

ADHESIVE FILM FOR WAFER TREATMENT

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 which may reduce or eliminate a stress generated during the wafer back grinding, thereby improving machineability.

Related art

[0002] With a recent development of technology, miniaturization, densification, and thinning of a semiconductor chip are required, and thus, thinning of a wafer is also required. A representative method for thinning a wafer chip achieves the thinning by grinding a back face of the wafer.

[0003] Because shear and compressive stresses (vibration, impact, and the like) occur with a temperature increase during such back face grinding process, in order to protect a surface of the wafer, the back face grinding process of the wafer is performed while an adhesive film for a treatment of the wafer is attached to the wafer.

[0004] As generally known back face grinding process methods of the wafer, a method for grinding the back face of the wafer first and then dividing the thinned wafer based on a chip size ('a grinding first method') as a method that has been used from the past, a method for defining a groove in the wafer in advance and then grinding the back face of the wafer to segment the wafer into the chips (a 'dicing first method' or 'DBG (Dicing Before Grinding)') as a recently applied method, and the like are mainly applied.

[0005] When the back face grinding is performed in the grinding first method, as an adhesive film for grinding the back face of the wafer, a form having a soft base and an adhesive layer to be attached to the wafer disposed on one face of the base, or having a hard base and the adhesive layer to be attached to the wafer disposed on one face of the base and at the same time having a soft buffer layer that may mitigate an impact on an opposite face of the adhesive layer has been representatively applied. However, when the soft base is used or

the hard base and the soft buffer layer are used as a base layer, as a strength of an entirety of the adhesive film for grinding the back face of the wafer is lowered, an applied tension is not relieved when the adhesive film for grinding the back face of the wafer is attached to the wafer, so that a residual stress remains on the film. When the wafer is thinned in the grinding first method while such stress remains, due to the residual stress on the wafer that has been ground, curl occurs in a direction in which the adhesive film is attached, so that, when the wafer is subsequently divided, the wafer becomes impossible to be adsorbed to a wafer fixing jig, making the dividing process impossible. Further, when the curl is very severe, the wafer itself may be damaged.

[0006] When the back face grinding is performed in the dicing first method, a shear stress generated in the grinding process after the segmentation of the wafer into the chips is applied. Under an influence of the shear stress, a movement of the chip caused by fluidity of the adhesive layer may occur, and crack defects caused by a collision between the chips may occur due to the movement of the chip.

[0007] In particular, recently, as a 'SDBG (Stealth DBG) method', a technology for dividing the wafer into individual device chips using a laser beam, is introduced, a distance between the chips (also referred to as a 'kerf width') after the segmentation of the wafer into the chips becomes very narrow, so that suppression of the chip movement is becoming technically important.

SUMMARY

[0008] The present disclosure is to provide an adhesive film for a wafer treatment that, while having an excellent protective effect (buffering effect) of a surface of a wafer during a wafer back grinding process, has excellent machineability by reducing or eliminating stress (shear stress) generated during the process so as to prevent damage to the wafer, suppressing curl that occurs in a direction in which the adhesive film is attached due to residual stress on the wafer, and preventing a movement or a collision and cracking of segmented semiconductor chips.

[0009] 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.

[0010] One aspect of the present disclosure provides an adhesive film for a wafer treatment, 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 a tensile strength of the adhesive film is in a range of 70 to 150 MPa, and wherein the first adhesive layer and the second adhesive layer satisfy both a following Relationship 1 and a following Relationship 2.

[0011] [Relationship 1] $0.2 \leq C1/C2 \leq 1.4$

[0012] in the Relationship 1, C1 is a creep amount (μm) at 30 °C of the first adhesive layer, and C2 is a creep amount (μm) at 30 °C of the second adhesive layer.

[0013] [Relationship 2] $0.2 \leq C1'/C2' \leq 1.4$

[0014] in the Relationship 2, C1' is a creep amount (μm) at 60 °C of the first adhesive layer, and C2' is a creep amount (μm) at 60 °C of the second adhesive layer.

[0015] In one implementation of the present disclosure, in the Relationship 1 and the Relationship 2, each of the C1 and the C1' may be in a range of 30 to 200 μm , and each of the C2 and the C2' may be in a range of 50 to 350 μm .

[0016] In one implementation of the present disclosure, a sum of thicknesses of the first adhesive layer and the second adhesive layer may be in a range of 20 to 150 μm .

