sensitive adhesive sheet for work processing 1
10 according to the present embodiment comprises a base material 11, a conductive layer 12 laminated at one side of the base material 11, and a pressure sensitive adhesive layer 13 laminated on the surface of the conductive layer 12 opposite to the base material 11.

15 [0022]

In the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment, the pressure sensitive adhesive layer 13 is composed of an energy ray-curable pressure sensitive adhesive. In the
20 pressure sensitive adhesive sheet for work processing 1 according to the present embodiment, the interlaminar strength, which will be described later, is 17 N/25 mm or more.

[0023]

25 When the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is used, a workpiece is attached to the surface, opposite to the base material 11, of the pressure sensitive adhesive layer 13 of the pressure sensitive adhesive sheet for work processing 1
30 (this surface may be referred to as a "pressure sensitive adhesive surface," hereinafter), and predetermined processing is performed for the workpiece on the pressure sensitive adhesive sheet for work processing 1.

Subsequently, the pressure sensitive adhesive layer 13 is irradiated with energy rays to cure the pressure sensitive adhesive layer 13 and, thereafter, the pressure sensitive adhesive sheet for work processing 1 and the workpiece are separated from each other. Here, the interlaminar strength is within the above range in the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment thereby to suppress the occurrence of delamination at the interface between the conductive layer 12 and the pressure sensitive adhesive layer 13 due to the separation of the pressure sensitive adhesive sheet for work processing 1 and the workpiece. As a result, the pressure sensitive adhesive which constitutes the pressure sensitive adhesive layer 13 is suppressed from attaching to the workpiece to be separated. That is, the adhesive residue on the workpiece is suppressed. Such an effect of suppressing the adhesive residue can be well obtained even when the pressure sensitive adhesive layer 13 is attached to the surface, which has fine recesses, of a workpiece having the fine recesses on its surface. Thus, the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment can obtain an antistatic function due to the conductive layer and an effect that the workpiece is readily separated by irradiation with energy rays, but nevertheless can suppress the adhesive residue on the workpiece.

[0024]

Examples of workpieces for which the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is used include semiconductor members, such as semiconductor chips, semiconductor wafers and semiconductor packages, and glass members, such as glass chips and glass plates.

[0025]

1. Physical Properties of Pressure Sensitive Adhesive Sheet for Work Processing

In the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment, the interlaminar strength is 17 N/25 mm or more and may be preferably 20 N/25 mm or more and particularly preferably 22 N/25 mm or more. The interlaminar strength is measured as a peel strength when, after the surface of the pressure sensitive adhesive sheet for work processing 1 at the pressure sensitive adhesive layer 13 side is fixed to a support and the pressure sensitive adhesive layer 13 is irradiated with energy rays, a laminate of the base material 11 and the conductive layer 12 is peeled off from the pressure sensitive adhesive layer 13 at a peeling speed of 300 mm/min and at 180°. If the interlaminar strength is less than 17 N/25 mm, when the pressure sensitive adhesive sheet for work processing 1 and the workpiece are separated from each other after the irradiation with energy rays, delamination may readily occur at the interface between the conductive layer 12 and the pressure sensitive adhesive layer 13. This may result in the occurrence of adhesive residue on the workpiece. The upper limit of the interlaminar strength is not particularly limited, but may preferably be 100 N/25 mm or less in general. Details of the method of measuring the above-described interlaminar strength are as described in the exemplary test, which will be described later.

[0026]

In the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment, the pressure sensitive adhesive sheet for work processing 1 before being irradiated with energy rays may have a holding

power of 1.0 mm or less, preferably 0.5 mm or less, and particularly preferably 0 mm, as an amount of displacement of the pressure sensitive adhesive sheet for work processing after 70,000 seconds. The holding power is
5 measured in accordance with JIS Z0237: 2009. When the holding power is 1.0 mm or less, the pressure sensitive adhesive which constitutes the pressure sensitive adhesive layer 13 is suppressed in its deformation and, even when the workpiece has fine recesses on its surface, the
10 pressure sensitive adhesive is less likely to get into the recesses and the adhesive residue can be effectively suppressed. Details of the method of measuring the above holding power are as described in the exemplary test, which will be described later.

15 [0027]

2. Constitutional Members of Pressure Sensitive Adhesive Sheet for Work Processing

(1) Base Material

In the pressure sensitive adhesive sheet for work
20 processing 1 according to the present embodiment, the base material 11 is not particularly limited, provided that it exhibits desired functions in a process of using the pressure sensitive adhesive sheet for work processing 1 and preferably exhibits good transmissivity to energy rays with
25 which the pressure sensitive adhesive layer 13 is irradiated to be cured.

[0028]

For example, the base material 11 may preferably be a resin film of which the main material is a resin-based
30 material. Specific examples include ethylene-vinyl acetate copolymer films; ethylene-based copolymer films, such as ethylene-(meth)acrylic acid copolymer films, ethylene-(meth)acrylic acid methyl copolymer films, and other

ethylene-(meth)acrylic ester copolymer films; polyolefin-based films, such as polyethylene films, polypropylene films, polybutene films, polybutadiene films, polymethylpentene films, ethylene-norbornene copolymer
5 films, and norbornene resin films; polyvinylchloride-based films, such as polyvinyl chloride films and vinyl chloride copolymer films; polyester-based films, such as polyethylene terephthalate films, polybutylene terephthalate films, and polyethylene naphthalate films;
10 (meth)acrylic ester copolymer films; polyurethane films; polyimide films; polystyrene films; polycarbonate films; and fluorine resin films. Examples of the polyethylene films include low density polyethylene (LDPE) films, linear low density polyethylene (LLDPE) films, and high density
15 polyethylene (HDPE) films. In an embodiment, modified films such as crosslinked films and ionomer films thereof may be used. In an embodiment, the base material 11 may be a laminated film obtained by laminating a plurality of the above-described films. In such a laminated film, materials
20 that constitute each layer may be the same type or may also be different types. Among the above films, the ethylene-(meth)acrylic acid methyl copolymer film may preferably be used as the base material 11 from the viewpoint of excellent flexibility. As used in the present description,
25 "(meth)acrylic acid" refers to both the acrylic acid and the methacrylic acid. The same applies to other similar terms.

[0029]

The base material 11 may contain various additives,
30 such as a flame retardant, plasticizer, antistatic, glidant, antioxidant, colorant, infrared absorber, ultraviolet absorber, and ion scavenger. The content of these additives is not particularly limited, but may preferably

be within a range in which the base material 11 exhibits desired functions.

[0030]

To enhance the interfacial adhesion with the
5 conductive layer 12, surface treatment such as primer treatment, corona treatment, and plasma treatment may be performed for the surface of the base material 11 on which or above which the conductive layer 12 is laminated.

[0031]

10 The thickness of the base material 11 can be appropriately set in accordance with a method in which the pressure sensitive adhesive sheet for work processing 1 is used, and may be preferably 20 μm or more in general and particularly preferably 25 μm or more. From another aspect,
15 the thickness may be preferably 450 μm or less in general and particularly preferably 300 μm or less.

