

DESCRIPTION

TITLE OF INVENTION:

REMOVABLE ADHESIVE SHEET FOR SEMICONDUCTOR PROCESSING

5

TECHNICAL FIELD

{0001}

The present invention relates to a removable adhesive sheet for semiconductor processing.

10

In more detail, minutely the present invention relates to a removable adhesive tape suitable for fixing and holding a semiconductor wafer at the time when, for example, the semiconductor wafer is diced into chips; and relates to a dicing removable adhesive tape which is used for a semiconductor package processing. In particular, the present invention relates to a dicing removable adhesive tape suitable for a high-density mounting semiconductor package processing.

15

Background

{0002}

20

The dicing removable adhesive tape is designed to protect and fix a semiconductor wafer at the dicing step by which a semiconductor wafer having a circuit pattern formed thereon is divided into a chip shape. The semiconductor wafer is fixed with a removable adhesive tape, and then is subjected to dicing by means of a rotary blade which is called a dicing blade, and then becomes semiconductor chips divided into a chip shape. The semiconductor chips are held together with a removable adhesive tape until a picking-up process.

25

{0003}

After that, in case where a plurality of semiconductor chips is molded

with a resin in a lump and the mold is individually divided to form an individual semiconductor package, the mold is attached and fixed to a dicing tape and is subjected to dicing by means of a rotary blade which is called a dicing blade. In the dicing step of the package collectively sealed with a resin as just described, a load at break is heavy, and moreover the package resin contains a mold release agent and further the surface of its resin has a structure having minute irregularities. For these reasons, as a removable adhesive used in the removable adhesive tape for semiconductor processing, a flexible removable adhesive is used in order to rigidly hold the package and thereby to avoid such troubles that the package at the time of dicing is scattered (hereinafter, referred to as "package fly") due to a failure of retention.

However, the use of such flexible removable adhesive causes problems such that the removable adhesive is adhered to a lateral side of the package due to dicing, and a laser mark sealed on the package is peeled.

In order to decrease such package fly, studies have been conducted from the past.

For example, a removable adhesive tape using (meth)acrylic acid ester in a removable adhesive layer has been proposed (see Patent Literature 1).

However, by the recently increased miniaturization of the package, an area in which the package is held with a removable adhesive tape becomes small and the package fly tends to occur more easily. For this reason, an improvement of the removable adhesive was not enough just to prevent the package fly.

Further, in order to suppress vibration of the semiconductor wafer, suppression of chipping at the dicing, which can be achieved by introducing an elastomer to a base material side of the removable adhesive sheet, is proposed (see Patent Literature 2). In this manner, by making not only the removable

adhesive but also the base material side more flexible, adhesiveness to the package is preferably increased. On the other hand, with a progress of miniaturization of the package in the market, it takes so much time for picking-up in a conventional pin-knock-up-based picking-up method. For this reason, the picking-up has been carried out by scrubbing a back of the tape with tweezers or the like to warp the tape, thereby to drop down the package at once (hereinafter, referred to as rubbing-off).

However, there was a problem that if an elastomer is introduced to the base material side of the removable adhesive sheet to make the base material side more flexible, the rubbing-off performs badly, because even if the tape is warped by the rubbing-off, the package does not stand due to its flexibility in reverse.

CITATION LIST

15 PATENT LITERATURE

{0005}

Patent Literature 1: JP-A-2007-100064 ("JP-A" means unexamined published Japanese patent application)

Patent Literature 2: JP-A-2009-170886

20

DISCLOSURE OF INVENTION

TECHNICAL PROBLEM

{0006}

The present invention aims to solve problems associated with the above-described prior arts, and therefore to provide a removable adhesive sheet for semiconductor processing, which allows decrease in a package fly which occurs at the time of dicing, and can be rapidly and certainly peeled apart from a removable adhesive tape, even by picking-up in way of rubbing-off or the like

after dicing.

SOLUTION TO PROBLEM

{0007}

5 As a result of intensive studies, in particular, as a result of detailed studies on a content of a styrene-based copolymer with respect to the base resin and a loss factor of the removable adhesive sheet, the present inventors have found it important to be such that the content of the styrene-based copolymer is small and a value of the loss factor is low, and have made the present invention.

