ADHESIVE FILM FOR GRINDING BACK FACE OF WAFER

BACKGROUND

Field

[0001] The present disclosure relates to an adhesive film used to protect a surface of a wafer in a wafer back grinding (or wafer lapping or wafer thinning) process. More specifically, the present disclosure relates to an adhesive film for grinding a back face of a wafer with excellent machineability by reducing or removing an occurrence of an adhesive residue when removing (peeling) the adhesive film after wafer back grinding.

Related art

[0002] With a recent development of technology, miniaturization, densification, and thinning of a semiconductor chip are required, and thus, the thinning is also required for a wafer. A representative method for thinning a wafer chip is to reduce a thickness by grinding a back face of the wafer. The thinning of the wafer chip may be achieved by performing the grinding process based on a type or a specification of an electronic device in which the semiconductor chip is used.

[0003] Because wafer back grinding of the semiconductor chip is a process in which a physical impact is applied, the wafer back grinding is generally performed while an adhesive film for grinding the back face of the wafer is attached in order to protect a surface of the wafer. In general, such adhesive film includes an adhesive layer for adhesion of a base and the wafer surface, and has a buffer layer or an impact absorbing layer formed on a back face of the base for a buffering effect. Further, in general, the adhesive layer is made of an energy ray-curable adhesive composition.

[0004] Further, in order to remove the adhesive film for grinding the back face of the wafer from the wafer surface after performing the wafer back grinding, an energy ray is irradiated to the adhesive film to lower an adhesive force, so that the adhesive film is peeled.

[0005] In one example, with a recent rapid development of an information and communication technology and a market expansion, densification of a semiconductor device is increasingly

required. Accordingly, as a thickness of an active layer placed on the wafer surface increases, an irregularity (or a pattern) of the active layer is also gradually increasing. For this reason, when peeling the adhesive film for grinding the back face of the wafer, there is a case in which energy ray curing does not proceed sufficiently in a shaded region caused by the irregularity of the active layer. As a result, as the adhesive force of the adhesive film for grinding the back face of the wafer is not sufficiently lowered, a peeling force is lowered. Therefore, an adhesive residue derived from the adhesive film easily remains on the wafer surface, which may lower machineability and, as a result, may adversely affect a quality of the manufactured semiconductor chip, so that there is a technical need to solve such problem.

SUMMARY

[0006] The present disclosure is to provide an adhesive film for grinding a back face of a wafer that may reduce or suppress an occurrence of an adhesive residue when peeling the adhesive film used to grind the back face of the wafer after the wafer back grinding process even when there is a relatively large irregularity in an active layer of the wafer or a wafer surface.

[0007] Purposes of the present disclosure are not limited to the above-mentioned purpose. Other purposes and advantages of the present disclosure that are not mentioned may be understood based on following descriptions, and may be more clearly understood based on embodiments of the present disclosure. Further, it will be easily understood that the purposes and advantages of the present disclosure may be realized using means shown in the claims and combinations thereof.

[0008] One aspect of the present disclosure provides an adhesive film for grinding a back face of a wafer, the adhesive film comprising: a multilayer base including an upper base layer and a lower base layer; a first adhesive layer disposed on a top face of the upper base layer; and a second adhesive layer disposed between the upper base layer and the lower base layer, wherein the second adhesive layer is made of an adhesive composition containing a light-transmissive adhesive resin and light-scattering particles, wherein the second adhesive layer satisfies a following [Relationship 1], and wherein the light-scattering particles have a refractive index in a range of 1.42 to 1.60:

[0009] [Relationship 1]: $0.05 \leq |A-B| \leq 0.2$

[0010] in the [Relationship 1], A is a refractive index of the light-transmissive adhesive resin, and B is the refractive index of the light-scattering particles.

[0010a] Disclosed herein is an adhesive film for grinding a back face of a wafer, the adhesive film comprising:

a multilayer base including an upper base layer and a lower base layer;

a first adhesive layer disposed on a top face of the upper base layer; and

a second adhesive layer disposed between the upper base layer and the lower base layer,

wherein the second adhesive layer is made of an adhesive composition containing a light-transmissive adhesive resin and light-scattering particles, wherein the second adhesive layer satisfies a following [Relationship 1], and wherein the light-scattering particles have a refractive index in a range of 1.42 to 1.60:

[Relationship 1]: $0.05 \leq |A-B| \leq 0.2$

wherein in the [Relationship 1], A is a refractive index of the light-transmissive adhesive resin, and B is the refractive index of the light-scattering particles;

wherein the light-scattering particles are contained in 0.1 to 10 parts by weight with respect to 100 parts by weight of the adhesive composition of the second adhesive layer; and

wherein an average particle diameter of the light-scattering particles is in a range of 1 to 50 μm.

[0011] In one implementation of the present disclosure, the light-scattering particles may be contained in 0.1 to 10 parts by weight with respect to 100 parts by weight of the adhesive composition of the second adhesive layer.

[0012] In one implementation of the present disclosure, the light-scattering particles may include at least one of inorganic particles and organic particles.

[0013] In one implementation of the present disclosure, an average particle diameter of the light-scattering particles may be in a range of 1 to 50 μm.

[0014] In one implementation of the present disclosure, the inorganic particles may include at least one selected from a group consisting of silica particles, glass powders, and quartz particles.

[0015] In one implementation of the present disclosure, the organic particles may include at least one selected from a group consisting of acrylic resin particles, polystyrene resin particles, styrene-acrylic copolymer component particles, polyethylene resin particles, epoxy resin particles, silicone resin particles, polyvinylidene fluoride particles, Teflon particles, divinylbenzene resin particles, phenol resin particles, urethane resin particles, cellulose acetate particles, nylon particles, cellulose particles, benzoguanamine resin particles, and melamine resin particles.