[0017] In one implementation of the present disclosure, the first adhesive layer may be made of a UV-curable adhesive composition.

[0018] In one implementation of the present disclosure, the second adhesive layer may be made of a thermosetting adhesive composition.

[0019] In one implementation of the present disclosure, a shear storage modulus at temperatures of 30 °C and 60 °C of the second adhesive layer may be in a range of 0.02 to 1.0 MPa.

[0020] 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 may be more preferably made of the polyethylene terephthalate.

[0021] In one implementation of the present disclosure, the adhesive film may further include a primer layer disposed on at least one of the top face of the upper base layer, a bottom face of the upper base layer, or a top face of the lower base layer.

[0022] When applying the adhesive film for the wafer treatment according to the present disclosure to the back face grinding process of the wafer, the protecting effect (the buffering effect) for the surface of the wafer is excellent.

[0023] The adhesive film for the wafer treatment according to the present disclosure may reduce or suppress the stress generated during the back face grinding process, thereby preventing the damage to the wafer.

[0024] The adhesive film for the wafer treatment according to the present disclosure may suppress the curl generated in the direction in which the adhesive film is attached caused by the residual stress on the wafer, and may prevent the movement or the collision and the cracking of the segmented semiconductor chips, thereby improving the wafer machineability and the quality of the manufactured semiconductor chip.

[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 is a cross-sectional view schematically showing an adhesive film for a wafer treatment according to an aspect of the present disclosure.

[0027] FIG. 2 is a cross-sectional view schematically showing an adhesive film for a wafer treatment according to another aspect of the present disclosure.

[0028] FIG. 3 is a schematic diagram for briefly illustrating a method for measuring a distance (=a kerf width) between chips in Experimental Example 5 of the present disclosure.

DETAILED DESCRIPTIONS

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] 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.

[0035] In interpreting a numerical value, the value is interpreted as including an error range unless there is no separate explicit description thereof.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] As used herein, "(meth)acrylate" is used as a term encompassing "acrylate" and "methacrylate", and the same is applied to terms similar thereto.

[0042] 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.

[0043] FIG. 1 is a cross-sectional view schematically showing an adhesive film 100 for a wafer treatment according to an embodiment of the present disclosure. Referring to FIG. 1, the adhesive film for the wafer treatment according to the present disclosure includes a multilayer base 110, a first adhesive layer 120 disposed on an upper base layer 112 of the multilayer base, and a second adhesive layer 115 disposed between the upper base layer 112 and a lower base layer 111.

[0044] The first adhesive layer 120 may be attached to a surface of a wafer and serve to fix the wafer, and the second adhesive layer 115 may be disposed between the upper base layer 112 and the lower base layer 111 so as to act as a buffer layer for relieving vibration and impact applied during back face grinding.

[0045] In particular, as a result of intensive research by the present inventors, it was identified that, as the upper base layer 112 and the lower base layer 111 are formed as a rigid base, a tensile strength of the adhesive film 100 for the wafer treatment may be increased to suppress residual stress during the back face grinding process, and the second adhesive layer 115 may mitigate impact occurred during the back face grinding process. However, when the tensile strength of the adhesive film 100 for the wafer treatment becomes too high, the adhesive film 100 may become too hard to be used for the back face grinding process. In consideration of the above problem, the tensile strength of the adhesive film 100 for the wafer treatment according to the present disclosure is preferably in a range of 70 to 150 MPa, more preferably in a range of 70 to 120 MPa, and most preferably in a range of 70 to 100 MPa.

[0046] Further, in the present disclosure, it was also experimentally identified that, by appropriately adjusting degrees of flow of the first adhesive layer 120 and the second adhesive layer 115, a problem of a movement of segmented semiconductor chips due to stress during the back face grinding process and a problem of cracking caused by a collision of the semiconductor chips with each other may be solved to remarkably improve processability.

[0047] Specifically, as means for adjusting the degrees of flow of the first adhesive layer 120 and the second adhesive layer 115, creep amounts (unit: μm) of the first adhesive layer 120 and the second adhesive layer 115 may be measured at 30 °C and 60 °C (maximum temperatures during the back face grinding process), and ratios thereof may be allowed to be within a specific range. Preferably, the range of the ratios may satisfy a range in Relationship 1 and Relationship 2 below.