10 In other words, the above-described problems of the present invention are solved by the following means.

{0008}

[1] A removable adhesive sheet for semiconductor processing, containing:
a base material film; and

15 a removable adhesive layer provided on the base material film,
wherein a loss factor is 0.08 or more and less than 0.15, which is measured in a form of a film by using a specimen prepared by processing the removable adhesive sheet for semiconductor processing to have a width of 5 mm at a frequency of 0.01 to 10 Hz by a dynamic viscoelasticity measurement apparatus;
20 wherein the base material film is single-layered, and contains a base resin, and 5 to 39 mass parts of a styrene-based block copolymer with respect to 100 mass parts of the base resin;

 wherein the styrene-based block copolymer is at least one kind of resin selected from the group consisting of a styrene-hydrogenated isoprene-styrene block
25 copolymer, a styrene-isoprene-styrene block copolymer, a styrene-hydrogenated butadiene-styrene block copolymer, and a styrene-hydrogenated isoprene/butadiene-styrene block copolymer; and
 wherein the base resin is at least one kind of resin selected from the group

consisting of a polypropylene, a high density polyethylene, a low density polyethylene, a linear low density polyethylene, an ethylene/propylene copolymer, a propylene copolymer, a vulcanizate of an ethylene/propylene/diene copolymer, a polybutene, a polybutadiene, a polymethylpentene, an ethylene/vinyl acetate copolymer, an ethylene/(meth)acrylic acid copolymer, an ethylene/methyl (meth)acrylate copolymer, an ethylene/ethyl (meth)acrylate copolymer, a polyvinyl chloride, a vinyl chloride/vinyl acetate copolymer, an ethylene/vinyl chloride/vinyl acetate copolymer, a polystyrene, a polyurethane, a polyamide, an ionomer, a nitrile rubber, a butyl rubber, a styrene/isoprene rubber, a styrene/butadiene rubber, a natural rubber, and hydrogenation products or modification products thereof.

[2] The removable adhesive sheet for semiconductor processing described in the above item [1], wherein the base resin is a polypropylene.

[3] The removable adhesive sheet for semiconductor processing described in the above item [1] or [2], wherein the removable adhesive for forming the removable adhesive layer is an acrylic based removable adhesive.

[4] The removable adhesive sheet for semiconductor processing described in any one of the above items [1] to [3], wherein 10 to 35 mass parts of the styrene-based block copolymer is contained with respect to 100 mass parts of the base resin.

[5] The removable adhesive sheet for semiconductor processing described in any one of the above items [1] to [4], which is used for dicing of a semiconductor package.

{0009}

In the present invention, in case of referring to the term “acrylic”, the term “acrylic” includes the term “methacrylic”.

Further, for more clarification of the term “acrylic”, the parentheses portion of “(meth)” in the term “(meth)acrylic” means the alternative of presence

or absence. For example, the term “(meth)acrylic” may be acrylic, methacrylic, or a combination thereof.

ADVANTAGEOUS EFFECTS OF INVENTION

5 {0010}

The present invention enabled the provision of a removable adhesive sheet for semiconductor processing, which allows decrease in a package fly which occurs at the time of dicing, and can be rapidly and certainly peeled apart from a removable adhesive tape, even by picking-up in way of the rubbing-off or
10 the like after dicing.

Other and further features and advantages of the invention will appear more fully from the following description, appropriately 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 removable adhesive sheet for semiconductor processing of the present invention.

20 {Fig. 2}

Fig. 2 is a cross-sectional view explaining the dicing step and the picking-up step for a semiconductor wafer.

{Fig. 3}

Fig. 3 is a cross-sectional view explaining the dicing step and the picking-up step for the semiconductor wafer.
25

{Fig. 4}

Fig. 4 is a cross-sectional view explaining the dicing step and the picking-up step for the semiconductor wafer.

{Fig. 5}

Fig. 5 is a cross-sectional view explaining the dicing step and the picking-up step for the semiconductor wafer.

5 MODE FOR CARRYING OUT THE INVENTION

{0012}

The removable adhesive sheet for semiconductor processing of the present invention is described below in detail.

{0013}

10 <<Removable adhesive sheet for semiconductor processing>>

Like a diagrammatic cross-sectional view schematically showing a flame format in Fig. 1, the removable adhesive sheet 12 for semiconductor processing of the present invention has a removable adhesive layer 2 on at least one surface of the base material film 1 thereof.

15 Firstly, explanation will start from the base material film.

{0014}

<Base material film>

In the present invention, the base material film is not a laminated body in which a plurality of resin films is laminated, but is single-layered, in other words,
20 is composed of a single resin film.

The resin which constitutes the base material film is not a single resin but is composed of a base resin and at least a styrene-based block copolymer.

{0015}

(Styrene-based block copolymer)

25 The styrene-based block copolymer is an elastomer and is also called a styrene-based thermoplastic elastomer or a styrene-based elastomer.

As the styrene-based block copolymer, a styrene block copolymer composed of a polystyrene hard segment and a soft segment is preferable.

Examples of the soft segment include polybutadiene, polyisobutylene, polyisoprene, hydrogenated polybutadiene (namely ethylene/propylene), hydrogenated polyisobutylene (namely ethylene/butylene), hydrogenated isoprene/butadiene (namely ethylene-ethylene/propylene), butadiene rubber, epoxidized polybutadiene and the like.

