

[DESCRIPTION]

[TITLE OF INVENTION]

BACK SURFACE PROTECTIVE FILM-FORMING COMPOSITE, METHOD OF
MANUFACTURING FIRST LAMINATE, METHOD OF MANUFACTURING THIRD
5 LAMINATE, AND METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE
EQUIPPED WITH BACK SURFACE PROTECTIVE FILM

[Technical Field]

[0001]

The present invention relates to a back surface protective film-forming
10 composite, a method of manufacturing a first laminate, a method of manufacturing a third
laminate, and a method of manufacturing a semiconductor device equipped with a back
surface protective film.

The present application claims priority on Japanese Patent Application No.
2020-028103, filed February 21, 2020, the contents of which are incorporated herein by
15 reference.

[Background Art]

[0002]

In recent years, semiconductor devices have been manufactured by employing a
mounting method called the “face down method”. In the face down method, a
20 semiconductor chip having an electrode, such as a bump, on a circuit surface is used, and
the electrode is bonded to a substrate. Consequently, there may be a case where the
back surface of the semiconductor chip opposite to the circuit surface is exposed.

[0003]

On the exposed back surface of the semiconductor chip, a resin film containing
25 an organic material may be formed as a back surface protective film, and the

semiconductor chip with a back surface protective film may be incorporated into a semiconductor device. The back surface protective film is utilized to prevent the occurrence of a crack in the semiconductor chip after dicing process or packaging (e.g., Patent Documents 1 and 2).

5 [0004]

Such a semiconductor chip with a back surface protective film is manufactured, for example, through the steps illustrated in Figs. 1A to 1G. That is, a method is known in which a back surface protective film-forming film 13 is laminated on a back surface 8b of a semiconductor wafer 8 (also referred to as a “semiconductor substrate”) having a circuit surface (Fig. 1A), the back surface protective film-forming film 13 is thermally cured or cured with energy rays to form a back surface protective film 13' (Fig. 1B), a laser marking is created on the back surface protective film 13' (Fig. 1C), a support sheet 10 is laminated on the back surface protective film 13' (Fig. 1D), the semiconductor wafer 8 and the back surface protective film 13' are diced to form a semiconductor chip 7 equipped with a back surface protective film (Fig. 1E and Fig. 1F), and the semiconductor chip 7 with the back surface protective film is picked up from the support sheet 10.

[Citation List]

[Patent Literature]

20 [0005]

Patent Document 1: Japanese Patent Granted Publication No. 4271597

Patent Document 2: Japanese Patent Granted Publication No. 5363662

[Summary of Invention]

[Problems to be Solved by the Invention]

25 [0006]

The laminate obtained in the lamination step in Fig. 1A is conveyed to a curing step illustrated in Fig. 1B, in which the back surface protective film-forming film 13 is thermally cured or cured with energy rays to form a back surface protective film 13'.

When the lamination step and the curing step are implemented with separate devices, the laminate obtained in the lamination step is conveyed in a state where a suctioning surface of a conveyance arm, the suctioning surface having suctioning holes, is suctioned to a film surface for forming a back surface protective film of the laminate, and the laminate is kept in a cassette and conveyed to the curing step. In this case, the back surface protective film-forming film may be contaminated or deformed while kept in the cassette and conveyed with the conveyance arm.

[0007]

If the lamination step and the curing step are implemented with a device for affixing a back surface protective film-forming film coupled to a device for curing the back surface protective film-forming film, the laminate obtained by the device that affixes the back surface protective film-forming film must be conveyed to the device for curing the back surface protective film-forming film, and the back surface protective film-forming film is liable to be contaminated or deformed while being conveyed.

[0008]

In a case where the steps from the lamination step to the curing step are implemented by the same device, for example, the steps can be implemented by a device provided with a table for affixing the back surface protective film-forming film, a curing unit, and a conveyance arm. Specifically, a workpiece (also referred to as a “semiconductor substrate”) inserted into the device is conveyed by the conveyance arm to the table for affixing the back surface protective film-forming film, and a back surface protective film-forming film, which has been processed to a size conforming to the

workpiece, either outside of the device in advance or inside of the device immediately prior thereto, is affixed to the back surface side of the workpiece, forming a laminate.

[0009]

The suctioning surface having the suctioning holes of the conveyance arm is
5 suctioned to the surface of the back surface protective film-forming film of the laminate, and the laminate is conveyed to the curing unit. Heat is applied to the laminate conveyed to the curing unit, or the laminate is irradiated with energy rays, and the back surface protective film-forming film becomes a back surface protective film.

[0010]

10 When the inventor of the present application observed the surface of the back surface protective film-forming film after the film had been conveyed by the conveyance arm, it was found that deformation (unevenness) attributed to the suctioning holes of the conveyance arm occurred. In addition, there is a possibility that debris and dust may adhere to and contaminate the back surface protective film-forming film during
15 conveyance. When deformation (unevenness) or the adherence of debris and dust occur as described above, the reliability of a semiconductor device is liable to decrease, which is disadvantageous.

[0011]

In light of the foregoing circumstances, an object of the present invention is to
20 provide: a back surface protective film-forming composite; a method of manufacturing a first laminate, in which the back surface protective film-forming composite is used; a method of manufacturing a third laminate; and a method of manufacturing a semiconductor device equipped with a back surface protective film, whereby, in the method of manufacturing a semiconductor device equipped with a back surface
25 protective film, contamination and deformation of the back surface protective film-

forming film can be prevented when a back surface protective film-forming film is affixed to the back surface of a semiconductor substrate and then conveyed.

[Means to Solve the Problems]

[0012]

5 To solve the problems described above, the present invention includes the following aspects.

 [1] A back surface protective film-forming composite including a protection layer and a back surface protective film-forming film, the protection layer and the back surface protective film-forming film being laminated, the back surface protective film-forming composite for use in a method of manufacturing a first laminate, the method including: a first lamination step of affixing the back surface protective film-forming film to a back surface of a semiconductor substrate to obtain a second laminate, the second laminate including the semiconductor substrate, the back surface protective film-forming film, and the protection layer, which are laminated in this order; a curing step of curing the back surface protective film-forming film of the second laminate to form a back surface protective film; and a conveyance step of conveying the second laminate from the first lamination step to the curing step, and wherein the first laminate includes the semiconductor substrate, the back surface protective film, and the protection layer, which are laminated in this order.

20 [2] A back surface protective film-forming composite including a protection layer and a back surface protective film-forming film, the protection layer and the back surface protective film-forming film being laminated, the back surface protective film-forming composite for use in a method of manufacturing a third laminate, the method including: a first lamination step of affixing the back surface protective film-forming film to a back surface of a semiconductor substrate to obtain a second laminate, the second

25

lamine including the semiconductor substrate, the back surface protective film-forming film, and the protection layer, which are laminated in this order; a second lamination step of affixing a support sheet to the protection layer of the second lamine to obtain a third lamine, the third lamine including the semiconductor substrate, the back surface
5 protective film-forming film, the protection layer, and the support sheet, which are laminated in this order; and a conveyance step of conveying the second lamine from the first lamination step to the second lamination step.

[3] A method of manufacturing a first lamine, the first lamine including a semiconductor substrate, a back surface protective film, and a protection layer, which are
10 laminated in this order, the method including: a first lamination step of affixing the back surface protective film-forming film of the back surface protective film-forming composite described in [1] to a back surface of the semiconductor substrate to obtain a second lamine, the second lamine including the semiconductor substrate, the back surface protective film-forming film, and the protection layer, which are laminated in this
15 order; a curing step of curing the back surface protective film-forming film of the second lamine to form a back surface protective film; and a conveyance step of conveying the second lamine from the first lamination step to the curing step.

[4] A method of manufacturing a third lamine, the third lamine including a semiconductor substrate, a back surface protective film-forming film, a protection layer,
20 and a support sheet, which are laminated in this order, the method including: a first lamination step of affixing the back surface protective film-forming film of the back surface protective film-forming composite described in [2] to a back surface of the semiconductor substrate to obtain a second lamine, the second lamine including the semiconductor substrate, the back surface protective film-forming film, and the
25 protection layer, which are laminated in this order; a second lamination step of affixing a

support sheet to the protection layer of the second laminate to obtain a third laminate, the third laminate including the semiconductor substrate, the back surface protective film-forming film, the protection layer, and the support sheet, which are laminated in this order; and a conveyance step of conveying the second laminate from the first lamination
5 step to the second lamination step.

[5] A method of manufacturing a semiconductor device equipped with a back surface protective film, the method including: a second lamination step of affixing a support sheet to the protection layer of a first laminate manufactured by the manufacturing method described in [3] to obtain a fourth laminate, the fourth laminate
10 including the semiconductor substrate, the back surface protective film, the protection layer, and the support sheet, which are laminated in this order; a step of dicing the semiconductor substrate and the back surface protective film of the fourth laminate to form a semiconductor device equipped with a back surface protective film; and a step of picking up the semiconductor device equipped with a back surface protective film from
15 the support sheet.

[6] A method of manufacturing a semiconductor device equipped with a back surface protective film, the method including: a curing step of curing the back surface protective film-forming film of a third laminate manufactured by the manufacturing method described in [4] to form a back surface protective film to obtain a fourth
20 laminate, the fourth laminate including the semiconductor substrate, the back surface protective film, the protection layer, and the support sheet, which are laminated in this order; a step of dicing the semiconductor substrate and the back surface protective film of the fourth laminate to form a semiconductor device equipped with a back surface protective film; and a step of picking up the semiconductor device equipped with a back
25 surface protective film from the support sheet.

[7] A method of manufacturing a semiconductor device equipped with a back surface protective film, the method including: a step of dicing the semiconductor substrate and the back surface protective film-forming film of the third laminate manufactured by the manufacturing method described in [4] to form a semiconductor device equipped with a back surface protective film-forming film; a curing step of curing the back surface protective film-forming film to form a back surface protective film; and a step of picking up the semiconductor equipped with a back surface protective film-forming film or a semiconductor device equipped with a back surface protective film from the support sheet.

10 [0013]

[8] A use of the back surface protective film-forming composite described in [1] or [2] for forming a back surface protective film.

[9] The back surface protective film-forming composite according to [1] or [2], the manufacturing method according to any of [3] to [7], or the use according to [8],
15 wherein the back surface protective film-forming film is formed by an uncured curable resin composition, and the protection layer is formed from a curable resin or thermoplastic resin that has been cured.

[Advantageous Effects of Invention]

[0014]

20 According to the present invention, provided are: a back surface protective film-forming composite; a method of manufacturing a first laminate, in which the back surface protective film-forming composite is used; a method of manufacturing a third laminate; and a method of manufacturing a semiconductor device equipped with a back surface protective film, whereby, in the method of manufacturing a semiconductor device
25 equipped with a back surface protective film, contamination and deformation of the back

surface protective film-forming film can be prevented when a back surface protective film-forming film is affixed to the back surface of a workpiece and then conveyed.

[Brief Description of Drawings]

[0015]

5 Fig. 1A is a schematic cross-sectional view schematically illustrating a portion of a process in an example of a conventional method of manufacturing a semiconductor chip equipped with a back surface protective film.

 Fig. 1B is a schematic cross-sectional view schematically illustrating a portion of a process in an example of a conventional method of manufacturing a semiconductor
10 chip equipped with a back surface protective film.

 Fig. 1C is a schematic cross-sectional view schematically illustrating a portion of a process in an example of a conventional method of manufacturing a semiconductor chip equipped with a back surface protective film.

 Fig. 1D is a schematic cross-sectional view schematically illustrating a portion
15 of a process in an example of a conventional method of manufacturing a semiconductor chip equipped with a back surface protective film.

 Fig. 1E is a schematic cross-sectional view schematically illustrating a portion of a process in an example of a conventional method of manufacturing a semiconductor chip equipped with a back surface protective film.

20 Fig. 1F is a schematic cross-sectional view schematically illustrating a portion of a process in an example of a conventional method of manufacturing a semiconductor chip equipped with a back surface protective film.

 Fig. 1G is a schematic cross-sectional view schematically illustrating a portion of a process in an example of a conventional method of manufacturing a semiconductor
25 chip equipped with a back surface protective film.

Fig. 2 is a schematic cross-sectional view illustrating an example of a back surface protective film-forming composite.

Fig. 3 is a schematic cross-sectional view illustrating an example of a back surface protective film-forming composite.

5 Fig. 4A is a schematic cross-sectional view schematically illustrating a portion of a process in an example of an embodiment of a method of manufacturing a first laminate.

 Fig. 4B is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a first
10 laminate.

 Fig. 4C is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a first laminate.

 Fig. 4D is a schematic cross-sectional view schematically illustrating a portion
15 of a process in the example of an embodiment of a method of manufacturing a first laminate.

 Fig. 5A is a schematic cross-sectional view schematically illustrating a portion of a process in an example of an embodiment of a method of manufacturing a first laminate.

20 Fig. 5B is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a first laminate.

 Fig. 5C is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a first
25 laminate.

Fig. 5D is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a first laminate.

5 Fig. 5E is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a first laminate.

Fig. 6A is a schematic cross-sectional view schematically illustrating a portion of a process in an example of an embodiment of a method of manufacturing a third laminate.

10 Fig. 6B is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a third laminate.

15 Fig. 6C is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a third laminate.

Fig. 6D is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a third laminate.

20 Fig. 6E is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a third laminate.

Fig. 7A is a schematic cross-sectional view schematically illustrating a portion of a process in an example of an embodiment of a method of manufacturing a third laminate.

Fig. 7B is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a third laminate.

Fig. 7C is a schematic cross-sectional view schematically illustrating a portion
5 of a process in the example of an embodiment of a method of manufacturing a third laminate.

Fig. 7D is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a third laminate.

10 Fig. 7E is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a third laminate.

Fig. 7F is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a third
15 laminate.

Fig. 8 is a schematic cross-sectional view illustrating an example of a support sheet 10 provided with a pressure sensitive adhesive layer 102 on a base material 101.

Fig. 9 is a schematic cross-sectional view illustrating an example of a back surface protective film-forming composite.

