SPECIFICATION

Title of the Invention:

WAFER-PROCESSING FILM AND METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE BY USING WAFER-PROCESSING FILM

Technical Field

[0001] The present invention relates to wafer-processing films and particularly relates to a wafer-processing film including a dicing/die-bonding film having two functions of a dicing tape and a die-bonding film. The present invention also relates to a method of manufacturing a semiconductor device by using the wafer-processing film.

Background Art

[0002] Recently, a dicing/die-bonding film that has, in combination, two functions, i.e., the function of a dicing tape and the function of a die-bonding film (also called a die attach film) has been under development. The dicing tape is for fixing a semiconductor wafer when the semiconductor wafer is to be cut and separated (diced) into individual semiconductor chips. The die-bonding film is for bonding the cut semiconductor chip onto, for example, a lead frame or a package substrate or for mutually stacking and bonding the semiconductor chips in a stacked package.

[0003] Examples of such a dicing/die-bonding film include a film which has undergone precut processing in consideration of workability for, for example, pasting to a semiconductor wafer or attachment to a ring frame upon dicing.

[0004] An example of a dicing/die-bonding film which has undergone precut processing is shown in FIG. 4 and FIG. 5. FIG. 4, FIG. 5 (A), and FIG. 5 (B) are, respectively, a schematic view, a plan view, and a cross sectional view of a wafer-processing film 30 provided with a dicing/die-bonding film 35. The wafer-processing film 30 is composed of a release film 31, an adhesive-agent layer 32, and a bonding film 33. The adhesive-agent layer 32 has a circular label shape which has been processed into a shape (for example, circular) corresponding to the shape of a semiconductor wafer. In the bonding film 33, a peripheral region of a circular part corresponding to the shape of a ring frame for dicing is removed, and the bonding film 33 has a circular label part 33a and a peripheral part 33b surrounding the outside of the circular label part 33a as shown in the drawings. The adhesive-agent layer 32 and the circular label part 33a of the bonding film 33 are stacked in a manner that the centers thereof mutually match, and the circular label part 33a of the bonding film 33 covers the adhesive-agent layer 32 and is in contact with the release film 31 by the periphery thereof. A multilayer structure composed of the adhesive-agent layer 32 and the circular label part 33a of the bonding film 33 constitutes the dicing/die-bonding film 35.

[0005] When the semiconductor wafer is to be diced, the release film 31 is peeled off from the adhesive-agent layer 32 and the bonding film 33, which are in a multilayer state, a back surface of the semiconductor wafer W is pasted onto

the adhesive-agent layer 32 as shown in FIG. 6, and the dicing ring frame R is adhesively fixed to an outer peripheral part of the circular label part 33a of the bonding film 33. The semiconductor wafer W is diced in this state to form separated semiconductor chips, the bonding film 33 (33a) is then subjected to hardening treatment such as ultraviolet radiation, and the semiconductor chips are picked up. At this point, the bonding force of the bonding film 33 (33a) is lowered because of the hardening treatment; therefore, the bonding film is easily peeled off from the adhesive-agent layer 32, and the semiconductor chips are picked up in the state in which the adhesive-agent layer 32 is attached to the back surface thereof. The adhesive-agent layer 32 attached to the back surface of the semiconductor chips then functions as a die bonding film when the semiconductor chips are to be bonded to lead frames, package substrates, or other semiconductor chips thereafter.

[0006] As shown in FIG. 4 and FIG. 5, in the wafer-processing film 30 as described above, the part in which the adhesive-agent layer 32 and the circular label part 33a of the bonding film 33 are stacked is thicker than the other part. The exposed part between the circular label part 33a of the release film 31 and the peripheral part 33b is the part from which the bonding film 33 is removed, and steps corresponding to the thickness of the bonding film 33 are formed between the parts of the bonding film 33 (33a, 33b). The wafer-processing film 30 is commercially

available as a product in a state in which the film is wound like a roll by using a roll core 50 (see FIG. 7). FIG. 7 shows an example of the roll core 50 in which a cylindrical hollow part 53 is formed at the rotation center thereof. Therefore, as shown in FIG. 8, when the wafer-processing film 30 is wound like a roll, the above described steps formed by the bonding film 33 and the release film 31 are mutually overlapped at the stacked part of the adhesive-agent layer 32 and the circular label part 33a of the bonding film 33, and a phenomenon in which the steps are transferred onto the flexible surface of the adhesive-agent layer 32 occurs, in other words, transfer traces (also referred to as label traces, wrinkles, or wind traces) as shown in FIG. 9 are generated. Such generation of the transfer traces is notable particularly in, for example, the case in which the adhesive-agent layer 32 is formed of a soft resin, the case in which the adhesive-agent layer is thick, and the case in which the number of winding of the wafer-processing film 30 is large. In the case in which the transfer traces are generated, when the back surface of the semiconductor wafer W is to be pasted on the adhesive-agent layer 32, the back surface is pasted while air is contained between the adhesive-agent layer 32 and the semiconductor wafer W. Therefore, the adhesive-agent layer 32 and the semiconductor wafer W do not cohere to each other, insufficient bonding is caused as a result, and failure may be caused upon processing of the semiconductor wafer.

[0007] It is conceivable to reduce the winding pressure of the wafer-processing film in order to suppress generation of the above described transfer traces. However, in this method, winding misalignment of the product may be caused, and a trouble may occur when the wafer-processing film is actually subjected to use, for example, setting to a tape mounter becomes difficult.

[0008] Patent Document 1 discloses an adhesive sheet in which a support layer having a film thickness equivalent to or more than the total film thickness of an adhesive-agent layer and a bonding film is provided outside of the adhesive-agent layer and the bonding film on a peel-off base material in order to suppress generation of label traces as described above. Since the adhesive sheet of Patent Document 1 is provided with the support layer, the winding pressure which has been applied to the adhesive sheet is dispersed or concentrated on the support layer to suppress generation of the transfer traces.