{0016}

By using the styrene-based block copolymer, the base material film is made flexible and adhesiveness to the semiconductor package is increased. Further, this allows easy expansion.

{0017}

Among these, in the present invention, at least one kind of resin selected from the group consisting of a styrene-hydrogenated isoprene-styrene block copolymer (SEPS), a styrene-isoprene-styrene copolymer (SIS), a styrene-hydrogenated butadiene-styrene copolymer (SEBS), and a styrene-hydrogenated isoprene/butadiene-styrene copolymer (SEEPS).

{0018}

Herein, in the styrene-based block copolymer, the expression “-” means a connection in block units (in one block), while the expression “/” means to form one recurring unit, which results in a block unit (one block).

{0019}

As the styrene-based block copolymer, one kind thereof may be used or a plurality of kinds may be used in combination.

{0020}

The styrene-based block copolymer is used together with a base resin. In the present invention, from 5 to 39 mass parts, preferably from 10 to 35 mass parts of the styrene-based block copolymer with respect to 100 mass parts of the base resin is contained therein.

If the content of the styrene-based block copolymer is less than 5 mass

parts, the base material film becomes adamant, which results in an inability to increase adhesiveness to the semiconductor package. In reverse, if the content thereof is more than 39 mass parts, the package does not stand even the removable adhesive sheet for semiconductor processing is warped by rubbing-off, which results in a failure of the rubbing-off.

{0021}

(Base resin)

In the present invention, the base resin is a resin other than the styrene-based block copolymer.

As the base resin, a thermoplastic resin is preferable and a resin that is excellent in terms of water proof and heat resistance of the base material film is more preferable. In particular, a synthetic resin film is preferable.

{0022}

Examples of the thermoplastic resin includes a polyolefin resin, a polyamide resin, a polyetheramide resin, a thermoplastic polyimide resin, a thermoplastic polyamideimide resin, a polyurethane resin, a urea resin, a polyester resin, a liquid crystalline polyester resin, a polyacetal resin, a polycarbonate resin, a polyphenylene ether (including a modified polyphenylene ether is) resin, a polysulfone resin, a polyethersulfone resin, a polyphenylenesulfide resin, a polyetheretherketone (including a modified polyetheretherketone) resin, a polyetherketone resin, a polyaryletherketone resin, a polyarylate resin, a fluorine-based resin, a polyphenyleneoxide resin, polylactic acid, a phenol resin, a melamine resin, an epoxy resin, a phenoxy resin, and a silicon resin.

Among these thermoplastic resins, a polyolefin resin is preferable.

Note that the thermoplastic resin may be modified by an acid denaturation or the like, and may be crystalline or non-crystalline.

{0023}

Among these, in the present invention, at least one kind of resin selected from the group consisting of a polypropylene, a high density polyethylene, a low density polyethylene, a linear low density polyethylene, an ethylene/propylene copolymer, a propylene copolymer, a vulcanizate of an ethylene/propylene/diene copolymer, a polybutene, a polybutadiene, a polymethylpentene, an ethylene/vinyl acetate copolymer, an ethylene/(meth)acrylic acid copolymer, an ethylene/methyl (meth)acrylate copolymer, an ethylene/ethyl (meth)acrylate copolymer, a polyvinyl chloride, a vinyl chloride/vinyl acetate copolymer, an ethylene/vinyl chloride/vinyl acetate copolymer, a polystyrene, a polyurethane, a polyamide, an ionomer, a nitrile rubber, a butyl rubber, a styrene/isoprene rubber, a styrene/butadiene rubber, a natural rubber, and hydrogenation products or modification products thereof is used.

{0024}

(Polyolefin resin)

The polyolefin resin is a polyolefin resin prepared by polymerizing at least one olefin, and may be a homopolymer or a copolymer.

Examples of such olefin include α -olefin having 4 to 12 carbon atoms including ethylene, propylene, isobutylene, and isobutene (1-butene), butadiene, isoprene, (meth)acrylic acid ester, (meth)acrylic acid, (meth)acrylamide, vinyl alcohol, vinyl acetate, vinyl chloride, styrene, and acrylonitrile.

{0025}

In addition, examples of the α -olefin having 4 to 12 carbon atoms include 1-butene, 2-methyl-1-propene, 2-methyl-1-butene, 3-methyl-1-butene, 1-hexene, 2-ethyl-1-butene, 2,3-dimethyl-1-butene, 2-methyl-1-pentene, 3-methyl-1-pentene, 4-methyl-1-pentene, 3,3-dimethyl-1-butene, 1-heptene, methyl-1-hexene, dimethyl-1-pentene, ethyl-1-pentene, trimethyl-1-butene, methylethyl-1-butene, 1-octene, methyl-1-pentene, ethyl-1-hexene, dimethyl-1-hexene, propyl-1-heptene, methylethyl-1-heptene, trimethyl-1-pentene, propyl-1-pentene, diethyl-1-butene,

1-nonene, 1-decene, 1-undecene and 1-dodecene.