[0016] In one implementation of the present disclosure, a total light transmittance of the adhesive film for grinding the back face of the wafer according to the present disclosure may be equal to or higher than 70 %, and a diffuse transmittance thereof may be equal to or higher than 6 %.

[0017] In one implementation of the present disclosure, a thickness of the first adhesive layer may be in a range of 10 to 100 μm, and a thickness of the second adhesive layer may be in a range of 10 to 100 μm.

[0018] In one implementation of the present disclosure, each of the lower base layer and the upper base layer may include at least one selected from a group consisting of polyethylene terephthalate, polyethylene naphthalate, polybutylene terephthalate, wholly aromatic polyester, polyimide, polyamide, polycarbonate, polyacetal, modified polyphenylene oxide, polyphenylene sulfide, polysulfone, polyether ketone, and biaxially stretched polypropylene, and preferably each of the lower base layer and the upper base layer may be made of the polyethylene terephthalate.

[0019] In one implementation of the present disclosure, the first adhesive layer may be made of an adhesive composition containing an acryl-based adhesive resin.

[0020] In one implementation of the present disclosure, the light-transmissive adhesive resin of the second adhesive layer may include a light-transmissive acryl-based adhesive resin.

[0021] In one implementation of the present disclosure, a shear storage modulus of the second adhesive layer at 30 ℃ may be in a range of 0.05 to 5.00 MPa.

[0022] In one implementation of the present disclosure, a primer layer may be additionally included on at least one of a top face of the upper base layer, a bottom face of the upper base layer, and a top face of the lower base layer.

[0023] When applying the adhesive film for grinding the back face of the wafer according to the present disclosure to the back face grinding process, even when there is the portion with the relatively large irregularity in the active layer of the wafer or the wafer surface, the adhesive film may have an excellent embedding property against the irregularity when attached to the wafer surface. In addition, when the adhesive film for grinding the back face of the wafer is peeled after the wafer back grinding process, the occurrence of the adhesive residue may be reduced or suppressed, thereby improving the wafer treatment processability and the quality of the semiconductor chip to be manufactured.

[0024] Further, when the adhesive film for grinding the back face of the wafer according to the present disclosure is applied to the back face grinding process, while the buffering effect (or the protective effect) on the surface of the wafer is excellent, the thickness uniformity of the wafer after the back face grinding process may also be improved.

[0025] The effect of the present disclosure is not limited to the above-mentioned effects, and another effect as not mentioned will be clearly understood by those skilled in the art from the following description. In addition to the above-described effects, specific effects of the present disclosure will be described together while describing specific details for carrying out the present disclosure below.

BRIEF DESCRIPTION OF DRAWINGS

[0026] FIG. 1 schematically shows a flowchart of a process of applying an adhesive film for grinding a back face of a wafer according to an aspect of the present disclosure to a wafer back grinding process and then peeling the adhesive film.

[0027] FIG. 2 shows a cross-sectional view of an adhesive film for grinding a back face of a wafer according to an aspect of the present disclosure.

DETAILED DESCRIPTIONS

[0028] Advantages and features of the present disclosure, and a method of achieving the advantages and features will become apparent with reference to embodiments described later in detail together with the accompanying drawings. However, the present disclosure is not limited to embodiments as disclosed below, but may be implemented in various different forms. Thus, these embodiments are set forth only to make the present disclosure complete, and to completely inform the scope of the present disclosure to those of ordinary skill in the technical field to which the present disclosure belongs, and the present disclosure is only defined by the scope of the claims.

[0029] A shape, a size, a ratio, an angle, a number, etc. disclosed in the drawings for describing the embodiments of the present disclosure are illustrative, and the present disclosure is not limited thereto. The same reference numerals refer to the same elements herein. Further, descriptions and details of well-known steps and elements are omitted for simplicity of the description. Furthermore, in the following detailed description of the present disclosure, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be understood that the present disclosure may be practiced without these specific details. In other instances, well-known methods, procedures, components, and circuits have not been described in detail so as not to unnecessarily obscure aspects of the present disclosure.

[0030] The terminology used herein is directed to the purpose of describing particular embodiments only and is not intended to be limiting of the present disclosure. As used herein, the singular constitutes "a" and "an" are intended to include the plural constitutes as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprise", "including", "include", and "including" when used in this specification, specify the presence of the stated features, integers, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, operations, elements, components, and/or portions thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. Expression such as "at least one of" when preceding a list of elements may modify an entirety of list of elements and may not modify the individual elements of the list. In interpretation of numerical values, an error or tolerance therein may occur even when there is no explicit description thereof.

[0031] In addition, it will also be understood that when a first element or layer is referred to as being present "on" a second element or layer, the first element may be disposed directly on the second element or may be disposed indirectly on the second element with a third element or layer being disposed between the first and second elements or layers. It will be understood that when an element or layer is referred to as being "connected to", or "coupled to" another element or layer, it may be directly on, connected to, or coupled to the other element or layer, or one or more intervening elements or layers may be present. In addition, it will also be understood that when an element or layer is referred to as being "between" two elements or layers, it may be the only element or layer between the two elements or layers, or one or more intervening elements or layers may also be present.

[0032] Further, as used herein, when a layer, film, region, plate, or the like may be disposed "on" or "on a top" of another layer, film, region, plate, or the like, the former may directly contact the latter or still another layer, film, region, plate, or the like may be disposed between the former and the latter. As used herein, when a layer, film, region, plate, or the like is directly disposed "on" or "on a top" of another layer, film, region, plate, or the like, the former directly contacts the latter and still another layer, film, region, plate, or the like is not disposed between the former and the latter. Further, as used herein, when a layer, film, region, plate, or the like may be disposed "below" or “under” another layer, film, region, plate, or the like, the former may directly contact the latter or still another layer, film, region, plate, or the like may be disposed between the former and the latter. As used herein, when a layer, film, region, plate, or the like is directly disposed "below" or "under" another layer, film, region, plate, or the like, the former directly contacts the latter and still another layer, film, region, plate, or the like is not disposed between the former and the latter.

