

[Name of Document] Description

[Title of Invention] DICING SHEET, METHOD FOR PRODUCING DICING SHEET, AND METHOD FOR PRODUCING MOLD CHIPS

[Technical Field]

5 [0001]

The present invention relates to a dicing sheet used when dicing a mold package such as a semiconductor package in which a plurality of chip-like components such as semiconductor chips is sealed with resin. The present invention also relates to
10 a method for producing the above dicing sheet and a method for producing mold chips using the above dicing sheet.

[Background Art]

[0002]

Components in which chip-like components such as
15 semiconductor chips are sealed with resin (referred to as "mold chips" in the present description) may ordinarily be produced in the following manner when the chip-like components to be sealed are, for example, semiconductor chips.

[0003]

20 First, semiconductor chips are placed on respective bases of a collected body, such as a TAB tape, which is configured such that a plurality of the bases is connected in series or in a matrix form, and these semiconductor chips are collectively sealed with resin to obtain an electronic component collected
25 body (referred to as a "semiconductor package" in the present description).

[0004]

Then, a pressure sensitive adhesive sheet comprising a base film and a pressure sensitive adhesive layer (referred to
30 as a "dicing sheet" in the present description) is attached to one surface of the semiconductor package thereby to fix the semiconductor package to the dicing sheet. This semiconductor package fixed to the dicing sheet is cut and separated (diced)

into individual pieces and a member is thus produced in which a plurality of mold chips is closely disposed on the dicing sheet (dicing step).

[0005]

5 The pressure sensitive adhesive layer of a dicing sheet may ordinarily be designed such that the pressure sensitive adhesion property of the pressure sensitive adhesive layer to an adherend surface is reduced by a specific stimulation. For example, irradiation with energy rays may be employed as the
10 specific stimulation. Thus, a step is involved in which the dicing sheet is irradiated with energy rays to reduce the pressure sensitive adhesion property of the pressure sensitive adhesive layer to an adherend surface before the following steps are performed.

15 [0006]

Subsequently, if necessary, the dicing sheet of that member may be expanded (elongated in a direction or directions in the main surface) to increase the space between the mold chips disposed on the dicing sheet (expanding step).

20 [0007]

The mold chips thus separated from one another on the dicing sheet are individually picked up to depart from the dicing sheet (pickup step) and transported to the next step. In this operation, the above step for reducing the pressure
25 sensitive adhesion property of the pressure sensitive adhesive layer to the surfaces of the mold chips is involved thereby to allow the pickup to easily be performed.

[0008]

In the dicing step among the series of steps, the
30 semiconductor package and the mold chips obtained by dicing the semiconductor package are required to maintain a state of being fixed on the dicing sheet. To this end, it is preferred for the pressure sensitive adhesive layer of the dicing sheet to

have a high pressure sensitive adhesion property to the surface of the semiconductor package and the surfaces of the mold chips before the irradiation with energy rays.

[0009]

5 Here, when an adherend for the dicing sheet is a semiconductor package, the adherend surface is ordinarily the surface of the sealing resin and irregularities on the adherend surface tend to be larger than those in a case in which the adherend is a semiconductor wafer. Accordingly, if a dicing
10 sheet for a semiconductor wafer as the adherend is diverted to a dicing sheet to be used in the above steps for a semiconductor package, the above pressure sensitive adhesion property to the adherend surface will be insufficient and troubles may occur that, when the semiconductor package is cut into mold chips in
15 the dicing step, some of the mold chips are released and fly away from the dicing sheet. Hereinafter, such troubles occurring in the dicing step are referred to as "chip fly."

[0010]

For the purpose of reducing the possibility of occurrence
20 of this mold chip fly, as described in Patent Literature 1, for example, the pressure sensitive adhesive layer of a dicing sheet may be configured to contain a resin material for improving the pressure sensitive adhesion property to an adherend surface before irradiation with energy rays (such a resin material is
25 referred to as a "tackifier resin" in the present description).

[Prior Art Literature]

[Patent Literature]

[0011]

[Patent Literature 1] JP2005-229040A

30 [Summary of the Invention]

[Problems to be solved by the Invention]

[0012]

A rosin-based material commonly used as the tackifier

resin is a material that is preferred in view of enhancing the pressure sensitive adhesion property of the pressure sensitive adhesive layer to an adherend surface, that is, the resin sealing surface of a mold package. However, when the resin sealing surface has a printing part that is defined by a recessed part formed through removing the resin material, such as by laser processing, the following problems may occur. This will be more specifically described. The pressure sensitive adhesive layer of a dicing sheet can contain a tackifier resin thereby to enhance the pressure sensitive adhesive property to a surface with relatively large irregularities, such as a resin sealing surface, but when the resin sealing surface has a printing part, materials that constitute the pressure sensitive adhesive layer tend to get into the recessed part of the printing part. When mold chips obtained by dividing a mold package into individual pieces are separated from the dicing sheet, therefore, the materials which constitute the pressure sensitive adhesive layer may remain in the recessed part of the printing part to deteriorate the visibility of printed characters. In general, a resin sealing surface has larger irregularities than those of a semiconductor wafer or protection film and, therefore, when the resin sealing surface is formed with a recessed part for printing, the degree of irregularities tends to be enhanced. Thus, the above problem of deterioration in the visibility of printed characters may readily occur.

[0013]

An object of the present invention is to provide a dicing sheet that is less likely to cause troubles in the dicing step and the above problem regarding the printed character visibility. Another object of the present invention is to provide a method for producing mold chips using the dicing sheet.

[Means for solving the Problems]

[0014]

The present invention provided to achieve the above objects is as follows.

5 (1) A dicing sheet comprising a base film and a pressure sensitive adhesive layer laminated on at least one surface of the base film, the pressure sensitive adhesive layer having a storage elastic modulus at 23°C of 50 kPa or more and 80 kPa or less before irradiation with energy rays and 5.0 MPa or more and 120 MPa or less after irradiation with energy rays, the
10 pressure sensitive adhesive layer having a thickness of less than 20 μm , the pressure sensitive adhesive layer having a surface of which an energy amount before irradiation with energy rays is 0.10 mJ/5 mm ϕ or more and 0.8 mJ/5 mm ϕ or less, the energy
15 amount being measured using probe tack under a condition in which a peeling speed is changed to 1 mm/minute in a method as described in JIS Z0237:1991.

[0015]

(2) The dicing sheet as described in the above (1), wherein,
20 when the dicing sheet is used, a resin sealing surface of a mold package is attached to a surface of the pressure sensitive adhesive layer opposite to the base film, and the resin sealing surface has a printing part formed of a recessed part.

[0016]

25 (3) The dicing sheet as described in the above (2), wherein the recessed part of the printing part on the resin sealing surface has an average depth of 0.5 μm or more.

[0017]

(4) The dicing sheet as described in any of the above (1)
30 to (3), wherein the pressure sensitive adhesive layer is formed of a pressure sensitive adhesive composition that contains an acrylic-based polymer (A) having an energy ray polymerizable group and a reactive functional group and an isocyanate-based

crosslinker (B) capable of a crosslinking reaction with the reactive functional group, and the acrylic-based polymer (A) is obtained by a reaction between an acrylic-based polymer (A1) having the reactive functional group and an isocyanate-based compound (A2) having the energy ray polymerizable group under presence of an organometallic catalyst (C) that contains at least one of titanium and zirconium.

[0018]

(5) The dicing sheet as described in the above (4), wherein a mass ratio of a monomer (m1) that gives a constitutional unit having the reactive functional group of the acrylic-based polymer (A1) to a total monomer that gives the acrylic-based polymer (A1) is 5 mass% or more and 30 mass% or less, and a use amount of the compound (A2) in the reaction for forming the acrylic-based polymer (A) is 0.4 equivalent or more and 0.8 equivalent or less to the monomer (m1).

[0019]

(6) The dicing sheet as described in the above (4) or (5), wherein the organometallic catalyst (C) includes a zirconium-containing chelate compound.

[0020]

(7) A method for producing mold chips, comprising: attaching a surface at a side of the pressure sensitive adhesive layer of the dicing sheet as described in any of the above (1) to (6) to the resin sealing surface of the mold package; and cutting the mold package on the dicing sheet into individual pieces to obtain a plurality of mold chips.