[0048] [Relationship 1] $0.2 \leq C1/C2 \leq 1.4$

[0049] In the Relationship 1, C1 is a creep amount (μm) at 30 °C of the first adhesive layer, and C2 is a creep amount (μm) at 30 °C of the second adhesive layer.

[0050] [Relationship 2] $0.2 \leq C1'/C2' \leq 1.4$

[0051] In the Relationship 2, C1' is a creep amount (μm) at 60 °C of the first adhesive layer, and C2' is a creep amount (μm) at 60 °C of the second adhesive layer.

[0052] Each adhesive layer sample for measuring the creep amount in the present disclosure was produced by applying an adhesive composition for forming an adhesive layer to be measured on polyethylene terephthalate (PET) and drying the composition at 100 °C for 4 minutes, and then aging the composition for 3 days in a constant temperature and constant humidity device maintained at a temperature of 40 °C and a relative humidity of 50 %. Thereafter, the produced adhesive layer sample was cut to have a size of 15 mm×120 mm, and attached to an adherend (SUS, Glass, and the like) for measuring the creep amount such that an area of attachment is 15 mm×15 mm. A deformed length (μm) of the adhesive layer in a direction in which a force was applied of when the force of 1.5 kg was applied for 1,000 seconds under 30 °C and 60 °C environments measured using a universal physical property analyzer (equipment name: TA.XT Plus_Stable Micro Systems) was used as the creep amount.

[0053] Further, when describing values of C1, C2, C1', and C2' in the Relationship 1 and the Relationship 2, the C1 and the C1' related to the first adhesive layer may be preferably in a range of 30 to 200 μm , more preferably in a range of 30 to 160 μm , and most preferably in a range of 70 to 160 μm . Further, the C2 and the C2' related to the second adhesive layer may be preferably in a range of 50 to 350 μm , more preferably in a range of 50 to 320 μm , and most preferably in a range of 80 to 320 μm .

[0054] When each of the values of C1, C2, C1', and C2' in the Relationship 1 and the Relationship 2 is smaller than preferred lower limit thereof, it may mean that the adhesive layer itself has a very high cohesive force, so that an adhesion to the adherend may be lowered, and a resistance to the shear stress may be lowered. Furthermore, when the C2 and the C2' related to the second adhesive layer are smaller than the lower limits thereof, a shear storage modulus of the second adhesive layer may become too high, so that the second adhesive layer may not be able to function sufficiently as the buffer layer. On the other hand, when the values are greater than preferred upper limits thereof, fluidity of the adhesive layer may increase, so that the chip movement and crack defects may occur.

[0055] Each of thicknesses of the first adhesive layer 120 and the second adhesive layer 115 according to the present disclosure may be within a range of 10 to 100 μ m. However, the present disclosure is not limited thereto.

[0056] Further, a sum of the thicknesses of the first adhesive layer 120 and the second adhesive layer 115 may be in a range of 20 to 150 μ m and more preferably in a range of 80 to 150 μ m. When the sum of the thicknesses of the first adhesive layer 120 and the second adhesive layer 115 is smaller than 20 μ m, vibration and impact caused by the shear stress may not be absorbed, so that the crack defects may occur. In addition, when the sum exceeds 150 μ m, due to an increase in the creep amount, the movement of the chip and the crack defects resulted therefrom may occur.

[0057] Hereinafter, each layer of the adhesive film for grinding the back face of the wafer will be described in detail.

[0058] <Multilayer base>

[0059] The multilayer base 110 includes the lower base layer 111, the upper base layer 112, and the second adhesive layer 115. The first adhesive layer 120 is disposed on the upper base layer 112, and the second adhesive layer 115 is disposed between the lower base layer 111 and the upper base layer 112. In the adhesive film for the wafer treatment according to the present disclosure, the multilayer base has a sandwich structure in which the second adhesive layer 115 is disposed between the lower base layer 111 and the upper base layer 112.

[0060] The lower base layer 111 and the upper base layer 112 may be made of a material having a high tensile modulus. More specifically, the lower base layer 111 and the upper base

layer 112 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, or equal to or higher than 2,000 MPa, and most preferably equal to or higher than 3,000 MPa.

[0061] When the tensile modulus of the lower base layer 111 and the upper base layer 112 is relatively low (lower than 1,000 MPa), a support force for the wafer or the segmented semiconductor chip is low, so that there is a possibility of the collision of the semiconductor chips in the back grinding process.