[0033] It will be understood that, although the terms "first", "second", "third", and so on may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section described below could be termed a second element, component, region, layer or section, without departing from the spirit and scope of the present disclosure.

[0034] In interpreting a numerical value, the value is interpreted as including an error range unless there is no separate explicit description thereof.

[0035] It will be understood that when an element or layer is referred to as being "connected to", or "coupled to" another element or layer, it may be directly on, connected to, or coupled to the other element or layer, or one or more intervening elements or layers may be present. In addition, it will also be understood that when an element or layer is referred to as being "between" two elements or layers, it may be the only element or layer between the two elements or layers, or one or more intervening elements or layers may also be present.

[0036] The features of the various embodiments of the present disclosure may be partially or entirely combined with each other, and may be technically associated with each other or operate with each other. The embodiments may be implemented independently of each other and may be implemented together in an association relationship.

[0037] In descriptions of temporal relationships, for example, temporal precedent relationships between two events such as “after”, “subsequent to”, “before”, etc., another event may occur therebetween unless “directly after”, “directly subsequent” or “directly before” is not indicated.

[0038] Unless otherwise defined, all terms including technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this inventive concept belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0039] Herein, terms such as "one face", "the other face", "both faces", and the like are used to distinguish one component from another component, and the components are not limited by the terms.

[0040] As used herein, "(meth)acrylate" is used as a term including "acrylate" and "methacrylate", and the same is applied to terms similar thereto.

[0041] Hereinafter, in describing the present disclosure, detailed descriptions of related known technologies that may unnecessarily obscure the gist of the present disclosure will be omitted.

[0042] FIG. 1 illustratively shows a flowchart of a process of applying an adhesive film 100 for grinding a back face of a wafer according to an aspect of the present disclosure to the wafer and then peeling the adhesive film by lowering an adhesive force via energy ray irradiation after grinding the back face.

[0043] Specifically, S1 in FIG. 1 refers to an operation (wafer loading) of preparing the wafer before the process for grinding the back face of the wafer and shows that an active layer 300 is disposed on a surface of the wafer 200. The active layer 300 may include a base layer including an irregularity (a pattern) existing on a wafer surface.

[0044] S2 in FIG. 1 is an operation of attaching (or adhering) the adhesive film 100 for grinding the back face of the wafer according to the present disclosure to the surface of the wafer. Thus, the adhesive film 100 serves to protect the surface of the wafer 200 and/or the active layer 300 during the back face grinding.

[0045] S3 in FIG. 1 schematically shows performing of the back face grinding process. For the back face grinding process, various back grinding equipment used in the art may be used without limitation. For example, equipment capable of rotating a grinding wheel after loading the wafer on a chuck table or the like may be used. In one example, a wafer thickness before the back face grinding process may be in a range of approximately 700 to 900 μm, and the wafer may be thinned after the back face grinding process such that a thickness of a final wafer is in a range approximately 30 to 300 μm depending on a specification of an electronic device to which a semiconductor chip is applied.

[0046] S4 in FIG. 1 briefly shows that, as an operation of irradiating an energy ray (representatively, ultraviolet (UV)) so as to peel the adhesive film 100 for grinding the back face of the wafer after the back face grinding process, a thickness of a wafer 210 after the back face grinding process is small compared to that of the wafer 200 before the back face grinding process. Accordingly, an adhesive layer of the adhesive film 100 for grinding the back face of the wafer is generally made of an energy ray-curable adhesive composition.

[0047] S5 in FIG. 1 briefly shows an operation of peeling the adhesive film 100 for grinding the back face of the wafer after the back face grinding process. In this regard, when an exposure of the energy ray reaching the adhesive film 100 for grinding the back face of the wafer is insufficient, the adhesive force is not lowered sufficiently for the adhesive film 100 to be finely peeled, so that a residue of the adhesive film 100 for grinding the back face of the wafer may remain in the peeling operation. A region R where the residue of the adhesive remains as described above is illustratively shown in FIG. 1.

[0048] When the residue of the adhesive film 100 for grinding the back face of the wafer remains on the wafer, processability and a quality of the semiconductor chip being manufactured may be adversely affected. Further, the more severe the degree of irregularities (patterns) of the active layer 300 disposed on the wafer 200 or the wafer surface, the more the shaded region where the energy ray is not able to reach, so that the problem is exacerbated.

[0049] The present inventor has paid attention to the above problem, and added light-scattering particles P to a second adhesive layer 30 of the adhesive film 100 for grinding the back face of the wafer such that the exposure of the energy ray to the adhesive film for grinding the back surface of the wafer is sufficient. As such, the second adhesive layer 30 is made of an adhesive composition containing a light-transmissive adhesive resin and the light-scattering particles P, and thus exhibits a light scattering effect. As a result, because the irradiated energy ray may be evenly distributed on the adhesive film 100 for grinding the back face of the wafer, the present inventor has completed the present disclosure by finding that the problem caused by the lack of the exposure of the ray described above may be solved.

[0050] Therefore, as shown in FIG. 2, the adhesive film for grinding the back face of the wafer according to the present disclosure may have a structure including: a multilayer base including an upper base layer 20 and a lower base layer 40; a first adhesive layer 10 disposed on a top face of the upper base layer 20; and the second adhesive layer 30 disposed between the upper base layer 20 and the lower base layer 40, and the second adhesive layer 30 may be made of the adhesive composition containing the light-transmissive adhesive resin and the light-scattering particles P.