Prior Art Document

Patent Document

[0009]

Patent Document 1: Japanese Patent Application Laid-open No. 2007-2173

Summary of the Invention

Problem to be Solved by the Invention

[0010] However, in the above described adhesive sheet of Patent Document 1, on a peel-off substrate, the support layer is formed at a part other than the adhesive-agent layer and the bonding film required for, for example, manufacturing a semiconductor device; therefore, there has been a problem that the width of the support layer is limited, the width of the support layer is narrow with respect to the outer diameters of the adhesive-agent layer and the bonding film, and the effect of suppressing label traces is not sufficient. Moreover, the support layer generally does not have adhesiveness and is not sufficiently pasted to the peel-off base material (PET film); therefore, there has been a problem that the support layer floats above the peel-off base material at the part where the support layer is the narrowest, the above described floating part is caught by a device when the dicing/die-bonding film is to be pasted on a semiconductor wafer, and the semiconductor wafer is damaged.

[0011] Increasing the width of the support layer is conceivable; however, usage of existing equipment becomes difficult since the width of the whole wafer-processing film is also increased. Since the support layer is a part which is disposed of in the end, increasing the width of the support layer leads to increase in material cost.

[0012] Therefore, it is an object of the present invention to provide a wafer-processing film capable of sufficiently suppressing generation of transfer traces on an adhesive-agent layer when the wafer-processing film

including a dicing/die-bonding film having the adhesive-agent layer and a bonding film is wound like a roll. Also, it is another object of the present invention to provide a method of manufacturing a semiconductor device by using such a wafer-processing film.

Means for Solving the Problems

[0013] In order to achieve above described objects, a wafer-processing film according to a first aspect of the present invention has: a bonding film composed of a base material film and a bonding-agent layer provided on the base material film; and an adhesive-agent layer provided on the bonding-agent layer; wherein the bonding-agent layer contains a radiation polymerizable compound and a first photo initiator at a position corresponding to at least a ring frame and contains the radiation polymerizable compound and a second photo initiator at a position other than a location containing the first photo initiator; and the wavelength of light reactable with the first photo initiator is different from the wavelength of light reactable with the second photo initiator.

[0014] According to the above described wafer-processing film of the invention, the bonding-agent layer contains the photo initiators reactable with mutually different wavelengths in the part corresponding to at least the ring frame and the part other than that. Therefore, when the bonding-agent layer is irradiated with the light having the wavelength reactable with the first photo initiator,

the part corresponding to at least the ring frame is hardened to reduce bonding force so that the adhesive-agent layer corresponding to the hardened part can be peeled off. Then, when the bonding-agent layer is irradiated with the light having the wavelength reactable with the second photo initiator, the semiconductor wafer and the adhesive-agent layer can be peeled off from the bonding-agent layer and picked up.

[0015] Pre-cutting an adhesive-agent layer and a bonding-agent layer covering the adhesive-agent layer into a shape corresponding to a ring frame has been essential in a conventional wafer-processing film; however, in the wafer-processing film of the present invention, the adhesive-agent layer can be gradually peeled off from the part corresponding to at least the ring frame and the part other than that, and pre-cutting is therefore not required. As a result, when the wafer-processing film is wound like a roll as a product, generation of transfer traces in the adhesive-agent layer can be prevented.

[0016] A wafer-processing film according to a second aspect of the present invention has: a bonding film composed of a base material film and a bonding-agent layer provided on the base material film; and an adhesive-agent layer provided on the bonding-agent layer; wherein the bonding-agent layer contains either one of a radiation polymerizable compound and a thermo-polymerizable compound in a part corresponding to at least a ring frame and contains the other one of the radiation polymerizable compound and

the thermo-polymerizable compound in a part other than the location containing one of the radiation polymerizable compound and the thermo-polymerizable compound.

[0017] According to the above described invention, in the case in which the part of the bonding-agent layer corresponding to at least the ring frame contains the radiation polymerizable compound, when the bonding-agent layer is irradiated with radiation, the part corresponding to at least the ring frame can be hardened to reduce bonding force, and the adhesive-agent layer corresponding to the hardened part can be peeled off. Then, since the part other than the part corresponding to at least the ring frame contains the thermo-polymerizable compound, when the part is thermo-polymerized and hardened, the semiconductor wafer and the adhesive-agent layer can be peeled off from the bonding-agent layer and picked up.

[0018] On the other hand, if the part of the bonding-agent layer corresponding to at least the ring frame contains the thermo-polymerizable compound, the part can be thermo-polymerized and hardened to reduce bonding force, and the adhesive-agent layer corresponding to the hardened part can be peeled off. Then, since the part other than the part corresponding to at least the ring frame contains the radiation polymerizable compound, the bonding-agent layer is irradiated with radiation to harden the part other than the part corresponding to at least the ring frame, and the semiconductor wafer and the adhesive-agent layer

can be peeled off from the bonding-agent layer and picked up.

[0019] Moreover, the wafer-processing film according to a third aspect of the present invention is the wafer-processing film according to the above described first or second aspect of the present invention, wherein the adhesive-agent layer has not been pre-cut into a shape corresponding to a semiconductor wafer, and the bonding-agent layer has not been pre-cut into a shape corresponding to the ring frame.

[0020] According to the above described invention, the adhesive-agent layer and the bonding-agent layer have not been pre-cut. Therefore, steps which have been conventionally formed at the stacking part of the adhesive-agent layer and the bonding film are not present. Therefore, when the wafer-processing film is wound like a roll as a product, transfer traces can be prevented from being generated in the adhesive-agent layer.

[0021] Moreover, the wafer-processing film according to a fourth aspect of the present invention is the wafer-processing film according to any one of above described first to third aspects of the present invention, wherein, in the adhesive-agent layer, an incision is provided at least outside of a position corresponding to the semiconductor wafer and inside of a position corresponding to the ring frame.

[0022] According to the above described wafer-processing film of the invention, the bonding-agent layer of the part

corresponding to at least the ring frame is hardened to reduce the bonding force, so that the adhesive-agent layer can be peeled off from the hardened part of the bonding-agent layer while using the incision as a base point.