[Advantageous Effect of the Invention]

[0021]

According to the present invention, there is provided a dicing sheet that is less likely to cause troubles in the dicing step and the previously-described problem regarding the printed character visibility. Moreover, such a dicing sheet can be used

thereby to produce high-quality mold chips excellent in the visibility of printed characters at low cost.

[Mode(s) for Carrying out the Invention]

[0022]

5 Embodiments of the present invention will be described hereinafter.

1. Dicing Sheet

 The dicing sheet according to an embodiment of the present invention comprises a base film and a pressure sensitive
10 adhesive layer.

[0023]

(1) Base Film

 Constitutional materials for the base film of the dicing sheet according to the present embodiment are not particularly
15 limited, provided that the base film does not fracture in the pickup step and other steps. The base film may ordinarily be composed of a film that comprises a resin-based material as the primary material. Specific examples of the film include:
20 polyolefin-based film such as low-density polyethylene (LDPE) film, linear low-density polyethylene (LLDPE) film, high-density polyethylene (HDPE) film and other polyethylene films, polypropylene film, polybutene film, polybutadiene film, polymethylpentene film, ethylene-norbornene copolymer film and norbornene resin film; polyvinyl chloride-based film such
25 as polyvinyl chloride film and vinyl chloride copolymer film; polyester-based film such as polyethylene terephthalate film and polybutylene terephthalate film; polyurethane film; polyimide film; ionomer resin film; ethylene-based copolymer film such as ethylene-vinyl acetate copolymer film,
30 ethylene-(meth)acrylic acid copolymer film and ethylene-(meth)acrylic ester copolymer film; polystyrene film; polycarbonate film; fluorine resin film; and films in which hydrogenated products and modified products of these

resins are used as the primary materials. There may also be used a crosslinked film and copolymer film thereof. One type of the above base film may be solely used, or a laminated film comprising a combination of two or more types thereof may also
5 be used. The “(meth)acrylic acid” as used in the present description means both acrylic acid and methacrylic acid. The same applies to other similar terms.

[0024]

The base film, of which the primary material is the above
10 resin-based material, may also contain various additives, such as colorant, fire retardant, plasticizer, antistatic, glidant and filler. Examples of the colorant include pigment, such as titanium dioxide and carbon black, and various dyes. Examples of the filler include organic material such as melamine resin,
15 inorganic material such as fumed silica, and metal-based material such as nickel particle. The content of such additives is not particularly limited, but may have to be within a range in which the base film exhibits a desirable function and does not lose desirable flatness and/or flexibility.

20 [0025]

When ultraviolet rays are used as energy rays with which the pressure sensitive adhesive layer is irradiated to be cured, the base film may preferably have transparency to the ultraviolet rays. When electron rays are used as the energy
25 rays, the base film may preferably have transparency to the electron rays.

[0026]

The thickness of the base film is not limited, provided that the dicing sheet can function appropriately in each of the
30 previously-described steps. The thickness may preferably be within a range of 20 to 450 μm , more preferably 25 to 200 μm , and particularly preferably 50 to 150 μm .

[0027]

The fracture elongation of the base film in the present embodiment may preferably be 100% or more and particularly preferably 200% or more and 1,000% or less as a value measured at 23°C and a relative humidity of 50%. The base film having
5 a fracture elongation of 100% or more as described above is less likely to fracture even when the expanding step is performed, and mold chips formed by cutting a mold package can be easily separated from one another. The fracture elongation as referred to herein is an elongation percentage of the length
10 of a test piece when the test piece fractures to the original length in a tensile test in accordance with JIS K7161: 1994.

[0028]

The tensile stress at a strain of 25% of the base film in the present embodiment, which is measured by a test in
15 accordance with JIS K7161: 1994, may preferably be 5 N/10 mm or more and 15 N/10 mm or less, and the maximum tensile stress may preferably be 15 MPa or more and 50 MPa or less. If the tensile stress at a strain of 25% is less than 5 N/10 mm and/or the maximum tensile stress is less than 15 MPa, then, when the
20 dicing sheet is fixed to a ring frame after a mold package is attached to the dicing sheet, the base film may loosen because of its yielding property, which may cause errors in transportation. If, on the other hand, the tensile stress at a strain of 25% exceeds 15 N/10 mm and/or the maximum tensile
25 stress exceeds 50 MPa, a problem may possibly occur such as that the dicing sheet itself is released from the ring frame because the load added to the dicing sheet is large when the expanding step is performed. The fracture elongation, the tensile stress at a strain of 25% and the maximum tensile stress in the present
30 invention refer to values as measured in the longitudinal direction of the base film.

[0029]

(2) Pressure Sensitive Adhesive Layer

As will be described below, the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment has a thickness of less than 20 μm and is provided with predetermined properties such as a storage elastic modulus.

5 In a preferred form, the pressure sensitive adhesive layer may be formed of a pressure sensitive adhesive composition that contains an acrylic-based polymer (A) having an energy ray polymerizable group and a reactive functional group and an isocyanate-based crosslinker (B) capable of a crosslinking
10 reaction with the reactive functional group.

[0030]

(2-1) Thickness

The thickness of the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment is less
15 than 20 μm . When the thickness of the pressure sensitive adhesive layer is less than 20 μm , the adhesive residue is less likely to occur and the possibility of occurrence of troubles can be reduced in the dicing step. Moreover, the previously-described problem regarding the printed character
20 visibility in the mold chips may not readily occur. In particular, if the dicing step is carried out to divide a mold package into individual mold chips, but the irradiation with energy rays is performed after a long period of time (e.g. 30 days), the previously-described problem regarding the printed
25 character visibility in the mold chips may readily occur when the thickness of the pressure sensitive adhesive layer is 20 μm or more because the pressure sensitive adhesive property of the pressure sensitive adhesive layer to the surfaces of mold chips becomes excessively high and the above pressure sensitive
30 adhesive property is not appropriately reduced even after being irradiated with energy rays. In the dicing sheet according to the present embodiment, the thickness of the pressure sensitive adhesive layer is less than 20 μm and, therefore, such a problem

regarding the printed character visibility in the mold chips as previously described is less likely to occur. The thickness of the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment may preferably be 17 μm or less, more preferably 13 μm or less, and particularly preferably 10 μm or less. In view of stably realizing that the pressure sensitive adhesive layer has an appropriate pressure sensitive adhesive property to an adherend surface, the thickness of the pressure sensitive adhesive layer may preferably be 2 μm or more, more preferably 4 μm or more, and particularly preferably 5 μm or more. The most preferred thickness of the pressure sensitive adhesive layer is therefore 5 μm or more and 10 μm or less.

[0031]

(2-2) Storage Elastic Modulus

The storage elastic modulus at 23°C of the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment before irradiation with energy rays (referred also to as an "elastic modulus before irradiation") is 50 kPa or more and 80 kPa or less.

[0032]

When the elastic modulus before irradiation is within the above range, materials that constitute the pressure sensitive adhesive layer before irradiation with energy rays are less likely to get into a recessed part on the surface of a sealing resin of the mold package as an adherend surface for the pressure sensitive adhesive layer, and the previously-described problem regarding the printed character visibility in the mold chips may not readily occur. Moreover, when the elastic modulus before irradiation is within the above range, the pressure sensitive adhesive property of the pressure sensitive adhesive layer to an adherend surface is appropriate and the chip fly is less likely to occur. In view of more stably reducing the possibility that the previously-described problem regarding

the printed character visibility in the mold chips and the chip fly occur, the elastic modulus before irradiation may preferably be 50 kPa or more and 75 kPa or less and more preferably 50 kPa or more and 70 kPa or less.

5 [0033]

The storage elastic modulus at 23°C of the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment after irradiation with energy rays (referred also to as an "elastic modulus after irradiation") is 5.0 MPa
10 or more and 120 MPa or less.

[0034]

When the elastic modulus after irradiation is 5.0 MPa or more, materials that constitute the pressure sensitive adhesive layer after irradiation with energy rays are less likely to
15 remain in a recessed part on the surface of a sealing resin of the mold package as an adherend surface for the pressure sensitive adhesive layer, in particular, the recessed part which constitutes a printing part, and the previously-described problem regarding the printed character visibility in the mold
20 chips may not readily occur. In view of more stably reducing the possibility of occurrence of the previously-described problem regarding the printed character visibility in the mold chips, the elastic modulus after irradiation may preferably be 10 MPa or more, more preferably 15 MPa or more, and particularly
25 preferably 20 MPa or more.