20 Fig. 10A is a schematic cross-sectional view schematically illustrating a portion of a process in an example of an embodiment of a method of manufacturing a fourth laminate.

Fig. 10B is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a fourth
25 laminate.

Fig. 10C is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a fourth laminate.

Fig. 11A is a schematic cross-sectional view schematically illustrating a portion
5 of a process in another example of an embodiment of a method of manufacturing a fourth laminate.

Fig. 11B is a schematic cross-sectional view schematically illustrating a portion of a process in the other example of an embodiment of a method of manufacturing a fourth laminate.

10 Fig. 11C is a schematic cross-sectional view schematically illustrating a portion of a process in the other example of an embodiment of a method of manufacturing a fourth laminate.

Fig. 12A is a schematic cross-sectional view schematically illustrating a portion of a process in an example of an embodiment of a method of manufacturing a
15 semiconductor device equipped with a back surface protective film.

Fig. 12B is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 12C is a schematic cross-sectional view schematically illustrating a portion
20 of a process in the example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 12D is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 12E is a schematic cross-sectional view schematically illustrating a portion of a process in the example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 13A is a schematic cross-sectional view schematically illustrating a portion of a process in another example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 13B is a schematic cross-sectional view schematically illustrating a portion of a process in the other example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 13C is a schematic cross-sectional view schematically illustrating a portion of a process in the other example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 14A is a schematic cross-sectional view schematically illustrating a portion of a process in another example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 14B is a schematic cross-sectional view schematically illustrating a portion of a process in the other example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 14C is a schematic cross-sectional view schematically illustrating a portion of a process in the other example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

Fig. 14D is a schematic cross-sectional view schematically illustrating a portion of a process in the other example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film.

[Description of Embodiments]

[0016]

Fig. 2 is a cross-sectional view schematically illustrating an embodiment of a back surface protective film-forming composite of the present invention.

Fig. 3 is a cross-sectional view schematically illustrating another embodiment of the back surface protective film-forming composite of the present invention.

In the drawings used in the following descriptions, to clarify features, characteristic portions may be enlarged for convenience, and the size ratio or the like of each component is not necessarily the same as that of an actual embodiment.

[0017]

A back surface protective film-forming composite 1 illustrated in Fig. 2 includes a protection layer 12 and a back surface protective film-forming film 13 in this order.

[0018]

The back surface protective film-forming composite 1 according to the present embodiment is used in a method of manufacturing a third laminate, the method including: a first lamination step of affixing the back surface protective film-forming film 13 to a back surface of a workpiece to obtain a second laminate, the second laminate including the workpiece, the back surface protective film-forming film 13, and the protection layer 12, which are laminated in this order; a second lamination step of affixing a support sheet to the protection layer 12 of the second laminate to obtain a third laminate, the third laminate including the workpiece, the back surface protective film-forming film 13, the protection layer 12, and the support sheet, which are laminated in this order; and a conveyance step of conveying the second laminate from the first lamination step to the second lamination step. The back surface protective film-forming composite 1 according to the present embodiment includes the protection layer 12, and

thereby can prevent contamination and deformation of the back surface protective film-forming film 13 (before curing) in the conveyance step.

[0019]

Furthermore, the back surface protective film-forming composite 1 according to
5 the present embodiment is used in a method of manufacturing a first laminate, the
method including: a first lamination step of affixing a back surface protective film-
forming film 13 to a back surface of a workpiece to obtain a second laminate, the second
laminate including the workpiece, the back surface protective film-forming film 13, and
the protection layer 12, which are laminated in this order; a curing step of curing the back
10 surface protective film-forming film 13 of the second laminate to form a back surface
protective film; and a conveyance step of conveying the second laminate from the first
lamination step to the curing step, and where the first laminate includes the workpiece,
the back surface protective film, and the protection layer 12, which are laminated in this
order. The back surface protective film-forming composite 1 according to the present
15 embodiment includes the protection layer 12, and thereby can prevent contamination and
deformation of the back surface protective film-forming film 13 (before curing) in the
conveyance step.

[0020]

A back surface protective film-forming composite 2 illustrated in Fig. 3 includes
20 a release film 151, a protection layer 12, and a back surface protective film-forming film
13, in this order.

[0021]

The back surface protective film-forming composite 2 according to the present
embodiment is used in a method of manufacturing a third laminate, the method
25 including: a first lamination step of affixing the back surface protective film-forming film

13 to a back surface of a workpiece to obtain a fifth laminate, the fifth laminate including the workpiece, the back surface protective film-forming film 13, the protection layer 12, and the release film 151, which are laminated in this order; a second lamination step of affixing a support sheet to the protection layer 12 of the second laminate obtained by
5 detaching the release film 151 from the fifth laminate to obtain the third laminate; and a conveyance step of conveying the second laminate from the first lamination step to the second lamination step. The back surface protective film-forming composite 2 according to the present embodiment includes the protection layer 12, and thereby can prevent contamination and deformation of the back surface protective film-forming film
10 13 (before curing) in the conveyance step.

[0022]

The back surface protective film-forming composite 2 according to the present embodiment is also used in a method of manufacturing the first laminate, the method including: a first lamination step of affixing a back surface protective film-forming film
15 13 to a back surface of a workpiece to obtain a fifth laminate, the fifth laminate including the workpiece, the back surface protective film-forming film 13, a protection layer 12, and a release film 151, which are laminated in this order; a curing step of curing the back surface protective film-forming film 13 of the second laminate obtained by detaching the release film 151 from the fifth laminate to form a back surface protective film; and a
20 conveyance step of conveying the second laminate from the first lamination step to the curing step. The back surface protective film-forming composite 2 according to the present embodiment includes the protection layer 12, and thereby can prevent contamination and deformation of the back surface protective film-forming film 13 (before curing) in the conveyance step.

25 [0023]

The back surface protective film-forming composite 1 and the back surface protective film-forming composite 2 according to the present embodiment are particularly preferably used in a method of manufacturing the third laminate, in which at least the process from the first lamination step to the second lamination step is implemented by a device that affixes the back surface protective film-forming film, the device being coupled with a device that affixes the support sheet, or is implemented by the same device.

[0024]

Additionally, the back surface protective film-forming composite 1 and the back surface protective film-forming composite 2 according to the present embodiment are preferably used in a method of manufacturing a first laminate, in which at least the process from the first lamination step to the curing step is implemented by a device that affixes the back surface protective film-forming film, the device being coupled with a device that cures the back surface protective film-forming film, or is implemented by the same device.

[0025]

The thickness of the back surface protective film-forming composite 1 is not particularly limited, but is preferably from 30 to 550 μm , more preferably from 35 to 450 μm , and even more preferably from 40 to 400 μm . When the thickness of the back surface protective film-forming composite 1 is equal to or greater than the lower limit described above, the strength of the back surface protective film is increased. When the thickness of the back surface protective film-forming composite 1 is not greater than the upper limit described above, the back surface protective film is easily diced.

The thickness of the back surface protective film-forming composite 2 is not particularly limited, but is preferably from 30 to 550 μm , more preferably from 35 to 450

μm, and even more preferably from 40 to 400 μm. When the thickness of the back surface protective film-forming composite 2 is equal to or greater than the lower limit described above, the strength of the back surface protective film is increased. When the thickness of the back surface protective film-forming composite 2 is not greater than the upper limit described above, the back surface protective film is easily diced.

[0026]

Next, each layer configuring the back surface protective film-forming composite of the present embodiment will be described.

[0027]

10 ○ Film for forming back surface protective film

In the back surface protective film-forming composite according to the present embodiment, the back surface protective film-forming film is affixed to a wafer (i.e., a workpiece) and cured, and is thereby used as a back surface protective film of the wafer. The back surface protective film-forming film is curable, and may be an energy curable film or a thermosetting film.

[0028]

Herein, “energy ray-curable” refers to a property of curing by irradiation with energy rays, and “thermosetting” refers to a property curing through the application of heat.

20 [0029]

In the present specification, “energy rays” means electromagnetic waves or charged particle beams having energy quanta. Examples of the energy rays include ultraviolet light, radioactive rays, and electron beams. The ultraviolet light can be irradiated by using, for example, a high-pressure mercury lamp, a fusion lamp, a xenon

lamp, a black light, or an LED lamp as an ultraviolet ray source. The electron beam can be generated by an electron beam accelerator or the like and irradiated.

[0030]

The thickness of the back surface protective film-forming film is not particularly limited, but is preferably from 3 to 300 μm , more preferably from 5 to 250 μm , and even more preferably from 7 to 200 μm . When the thickness of the back surface protective film-forming film is equal to or greater than the lower limit described above, the strength of the back surface protective film is further enhanced. When the thickness of the back surface protective film-forming film is not greater than the upper limit value described above, the back surface protective film is easily diced.

[0031]

Back surface protective film-forming composition

The composition of the back surface protective film-forming composition for forming the back surface protective film-forming film preferably contains a binder polymer component and a curable component. In other words, the back surface protective film-forming composition is a curable resin composition (that is uncured), and the back surface protective film-forming film is preferably formed of such a curable resin composition.

[0032]

Binder polymer component

The binder polymer component is used to impart sufficient adhesiveness and film formability (sheet formability) to the back surface protective film-forming film. For the binder polymer component, a polymer known in the art, such as an acrylic polymer, a polyester resin, a urethane resin, an acrylic urethane resin, a silicone resin, or a rubber polymer, can be used.

[0033]

The weight average molecular weight (M_w) of the binder polymer component is preferably from 10000 to 2000000 and more preferably from 100000 to 1200000. With an extremely low weight average molecular weight of the binder polymer component, the adhesive strength between the back surface protective film-forming film and the support sheet would increase, and this may cause transfer failure of the back surface protective film-forming film, while with an extremely high weight average molecular weight, the adhesiveness of the back surface protective film-forming film would decrease, and the back surface protective film-forming film may fail to be transferred to a chip or the like or may peel off from a chip or the like after transfer. That is, when the weight average molecular weight of the binder polymer component is equal to or greater than the lower limit described above, the matter of the adhesive strength between the back surface protective film-forming film and the support sheet increasing and a transfer failure of the back surface protective film-forming film occurring can be suppressed. When the weight average molecular weight of the binder polymer component is equal to or less than the upper limit described above, the matter of the adhesiveness of the back surface protective film-forming film decreasing, making it impossible to transfer the back surface protective film-forming film to a chip or the like can be suppressed. In addition, when the weight average molecular weight of the binder polymer component is not greater than the upper limit described above, peeling of the back surface protective film from the chip or the like after the transfer can be suppressed.

In the present specification, unless otherwise noted, the “weight average molecular weight” is the weight average molecular weight of a standard polystyrene equivalent value measured by gel permeation chromatography (GPC).

25 [0034]

An acrylic polymer is preferably used as the binder polymer component. The glass transition temperature (T_g) of the acrylic polymer is in a range preferably of -60 to 50°C, more preferably of -50 to 40°C, and particularly preferably of -40 to 30°C. In a case of the acrylic polymer having an extremely low glass transition temperature, the release strength between the back surface protective film-forming film and the support sheet would increase, and this may cause transfer failure of the back surface protective film-forming film, while in a case of the acrylic polymer having an extremely high glass transition temperature, the adhesion of the back surface protective film-forming film would decrease, and the back surface protective film-forming film may fail to be transferred to a chip or the like or may peel off from a chip or the like after transfer. That is, when the glass transition temperature of the acrylic polymer is equal to or greater than the lower limit described above, the issue caused by the increase of the release strength between the support sheet and the back surface protective film-forming film, which results in a transfer failure of the back surface protective film-forming film, can be suppressed. When the glass transition temperature of the acrylic polymer is equal to or less than the upper limit described above, the issue of the adhesiveness of the back surface protective film-forming film decreasing, making it difficult to transfer the back surface protective film-forming film to a chip or the like can be suppressed. In addition, when the glass transition temperature of the acrylic polymer is equal to or less than the upper limit described above, peeling of the back surface protective film from the chip or the like after the transfer can be suppressed.

The glass transition temperature of the acrylic polymer is determined, for example, through differential scanning calorimetry (DSC).

[0035]

Examples of the monomers constituting the acrylic polymer include

(meth)acrylate monomers or their derivatives. Examples include alkyl(meth)acrylates with an alkyl group having from 1 to 18 carbon atoms, specifically methyl(meth)acrylate, ethyl(meth)acrylate, propyl(meth)acrylate, butyl(meth)acrylate, and 2-

5 ethylhexyl(meth)acrylate. In addition, examples include (meth)acrylates having a cyclic backbone, specifically cyclohexyl(meth)acrylate, benzyl(meth)acrylate, isobornyl(meth)acrylate, dicyclopentanyl(meth)acrylate, dicyclopentenyl(meth)acrylate, dicyclopentenylxyethyl(meth)acrylate, and imide(meth)acrylate. Furthermore, examples of the monomer having a functional group include

10 hydroxymethyl(meth)acrylate, 2-hydroxyethyl(meth)acrylate, and 2-hydroxypropyl(meth)acrylate, which have a hydroxyl group; and in addition, glycidyl(meth)acrylate, which has an epoxy group. The acrylic polymer is preferably an acrylic polymer containing a monomer having a hydroxyl group because of good compatibility with the curable component described later. In addition, the acrylic
15 polymer may be a polymer copolymerized with acrylic acid, methacrylic acid, itaconic acid, vinyl acetate, acrylonitrile, styrene, or the like.

[0036]

In the present specification, “(meth)acrylic acid” is a concept encompassing both “acrylic acid” and “methacrylic acid”. The same applies to terms similar to

20 (meth)acrylic acid, and, for example, “(meth)acrylate” is a concept encompassing both “acrylate” and “methacrylate”, and a “(meth)acryloyl group” is a concept encompassing both an “acryloyl group” and a “methacryloyl group”.