[0051] Hereinafter, characteristics of the adhesive film for grinding the back face of the wafer and a structure of each layer will be described in detail.

[0052] <Multilayer base>

[0053] The multilayer base includes the lower base layer 40, the upper base layer 20, and the second adhesive layer 30. The first adhesive layer 10 is disposed on a top face of the upper base layer 20, and the second adhesive layer 30 is disposed between the lower base layer 40 and the upper base layer 20. In the adhesive film for grinding the back face of the wafer according to the present disclosure, the multilayer base has a sandwich structure in which the second adhesive layer 30 is disposed between the lower base layer 40 and the upper base layer 20.

[0054] The lower base layer 40 and the upper base layer 20 may be made of a material having a high tensile modulus. More specifically, the lower base layer 40 and the upper base layer 20 may have the tensile modulus equal to or higher than 1,000 MPa, for example, equal to or higher than 1,200 MPa, equal to or higher than 1,500 MPa, equal to or higher than 2,000 MPa, or equal to or higher than 3,000 MPa. In this regard, the tensile modulus is based on a measurement at 23 ℃.

[0055] When the tensile modulus of the lower base layer 40 and the upper base layer 20 is relatively low (lower than 1,000 MPa), a support force for the wafer or the semiconductor chip is low, so that there is a possibility of a collision of the semiconductor chips in the back face grinding process (the back grinding process).

[0056] Each of the lower base layer 40 and the upper base layer 20 may contain at least one selected from a group consisting of polyethylene terephthalate (PET), polyethylene naphthalate (PEN), polybutylene terephthalate (PBT), polyester such as wholly aromatic polyester, polyimide (PI), polyamide (PA), polycarbonate (PC), polyacetal, modified polyphenylene oxide, polyphenylene sulfide, polysulfone, polyether ketone, and biaxially stretched polypropylene (oriented polypropylene).

[0057] Further, the lower base layer 40 and the upper base layer 20 may be made of the same material, and, for example, the lower base layer 40 and the upper base layer 20 may be made of polyethylene terephthalate (PET).

[0058] Thicknesses of the lower base layer 40 and the upper base layer 20 may not be particularly limited, and the lower base layer 40 and the upper base layer 20 may have the same

thickness. For example, each of the lower base layer 40 and the upper base layer 20 may have a thickness in a range of approximately 10 to 150 μm. In one example, in the present disclosure, because the lower base layer 40 and the upper base layer 20 have the high tensile modulus, when the thickness of the lower base layer 40 and the upper base layer 20, especially, the thickness of the upper base layer 20 is too great, the base layer may be vulnerable to an impact occurring in the back face grinding process. Therefore, for example, the thickness of the lower base layer 40 and the upper base layer 20 may be about 150 μm or smaller, but the present disclosure may not be limited thereto.

[0059] In one example, the lower base layer 40 and/or the upper base layer 20 may contain a small amount of various additives such as a coupling agent, a plasticizer, an antistatic agent, an antioxidant, and the like, as needed.

[0060] <First adhesive layer>

[0061] In FIG. 2, the first adhesive layer 10 is a portion that is adhered (or attached) to the wafer. The first adhesive layer 10 may not be particularly limited as long as it has adequate adhesiveness at a room temperature, and may be made of various adhesive compositions, such as an acryl-based adhesive composition, a silicone-based adhesive composition, a polyester-based adhesive composition, a polyamide-based adhesive composition, an urethane-based adhesive composition, a styrene-diene block copolymer adhesive composition, and the like, which are known UV (ultraviolet)-curable adhesive compositions, and may be preferably made of the acryl-based adhesive composition.

[0062] For example, the first adhesive layer 10 may be made of an adhesive composition containing an acryl-based adhesive resin, and as the acryl-based adhesive resin may be a polymer of a (meth)acryl-based monomer having an alkyl group with 1 to 14 carbon atoms, specifically may be a polymer of at least one selected from a group consisting of ethylhexyl acrylate, butyl acrylate, ethyl acrylate, methyl acrylate, acrylic acid, hydroxyethyl acrylate, and hydroxybutyl acrylate, and preferably may be a polymer of a monomer including a monomer to which a carboxyl group or a hydroxyl group is bonded.

[0063] Further, the adhesive composition for forming the first adhesive layer 10 may further contain a photopolymerization initiator and a crosslinking agent, which are not be particularly limited as long as commonly used in the art.

[0064] The crosslinking agent serves to increase a cohesive force of the adhesive composition, and for example, one or more of an isocyanate-based crosslinking agent, an epoxy-based crosslinking agent, an aziridine-based crosslinking agent, and a metal chelate-based crosslinking agent, and the like may be mixed and used.

[0065] The photopolymerization initiator is a substance that initiates a reaction of a UV-curable crosslinking agent by UV irradiation. The photopolymerization initiator is used by appropriately selecting a type and a content thereof in consideration of a curing speed and the like of the resin composition. One or more types of the photopolymerization initiator may be mixed and used.

[0066] For example, hydroxycyclohexylphenylketone (Irgacure 184), 2-methyl-1[4-(methylthio)phenyl]-2-morpholino-propan-1-one (2-methyl-1 [4-(methythio)phenyl]-2-morpholino-propan-1-on (Irgacure 907), α,α-methoxy-αhydroxyacetophenone (Irgacure 651), 2-hydroxy- 2-methyl-1-phenyl-propan-1-one (Irgacure 1173), and the like may be used.

[0067] In one example, a thickness of the first adhesive layer 10 may not be particularly limited, and may be, for example, approximately in a range of 10 to 100 μm.