[0032]

(2) Conductive Layer

In the pressure sensitive adhesive sheet for work
20 processing 1 according to the present embodiment, the conductive layer 12 is not particularly limited, provided that it exhibits desired functions, such as antistatic properties, and achieves the previously-described interlaminar strength.

25 [0033]

The conductive layer 12 may preferably contain a conductive material and a binder resin. Examples of the conductive material include a conductive polymer, conductive filler, anionic or cationic compound, and
30 compound having a quaternary ammonium base in the main chain or side chain of the molecule.

[0034]

Examples of the above conductive polymer include a

polythiophene-based, polyaniline-based, and polypyrrole-based conductive polymers. Examples of the polythiophene-based conductive polymer include polythiophene, poly(3-alkylthiophene), poly(3-thiophene- β -ethanesulfonic acid),
5 and a mixture of polyalkylenedioxythiophene and polystyrene sulfonate. Examples of the polyalkylenedioxythiophene include polyethylene dioxythiophene, polypropylene dioxythiophene, and poly(ethylene/propylene) dioxythiophene. Examples of the polyaniline-based conductive polymer
10 include polyaniline, polymethylaniline, and polymethoxyaniline. Examples of the polypyrrole-based conductive polymer include polypyrrole, poly3-methylpyrrole, and poly3-octylpyrrole. One type of these conductive polymer compounds may be used alone and two or more types
15 may also be used in combination. In an embodiment, such a conductive polymer may preferably be dispersed in water and used in the form of an aqueous solution.

[0035]

Examples of the conductive filler include particles of
20 gold, silver, copper, nickel, aluminum, stainless steel, carbon, conductive ceramics, tin oxide, antimony doped tin oxide (ATO), indium oxide-tin oxide (ITO), zinc oxide, and antimony pentoxide.

[0036]

25 Examples of the anionic and cationic compounds include an ionic liquid, ionic solid, anion-based surfactant, alkali metal salt, cation-based surfactant, and nonion-based surfactant. Examples of the ionic liquid and ionic solid include nitrogen-containing onium salt, sulfur-
30 containing onium salt, and phosphorus-containing onium salt. Examples of the alkali metal salt include lithium salt and potassium salt. These may each be used alone and two or more types may also be used in combination.

[0037]

Specific examples of the compound having a quaternary ammonium base include quaternized compounds of pyrrolidinium ring and/or alkylamine, compounds obtained by
5 copolymerizing them with acrylic acid and/or methacrylic acid, quaternized compounds of N-alkylaminoacrylamide, vinyl benzyl trimethyl ammonium salt, and 2-hydroxy3-methacryloxypropyl trimethyl ammonium salt.

[0038]

10 The above compound having a quaternary ammonium base may desirably be a polymer compound. The number-average molecular weight of the compound having a quaternary ammonium base may be preferably 1,000 or more, particularly preferably 2,000 or more, and further preferably 5,000 or
15 more. With regard to the upper limit of the number-average molecular weight, the number-average molecular weight may preferably be 500,000 or less from the viewpoint of preventing an unduly high viscosity of a coating liquid that contains the conductive material. As used in the
20 present description, the number-average molecular weight refers to a standard polystyrene equivalent value that is measured using a gel permeation chromatography (GPC) method.

[0039]

The content of the conductive material in the
25 conductive layer 12 may be preferably 1 mass% or more and particularly preferably 5 mass% or more. From another aspect, the content may be preferably 30 mass% or less and particularly preferably 20 mass% or less. When the content of the conductive material is 1 mass% or more, desired
30 functions such as antistatic properties can be effectively exhibited. When the content of the conductive polymer is 30 mass% or less, the ratio of the binder resin in the conductive layer 12 may be sufficient, and the coating film

strength of the conductive layer 12 itself can be satisfactory.

[0040]

Examples of the binder resin include melamine resin,
5 polyester, polyurethane, acrylic resin, vinyl resin, epoxy resin, amide resin, and polyvinyl alcohol. Examples of the melamine resin include methylated melamine resin, butylated melamine resin, and methylated/butylated melamine resin, among which the butylated melamine resin may preferably be
10 used. Such binder resins may be those in which the skeleton structure has a composite structure due to copolymerization or the like. Examples of the binder resin having a composite structure include acrylic resin graft polyester, acrylic resin graft polyurethane, vinyl resin
15 graft polyester, and vinyl resin graft polyurethane.

[0041]

The conductive layer 12 may further contain a crosslinking reactive compound. The crosslinking reactive compound may be obtained by including a crosslinker in a
20 coating liquid that contains the conductive material and crosslinking the crosslinker with functional groups of the compounds contained in the coating liquid. By including a crosslinker in the coating liquid, the water resistance, solvent resistance, mechanical strength and the like of the
25 conductive layer 12 can be improved.

[0042]

Examples of the crosslinker include a melamine-based crosslinker and an epoxy-based crosslinker. Examples of the melamine-based crosslinker include methoxymethylated
30 melamine and butoxymethylated melamine which are alkylolated or alkoxyalkylolated melamine compounds. Compounds obtained by cocondensing a part of melamine with urea or the like may also be used. It may be preferred to

use a water-soluble compound or a compound having an epoxy group of which the water solubility is 50% or more, as the epoxy-based crosslinker.

[0043]

5 If necessary, the conductive layer 12 may contain at least one type of additives, such as an antifoam, coatability improving agent, thickener, organic-based lubricant, organic particles, and inorganic particles.

[0044]

10 The conductive layer 12 can be formed through coating one surface of the base material 11 with a coating liquid that contains the above-described conductive polymer, binder resin, and other necessary components and drying the obtained coating film. In an embodiment, it may be
15 preferred to perform at least one of electron beam irradiation and plasma treatment, which will be described later, for the surface of the conductive layer 12 on which the pressure sensitive adhesive layer 13 is to be laminated, after the formation of the conductive layer 12 and prior to
20 the lamination. It may be particularly preferred to perform both the electron beam irradiation and the plasma treatment.

[0045]

25 The thickness of the conductive layer 12 can be appropriately set in accordance with a method in which the pressure sensitive adhesive sheet for work processing 1 is used, and may be preferably 0.003 μm or more in general and particularly preferably 0.005 μm or more. From another aspect, the thickness may be preferably 1.5 μm or less and
30 particularly preferably 0.5 μm or less.

[0046]

(3) Pressure Sensitive Adhesive Layer

In the pressure sensitive adhesive sheet for work

processing 1 according to the present embodiment, the pressure sensitive adhesive layer 13 is not particularly limited, provided that it is composed of an energy ray-curable pressure sensitive adhesive and exhibits the
5 desired adhesive strength to a workpiece and further can achieve the previously-described interlaminar strength of the pressure sensitive adhesive sheet for work processing 1. The pressure sensitive adhesive layer 13 is composed of an energy ray-curable pressure sensitive adhesive thereby to
10 allow the pressure sensitive adhesive layer 13 to be cured by energy ray irradiation, thus reducing the adhesive strength of the pressure sensitive adhesive sheet for work processing 1 to a workpiece attached to the pressure sensitive adhesive surface of the pressure sensitive
15 adhesive layer 13, when the workpiece is separated from the pressure sensitive adhesive surface. This enables easy separation between the pressure sensitive adhesive surface of the pressure sensitive adhesive layer 13 and the workpiece.