[0035]

Materials that constitute the pressure sensitive adhesive layer may get into a recessed part on the surface of a sealing resin of the mold package as an adherend surface for
30 the pressure sensitive adhesive layer, in particular, the recessed part which constitutes a printing part. When the elastic modulus after irradiation is 120 MPa or less, such materials may readily be separated from the above recessed part

in the pickup step. Thus, the previously-described problem regarding the printed character visibility in the mold chips is less likely to occur. In view of more stably reducing the possibility of occurrence of the previously-described problem regarding the printed character visibility in the mold chips, the elastic modulus after irradiation may preferably be 100 MPa or less, more preferably 80 MPa or less, further preferably 60 MPa or less, and particularly preferably 50 MPa or less.

[0036]

10 (2-3) Tack Value

The pressure sensitive adhesive layer of the dicing sheet according to the present embodiment has a surface of which an energy amount before irradiation with energy rays is 0.10 mJ/5 mmφ or more and 0.8 mJ/5 mmφ or less. The energy amount before irradiation with energy rays (referred also to as a "tack value" in the present description) is measured using probe tack under a condition in which a peeling speed is changed to 1 mm/minute in a method as described in JIS Z0237:1991. The tack value is obtained as an accumulated value of a peak that is measured from the start of test to release of the probe. When the tack value is within the above range, the occurrence of chip fly can be suppressed. In view of more stably reducing the possibility of occurrence of the chip fly, the tack value may preferably be 0.13 mJ/5 mmφ or more and 0.75 mJ/5 mmφ or less, more preferably 0.15 mJ/5 mmφ or more and 0.7 mJ/5 mmφ or less, and particularly preferably 0.18 mJ/5 mmφ or more and 0.65 mJ/5 mmφ or less.

[0037]

(2-4) Acrylic-based Polymer (A)

30 In a preferred form, the pressure sensitive adhesive composition for forming the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment may contain an acrylic-based polymer (A) that has an energy ray

polymerizable group and a reactive functional group. The acrylic-based polymer (A) is an acrylic-based polymer that includes, as a unit that constitutes its skeleton, a constitutional unit based on an acrylic-based compound having
5 the energy ray polymerizable group and the reactive functional group. The acrylic-based polymer (A) may be a homopolymer obtained by polymerization of one type of monomer or may also be a copolymer obtained by polymerization of a plurality of types of monomers. In view of easy control of physical
10 properties and chemical properties of the polymer, the acrylic-based polymer (A) may preferably be a copolymer.

[0038]

The polystyrene equivalent weight-average molecular weight (M_w) of the acrylic-based polymer (A) may preferably be
15 10,000 to 2,000,000. Such an acrylic-based polymer (A) exhibits an effect of maintaining the cohesive property of the pressure sensitive adhesive layer as a general function of a pressure sensitive adhesive primary agent. Such an effect is enhanced as the molecular weight increases. However, if the
20 molecular weight of the acrylic-based polymer (A) is unduly large, the pressure sensitive adhesive layer may be difficult to be thin when produced. Thus, the polystyrene equivalent weight-average molecular weight (M_w) of the acrylic-based polymer (A) may more preferably be 100,000 to 1,500,000. The
25 glass-transition temperature T_g of the acrylic-based polymer (A) may preferably be within a range of -70°C to 30°C and further preferably within a range of -60°C to 20°C . In the present description, the polystyrene equivalent weight-average molecular weight (M_w) refers to a polystyrene equivalent value
30 as measured by a gel permeation chromatography (GPC) method.

[0039]

The reactive functional group of the acrylic-based polymer (A) is a functional group capable of a crosslinking

reaction with an isocyanate-based crosslinker (B) which will be described later. Examples of the reactive functional group include a hydroxyl group, carboxyl group, and amino group. Among these, the hydroxyl group may be preferred as the reactive
5 functional group of the acrylic-based polymer (A) because the hydroxyl group has high reactivity with the isocyanate group of the isocyanate-based crosslinker (B).

[0040]

The type of the energy ray polymerizable group of the
10 acrylic-based polymer (A) is not particularly limited. Specific examples thereof include a functional group having an ethylenic unsaturated bond, such as a vinyl group and (meth)acryloyl group. In view of excellent polymerization reactivity, the energy ray polymerizable group may preferably
15 be a functional group having an ethylenic unsaturated bond and, in particular, a (meth)acryloyl group may be more preferred from the viewpoint of the high reactivity when irradiated with energy rays.

[0041]

20 Examples of the energy rays for reacting the energy ray polymerizable group include ionizing radiation, that is, X-rays, ultraviolet rays, electron rays or the like. Among these, ultraviolet rays may be preferred because the introduction of irradiation equipment is relatively easy.

25 [0042]

When ultraviolet rays are used as the ionizing radiation, near-ultraviolet rays including rays of wavelengths of about 200 to 380 nm may be used in view of easy management. The amount of ultraviolet rays may be appropriately set in accordance with
30 the type of the energy ray polymerizable group of the acrylic-based polymer (A) and the thickness of the pressure sensitive adhesive layer and may ordinarily be about 50 to 500 mJ/cm², preferably 100 to 450 mJ/cm², and more preferably 150

to 400 mJ/cm². The illuminance of ultraviolet rays may ordinarily be about 50 to 500 mW/cm², preferably 100 to 450 mW/cm², and more preferably 150 to 400 mW/cm². The ultraviolet ray source is not particularly restricted, and examples thereof to
5 be used include a high-pressure mercury lamp and metal halide lamp.

[0043]

When electron rays are used as the ionizing radiation, the accelerating voltage may be appropriately set in accordance
10 with the type of the energy ray polymerizable group of the acrylic-based polymer (A) and the thickness of the pressure sensitive adhesive layer and may preferably be about 10 to 1,000 kV in general. The amount of irradiated rays may be set within a range in which the reaction of the energy ray polymerizable
15 group of the acrylic-based polymer (A) appropriately progress, which may ordinarily be selected within a range of 10 to 1,000 krad. The electron ray source is not particularly restricted, and examples thereof to be used include various electron ray accelerators, such as of Cockcroft-Walton type, Van de Graaff
20 type, resonance transformer type, insulated core transformer type, linear type, dynamitron type, and high-frequency type.

[0044]

The acrylic-based polymer (A) is obtained by a reaction between an acrylic-based polymer (A1) having the reactive
25 functional group and an isocyanate-based compound (A2) having the energy ray polymerizable group under the presence of an organometallic catalyst (C) that contains at least one of titanium and zirconium. Such reaction under the presence of the organometallic catalyst (C) allows the pressure sensitive
30 adhesive composition, which contains the obtained acrylic-based polymer (A), to form a pressure sensitive adhesive layer that has an appropriate elastic modulus before irradiation and an appropriate tack value.

[0045]

(2-4-1) Acrylic-based Polymer (A1)

The acrylic-based polymer (A1) is an acrylic-based polymer that has the previously-described reactive functional group. The mass ratio of a monomer (m1) that gives a constitutional unit having the reactive functional group of the acrylic-based polymer (A1) to a total monomer that gives the acrylic-based polymer (A1) may preferably be 5 mass% or more and 30 mass% or less. Satisfying the above condition of the mass ratio allows the pressure sensitive adhesive composition, which contains the acrylic-based polymer (A) obtained from the acrylic-based polymer (A1), to form a pressure sensitive adhesive layer that has an appropriate elastic modulus before irradiation and an appropriate tack value. The above mass ratio may preferably be 7 mass% or more and 25 mass% or less, more preferably 10 mass% or more and 20 mass% or less, and particularly preferably 12 mass% or more and 17 mass% or less.

[0046]

Monomers for forming the acrylic-based polymer (A1) will be described as specific examples when the acrylic-based polymer (A1) has a hydroxyl group as the reactive functional group.