[0023] A method of manufacturing the semiconductor device according to the first aspect of the present invention is a method of manufacturing the semiconductor device by using the wafer-processing film according to any one of the first to fourth aspects of the present invention, wherein the method includes: a step of hardening a part of the bonding-agent layer that is other than a part corresponding to a wafer and is corresponding to at least the ring frame and peeling off the adhesive-agent layer from the hardened part of the bonding-agent layer; a step of pasting the wafer on the adhesive-agent layer; a step of fixing the ring frame to the bonding-agent layer; a step of dicing the wafer to form separated chips with the adhesive-agent layer; and a step of hardening the part of the bonding-agent layer corresponding to the wafer and picking up the separated chips with the adhesive-agent layer.

[0024] According to the above described method of manufacturing the semiconductor device of the invention, the part of the bonding-agent layer that is other than the part corresponding to the wafer and is corresponding to at least the ring frame and the part of the bonding-agent layer corresponding to the semiconductor wafer are gradually hardened to reduce the bonding force of the bonding-agent layer, so that the peelable positions can be changed between

the adhesive-agent layer and the bonding-agent layer. Therefore, the design of a desired semiconductor device can be changed without greatly changing existing equipment.

[0025] In the above described method of manufacturing the semiconductor device of the invention, the adhesive-agent layer and the bonding-agent layer are not required to be pre-cut in relation to the wafer-processing film before manufacturing the semiconductor device. Therefore, steps which have been generated at the stacking part of the adhesive-agent layer and the bonding film when the film is wound like a roll as a product are not present, and transfer traces can be therefore prevented from being generated in the adhesive-agent layer.

Effects of the Invention

[0026] According to the wafer-processing film according to the first aspect of the present invention, the bonding-agent layer contains the photo initiators reactable with different wavelengths in the part corresponding to at least the ring frame and the part other than that; therefore, when the bonding-agent layer is irradiated with the wavelength reactable with the first photo initiator, the part corresponding to at least the ring frame is hardened to reduce bonding force so that the adhesive-agent layer corresponding to the hardened part can be peeled off. Then, when the bonding-agent layer is irradiated with the light of the wavelength reactable with the second photo initiator, the semiconductor wafer and the adhesive-agent layer can

be peeled off from the bonding-agent layer and picked up. In a conventional wafer-processing film, pre-cutting the adhesive-agent layer and the bonding-agent layer covering the adhesive-agent layer into the shape corresponding to the ring frame has been essential; however, in the wafer-processing film of the present invention, the adhesive-agent layer can be gradually peeled off from the part corresponding to at least the ring frame and the part other than that, and pre-cutting is therefore not required. As a result, when the wafer-processing film is wound like a roll as a product, transfer traces can be prevented from being generated in the adhesive-agent layer. Therefore, reduction in the cohesiveness between the adhesive-agent layer and the semiconductor wafer caused when air is involved between the adhesive-agent layer and the semiconductor wafer can be prevented, and insufficient bonding upon bonding of the semiconductor chip to a lead frame, a package substrate, or another semiconductor chip and failure upon processing of the semiconductor wafer can be prevented.

[0027] According to the wafer-processing film according to the second aspect of the present invention, in the case in which the part of the bonding-agent layer corresponding to at least the ring frame contains the radiation polymerizable compound, when the bonding-agent layer is irradiated with radiation, the part corresponding to at least the ring frame can be hardened to reduce bonding force so that the adhesive-agent layer corresponding to the hardened part can be peeled off. Since the part other than

the part corresponding to at least the ring frame contains the thermo-polymerizable compound, when the part is thermally polymerized and hardened, the semiconductor wafer and the adhesive-agent layer can be peeled off from the bonding-agent layer and picked up. On the other hand, if the part of the bonding-agent layer corresponding to at least the ring frame contains the thermo-polymerizable compound, the part is thermally polymerized and hardened to reduce bonding force so that the adhesive-agent layer corresponding to the hardened part can be peeled off. Since the part other than the part corresponding to at least the ring frame contains the radiation polymerizable compound, the bonding-agent layer is irradiated with radiation to harden the part other than the part corresponding to at least the ring frame so that the semiconductor wafer and the adhesive-agent layer can be peeled off from the bonding-agent layer and picked up. In a conventional wafer-processing film, it has been essential to pre-cut an adhesive-agent layer and a bonding-agent layer covering the adhesive-agent layer into the shape corresponding to a ring frame. However, in the wafer-processing film of the present invention, the adhesive-agent layer can be gradually peeled off in the part of the bonding-agent layer corresponding to the ring frame and the part other than that; therefore, pre-cutting becomes unnecessary. As a result, when the wafer-processing film is wound like a roll as a product, transfer traces can be prevented from being generated in the adhesive-agent layer. Therefore,

reduction in the cohesiveness between the adhesive-agent layer and the semiconductor wafer caused when air is involved between the adhesive-agent layer and the semiconductor wafer can be prevented, and insufficient bonding upon bonding of the semiconductor chip to a lead frame, a package substrate, or another semiconductor chip and failure upon processing of the semiconductor wafer can be prevented.

[0028] According to the wafer-processing film according to the third aspect of the present invention, the adhesive-agent layer and the bonding-agent layer have not been pre-cut; therefore, steps which have been conventionally generated at the stacking part of the adhesive-agent layer and the bonding film are also not present. Therefore, when the wafer-processing film is wound like a roll as a product, transfer traces can be prevented from being generated in the adhesive-agent layer. Therefore, reduction in cohesiveness between the adhesive-agent layer and the semiconductor wafer caused when air is involved between the adhesive-agent layer and the semiconductor wafer can be prevented, and insufficient bonding upon bonding of the semiconductor chip to a lead frame, a package substrate, or another semiconductor chip and failure upon processing of the semiconductor wafer can be prevented.

[0029] According to the wafer-processing film according to the fourth aspect of the present invention, the bonding-agent layer of the part corresponding to at least the ring frame is hardened to reduce bonding force so that the adhesive-agent layer can be peeled off from the hardened

part of the bonding-agent layer while using the incision as a base point.