[0062] In the present disclosure, as the lower base layer 111 as well as the upper base layer 112 on a side where the wafer is adhered are applied as the rigid base, the tensile strength of the adhesive film for the wafer treatment will be able to satisfy the condition of equal to or higher than 70 MPa. When the tensile strength is to or higher than 70 MPa, the adhesive film may have resistance to strong stress during the back face grinding process, thereby improving processability.

[0063] Each of the lower base layer 111 and the upper base layer 112 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).

[0064] Preferably, the lower base layer 111 and the upper base layer 112 may be made of the same material. For example, the lower base layer 111 and the upper base layer 112 may be made of the polyethylene terephthalate (PET) material having a tensile modulus equal to or higher than 3,000 MPa.

[0065] The lower base layer 111 and the upper base layer 112 may have the same thickness, but the present disclosure may not be limited thereto. Each of the lower base layer 111 and the upper base layer 112 may have a thickness in a range of approximately 10 to 150 μ m.

[0066] In one example, in the present disclosure, because the lower base layer 111 and the upper base layer 112 have the high tensile modulus, when the thickness of the lower base layer 111 and the upper base layer 112, especially, the thickness of the upper base layer 112 is too great, the base layer may be vulnerable to the impact occurring in the back face

grinding process. Therefore, the thickness of each of the lower base layer 111 and the upper base layer 112 may be preferably set to about 150 μ m or smaller.

[0067] In one example, the lower base layer 111 and/or the upper base layer 112 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.

[0068] <First adhesive layer>

[0069] In FIG. 1, the first adhesive layer 120 is a portion that is adhered to the wafer. The first adhesive layer 120 may not be particularly limited as long as it has adequate adhesiveness at a room temperature, and a known UV-curable adhesive composition may be applied thereto in various ways.

[0070] For example, the first adhesive layer may be made of an adhesive composition or the like including acryl-based, urethane-based, rubber-based, and silicone-based adhesive resins, but preferably made of an adhesive composition (an acryl-based adhesive composition) containing a UV-curable acryl-based adhesive resin.

[0071] The UV-curable acryl-based adhesive resin may be prepared by polymerizing a monomer at least containing alkyl (meth)acrylate. Examples of the monomer may include methyl (meth)acrylate, ethyl (meth)acrylate, n-propyl (meth)acrylate, n-butyl (meth)acrylate, n-pentyl (meth)acrylate, n-hexyl (meth)acrylate, n-heptyl (meth)acrylate, n-octyl (meth)acrylate, isooctyl (meth)acrylate, n-nonyl (meth)acrylate, n-decyl (meth)acrylate, dodecyl (meth)acrylate, 2-ethylhexyl acrylate, 4-methyl-2-pentyl acrylate, and the like, and one or two or more types of alkyl (meth)acrylate may be included.

[0072] When necessary, in order to adjust adhesive properties of the acrylic adhesive composition, in addition to the alkyl (meth)acrylate monomer, a monomer containing a functional group may be further contained and polymerized. Examples of the functional group include a hydroxyl group, a carboxyl group, an amino group, an epoxy group, and the like.

[0073] A hydroxyl group-containing monomer may include hydroxyalkyl (meth)acrylate, such as 2-hydroxyethyl (meth)acrylate, 2 hydroxypropyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxybutyl (meth)acrylate, 4-

hydroxybutyl (meth)acrylate, and the like, or unsaturated alcohol, such as vinyl alcohol, allyl alcohol, and the like.

[0074] The polymerized acryl-based adhesive composition containing the functional group-containing monomer may be prepared via additional reaction of a compound having a photopolymerizable unsaturated group. The compound having the unsaturated group is a compound having both a substituent and the photopolymerizable unsaturated group capable of bonding with the functional group in the acrylic adhesive composition. Examples of the photopolymerizable unsaturated group may include a (meth)acryloyl group, a vinyl group, an allyl group, a vinylbenzyl group, and the like, and the (meth)acryloyl group may be preferable.

[0075] Further, in the compound having the unsaturated group, examples of the substituent capable of bonding with the functional group include isocyanate, a glycidyl group, and the like. For example, as the compound having the unsaturated group, there are (meth)acryloyloxyethyl isocyanate, (meth)acryloyl isocyanate, glycidyl (meth)acrylate, and the like.

[0076] The first adhesive composition may further contain one or more of a crosslinking agent and a photopolymerization initiator.