[0037]

Furthermore, a thermoplastic resin may be contained as a binder polymer

25 component to retain the flexibility of the back surface protective film after curing. Such

a thermoplastic resin has a weight average molecular weight preferably from 1000 to 100000 and more preferably of 3000 to 80000. The glass transition temperature of the thermoplastic resin is preferably from -30 to 120°C and more preferably from -20 to 120°C. Examples of the thermoplastic resin include polyester resins, thermoplastic urethane resins, phenoxy resins, polybutenes, polybutadienes, and polystyrenes. One of these thermoplastic resins can be used alone, or two or more can be mixed and used. Containing the thermoplastic resin described above allows the back surface protective film-forming film to conform to a transfer surface of the back surface protective film-forming film and can prevent the occurrence of a void or the like.

10 [0038]

Curable component

One or more components selected from the thermosetting components and the energy ray-curable components are used as the curable component.

[0039]

15 For the thermosetting components, a thermosetting resin and a thermosetting agent are used. The thermosetting resin is, for example, preferably an epoxy resin.

[0040]

For the epoxy resin, an epoxy resin known in the art can be used. Examples of the epoxy resin specifically include epoxy compounds having two or more functional groups in the molecule, such as multifunctional epoxy resins, biphenyl compounds, bisphenol A diglycidyl ethers and their hydrogenated products, ortho-cresol novolac epoxy resins, dicyclopentadiene-type epoxy resins, biphenyl-type epoxy resins, bisphenol A-type epoxy resins, bisphenol F-type epoxy resins, and phenylene backbone-type epoxy resins. One of these epoxy resins can be used alone, or two or more can be used in combination.

20

25

[0041]

The back surface protective film-forming film contains a thermosetting resin at an amount of preferably from 1 to 1000 parts by mass, more preferably from 10 to 500 parts by mass, and particularly preferably from 20 to 200 parts by mass relative to 100 parts by mass of the binder polymer component. When the content of the thermosetting resin is less than 1 part by mass, sufficient adhesiveness may not be obtained, whereas when the content of the thermosetting resin exceeds 1000 parts by mass, the release strength between the back surface protective film-forming film and a pressure sensitive adhesive (PSA) sheet or a base material film increases and may cause a transfer failure of the back surface protective film-forming film. That is, when the content of the thermosetting resin is equal to or greater than the lower limit described above, sufficient adhesiveness can be obtained. When the content of the thermosetting resin is equal to or less than the upper limit described above, the matter of the release strength between the back surface protective film-forming film and a PSA sheet or a base material film increasing and causing a transfer failure of the back surface protective film-forming film can be suppressed.

[0042]

The thermosetting agent functions as a curing agent for the thermosetting resin, and particularly for an epoxy resin. Examples of the preferred thermosetting agent include compounds having two or more functional groups reactive with an epoxy group per molecule. Examples of the functional group include a phenolic hydroxyl group, an alcoholic hydroxyl group, an amino group, a carboxyl group, and an acid anhydride. Of these, examples preferably include a phenolic hydroxyl group, an amino group, and an acid anhydride, and more preferably include a phenol hydroxyl group and an amino group.

[0043]

Specific examples of the phenolic curing agent include multifunctional phenolic resins, biphenol, novolac-type phenolic resins, dicyclopentadiene phenolic resins, Xylok-type phenolic resins, and aralkyl phenolic resins. Specific examples of the amine curing agent include dicyandiamide (DICY). One of these can be used alone, or two or more can be mixed and used.

[0044]

The content of the thermosetting agent is preferably from 0.1 to 500 parts by mass and more preferably from 1 to 200 parts by mass relative to 100 parts by mass of the thermosetting resin. With a small content of the thermosetting agent, the back surface protective film-forming film may fail to have sufficient adhesiveness because of insufficient curing, while with an excessive amount of the thermosetting agent, the back surface protective film-forming film would have an increased moisture absorption rate, and this may reduce the reliability of the semiconductor device. That is, when the content of the thermosetting agent is equal to or greater than the lower limit described above, the thermosetting resin is sufficiently cured, and sufficient adhesiveness can be obtained. When the content of the thermosetting agent is equal to or less than the upper limit described above, the matter of an increase in the moisture absorption rate and a reduction in the reliability of the semiconductor device can be suppressed.

[0045]

For the energy ray-curable component, a low molecular compound (energy ray-polymerizable compound) that contains an energy ray-polymerizable group and polymerizes and cures upon irradiation with energy rays, such as ultraviolet light or an electron beam, can be used. Specific examples of such an energy ray-curable component include acrylate-based compounds, such as trimethylolpropane triacrylate,

pentaerythritol triacrylate, pentaerythritol tetra-acrylate, dipentaerythritol monohydroxy penta-acrylate, dipentaerythritol hexaacrylate or 1,4-butylene glycol diacrylate, 1,6-hexanediol diacrylate, polyethylene glycol diacrylate, oligoester acrylate, urethane acrylate-based oligomers, epoxy-modified acrylates, polyether acrylate, and itaconic acid oligomers. Such compounds have at least one polymerizable double bond in the molecule and have a weight average molecular weight typically from 100 to 30000 and preferably from approximately 300 to 10000. The blending amount of the energy ray-polymerizable compound is preferably from 1 to 1500 parts by mass, more preferably from 10 to 500 parts by mass, and particularly preferably from 20 to 200 parts by mass relative to 100 parts by mass of the binder polymer component.

[0046]

In addition, as the energy ray-curable component, an energy ray-curable polymer in which an energy ray-polymerizable group is bonded to a main chain or side chain of the binder polymer component may be used. Such an energy ray-curable polymer has both functions as a binder polymer component and as a curable component.

[0047]

The main backbone of the energy ray-curable polymer is not particularly limited and may be an acrylic polymer widely used as a binder polymer component, or may be a polyester, polyether, or the like. However, the energy ray-curable polymer particularly preferably includes an acrylic polymer as the main backbone because of the ease of controlling the synthesis and physical properties.

[0048]

The energy ray-polymerizable group bonded to a main chain or side chain of the energy ray-curable polymer is, for example, a group containing an energy ray-polymerizable carbon-carbon double bond and is specifically exemplified by a

(meth)acryloyl group. The energy ray-polymerizable group may be a group bonded to the energy ray-curable polymer via an alkylene group, an alkyleneoxy group, or a polyalkyleneoxy group.

[0049]

5 The weight average molecular weight (Mw) of the energy ray-curable polymer to which the energy ray-polymerizable group is bonded is preferably from 10000 to 2000000 and more preferably from 100000 to 1500000. In addition, the glass transition temperature (Tg) of the energy ray-curable polymer is in a range preferably from -60 to 50°C, more preferably from -50 to 40°C, and particularly preferably from -40 to 30°C.

10 [0050]

 The energy ray-curable polymer is obtained, for example, by reacting an acrylic polymer containing a functional group, such as a hydroxyl group, a carboxyl group, an amino group, a substituted amino group, or an epoxy group, with a polymerizable group-containing compound that reacts with the functional group thereof. Examples of the
15 polymerizable group-containing compound include compounds having a substituent that reacts with the functional group described above and an energy ray-polymerizable carbon-carbon double bond per molecule at quantity from 1 to 5. Examples of the substituent that reacts with the functional group include an isocyanate group, a glycidyl group, and a carboxyl group.

20 [0051]

 Examples of the polymerizable group-containing compound include (meth)acryloyloxyethyl isocyanate, meta-isopropenyl- α,α -dimethylbenzyl isocyanate, (meth)acryloyl isocyanate, allyl isocyanate, glycidyl(meth)acrylate, and (meth)acrylic acid.

25 [0052]

The acrylic polymer is preferably a copolymer formed from a (meth)acrylic monomer or a derivative thereof, having a functional group, such as a hydroxyl group, a carboxyl group, an amino group, a substituted amino group, or an epoxy group, and another (meth)acrylate monomer or a derivative thereof, copolymerizable with the monomer described above.

[0053]

Examples of the (meth)acrylic monomer or derivative thereof, having a functional group, such as a hydroxyl group, a carboxyl group, an amino group, a substituted amino group, or an epoxy group include 2-hydroxyethyl (meth)acrylate and 2-hydroxypropyl (meth)acrylate, which have a hydroxyl group; acrylic acid, methacrylic acid, and itaconic acid, which have a carboxyl group; and glycidyl methacrylate and glycidyl acrylate, which have an epoxy group.

[0054]

Examples of the other (meth)acrylate monomer or derivative thereof, copolymerizable with the monomer described above include alkyl(meth)acrylates with an alkyl group having from 1 to 18 carbons, specifically methyl(meth)acrylate, ethyl(meth)acrylate, propyl(meth)acrylate, butyl(meth)acrylate, and 2-ethylhexyl(meth)acrylate; (meth)acrylates having a cyclic backbone, specifically cyclohexyl(meth)acrylate, benzyl(meth)acrylate, isobornyl acrylate, dicyclopentanyl acrylate, dicyclopentenyl acrylate, dicyclopentenylloxyethyl acrylate, and imide acrylate. In addition, the acrylic polymer may be a polymer copolymerized with vinyl acetate, acrylonitrile, styrene, or the like.

[0055]

Even when an energy ray-curable polymer is used, the energy ray-polymerizable compound described above may be used in combination, and the binder polymer

component may be used in combination. The relationship between the blended amounts of these three compounds in the back surface protective film-forming film in the present embodiment is such that the content of the energy ray-polymerizable compound is preferably from 1 to 1500 parts by mass, more preferably from 10 to 500 parts by mass, and particularly preferably from 20 to 200 parts by mass relative to 100 parts by mass of the sum of the masses of the energy ray-curable polymer and the binder polymer component. When the content of the energy ray-polymerizable compound is within the numerical ranges described above, the curability of the back surface protective film-forming composition is further enhanced.

10 [0056]

When the thermosetting component and the energy ray-curable component are used in combination, the mass ratio of the thermosetting component to the energy ray-curable component is, for example, preferably from 5:95 to 95:5, more preferably from 10:90 to 90:10, and even more preferably from 15:85 to 85:15. When the mass ratio of the thermosetting component and the energy ray-curable component is within the numerical ranges described above, the curability of the back surface protective film-forming composition is further enhanced.

[0057]

Imparting energy ray-curability to the back surface protective film-forming film allows the back surface protective film-forming film to be easily cured in a short amount of time, thereby improving the production efficiency of chips equipped with a back surface protective film. The energy ray-curable back surface protective film-forming film is cured in a short amount of time by irradiation with energy rays, and thus can easily form the back surface protective film and contribute to improved production efficiency.

[0058]

The back surface protective film-forming film can contain a below-described component in addition to the binder polymer component and the curable component.

[0059]

5 Colorant

The back surface protective film-forming film preferably contains a colorant.

When a colorant is blended into the film for forming back surface protective film, and a semiconductor device with the back surface protective film is incorporated into a device, the back surface protective film containing the colorant blocks infrared light or the like
10 generated from a surrounding device and can prevent a malfunction of the semiconductor device caused by the infrared light or the like. In addition, blending a colorant into the back surface protective film-forming film improves visibility of text when a product number or the like is printed on the back surface protective film obtained by curing the back surface protective film-forming film. That is, in a semiconductor device or
15 semiconductor chip on which a back surface protective film is formed, a product number or the like is printed onto the surface of the back surface protective film typically by a laser marking method (a method of printing by scraping the surface of the back surface protective film with laser light), and when the back surface protective film contains a colorant, a sufficient contrast difference between the portion scraped with laser light and
20 the unscraped portion in the protective film can be obtained, and thereby visibility is improved. For the colorant, organic or inorganic pigments and dyes are used. Of these, a black pigment is preferred from the viewpoint of blocking properties against an electromagnetic wave or infrared light. For the black pigment, carbon black, iron oxide, manganese dioxide, aniline black, activated carbon, or the like is used, but the black
25 pigment is not limited to these. From the viewpoint of improving the reliability of the

semiconductor device, carbon black is particularly preferred. One of the colorants may be used alone, or two or more may be used in combination. The high level of curability of the back surface protective film-forming film of the present embodiment is

particularly preferably exhibited when a colorant is used and the permeability of

5 ultraviolet light is reduced. Examples of such colorants include colorants that reduce the permeability of visible light, colorants that reduce the permeability of infrared light and ultraviolet light, and colorants that reduce the permeability of visible light, infrared light and ultraviolet light. In addition to the abovementioned black pigments, such colorants are not particularly limited as long as they exhibit absorbency or reflectivity in the
10 wavelength range of visible light, the wavelength ranges of infrared light and ultraviolet light, or the wavelength ranges of visible light, infrared light and ultraviolet light.

[0060]

The blending amount of the colorant is preferably from 0.1 to 35 parts by mass, more preferably from 0.5 to 25 parts by mass, and particularly preferably from 1 to 15

15 parts by mass relative to 100 parts by mass of a total solid content constituting the back surface protective film-forming film. When the blending amount of the colorant is equal to or greater than the lower limit described above, infrared light and the like can be sufficiently blocked. When the blending amount of the colorant is less than or equal to the upper limit described above, the curability of the back surface protective film-
20 forming film is further enhanced.

[0061]

Curing accelerator

A curing accelerator is used to adjust the curing rate of the back surface protective film-forming film. The curing accelerator is preferably used particularly

when an epoxy resin and a thermosetting agent are used in combination in the curable component.

[0062]

Examples of a preferred curing accelerator include tertiary amines, such as
5 triethylenediamine, benzyldimethylamine, triethanolamine, dimethylaminoethanol, and
tris(dimethylaminomethyl)phenol; imidazoles, such as 2-methylimidazole, 2-
phenylimidazole, 2-phenyl-4-methylimidazole, 2-phenyl-4,5-dihydroxymethylimidazole,
and 2-phenyl-4-methyl-5-hydroxymethylimidazole; organic phosphines, such as
tributylphosphine, diphenylphosphine, and triphenylphosphine; and tetraphenylboron
10 salts, such as tetraphenylphosphonium tetraphenylborate and triphenylphosphine
tetraphenylborate. One of these curing accelerators can be used alone, or two or more
can be mixed and used.