20 [0047]

The energy ray-curable pressure sensitive adhesive which constitutes the pressure sensitive adhesive layer 13 may contain a polymer, as the main component, having an energy ray-curable property and may also contain a mixture,
25 as the main component, of a non-energy ray-curable polymer (polymer having no energy ray-curable property) and a monomer and/or oligomer having at least one or more energy ray-curable groups. In an alternative embodiment, the energy ray-curable pressure sensitive adhesive may be a
30 mixture of a polymer having an energy ray-curable property and a non-energy ray-curable polymer, may be a mixture of a polymer having an energy ray-curable property and a monomer and/or oligomer having at least one or more energy ray-

curable groups, and may also be a mixture of the above three types.

[0048]

The following description will first be directed to a
5 case in which the energy ray-curable pressure sensitive adhesive contains a polymer, as the main component, having an energy ray-curable property.

[0049]

The polymer having an energy ray-curable property may
10 preferably be a (meth)acrylic ester (co)polymer (A) in which a functional group having an energy ray-curable property is introduced into a side chain (this (meth)acrylic ester (co)polymer (A) may be referred to as an "energy ray-curable polymer (A)," hereinafter). The
15 energy ray-curable polymer (A) may preferably be obtained by reacting an acrylic-based copolymer (a1) having a functional group-containing monomer unit with an unsaturated group-containing compound (a2) having a functional group that can be bonded to the functional group
20 of the acrylic-based copolymer (a1).

[0050]

The acrylic-based copolymer (a1) may preferably contain a constitutional unit derived from a functional group-containing monomer and a constitutional unit derived
25 from a (meth)acrylic ester monomer or its derivatives.

[0051]

The functional group-containing monomer as the constitutional unit of the acrylic-based copolymer (a1) may preferably be a monomer having a polymerizable double bond
30 and a functional group, such as a hydroxy group, carboxy group, amino group, substituted amino group, and epoxy group, in the molecule.

[0052]

Examples of the hydroxy group-containing monomer include 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxybutyl (meth)acrylate, and 4-hydroxybutyl (meth)acrylate. These may each be used alone and two or more types may also be used in combination.

[0053]

Examples of the carboxy group-containing monomer include an ethylenically-unsaturated carboxylic acid, such as acrylic acid, methacrylic acid, crotonic acid, maleic acid, itaconic acid, and citraconic acid. These may each be used alone and two or more types may also be used in combination.

[0054]

Examples of the amino group-containing monomer or the substituted amino group-containing monomer include aminoethyl (meth)acrylate and n-butylaminoethyl (meth)acrylate. These may each be used alone and two or more types may also be used in combination.

[0055]

Examples to be preferably used as the (meth)acrylic ester monomer which constitutes the acrylic-based copolymer (a1) include alkyl (meth)acrylate of which the carbon number of the alkyl group is 1 to 20 and a monomer having an alicyclic structure in the molecule (alicyclic structure-containing monomer).

[0056]

Examples to be preferably used as the alkyl (meth)acrylate include those of which the carbon number of the alkyl group is, in particular, 1 to 18, such as methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, n-butyl (meth)acrylate, and 2-ethylhexyl (meth)acrylate. These may each be used alone and two or more types may also

be used in combination.

[0057]

Examples to be preferably used as the alicyclic structure-containing monomer include cyclohexyl
5 (meth)acrylate, dicyclopentanyl (meth)acrylate, adamantyl (meth)acrylate, isobornyl (meth)acrylate, dicyclopentenyl (meth)acrylate, and dicyclopentenylloxyethyl (meth)acrylate. These may each be used alone and two or more types may also be used in combination.

10 [0058]

The acrylic-based copolymer (a1) may preferably contain 1 mass% or more, particularly preferably contain 5 mass% or more, and further preferably contain 10 mass% or more, as the ratio, of the constitutional unit derived from
15 the above functional group-containing monomer. From another aspect, the acrylic-based copolymer (a1) may preferably contain 35 mass% or less and particularly preferably contain 30 mass% or less of the constitutional unit derived from the above functional group-containing
20 monomer.

[0059]

The acrylic-based copolymer (a1) may preferably contain 50 mass% or more, particularly preferably contain 60 mass% or more, and further preferably contain 70 mass%
25 or more, as the ratio, of the constitutional unit derived from the (meth)acrylic ester monomer or its derivatives. From another aspect, the acrylic-based copolymer (a1) may preferably contain 99 mass% or less, particularly preferably contain 95 mass% or less, and further preferably
30 contain 90 mass% or less, as the ratio, of the constitutional unit derived from the (meth)acrylic ester monomer or its derivatives.

[0060]

The acrylic-based copolymer (a1) can be obtained by copolymerizing the functional group-containing monomer with the (meth)acrylic ester monomer or its derivatives as the above in an ordinary method, but in addition to these
5 monomers, dimethyl acrylamide, vinyl formate, vinyl acetate, styrene and the like may also be copolymerized.

[0061]

The energy ray-curable polymer (A) can be obtained by reacting the acrylic-based copolymer (a1) having the above
10 functional group-containing monomer unit with the unsaturated group-containing compound (a2) having a functional group that can be bonded to the functional group of the acrylic-based copolymer (a1).

[0062]

15 The functional group of the unsaturated group-containing compound (a2) can be appropriately selected in accordance with the functional group type of the functional group-containing monomer unit of the acrylic-based copolymer (a1). For example, when the functional group of
20 the acrylic-based copolymer (a1) is a hydroxy group, an amino group or a substituted amino group, the functional group of the unsaturated group-containing compound (a2) may preferably be an isocyanate group or epoxy group. When the functional group of the acrylic-based copolymer (a1) is an
25 epoxy group, the functional group of the unsaturated group-containing compound (a2) may preferably be an amino group, carboxy group, or aziridinyl group.

[0063]

The above unsaturated group-containing compound (a2)
30 may contain at least one, preferably 1 to 6, and further preferably 1 to 4 energy ray-polymerizable carbon-carbon double bonds. Specific examples of such an unsaturated group-containing compound (a2) include 2-

methacryloyloxyethyl isocyanate; meta-isopropenyl- α,α -dimethylbenzyl isocyanate; methacryloyl isocyanate; allyl isocyanate; 1,1-(bisacryloyloxymethyl)ethyl isocyanate; an acryloyl monoisocyanate compound obtained by reaction
 5 between a diisocyanate compound or polyisocyanate compound and hydroxyethyl (meth)acrylate; an acryloyl monoisocyanate compound obtained by reaction of a diisocyanate compound or polyisocyanate compound, a polyol compound, and hydroxyethyl (meth)acrylate; glycidyl (meth)acrylate;
 10 (meth)acrylic acid; 2-(1-aziridinyl)ethyl (meth)acrylate; 2-vinyl-2-oxazoline; and 2-isopropenyl-2-oxazoline.