[0030] According to the method of manufacturing the semiconductor device according to the first aspect of the present invention, the part of the adhesive-agent layer that is other than the part corresponding to the semiconductor wafer and is corresponding to at least the ring frame and the part of the bonding-agent layer corresponding to the semiconductor wafer are gradually hardened to reduce the bonding force of the bonding-agent layer so that the peelable positions can be changed between the adhesive-agent layer and the bonding-agent layer. Therefore, the design of a desired semiconductor device can be changed without greatly changing existing equipment. In relation to the wafer-processing film before manufacturing the semiconductor device, the steps which have been generally present at the stacking part of the adhesive-agent layer and the bonding film are not present since the adhesive-agent layer and the bonding-agent layer are not required to be pre-cut. Therefore, when the film is wound like a roll as a product, transfer traces can be prevented from being generated in the adhesive-agent layer.

Brief Description of the Drawings

[0031] FIG. 1 is a cross sectional view of a wafer-processing film according to a present embodiment.

FIG. 2 shows drawings for explaining a method of manufacturing a semiconductor device by using the wafer-processing film according to the present embodiment.

FIG. 3 shows drawings explaining the method of manufacturing the semiconductor device by using the wafer-processing film according to the present embodiment.

FIG. 4 is a schematic view of a conventional wafer-processing film.

FIG. 5 (A) is a plan view of the conventional wafer-processing film, and FIG. 5 (B) is a cross sectional view thereof.

FIG. 6 is a cross sectional view showing a state in which a dicing/die-bonding film and a ring frame for dicing are pasted with each other.

FIG. 7 (A) is a cross sectional view of a conventional roll core, and FIG. 7 (B) is a lateral view thereof.

FIG. 8 is a drawing explaining a state in which a wafer-processing film is wound by using the conventional roll core.

FIG. 9 is a schematic view for explaining a problem of the conventional wafer-processing film.

Description of Embodiments

[0032] Hereinafter, embodiments of the present invention will be explained in detail based on drawings. FIG. 1 is a cross sectional view of a wafer-processing film according to the present embodiment. FIG. 2 and FIG. 3 are drawings explaining a method of manufacturing a semiconductor device

by using the wafer-processing film according to the present embodiment.

[0033] <First Embodiment>

Hereinafter, constituent elements of a wafer-processing film according to a first embodiment of the present invention will be explained in detail. As shown in FIG. 1, the wafer-processing film 10 according to the first embodiment of the present invention is a dicing/die-bonding film 15 having a bonding film 14, which is composed of a base material film 11 and a bonding-agent layer 12 provided on the base material film 11, and an adhesive-agent layer 13 provided on the bonding-agent layer 12. The adhesive-agent layer 13 has not been pre-cut into the shape corresponding to a semiconductor wafer (or referred to as wafer), and the bonding-agent layer 12 has not been pre-cut into the shape corresponding to a ring frame. In the present embodiment, the bonding-agent layer 12 and the adhesive-agent layer 13 are stacked on the base material film 11 so as to be long like the base material film 11, and the wafer-processing film 10 has no part that has an uneven thickness. The bonding-agent layer 12 contains a radiation polymerizable compound and two types of photo initiators for which the wavelength of reactable light is mutually different.

[0034] When the dicing/die-bonding film 15 is distributed as a product, an unshown release film serving as a protective film is pasted on the entire surface thereof in the adhesive-agent layer 13 side, and the dicing/die-bonding

film is distributed to the market as the wafer-processing film 10. Hereinafter, the release film, the adhesive-agent layer 13, and the bonding film 14 composed of the base material film 11 and the bonding-agent layer 12, which are constituent elements of the wafer-processing film 10, will be explained.

[0035] (Release Film)

As the release film used in the wafer-processing film 10, a known film such as a polyethylene terephthalate (PET) based, polyethylene based, or other release-treated film can be used. The thickness of the release film is not particularly limited and may be arbitrarily set; however, the thickness is preferred to be 25 to 50 μm.

[0036] (Adhesive-Agent Layer)

The adhesive-agent layer 13 is used as an adhesive agent which is peeled off from the bonding film 14 and attached to a chip to fix the chip to a substrate or a lead frame when the semiconductor chip (or referred to as chip), which has been separated, is to be picked up after a semiconductor wafer or the like is pasted thereon and diced. Therefore, the adhesive-agent layer 13 has peelability that the adhesive-agent layer 13 can be peeled off from the bonding film 14 in the state in which the adhesive-agent layer is attached to the separated chip when the chip is to be picked up, and, furthermore, the adhesive-agent layer 13 has sufficient adhesive reliability in order to adhesively fix the chip to a substrate or a lead frame upon die bonding.

[0037] The adhesive-agent layer 13 is an adhesive agent formed into a film in advance; and, for example, a

publicly-known polyimide resin, polyamide resin, polyetherimide resin, polyamide imide resin, polyester resin, polyester resin, polyester imide resin, phenoxy resin, polysulfone resin, polyether sulfone resin, polyphenylene sulfide resin, polyether ketone resin, chlorinated polypropylene resin, acrylic resin, polyurethane resin, epoxy resin, polyacrylamide resin, melamine resin, or the like used in an adhesive agent or a mixture thereof can be used. Moreover, in order to reinforce the adhesive force with respect to the chip or the lead frame, it is desired to add a silane coupling agent or a titanium coupling agent as an additive to the above described material or mixture thereof.

[0038] The thickness of the adhesive-agent layer 13 is not particularly limited, but is normally preferred to be about 5 to 100 μm. The adhesive-agent layer 13 of the wafer-processing film 10 according to the present embodiment is stacked on the entire surface of the bonding-agent layer 12 of the bonding film 14 and has not undergone pre-cut corresponding to, for example, the shape of a semiconductor wafer, and an incision 13a is provided at least outside of a position corresponding to the semiconductor wafer and inside of a position corresponding to the ring frame. The incision 13a may be provided at a part where the inner periphery and the outer periphery of the ring frame is positioned when the ring frame is pasted thereon; however, in the present embodiment, the incision 13a is provided

at a position of the adhesive-agent layer 13 corresponding to the outer periphery of the semiconductor wafer.