[0047]

Examples of a monomer that can be a raw material for forming the acrylic-based polymer (A1) having a hydroxyl group as the above (such a monomer may also be referred to as a "raw material monomer" in the present description) include an acrylic-based monomer having a hydroxyl group (referred to as a "hydroxy acrylic-based monomer") in the present description), a non-acrylic-based monomer having a hydroxyl group, an acrylic-based monomer having no hydroxyl group, and a non-acrylic-based monomer having no hydroxyl group. The acrylic-based polymer (A1) having a hydroxyl group may include,

among the above raw material monomers, a constitutional unit originated from at least one type of the hydroxy acrylic-based monomer and the acrylic-based monomer having no hydroxyl group so that the polymer will be an acrylic-based polymer, and may also include a constitutional unit originated from at least one type of the hydroxy acrylic-based monomer and the non-acrylic-based monomer having a hydroxyl group so that the polymer (A1) will have a hydroxyl group.

[0048]

Specific examples of the hydroxy acrylic-based monomer include (meth)acrylate having a hydroxyl group, such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, and N-methylol acrylamide. Specific examples of the non-acrylic-based monomer having a hydroxyl group include hydroxy vinyl acetate. In view of enhancing the handling property and making it easy to adjust the physical properties of the pressure sensitive adhesive layer, the acrylic-based polymer having a hydroxyl group may preferably include a constitutional unit originated from the hydroxy acrylic-based monomer. Such a monomer having a hydroxyl group may preferably have only one hydroxyl group because in this case it is easy to control the abundance of the energy ray polymerizable groups in the acrylic-based polymer (A).

[0049]

Specific examples of the acrylic-based monomer having no hydroxyl group, among the above raw material monomers, include (meth)acrylic acid, (meth)acrylic ester, and derivatives thereof (such as acrylonitrile). Specific examples of the (meth)acrylic ester include: (meth)acrylate having a chain-like skeleton, such as methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, butyl (meth)acrylate and 2-ethylhexyl (meth)acrylate; (meth)acrylate having a cyclic skeleton, such as cycloalkyl (meth)acrylate, benzyl

(meth)acrylate, isobornyl (meth)acrylate, dicyclopentanyl (meth)acrylate, dicyclopentenyl (meth)acrylate, dicyclopentenyl oxyethyl (meth)acrylate, tetrahydrofurfuryl (meth)acrylate and imide acrylate; and (meth)acrylate having
 5 a reactive functional group other than a hydroxyl group, such as glycidyl (meth)acrylate and N-methylaminoethyl (meth)acrylate. When the acrylic-based monomer having no hydroxyl group is alkyl (meth)acrylate, the carbon number of the alkyl group may preferably be within a range of 1 to 18.
 10 Examples of the non-acrylic-based monomer having no hydroxyl group include olefin such as ethylene and norbornene, vinyl acetate, and styrene.

[0050]

(2-4-2) Isocyanate-based Compound (A2)

15 The isocyanate-based compound (A2) is a compound that has an energy ray polymerizable group and can have an isocyanate group when reacting with the reactive functional group of the acrylic-based polymer (A1). Examples of such an isocyanate-based compound include a compound having an
 20 isocyanate group, a compound having a block isocyanate group, a biuret product and isocyanurate product of a compound having an isocyanate group, and a modified product such as an adduct product that is a reaction product of a compound having an isocyanate group and a non-aromatic low molecule active
 25 hydrogen-containing compound such as ethylene glycol, trimethylol propane and castor oil.

[0051]

Specific examples of the isocyanate-based compound (A2) include (meth)acryloyl oxyethyl isocyanate. Specific
 30 examples of the isocyanate-based compound (A2) further include a reaction product of (meth)acrylate in which at least one hydroxyl group remains and a polyisocyanate compound. Among these, an isocyanate compound having only one energy ray

polymerizable group may be preferred because it is easy to control the abundance of the energy ray polymerizable groups in the acrylic-based polymer (A), and (meth)acryloyl oxyethyl isocyanate may more preferred.

5 [0052]

In a reaction for forming the acrylic-based polymer (A), the use amount of the compound (A2) may preferably be 0.4 equivalent or more and 0.8 equivalent or less to the monomer (m1) of the acrylic-based polymer (A). When the above condition
10 of the use amount of the compound (A2) is satisfied, the pressure sensitive adhesive composition, which contains the acrylic-based polymer (A) obtained from the acrylic-based polymer (A1) and the isocyanate-based compound (A2), can avoid troubles in that the obtained pressure sensitive adhesive layer
15 is excessively cured after the irradiation with energy rays and that the pressure sensitive adhesive property to an adherend surface is insufficiently reduced even by the irradiation with energy rays. Consequently, the previously-described problem regarding the printed character visibility in the mold chips
20 is less likely to occur. The above use amount of the compound (A2) to the monomer (m1) may preferably be 0.4 equivalent or more and 0.75 equivalent or less, more preferably 0.45 equivalent or more and 0.7 equivalent or less, and particularly preferably 0.5 equivalent or more and 0.7 equivalent or less.

25 [0053]

(2-5) Isocyanate-based Crosslinker (B)

In the present description, the "isocyanate-based crosslinker" collectively refers to polyisocyanate compounds that have crosslinking property. Specific examples include:
30 aromatic polyisocyanate, such as tolylene diisocyanate, diphenylmethane diisocyanate and xylylene diisocyanate; alicyclic isocyanate compounds, such as dicyclohexylmethane-4,4'-diisocyanate, bicycloheptane

triisocyanate, cyclopentylene diisocyanate, cyclohexylene diisocyanate, methylcyclohexylene diisocyanate and hydrogenated xylylene diisocyanate; acyclic aliphatic isocyanate, such as hexamethylene diisocyanate, trimethyl
5 hexamethylene diisocyanate and lysine isocyanate; biuret products and isocyanurate products of these compounds; and adduct products and other modified produces that are reaction products of compounds having an isocyanate group and non-aromatic low molecule active hydrogen-containing
10 compounds such as ethylene glycol, trimethylol propane and castor oil. The compound which functions as the isocyanate-based crosslinker (B) in the pressure sensitive adhesive composition may be composed of one type or may also be composed of a plurality of types.

15 [0054]

The content of the isocyanate-based crosslinker (B) in the pressure sensitive adhesive composition is not limited. The content may be appropriately set in accordance with the type of the isocyanate-based crosslinker (B). As a nonlimiting
20 example, the content may preferably be 0.01 mass% or more and 10 mass% or less, more preferably 0.05 mass% or more and 7 mass% or less, and particularly preferably 0.1 mass% or more and 3 mass% or less.

[0055]

25 (2-6) Organometallic Catalyst (C)

The organometallic catalyst (C) contains at least one of titanium and zirconium. Specifically, the organometallic catalyst (C) is composed of an organometallic compound that contains at least one of titanium and zirconium. Examples of
30 such an organometallic compound include alkoxide, chelate, and acylate of these metal elements. Specific examples include titanium alkoxide, titanium chelate, zirconium alkoxide, and zirconium chelate. The metal elements contained in the

organometallic compound may preferably include zirconium among the above and such a metal element may preferably be zirconium. The organometallic compound may preferably be a chelate compound. Thus, the organometallic catalyst (C) may preferably include a zirconium-containing chelate compound and may more preferably be composed of a zirconium-containing chelate compound.

[0056]

Preferably, the organometallic catalyst (C) may not contain a tin-containing organometallic compound. The reason of this is not apparent, but when the organometallic catalyst (C) for the pressure sensitive adhesive composition does not contain a tin-containing organometallic compound, it is easy to form a pressure sensitive adhesive layer that has an appropriate elastic modulus before irradiation and an appropriate tack value.

[0057]

The use amount of the organometallic catalyst (C) used in the reaction for obtaining the acrylic-based polymer (A) is not limited. The use amount may preferably be 0.01 mass parts or more and 0.5 mass parts or less, more preferably 0.01 mass parts or more and 0.3 mass parts or less, and particularly preferably 0.01 mass parts or more and 0.25 mass parts or less, to 100 mass parts of the solid content of the acrylic-based polymer (A1).

[0058]

(2-7) Other Components

The pressure sensitive adhesive composition for forming the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment may contain, in addition to the above components, various additives, such as photopolymerization initiator (D), tackifier resin, colorant such as dye and pigment, flame retardant, filler, and

antistatic.