{0026}

Examples of the polyolefin resin include a polyethylene resin, a polypropylene resin, a polyisobutylene resin, a polyisobutene resin, a polyisoprene resin, a polybutadiene resin, a (meth)acrylic resin (usually referred to as an allyl resin), a vinyl resin such as a poly(vinyl chloride) resin, a poly(meth)acrylamide resin, a polystyrene resin, an acrylonitrile-butadiene-styrene copolymer resin (ABS resin), an ethylene-(meth)acrylate copolymer and an ethylene-vinyl acetate copolymer.

10 {0027}

Among these resins, a polyethylene resin, a polypropylene resin, and an acrylonitrile-butadiene-styrene copolymer resin (ABS resin) are preferable, and a polyethylene resin and a polypropylene resin are more preferable.

{0028}

15 Examples of the polyethylene resin include an ethylene homopolymer, and an ethylene- α -olefin copolymer. As the α -olefin, 1-butene, 1-pentene, 1-hexene, and 1-octene are preferable.

{0029}

20 Examples of the ethylene- α -olefin copolymer include an ethylene-1-butene copolymer, an ethylene-1-pentene copolymer, an ethylene-1-hexene copolymer, and an ethylene-1-octene copolymer.

{0030}

25 In addition, in a case where classification is made depending on density or shape, any of a high density polyethylene (HDPE), a low density polyethylene (LDPE), a very low density polyethylene (VLDPE), a linear low density polyethylene (LLDPE) and an ultra-high molecular weight polyethylene (UHMW-PE) may be used.

{0031}

Specific examples of the polypropylene resin include a propylene homopolymer, a propylene-ethylene random copolymer, a propylene- α -olefin random copolymer, a propylene-ethylene- α -olefin copolymer and a propylene block copolymer (composed of a propylene homopolymer component or a

5 copolymer component mainly composed of propylene, and a copolymer obtained by copolymerizing propylene with at least one kind of a monomer selected from ethylene and α -olefin). These polypropylene resins may be used singly or two or more kinds thereof may be used in combination.

{0032}

10 As the α -olefin used in the polypropylene resin, 1-butene, 1-pentene, 1-hexene, 4-methyl-1-pentene, 1-octene, and 1-decene are preferable, and 1-butene, 1-hexene, and 1-octene are more preferable.

{0033}

Examples of the propylene- α -olefin random copolymer include a

15 propylene-1-butene random copolymer, a propylene-1-hexene random copolymer, and a propylene-1-octene random copolymer.

{0034}

Examples of the propylene-ethylene- α -olefin copolymer include a propylene-ethylene-1-butene copolymer, a propylene-ethylene-1-hexene

20 copolymer, and a propylene-ethylene-1-octene copolymer.

{0035}

Examples of the propylene block copolymer include a (propylene)-(propylene-ethylene) copolymer, a (propylene)-(propylene-ethylene-1-butene) copolymer, a (propylene)-(propylene-ethylene-1-hexene) copolymer, a

25 (propylene)-(propylene-1-butene) copolymer, a (propylene)-(propylene-1-hexene) copolymer, a (propylene-ethylene)-(propylene-ethylene) copolymer, a (propylene-ethylene)-(propylene-ethylene-1-butene) copolymer, a (propylene-ethylene)-(propylene-ethylene-1-hexene) copolymer, a (propylene-ethylene)-(propylene-1-

butene) copolymer, a (propylene-ethylene)-(propylene-1-hexene) copolymer, a (propylene-1-butene)-(propylene-ethylene) copolymer, a (propylene-1-butene)-(propylene-ethylene-1-butene) copolymer, a (propylene-1-butene)-(propylene-ethylene-1-hexene) copolymer, a (propylene-1-butene)-(propylene-1-butene) copolymer and a (propylene-1-butene)-(propylene-1-hexene) copolymer.

{0036}

Among these polypropylene resins, a propylene homopolymer, a propylene-ethylene random copolymer, a propylene-1-butene random copolymer, a propylene-ethylene-1-butene copolymer, and a propylene block copolymer are preferable.

{0037}

Crystallinity of the polypropylene resin is determined by a melting temperature (melting point) or stereoregularity, and adjusted according to quality required for the polyolefin resin composition of the present invention, and quality required for a molded article obtained by molding the composition.

In addition, the stereoregularity refers to an isotactic index or a syndiotactic index.

{0038}

The isotactic index can be determined by a ^{13}C -NMR method described in *Macromolecules*, Vol. 8, p.687 (1975). Specifically, the isotactic index of the polypropylene resin is determined as an area fraction of an mmmm peak in a total absorption peak in a carbon region of a methyl group in a ^{13}C -NMR spectrum.