[0068] Although not shown in FIG. 2, a release film disposed on a top face of the first adhesive layer and adhered by the first adhesive layer may be further included. One face of the release film may be subjected to a release treatment. The release treatment may use a material that may be normally used for the release treatment in the art without limitation. For example, it is preferable to perform the release treatment with silicone.

[0069] <Second adhesive layer>

[0070] In FIG. 2, the second adhesive layer 30 is disposed between the upper base layer 20 and the lower base layer 40, and acts as a buffer layer that may alleviate the impact on the wafer during the back face grinding process and as a light diffusive layer having a light scattering effect.

[0071] As such, the lower the shear storage modulus of the second adhesive layer 30 of the present disclosure, the more advantageous for a buffering effect. However, when the second adhesive layer 30 has an excessively low shear storage modulus, the buffer layer may flow at a high temperature or a thickness of the buffer layer may become non-uniform in the back face

grinding process due to a temperature increase. In consideration of the above, the shear storage modulus of the second adhesive layer 30 at a temperature of 30 ℃ is preferably in a range of 0.05 to 5 MPa, more preferably in a range of 0.05 to 3 MPa, and the most preferably in a range of 0.05 to 2.5 MPa. The adhesive film 100 used to grind the back face of the wafer, including the second adhesive layer 30 of the present disclosure, may have an excellent buffering effect on the surface of the wafer and may improve thickness uniformity of the wafer after the back face grinding process.

[0072] Further, because the second adhesive layer 30 of the present disclosure is made of the adhesive composition containing the light-transmissive adhesive resin and the light-scattering particles P, the second adhesive layer 30 acts as the light diffusive layer imparting the light scattering effect. Because of the light scattering effect of the second adhesive layer 30 as described above, the energy ray irradiated to peel the adhesive film for grinding the back face of the wafer is evenly distributed, so that the occurrence of the adhesive residue during the peeling may be reduced or suppressed, thereby improving the processability and the quality of the semiconductor chip to be manufactured. Further, in the adhesive composition for forming the second adhesive layer 30, when necessary, one or more of metal chelate-based, isocyanate-based, and epoxy-based crosslinking agents, and the like may be mixed with each other and used.

[0073] Therefore, it was experimentally derived that a difference in refractive index between the light-transmissive adhesive resin and the light-scattering particles P is preferably in a range of 0.05 to 0.2 for the second adhesive layer 30 to exhibit a scattering effect, and such relationship may be specified as [Relationship 1].

[0074] [Relationship 1]: $0.05 \leq |A-B| \leq 0.2$

[0075] In the [Relationship 1], A is a refractive index of the light-transmissive adhesive resin, and B is a refractive index of the light-scattering particles.

[0076] Further, it is preferable that parts by weight of the light-scattering particles P is in a range of 0.1 to 10 parts by weight based on 100 parts by weight of the adhesive composition for forming the second adhesive layer 30 of the present disclosure. When a content of the light-scattering particles P is lower than 0.1 parts by weight, the light scattering effect may not be sufficient. Further, when the content of the light-scattering particles P exceeds 10 parts by

weight, as a total light transmittance is lowered, curing by the energy ray does not proceed to a required extent in the peeling process, so that the effect of reducing the adhesive residue may not be sufficient, and uniformity of the wafer after the wafer back grinding process may be adversely affected by an excessive amount of the particles.

[0077] Hereinafter, each of the light-transmissive adhesive resin and the light-scattering particles P contained in the second adhesive layer 30 will be described in detail.

[0078] Light-scattering particles

[0079] The light-scattering particles P are particles for diffusing or scattering light, and are preferably transparent fine particles so as to have a light transmitting property, but do not necessarily have to be colorless as long as the light transmitting property is great, and are able to be colored. Further, the light-scattering particles P preferably have a sphere shape such that the light scattering effect may be uniform. Further, in order to have the great light transmitting property, the refractive index of the light-scattering particles P is preferably in a range of 1.42 to 1.60.

[0080] Further, an average particle diameter of the light-scattering particles P is preferably in a range of 1 to 50 μm, and more preferably in a range of 1 to 10 μm. When the average particle diameter is smaller than 1 μm, the light diffusion effect or the light scattering effect is low. In addition, when the average particle diameter exceeds 50 μm, because the particles are too coarse, thickness uniformity of the second adhesive layer 30 and the adhesive film for grinding the back face of the wafer 100 containing such particles may be degraded. In one example, the average particle diameter is measured according to the coulter counter method. It is generally preferable that the average particle diameter of the light-scattering particles P is uniform for a purpose of improving the uniformity, but in order to adjust the diffusion characteristics, two or more types of the light-scattering particles P made of different materials or having different particle diameters may be mixed with each other and used.

[0081] When the above conditions are able to be satisfied, the type of light-scattering particles P may not be particularly limited, and one or more of inorganic particles and organic particles may be included. The inorganic particles may include at least one selected from a group consisting of silica particles, glass powders, and quartz particles. The organic particles may include at least one selected from a group consisting of acrylic resin particles, polystyrene resin

particles, styrene-acrylic copolymer component particles, polyethylene resin particles, epoxy resin particles, silicone resin particles, polyvinylidene fluoride particles, Teflon particles, divinylbenzene resin particles, phenol resin particles, urethane resin particles, cellulose acetate particles, nylon particles, cellulose particles, benzoguanamine resin particles, and melamine resin particles.

[0082] Light-transmissive adhesive resin

[0083] In order for the second adhesive layer 30 of the present disclosure to function as the light diffusive layer, the adhesive resin forming the same needs to be selected as the light-transmissive adhesive resin.

[0084] For example, the refractive index of the light-transmissive adhesive resin is preferably in a range of 1.40 to 1.70, more preferably in a range of 1.45 to 1.55.