[0064]

The above unsaturated group-containing compound (a2) may be used preferably at 50 mol% or more, particularly
 15 preferably at 60 mol% or more, and further preferably at 70 mol% or more as the ratio with respect to the mol number of the functional group-containing monomer of the above acrylic-based copolymer (a1). From another aspect, the above unsaturated group-containing compound (a2) may be
 20 used preferably at 95 mol% or less, particularly preferably at 93 mol% or less, and further preferably at 90 mol% or less as the ratio with respect to the mol number of the functional group-containing monomer of the above acrylic-based copolymer (a1).

25 [0065]

In the reaction between the acrylic-based copolymer (a1) and the unsaturated group-containing compound (a2), the reaction temperature, pressure, solvent, time, presence or absence of catalyst, and type of catalyst can be
 30 appropriately selected in accordance with the combination of the functional group of the acrylic-based copolymer (a1) and the functional group of the unsaturated group-containing compound (a2). This allows the reaction to

proceed between the functional group existing in the acrylic-based copolymer (a1) and the functional group in the unsaturated group-containing compound (a2), so that the unsaturated group is introduced into a side chain of the acrylic-based copolymer (a1), and the energy ray-curable polymer (A) can thus be obtained.

[0066]

The weight-average molecular weight (Mw) of the energy ray-curable polymer (A) thus obtained may be preferably 10,000 or more, particularly preferably 150,000 or more, and further preferably 200,000 or more. From another aspect, the weight-average molecular weight (Mw) may be preferably 1,500,000 or less and particularly preferably 1,000,000 or less. As used in the present description, the weight-average molecular weight (Mw) refers to a standard polystyrene equivalent value that is measured using a gel permeation chromatography method (GPC method).

[0067]

Even when the energy ray-curable pressure sensitive adhesive contains a polymer, such as the energy ray-curable polymer (A), having an energy ray-curable property as the main component, the energy ray-curable pressure sensitive adhesive may further contain an energy ray-curable monomer and/or oligomer (B).

[0068]

Examples to be used as the energy ray-curable monomer and/or oligomer (B) include esters of polyhydric alcohol and (meth)acrylic acid.

[0069]

Examples of such an energy ray-curable monomer and/or oligomer (B) include monofunctional acrylic esters, such as cyclohexyl (meth)acrylate and isobornyl (meth)acrylate; polyfunctional acrylic esters, such as trimethylolpropane

tri(meth)acrylate, pentaerythritol tri(meth)acrylate,
 pentaerythritol tetra(meth)acrylate, dipentaerythritol
 hexa(meth)acrylate, 1,4-butanediol di(meth) acrylate, 1,6-
 hexanediol di(meth)acrylate, polyethylene glycol
 5 di(meth)acrylate, and dimethylol tricyclodecane
 di(meth)acrylate; polyester oligo(meth)acrylate; and
 polyurethane oligo(meth)acrylate.

[0070]

When the energy ray-curable monomer and/or oligomer
 10 (B) is compounded in the energy ray-curable polymer (A),
 the content of the energy ray-curable monomer and/or
 oligomer (B) in the energy ray-curable pressure sensitive
 adhesive may be preferably more than 0 mass parts and
 particularly preferably 60 mass parts or more with respect
 15 to 100 mass parts of the energy ray-curable polymer (A).
 From another aspect, the content may be preferably 250 mass
 parts or less and particularly preferably 200 mass parts or
 less with respect to 100 mass parts of the energy ray-
 curable polymer (A).

20 [0071]

Here, when ultraviolet rays are used as the energy
 rays for curing the energy ray-curable pressure sensitive
 adhesive, it is preferred to add a photopolymerization
 initiator (C). Use of the photopolymerization initiator
 25 (C) can reduce the polymerization curing time and the
 amount of irradiation with energy rays.

[0072]

Specific examples of the photopolymerization initiator
 (C) include benzophenone, acetophenone, benzoin, benzoin
 30 methyl ether, benzoin ethyl ether, benzoin isopropyl ether,
 benzoin isobutyl ether, benzoin benzoic acid, benzoin
 methyl benzoate, benzoin dimethyl ketal, 2,4-
 diethylthioxanthone, 1-hydroxycyclohexyl phenyl ketone,

benzyl diphenyl sulfide, tetramethyl thiuram monosulfide, azobisisobutyronitrile, benzyl, dibenzyl, diacetyl, β -chloroanthraquinone, (2,4,6-trimethylbenzyl)diphenyl phosphine oxide, 2-benzothiazole-N,N-diethyl dithiocarbamate, oligo{2-hydroxy-2-methyl-1-[4-(1-propenyl)phenyl]propanone}, and 2,2-dimethoxy-1,2-diphenylethan-1-one. These may each be used alone and two or more types may also be used in combination.

[0073]

10 The photopolymerization initiator (C) may be used preferably at 0.1 mass parts or more and particularly preferably at 0.5 mass parts or more as the amount with respect to 100 mass parts of the energy ray-curable polymer (A) (when the energy ray-curable monomer and/or oligomer
15 (B) is compounded, 100 mass parts of the total amount of the energy ray-curable polymer (A) and the energy ray-curable monomer and/or oligomer (B)). From another aspect, the photopolymerization initiator (C) may be used preferably at 10 mass parts or less and particularly
20 preferably at 6 mass parts or less as the amount with respect to 100 mass parts of the energy ray-curable polymer (A) (when the energy ray-curable monomer and/or oligomer (B) is compounded, 100 mass parts of the total amount of the energy ray-curable polymer (A) and the energy ray-
25 curable monomer and/or oligomer (B)).

[0074]

In the energy ray-curable pressure sensitive adhesive, other components may be added as appropriate in addition to the above components. Examples of such other components
30 include a non-energy ray-curable polymer component or oligomer component (D) and a crosslinker (E).

[0075]

Examples of the non-energy ray-curable polymer

component or oligomer component (D) include polyacrylic esters, polyesters, polyurethanes, polycarbonates, and polyolefins. Polymers or oligomers having a weight-average molecular weight (Mw) of 3,000 to 2,500,000 may be preferred. Compounding of the component (D) can improve the adhesive strength and releasability before curing, the strength after curing, the interfacial adhesion with other layers, the storage stability, and other properties. The compounding amount of the component (D) is not particularly limited and may be appropriately determined within a range of more than 0 mass parts and 50 mass parts or less with respect to 100 mass parts of the energy ray-curable polymer (A).

[0076]

Examples to be used as the crosslinker (E) include polyfunctional compounds having reactivity with the functional group of the energy ray-curable polymer (A) or the like. Examples of such polyfunctional compounds include isocyanate compounds, epoxy compounds, amine compounds, melamine compounds, aziridine compounds, hydrazine compounds, aldehyde compounds, oxazoline compounds, metal alkoxide compounds, metal chelate compounds, metal salts, ammonium salts, and reactive phenol resins.

[0077]

The compounding amount of the crosslinker (E) may be preferably 0.01 mass parts or more, particularly preferably 0.03 mass parts or more, and further preferably 0.04 mass parts or more with respect to 100 mass parts of the energy ray-curable polymer (A). From another aspect, the compounding amount of the crosslinker (E) may be preferably 8 mass parts or less, particularly preferably 5 mass parts or less, and further preferably 3.5 mass parts or less with

respect to 100 mass parts of the energy ray-curable polymer (A).