A material having a high isotactic index has high crystallinity, and the isotactic index is preferably 0.96 or more, more preferably 0.97 or more, and further preferably 0.98 or more.

{0039}

On the other hand, the syndiotactic index can be determined by a method described in *J. Am. Chem. Soc.*, 110, 6255 (1988) and *Angew. Chem. Int.*

Ed. Engl., 1955, 34, 1143-1170, and a material having a high syndiotactic index has high crystallinity.

{0040}

Specific examples of the vinyl resin include a vinyl chloride resin [a
5 homopolymer of a vinyl chloride monomer (poly(vinyl chloride) resin and the like),
a copolymer of a vinyl chloride monomer with other monomer (a vinyl chloride-
vinyl acetate copolymer, a vinyl chloride-(meth)acrylic acid ester copolymer) and
the like], a vinyl alcohol resin (a homopolymer such as poly(vinyl alcohol), a
copolymer such as an ethylene-vinyl alcohol copolymer and the like), and a
10 poly(vinyl acetal) resin such as poly(vinyl formal). These vinyl-based resins can
be used singly or two or more kinds thereof can be used in combination.

{0041}

Melt flow rate (MFR) of a polyolefin resin is usually 0.01 to 400 g/10
minutes, and, from the standpoint of enhancing mechanical strength and
15 production stability, preferably 1 to 400 g/10 minutes, more preferably 1 to 100
g/10 minutes, and further preferably 1 to 50 g/10 minutes.

Note that, in the present invention, the melt flow rate (MFR) means a
mass of a polymer flowing outwardly per 10 minutes (g/10 min.) under 2.16kg of
load at 190°C in conformity to JIS K7210.

20 {0042}

In the present invention, the base resin is particularly preferably a
polypropylene.

{0043}

The surface of the base material film which is brought into contact with
25 the removable adhesive layer may be subjected to a corona treatment or may be
provided with another layer such as a primer layer, in order to increase
adhesiveness.

There are no particular limitations on the thickness of the base material

film, but the thickness is preferably 30 to 300 μm , more preferably 30 to 200 μm , and furthermore preferably 50 to 150 μm .

In the present invention, the thickness is also preferably more than 100 μm . In this case, the thickness is preferably more than 100 μm and 300 μm or less, more preferably 110 to 300 μm , further preferably 110 to 250 μm , and particularly preferably 110 to 200 μm .

{0044}

<Removable adhesive and Removable adhesive layer>

The removable adhesive layer can be formed from various removable adhesives, which are known more than before. There are no limitations in such a removable adhesive. Removable adhesives are used, which employ, as a base polymer, for example, a rubber-based polymer, acrylic based polymers, silicone-based polymers, polyvinyl ether-based polymers or the like.

In the present invention, an acrylic based removable adhesive is preferable.

{0045}

In order to impart a cohesive force to these based polymers, a crosslinking agent can be incorporated thereinto.

In regard to this crosslinking agent, corresponding to the based polymers, examples include an isocyanate-based crosslinking agent, an epoxy-based crosslinking agent, a metal chelate-based crosslinking agent, an aziridine-based crosslinking agent, and an amine resin. Further, the removable adhesive can also contain, if desired, various additive components to the extent that the purpose of the present invention is not impaired.

{0046}

In addition, as the removable adhesive, a radiation-curable type removable adhesive or a thermal foaming type removable adhesive can be used.

As the radiation-curable type removable adhesive, a removable adhesive

which is cured by ultraviolet radiation, an electron beam or the like and is easily peeled off at the time of peeling can be used. As the thermal foaming type removable adhesive, a removable adhesive which becomes more easily peelable when heated, under the action of a foaming agent or a swelling agent, can be used. Further, the removable adhesive may be a dicing/die bonding double functioning removable adhesive. As the radiation-curable type removable adhesive, for example, those described in JP-B-1-56112 ("JP-B" means examined Japanese patent publication), JP-A-7-135189 and the like are preferably used, but the removable adhesive is not limited to these. In the present invention, it is preferable to use an ultraviolet-curable type removable adhesive. In that case, it is desirable for the removable adhesive to have a property of being cured by radiation and forming a three-dimensional network. For example, a material prepared by incorporating a low molecular weight photopolymerizable compound having at least two photopolymerizable carbon-carbon double bonds in the molecule (hereinafter, referred to as a photopolymerizable compound) and a photopolymerization initiator into an ordinary rubber-based or acrylic based pressure-sensitive resin (polymer) is used.

{0047}

As the rubber-based or acrylic-based base resin, a rubber-based polymer such as a natural rubber and various synthetic rubbers, or an acrylic based polymer such as a poly((meth)acrylic acid alkyl ester), a (meth)acrylic acid alkyl ester, or a copolymer of a (meth)acrylic acid alkyl ester and another unsaturated monomer capable of copolymerization with the ester.