[0059]

The photopolymerization initiator (D) will be described relatively in detail. Examples of the photopolymerization
5 initiator (D) include photo initiators, such as benzoin compound, acetophenone compound, acyl phosphine oxide compound, titanocene compound, thioxanthone compound and peroxide compound, and photo sensitizers, such as amine and quinone. Specifically, there may be exemplified 1-hydroxycyclohexyl
10 phenyl ketone, benzoin, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzyl diphenyl sulfide, tetramethyl thiuram monosulfide, azobisisobutyronitrile, dibenzyl, diacetyl, β -chloroanthraquinone, 2,4,6-trimethyl benzoyl diphenyl phosphine oxide, and the like. When
15 ultraviolet rays are used as the energy rays, the photopolymerization initiator (D) may be compounded thereby to reduce the irradiation time and irradiation amount.

[0060]

(2-8) Method for Producing Pressure Sensitive Adhesive
20 Composition

When the pressure sensitive adhesive layer of the dicing sheet according to an embodiment of the present invention is formed of a pressure sensitive adhesive composition that contains an acrylic-based polymer (A) having an energy ray
25 polymerizable group and a reactive functional group and an isocyanate-based crosslinker (B) capable of a crosslinking reaction with the reactive functional group, the method for producing the pressure sensitive adhesive composition is not limited. A preferred method for producing the pressure
30 sensitive adhesive composition may be as follows.

[0061]

First, in a first step, the acrylic-based polymer (A1) and the isocyanate-based compound (A2) are reacted under the

presence of the organometallic catalyst (C) to obtain a product that includes components based on the acrylic-based polymer (A) and the organometallic catalyst (C). An appropriate solvent may be used in the above reaction. The reaction condition of the reaction in the first step may be appropriately set in accordance with the types and contents of the acrylic-based polymer (A1) and isocyanate-based compound (A2) as reaction raw materials and the organometallic catalyst (C). Through such a reaction, the product can be obtained which includes components based on the acrylic-based polymer (A) and the organometallic catalyst (C). The component based on the organometallic catalyst (C) may preferably maintain the catalytic activity. By maintaining the catalytic activity, the component based on the organometallic catalyst (C) can function as a catalyst for the reaction of the acrylic-based polymer (A) and the isocyanate-based crosslinker (B) which occurs when forming the pressure sensitive adhesive layer from the pressure sensitive adhesive composition.

[0062]

The first step is followed by a second step, in which a mixture that includes the product of the first step and the isocyanate-based crosslinker (B) and further includes the photopolymerization initiator (D) and the like as necessary may be obtained as the pressure sensitive adhesive composition. The product of the first step may be obtained after a necessary process such as removal of solvent, provided that the product includes the acrylic-based polymer (A). The method of mixing is not limited and may be appropriately set so as to enhance the homogeneity of the mixture.

[0063]

(3) Release Sheet

For the purpose of protecting the pressure sensitive adhesive layer before it is attached to a mold package (specific

examples include a semiconductor package) as the adherend, the dicing sheet according to the present embodiment may be configured such that the release surface of a release sheet is provisionally attached to a surface of the pressure sensitive adhesive layer opposite to the surface facing the base film. The release sheet may be arbitrarily configured and examples thereof include a configuration in which a plastic film is coated with a release agent. Specific examples of the plastic film include a film of polyester, such as polyethylene terephthalate, polybutylene terephthalate and polyethylene naphthalate, and a film of polyolefin, such as polypropylene and polyethylene. Examples of the release agent to be used include silicone-based, fluorine-based and long-chain alkyl-based ones, among which the silicone-based release agent may be preferred because a stable property can be obtained at low cost. The above plastic film of the release sheet may be substituted by a paper base such as glassine paper, coated paper and high-quality paper, or a laminated paper obtained by laminating a paper base with a thermoplastic resin such as polyethylene. The thickness of the release sheet may ordinarily be about 20 μm or more and 250 μm or less, but is not limited thereto.

[0064]

2. Method for Producing Dicing Sheet

The method for producing the dicing sheet according to an embodiment of the present invention is not limited. When the pressure sensitive adhesive layer of the dicing sheet according to an embodiment of the present invention is formed of a pressure sensitive adhesive composition that contains an acrylic-based polymer (A) having an energy ray polymerizable group and a reactive functional group and an isocyanate-based crosslinker (B) capable of a crosslinking reaction with the reactive functional group, the method is not particularly

limited in detail, provided that the pressure sensitive adhesive layer formed of the previously-described pressure sensitive adhesive composition can be laminated on one surface of the base film. As one example, the pressure sensitive
5 adhesive layer can be formed through: preparing a coating liquid that contains the previously-described pressure sensitive adhesive composition and if necessary further contains some solvent; coating one surface of the base film with the coating liquid using a coater, such as die coater, curtain coater, spray
10 coater, slit coater and knife coater; and drying the coating film on the one surface. Properties of the coating liquid are not particularly limited, provided that the coating can be performed, and the component for forming the pressure sensitive adhesive layer may be contained therein as a solute or as a
15 dispersed material.

[0065]

Conditions for the above drying (such as temperature and time) may be adjusted, or a heating process for crosslinking may be separately provided, thereby to progress the
20 crosslinking reaction of the acrylic-based polymer (A) and the isocyanate-based crosslinker (B) in the coating film, so that a crosslinked structure is formed with a desired existing density in the pressure sensitive adhesive layer. To sufficiently progress this crosslinking reaction, after the
25 pressure sensitive adhesive layer is laminated on the base film using the above method or the like, aging may be performed such that the obtained dicing sheet is stationarily placed, for example, in an environment of 23°C and a relative humidity of 50% for several days.

30 [0066]

Another method may include: coating the release surface of the above release sheet with the coating liquid to form a coating liquid layer; drying it to form a laminate comprising

the pressure sensitive adhesive layer and the release sheet; and attaching a surface of the pressure sensitive adhesive layer of the laminate opposite to the surface facing the release sheet to one surface of the base film, so that a laminate of the dicing
5 sheet and the release sheet is obtained. The release sheet of the laminate may be released as a process material or may keep protecting the pressure sensitive adhesive layer before the dicing sheet is attached to a mold package.

[0067]

10 As described above, the production method according to an embodiment of the present invention comprises any of the following steps:

a step of obtaining the dicing sheet through coating one surface of the base film with the pressure sensitive adhesive
15 composition, which contains the acrylic-based polymer (A) and the isocyanate-based crosslinker (B), and forming the pressure sensitive adhesive layer from the obtained coating film; and

a step of obtaining the dicing sheet through coating the release surface of a release sheet with the pressure sensitive
20 adhesive composition, forming the pressure sensitive adhesive layer from the obtained coating film, and attaching a surface of the pressure sensitive adhesive layer on the release sheet to one surface of the base film, wherein the surface of the pressure sensitive adhesive layer is opposite to a side facing
25 the release sheet and the dicing sheet is obtained in a state in which the release sheet is attached to a surface at a side of the pressure sensitive adhesive layer

[0068]

As previously described, in a preferred embodiment, the
30 acrylic-based polymer (A) may be obtained by a reaction between the acrylic-based polymer (A1) and the isocyanate-based compound (A2) under the presence of the organometallic catalyst (C), the mass ratio of the monomer (m1) in the acrylic-based

polymer (A1) to the total monomer which gives the acrylic-based polymer (A1) may be 5 mass% or more and 30 mass% or less, and the use amount of the compound (A2) in the reaction for forming the acrylic-based polymer (A) may be 0.4 equivalent or more and
5 0.9 equivalent or less to the monomer (m1).

[0069]

3. Method for Producing Mold Chips

A method for producing mold chips from a mold package using the dicing sheet according to the present embodiment will be
10 described below as a specific example in which the mold package comprises a semiconductor package.

[0070]

As described above, a semiconductor package is an electronic component collected body configured such that
15 semiconductor chips are placed on respective bases of a collected body of bases and these semiconductor chips are collectively sealed with resin. In general, such a semiconductor package has a substrate surface and a resin sealing surface, and the thickness thereof may be about 200 to
20 2,000 μm . The resin sealing surface has an arithmetic average roughness Ra (JIS B0601: 2001 (ISO 4287: 1997)) of about 0.5 μm , which may be coarse. In addition, to allow for easy release from a mold of a sealing apparatus, the sealing material may contain a release component. When the pressure sensitive
25 adhesive sheet is attached to the resin sealing surface, therefore, there is a tendency that a sufficient fixing property cannot be exhibited.