[0063]

The content of the curing accelerator is preferably from 0.01 to 10 parts by mass
15 and more preferably from 0.1 to 1 part by mass, relative to 100 parts by mass of the
curable component. The back surface protective film-forming film containing the curing
accelerator in the above range has excellent adhesive properties even when exposed to
high temperature and high humidity conditions and can achieve high reliability even
when exposed to severe reflow conditions. With a small content of the curing
20 accelerator, the back surface protective film-forming film would fail to have sufficient
adhesive properties because of insufficient curing, while with an excessive amount, the
curing accelerator, which has high polarity, would migrate through the back surface
protective film-forming film to the adhesive interface side under high temperature and
high humidity and segregate there, and this would reduce the reliability of the
25 semiconductor device.

[0064]

Coupling agent

A coupling agent may be used to improve the adhesiveness and adherence of the back surface protective film-forming film to a chip and/or cohesiveness of the back surface protective film. In addition, use of a coupling agent can improve water resistance of the back surface protective film obtained by curing the back surface protective film-forming film, without impairing heat resistance of the back surface protective film.

[0065]

For the coupling agent, a compound having a group reactive with a functional group contained in the binder polymer component, the curable component, or the like is preferably used. The coupling agent is desirably a silane coupling agent. Examples of such a coupling agent include γ -glycidoxypropyltrimethoxysilane, γ -glycidoxypropylmethyldiethoxysilane, β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane, γ -(methacryloxypropyl)trimethoxysilane, γ -aminopropyltrimethoxysilane, N-6-(aminoethyl)- γ -aminopropyltrimethoxysilane, N-6-(aminoethyl)- γ -aminopropylmethyldiethoxysilane, N-phenyl- γ -aminopropyltrimethoxysilane, γ -ureidopropyltriethoxysilane, γ -mercaptopropyltrimethoxysilane, γ -mercaptopropylmethyldimethoxysilane, bis(3-triethoxysilylpropyl)tetrasulfane, methyltrimethoxysilane, methyltriethoxysilane, vinyltrimethoxysilane, vinyltriacetoxysilane, and imidazole silane. One of these coupling agents can be used alone, or two or more can be mixed and used.

[0066]

The content of the coupling agent is typically from 0.1 to 20 parts by mass, preferably from 0.2 to 10 parts by mass, and more preferably from 0.3 to 5 parts by mass,

relative to a total of 100 parts by mass of the binder polymer component and the curable component. A coupling agent content of less than 0.1 parts by mass could lead to the inability to obtain the effects described above, while a coupling agent content exceeding 20 parts by mass could cause outgassing. That is, when the content of the coupling agent is equal to or greater than the lower limit described above, the effects described above can be obtained. Further, when the content of the coupling agent is equal to or less than the upper limit described above, the generation of outgasses can be suppressed.

[0067]

Inorganic filler

The thermal expansion coefficient of the back surface protective film after curing can be adjusted by blending an inorganic filler into the back surface protective film-forming film. Therefore, the reliability of a semiconductor device can be improved by optimizing the thermal expansion coefficient of the back surface protective film after curing with respect to a semiconductor chip. In addition, use of an inorganic filler can also reduce the moisture absorption rate of the back surface protective film after curing.

[0068]

Examples of a preferred inorganic filler include powders of silica, alumina, talc, calcium carbonate, titanium oxide, iron oxide, silicon carbide, and boron nitride; spherical beads formed from these powders; single crystal fibers, and glass fibers of these. Of these, silica fillers and alumina fillers are preferred. A single type of inorganic filler can be used alone, or two or more types can be mixed and used. The content of the inorganic filler can be adjusted in a range typically of 1 to 80 parts by mass relative to 100 parts by mass of a total solid content constituting the back surface protective film-forming film.

[0069]

Photopolymerization initiator

The back surface protective film-forming film containing the energy ray-curable component as the curable component described above is irradiated with an energy ray, such as ultraviolet light, to cure the energy ray-curable component when the film is used.

- 5 At this time, the polymerization curing time and the light irradiation amount can be reduced by including a photopolymerization initiator in the back surface protective film-forming composition.

[0070]

Examples of such a photopolymerization initiator specifically include

- 10 benzophenone, acetophenone, benzoin, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzoin isobutyl ether, benzoinbenzoic acid, methyl benzoinbenzoate, benzoin dimethyl ketal, 2,4-diethylthioxanthone, α -hydroxycyclohexyl phenyl ketone, benzyldiphenyl sulfide, tetramethylthiuram monosulfide, azobis-isobutyronitrile, benzyl, dibenzyl, diacetyl, 1,2-diphenylmethane, 2-hydroxy-2-methyl-1-
- 15 [4-(1-methylvinyl)phenyl]propanone, 2,4,6-trimethylbenzoyldiphenylphosphine oxide, and β -chloroanthraquinone. A single type of photopolymerization initiator can be used alone, or a combination of two or more types can be used.

[0071]

The blending ratio of the photopolymerization initiator is preferably from 0.1 to

- 20 10 parts by mass and more preferably from 1 to 5 parts by mass relative to 100 parts by mass of the energy ray-curable component. When the blending ratio is less than 0.1 parts by mass, photopolymerization may be insufficient, resulting in the inability to obtain satisfactory transfer properties, and when the blending ratio exceeds 10 parts by mass, a residue not contributing to photopolymerization could be produced, and this may
- 25 result in insufficient curability of the back surface protective film-forming film. That is,

when the blending ratio of the photopolymerization initiator is greater than or equal to the lower limit described above, photopolymerization is sufficiently implemented, and satisfactory transfer properties are obtained. When the blending ratio of the photopolymerization initiator is equal to or less than the upper limit described above, the production of residue not contributing to photopolymerization is suppressed, and the curability of the back surface protective film-forming film is further enhanced.

[0072]

Crosslinking agent

A crosslinking agent can also be added to adjust the initial adhesive strength and cohesive strength of the back surface protective film-forming film. Examples of the crosslinking agent include organic polyvalent isocyanate compounds and organic polyvalent imine compounds.

[0073]

Examples of the organic polyvalent isocyanate compound include aromatic polyvalent isocyanate compounds, aliphatic polyvalent isocyanate compounds, alicyclic polyvalent isocyanate compounds, and trimers of these organic polyvalent isocyanate compounds; and terminal isocyanate urethane prepolymers obtained by reacting these organic polyvalent isocyanate compounds and a polyol compound.

[0074]

Examples of the organic polyvalent isocyanate compound include 2,4-tolylene diisocyanate, 2,6-tolylene diisocyanate, 1,3-xylylene 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, trimethylolpropane adduct tolylene diisocyanate, and lysine isocyanate.

[0075]

Examples of the organic polyvalent imine compound include N,N'-diphenylmethane-4,4'-bis(1-aziridinecarboxamide), trimethylolpropane-tri- β -aziridiny propionate, tetramethylolmethane-tri- β -aziridiny propionate, and N,N'-toluene-2,4-bis(1-aziridinecarboxamide)triethylenemelamine.

[0076]

The crosslinking agent is used at a ratio typically from 0.01 to 20 parts by mass, preferably from 0.1 to 10 parts by mass, and more preferably from 0.5 to 5 parts by mass relative to a total of 100 parts by mass of the binder polymer component and the energy ray-curable polymer. When the content of the cross-linking agent is within the above numerical ranges, the initial adhesive strength and cohesive strength of the back surface protective film-forming film can be further enhanced.

[0077]

General purpose additives

The back surface protective film-forming film may contain various additives (general purpose additives) as necessary in addition to the above. Examples of the various other additives include leveling agents, plasticizers, antistatic agents, antioxidants, ion scavengers, gettering agents, and chain transfer agents.

[0078]

Solvent

The back surface protective film-forming composition preferably further contains a solvent. When the back surface protective film-forming composition contains a solvent, the composition exhibits good handling properties.

The solvent is not particularly limited, but preferred examples include hydrocarbons, such as toluene and xylene; alcohols, such as methanol, ethanol, 2-

propanol, isobutyl alcohol (2-methylpropan-1-ol), and 1-butanol; esters, such as ethyl acetate; ketones, such as acetone and methyl ethyl ketone; ethers, such as tetrahydrofuran; and amides, such as dimethylformamide and N-methylpyrrolidone (compounds having an amide bond).

5 The back surface protective film-forming composition may contain only a single type of solvent, or may contain two or more types, and when two or more solvents are contained, the combination and ratio thereof can be arbitrarily selected.

 The content of the solvent is preferably from 5 to 95 mass%, more preferably from 7 to 93 mass%, and even more preferably from 10 to 90 mass%, relative to the total
10 mass of the back surface protective film-forming composition. When the content of the solvent is greater than or equal to the lower limit described above, the handling properties of the back surface protective film-forming composition are further enhanced. When the content of the solvent is equal to or less than the upper limit described above, the curability of the back surface protective film-forming composition is further enhanced.

15 [0079]

 From the perspective of being able to more uniformly mix components contained in the back surface protective film-forming composition, the solvent contained in the back surface protective film-forming composition is preferably methyl ethyl ketone or the like.

20 [0080]

 The back surface protective film-forming film is obtained by applying and drying the back surface protective film-forming composition composed of the various components described above, and exhibits adhesiveness and curability and is easily adhered in an uncured state by pressing onto a workpiece (such as a semiconductor wafer
25 or a chip). When being pressed, the back surface protective film-forming film may be

affixed while being heated. In addition, a back surface protective film with high impact resistance can be ultimately provided through curing, and the protective film also has excellent adhesive strength and can retain a sufficient protective function even under severe high temperature and high humidity conditions. The back surface protective film-forming film may have a single layer structure, or may have a multilayer structure as long as the film contains one or more layers containing the components described above. [0081]

Method for producing back surface protective film-forming composition

The back surface protective film-forming composition is obtained by blending each component configuring the same.

The order in which each of the components are added when blended is not particularly limited, and two or more types of components may be added simultaneously.

When a solvent is used, the solvent may be mixed with any of the to-be-blended components other than the solvent, and the blended components thereof may be pre-diluted and used, or the solvent may be mixed with these to-be-blended components and used without pre-diluting any of the to-be-blended components other than the solvent.

The method for mixing the components when blending is not particularly limited and may be selected as appropriate from well-known methods, such as a method of mixing by rotating a stirrer, a stirring blade, or the like, a method of mixing using a mixer, and a method of mixing with the application of ultrasonic waves.

The temperature and time when adding and mixing the various components are not particularly limited as long as each of the to-be-blended components is not degraded, and may be adjusted as appropriate, but the temperature is preferably from 15 to 30°C.

[0082]

Method of manufacturing film for forming back surface protective film

The back surface protective film-forming film can be formed by using the back surface protective film-forming composition containing the constituent materials. For example, a back surface protective film-forming film can be formed on a targeted location by coating the back surface protective film-forming composition onto a surface on which the back surface protective film-forming film is to be formed, and then drying as necessary. In the back surface protective film-forming composition, the ratio of the content of components that do not vaporize at ordinary temperature is ordinarily the same as the ratio of the content of the components of the back surface protective film-forming film. Note that in the present specification, “ordinary temperature” refers to a temperature that does not particularly cause cooling or heating, that is, a normal temperature, and is, for example, a temperature from 15 to 25°C.

[0083]

The back surface protective film-forming composition may be applied by a well-known method including, for example, methods using various coaters such as an air knife coater, a blade coater, a bar coater, a gravure coater, a roll coater, a roll knife coater, a curtain coater, a die coater, a knife coater, a screen coater, a Mayer bar coater, and a kiss coater.

[0084]

The drying conditions of the back surface protective film-forming composition are not particularly limited, but when the back surface protective film-forming composition contains a below-described solvent, the back surface protective film-forming composition is preferably heated and dried. The back surface protective film-forming composition containing a solvent is preferably dried at a temperature from 70 to 130°C for 10 seconds to 5 minutes. The back surface protective film-forming composition containing a solvent is, for example, more preferably dried at a temperature

from 80 to 130°C for 20 seconds to 4 minutes, and is further preferably dried at a temperature from 90 to 130°C for 30 seconds to 3 minutes. When the heating temperature during heating and drying is equal to or higher than the lower limit described above, the back surface protective film-forming composition can be sufficiently cured.

- 5 When the heating temperature during heating and drying is equal to or lower than the upper limit described above, deterioration of the workpiece can be suppressed. When the drying time during heating and drying is equal to or greater than the lower limit described above, the back surface protective film-forming composition can be sufficiently cured. When the drying time during heating and drying is equal to or less
- 10 than the upper limit described above, productivity of the back surface protective film-forming film can be improved.

[0085]

○ Protection layer

In the back surface protective film-forming composite according to the present

15 embodiment, the protection layer is used as a layer protecting the back surface protective film-forming film. Specifically, the method of manufacturing a third laminate includes: a first lamination step of affixing the back surface protective film-forming film of the back surface protective film-forming composite to a back surface of a semiconductor substrate to obtain a second laminate, the second laminate including the semiconductor

20 substrate, the back surface protective film-forming film, and the protection layer, which are laminated in this order; a second lamination step of affixing a support sheet to the protection layer of the second laminate to obtain a third laminate, the third laminate including the semiconductor substrate, the back surface protective film-forming film, the protection layer, and the support sheet, which are laminated in this order; and a

25 conveyance step of conveying the second laminate from the first lamination step to the

second lamination step, and in the conveyance step of the method of manufacturing a third laminate, the protection layer prevents contamination and deformation of the back surface protective film-forming film (before curing).

[0086]

5 Furthermore, the method of manufacturing a first laminate includes: a first lamination step of affixing, of the back surface protective film-forming composite, the back surface protective film-forming film to a back surface of a semiconductor substrate to obtain a second laminate, the second laminate including the semiconductor substrate, the back surface protective film-forming film, and the protection layer, which are
10 laminated in this order; a curing step of curing the back surface protective film-forming film of the second laminate to form a back surface protective film; and a conveyance step of conveying the second laminate from the first lamination step to the curing step, and in the conveyance step of the method of manufacturing a first laminate, the protection layer prevents contamination and deformation of the back surface protective film-forming film
15 (before curing).