[0077] The UV-curable crosslinking agent may include an isocyanate-based crosslinking agent, such as tolylenediisocyanate (TDI), hexamethylene diisocyanate, and the like, an epoxy crosslinking agent, such as ethylene glycol glycidyl ether and the like, an aziridine-based crosslinking agent, such as hexa[1-(2-methyl)-aziridinyl]triphosphatriazine and the like, a chelate-based crosslinking agent, such as aluminum chelate and the like, or the like.

[0078] The photopolymerization initiator may include a benzoin compound, an acetophenone compound, an acyl phosphin oxide compound, a titanocene compound, a thioxanthone compound, and a peroxide compound, and examples thereof include 1-hydroxycyclohexylphenyl ketone, 2-hydroxy-2-methyl-1-phenyl-propan-1-one, benzoinmethyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzylphenyl sulfide, tetramethylthiuram monosulfide, azobisisobutyronitrile, dibenzyl, diacetyl, 8-chloranthraquinone, and bis(2,4,6-trimethylbenzoyl)phenylphosphine oxide, and the like.

[0079] A thickness of the first adhesive layer 120 may not be particularly limited, and may be, for example, in a range of approximately 10 to 100 μ m.

[0080] FIG. 2 is a cross-sectional view schematically showing the adhesive film 100 for the wafer treatment according to another embodiment of the present disclosure.

[0081] Referring to FIG. 2, a primer layer 113 may be additionally disposed on a top face of the upper base layer 112 of the multilayer base. The primer layer 113 may be provided to improve adhesion between the first adhesive layer 120 and the multilayer base 110.

[0082] The primer layer 113 may be formed as a separate layer on the top face of the upper base layer 112, that is, a face on which the first adhesive layer 120 is formed. As another example, the primer layer 113 may be formed by modifying the top face of the upper base layer 112.

[0083] FIG. 2 shows an example in which the primer layer 113 is formed on the top face of the upper base layer 112. However, the present disclosure is not limited thereto. The primer layer may be formed on a bottom face of the upper base layer 112 or a top face of the lower base layer 111.

[0084] Although not shown in FIG. 2, a release film disposed on a top face of the first adhesive layer and adhered by the 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.

[0085] <Second adhesive layer>

[0086] In the present disclosure, the second adhesive layer 115 may be an adhesive layer disposed between the upper base layer 112 and the lower base layer 111, and may function as a buffer layer or an impact absorbing layer with a high buffer effect for protecting the wafer surface during wafer processing.

[0087] The second adhesive layer according to the present disclosure may be made of a thermosetting resin composition, and a known thermosetting adhesive composition may be applied thereto in various ways. Preferably, the second adhesive layer may use an adhesive composition containing a thermosetting acryl-based adhesive resin.

[0088] Thermosetting acryl-based adhesive resin may be prepared by polymerizing a monomer containing an alkyl (meth)acrylate having 4 or more carbon atoms, or may be prepared by further polymerizing the monomer containing the functional group in addition to the alkyl (meth) acrylate monomer when necessary so as to adjust the adhesive properties. Examples of the functional group include the hydroxyl group, the carboxyl group, the amino group, the epoxy group, and the like.

[0089] As an acrylate compound usable for thermosetting acryl-based adhesive composition, there are (meth)acrylate, the alkyl (meth)acrylate, such as the alkyl (meth)acrylate having the 4 or more carbon atoms in the alkyl group, non-urethane-based polyfunctional (meth)acrylate, and the like, but the present disclosure is not limited thereto.

[0090] The second adhesive composition may further include a thermosetting agent, and for example, thermosetting agent may be an isocyanate-based thermosetting agent, a carbodiimide-based thermosetting agent, an oxazoline-based thermosetting agent, an epoxy-based thermosetting agent, an aziridine-based thermosetting agent, a peroxide-based thermosetting agent, and the like, but the present disclosure may not be limited thereto.

[0091] 2 parts by weight or lower of thermosetting agent may be contained with respect to 100 parts by weight of the adhesive resin of the second adhesive composition, but the present disclosure may not be necessarily limited thereto.