[0085] The light-transmissive adhesive resin is not particularly limited as long as it is a light-transmissive resin material, such as a thermoplastic resin, a thermosetting resin, or a light-curable resin having the light transmitting property. For example, a room temperature pressure-sensitive adhesive resin, such as a polyethylene resin, a polypropylene resin, a cycloolefin resin, a polyester-based resin, an epoxy-based resin, a polyurethane-based resin, a silicone-based resin, an acryl-based resin, and the like, may be used. Alternatively, a resin that does not have the room temperature pressure-sensitive adhesiveness, such as a polymethyl methacrylate resin, a polycarbonate resin, a polyethylene terephthalate resin, a polyvinyl chloride resin, and the like, may also be used.

[0086] Preferably, in the present disclosure, the acryl-based adhesive resin may be used as the light-transmissive adhesive resin. For example, the acryl-based adhesive resin may be a homopolymer or a copolymer of an acryl-based monomer, such as acrylic acid and ester thereof, methacrylic acid and ester thereof, acrylamide, acrylonitrile, and the like, and may be a copolymer of at least one kind of acryl-based monomers and a vinyl monomer, such as vinyl acetate, maleic anhydride, styrene, and the like.

[0087] Further, the second adhesive layer 30 may be further copolymerized with at least one selected from a group consisting of a monomer, such as ethyl acrylate, butyl acrylate, 2-ethylhexyl acrylate, and the like exhibiting adhesiveness; a monomer, such as vinyl acetate,

acrylamide, acrylonitrile, styrene, methacrylate, and the like used as a component with a cohesive force; a functional group-containing monomer, such as acrylic acid, methacrylic acid, itaconic acid, maleic anhydride, hydroxyethyl methacrylate, hydroxypropyl methacrylate, dimethylaminoethyl methacrylate, methylolacrylamide, glycidyl methacrylate, and the like that may further improve adhesion; and fluorine-containing acrylate or sulfur-containing acrylate for adjusting the refractive index, and may be used as the acryl-based adhesive resin.

[0088] In one example, the thickness of the second adhesive layer 30 is not particularly limited, and may be, for example, in a range of approximately 10 to 100 μm.

[0089] <Adhesive film for grinding back face of wafer>

[0090] The adhesive film 100 for grinding the back face of the wafer according to the present disclosure preferably has the total light transmittance equal to or higher than 70 %, and a diffuse transmittance equal to or higher than 6 %.

[0091] Specifically, in order to peel the adhesive film 100 for grinding the back face of the wafer from the wafer, the energy ray (representatively, the UV) is irradiated to reduce the adhesive force, so that a curing reaction proceeds. In this regard, it is preferable that the total light transmittance is equal to or higher than 70 % such that the curing reaction by the energy ray may proceed sufficiently.

[0092] In one example, as the second adhesive layer 30 of the present disclosure contains the light-scattering particles P, the light scattering or light diffusion effect is exhibited in an entire structure of the adhesive film 100 for grinding the back face of the wafer. In order for the light scattering or light diffusion effect to be sufficiently exhibited as described above, a diffusion transmittance for the entire structure of the adhesive film 100 for grinding the back face of the wafer is preferably equal to or higher than 6 %.

[0093] Hereinafter, a configuration and an operation of the present disclosure will be described in more detail through a preferred embodiment of the present disclosure. However, this is presented as a preferred example of the present disclosure, and it is not able to be construed as limiting the present disclosure in any way. Because contents not described herein may be technically inferred sufficiently by those of ordinary skill in the art, descriptions thereof will be omitted.

[0094] **Preparation Example 1: Preparation of first adhesive composition for forming first adhesive layer**

[0095] A mixture of a monomer composed of 27 g of butyl acrylate (BA), 48 g of methyl acrylate (MA), and 25 g of hydroxyethyl acrylate (HEA) was put into a reactor in which nitrogen gas is refluxed and a cooling apparatus is installed so as to facilitate temperature adjustment.

[0096] Then, 100 parts by weight of ethyl acetate (EAc) as a solvent was added with respect to 100 parts by weight of the monomer mixture, and sufficiently mixed at 30 ℃ for 30 minutes or longer while injecting nitrogen thereto so as to remove oxygen in the reactor. Thereafter, the temperature was raised and maintained at 50 ℃ and 0.1 parts by weight of azobisisobutyronitrile, which is a reaction initiator, was added into the mixture and a reaction was initiated, followed by polymerization for 24 hours to prepare a primary reaction product.

[0097] 24.6 parts by weight of 2-methacroyloxyethyl isocyanate (MOI) and 1 part by weight of a catalyst (DBTDL: dibutyl tin dilaurate) relative to the MOI were mixed in the primary reaction product, and reacted at 40 ℃ for 24 hours to obtain an acryl-based adhesive resin with a weight average molecular weight of 500,000.

[0098] 0. 1 parts by weight of Irgacure 184 (BASF) as the photopolymerization initiator and 2 parts by weight of the isocyanate-based crosslinking agent (Nippon Polyurethane Kogyo, trade name: Coronate C) as the crosslinking agent were added with respect to 100 parts by weight of the acryl-based adhesive resin and then sufficiently mixed with each other to prepare the first adhesive composition for forming the first adhesive layer.

[0099] **Preparation Example 2: Preparation of second adhesive composition for forming second adhesive layer**

[00100] 20 parts by weight of butyl acrylate, 10 parts by weight of ethylhexyl acrylate, 55 parts by weight of methyl acrylate, 7 parts by weight of 2-hydroxylethyl acrylate, 8 parts by weight of acrylic acid, 0.05 parts by weight of azobisisobutyronitrile, and 100 parts by weight of ethyl acetate were mixed with each other to form a mixture. The mixture was polymerized at 60 ℃ under a nitrogen atmosphere for 6 hours to obtain the acryl-based adhesive resin with a weight average molecular weight of 600,000.