[0087]

 The thickness of the protection layer is not particularly limited, but is preferably from 1 to 100 μm , more preferably from 2 to 95 μm , and even more preferably from 3 to 90 μm . When the thickness of the protection layer is equal to or greater than the lower
20 limit described above, contamination and deformation of the back surface protective film-forming film can be further suppressed. When the thickness of the protection layer is equal to or less than the upper limit described above, the handling properties of the back surface protective film-forming composite are further enhanced.

The thickness of the protection layer is determined, for example, by using a microscope or other such device to observe a cut surface obtained by cutting the back surface protective film-forming composite in the thickness direction.

[0088]

5 The protection layer is not particularly limited, but is, for example, an energy ray-curable film or base material. As the energy ray-curable film, a film obtained by curing the energy ray-curable film described with regard to the back surface protective film-forming film can be used. When an uncured energy ray-curable film is used as the protection layer, a different type of film than the back surface protective film-forming film is preferably used. Also, the following protection layer energy ray-curable film can be used as the protection layer. Hereinafter, a protection layer energy-curable film and a protection layer base material that can be used as a protection layer will be described.

[0089]

Protection layer energy ray-curable film

15 The protection layer energy ray-curable film other than the energy ray-curable film described with regard to the back surface protective film-forming film is not particularly limited, but for example, an energy ray-curable urethane-containing resin can be used.

Examples of the energy ray-curable urethane-containing resin include an energy ray-curable resin containing, as main components, a urethane (meth)acrylate resin or a urethane polymer, and an energy ray-polymerizable monomer.

Note that the protection layer energy ray-curable film is preferably cured before the first lamination step of the present embodiment.

[0090]

25 Base material

A resin film is preferable as the base material that can be used as a protection layer.

Examples of the resin film include polyethylene films, such as low density polyethylene (LDPE) films and linear low density polyethylene (LLDPE) films; ethylene-propylene copolymer films; polypropylene films; polybutene films; polybutadiene films; polymethylpentene films; polyvinyl chloride films; vinyl chloride copolymer films; polyethylene terephthalate films; polyethylene naphthalate films; polybutylene terephthalate films; polyurethane films; ethylene-vinyl acetate copolymer films; ionomer resin films; ethylene-(meth)acrylic acid copolymer films; ethylene-(meth)acrylate copolymer films; polystyrene films; polycarbonate films; polyimide films; and fluorine resin films.

The base material used in an aspect of the present invention may be a single layer film composed of one resin film or may be a laminated film in which two or more resin films are laminated.

In addition, in an aspect of the present invention, a sheet obtained by surface treating the surface of a base material, such as a resin film described above, may be used as the protection layer.

[0091]

These resin films may be crosslinked films.

In addition, resin films prepared by subjecting these resin films to coloring, printing, or the like can also be used. Further, the resin film may be a sheet obtained by extruding a thermoplastic resin or may be a stretched resin film, or a sheet obtained by thinning and curing a curable resin by a given means may be used.

[0092]

Among these resin films, a base material having excellent heat resistance and a glass transition temperature of 70°C or higher is preferred.

Examples of films having excellent heat resistance include polyester films, polycarbonate films, polyphenylene sulfide films, cyclo-olefin resin films, polyimide
5 resin films, films obtained by casting and curing a UV curable resin, and laminates of two or more types of these films.

[0093]

When the base material is used, the base material alone may be used as the protection layer, or a sheet having a pressure sensitive adhesive layer or a release agent
10 layer on the base material may be used as the protection layer. When a sheet having a pressure sensitive adhesive layer or a release agent layer on a base material is used as the protection layer, the pressure sensitive adhesive layer or the release agent layer is preferably laminated between the base material and the back surface protective film-forming film in the back surface protective film-forming composite.

15 [0094]

The pressure sensitive adhesive layer can be appropriately selected from among the pressure sensitive adhesive layers described with regard to the below-described support sheet, in accordance with the type of base material and back surface protective film-forming film.

20 The release agent layer may be appropriately selected from among release agent layers such as silicone-based, olefin-based, long-chain alkyl-based, alkyd-based, and fluorine-based release agent layers according to the type of the base material and back surface protective film-forming film.

[0095]

25 ○ Release film

A protective film is preferable as the release film 151 in the back surface protective film-forming composite 2 of the present embodiment. The protective film is typically configured from a base material film and a pressure sensitive adhesive layer laminated thereon. The base material film can be formed from a thermoplastic resin, for example. Examples of the thermoplastic resin include polyolefin resins, such as polyethylene-based resins and polypropylene-based resins; polyester-based resins, such as polyethylene terephthalate and polyethylene naphthalate; polycarbonate-based resins; and (meth)acrylic-based resins. The pressure sensitive adhesive layer can be configured as an acrylic type, a rubber type, a urethane type, or a silicone type. The release film of the present embodiment is removable after being affixed.

[0096]

Method of manufacturing third laminate

Figs. 6A to 6E are schematic cross-sectional views schematically illustrating an example of an embodiment of a method of manufacturing a third laminate in which a back surface protective film-forming composite 1 is used. The method of manufacturing the third laminate according to the present embodiment is a method of manufacturing a third laminate 25 including a workpiece 14, a back surface protective film-forming film 13, a protection layer 12, and a support sheet 10, which are laminated in this order, the method including, in the following order: a first lamination step (Fig. 6B and Fig. 6C) of affixing the back surface protective film-forming film 13 of a back surface protective film-forming composite 1 to a back surface 14b of the workpiece 14 to obtain a second laminate 24 including the workpiece 14, the back surface protective film-forming film 13, and the protection layer 12, which are laminated in this order; a conveyance step (Fig. 6C to Fig. 6D) of conveying the second laminate 24 to a second lamination step, in which

a support sheet 10 is affixed to the second laminate 24; and the second lamination step (Fig. 6D and Fig. 6E) of affixing the support sheet 10 to the protection layer 12.

[0097]

Figs. 7A to 7F are schematic cross-sectional views schematically illustrating an example of an embodiment of a method of manufacturing a third laminate in which a back surface protective film-forming composite 2 is used. The method of manufacturing the third laminate according to the present embodiment is a method of manufacturing a third laminate 25, the third laminate 25 including a workpiece 14, a back surface protective film-forming film 13, a protection layer 12, and a support sheet 10, which are laminated in this order, the method including, in the following order: a first lamination step (Fig. 7B and Fig. 7C) of affixing the back surface protective film-forming film 13 of a back surface protective film-forming composite 2 to a back surface 14b of the workpiece 14 to obtain a laminate including the workpiece 14, the back surface protective film-forming film 13, the protection layer 12, and a release film 151, which are laminated in this order; a conveyance step (Figs. 7C to 7E) of conveying the laminate to a second lamination step, in which the support sheet 10 is affixed to the protection layer 12 after the release film 151 has been detached from the laminate; and the second lamination step (Fig. 7E and Fig. 7F) of affixing the support sheet to the protection layer 12.

[0098]

20 Method of manufacturing first laminate

Figs. 4A to 4D are schematic cross-sectional views schematically illustrating an example of an embodiment of a method of manufacturing a first laminate in which a back surface protective film-forming composite 1 is used. The method of manufacturing a first laminate according to the present embodiment is a method of manufacturing a first laminate 23 in which a workpiece 14, a back surface protective film 13', and a protection

layer 12 are laminated in this order, the method including, in the following order: a first lamination step (Fig. 4B and Fig. 4C) of affixing a back surface protective film-forming film 13 of a back surface protective film-forming composite 1 to a back surface 14b of the workpiece 14 to obtain a second laminate 24 in which the workpiece 14, the back surface protective film-forming film 13, and the protection layer 12 are laminated in this order; a conveyance step (Figs. 4C and 4D) of conveying the second laminate 24 to a curing step in which the back surface protective film-forming film 13 is cured to obtain a back surface protective film 13'; and the curing step (Fig. 4D) of curing the back surface protective film-forming film 13 of the second laminate 24 to obtain the back surface protective film 13'.

[0099]

Figs. 5A to 5E are schematic cross-sectional views schematically illustrating an example of an embodiment of a method of manufacturing a first laminate in which a back surface protective film-forming composite 2 is used. The method of manufacturing a first laminate according to the present embodiment is a method of manufacturing a first laminate 23 in which a workpiece 14, a back surface protective film 13', and a protection layer 12 are laminated in this order, the method including, in the following order: a first lamination step (Fig. 5B and Fig. 5C) of affixing a back surface protective film-forming film 13 of a back surface protective film-forming composite 2 to a back surface 14b of the workpiece 14 to obtain a laminate, the laminate including the workpiece 14, the back surface protective film-forming film 13, the protection layer 12, and a release film 151, which are laminated in this order; a step of detaching the release film 151 from the laminate to obtain a second laminate 24; a conveyance step (Figs. 5D and 5E) of conveying the second laminate 24 to a curing step in which the back surface protective film-forming film 13 is cured to obtain a back surface protective film 13'; and the curing

step (Fig. 5E) of curing the back surface protective film-forming film 13 of the second laminate 24 to obtain the back surface protective film 13'.

[0100]

Hereinafter, items that are common between the method of manufacturing a first laminate and the method of manufacturing a third laminate will be described. In the present embodiment, a semiconductor wafer is used as the workpiece 14 illustrated in Fig. 4A, Fig. 5A, Fig. 6A, and Fig. 7A. One surface of the semiconductor wafer is a circuit surface on which bumps are formed. In addition, the circuit surface bumps of the semiconductor wafer are protected with a circuit surface-protecting tape 17 to prevent collapse of the circuit surface and bumps of the semiconductor wafer during grinding of the back surface of the semiconductor wafer and the occurrence of dimples or cracks on the wafer back surface. The circuit surface-protecting tape 17 is a tape for grinding a back surface, and the back surface of the semiconductor wafer used as the workpiece 14 (i.e., the back surface of the workpiece) is a ground surface. Note that, although not illustrated with regard to the methods of manufacturing the first laminate represented in Figs. 4A to 4D and Figs. 5A to 5E, the circuit surface and bumps of the semiconductor wafer are preferably protected by the circuit surface-protecting tape 17 in the method of manufacturing the first laminate. In this case, the circuit surface-protecting tape is preferably peeled off at any stage before the curing step represented in Fig. 4D or Fig. 5E.

[0101]

The workpiece 14 is not limited as long as the workpiece 14 includes a circuit surface on one side and another surface, which is a back surface, on another side. The workpiece 14 can be exemplified by semiconductor wafers having a circuit surface on one side; and semiconductor device panels composed of an assembly of semiconductor

devices with a terminal, in which individual electronic components in a form of individual pieces are sealed with a sealing resin and the assembly has a terminal-forming surface (in other words, a circuit surface) of the semiconductor device with a terminal on one side.

5 [0102]

For the circuit surface-protecting tape 17, a surface protective sheet disclosed, for example, in JP 2016-192488 A or JP 2009-141265 A can be used. The circuit surface-protecting tape 17 is provided with a pressure sensitive adhesive layer having moderate removability. The pressure sensitive adhesive layer may be formed from a pressure sensitive adhesive of a versatile weak pressure sensitive adhesive type, such as a rubber pressure sensitive adhesive, an acrylic pressure sensitive adhesive, a silicone pressure sensitive adhesive, a urethane pressure sensitive adhesive, or a vinyl ether pressure sensitive adhesive. In addition, the pressure sensitive adhesive layer may be an energy ray-curable pressure sensitive adhesive that becomes removable when cured by irradiation with energy rays.

[0103]

In the method of manufacturing a third laminate, the first lamination step (Figs. 6B to 6C, or Figs. 7B to 7D) and the second lamination step (Figs. 6D to 6E, or Figs. 7E to 7F) may be implemented with separate devices (hereinafter, also referred to as Method 1).

In the method of manufacturing a third laminate, the processes from the first lamination step to the second lamination step (Figs. 6B to 6E, or Figs. 7B to 7F) are preferably implemented by a device that affixes the back surface protective film-forming film, coupled with a device that affixes the support sheet, or are implemented by the same device (hereinafter, referred to as Method 2).

[0104]

In the method of manufacturing the first laminate, the first lamination step (Figs. 4B to 4C, or Figs. 5B to 5D) and the curing step (Fig. 4D, or Fig. 5E) may be implemented in separate devices (hereinafter, also referred to as Method 3).

5 In the method of manufacturing the first laminate, the processes from the first lamination step to the curing step (Figs. 4B to 4D, Figs. 5B to 5E) are preferably implemented by a device that affixes the back surface protective film-forming film, coupled with a device that cures the back surface protective film-forming film, or are implemented by the same device (hereinafter, referred to as Method 4).

10 [0105]

In Method 2, in the processes from the first lamination step to the second lamination step, the second laminate in which the back surface protective film-forming film 13 and the protection layer 12 are laminated to the workpiece 14 can be conveyed one by one to the second lamination step illustrated in Figs. 6D to 6E or Figs. 7E to 7F
15 without being kept in the cassette.

In Method 4, in the processes from the first lamination step to the curing step, the second laminate in which the back surface protective film-forming film 13 and the protection layer 12 are laminated to the workpiece 14 can be conveyed one by one to the curing step illustrated in Fig. 4D or Fig. 5E without being kept in the cassette.

20 Performing the steps in the same device can further reduce the device space. By performing these steps with the device for affixing the back surface protective film-forming film coupled to the device for affixing the support sheet (or the device for curing the back surface protective film-forming film), conventional devices can be modified and used without designing from scratch, and initial costs can be reduced. Furthermore, the
25 second laminate is not kept in a cassette and conveyed to outside of the device, and thus

production efficiency can be improved, and contamination of the second laminate can be prevented.

[0106]

5 The protection layer 12 and the back surface protective film-forming film 13 used in the first lamination step may be processed in advance into the shape of the workpiece or may be processed in the same device immediately before implementing the first lamination step.