[0078]

Description will then be directed to a case in which
5 the energy ray-curable pressure sensitive adhesive contains a mixture, as the main component, of a non-energy ray-curable polymer component and a monomer and/or oligomer having at least one or more energy ray-curable groups.

[0079]

10 The same components as in the previously-described acrylic-based copolymer (a1) can be used as the non-energy ray-curable polymer component.

[0080]

The same components as in the previously-described
15 component (B) can be used as the monomer and/or oligomer having at least one or more energy ray-curable groups. The compounding ratio of the monomer and/or oligomer having at least one or more energy ray-curable groups to the non-energy ray-curable polymer component may be preferably 1
20 mass part or more and particularly preferably 60 mass parts or more of the monomer and/or oligomer having at least one or more energy ray-curable groups with respect to 100 mass parts of the non-energy ray-curable polymer component. From another aspect, the compounding ratio may be
25 preferably 200 mass parts or less and particularly preferably 160 mass parts or less of the monomer and/or oligomer having at least one or more energy ray-curable groups with respect to 100 mass parts of the non-energy ray-curable polymer component.

30 [0081]

Also in this case, the photopolymerization initiator (C) and/or the crosslinker (E) may be appropriately compounded as in the above.

[0082]

The thickness of the pressure sensitive adhesive layer can be appropriately set in accordance with a method in which the pressure sensitive adhesive sheet for work
5 processing 1 is used, but may be preferably 3 μm or more in general and particularly preferably 5 μm or more. From another aspect, the thickness may be preferably 50 μm or less and particularly preferably 40 μm or less.

[0083]

10 (4) Release Sheet

In the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment, a release sheet may be laminated on the pressure sensitive adhesive surface of the pressure sensitive adhesive layer 13 for the
15 purpose of protecting the pressure sensitive adhesive surface until the surface is attached to a workpiece. The configuration of the release sheet may be freely determined. Examples of the release sheet include those in which release treatment is performed for a plastic film, such as
20 using a release agent. Specific examples of the plastic film include films of polyester, such as polyethylene terephthalate, polybutylene terephthalate and polyethylene naphthalate, and films of polyolefin, such as polypropylene and polyethylene. Examples to be used as the release agent
25 include silicone-based, fluorine-based, and long-chain alkyl-based release agents, among which the silicone-based release agent may be preferred because stable performance can be obtained at low cost. The thickness of the release sheet is not particularly restricted, but may ordinarily be
30 20 μm or more and 250 μm or less.

[0084]

3. Method of manufacturing Pressure Sensitive Adhesive Sheet for Work Processing

The method of manufacturing the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is not particularly limited, provided that the previously-described interlaminar strength can be achieved. The pressure sensitive adhesive sheet for work processing 1 according to the present embodiment may preferably be manufactured through laminating the conductive layer 12 at one side of the base material 11, then performing at least one surface treatment of electron beam irradiation and plasma treatment for the surface of the conductive layer 12 opposite to the base material 11, and subsequently laminating the pressure sensitive adhesive layer 13 on the surface, for which the surface treatment is performed, of the conductive layer 12. Thus, by performing at least one of electron beam irradiation and plasma treatment for one surface of the conductive layer 12 before laminating the pressure sensitive adhesive layer 13 on the one surface of the conductive layer 12, the previously-described interlaminar strength can readily be achieved. As a result, the occurrence of adhesive residue on the workpiece can be effectively suppressed.

[0085]

Lamination of the conductive layer 12 at one side of the base material 11 can be performed in any known method. For example, the conductive layer 12 can be formed through preparing a coating liquid that contains a composition including a conductive material and, if desired, further contains a solvent or dispersion medium, coating one surface of the base material 11 with the prepared coating liquid using an appropriate coater, such as a die coater, curtain coater, spray coater, slit coater, and knife coater, to form a coating film, and drying the coating film. Properties of the coating liquid are not particularly

limited, provided that coating can be performed using the coating liquid. The components for forming the conductive layer 12 may each be contained as a solute and/or a dispersant.

5 [0086]

The above electron beam irradiation can be performed in any known method. The surface of the conductive layer 12 opposite to the base material 11 may be irradiated with an electron beam thereby to obtain a state in which the
10 components constituting the conductive layer 12 are ionized or excited on that surface. When the pressure sensitive adhesive layer 13 is laminated thereon, the interfacial adhesion between the pressure sensitive adhesive layer 13 and the conductive layer 12 can be improved. The electron
15 beam as used herein refers to a free electron flux, that is, a cathode ray. The electron beam irradiation may ordinarily be performed through generating an electron beam using an electron beam source (including any type of high energy, low energy, scanning, etc.) and passing an
20 irradiation object under the generated electron beam under a predetermined condition (such as irradiation amount and irradiation time). The type of the electron beam source is not particularly restricted and various types of electron beam accelerators can be used, such as Cockcroft-Walton
25 type, Van de Graaff type, resonance transformer type, insulated core transformer type, linear type, dynamitron type, and high-frequency type. As will be understood, the electron beam may be a β beam (i.e. an electron beam generated by radioactive decay of nuclei).

30 [0087]

When the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is manufactured, the irradiation amount of the electron beam

may be preferably 100 kGy or more and further preferably 110 kGy or more. From another aspect, the irradiation amount of the electron beam may be preferably 300 kGy or less and further preferably 200 kGy or less. The
5 irradiation time of the electron beam may be preferably 8 seconds or less and further preferably 3 seconds or less. When the irradiation amount and irradiation time of the electron beam are within the above ranges, the previously-described interlaminar strength can readily be achieved.
10 As a result, the occurrence of adhesive residue on the workpiece can be effectively suppressed.

[0088]

The above plasma treatment can be performed in any known method. The plasma treatment may be performed for
15 the surface of the conductive layer 12 opposite to the base material 11 thereby to obtain a state in which the components constituting the conductive layer 12 are ionized or excited on that surface. When the pressure sensitive adhesive layer 13 is laminated thereon, the interfacial
20 adhesion between the pressure sensitive adhesive layer 13 and the conductive layer 12 can be improved. The plasma treatment can be performed, for example, by using a general plasma treatment apparatus and using hydrogen, nitrogen, oxygen, argon, helium, fluorocarbon or the like alone as
25 the plasma source or in a mixture as the plasma source.

[0089]

When the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is manufactured, the plasma pressure in the plasma treatment
30 may be preferably 1.0×10^{-3} Pa or more and particularly preferably 1.0×10^{-2} Pa or more. From another aspect, the plasma pressure may be preferably 5.0×10^1 Pa or less and particularly preferably 3.0×10^1 Pa or more. When the

plasma pressure is within the above range, the previously-described interlaminar strength can readily be achieved. As a result, the occurrence of adhesive residue on the workpiece can be effectively suppressed.