[0039] Therefore, when part of the bonding-agent layer formed below the part of the adhesive-agent layer of the part outside the incision 13a of the adhesive-agent layer 13 is hardened, the bonding force of the hardened part of the bonding-agent layer is reduced, and the adhesive-agent layer 13 can be peeled off from the hardened part of the bonding-agent layer 12 using the incision 13a as a base point before the ring frame is fixed to the bonding-agent layer 12. Instead of the above described incision 13a provided at the position corresponding to the outer periphery of the semiconductor wafer, incisions may be provided at the positions corresponding to the inner periphery and the outer periphery of the ring frame, the part of the bonding-agent layer at the position corresponding to the ring frame may be hardened, and the part of the adhesive-agent layer 13 corresponding to the ring frame may be peeled off from the bonding-agent layer 12.

[0040] As a result, the wafer-processing film in which: the adhesive-agent layer 13 is present at the part on which the semiconductor wafer is to be pasted, and the adhesive-agent layer 13 is not present but only the bonding film 14 in which the bonding-agent layer 12 is hardened is present at the part on which the ring frame for dicing is to be pasted can be formed.

[0041] (Bonding Film)

The bonding film 14 according to the present embodiment is the base material film 11 provided with the adhesive-agent layer 12. The bonding film 14 has sufficient bonding force when the wafer is to be diced so that the wafer is not peeled off and has low bonding force when the chips are to be picked up after dicing so that the chips can be easily peeled off from the adhesive-agent layer 13. In the wafer-processing film 10 according to the present embodiment, the position of the adhesive-agent layer 13 corresponding to the ring frame is not precut; therefore, the bonding force of the bonding-agent layer 12 positioned below the part including the position of the adhesive-agent layer 13 corresponding to the ring frame has to be reduced before attaching the ring frame. Therefore, the bonding-agent layer 12 of the bonding film 14 contains the radiation polymerizable compound and first photo initiator in the part other than the part corresponding to the wafer and contains the radiation polymerizable compound and second photo initiator in the part other than the location containing the first photo initiator, in other words, in the part corresponding to the wafer. The part other than the part corresponding to the wafer is the part including the position corresponding to the ring frame; wherein, only the part corresponding to the ring frame may be configured to contain the first photo initiator, and the other part may be configured to contain the second photo initiator.

[0042] A conventionally publicly-known one can be used as the base material film 11 of the bonding film 14 without

particular limitation. However, since the bonding-agent layer 12 of the bonding film 14 according to the present embodiment contains the radiation-hardening radiation polymerizable compound, a film having radiation transparency is preferred to be used.

[0043] Examples of the material thereof include: a homopolymer or a copolymer of α-olefin such as polyethylene, polypropylene, ethylene-propylene copolymer, polybutene-1, poly-4-methylpenetene-1, ethylene-vinyl acetate copolymer, ethylene-ethyl acrylate copolymer, ethylene-methyl acrylate copolymer, ethylene-acrylate copolymer, and ionomer or a mixture thereof; polyurethane, styrene-ethylene-butene, or pentene copolymer; thermoplastic elastomer such as polyamide-polyol copolymer; and mixtures thereof. The base material film 11 may be a mixture of two or more materials selected from this group or may be a single layer or a plurality of layers thereof. The thickness of the base material film 11 is not particularly limited, but may be arbitrarily set, wherein 50 to 200 μm is preferred.

[0044] A resin used in the bonding-agent layer 12 of the bonding film 14 is not particularly limited; and a publicly-known chlorinated polypropylene resin, acrylic resin, polyester resin, polyurethane resin, epoxy resin, or the like used in a bonding agent can be used.

[0045] It is preferred to prepare an adhesive agent by arbitrarily mixing an acrylic bonding agent, a radiation polymerizable compound, a photopolymerization initiator,

a hardening agent, or the like with the resin of the bonding-agent layer 12, and the resin of the bonding-agent layer 12 according to the present embodiment contains the radiation polymerizable compound. Therefore, the radiation polymerizable compound is mixed in the bonding-agent layer 12 so that the bonding-agent layer 12 can be easily peeled off from the adhesive-agent layer 13 by radiation hardening. The thickness of the bonding-agent layer 12 is not particularly limited, but may be arbitrarily set, wherein 5 to 30 μm is preferred.

[0046] Examples of the radiation polymerizable compound which can be applied include: trimethylolpropane triacrylate, pentaerythritol triacrylate, pentaerythritol tetraacrylate, dipentaerythritol monohydroxy pentaacrylate, dipentaerythritol hexaacrylate, 1,4-butylene glycol diacrylate, 1,6hexanediol diacrylate, polyethylene glycol diacrylate, and oligo ester acrylate.

[0047] Other than the above described acrylate compounds, an urethane acrylate oligomer can be also used. The urethane acrylate oligomer can be obtained by reacting a terminal isocyanate urethane polymer, which is obtained by reacting a polyol compound of, for example, a polyester-type or polyether-type with a multivalent isocyanate compound (for example, 2,4-tolylenediisocyanate, 2,6-tolylenediisocyanate, 1,3-xylylenediisocyanate, 1,4-xylylenediisocyanate, diphenylmethane 4,4-diisocyanate), with acrylate or methacrylate having a hydroxyl group (for example, 2-hydroxyethyl acrylate,

2-hydroxyethyl methacrylate, 2-hydroxypropyl acrylate, 2-hydroxypropyl methacrylate, polyethyleneglycol acrylate, polyethyleneglycol methacrylate). The bonding-agent layer 12 may be a mixture of two or more species selected from the above described resins.