[0107]

10 The protection layer 12 and the back surface protective film-forming film 13 may be processed in the following manner after the first lamination step has been implemented. When the back surface protective film-forming composite 1 is used, in the first lamination step, the back surface protective film-forming film 13 of the back surface protective film-forming composite 1 is affixed to the back surface of a workpiece 14, and the second laminate in which the workpiece 14, the back surface protective film-
15 forming film 13, and the protection layer 12 are laminated in this order is obtained, after which the protection layer 12 and the back surface protective film-forming film 13 are processed into the shape of the workpiece.

[0108]

20 When the back surface protective film-forming composite 2 is used, in the first lamination step, the back surface protective film-forming film 13 of the back surface protective film-forming composite 2 is affixed to the back surface of a workpiece 14, a release film 151 is detached, and a laminate in which the workpiece 14, the back surface protective film-forming film 13, and the protection layer 12 are laminated in this order is obtained, after which the protection layer 12 and the back surface protective film-forming
25 film 13 are processed into the shape of the workpiece.

[0109]

In another embodiment, a conveyance distance of the workpiece 14 from an affixing starting point in the first lamination step to an affixing completion point in the second lamination step (or from the affixing starting point in the first lamination step to a curing completion point in the curing step) can be designed to be 7000 mm or shorter, and the device space can be reduced. The conveyance distance of the workpiece 14 from the affixing starting point in the first lamination step to the affixing completion point in the second lamination (or from the affixing starting point in the first lamination step to the curing completion point in the curing step) can be set to 6500 mm or shorter, 6000 mm or shorter, 4500 mm or shorter, or 3000 mm or shorter. The lower limit of the conveyance distance of the workpiece 14 is not particularly limited, but can be, for example, 100 mm.

[0110]

In yet another embodiment, a conveyance time of the workpiece 14 from an affixing starting time in the first lamination step to an affixing completion time in the second lamination step (or from the affixing starting time in the first lamination step to a curing completion time in the curing step) can be set to 400 s or shorter, and the step times can be reduced. The conveyance time of the workpiece 14 from the affixing starting time in the first lamination step to the affixing completion time in the second lamination step (or from the affixing starting time in the first lamination step to the curing completion time in the curing step) can be set to 300 s or shorter, 250 s or shorter, 200 s or shorter, or 150 s or shorter. The lower limit of the conveyance time of the workpiece 14 is not particularly limited, but can be, for example, 10 s.

[0111]

The speed at which the exposed surface of the back surface protective film-forming film 13 is affixed to the workpiece 14 in the first lamination step of the method of manufacturing a first laminate and the method of manufacturing a third laminate and the speed at which the support sheet 10 is affixed to the exposed surface of the protection layer 12 in the second lamination step of the method of manufacturing a third laminate can be set to 100 mm/s or lower, 80 mm/s or lower, 60 mm/s or lower, or 40 mm/s or lower. Good adherence between the workpiece 14 and the back surface protective film-forming film 13 and between the protection layer 12 and the support sheet 10 can be obtained by setting the affixing speed in the first lamination step and the affixing speed in the second lamination step to equal to or less than the upper limit described above.

The affixing speed in the first lamination step and the affixing speed in the second lamination step can be set to 2 mm/s or higher, 5 mm/s or higher, or 10 mm/s or higher. Production efficiency of the first laminate 23 and the third laminate 25 can be improved, and the conveyance time for conveying the workpiece 14 from the affixing starting time in the first lamination step to the affixing completion time in the second lamination step (or from the affixing starting time in the first lamination step to the curing completion time in the curing step) can be set to 400 s or shorter by setting the affixing speed in the first lamination step and the affixing speed in the second lamination to not lower than the lower limit described above.

[0112]

The method of manufacturing the first laminate and the method of manufacturing the third laminate according to the present embodiment can be implemented by coupling a device for affixing a back surface protective film-forming film, with a device for affixing a support sheet (or a device for curing a back surface protective film-forming film), or can be implemented in the same device.

In a case in which the same device is used in both methods, for example, the methods can be implemented using a device equipped with a table for affixing the back surface protective film-forming film, a table for affixing the support sheet (or a curing unit), and a conveyance arm.

5 Specifically, a workpiece inserted into the device is conveyed by the conveyance arm to the table for affixing the back surface protective film-forming film, and the back surface protective film-forming film of the back surface protective film-forming composite 1 is affixed to the back surface side of the workpiece (first lamination step).

10 [0113]

A suctioning surface having suctioning holes of the conveyance arm is suctioned to the protection layer surface of the laminate obtained in the first lamination step, and the laminate is conveyed (conveyance step) to a second lamination step in which the support sheet is affixed (or to a curing step of curing the back surface protective film-forming film).

15 [0114]

After the conveyance step, the support sheet is affixed to the protection layer, and thereby a third laminate in which the workpiece, the back surface protective film-forming film, the protection layer, and the support sheet are laminated in this order is obtained (second lamination step).

20 [0115]

Furthermore, by curing the back surface protective film-forming film after the conveyance step, a first laminate in which the workpiece, the back surface protective film, and the protection layer are laminated in this order is obtained (curing step).

[0115]

Contamination and deformation of the back surface protective film-forming film 13 can be prevented in the conveyance step by using the back surface protective film-forming composite 1 according to the present embodiment.

[0116]

5 The device is preferably provided with from 1 to 5, or more preferable from 1 to 3 tables for affixing the back surface protective film-forming film. When, in the device, the number of the tables for affixing the back surface protective film-forming film is equal to or greater than the lower limit of this range, production efficiency is increased, and when the number is equal to or less than the upper limit, the space of the device can
10 be reduced.

[0117]

 The device is preferably provided with from 1 to 5, or more preferable from 1 to 3 tables for affixing the support sheet. When, in the device, the number of the tables for affixing the support sheet is equal to or greater than the lower limit of this range,
15 production efficiency is increased, and when the number is equal to or less than the upper limit, the space of the device can be reduced.

[0118]

 The device preferably includes conveyance arms in accordance with each conveyance path. Production efficiency can be improved by setting the ratio of the
20 number of conveyance arms to the total number of tables to 1 or more. In addition, for a case in which two or more tables are provided, the space of the device can be reduced when the ratio of the number of conveyance arms to the total number of tables is greater than 0 and less than 1 (for example, the total number of conveyance arms is 1 relative to 2 tables).

25 [0119]

A specific example in which a device for affixing a back surface protective film-forming film and a device for affixing a support sheet are coupled is a method in which a device having a mechanism for affixing the back surface protective film-forming film and a device having a mechanism for affixing a support sheet are operated in succession, and a conveyance arm is used to convey, one at a time and between mechanisms, a second laminate in which the back surface protective film-forming film 13 is affixed to the workpiece 14.

A specific example in which a device for affixing a back surface protective film-forming film and a device for curing the back surface protective film-forming film are coupled is a method in which a device having a mechanism for affixing the back surface protective film-forming film and a device having a mechanism for curing the back surface protective film-forming film are operated in succession, and a conveyance arm is used to convey, one at a time and between mechanisms, a second laminate in which the back surface protective film-forming film 13 is affixed to the workpiece 14.

[0120]

The first lamination step in the method of manufacturing the first laminate and the method of manufacturing the third laminate according to the present embodiment is preferably implemented by the following method. A case where the back surface protective film-forming film 13 and protection layer 12, used in the first lamination step, are processed in advance into the shape of the workpiece or are processed in the same device immediately before implementing the first lamination step is described below.

A band-shaped back surface protective film-forming composite 3 illustrated in Fig. 9 and having a release film 152 on the outermost surface of the back surface protective film-forming film 13 of the back surface protective film-forming composite 2 according to the present embodiment is prepared.

The band-shaped back surface protective film-forming composite 3 is preferably wound in a roll shape and stored.

First, the release film 152 is peeled off, and the back surface protective film-forming film 13 and the protection layer 12 are cut into the shape of the workpiece 14.

5 A laminate of the outer peripheral portion, the laminate being formed from the back surface protective film-forming film 13 and the protection layer 12, is wound and thereby removed.

[0121]

When the protection layer 12 is not present, the winding of the outer peripheral
10 portion described above involves winding only the back surface protective film-forming film 13. The back surface protective film-forming film 13 is thin and fragile, and therefore the back surface protective film-forming film 13 may tear during winding, and winding of the outer peripheral portion may not be successful.

When the back surface protective film-forming composite 3 of the present
15 embodiment is used, winding of the outer peripheral portion described above involves winding a laminate formed from the back surface protective film-forming film 13 and the protection layer 12. When the protection layer 12 is provided, the laminate becomes thicker and stronger, and thus the likelihood of tearing occurring during winding decreases, and the outer peripheral portion can be efficiently wound.

20 [0122]

The back surface protective film-forming composite 2 of the present
embodiment, which has been cut into the shape of the workpiece in this manner, is affixed to the back surface of the workpiece 14, and a laminate in which the workpiece 14, the back surface protective film-forming film 13, the protection layer 12, and the
25 release film 151 are laminated in this order is obtained. As described above, the release

film 151 is not cut, and thus remains in a band-shape. The band-shaped release film 151 is wound to thereby detach the release film 151, and a second laminate 24 in which the workpiece 14, the back surface protective film-forming film 13, and the protection layer 12 are laminated in this order is obtained.

5 [0123]

In the method of manufacturing a third laminate, a support sheet 10 is laminated to the protection layer 12 in the second lamination step illustrated in Fig. 6D or Fig. 7E.

The support sheet 10 is, for example, a circular polyolefin film having a thickness of 80 μm and a diameter of 270 mm and may be provided with an adhesive layer for a jig on

10 the outer peripheral portion. In the present embodiment, the workpiece 14 may be fixed to a fixing jig 18 together with the back surface protective film-forming film 13 and the protection layer 12. In addition, the support sheet 10 may be laminated onto the protection layer 12 and fixed to the fixing jig 18 (Fig. 6E or Fig. 7F).

[0124]

15 Support sheet

Examples of the support sheet 10 used in an aspect of the present invention include a sheet constituted only of a base material 101, and a PSA sheet having a pressure sensitive adhesive layer 102 on the base material 101.

The support sheet included in the third laminate according to an aspect of the present invention may serve as a release sheet for preventing adherence of dust or the like on the surface of the back surface protective film-forming film, or as a dicing sheet for protecting the surface of the back surface protective film-forming film in dicing or the like.

[0125]

The thickness of the support sheet is appropriately selected according to the application, but from the viewpoint of imparting sufficient flexibility to a composite sheet and providing good attaching to a silicon wafer, the thickness is preferably from 10 to 500 μm , more preferably from 20 to 350 μm , and even more preferably from 30 to 200 μm .

The thickness of the support sheet described above includes not only the thickness of the base material constituting the support sheet but also the thicknesses of a layer and a film when the support sheet includes a pressure sensitive adhesive layer.

[0126]

10 A base material described with regard to the protection layer can be used as the base material 101 constituting the support sheet 10.

In addition, in an aspect of the present invention, a sheet surface-treated on the surface of the base material, such as the resin film described above, may be used as the support sheet.

15 [0127]

Of these resin films, a base material containing a polypropylene film is preferred from the viewpoint of having excellent heat resistance, having expansion suitability for providing moderate flexibility, and easily maintaining pickup suitability.

The configuration of the base material containing a polypropylene film may be a
20 single layer structure composed only of a polypropylene film or may be a multilayer structure composed of a polypropylene film and another resin film.

When the back surface protective film-forming film is heat curable, the resin film constituting the substrate has heat resistance, and thus damage due to heat of the base material is suppressed, and the occurrence of a defect in the manufacturing process
25 of the semiconductor device can be suppressed.

[0128]

When a sheet constituted only of a base is used as the support sheet, the surface tension of the surface of the base material coming into contact with the surface of the back surface protective film-forming film is preferably from 20 to 50 mN/m, more preferably from 23 to 45 mN/m, and even more preferably from 25 to 40 mN/m from the viewpoint of adjusting the release strength to a certain range.

[0129]

The thickness of the base material constituting the support sheet is preferably from 10 to 500 μm , more preferably from 15 to 300 μm , and even more preferably from 20 to 200 μm .

[0130]

PSA sheet

Examples of the PSA sheet used as the support sheet 10 in an aspect of the present invention include a sheet having the pressure sensitive adhesive layer 102 formed from a pressure sensitive adhesive on the base material 101, such as the resin film described above.

Fig. 8 is a schematic cross-sectional view illustrating an example of the support sheet 10 provided with the pressure sensitive adhesive layer 102 on the base material 101.

When the support sheet 10 is provided with the pressure sensitive adhesive layer 102, the pressure sensitive adhesive layer 102 of the support sheet 10 is laminated to the protection layer 12 in the second lamination step.

[0131]

Examples of the pressure sensitive adhesive used as a material for forming the pressure sensitive adhesive layer include a pressure sensitive adhesive composition

containing a pressure sensitive adhesive resin, and the pressure sensitive adhesive composition may further contain a general purpose additive, such as the crosslinking agent or tackifier described above.

5 Examples of the pressure sensitive adhesive resin, when attention is paid to the structure of the resin, include acrylic resins, urethane resins, rubber resins, silicone resins, and vinyl ether resins, while when attention is paid to the function of the resin, examples include energy ray-curable pressure sensitive adhesives, heat-foaming pressure sensitive adhesives, and energy ray-foaming pressure sensitive adhesives.

10 In one aspect of the present invention, the pressure sensitive adhesive layer 102 of the support sheet is preferably a strong pressure sensitive adhesive layer in order to ensure adherence with the protection layer. An energy ray-curable pressure sensitive adhesive layer formed from a pressure sensitive adhesive composition containing an energy ray-curable resin may be used.

[0132]

15 Furthermore, from the viewpoint of adjusting the release strength to a certain range, a pressure sensitive adhesive containing an acrylic resin is preferred.

20 The acrylic resin is preferably an acrylic polymer having a constituent unit (x1) derived from an alkyl(meth)acrylate and more preferably an acrylic copolymer having the constituent unit (x1) and a constituent unit (x2) derived from a functional group-containing monomer.

[0133]

 The alkyl group contained in the alkyl(meth)acrylate has preferably from 1 to 18, more preferably from 1 to 12, and even more preferably from 1 to 8 carbon atoms.