[00101] 3 parts by weight of the isocyanate-based crosslinking agent (Nippon Polyurethane Kogyo, trade name: Coronate C) was added with respect to 100 parts by weight of the acryl-based adhesive resin and then sufficiently mixed to prepare the second adhesive composition for forming the second adhesive layer.

[00102] The refractive index of the prepared second adhesive composition was measured to be 1.48, and the refractive index was measured using an Abbe refractometer.

[00103] **Present Example 1**

[00104] The first adhesive composition of Preparation Example 1 was coated on a release-treated PET (a polyethylene terephthalate film, thickness 50 μm) such that the thickness of the first adhesive layer is 20 μm, and then a biaxially stretched polyethylene terephthalate (PET) film (the base) having a thickness of 50 μm was bonded thereto to produce a first composite film having the first adhesive layer having a thickness of 120 μm.

[00105] Then, 1.0 parts by weight of organic particles (referred to as 'b1') of a polystyrene component having a refractive index of 1.59 and an average particle diameter of 3 μm were added as light-scattering particles with respect to 100 parts by weight of the second adhesive composition of Preparation Example 2, then sufficiently mixed, and then coated on the biaxially stretched polyethylene terephthalate (PET) film having a thickness of 25 μm so as to have a thickness of 20 μm to produce the second composite film having the second adhesive layer having a thickness of 45 μm.

[00106] The first composite film and the second composite film were bonded with each other to produce the adhesive film for grinding the back face of the wafer with a total thickness of 115 μm (the thickness of the release PET is excluded from the total thickness).

[00107] **Present Examples 2 to 3 and Comparative Examples 1 to 3**

[00108] In Present Example 1, the adhesive films used for grinding the back face of the wafer were produced in the same manner as in Present Example 1, except that the type or the content of each component, the thickness of the adhesive layer, and the like in Present Example 1 were changed as shown in Table 1 below.

[00109] **Experimental Example 1: Evaluation of Optical Characteristics**

[00110] For the adhesive films for grinding the back face of the wafer of the Present Examples 1 to 3 and Comparative Examples 1 to 3, a total transmittance (T.T, %) and a diffuse transmittance (D.T, %) were measured using hazemeter equipment (Nippon Denshoku, NDH5000), and results thereof are shown in Table 1.

[00111] **Experimental Example 2: Measurement of shear storage modulus of second adhesive layer**

[00112] Using a Rheometer (TA instruments; ARES-G2), which is a shear storage modulus measuring device, shear storage modulus was measured at 1 Hz under an environment in a range of -20 ℃ to 120 ℃ on samples with a size of diameter of 8 mm × thickness 1 mm obtained by stacking single adhesive layers formed with second adhesive composition solutions for forming the second adhesive layers of the adhesive films for grinding the back face of the wafer of the Present Examples 1 to 3 and Comparative Examples 1 to 3, and a shear storage modulus at 30 ℃ was recorded and is shown in Table 1 below.

[00113] **Experimental Example 3: Thickness uniformity and residue test after grinding back face of wafer**

[00114] the After attaching the adhesive films for grinding the back face of the wafer of the Present Examples 1 to 3 and Comparative Examples 1 to 3 to a semiconductor circuit face (=the wafer surface), the back face grinding was performed on a wafer with a thickness of 725 μm such that the thickness thereof becomes 100 μm using back grinding equipment (DISCO, DGP8760).

[00115] After the back face grinding process was completed, UV A 300 mJ/cm^2 was irradiated using exposure equipment (Semyung Bakktron Co.; TRSJ-3000). Then, a heat sealing tape (MBS-100R) was thermocompressed at 220 ℃ to one outer portion of the adhesive film for grinding the back face of the wafer, and then the adhesive film for grinding the back face of the wafer was removed.

[00116] After the back face grinding process, the thickness uniformity and whether the adhesive residues have occurred of the wafer were identified via microscopic observation at 20 points on the surface of the wafer from which the adhesive film was removed, and a detailed method thereof is as follows.

[00117] **(1) Adhesive residue test**

[00118] Sizes of the residues at the 20 points in the wafer whose back face is ground were measured and evaluated as follows, and results thereof are shown in Table 1 below.

[00119] ○ : there are no residues with a size equal to or smaller than 10 μm

[00120] △ : residues with a size equal to or smaller than 10 μm have occurred

[00121] × : a large amount of residues with a size equal to or greater than 10 μm have occurred

[00122] **(2) Wafer thickness uniformity test**

[00123] When a standard deviation of the thickness at the 20 points in the wafer whose back face is ground was equal to or smaller than ±4 μm, a thickness uniformity level of the wafer was evaluated as good (○). When the standard deviation of the thickness was equal to or smaller than ±6 μm, the thickness uniformity level of the wafer was evaluated as defective (×). Results thereof are shown in Table 1 below.

[00124] 【Table 1】

		Present Example 1	**Present Example 2**	**Present Example 3**	**Comparative Example 1**	**Comparative Example 2**	**Comparative Example 3**
First adhesive layer thickness (㎛)		20	20	20	20	20	20
Second adhesive layer thickness (㎛)		20	20	40	40	20	40
Content of light scattering particles (%)	b1 (1.59)	1.0	8.0	-	-	15.0	-
	b2 (1.42)	-	-	5.0	-	-	-
	b3(1.49)	-	-	-	-	-	8.0
Value of Relationship 1		0.11	0.11	0.06	1.48	0.11	0.01
Total transmittance (%)		83.4	79.6	71.9	86.5	59.8	85.7
Diffuse transmittance (%)		6.3	17.2	21.1	3.5	25.2	4.5

Shear storage modulus of second adhesive layer (Mpa, @ 30℃)	0.15	2.32	1.45	0.12	5.33	1.96
Adhesive residue test result	○	○	○	×	△	△
Thickness uniformity test result	○	○	○	○	×	○

[00125] b1 to b3 in the Table 1 are as follows.