[0048] Examples of the photo initiators include: α-ketol based compounds such as 4-(2-hydroxyethoxy)phenyl(2-hydroxy-2-propyl)ketone, α-hydroxy-α, α'-dimethyl acetophenone, 2-methyl-2-hydroxypropiophenone, and 1-hydroxycyclohexyl phenylketone; acetophenone based compounds such as methoxy acetophenone, 2,2-dimethoxy-2-phenylacetophenone, 2,2-diethoxyacetophenone, and 2-methyl-1-[4-(methylthio)-phenyl]-2-morpholinopropane-1; benzoin ether based compounds such as benzoin ethyl ether, benzoin isopropyl ether, and anisoin methyl ether; ketal based compounds such as benzil dimethyl ketal; aromatic sulfonyl chloride based compounds such as 2-naphthalenesulfonylchloride; photoactive oxime based compounds such as 1-phenone-1, and 1-propanedione-2-(o-ethoxycarbonyl)oxime; benzophenone based compounds such as benzophenone, benzoylbenzoic acid, and 3,3'-dimethyl-4-methoxybenzophenone; thioxanthone based compounds such as thioxanthone, 2-chlorothioxanthone, 2-methylthioxanthone, 2,4-dimethylthioxanthone, isopropylthioxanthone, 2,4-dichlorothioxanthone, 2,4-diethylthioxanthone, and 2,4-diisopropylthioxanthone; camphorquinone; halogenated ketone; acylphosphinoxide; and

acylphosphonate. The mixing amount of these photo initiators is preferred to be 0.01 to 5 parts by mass with respect to 100 parts by mass of acrylic copolymer.

[0049] An acetophenone-based photo initiator such as 1-(4-isopropylphenyl)-2-hydroxy-2methylpropane-1-on, 1-phenyl-1,2-propanedione-2-(o-ethoxycarbonyl)oxime has an ultraviolet-range effective exciting wavelength of 220 to 260 nm. A benzophenone-based photo initiator such as 3,3-dimethyl-4-methoxybenzophenone, or tetra(t-butylperoxycarbonyl)benzophenone has an ultraviolet-range effective exciting wavelength of 210 to 260 nm. A thioxanthone-based photo initiator such as 2,4-diethylthioxanthone, 2,4-diisopropylthioxanthone, 2,4-dimethylthioxanthone, or isopropylthioxanthone has an ultraviolet-range effective exciting wavelength of 259 to 260 nm. Benzoin isopropylether which is a benzoinether-based photo initiator has an ultraviolet-range effective exciting wavelength of 360 nm. Therefore, when these photo initiators are appropriately combined, the two types of photo initiators having different reactive wavelengths can be contained in the part of the bonding-agent layer 12 corresponding to the wafer and in the part other than that, respectively. As long as the part corresponding to the wafer and the part other than that have different reactive wavelengths, a plurality of types of photo initiators may be contained in each of them.

[0050] For example, when ultraviolet rays having two different types of wavelengths are generated by using, for

example, a low-pressure mercury lamp, which generates ultraviolet rays of 185 to 254 nm, and a high-pressure mercury lamp, which generates ultraviolet rays of 365 nm to irradiate the bonding-agent layer 12 containing the two types of photo initiators having different reactive wavelengths, the part corresponding to the wafer of the bonding-agent layer 12 and the part other than that can be hardened separately in two levels respectively by the ultraviolet rays having the wavelengths at which the photo initiators react.

[0051] Such bonding film 14 can be manufactured, for example, by providing masking at the position of the base material film 11 corresponding to the wafer, applying a bonding-agent layer composition containing the first photo initiator, drying the composition, then providing masking at this part, and applying a bonding-agent layer composition containing the second photo initiator.

[0052] <Second Embodiment>

As well as the wafer-processing film 10 (see FIG. 1) according to the first embodiment of the present invention, a wafer-processing film according to a second embodiment of the present invention has: a bonding film (corresponding to reference numeral 14 of FIG. 1), which is composed of a base material film (corresponding to reference numeral 11 of FIG. 1) and a bonding-agent layer (corresponding to reference numeral 12 of FIG. 1) provided on the base material film, and an adhesive-agent layer (corresponding to reference numeral 13 of FIG. 1) provided on the bonding-agent layer; wherein, the adhesive-agent layer has not been pre-cut

into the shape corresponding to the semiconductor wafer, and the bonding-agent layer has also not been pre-cut into the shape corresponding to the ring frame. Moreover, in the adhesive-agent layer, an incision is provided at least outside of the position corresponding to the semiconductor wafer and inside of the position corresponding to the ring frame. The bonding-agent layer and the adhesive-agent layer are stacked on the base material film so as to be long like the base material film, and the wafer-processing film has no part that has an uneven thickness.

[0053] Points different between the wafer-processing film according to the second embodiment of the present invention and the wafer-processing film 10 according to the first embodiment of the present invention are as described below. The bonding-agent layer 12 of the bonding film 14 of the wafer-processing film 10 according to the first embodiment contains the radiation polymerizable compound and the two types of photo initiators for which the wavelength of reactable light is mutually different. On the other hand, the bonding-agent layer of the bonding film of the wafer-processing film according to the second embodiment contains one type of photo initiator and a thermo-polymerizable compound instead of the two types of photo initiators, in other words, the bonding-agent layer of the bonding film of the wafer-processing film according to the second embodiment contains a radiation polymerizable compound, the photo initiator, and the thermo-polymerizable compound. Therefore, in the bonding-agent layer, the part

other than the part corresponding to the wafer and the part corresponding to the wafer contain mutually different materials, i.e., the radiation polymerizable compound and the thermo-polymerizable compound, respectively; therefore, the part of the bonding-agent layer corresponding to the wafer and the part other than that can be hardened separately in two levels. More specifically, if the radiation polymerizable compound is contained in the part other than the part corresponding to the wafer, the thermo-polymerizable compound is contained in the part corresponding to the wafer; and, if the thermo-polymerizable compound is contained in the part other than the part corresponding to the wafer, the radiation polymerizable compound is contained in the part corresponding to the wafer. The part other than the part corresponding to the wafer includes the position corresponding to the ring frame; and, also in the part other than the part corresponding to the wafer, the part corresponding to the ring frame and the part other than that may be configured to contain different materials, i.e., the radiation polymerizable compound and the thermo-polymerizable compound, respectively.