[0092] In one example, the second adhesive layer 115 functions as the buffer layer, so that the lower the shear storage modulus, the better the buffering effect. Therefore, the second adhesive layer 115 may effectively protect the surface of the wafer. On the other hand, in a case of the buffer layer having a low shear storage modulus, the buffer layer may flow or the thickness of the buffer layer may become non-uniform at a high temperature due to a temperature increase during the back face grinding process. In consideration of such point, at a temperature in a range of 30 °C to 60 °C, the second adhesive layer 115 may have the shear storage modulus preferably in a range of 0.02 to 1.0 MPa, more preferably in a range of 0.02 to 0.5 MPa. and most preferably in a range of 0.02 to 0.2 MPa.

[0093] The second adhesive layer 115 may have a glass transition temperature (T_g) equal to or lower than 10 °C, preferably may have a glass transition temperature in a range of -35 to 10 °C, more preferably may have a glass transition temperature in a range of -30 to 8 °C.

Because of such low glass transition temperature of the second adhesive layer, the second adhesive layer may have a strong adhesive force. As a result, even when the temperature of the wafer back grinding process rises from a room temperature to a maximum of 90 °C, separation of the upper base layer 112 and the lower base layer 111 may be prevented. However, when the second adhesive layer has an excessively low glass transition temperature of lower than -35 °C, the second adhesive composition may flow by heat and pressure generated in the wafer back grinding process and may contaminate the wafer.

[0094] 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.

[0095] [Preparation Example 1] Preparation of adhesive composition A1

[0096] A mixture of monomers composed of 27 g of n-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.

[0097] 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 °C 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 °C 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.

[0098] 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 °C for 24 hours to obtain an acryl-based resin with a weight average molecular weight of 600,000.

[0099] 0.1 parts by weight of Irgacure 184 (BASF, trade name) as the photopolymerization initiator was blended into the polymerization solution (an acryl-based polymer. content: 100

parts by weight) obtained by the operation, and 2 parts by weight of the isocyanate-based crosslinking agent (Nippon Polyurethane Kogyo, trade name: Coronate C) was added thereto to obtain the adhesive composition A1.

[00100] [Preparation Example 2] Preparation of adhesive composition A2

[00101] The adhesive composition A2 was prepared in the same manner as the adhesive composition A1 except that, in the preparation process of the adhesive composition A1, the mixture of monomers was changed to a mixture of monomers composed of 45 g of n-butyl acrylate (BA), 30 g of methyl acrylate (MA), and 25 g of hydroxyethyl acrylate (HEA), and the content of the isocyanate-based crosslinking agent (Coronate C) was changed to 1 part by weight.

[00102] [Preparation Example 3] Preparation of adhesive composition B1

[00103] A mixture of monomers composed of 33 g of n-butyl acrylate (BA), 50 g of methyl acrylate (MA), 10 g of hydroxyethyl acrylate (HEA), and 10 g of 2-ethylhexyl acrylate (EHA) was put into a reactor in which nitrogen gas is refluxed and a cooling apparatus is installed so as to facilitate temperature adjustment.

[00104] 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 °C 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 °C 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 obtain an acryl-based resin with an average molecular weight of 500,000.

[00105] 1.5 parts by weight of the isocyanate-based crosslinking agent (Nippon Polyurethane Kogyo, trade name: Coronate C) was added into the polymerization solution (an acryl-based polymer. content: 100 parts by weight) obtained by the operation to obtain the adhesive composition B1.

[00106] [Preparation Example 4] Preparation of adhesive composition B2

[00107] The adhesive composition B2 was prepared in the same manner as the adhesive composition A1 except that, in the preparation process of the adhesive composition

A1, the mixture of monomers was changed to a mixture of monomers composed of 50 g of n-butyl acrylate (BA), 20 g of methyl acrylate (MA), 8 g of hydroxyethyl acrylate (HEA), and 22 g of 2-ethylhexyl acrylate (EHA) and the content of the isocyanate-based crosslinking agent (Coronate C) was changed to 0.5 parts by weight.

[00108] [Present Example 1]

[00109] The adhesive composition A1 of Preparation Example 1 was coated on a release-treated PET (a polyethylene terephthalate film, thickness 50 μ m) such that a thickness thereof is 30 μ m, and then a biaxially stretched polyethylene terephthalate (PET) film (the upper base layer) having a thickness of 50 μ m was bonded thereto to produce a composite film having the first adhesive layer having a thickness of 130 μ m.

[00110] Then, the adhesive composition B1 of Preparation Example 3 was coated on a biaxially stretched polyethylene terephthalate (PET) film (the lower base layer) having a thickness of 25 μ m such that a thickness thereof is 50 μ m to produce a composite film having the second adhesive layer having a thickness of 75 μ m.