[0071]

The resin sealing surface of a semiconductor package
30 (mold package) may have a printing part that is defined by a recessed part formed through removing the resin material, such as by laser processing. A semiconductor package has a difference in height between the resin sealing surface other

than the printing part and the flat surface of the printing part. In the present description, such a difference in height is referred to as a depth (average depth) of the recessed part of a printing part. In view of improving the visibility of printed
5 characters in a printing part, the average depth of the recessed part of a printing part may preferably be $0.5\text{ }\mu\text{m}$ or more and more preferably $0.5\text{ }\mu\text{m}$ or more and $10\text{ }\mu\text{m}$ or less. In the present description, the average depth of the recessed part of a printing part is to be obtained as follows. The resin sealing
10 surface other than the printing part of a semiconductor package and the flat surface of a recessed part that constitutes the printing part are observed using a laser microscope to measure the difference in height. Five measurement points are set within a region that includes the border between the printing
15 part and the other part, and the average value of differences in height at the measurement points is used as the average depth of the recessed part of the printing part.

[0072]

When the dicing sheet according to the present embodiment
20 is used, the surface at the side of the pressure sensitive adhesive layer (i.e., the surface of the pressure sensitive adhesive layer opposite to the base film) is attached to the resin sealing surface of a semiconductor package (mold package).

25 [0073]

If a release sheet is attached to the surface of the dicing sheet at the side of the pressure sensitive adhesive layer, the release sheet is released to expose the surface at the side of the pressure sensitive adhesive layer, and the surface may be
30 attached to the resin sealing surface of a semiconductor package. In general, an outer circumferential portion of the dicing sheet is attached, via the pressure sensitive adhesive layer provided at that portion, to a circular jig referred to as a ring frame

for transportation and/or fixation to an apparatus. Since the pressure sensitive adhesive layer has an appropriate tack value and the like, when the semiconductor package attached to the dicing sheet is put into the dicing step, the possibility may
5 be reduced that the mold chips obtained by dividing the semiconductor package into individual pieces fly away during the processing.

[0074]

While the size of mold chips formed in the dicing step
10 is ordinarily 5 mm×5 mm or less, and may even be about 1 mm×1 mm in recent years, the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment has an appropriate tack value and can thus respond to the dicing at such a fine pitch.

15 [0075]

By carrying out the dicing step as described above, a plurality of mold chips can be obtained from the semiconductor package. After completion of the dicing step, for easy pickup of the plurality of mold chips closely disposed on the dicing
20 sheet, the expanding step may be performed in general to elongate the dicing sheet in a direction or directions in the main surface. The degree of this elongation may appropriately be set in consideration of the space which the adjacent mold chips should have, the tensile strength of the base film, etc.

25 [0076]

After the expanding step is optionally carried out as the above, pickup of the mold chips on the pressure sensitive adhesive layer is performed by a general-purpose means such as a suction collet. The picked-up mold chips are delivered to
30 the subsequent step such as a transportation step.

[0077]

After completion of the dicing step and before initiating the pickup step, irradiation with energy rays may be performed

from the side of the base film of the dicing sheet according to the present embodiment thereby to progress the reaction of the energy ray polymerizable group contained in the pressure sensitive adhesive layer of the dicing sheet, so that the pressure sensitive adhesive property of the pressure sensitive adhesive layer to the surfaces of the mold chips can be reduced. Moreover, the pressure sensitive adhesive layer of the dicing sheet according to the present embodiment is formed of an appropriate pressure sensitive adhesive composition and, therefore, materials that constitute the pressure sensitive adhesive layer are less likely to remain in a recessed part on the resin sealing surface of the semiconductor package as an adherend, particularly in a recessed part that constitutes a printing part. Thus, the previously-described problem regarding the printed character visibility in the mold chips is less likely to occur.

[0078]

As described above, the method for producing mold chips according to the present embodiment is less likely to cause the chip fly and troubles are also less likely to occur in the subsequent step or steps. The yield rate may therefore not readily deteriorate in the series of steps including the dicing step and pickup step in which the mold package such as a semiconductor package is divided into a plurality of mold chips, to the next step or steps. Hence, the mold chips obtained through the production method according to the present embodiment using the dicing sheet according to the present embodiment can be advantageous in cost. The chip fly may lead to a problem, such as breakage of other mold chips than those relating directly to these troubles, that is, mold chips produced in the same lot, due to collision of chips or the like. The mold chips produced through the method for producing mold chips according to the present embodiment are therefore

excellent in their quality because the possibility of having such a problem is reduced.

[0079]

The embodiments heretofore explained are described to
5 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.

10 [Examples]

[0080]

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 examples,
15 etc.

[0081]

«Example 1»

(1) Preparation of Coating Liquid

Coating liquid having a composition below was prepared.
20 Copolymer (polystyrene equivalent weight-average molecular weight of 700,000) was obtained as the acrylic-based polymer (A) by copolymerization of 75 mass parts of 2-ethylhexyl acrylate, 10 mass parts of methyl methacrylate, and 15 mass parts of 2-hydroxyethyl acrylate (HEA).

25 [0082]

Methacryloyl oxyethyl isocyanate (MOI) as the compound (A2) and the above acrylic-based polymer (A1) were reacted under the presence of a zirconium chelate catalyst ("ZC-700" available from Matsumoto Fine Chemical Co. Ltd.) as the
30 organometallic catalyst (C). The use amount of the compound (A2) was 0.6 equivalent to the HEA positioned as the monomer (m1) giving a constitutional unit having a hydroxyl group as the reactive functional group in the acrylic-based polymer (A1).

The additive amount of the organometallic catalyst (C) was 0.1 mass parts to 100 mass parts of the solid content of the acrylic-based polymer (A1). Through the above reaction, a product including components based on the acrylic-based polymer (A) and the organometallic catalyst (C) was obtained.

[0083]

A pressure sensitive adhesive composition was obtained by compounding the above product and 0.3 mass parts of the isocyanate-based crosslinker (B) ("BHS-8515" available from TOYO CHEM CO., LTD.) and 3.0 mass parts of the photopolymerization initiator (D) ("IRGACURE (registered trademark) 184" available from BASF) to 100 mass parts of the acrylic-based polymer (A) in the product (each compounding ratio being in terms of the solid content equivalent).

[0084]

(2) Production of Dicing Sheet

A release sheet ("SP-PET381031" available from LINTEC Corporation) was prepared having a release surface formed with a silicone-based release agent layer on one surface of a polyethylene terephthalate base film of a thickness of 38 μm . The release surface of the release sheet was coated with the previously-described coating liquid using a knife coater. The coating film thus obtained with the release sheet was carried to pass through an environment of 100°C for 1 minute thereby to dry the coating film and progress the crosslinking reaction, and a laminate comprising the release sheet and the pressure sensitive adhesive layer (thickness of 10 μm) was obtained.

The surface of the above laminate at the side of the pressure sensitive adhesive layer was attached to one surface (subjected to corona treatment, surface tension: 54 mN/m) of a base film comprising an ethylene-methacrylic acid copolymer (EMAA) film having a thickness of 140 μm , and a dicing sheet comprising the base film and the pressure sensitive adhesive

layer was thus obtained in a state of being further laminated thereon with the release sheet.

[0085]

«Example 2»

5 A dicing sheet was obtained with a release sheet laminated on the surface at the side of the pressure sensitive adhesive layer as in Example 1 except that, instead of the zirconium chelate catalyst, a titanium chelate catalyst ("TC-750" available from Matsumoto Fine Chemical Co. Ltd.) was used as
10 the organometallic catalyst (C) for obtaining the acrylic-based polymer (A) and its use amount was 0.03 mass parts to 100 mass parts of the solid content of the acrylic-based polymer (A1).

[0086]

«Comparative Example 1»

15 A dicing sheet was obtained with a release sheet laminated on the surface at the side of the pressure sensitive adhesive layer as in Example 1 except that, instead of the zirconium chelate catalyst, a tin catalyst ("BXX-3778" available from TOYOCEM CO., LTD.) was used as the organometallic catalyst (C)
20 for obtaining the acrylic-based polymer (A) and its use amount was 0.03 mass parts to 100 mass parts of the solid content of the acrylic-based polymer (A1).

[0087]

«Example 3»

25 A dicing sheet was obtained with a release sheet laminated on the surface at the side of the pressure sensitive adhesive layer as in Example 1 except that the use amount of the MOI as the compound (A2) used for obtaining the acrylic-based polymer (A) was 0.7 equivalent to the HEA.