[0054] Therefore, as well as the case of the wafer-processing film 10 according to the first embodiment of the present invention, also in the case of the wafer-processing film according to the second embodiment of the present invention, the hardened part of the bonding-agent layer can be separately formed gradually. Therefore, the adhesive-agent layer and the bonding-agent

layer covering the adhesive-agent layer are not required to be pre-cut into a predetermined shape. Therefore, when the wafer-processing film is wound like a roll as a product, transfer traces can be prevented from being generated in the adhesive-agent layer.

[0055] Examples of the thermo-polymerizable compound, which is polymerized by heat include: compounds having functional groups such as glycidyl groups, acryloyl groups, methacryloyl groups, hydroxyl groups, carboxyl groups, isocyanurate groups, amino groups, and amido groups; and these can be used singularly or in combination of two or more. In consideration of the thermal resistance of the wafer-processing film, a material which is hardened by heat, reduces the bonding force of the hardened part of the bonding-agent layer, and can be peeled off between the adhesive-agent layer and the bonding-agent layer is used.

[0056] <Method of Manufacturing Semiconductor Device>

A method of manufacturing a semiconductor device by using the wafer-processing film 10 according to the first embodiment will be explained by using FIG. 2 and FIG. 3. FIG. 2 and FIG. 3 are drawings explaining the method of manufacturing the semiconductor device by using the wafer-processing film 10 according to the first embodiment. FIG. 2 (A) is a cross sectional view of the wafer-processing film showing a state in which a release film 16 is pasted on the adhesive-agent layer 13, and FIG. 2 (B) is a cross sectional view of the wafer-processing film showing a state in which part of the bonding-agent layer 12 is hardened

and the adhesive-agent layer 13 above the hardened bonding-agent layer part 12a is peeled off. FIG. 2 (C) is a cross sectional view of a wafer and the wafer-processing film showing a state in which the wafer W is pasted on the wafer-processing film, and FIG. 2 (D) is a cross sectional view of the wafer and the wafer-processing film showing a state in which the wafer has been diced. FIG. 2 (E) is a cross sectional view of the wafer and the wafer-processing film showing a state in which a bonding-agent layer part 12b at a position corresponding to the wafer is hardened. Furthermore, FIG. 3 (A) is a cross sectional view showing the wafer and the wafer-processing film in a state in which the wafer-processing film bonded with the diced wafer is mounted on an expanding device, and FIG. 3 (B) is a cross sectional view showing the wafer and the wafer-processing film after expanding.

[0057] (Preparation Step)

As shown in FIG. 2 (A), first, the wafer-processing film is prepared. In the wafer-processing film, from the adhesive-agent layer 13 side, the release film 16 is pasted on the dicing/die-bonding film 15 having the bonding film 14, which is composed of the base material film 11 and the bonding-agent layer 12 provided on the base material film 11, and the adhesive-agent layer 13 in which the incision 13a is provided at the position corresponding to the outer periphery of the unshown wafer. Since the adhesive-agent layer 13, etc. have not been pre-cut, the wafer-processing film is free from steps which have been conventionally

generated at the stacked part of the adhesive-agent layer 13 and the bonding film 14; therefore, transfer traces can be prevented from being generated in the adhesive-agent layer 13 when the wafer-processing film is wound like a roll as a product to which the release film 16 is pasted.

[0058] (First-Stage Ultraviolet Irradiation Step)

Next, the bonding-agent layer 12 is irradiated and hardened with the ultraviolet rays having a wavelength (referred to as "wavelength A") with which the first photo initiator, in other words, the photo initiator contained in the part of the bonding-agent layer 12 that is other than the part corresponding to the wafer is reacted. Since the bonding force of the hardened part 12a is reduced, as shown in FIG. 2 (B), the release film 16 is peeled off from the wafer-processing film, and only the adhesive-agent layer 13 above the hardened bonding-agent layer part 12a can be peeled off while the incision 13a of the adhesive-agent layer 13 is serving as a base point.

[0059] (Pasting Step)

Next, as shown in FIG. 2 (C),a ring frame 20 is pasted at a predetermined position of the hardened bonding-agent layer part 12a, and the back surface of the semiconductor wafer W is pasted on the adhesive-agent layer 13 from the adhesive-agent layer 13 side of the dicing/die-bonding film 15. Note that, in the steps thereafter, if one set of the ring frame 20 and the semiconductor wafer W is to be individually conveyed instead of conveying the ring frame 20 and the semiconductor wafer W in the steps in the state

in which they are pasted on the long dicing/die-bonding film 15, the dicing/die-bonding film 15 is preferred to be cut along the outer periphery of the ring frame 20 before or after the ring frame 20 is pasted thereon.

[0060] (Dicing Step)

The wafer-processing film is fixed to a dicing device (not shown) via the ring frame 20, and the semiconductor wafer W is mechanically cut by using a blade to separate the wafer into a plurality of semiconductor chips C and to also divide the adhesive-agent layer 13 (FIG. 2 (D)).

[0061] (Second-Stage Ultraviolet Irradiation Step)

Then, as shown in FIG. 2 (E), in order to react the photo initiator which is contained in the bonding-agent layer part 12b corresponding to the position of the wafer divided into the plurality of semiconductor chips C and is reactable with the wavelength (referred to as "wavelength B") other than the wavelength A, the bonding-agent layer 12 is irradiated and hardened with ultraviolet rays of the wavelength B different from the wavelength A. Since the bonding force of the hardened part 12b is reduced, the adhesive-agent layer 13 above the hardened bonding-agent layer part 12b can be peeled off.

[0062] (Placing Step)

After the adhesive-agent layer part 12b corresponding to the position of the wafer divided into the semiconductor chips C is hardened by the ultraviolet radiation of the wavelength B, as shown in FIG. 3 (A), the wafer-processing film retaining the plurality of divided semiconductor chips

C is placed on a stage 21 of an expanding device. In the drawing, reference numeral 22 represents a hollow-cylindrical-shaped push-up member of the expanding device.