5 [0090]

Only one of the previously-described electron beam irradiation and plasma treatment may be performed, but from the viewpoint of readily achieving the previously-described interlaminar strength, it may be preferred to perform both
10 the electron beam irradiation and the plasma treatment. When both the electron beam irradiation and the plasma treatment are performed, it may be preferred to perform the electron beam irradiation and thereafter perform the plasma treatment. In general, the effect of surface treatment by
15 the plasma treatment is more likely to attenuate than the effect of surface treatment by the electron beam irradiation. Thus, by performing the plasma treatment after the electron beam irradiation, the effect of surface treatment by the plasma treatment can be well obtained, and
20 the previously-described interlaminar strength can be effectively achieved.

[0091]

As previously described, the electron beam irradiation and the plasma treatment may ionize or excite the
25 components, which constitute the conductive layer 12, on the surface of the conductive layer 12. The pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is obtained by laminating the pressure sensitive adhesive layer 13 on such a surface of
30 the conductive layer 12. With regard to the state of the surface of the conductive layer 12 after performing the electron beam irradiation and/or the plasma treatment and the state of the interface between the conductive layer 12

and the pressure sensitive adhesive layer 13 due to the electron beam irradiation and/or the plasma treatment, direct identification by the structure or properties of such a state may require a considerably excessive economic
5 expenditure and time and may thus be not practical.

[0092]

Lamination of the pressure sensitive adhesive layer 13 on the surface of the conductive layer 12 opposite to the base material 11 can be performed in any known method. For
10 example, it may be preferred to form the pressure sensitive adhesive layer 13 on a release sheet and then transfer the pressure sensitive adhesive layer 13 to the surface of the conductive layer 12 opposite to the base material 11. In this case, the pressure sensitive adhesive layer 13 can be
15 formed through preparing a coating liquid that contains a pressure sensitive adhesive for constituting the pressure sensitive adhesive layer and, if desired, further contains a solvent or dispersion medium, coating a surface of the release sheet for which release treatment is performed
20 (this surface may be referred to as a "release surface," hereinafter) with the prepared coating liquid using an appropriate coater, such as a die coater, curtain coater, spray coater, slit coater, and knife coater, to form a coating film, and drying the coating film. Properties of
25 the coating liquid are not particularly limited, provided that coating can be performed using the coating liquid. The components for forming the pressure sensitive adhesive layer 13 may each be contained as a solute and/or a dispersant. In the obtained laminate, the release sheet
30 may be removed as a process material and may also be used for protecting the pressure sensitive adhesive surface of the pressure sensitive adhesive layer 13 until the pressure sensitive adhesive sheet for work processing 1 is attached

to a workpiece.

[0093]

When the coating liquid for forming the pressure sensitive adhesive layer 13 contains a crosslinker, the condition for the above drying (such as temperature and time) may be changed, or heating treatment may be separately provided, thereby to progressing the crosslinking reaction between the crosslinker and a non-energy ray-curable acrylic-based pressure sensitive adhesive (N) or an energy ray-curable pressure sensitive adhesive (A) in the coating film to form a crosslinked structure in the pressure sensitive adhesive layer 13 with a desired existence density. To sufficiently progress the crosslinking reaction, aging may be performed such that, after the pressure sensitive adhesive layer 13 is laminated above the base material using the above method or the like, the obtained pressure sensitive adhesive sheet for work processing 1 is stationarily left for several days, for example, under an environment of 23°C and a relative humidity of 50%.

[0094]

The pressure sensitive adhesive layer 13 may be formed directly above the base material 11 instead of transferring the pressure sensitive adhesive layer 13 formed on the release sheet to the surface of the conductive layer 12 opposite to the base material 11 as described above. In this case, the pressure sensitive adhesive layer 13 may be formed through coating the surface of the conductive layer 12 opposite to the base material 11 with the previously-described coating liquid for forming the pressure sensitive adhesive layer 13 so that a coating film is formed and drying the coating film.

[0095]

4. Method of using Pressure Sensitive Adhesive Sheet for Work Processing

The pressure sensitive adhesive sheet for work processing 1 according to the present embodiment can be used for processing a workpiece. That is, after the pressure sensitive adhesive surface of the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is attached to a workpiece, processing of the workpiece can be performed on the pressure sensitive adhesive sheet for work processing 1. Examples of the processing include backgrinding of a semiconductor wafer, glass plate and the like, dicing of a semiconductor wafer, glass plate and the like, expanding for semiconductor chips, glass chips and the like, and picking-up of semiconductor chips, glass chips and the like.

[0096]

Here, the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment includes the conductive layer 12. Electrostatic charge can therefore be suppressed when the pressure sensitive adhesive sheet for work processing 1 is conveyed and used. This results in effective suppression of damage of the workpiece and erroneous operation and the like of the apparatus which performs the processing.

[0097]

After the processing of the workpiece on the pressure sensitive adhesive sheet for work processing 1 is completed, the pressure sensitive adhesive sheet for work processing 1 and the workpiece can be separated from each other. This process for separation may include, for example, dicing a semiconductor wafer or glass plate as the workpiece on the pressure sensitive adhesive sheet for work processing 1 into a plurality of individual semiconductor chips or glass

chips, then, if necessary, expanding the pressure sensitive adhesive sheet for work processing 1, and thereafter picking up each of the semiconductor chips or glass chips from the pressure sensitive adhesive sheet for work
5 processing 1.

[0098]

Here, in the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment, the pressure sensitive adhesive layer 13 is composed of an
10 energy ray-curable pressure sensitive adhesive. The adhesion property between the pressure sensitive adhesive layer 13 and the workpiece can therefore be reduced by irradiating the pressure sensitive adhesive layer 13 with energy rays to cure the pressure sensitive adhesive layer
15 13. As such, when the semiconductor chips or glass chips originated from the workpiece are picked up as described above, they can be readily picked up from the pressure sensitive adhesive sheet for work processing 1. Moreover, in the pressure sensitive adhesive sheet for work
20 processing 1 according to the present embodiment, the interlaminar strength falls within the previously-described range thereby to suppress the occurrence of delamination at the interface between the conductive layer 12 and the pressure sensitive adhesive layer 13 when the semiconductor
25 chips or glass chips are picked up from the pressure sensitive adhesive sheet for work processing 1. As a result, the pressure sensitive adhesive which constitutes the pressure sensitive adhesive layer 13 is prevented from attaching to the surfaces of the picked-up semiconductor
30 chips or glass chips. That is, the occurrence of adhesive residue on the semiconductor chips is suppressed.

[0099]

In particular, the pressure sensitive adhesive sheet

for work processing 1 according to the present embodiment can be especially preferably used for a workpiece having recesses on its surface. In this case, the pressure sensitive adhesive surface of the pressure sensitive adhesive sheet for work processing 1 may be attached to the surface of the workpiece on which the recesses exist. Examples of such recesses include characters printed by laser printing and cut grooves. Thus, even when the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is used for a workpiece having recesses on its surface, the interlaminar strength falls within the previously-described range thereby to well obtain an effect of suppressing the occurrence of adhesive residue.