25 Examples of the alkyl(meth)acrylate include the same alkyl(meth)acrylates described in the above section pertaining to the binder polymer component.

The alkyl(meth)acrylate may be used alone or in combination of two or more.

The content of the constituent unit (x1) is typically from 50 to 100 mass%, preferably from 50 to 99.9 mass%, more preferably from 60 to 99 mass%, and even more preferably from 70 to 95 mass% relative to all constituent units (100 mass%) of the acrylic polymer.

[0134]

Examples of the functional group-containing monomer include hydroxy group-containing monomers, carboxy group-containing monomers, and epoxy group-containing monomers, and specific examples of each monomer are the same as those exemplified in the section of the binder polymer component.

These may be used alone or in combination of two or more.

The content of the constituent unit (x2) is typically from 0 to 40 mass%, preferably from 0.1 to 40 mass%, more preferably from 1 to 30 mass%, and even more preferably from 5 to 20 mass% relative to all constituent units (100 mass%) of the acrylic polymer.

[0135]

In addition, the acrylic resin used in an aspect of the present invention may be an energy ray-curable acrylic resin obtained by reacting the acrylic copolymer having the constituent units (x1) and (x2) further with a compound having an energy ray-polymerizable group.

The compound having an energy ray-polymerizable group is a compound having a polymerizable group, such as a (meth)acryloyl group or a vinyl group.

[0136]

The pressure sensitive adhesive containing an acrylic resin when used preferably contains a crosslinking agent together with the acrylic resin from the viewpoint of adjusting the release strength to a certain range.

Examples of the crosslinking agent include isocyanate crosslinking agents,
5 imine crosslinking agents, epoxy crosslinking agents, oxazoline crosslinking agents, and carbodiimide crosslinking agents, but isocyanate crosslinking agents are preferred from the viewpoint of adjusting the release strength to a certain range.

The content of the crosslinking agent is preferably from 0.01 to 20 parts by mass, more preferably from 0.1 to 15 parts by mass, even more preferably from 0.5 to 10
10 parts by mass, and still more preferably from 1 to 8 parts by mass relative to a total mass (100 parts by mass) of the acrylic resin contained in the pressure sensitive adhesive.
[0137]

The support sheet 10 may be composed of one layer (single layer) or may be composed of two or more layers (multiple layers). In the support sheet composed of
15 multiple layers, the constituent materials and thicknesses of these multiple layers may be identical to each other or different from each other, and the combination of these multiple layers is not particularly limited as long as the effects of the present invention are not impaired.
[0138]

20 In the present specification, “multiple layers may be identical to each other or different from each other” means that “all layers may be identical, all layers may be different, or only some layers may be identical”, and furthermore, “multiple layers are different from each other” means that “at least one of the constituent materials or thicknesses of the various layers is different from the others”, and this is not limited to
25 the support sheet.

[0139]

The support sheet may be transparent or opaque and may be colored according to the purpose.

For example, for the back surface protective film-forming film having energy
5 ray-curability, the support sheet preferably transmits energy rays.

For example, to optically inspect the back surface protective film-forming film through the support sheet, the support sheet is preferably transparent.

[0140]

In the present embodiment, the circuit surface of the workpiece 14 is protected
10 with the circuit surface-protecting tape 17, and the method can include a peeling step in which the circuit surface-protecting tape 17 is peeled from the circuit surface of the workpiece 14 after the second lamination step. In the present embodiment, the circuit surface-protecting tape 17 includes a pressure sensitive adhesive layer on the side affixed to the circuit surface. The type of pressure sensitive adhesive layer is not limited as long
15 as the pressure sensitive adhesive layer exhibits suitable removability with respect to the workpiece, and the pressure sensitive adhesive layer may be formed from a general purpose pressure sensitive adhesive, such as a rubber pressure sensitive adhesive, an acrylic pressure sensitive adhesive, a silicone pressure sensitive adhesive, a urethane pressure sensitive adhesive, or a vinyl ether pressure sensitive adhesive. In addition, the
20 pressure sensitive adhesive layer may be formed from an energy ray-curable pressure sensitive adhesive that becomes removable when cured by irradiation with energy rays. If the pressure sensitive adhesive layer is formed from an energy ray-curable pressure sensitive adhesive, in the peeling step, the circuit surface-protecting tape 17 can be easily peeled from the circuit surface of the workpiece 14 by irradiating the pressure sensitive

adhesive layer of the circuit surface-protecting tape 17 with energy rays to cure the pressure sensitive adhesive layer and make the layer removable.

[0141]

The method of manufacturing the third laminate according to the present
5 embodiment may include a step of irradiating the back surface protective film-forming film 13 with a laser from the side of the support sheet 10 to create a laser marking on the back surface protective film-forming film 13. In the method of manufacturing a third laminate according to the present embodiment, the support sheet 10 is laminated on the protection layer 12, and therefore irradiation with a laser from the side of the support
10 sheet 10 through the support sheet and the protection layer results in laser markings on the surface of the back surface protective film-forming film 13, the surface being in contact with the protection layer 12.

The method of manufacturing the first laminate according to the present embodiment may include a step of irradiating the back surface protective film-forming
15 film 13 or the back surface protective film 13' with a laser.

[0142]

In the method of manufacturing the first laminate as well as the method of manufacturing the third laminate, contamination and deformation of the back surface protective film-forming film 13 are prevented by using the back surface protective film-forming composite 1 of the present embodiment. Therefore, contamination and
20 deformation of the back surface protective film 13' obtained by curing the back surface protective film-forming film 13 are also prevented. When the back surface protective film-forming film 13 or the back surface protective film 13' is contaminated and deformed (when unevenness is present on the surface), if laser marking is implemented

by irradiating with a laser through the support sheet 10, defects in the printing occur, and a problem of worsening visibility after printing may result.

However, with the method of manufacturing a first laminate and the method of manufacturing a third laminate, a back surface protective film-forming composite 1

5 according to the present invention is used, and thereby contamination and deformation of the back surface protective film-forming film 13 (back surface protective film 13') are suppressed, and as a result, the abovementioned defects in printing are suppressed, and visibility after printing is favorable.

[0143]

10 Method of manufacturing fourth laminate

A method of manufacturing a fourth laminate according to the present embodiment is a method of manufacturing a fourth laminate 26, in which a workpiece 14, a back surface protective film 13', a protection layer 12, and a support sheet 10 are laminated in this order, the method including a curing step of curing the back surface

15 protective film-forming film 13 of the third laminate 25 manufactured by the method of manufacturing a third laminate, and thereby obtaining the back surface protective film 13'.

In addition, the method of manufacturing a fourth laminate according to the present embodiment is also a method of manufacturing a fourth laminate 26, the method including a second lamination step of affixing the support sheet 10 to the protection layer 12 of the first laminate 23 manufactured by the method of manufacturing a first laminate to obtain the fourth laminate in which a workpiece 14, a back surface protective film 13', the protection layer 12, and the support sheet 10 are laminated in this order.

[0144]

Figs. 10A to 10C are schematic cross-sectional views schematically illustrating an example of an embodiment of the method of manufacturing a fourth laminate. The method of manufacturing a fourth laminate according to the present embodiment includes: a peeling step of peeling the circuit surface-protecting tape 17 from the circuit surface of the workpiece 14 after the second lamination step in the method of manufacturing a third laminate (Fig. 10A); a step of irradiating the back surface protective film-forming film 13 with a laser from the support sheet 10 side to form a laser marking thereon (Fig. 10B); and a curing step of curing the back surface protective film-forming film 13 to form a back surface protective film 13' (Fig. 10C). In the present embodiment, a thermosetting back surface protective film-forming film is used, and in the curing step according to the present embodiment, the film is thermally cured under conditions of 130°C for 2 h.

[0145]

The curing conditions for heat treating and thermally curing the thermosetting back surface protective film-forming film to form a back surface protective film are not particularly limited as long as the back surface protective film has a degree of curing sufficient to exhibit the functions of the back surface protective film, and the curing conditions are appropriately selected according to the type of the thermosetting back surface protective film-forming film.

[0146]

For example, the heating temperature during the thermal curing is preferably from 100 to 200°C, more preferably from 110 to 180°C, and particularly preferably from 120 to 170°C. In addition, the heating time during the thermal curing is preferably from 0.5 to 5 hours, more preferably from 0.5 to 3 hours, and particularly preferably from 1 to 2 hours. In the curing step, when thermal curing is adopted, the peeling step is

preferably implemented before the curing step in consideration of the heat resistance of the circuit surface-protecting tape 17.

[0147]

Figs. 11A to 11C are schematic cross-sectional views schematically illustrating another example of an embodiment of the method of manufacturing a fourth laminate. The method of manufacturing a fourth laminate according to the present embodiment includes: a peeling step of peeling the circuit surface-protecting tape 17 from the circuit surface of the workpiece 14 after the second lamination step in the method of manufacturing a third laminate (Fig. 11A); a curing step of curing the back surface protective film-forming film 13 to form a back surface protective film 13' (Fig. 11B); and a step of irradiating the back surface protective film 13' from the support sheet 10 side to create a laser marking on the back surface protective film 13' (Fig. 11C).

[0148]

Figs. 12A, 12B are schematic cross-sectional views schematically illustrating another example of an embodiment of the method of manufacturing a fourth laminate. The method of manufacturing the fourth laminate of the present embodiment includes a second lamination step of affixing a support sheet to the first laminate 23 manufactured by the method of manufacturing the first laminate. The peeling step of peeling the circuit surface-protecting tape 17 and the step of irradiating from the support sheet 10 side to create a laser marking may be included in the step of manufacturing the first laminate 23, or may be included in the step of manufacturing the fourth laminate 26 from the first laminate 23 illustrated in Figs. 12A and 12B.

[0149]

Method of manufacturing semiconductor device with back surface protective film

Figs. 12C to 12E and Figs. 13A to 13C are schematic cross-sectional views schematically illustrating an example of an embodiment of a method of manufacturing a semiconductor device equipped with a back surface protective film. The method of manufacturing a semiconductor device equipped with a back surface protective film according to the present embodiment includes: a step of dicing the workpiece 14, the back surface protective film 13', and the protection layer 12 of the fourth laminate 26 manufactured by the method of manufacturing a fourth laminate, and thereby forming a semiconductor device 22' equipped with a back surface protective film (Fig. 12C, Fig. 12D, Fig. 13A and Fig. 13B); and a step of picking up the semiconductor device 22' equipped with a back surface protective film from the protection layer 12 (Fig. 12E, Fig. 13C).

[0150]

Figs. 14A to 14D are schematic cross-sectional views schematically illustrating another example of an embodiment of the method of manufacturing a semiconductor device equipped with a back surface protective film. The method of manufacturing a semiconductor device equipped with a back surface protective film according to the present embodiment includes: a step of dicing the back surface protective film-forming film 13, the workpiece 14, and the protection layer 12 of the third laminate 25 manufactured by the method of manufacturing a third laminate, and thereby forming a semiconductor device 22 equipped with a back surface protective film-forming film (Fig. 14A and Fig. 14B); a curing step of curing the back surface protective film-forming film 13 to form a back surface protective film 13' (Fig. 14C); and a step of picking up a semiconductor device 22' equipped with a back surface protective film from the support sheet 10 (protection layer 12) (Fig. 14D).

[0151]

Dicing in the above-described method for manufacturing a semiconductor device can be implemented by various dicing methods such as blade dicing using a blade, laser dicing through laser irradiation, or water dicing by spraying water containing an abrasive. In these dicing methods, the protection layer and the back surface protective film (back surface protective film-forming film) held on the support sheet through the protection layer and the back surface protective film (back surface protective film-forming film) are cut for each workpiece.

[0152]

Dicing in the method of manufacturing the semiconductor device described above can also be implemented through the Stealth Dicing (trade name) process. In the Stealth Dicing (trade name) process, first, the location at which the wafer is to be divided is established within the wafer, and with this location as the focal point, the wafer is irradiated with laser light focused on this focal point, and thereby a modified layer is formed in the wafer. Unlike other locations of the wafer, the modified layer of the wafer is altered by irradiation with the laser light, and the strength is weakened. Therefore, when force is applied to the wafer, cracks extending in the direction of both sides of the wafer are generated in the modified layer inside the wafer, and the cracks serve as a starting point for dividing (cutting) the wafer. Next, a force is applied to the wafer, causing the wafer to be divided at the location of the modified layer, and a chip is thereby produced. At this time, for example, the wafer in which the modified layer is formed and which is held on the support sheet through the protection layer and the back surface protective film (back surface protective film-forming film) is stretched in a direction parallel to the surface of the wafer along with the support sheet, the protection layer, and the back surface protective film (back surface protective film-forming film), and thereby

force is applied to the wafer, and a chip equipped with a back surface protective film can be produced.

[0153]

In the method of manufacturing a semiconductor device equipped with a back
5 surface protective film according to the present embodiment, the back surface protective
film-forming film 13 is thermally curable, and in the curing of the back surface protective
film-forming film 13 to form a back surface protective film according to the present
embodiment, for example, the back surface protective film-forming film 13 is thermally
cured under conditions of 130°C for 2 h.

10 [0154]

The curing conditions for thermally curing the thermosetting back surface
protective film-forming film to form a back surface protective film are not particularly
limited as long as the back surface protective film has a degree of curing sufficient to
exhibit its function as described above, and the curing conditions are appropriately
15 selected according to the type of the thermosetting back surface protective film-forming
film.

[0155]

In the method of manufacturing a semiconductor device equipped with a back
surface protective film according to the present embodiment, the back surface protective
20 film-forming film 13 is energy ray-curable, and the step of forming the back surface
protective film may be a step of irradiating the back surface protective film-forming film
13 with energy rays to thereby cure the back surface protective film-forming film with
energy rays.

[0156]

The curing conditions for curing the energy ray-curable back surface protective film-forming film with energy rays to form the back surface protective film are not particularly limited as long as the back surface protective film has a degree of curing sufficient to exhibit the functions of the back surface protective film, and the curing conditions are appropriately selected according to the type of the energy ray-curable back surface protective film-forming film.