{0048}

Further, by mixing an isocyanate-based curing agent in the above-described removable adhesive, an initial adhesion force can be set to an arbitrary value. Specifically, as the 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

5 is used.

{0049}

In the case of an ultraviolet-curable removable adhesive, the time for polymerization curing by ultraviolet irradiation, and ultraviolet irradiation amount can be reduced by incorporating a photopolymerization initiator into the

10 removable adhesive.

Specific examples of such a photopolymerization initiator include benzoin, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzyldiphenyl sulfide, tetramethylthiuram monosulfide, azobisisobutyronitrile, dibenzil, diacetyl, and β -chloroanthraquinone.

15 {0050}

The mass-average molecular weight (M_w) of the base polymer of the acrylic based removable adhesive is preferably 100,000 or more, more preferably 200,000 or more, further preferably 250,000 or more, particularly preferably 300,000 or more, and most preferably 400,000 or more. The upper limit of the mass-average molecular weight (M_w) is preferably 2,000,000 or less, more preferably 1,500,000 or less, further preferably 1,000,000 or less, and particularly preferably 800,000 or less.

20 In the present invention, for example, a preferable range of the mass-average molecular weight includes a range of 100,000 to 2,000,000, and a more preferable range thereof includes a range of 250,000 to 2,000,000. An another range also includes, for example, a range of 200,000 to 1,500,000.

The mass-average molecular weight means a value calculated by a standard polystyrene conversion method using a gel permeation chromatography

(GPC).

{0051}

The thickness of the removable adhesive layer is not particularly limited, but the thickness is preferably 4 to 30 μm , and particularly preferably 5 to 25 μm .

5 {0052}

<Loss factor of removable adhesive sheet for semiconductor processing>

Using a specimen processed so that a removable adhesive sheet for semiconductor processing has a width of 5 mm, a loss factor ($\tan\delta$), which is obtained by a measurement of the specimen in the form of a film using a dynamic viscoelasticity measurement apparatus in accordance with a JIS K 7244-compliant method, is 0.08 or more and less than 0.15 at a frequency of 0.01 to 10 Hz.

In the present invention, the loss factor ($\tan\delta$) is preferably 0.1 to 0.13.

Note that the loss factor ($\tan\delta$) is expressed by the following equation:

15 $\tan\delta = \text{loss elastic modulus } E'' / \text{storage elastic modulus } E'$. The larger the value is, the more flexible the material becomes.

{0053}

If the loss factor ($\tan\delta$) is less than 0.08, a risk of the package fly is increased. If the loss factor ($\tan\delta$) is equal to or more than 0.13, a residual risk of chips remaining on a removable adhesive sheet for semiconductor processing by the rubbing-off picking-up method is increased.

{0054}

The loss factor can be determined by using, for example, dynamic viscoelasticity measurement apparatus (e.g., manufactured by UBM, Rheogel-E4000).

In the present invention, the loss factor is a value obtained by cutting a specimen having a width of 5mm $\times$ a length of 10mm out of a removable adhesive sheet for semiconductor processing, and fixing the specimen to a

dynamic viscoelasticity measurement apparatus with a support jig, and then measuring it at a temperature of 23°C and a frequency of 0.01 to 10 Hz.

{0055}

5 A control of the loss factor to the above-described range can be achieved by properly adjusting a kind and a blended amount of the base resin, the styrene-based block copolymer and the removable adhesive.

{0056}

10 A semiconductor wafer can be bonded to the removable adhesive sheet for semiconductor processing of the present invention, and dicing and picking-up of the wafer can be carried out as shown in Figs. 2 to 5 by ordinary method. In regard to the method for processing a semiconductor wafer using the removable adhesive sheet for semiconductor processing of the present invention, it is preferable not to insert the cut into the base material film, from the viewpoint of reducing the cutting resistance of the dicing blade, smoothening the semiconductor wafer cutting, and reducing chipping. In order to prevent the cut from reaching the base material film, for example, the setting for the cutting depth of the dicing apparatus used may be appropriately varied according to the manual.

{0057}

20 There are no particular limitations on a bare wafer used in the present invention, and any bare wafer that is conventionally used can be appropriately selected and used.

EXAMPLES

{0058}

25 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.

{0059}

<Production of base material film>

1) Base material film A

A base material film A having a thickness of 150 μ m was produced by mixing a styrene-hydrogenated isoprene-styrene block copolymer (SEPS) [trade name: SEPTON KF-2104, manufactured by Kuraray Co., Ltd.] and

- 5 homopropylene (PP) [trade name: J-105G, manufactured by Ube Industries Ltd.] in the blended ratio shown in Table 1, and then processing the mixture by extrusion molding into a film at 200°C using a biaxial kneader.