[0100]

In the above workpiece having recesses on its surface, the recesses may have any shape, but the width of the recesses may preferably be 1 μm or more in the cross-sectional view. From another aspect, the width may preferably be 100 μm or less. The depth of the recesses may preferably be 1 μm or more in the cross-sectional view. From another aspect, the depth may preferably be 50 μm or less. Even when the pressure sensitive adhesive sheet for work processing 1 according to the present embodiment is used for such a workpiece having recesses on its surface, the occurrence of adhesive residue can be effectively suppressed.

[0101]

It should be appreciated that the embodiments heretofore explained are described to facilitate understanding of the present invention and are not described to limit the present invention. It is therefore intended that the elements disclosed in the above

embodiments include all design changes and equivalents to fall within the technical scope of the present invention.

[0102]

For example, one or more other layers may be provided
5 between the base material 11 and the conductive layer 12, on the surface of the base material 11 opposite to the conductive layer 12, and/or on the surface of the pressure sensitive adhesive layer 13 opposite to the conductive layer 12.

10 [Examples]

[0103]

Hereinafter, the present invention will be described further specifically with reference to examples, etc., but the scope of the present invention is not limited to these
15 examples, etc.

[0104]

<Example 1>

(1) Preparation of Pressure Sensitive Adhesive Composition

An acrylic-based copolymer was obtained by reacting 52
20 mass parts of butyl acrylate (BA), 20 mass parts of methyl methacrylate (MMA), and 28 mass parts of 2-hydroxyethyl acrylate (HEA). An energy ray-curable polymer was obtained by reacting 100 g of the acrylic-based copolymer with 33.7 g (corresponding to 0.9 equivalent to 2-hydroxyethyl
25 acrylate) of methacryloyloxyethyl isocyanate (MOI). The weight-average molecular weight (Mw) of the energy ray-curable polymer was 600,000.

[0105]

A pressure sensitive adhesive composition was obtained
30 by mixing 100 mass parts (solid content equivalent, here and hereinafter) of the obtained energy ray-curable polymer, 3 mass parts of 1-hydroxycyclohexyl phenyl ketone (available from BASF, product name "IRGACURE 184") as a

photopolymerization initiator, and 0.214 mass parts of toluene diisocyanate (available from Tosoh Corporation, product name "Coronate L") as a crosslinker.

[0106]

5 (2) Formation of Pressure Sensitive Adhesive Layer

A release sheet (available from LINTEC Corporation, product name "SP-PET381031") was prepared in which a silicone-based release agent layer was formed on a polyethylene terephthalate (PET) film having a thickness of
10 38 μm . The release surface of the release sheet was coated with the above pressure sensitive adhesive composition, which was then dried by heating to form a pressure sensitive adhesive layer having a thickness of 10 μm on the release sheet.

15 [0107]

(3) Formation of Conductive Layer

An emulsion containing a polypyrrole-based conductive polymer as a conductive material was prepared. The polypyrrole-based conductive polymer was obtained by
20 emulsion polymerization of a pyrrole monomer. A coating liquid for a conductive layer was obtained by adding 2 mass parts, with respect to 100 mass parts of the polypyrrole-based conductive polymer, of a butylated melamine resin (available from DIC Corporation, product name "SUPER
25 BECKAMINE J820-60") as a binder resin to the prepared emulsion and sufficiently mixing them.

[0108]

One surface of an ethylene-methacrylic acid copolymer (EMAA) film as a base material having a thickness of 80 μm
30 was coated with the obtained coating liquid, which was then dried by heating to form a conductive layer having a thickness of 50 nm. A laminate of the base material and the conductive layer was thus obtained.

[0109]

(4) Electron Beam Irradiation

The surface at the conductive layer side of the laminate obtained in the above step (3) was irradiated with
5 an electron beam under the following irradiation condition using an electron beam irradiation apparatus (available from Electro Scientific Industries, Inc., product name "TYPE 300/165/800").

Irradiation amount: 110 kGy

10 Irradiation time: 2.2 seconds

[0110]

(5) Plasma Treatment

Plasma treatment was performed for the surface, which was irradiated with the electron beam in the above step (4),
15 of the laminate for which the electron beam irradiation was performed, under the following condition using a plasma apparatus (available from Yamato Material Co., Ltd., product name "PDC 200").

RF power (frequency of 13.56 MHz): 300 W

20 Plasma sources: Ar, O₂

Gas flow rate: Ar: 100 ml/min, O₂: 100 ml/min

Plasma pressure: 20 Pa

Treatment time: 3 min

[0111]

25 (6) Manufacturing of Pressure Sensitive Adhesive Sheet for Work Processing

A pressure sensitive adhesive sheet for work processing was obtained by attaching the surface, opposite to the release sheet, of the pressure sensitive adhesive
30 layer formed in the above step (2) to the surface at the conductive layer side of the laminate comprising the base material and the conductive layer after performing the plasma treatment of the above step (5).

[0112]

<Examples 2 to 6>

Pressure sensitive adhesive sheets for work processing were manufactured as in Example 1 except that the content of the crosslinker in the pressure sensitive adhesive composition was changed as listed in Table 1.

[0113]

<Comparative Example 1>

A pressure sensitive adhesive sheet for work processing was manufactured as in Example 1 except that the content of the crosslinker in the pressure sensitive adhesive composition was changed as listed in Table 1 and the electron beam irradiation and the plasma irradiation were not performed for the conductive layer.

[0114]

<Comparative Example 2>

An acrylic-based copolymer was obtained by reacting 2-ethylhexyl acrylate (2-EHA)/vinyl acetate (Vac)/2-hydroxyethyl acrylate (HEA)=40/40/20 (mass parts). An energy ray-curable polymer was obtained by reacting 100 g of the acrylic-based copolymer with 21.4 g (corresponding to 0.8 equivalent to 2-hydroxyethyl acrylate) of methacryloyloxyethyl isocyanate (MOI). The weight-average molecular weight (Mw) of the energy ray-curable polymer was 600,000.

[0115]

A pressure sensitive adhesive sheet for work processing was manufactured as in Example 1 except that the above energy ray-curable polymer was used and the electron beam irradiation and the plasma irradiation were not performed for the conductive layer.

[0116]

<Exemplary Test 1> (Measurement of Interlaminar Strength)

A high-adhesive-strength UV pressure sensitive adhesive sheet (available from LINTEC Corporation, product name "Adwill D-510T") was prepared, comprising three layers: a base material; a pressure sensitive adhesive
5 layer laminated on one surface of the base material and composed of a high-adhesive-strength ultraviolet ray-curable pressure sensitive adhesive; and a release sheet laminated on the pressure sensitive adhesive layer opposite to the base material. The surface at the base material
10 side of the high-adhesive-strength UV pressure sensitive adhesive sheet was fixed to one surface of a stainless steel plate (SUS304 #600) as a support via a two-sided pressure sensitive adhesive tape (available from LINTEC Corporation, product name "TackLiner").

15 [0117]

Then, the release sheet was removed from the above high-adhesive-strength UV pressure sensitive adhesive sheet to expose the surface of the above pressure sensitive adhesive layer opposite to the base material. Subsequently,
20 the release sheet was removed from the pressure sensitive adhesive sheet for work processing manufactured in each of the examples and comparative examples to expose the pressure sensitive adhesive surface, which was then attached to the exposed surface of the pressure sensitive
25 adhesive layer of the above high-adhesive-strength UV pressure sensitive adhesive sheet.