For example, the illuminance of the energy rays during the energy ray curing of the energy ray-curable back surface protective film-forming film is preferably from 4 to 280 mW/cm². In addition, the dose of the energy rays during the curing is preferably from 3 to 1000 mJ/cm².

[0157]

For the energy ray-curable back surface protective film-forming film, a film disclosed, for example, in WO 2017/188200 or WO 2017/188218 can be also used.

[0158]

When the protection layer 12 is not provided, the semiconductor device 22' equipped with the back surface protective film is picked up from the support sheet 10. If a thermosetting film is used as the back surface protective film-forming film 13, the pressure sensitive adhesive strength between the support sheet 10 and the back surface protective film 13' after curing increases, and pickup may be difficult. In this case, it is necessary to adjust the composition of the pressure sensitive adhesive component of the support sheet.

On the other hand, when the back surface protective film-forming composite 1 of the present embodiment is used, the semiconductor device 22' equipped with a back surface protective film is picked up from the protection layer 12. In this case, if the pressure sensitive adhesive strength between the protection layer 12 and the support sheet

10 is sufficiently large, the semiconductor device 22' equipped with a back surface protective film can be easily picked up without optimizing the pressure sensitive adhesive strength of the protection layer 12 and the device 22' equipped with a back surface protective film.

5 Examples

[0159]

Hereinafter, the present invention will be described in further detail with reference to specific examples. However, the present invention is in no way limited to the examples described below.

10 [0160]

Evaluating suppression of deformation to back surface protective film-forming film in conveyance step

Wafers equipped with a back surface protective film-forming composite obtained in Examples 1 to 3 and Comparative Example 1 described below were set on a
15 table at a temperature setting of 40°C with the semiconductor wafer side facing downward, and the wafers were left in that state for one minute. At this time, the measured surface temperature of the table was from 37 to 38°C. A wafer equipped with a back surface protective film-forming composite was suctioned from the upper side of the wafer equipped with a back surface protective film-forming composite using a
20 standard 8" I-type robot arm (suction area of arm leading end part: diameter of 34 mm) having suctioning holes with a vacuum source pressure of -80 kPa or less for 30 minutes. Subsequently, the wafer equipped with the back surface protective film-forming composite was set on a table at room temperature with the semiconductor wafer facing downward, and suctioning by the robot arm was stopped. The upper surface of the
25 wafer equipped with the back surface protective film-forming composite was visually

checked, and those with no visible suction marks were given an evaluation of A, and those with visible suction marks were given an evaluation of B.

[0161]

Manufacturing of back surface protective film-forming film

5 A first release sheet (SP-PET5011, available from Lintec Corporation, thickness of 50 μm) having a silicone-based release agent layer formed on one side of a polyethylene terephthalate (PET) film, and a second release sheet (SP-PET381031, available from Lintec Corporation, thickness of 38 μm) having a silicone-based release agent layer formed on one side of a PET film were prepared.

10 [0162]

A coating solution for a back surface protective film-forming film was applied with a knife coater onto the release surface of the first release sheet, and then dried in an oven at 120°C for 2 minutes to form a back surface protective film-forming film having a thickness of 40 μm . Next, the release surface of the second release sheet was

15 superimposed on the back surface protective film-forming film, the second release sheet and the back surface protective film-forming film were bonded together, and a back surface protective film-forming sheet formed from the first release sheet, a back surface protective film-forming film (LC2846, available from Lintec Corporation, thickness of 40 μm), and the second release sheet was obtained.

20 [0163]

Protection layer

A sheet (SP-PET5011, available from Lintec Corporation, thickness of 50 μm) obtained by forming a silicone-based release agent layer on one side of a polyethylene terephthalate (PET) film and which is the first release sheet described above was used as
25 a protection layer 1.

[0164]

A film for forming a protection layer 2 was manufactured by the following method.

A pressure sensitive adhesive composition having a solids content concentration
5 of 30 mass% was prepared, the pressure sensitive adhesive composition containing an
acrylic polymer (100 parts by mass, solids content) and a tri-functional xylylene
diisocyanate-based crosslinking agent (Takenate D110N, available from Mitsui Takeda
Chemicals, Inc.) (10.7 parts by mass, solids content), and further containing methyl ethyl
ketone as a solvent. Note that the acrylic polymer was obtained by copolymerizing 2-
10 ethylhexyl acrylate (36 parts by mass), butyl acrylate (59 parts by mass), and 2-
hydroxyethyl acrylate (5 parts by mass), and had a weight average molecular weight of
600000.

A release film (SP-PET381031, available from Lintec Corporation, thickness of
38 μm) obtained by release treating one surface of a polyethylene terephthalate (PET)
15 film with a silicone treatment was used, the release-treated surface was coated with the
pressure sensitive adhesive composition obtained above and then heated and dried for
two minutes at 120°C, and thereby a pressure sensitive adhesive layer having a thickness
of 5 μm was formed.

Next, a polypropylene-based film (Young's modulus of 400 MPa, thickness of
20 80 μm) was adhered, as a base material, onto an exposed surface of this pressure
sensitive adhesive layer, and thereby a film for forming a protection layer 2 provided
with the pressure sensitive adhesive layer on one surface of the base material was
obtained.

[0165]

The polypropylene-based film used in the production of the film for forming the protection layer 2 was used as a film for forming a protection layer 3 (no pressure sensitive adhesive layer).

[0166]

5 Example 1

The second release sheet on the back surface protective film-forming film side was peeled off, and the exposed surface was affixed to an 8-inch semiconductor wafer (thickness of 300 μm), and a wafer equipped with a back surface protective film-forming composite A was obtained with the first release sheet remaining as the protection layer 1.

10 The wafer equipped with the back surface protective film-forming composite A was subjected to a deformation evaluation of the back surface protective film-forming film in the conveyance step by the method described above. The suction pressure and results of the evaluation described above are shown in Table 1.

[0167]

15 Example 2

The second release sheet on the back surface protective film-forming film side was peeled off, the exposed surface was affixed to an 8-inch semiconductor wafer (thickness of 300 μm), and a pressure sensitive adhesive layer exposed by peeling off the release film of the film for forming the protection layer 2 was affixed to the back surface
20 protective film-forming film exposed by peeling off the first release sheet, and a wafer equipped with a back surface protective film-forming composite B was obtained.

The wafer equipped with the back surface protective film-forming composite B was subjected to a deformation evaluation of the back surface protective film-forming film in the conveyance step by the method described above. The suction pressure and
25 results of the evaluation described above are shown in Table 1.

[0168]

Example 3

The second release sheet on the back surface protective film-forming film side was peeled off, the exposed surface was affixed to an 8-inch semiconductor wafer (thickness of 300 μm), and the film for forming a protection layer 3 was affixed to the back surface protective film-forming film exposed by peeling off the first release sheet, and a wafer equipped with a back surface protective film-forming composite C was obtained.

The wafer equipped with the back surface protective film-forming composite C was subjected to a deformation evaluation of the back surface protective film-forming film in the conveyance step by the method described above. The suction pressure and results of the evaluation described above are shown in Table 1.

[0169]

Comparative Example 1

The second release sheet on the back surface protective film-forming film side was peeled off, and the exposed surface was affixed to an 8-inch semiconductor wafer (thickness of 300 μm), the first release sheet was then peeled off, and a wafer equipped with a back surface protective film-forming film was obtained.

The wafer equipped with a back surface protective film-forming film was subjected to deformation evaluation of the back surface protective film-forming film in the conveyance step by the method described above. The suction pressure and results of the evaluation described above are shown in Table 1.

[0170]

Table 1

	Sample	Protection Layer	Suction Pressure (kPa)	Results
Example 1	Wafer with back surface protective film-forming composite A	Protection layer 1	-83.5	A
Example 2	Wafer with back surface protective film-forming composite B	Protection layer 2	-83.5	A
Example 3	Wafer with back surface protective film-forming composite C	Protection layer 3	-83.6	A
Comparative Example	Wafer with back surface protective film-forming film	None	-83.8	B

[0171]

Absolutely no suction marks were confirmed in Examples 1 to 3 having the protection layer of the present invention. On the other hand, suction marks were confirmed in Comparative Example 1, which did not include the protection layer of the present invention.

[Industrial Applicability]

[0172]

The back surface protective film-forming composite of the present invention can be used for manufacturing a semiconductor device equipped with a back surface protective film.

[Reference Signs List]

[0173]

- 1: Back surface protective film-forming composite
- 2: Back surface protective film-forming composite
- 3: Back surface protective film-forming composite

	7:	Semiconductor chip equipped with back surface protective film
	8:	Semiconductor wafer
	8a:	Circuit surface of semiconductor wafer
	8b:	Back surface of semiconductor wafer
5	9:	Semiconductor chip
	10:	Support sheet
	101:	Base material
	102:	Pressure sensitive adhesive layer
	12:	Protection layer
10	13:	Back surface protective film-forming film
	13':	Back surface protective film
	14:	Workpiece
	14a:	Circuit surface of workpiece
	14b:	Back surface of workpiece 14
15	151:	Release film
	152:	Release film
	17:	Circuit surface-protecting tape
	18:	Fixing jig
	21:	Semiconductor device
20	22:	Semiconductor device equipped with back surface protective film-forming film
	22':	Semiconductor device equipped with back surface protective film
	23:	First laminate
	24:	Second laminate
25	25:	Third laminate

26: Fourth laminate

CLAIMS

[Claim 1]

A back surface protective film-forming composite comprising a protection layer and a back surface protective film-forming film, the protection layer and the back surface protective film-forming film being laminated, the back surface protective film-forming composite for use in a method of manufacturing a first laminate, the method comprising:

a first lamination step of affixing the back surface protective film-forming film to a back surface of a semiconductor substrate to obtain a second laminate, the second laminate comprising the semiconductor substrate, the back surface protective film-forming film, and the protection layer, which are laminated in this order;

a curing step of curing the back surface protective film-forming film of the second laminate to form a back surface protective film; and

a conveyance step of conveying the second laminate from the first lamination step to the curing step,

wherein the first laminate comprises the semiconductor substrate, the back surface protective film, and the protection layer, which are laminated in this order.

[Claim 2]

A back surface protective film-forming composite comprising a protection layer and a back surface protective film-forming film, the protection layer and the back surface protective film-forming film being laminated, the back surface protective film-forming composite for use in a method of manufacturing a third laminate, the method comprising:

a first lamination step of affixing the back surface protective film-forming film to a back surface of a semiconductor substrate to obtain a second laminate, the second laminate comprising the semiconductor substrate, the back surface protective film-forming film, and the protection layer, which are laminated in this order;

a second lamination step of affixing a support sheet to the protection layer of the second laminate to obtain a third laminate, the third laminate comprising the semiconductor substrate, the back surface protective film-forming film, the protection layer, and the support sheet, which are laminated in this order; and

5 a conveyance step of conveying the second laminate from the first lamination step to the second lamination step.

[Claim 3]

A method of manufacturing a first laminate, the first laminate comprising a semiconductor substrate, a back surface protective film, and a protection layer, which are
10 laminated in this order, the method comprising:

a first lamination step of affixing the back surface protective film-forming film of the back surface protective film-forming composite described in claim 1 to a back surface of the semiconductor substrate to obtain a second laminate, the second laminate comprising the semiconductor substrate, the back surface protective film-forming film,
15 and the protection layer, which are laminated in this order;

a curing step of curing the back surface protective film-forming film of the second laminate to form a back surface protective film; and

a conveyance step of conveying the second laminate from the first lamination step to the curing step.

20 [Claim 4]

A method of manufacturing a third laminate, the third laminate comprising a semiconductor substrate, a back surface protective film-forming film, a protection layer, and a support sheet, which are laminated in this order, the method comprising:

a first lamination step of affixing the back surface protective film-forming film
25 of the back surface protective film-forming composite described in claim 2 to a back

surface of the semiconductor substrate to obtain a second laminate, the second laminate comprising the semiconductor substrate, the back surface protective film-forming film, and the protection layer, which are laminated in this order;

a second lamination step of affixing a support sheet to the protection layer of the
5 second laminate to obtain a third laminate, the third laminate comprising the semiconductor substrate, the back surface protective film-forming film, the protection layer, and the support sheet, which are laminated in this order; and

a conveyance step of conveying the second laminate from the first lamination step to the second lamination step.

10 [Claim 5]

A method of manufacturing a semiconductor device equipped with a back surface protective film, the method comprising:

a second lamination step of affixing a support sheet to the protection layer of a first laminate manufactured by the manufacturing method described in claim 3 to obtain a
15 fourth laminate, the fourth laminate comprising the semiconductor substrate, the back surface protective film, the protection layer, and the support sheet, which are laminated in this order;

a step of dicing the semiconductor substrate and the back surface protective film of the fourth laminate to form a semiconductor device equipped with a back surface
20 protective film; and

a step of picking up the semiconductor device equipped with a back surface protective film from the support sheet.

[Claim 6]

A method of manufacturing a semiconductor device equipped with a back
25 surface protective film, the method comprising:

a curing step of curing the back surface protective film-forming film of a third laminate manufactured by the manufacturing method described in claim 4 to form a back surface protective film and obtain a fourth laminate, the fourth laminate comprising the semiconductor substrate, the back surface protective film, the protection layer, and the support sheet, which are laminated in this order;

a step of dicing the semiconductor substrate and the back surface protective film of the fourth laminate to form a semiconductor device equipped with a back surface protective film; and

a step of picking up the semiconductor device equipped with a back surface protective film from the support sheet.

[Claim 7]

A method of manufacturing a semiconductor device equipped with a back surface protective film, the method comprising:

a step of dicing the semiconductor substrate and the back surface protective film-forming film of the third laminate manufactured by the manufacturing method described in claim 4 to form a semiconductor device equipped with a back surface protective film-forming film;

a curing step of curing the back surface protective film-forming film to form a back surface protective film; and

a step of picking up the semiconductor equipped with a back surface protective film-forming film or a semiconductor device equipped with a back surface protective film from the support sheet.