30 [0088]

«Comparative Example 2»

 A dicing sheet was obtained with a release sheet laminated on the surface at the side of the pressure sensitive adhesive

layer as in Example 1 except that the use amount of the MOI as the compound (A2) used for obtaining the acrylic-based polymer (A) was 0.9 equivalent to the HEA.

[0089]

5 «Comparative Example 3»

A dicing sheet was obtained with a release sheet laminated on the surface at the side of the pressure sensitive adhesive layer as in Example 1 except that the use amount of the MOI as the compound (A2) used for obtaining the acrylic-based polymer
10 (A) was 0.3 equivalent to the HEA.

[0090]

«Comparative Example 4»

A dicing sheet was obtained with a release sheet laminated on the surface at the side of the pressure sensitive adhesive
15 layer as in Example 1 except that the thickness of the pressure sensitive adhesive layer was 30 μm .

[0091]

«Comparative Example 5»

Copolymer (polystyrene equivalent weight-average
20 molecular weight of 700,000) was obtained by copolymerization of 85 mass parts of 2-ethylhexyl acrylate and 15 mass parts of 2-hydroxyethyl acrylate. A dicing sheet was obtained with a release sheet laminated on the surface at the side of the pressure sensitive adhesive layer as in Example 1 except that
25 this copolymer was used as substitute for the acrylic-based polymer (A1).

[0092]

«Comparative Example 6»

A dicing sheet was obtained with a release sheet laminated
30 on the surface at the side of the pressure sensitive adhesive layer as in Example 1 except that the pressure sensitive adhesive composition was prepared by a method as described below.

A composition for coating a pressure sensitive adhesive was obtained as a solution of an organic solvent by adding 10 mass parts of a crosslinker and 40 mass parts of an energy ray curable compound to 100 mass parts of a copolymer (each
5 compounding amount being in terms of the solid content equivalent).

Details of the above copolymer, crosslinker, and energy ray curable compound were as follows:

copolymer: 2-ethylhexyl acrylate/methyl
10 acrylate/acrylic acid of a composition ratio of 50/40/10, polystyrene equivalent weight-average molecular weight: 800,000;

crosslinker: trimethylolpropane tolylenediisocyanate (TDI-TMP), "BHS 8515" available from TOYOCEM CO., LTD.; and
15 energy ray curable compound: deca-functional urethane acrylate, molecular weight: 1,700, "UV-1700B" available from The Nippon Synthetic Chemical Industry Co., Ltd.

[0093]

«Exemplary Test 1» <Evaluation of Chip Fly >

20 A resin for semiconductor packages ("G700" available from Sumitomo Bakelite Co., Ltd.) was used to produce a simulated semiconductor package having a size of 50 mm×50 mm and a thickness of 600 μm with an arithmetic average roughness Ra at the sealing resin surface of 1 μm. The surface of each dicing
25 sheet produced in the above examples and comparative examples at the side of the pressure sensitive adhesive layer was attached to the sealing resin surface of the above-described simulated semiconductor package using a tape mounter ("Adwill RAD2500" available from LINTEC Corporation). The laminate of
30 the dicing sheet and the simulated semiconductor package thus obtained was attached to a ring frame for dicing ("2-6-1" available from DISCO Corporation), and a dicing apparatus ("DFD-651" available from DISCO Corporation) was used to

perform the dicing step for cutting the laminate from the side of the simulated semiconductor package and dividing it into mold chips of a size of 1 mm×1 mm. The dicing condition was as follows:

5 dicing blade: "ZBT-5074 (Z1110LS3)" available from DISCO Corporation;

 blade thickness: 0.17 mm;

 protruding amount of blade: 3.3 mm;

 rotation speed of blade: 30,000 rpm;

10 cutting rate: 100 mm/min;

 depth of cutting into base film: 50 μm;

 cutting water amount: 1.0 L/min; and

 cutting water temperature: 20°C

 [0094]

15 Visual observation was performed for a member obtained in the dicing step, that is, the dicing sheet having the mold chips attached to the surface at the side of the pressure sensitive adhesive layer, to count the number of the mold chips dropped off from the dicing sheet in the dicing step, and the
20 number was divided by the division number in the dicing step to calculate the mold chip fly rate (unit: %). The chip fly rate of less than 10% was determined to be good and the chip fly rate of 10% or more was determined to be bad. Results are listed in Table 1. In Table 1, "A" represents the determination
25 of good and "B" represents the determination of bad.

 [0095]

«Exemplary Test 2» <Evaluation of Printed Character Visibility in Mold Chips>

 A resin for semiconductor packages ("G700" available from
30 Sumitomo Bakelite Co., Ltd.) was used to produce a simulated semiconductor package having a size of 50 mm×50 mm and a thickness of 600 μm with an arithmetic average roughness Ra at the sealing resin surface of 1 μm. Printing parts were formed

on the resin sealing surface of the simulated semiconductor package by performing a printing process under the condition as below:

laser printing apparatus: "LP-V10U-W20" available from
5 Panasonic Corporation;

laser for printing: FAYb Laser;

laser wavelength: 1,064 nm;

scan speed: 400 mm/sec; and

printing pulse period: 1,000 μ s.

10 The average depth of the recessed part of each printing part was 2 μ m. The average depth of the recessed part of a printing part was obtained as follows. The resin sealing surface other than the printing part of the semiconductor package and the flat surface of a recessed part constituting
15 the printing part were observed using a laser microscope ("VK-9700" available from KEYENCE CORPORATION) to measure the difference in height. Five measurement points were set within a region including the border between the printing part and the other part, and the average value of differences in height at
20 the measurement points was used as the average depth of the recessed part of the printing part.

[0096]

The surface of each dicing sheet produced in the above examples and comparative examples at the side of the pressure
25 sensitive adhesive layer was attached to the sealing resin surface of the above-described simulated semiconductor package using a tape mounter ("Adwill RAD2500" available from LINTEC Corporation). The laminate of the dicing sheet and the simulated semiconductor package thus obtained was attached to
30 a ring frame for dicing ("2-6-1" available from DISCO Corporation), and a dicing apparatus ("DFD-651" available from DISCO Corporation) was used to perform the dicing step for cutting the laminate from the side of the simulated

semiconductor package and dividing it into mold chips of a size of 10 mm×10 mm. The dicing condition was as follows:

dicing blade: "ZBT-5074 (Z1110LS3)" available from DISCO Corporation;

5 blade thickness: 0.17 mm;
protruding amount of blade: 3.3 mm;
rotation speed of blade: 30,000 rpm;
cutting rate: 100 mm/min;
depth of cutting into base film: 50 μ m;
10 cutting water amount: 1.0 L/min; and
cutting water temperature: 20°C
[0097]

After completion of the above dicing step, the dicing sheet was stationarily placed for 30 days in a state in which
15 a collection of the mold chips was disposed on the dicing sheet. The dicing sheet after the dicing step and the stationary placement for 30 days was irradiated with ultraviolet rays (illuminance: 230 mW/cm², ultraviolet ray amount: 190 mJ/cm²) from the side of the base film in nitrogen atmosphere using an
20 ultraviolet ray irradiation apparatus ("RAD-2000m/12" available from LINTEC Corporation).

[0098]

After the irradiation with ultraviolet rays, for the member in which mold chips were attached to the surface of the
25 dicing sheet at the side of the pressure sensitive adhesive layer, the expanding step was performed to expand the dicing sheet by 20 mm in a direction or directions in the main surface of the sheet at a speed of 1 mm/sec using an expanding apparatus ("ME-300B-type" available from JCM).

30 [0099]

Subsequently, a pickup test was performed for 100 mold chips located on the dicing sheet. More specifically, a part of the dicing sheet contacting with mold chips as the pickup

objects was elevated by 1.5 mm using needles from the side of the base film, and a vacuum collet was attached to surfaces of the projected mold chips opposite to the surfaces facing the dicing sheet to raise the mold chips attached to the vacuum
5 collet.

Regions including the printing parts on the resin sealing surfaces of the picked-up mold chips were observed, and if necessary, the recessed parts of the printing parts were measured using a micro FT-IR ("Spectrum One" available from
10 PerkinElmer Inc.) to evaluate the printed character visibility in the mold chips in accordance with the criteria below. Results are listed in Table 1.

A: There were no mold chips recognized to deteriorate the visibility of printed characters.