[00111] The composite film having the second adhesive layer was bonded to the composite film having the first adhesive layer to produce the adhesive film for the wafer treatment with a total thickness of 205 μ m.

[00112] [Present Examples 2 to 9 and Comparative Examples 1 to 5]

[00113] Adhesive films for wafer treatment were produced in the same manner as in Present Example 1, but respective adhesive films for a wafer treatment in Present Examples 2 to 9 and Comparative Examples 1 to 5 were produced by changing types and thicknesses of the adhesive compositions and types and thicknesses of the upper base layer and the lower base layer as shown in Table 1 to Table 3 below.

[00114] [Experimental Example 1: Tensile modulus of base layer and tensile strength of adhesive film for wafer treatment]

[00115] Tensile modulus of the upper base layers and the lower base layers and tensile strengths of the adhesive films for the wafer treatment in Present Examples 1 to 9 and Comparative Examples 1 to 5 were measured at a speed of 200 mm/min using universal

material testing equipment (equipment name: 5566A_Instron) by preparing specimens with a size of 15 mm×200 mm, and the measurements are shown in Table 1 to Table 3 below.

[00116] [Experimental Example 2: Shear storage modulus of second adhesive layer]

[00117] The adhesive compositions in Preparation Examples 3 and 4 were stacked to prepare circular specimens having a diameter of 8 mm and a thickness of 500 μ m, and shear storage modulus of the second adhesive layers in Present Examples 1 to 9 and Comparative Examples 1 to 5 were measured on the circular specimens with a shear storage modulus measuring device (equipment name: ARES G2_TA Instruments) by setting a measurement temperature to be in a range of 0 to 80 °C, a temperature increase rate to 10/min, and a measurement frequency to 0.796 Hz. The measurements are shown in Table 1 to Table 3 below.

[00118] [Experimental Example 3: Creep amount]

[00119] Samples were prepared to measure creep amounts of the first adhesive compositions and the second adhesive compositions in Present Examples 1 to 9 and Comparative Examples 1 to 5. Each sample was produced by applying adhesive compositions for forming adhesive layers to be measured on polyethylene terephthalate (PET) as much as the thicknesses of the first adhesive layer and the second adhesive layer described in Table 1 to Table 3 below and drying the compositions at 100 °C for 4 minutes, and then aging the compositions for 3 days in a constant temperature and constant humidity device maintained at a temperature of 40 °C and a relative humidity of 50 %. Thereafter, the produced adhesive layer samples were cut to have a size of 15 mm×120 mm, and attached to an adherend for measuring the creep amount such that an area of attachment is 15 mm×15 mm. A deformed length (μ m) in a direction in which a force was applied of the adhesive layer of when the force of 1.5 kg was applied for 1,000 seconds under 30 °C and 60 °C environments measured using a universal physical property analyzer (equipment name: TA.XT Plus_Stable Micro Systems) was used as the creep amount, and is shown in Table 1 to Table 3 below.

[00120] [Experimental Example 4: Back face grinding process]

[00121] A half cutting (dicing first) to a size of 5 mm×5 mm was performed with a blade having a width of 32.5 μ m using a dicing sawing device (equipment name:

DFD6341_DISCO) on a semiconductor circuit face of the wafer having a diameter of 8 inches and a thickness of 775 μ m. Then, each of the adhesive films for the wafer treatment in Present Examples 1 to 9 and Comparative Examples 1 to 5 was attached to the wafer (equipment name: DT-ECS2030-SL_Dynatech). Thereafter, the back face grinding process (equipment name: DGP8760_DISCO) was performed on the wafer until the thickness of the wafer becomes 50 μ m. After attaching a dicing tape to the back face of the wafer to which each adhesive film for the wafer treatment is attached after the back face grinding process, UV A 300 mJ/cm² was irradiated to a face of the adhesive film for the wafer treatment, and then, the adhesive film for the wafer treatment was removed to obtain the segmented wafer chips.