[00126] - b1: As the light-scattering particles, a polystyrene component has a refractive index of 1.59 and an average particle diameter of 3 μm.

[00127] - b2: As the light-scattering particles, a Teflon component has a refractive index of 1.42 and an average particle diameter of 3 μm.

[00128] - b3: as the light-scattering particles, a polymethyl methacrylate component has a refractive index of 1.49 and an average particle diameter of 3 μm.

[00129] As may be seen from Table 1, in Present Examples 1 to 3 according to the present disclosure, while the second adhesive layer functions as the buffer layer and has a protective effect during the wafer back face grinding, the second adhesive layer contains the light-scattering particles, thereby exhibiting excellent results in the adhesive residue test and the thickness uniformity test.

[00130] On the other hand, in Comparative Example 1, the light-scattering particles are not contained in the second adhesive layer, and a large amount of residues with a size equal to or greater than 10 μm have occurred in the adhesive residue test. In Comparative Example 2, an excessive amount of the light-scattering particles was contained, results were poor in the adhesive residue test and the thickness uniformity test, and the shear storage modulus of the second adhesive layer was higher than that of Present Example. In Comparative Example 3, a difference in the refractive index between the adhesive resin and the light-scattering particles for forming the adhesive layer was too low to satisfy Relationship 1, so that the light scattering (diffusion) effect is not sufficient. Therefore, in the adhesive residue test result, the residues with the size equal to or smaller than 10 μm have occurred, so that the effect of suppressing the occurrence of the residues was not excellently derived.

[00131] A scope of protection of the present disclosure should be construed by the scope of the claims, and all technical ideas within the scope equivalent thereto should be construed as being included in the scope of the present disclosure. Although the embodiments of the present disclosure have been described in more detail with reference to the accompanying drawings, the present disclosure is not necessarily limited to these embodiments. The present disclosure may be implemented in various modified manners within the scope not departing from the technical idea of the present disclosure. Accordingly, the embodiments disclosed in the present disclosure are not intended to limit the technical idea of the present disclosure, but to describe the present disclosure. the scope of the technical idea of the present disclosure is not limited by the embodiments. Therefore, it should be understood that the embodiments as described above are illustrative and non-limiting in all respects. The scope of protection of the present disclosure should be interpreted by the claims, and all technical ideas within the scope of the present disclosure should be interpreted as being included in the scope of the present disclosure.

WHAT IS CLAIMED IS:

1. An adhesive film for grinding a back face of a wafer, the adhesive film comprising:

a multilayer base including an upper base layer and a lower base layer;

a first adhesive layer disposed on a top face of the upper base layer; and

a second adhesive layer disposed between the upper base layer and the lower base layer,

wherein the second adhesive layer is made of an adhesive composition containing a light-transmissive adhesive resin and light-scattering particles, wherein the second adhesive layer satisfies a following [Relationship 1], and wherein the light-scattering particles have a refractive index in a range of 1.42 to 1.60:

[Relationship 1]: $0.05 \leq |A-B| \leq 0.2$

wherein in the [Relationship 1], A is a refractive index of the light-transmissive adhesive resin, and B is the refractive index of the light-scattering particles;

wherein the light-scattering particles are contained in 0.1 to 10 parts by weight with respect to 100 parts by weight of the adhesive composition of the second adhesive layer; and

wherein an average particle diameter of the light-scattering particles is in a range of 1 to 50 μm.

2. The adhesive film of claim 1, wherein a total light transmittance of the adhesive film is equal to or higher than 70 %.

3. The adhesive film of claim 1, wherein a diffuse transmittance of the adhesive film is equal to or higher than 6 %.

4. The adhesive film of claim 1, wherein the light-scattering particles include at least one of inorganic particles and organic particles.

5. The adhesive film of claim 4, wherein the inorganic particles include at least one selected from a group consisting of silica particles, glass powders, and quartz particles.

6. The adhesive film of claim 4, wherein the organic particles include at least one selected from a group consisting of acrylic resin particles, polystyrene resin particles, styrene-acrylic copolymer component particles, polyethylene resin particles, epoxy resin particles, silicone resin particles, polyvinylidene fluoride particles, Teflon particles, divinylbenzene resin particles, phenol resin particles, urethane resin particles, cellulose acetate particles, nylon particles, cellulose particles, benzoguanamine resin particles, and melamine resin particles.

7. The adhesive film of claim 1, wherein a thickness of the first adhesive layer is in a range of 10 to 100 μm,

wherein a thickness of the second adhesive layer is in a range of 10 to 100 μm.

8. The adhesive film of claim 1, wherein each of the lower base layer and the upper base layer includes at least one selected from a group consisting of polyethylene terephthalate, polyethylene naphthalate, polybutylene terephthalate, wholly aromatic polyester, polyimide, polyamide, polycarbonate, polyacetal, modified polyphenylene oxide, polyphenylene sulfide, polysulfone, polyether ketone, and biaxially stretched polypropylene.

9. The adhesive film of claim 8, wherein each of the lower base layer and the upper base layer is made of the polyethylene terephthalate.

10. The adhesive film of claim 1, wherein the first adhesive layer is made of an adhesive composition containing an acryl-based adhesive resin.

11. The adhesive film of claim 1, wherein the light-transmissive adhesive resin of the second adhesive layer includes a light-transmissive acryl-based adhesive resin.

12. The adhesive film of claim 1, wherein a shear storage modulus of the second adhesive layer at 30 ℃ is in a range of 0.05 to 5.00 MPa.