{0060}

2) Base material film B

- 10 A base material film B having a thickness of 150 μ m was produced by mixing a styrene-isoprene-styrene copolymer (SIS) [trade name: HYBRAR 5127, manufactured by Kuraray Co., Ltd.] and homopropylene (PP) [trade name: J-105G, manufactured by Ube Industries Ltd.] in the blended ratio shown in Table 1, and then processing the mixture by extrusion molding into a film at 200°C using a
- 15 biaxial kneader.

{0061}

3) Base material film C

- A base material film C having a thickness of 150 μ m was produced by mixing a styrene-hydrogenated butadiene-styrene copolymer (SEBS) [trade
- 20 name: SEPTON 8104, manufactured by Kuraray Co., Ltd.] and homopropylene (PP) [trade name: J-105G, manufactured by Ube Industries Ltd.] in the blended ratio shown in Table 1, and then processing the mixture by extrusion molding into a film at 200°C using a biaxial kneader.

{0062}

- 25 4) Base material film D

A base material film D having a thickness of 150 μ m was produced by mixing a styrene-hydrogenated isoprene/butadiene-styrene copolymer (SEEPS) [trade name: SEPTON 4033, manufactured by Kuraray Co., Ltd.] and

homopropylene (PP) [trade name: J-105G, manufactured by Ube Industries Ltd.] in the blended ratio shown in Table 1, and then processing the mixture by extrusion molding into a film at 200°C using a biaxial kneader.

{0063}

5 <Preparation of removable adhesive>

To 100 mass parts of an acrylic base polymer (a copolymer composed of 2-ethylhexyl acrylate, methyl acrylate and 2-hydroxyethyl acrylate, mass-average molecular weight: 400,000, glass transition temperature: -35°C), 3 mass parts of a polyisocyanate compound [trade name: COLONATE L; manufactured by

10 Nippon Polyurethane Industry Co., Ltd.], 50 mass parts of tetramethylol methane tetraacrylate as a compound having a photo-polymerizable carbon-carbon double bond, and 1 mass part of α -hydroxycyclohexylphenyl ketone as a photo-polymerization initiator were added and mixed to obtain a removable adhesive.

{0064}

15 Examples 1 to 3 and Comparative Example1

On one surface of the above-described basic material film A, the above-described removable adhesive was coated so as to be a 20 μ m-thickness thereby to form a removable adhesive layer. Thus, each of the removable adhesive sheets for semiconductor processing of Examples 1 to 3 and Comparative

20 Example 1 was produced.

{0065}

Example 4

A removable adhesive sheet for semiconductor processing was produced in the same manner as in Example 1, except that the above-described

25 base material film B was used.

{0066}

Example 5

A removable adhesive sheet for semiconductor processing was

produced in the same manner as in Example 1, except that the above-described base material film C was used.

{0067}

Example 6

- 5 A removable adhesive sheet for semiconductor processing was produced in the same manner as in Example 1, except that the above-described base material film D was used.

{0068}

- 10 With respect to each of these removable adhesive sheets for semiconductor processing, evaluation of loss factor ($\tan\delta$), package fly, and success rate of the picking-up was conducted in the following manner.

{0069}

(Loss factor)

- 15 A specimen having a width of 5 mm $\times$ a length of 10 mm was cut out of a removable adhesive sheet for semiconductor processing.

- Measurement was carried out at a temperature of 23°C and a frequency of 0.01 to 10 Hz by fixing the specimen to a dynamic viscoelasticity measurement apparatus (Rheogel-E4000, manufactured by Kabushiki Kaisha UBM) with a support jig in accordance with a JIS K 7244-compliant method. A loss factor
20 ($\tan\delta = \text{loss elastic modulus } E'' / \text{storage elastic modulus } E'$) within this frequency range was obtained.

{0070}

(Package fly)

- 25 On each removable adhesive sheet for semiconductor processing, a QFN package (60 mm $\times$ 150 mm, thickness: 0.95 mm) was laminated. This laminate was subjected to dicing for a chip size of 1 mm $\times$ 1 mm by using a dicer [DFD6340, manufactured by DISCO Corporation] under the conditions of blade rotation frequency: 20,000 rpm, cutting rate: 30 mm/min, and amount of incision

into the removable adhesive sheet: 60 μm .

After dicing, evaluation was conducted in accordance with the following criteria.

{0071}

5 Evaluation criteria

○: All of the chips remained on the removable adhesive sheet for semiconductor processing

×: At least one of chips flied therefrom

{0072}

10 (Success rate of picking-up)

Evaluation was conducted by the following rubbing-off method.

After dicing, followed by ultraviolet irradiation (200 mJ/cm²), a back of the removable adhesive sheet for semiconductor processing was scrubbed with tweezers to drop out chips.

15 {0073}

The results are comprehensively shown in Table 1 below.

Note that the blank in Table means to be not in use.