15 B: Some mold chips were recognized to slightly deteriorate the visibility of printed characters, but the majority of mold chips were not recognized to deteriorate the visibility of printed characters. With regard to the mold chips recognized to slightly deteriorate the visibility of printed
20 characters, the recessed parts of the printing parts were measured using the micro FT-IR, but substances identified as materials constituting the pressure sensitive adhesive layer were not confirmed to attach thereto.

C: A number of mold chips were recognized to slightly
25 deteriorate the visibility of printed characters. With regard to the mold chips recognized to slightly deteriorate the visibility of printed characters, the recessed parts of the printing parts were measured using the micro FT-IR, but substances identified as materials constituting the pressure
30 sensitive adhesive layer were not confirmed to attach thereto.

D: Some mold chips were recognized to apparently deteriorate the visibility of printed characters. With regard to the mold chips recognized to apparently deteriorate the

visibility of printed characters, the recessed parts of the printing parts were measured using the micro FT-IR, and substances identified as materials constituting the pressure sensitive adhesive layer were confirmed to attach thereto.

5 [0100]

«Exemplary Test 3» <Measurement of Tack Value>

In a state before being irradiated with energy rays, the surface of the pressure sensitive adhesive layer of the dicing sheet produced in each of the examples and comparative examples was measured using a probe tack tester ("RPT-100" available from RHESCA Co., LTD.) with a probe of a diameter of 5 mm (5 mm ϕ). In the method of measurement, the method described in JIS Z0237:1991 was modified such that the peeling speed was changed to 1 mm/min, but the load was 100 gf/cm² and the contact time was 1 second as defined by the above provision of JIS. The measured energy amount (peak accumulated value) was obtained as a tack value (unit: mJ/5 mm ϕ). Results are listed in Table 1.

[0101]

20 «Exemplary Test 4» <Measurement of Thickness of Pressure Sensitive Adhesive Layer>

One surface of a polyethylene terephthalate film having a thickness of 38 μ m was coated with the pressure sensitive adhesive composition used in each of the examples and comparative examples, and the pressure sensitive adhesive composition was dried to obtain a laminate comprising the film and the pressure sensitive adhesive layer under the same condition as in each of the examples and comparative examples. The thickness of the laminate was measured using a constant-pressure thickness gauge ("PG-02J" available from TECLOCK Corporation) and the thickness of the film was subtracted from the measured value to obtain the thickness (unit: μ m) of the pressure sensitive adhesive layer. Results

are listed in Table 1.

[0102]

«Exemplary Test 5» <Measurement of Elastic Modulus before Irradiation and Elastic Modulus after Irradiation>

5 The release surface of a release film ("SP-PET381031" available from LINTEC Corporation) having a thickness of 38 μm was coated with the pressure sensitive adhesive composition used in each of the examples and comparative examples so that the thickness after drying would be 40 μm , and the obtained
10 laminate comprising the coating film and the release film was maintained at 100°C for 1 minute thereby to dry the coating film. A plurality of the pressure sensitive adhesive layers on the release films obtained through the above procedure was prepared and they were attached to one another to produce a laminate
15 having a thickness of 800 μm . The laminate was punched out into a circular form having a diameter of 10 mm and used as a sample for the measurement. A viscoelasticity measuring apparatus ("ARES" available from TA Instruments) was used to apply a strain to the sample at a frequency of 1 Hz to measure the storage
20 elastic moduli within a range of -50°C to 150°C, and a value of the storage elastic modulus at 23°C was obtained as the elastic modulus before irradiation (unit: kPa). Results are listed in Table 1.

[0103]

25 In a similar manner to the above, a member was obtained in which the pressure sensitive adhesive layer formed of the pressure sensitive adhesive composition used in each of the examples and comparative examples was laminated on a release film. The member was irradiated with ultraviolet rays
30 (illuminance: 230 mW/cm^2 , ultraviolet ray amount: 190 mJ/cm^2) from the side of the release film of the above member in nitrogen atmosphere using an ultraviolet ray irradiation apparatus ("RAD-2000m/12" available from LINTEC Corporation). For the

member after irradiation with ultraviolet rays, the same operation was performed as in the above measurement of the elastic modulus before irradiation, and a value of the storage elastic modulus at 23°C was obtained as the elastic modulus after irradiation (unit: kPa). Results are listed in Table 1.

[0104]

[Table 1]

	Thickness (μm)	Elastic modulus before irradiation (kPa)	Elastic modulus after irradiation (MPa)	Tack value (mJ/5mm Φ)	Chip fly	Printed character visibility
Example 1	10	52.5	27.6	0.21	A	A
Example 2	10	51.2	32.2	0.3	A	B
Example 3	10	52.4	46.6	0.18	A	C
Comparative Example 1	10	54.4	23.5	0.09	B	A
Comparative Example 2	10	51.0	123.4	0.19	A	D
Comparative Example 3	10	54.0	4.85	0.22	A	D
Comparative Example 4	30	52.5	27.6	0.5	A	D
Comparative Example 5	10	48.2	13.2	0.12	B	A
Comparative Example 6	10	81.3	850.2	2.2	A	D

[0105]

As found from Table 1, it can be said that the dicing sheets according to the examples satisfying the condition in the present invention are less likely to cause troubles in the dicing step and the previously-described problem regarding the printed character visibility in the mold chips.

[Industrial Applicability]

[0106]

The dicing sheet according to the present invention can be suitably used as a dicing sheet for a mold package having a printing part on a resin sealing surface as the adherend surface.

[Name of Document] Claims

[Claim 1]

A dicing sheet comprising a base film and a pressure
5 sensitive adhesive layer laminated on at least one surface of
the base film,

the pressure sensitive adhesive layer having a storage
elastic modulus at 23°C of 50 kPa or more and 80 kPa or less
before irradiation with energy rays and 5.0 MPa or more and 120
10 MPa or less after irradiation with energy rays,

the pressure sensitive adhesive layer having a thickness
of less than 20 μm ,

the pressure sensitive adhesive layer having a surface
of which an energy amount before irradiation with energy rays
15 is 0.10 mJ/5 mm ϕ or more and 0.8 mJ/5 mm ϕ or less, the energy
amount being measured using probe tack under a condition in
which a peeling speed is changed to 1 mm/minute in a method as
described in JIS Z0237:1991.

20 [Claim 2]

The dicing sheet as recited in claim 1, wherein,
when the dicing sheet is used, a resin sealing surface
of a mold package is attached to a surface of the pressure
sensitive adhesive layer opposite to the base film, and
25 the resin sealing surface has a printing part formed of
a recessed part.

[Claim 3]

The dicing sheet as recited in claim 2, wherein the
30 recessed part of the printing part on the resin sealing surface
has an average depth of 0.5 μm or more.

[Claim 4]

The dicing sheet as recited in any one of claims 1 to 3,
wherein

the pressure sensitive adhesive layer is formed of a
pressure sensitive adhesive composition that contains an
5 acrylic-based polymer (A) having an energy ray polymerizable
group and a reactive functional group and an isocyanate-based
crosslinker (B) capable of a crosslinking reaction with the
reactive functional group, and

the acrylic-based polymer (A) is obtained by a reaction
10 between an acrylic-based polymer (A1) having the reactive
functional group and an isocyanate-based compound (A2) having
the energy ray polymerizable group under presence of an
organometallic catalyst (C) that contains at least one of
titanium and zirconium.

15

[Claim 5]

The dicing sheet as recited in claim 4, wherein

a mass ratio of a monomer (m1) that gives a constitutional
unit having the reactive functional group of the acrylic-based
20 polymer (A1) to a total monomer that gives the acrylic-based
polymer (A1) is 5 mass% or more and 30 mass% or less, and

a use amount of the compound (A2) in the reaction for
forming the acrylic-based polymer (A) is 0.4 equivalent or more
and 0.8 equivalent or less to the monomer (m1).

25

[Claim 6]

The dicing sheet as recited in claim 4 or 5, wherein the
organometallic catalyst (C) includes a zirconium-containing
chelate compound.

30

[Claim 7]

A method for producing mold chips, comprising:
attaching a surface at a side of the pressure sensitive

adhesive layer of the dicing sheet as recited in any one of claims 1 to 6 to the resin sealing surface of the mold package; and
cutting the mold package on the dicing sheet into individual pieces to obtain a plurality of mold chips.