[0063] (Expanding Step)

Then, as shown in FIG. 3 (B), an expanding step of stretching, in the circumferential direction of the ring frame 20, the bonding film 14, which is composed of the base material film 11 and the bonding-agent layer 12 (12a and 12b) retaining the diced semiconductor chips C and the adhesive-agent layer 13, is carried out. Specifically, with respect to the bonding film 14 in the state in which the plurality of diced semiconductor chips C and the adhesive film 13 are retained, the push-up member 22 having the hollow cylindrical shape is moved up from the lower surface side of the bonding film 14 to stretch the bonding film 14 in the circumferential direction of the ring frame 20. By the expanding step, the intervals between the semiconductor chips C can be increased, the recognition performance of the semiconductor chips C by a CCD camera or the like can be improved, and re-bonding between the semiconductor chips C caused when the mutually adjacent semiconductor chips C are brought into contact upon pick-up can be prevented.

[0064] (Pick-Up Step)

After the expanding step is carried out, in the state in which the bonding film 14 is expanded, a pick-up step of picking up the semiconductor chips C is carried out. Specifically, the semiconductor chip C is pushed up by

a pin (not shown) from the lower side of the bonding film 14, and the semiconductor chip C is sucked by a sucking jig (not shown) from the upper surface side of the bonding film 14, thereby picking up the separated semiconductor chip C together with the adhesive-agent layer 13 in the state in which the adhesive-agent layer is attached to the semiconductor chip C.

[0065] (Die-Bonding Step)

Then, after the pick-up step is carried out, a die-bonding step is carried out. Specifically, the semiconductor chip C is bonded on a lead frame, a package substrate, or the like by the adhesive-agent layer 13, which has been picked up in the pick-up step together with the semiconductor chip C, to manufacture a semiconductor device.

[0066] In the method of manufacturing the semiconductor device by using the wafer-processing film 10 according to the first embodiment, the wafer-processing film containing the photo initiators, for which the wavelength of reactable light is mutually different, in the part of the bonding-agent layer 12 corresponding to the wafer and the part other than that, respectively, is used; therefore, the ultraviolet rays of different wavelengths (ultraviolet rays of the wavelength A and the wavelength B) are radiated separately in two stages. In the first stage, the part 12a other than the part corresponding to the wafer (part including the part corresponding to the ring frame) is hardened, and the adhesive-agent layer 13 above the bonding-agent layer 12a is peeled off in order to attach the ring frame R. However,

if the wafer-processing film according to the second embodiment is used, since each of the part of the bonding-agent layer 12 corresponding to the wafer and the part other than that contains either one of the photo initiator and the thermo-polymerizable compound. Therefore, it is preferred that hardening of the bonding-agent layer part 12a and hardening of the bonding-agent layer part 12b be carried out separately in two stages of thermal hardening and ultraviolet hardening, the part other than the part corresponding to the wafer (part including the part corresponding to the ring frame R) be hardened in the first stage, and the adhesive-agent layer 13 above the hardened bonding-agent layer 12 be peeled off to attach the ring frame R.

[0067] As described above, according to the wafer-processing film according to the present embodiment, pre-cutting is not required to be provided. Therefore, when the wafer-processing film is wound like a roll, generation of transfer traces in the adhesive-agent layer can be sufficiently suppressed, reduction in cohesiveness between the adhesive-agent layer and the semiconductor wafer caused when air is involved between the adhesive-agent layer and the semiconductor wafer can be prevented, and insufficient contact upon bonding of the semiconductor chip to a lead frame, a package substrate, or another semiconductor chip and failure upon wafer processing can be prevented. Furthermore, according to the method of manufacturing the semiconductor device by using the wafer-processing film

of the present invention, the design of a desired semiconductor device can be changed without greatly changing existing equipment.

Reference Numerals

[0068] 10, 30: Wafer-processing film

11: Base material film

12: Bonding-agent layer

13: Adhesive-agent layer

13a: Incision of adhesive-agent layer

14: Bonding film

15: Dicing/die-bonding film

16: Release film

Claims

[Claim 1]

A wafer-processing film comprising:

a bonding film composed of a base material film and a bonding-agent layer provided on the base material film; and

an adhesive-agent layer provided on the bonding-agent layer; wherein

the bonding-agent layer contains a radiation polymerizable compound and a first photo initiator in a part corresponding to at least a ring frame and contains the radiation polymerizable compound and a second photo initiator in a part other than a location containing the first photo initiator; and

the wavelength of light reactable with the first photo initiator is different from the wavelength of light reactable with the second photo initiator.

[Claim 2]

A wafer-processing film comprising:

a bonding film composed of a base material film and a bonding-agent layer provided on the base material film; and

an adhesive-agent layer provided on the bonding-agent layer; wherein

the bonding-agent layer contains either one of a radiation polymerizable compound and a thermo-polymerizable

compound in a part corresponding to at least a ring frame and contains the other one of the radiation polymerizable compound and the thermo-polymerizable compound in a part other than the location containing one of the radiation polymerizable compound and the thermo-polymerizable compound.

[Claim 3]

The wafer-processing film according to claim 1 or 2, wherein

the adhesive-agent layer has not been pre-cut into a shape corresponding to a semiconductor wafer, and the bonding-agent layer has not been pre-cut into a shape corresponding to the ring frame.

[Claim 4]

The wafer-processing film according to any one of claim 1 to claim 3, wherein,

in the adhesive-agent layer, an incision is provided at least outside of a position corresponding to the semiconductor wafer and inside of a position corresponding to the ring frame.

[Claim 5]

A method of manufacturing a semiconductor device by using the wafer-processing film according to any one of claim 1 to claim 4, the method including:

a step of hardening a part of the bonding-agent layer that is other than a part corresponding to a wafer and is corresponding to at least the ring frame and peeling off the adhesive-agent layer from the hardened part of the bonding-agent layer;

a step of pasting the wafer on the adhesive-agent layer;

a step of fixing the ring frame to the bonding-agent layer;

a step of dicing the wafer to form separated chips with the adhesive-agent layer; and

a step of hardening the part of the bonding-agent layer corresponding to the wafer and picking up the separated chips with the adhesive-agent layer.