{0074}

Table 1

		Example						Comparative example	
		1	2	3	4	5	6	1	2
Blended ratio of materials (mass parts)	PP	100	100	100	100	100	100	100	100
	SEPS	25	5	39				40	4
	SIS				25				
	SEBS					25			
	SEEPS						25		
Loss factor	(Max)	0.13	0.12	0.145	0.13	0.13	0.13	0.18	0.11
	(Min)	0.1	0.08	0.13	0.1	0.1	0.1	0.16	0.07
Package fly		○	○	○	○	○	○	○	×
Success rate of picking-up (%)	Rubbing-off	100%	100%	100%	100%	100%	100%	80%	100%

{0075}

From the above Table 1, in each of the removable adhesive sheets for semiconductor processing of Examples 1 to 6, the value of the loss factor was 0.08 or more and less than 0.15, and the package fly did not occur, and also a
5 good picking-up performance by the rubbing-off was achieved.

In contrast, in the removable adhesive sheet for semiconductor processing of Comparative Example 1, a large content of the elastomer component was contained and a value of loss factor got higher, which resulted in no occurrence of package fly. However, at the time of the rubbing-off picking-up
10 step, all of the packages did not stand even though the removable adhesive sheet for semiconductor processing was warped, so that the chips to which the rubbing-off did not work remained on the removable adhesive sheet for semiconductor processing.

On the other hand, in the removable adhesive sheet for semiconductor processing of Comparative Example 2, a small content of the elastomer component was contained and a value of loss factor got lower. As a result, because the removable adhesive sheet for semiconductor processing had more to do than one can absorb vibration at the time of dicing, the package fly occurred.
{0076}

20 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.

{0077}

25 This application claims priority on Patent Application No. 2016-073263 filed in Japan on March 31, 2016, which is entirely herein incorporated by reference.

REFERENCE NUMERALS

{0078}

- 1 Base material film
- 2 Removable adhesive layer
- 5 11 Holder
- 12 Removable adhesive sheet for semiconductor processing
- 13 Semiconductor wafer
- 14 Semiconductor chip
- 15 Direction of solid line arrow
- 10 16 Expander
- 17 Direction of broken line arrow

CLAIMS

{Claim 1}

- A removable adhesive sheet for semiconductor processing, comprising:
- 5 a base material film; and
- a removable adhesive layer provided on the base material film,
- wherein a loss factor is 0.08 or more and less than 0.15, which is measured in a form of a film by using a specimen prepared by processing the removable adhesive sheet for semiconductor processing to have a width of 5 mm at a
- 10 frequency of 0.01 to 10 Hz by a dynamic viscoelasticity measurement apparatus; wherein the base material film is single-layered, and contains a base resin, and 5 to 39 mass parts of a styrene-based block copolymer with respect to 100 mass parts of the base resin;
- wherein the styrene-based block copolymer is at least one kind of resin selected
- 15 from the group consisting of a styrene-hydrogenated isoprene-styrene block copolymer, a styrene-isoprene-styrene block copolymer, a styrene-hydrogenated butadiene-styrene block copolymer, and a styrene-hydrogenated isoprene/butadiene-styrene block copolymer; and
- wherein the base resin is at least one kind of resin selected from the group
- 20 consisting of a polypropylene, a high density polyethylene, a low density polyethylene, a linear low density polyethylene, an ethylene/propylene copolymer, a propylene copolymer, a vulcanizate of an ethylene/propylene/diene copolymer, a polybutene, a polybutadiene, a polymethylpentene, an ethylene/vinyl acetate copolymer, an ethylene/(meth)acrylic acid copolymer, an ethylene/methyl
- 25 (meth)acrylate copolymer, an ethylene/ethyl (meth)acrylate copolymer, a polyvinyl chloride, a vinyl chloride/vinyl acetate copolymer, an ethylene/vinyl chloride/vinyl acetate copolymer, a polystyrene, a polyurethane, a polyamide, an ionomer, a nitrile rubber, a butyl rubber, a styrene/isoprene rubber, a

styrene/butadiene rubber, a natural rubber, and hydrogenation products or modification products thereof.

{Claim 2}

- 5 The removable adhesive sheet for semiconductor processing according to Claim 1, wherein the base resin is a polypropylene.

{Claim 3}

- 10 The removable adhesive sheet for semiconductor processing according to Claim 1 or 2, wherein the removable adhesive for forming the removable adhesive layer is an acrylic based removable adhesive.

{Claim 4}

- 15 The removable adhesive sheet for semiconductor processing according to any one of Claims 1 to 3, wherein 10 to 35 mass parts of the styrene-based block copolymer is contained with respect to 100 mass parts of the base resin.

{Claim 5}

- 20 The removable adhesive sheet for semiconductor processing according to any one of Claims 1 to 4, which is used for dicing of a semiconductor package.