[0118]

Subsequently, the pressure sensitive adhesive layer of the pressure sensitive adhesive sheet for work processing
30 was irradiated with ultraviolet rays from the surface at the base material side of the pressure sensitive adhesive sheet for work processing (illuminance: 140 mW/cm^2 , light amount: 150 mJ/cm^2).

[0119]

Thereafter, the laminate comprising the base material and the conductive layer of the pressure sensitive adhesive sheet for work processing was peeled off from the pressure sensitive adhesive layer of the pressure sensitive adhesive sheet for work processing under a condition of a peeling angle of 180° and a peeling speed of 300 mm/min using a universal tensile tester (available from SHIMADZU CORPORATION, product name "Autograph AG-IS") to measure the peel strength (N/25 mm) at that time. The peel strength was employed as the interlaminar strength (N/25 mm). Results are listed in Table 1.

[0120]

<Exemplary Test 2> (Measurement of Holding Power)

The holding power of the pressure sensitive adhesive sheet for work processing manufactured in each of the examples and comparative examples was measured in accordance with JIS Z0237: 2009. Specifically, the pressure sensitive adhesive sheet for work processing was cut into a size of 25 mm×100 mm and the release sheet was removed. Then, a region of 25 mm in the longitudinal direction from the end of the exposed pressure sensitive adhesive surface was attached to one surface of a stainless steel plate (SUS304 #600) so as to have an attaching area of 25 mm×25 mm.

[0121]

Thereafter, the stainless steel plate was disposed perpendicularly to the ground such that the pressure sensitive adhesive sheet for work processing was hung from the stainless steel plate. After twenty minutes passed from attaching the pressure sensitive adhesive sheet for work processing to the stainless steel plate, the pressure sensitive adhesive sheet for work processing was left for

70,000 seconds under an environment of 40°C while being applied with a load of 1 kg, and an amount of displacement (mm) after 70,000 seconds was measured. The amount of displacement was employed as the holding power (mm).

5 Results are listed in Table 1.

[0122]

<Exemplary Test 3> (Evaluation of Adhesive Residue)

For the mirror surface of a silicon wafer, printing was performed using a laser printing apparatus (available
10 from KEYENCE CORPORATION, product name "MD-S9910A"). Due to this printing, the mirror surface was formed with grooves of a width of about 50 μm and a depth of about 25 μm in the cross-sectional view.

[0123]

15 Subsequently, the release sheet was removed from the pressure sensitive adhesive sheet for work processing manufactured in each of the examples and comparative examples to expose the pressure sensitive adhesive surface, which was then attached to the mirror surface after the
20 above laser printing using a rubber roller of 2 kg and left for 20 minutes.

[0124]

Thereafter, the above mirror surface and pressure sensitive adhesive sheet for work processing were separated
25 from each other, and the adhesive residue at the printed portions on the mirror surface was confirmed. When no adhesive residue was present, the evaluation was "o" while when adhesive residue was present, the evaluation was "x." Results are listed in Table 1.

30 [0125]

[Table 1]

	Composition of pressure sensitive adhesive composition				Treatment for conductive layer surface	Interlaminar strength (N/25 mm)	Holding power (mm)	Evaluation of adhesive residue
	Energy ray-curable polymer	Photopolymeriz ation initiator	Crosslinker					
	Composition	(mass parts)	(mass parts)	(mass parts)				
Example 1	BA/MMA/HEA(MOI) = 52/20/28 (0.9 equivalent)	100	3	0.214	Plasma treatment after electron beam irradiation	21.8	0.5	○
Example 2		100	3	0.321		22.2	0	○
Example 3		100	3	0.536		22.8	0	○
Example 4		100	3	1.071		24.6	0	○
Example 5		100	3	1.607		25.6	0	○
Example 6		100	3	2.143		28.8	0	○
Comparative Example 1		100	3	0.107		16.1	2.5	×
Comparative Example 2	2-EHA/Vac/HEA(MOI) = 40/40/20 (0.8 equivalent)	100	3	0.214	None	6	0	×

[0126]

As found from Table 1, when the pressure sensitive adhesive sheets for work processing obtained in the 5 examples were used, adhesive residue did not occur.

[Industrial Applicability]

[0127]

The pressure sensitive adhesive sheet for work processing of the present invention can be suitably used 10 for a workpiece having recesses on its surface.

[Description of Reference Numerals]

[0128]

- 1... Pressure sensitive adhesive sheet for work processing
- 11... Base material
- 12... Conductive layer
- 13... Pressure sensitive adhesive layer

CLAIMS

[Claim 1]

A pressure sensitive adhesive sheet for work processing, comprising:

a base material;

a conductive layer laminated at one side of the base material; and

a pressure sensitive adhesive layer laminated on a surface of the conductive layer opposite to the base material,

the pressure sensitive adhesive layer being composed of an energy ray-curable pressure sensitive adhesive,

the pressure sensitive adhesive sheet having an interlaminar strength of 17 N/25 mm or more, the interlaminar strength being measured as a peel strength when, after a surface of the pressure sensitive adhesive sheet at the pressure sensitive adhesive layer side is fixed to a support and the pressure sensitive adhesive layer is irradiated with energy rays, a laminate of the base material and the conductive layer is peeled off from the pressure sensitive adhesive layer at a peeling speed of 300 mm/min and at 180°.

[Claim 2]

The pressure sensitive adhesive sheet for work processing as recited in claim 1, wherein the pressure sensitive adhesive sheet before being irradiated with energy rays has a holding power of 1.0 mm or less as an amount of displacement of the pressure sensitive adhesive sheet after 70,000 seconds, wherein the holding power is measured in accordance with JIS Z0237: 2009.

[Claim 3]

The pressure sensitive adhesive sheet for work processing as recited in claim 1 or 2, wherein a surface of the pressure sensitive adhesive layer opposite to the conductive layer is attached to a workpiece having recesses on its surface, wherein the surface of the pressure sensitive adhesive layer is attached to the surface of the workpiece on which the recesses exist.

[Claim 4]

The pressure sensitive adhesive sheet for work processing as recited in claim 3, wherein the recesses of the workpiece have a width of 1 μm or more and 100 μm or less and a depth of 1 μm or more and 50 μm or less in a cross-sectional view.

[Claim 5]

A method of manufacturing the pressure sensitive adhesive sheet for work processing as recited in any one of claims 1 to 4, the method comprising:

- a step of laminating the conductive layer at one side of the base material;

- a step of performing electron beam irradiation for a surface of the conductive layer opposite to the base material;

- a step of performing plasma treatment for the surface of the conductive layer opposite to the base material; and

- a step of laminating the pressure sensitive adhesive layer on the surface of the conductive layer for which the electron beam irradiation and the plasma treatment are performed.

[Claim 6]

The method of manufacturing the pressure sensitive adhesive sheet for work processing as recited in claim 5, wherein the step of performing electron beam irradiation is performed prior to the step of performing plasma treatment.