[00122] [Experimental Example 5: Measurement of distance between chips (=kerf)]

[00123] In the Experimental Example 4, when a point at which edges of four arbitrary wafer chips gather on the segmented wafer attached to the dicing tape is referred to as a measurement point P, a distance between two neighboring chips among the 4 chips around the P is referred to as L (4 inter-chip distances are measured for one P, L1 to L4). 12 arbitrary Ps were selected for each wafer (P1 to P12), and L1 to L48 were measured (see FIG. 3 for a detailed measurement method). In this regard, a difference between the largest value and the smallest value among L1 to L48 was defined as a change in the inter-chip distance (=a kerf change). The kerf change was measured for each of the adhesive films for the wafer treatment in Present Examples 1 to 9 and Comparative Examples 1 to 5, and the measurements are shown in Table 1 to Table 3 below.

[00124] [Experimental Example 6: Inter-chip crack occurrence percentage]

[00125] In the Experimental Example 4, cracks were observed by observing the chips attached to the dicing tape under a microscope. A crack occurrence percentage means a ratio of cracked chips among all the segmented wafer chips, and is defined by Relationship3 below, calculated, and shown in Table 1 to Table 3 below.

[00126] [Relationship3] Crack occurrence percentage (%) = (number of cracked wafer chips/total number of wafer chips) $\times$ 100 (%)

[00127] [Experimental Example 7: Curl measurement]

[00128] Each of the adhesive films for the wafer treatment in Present Examples 1 to 9 and Comparative Examples 1 to 5 was attached to the semiconductor circuit face of the wafer having the diameter of 8 inches and the thickness of 775 μ m (equipment name: DT-ECS2030-SL_Dynatech). Thereafter, the back face grinding process (equipment name: DGP8760_DISCO) was performed until the wafer thickness becomes 50 μ m.

[00129] After the back face grinding process, the wafer to which the adhesive film is attached was put on a horizontal table under an environment of a temperature 25 °C and a relative humidity of 50 % such that a convex portion thereof is in contact with the table, and a vertical level of a position at which the adhesive film is lifted from the horizontal table at most was measured and a length thereof was defined as a curl. When the length of the curl is equal to or smaller than 10 mm, it was evaluated as good (○), and when the length of the curl exceeds 10 mm, it was evaluated as bad (×). The evaluation results are shown in Table 1 to Table 3 below.

[00130] **【Table 1】**

		Present Example 1	Present Example 2	Present Example 3	Present Example 4	Present Example 5
Type and thickness [μ m] of first adhesive layer	A1	30	30			60
	A2			30	30	
Type and thickness [μ m] of second adhesive layer	B1	50	50	50	50	50
	B2					
Type and thickness [μ m] of upper base layer		PET (50)	PET (50)	PET (50)	PET (50)	PET (50)
Type and thickness [μ m] of lower base layer		PET (25)	PET (50)	PET (25)	PET (50)	PET (25)
Tensile modulus [MPa] of upper base layer		3000	3000	3000	3000	3000
Tensile modulus [MPa] of lower base layer		3000	3000	3000	3000	3000
Shear storage	30°C	0.19	0.19	0.19	0.19	0.19

modulus [MPa] of second adhesive layer	60°C	0.1	0.1	0.1	0.1	0.1
Tensile strength [MPa]		79	98	78	97	79
Creep amount (μm , @30°C)	C1	72	72	94	94	91
	C2	81	81	81	81	81
Creep amount (μm , @60°C)	C1'	98	98	153	153	131
	C2'	115	115	115	115	115
Creep amount ratio	C1 / C2	0.89	0.89	1.16	1.16	1.12
	C1' / C2'	0.85	0.85	1.33	1.33	1.14
Kerf change (μm)		19.7	11.4	21.0	12.3	20.8
Crack occurrence percentage (%)		0.8	0.6	1.5	1.0	1.4
Curl		○	○	○	○	○

[00131] 【Table 2】

		Present Example 6	Present Example 7	Present Example 8	Present Example 9
Type and thickness [μm] of first adhesive layer	A1	60	30	30	30
	A2				
Type and thickness [μm] of second adhesive layer	B1		100	50	50
	B2	50			
Type and thickness [μm] of upper base layer		PET (50)	PET (50)	PET (50)	PET (50)
Type and thickness [μm] of lower base layer		PET (25)	PET (25)	PI (25)	PEN (25)
Tensile modulus [MPa] of upper base layer		3000	3000	3000	3000
Tensile modulus [MPa] of lower base layer		3000	3000	4300	5000

base layer					
Shear modulus [MPa] of second adhesive layer	storage 30°C	0.08	0.19	0.19	0.19
	60°C	0.02	0.1	0.1	0.1
Tensile strength [MPa]		78	79	85	89
Creep amount (μm , @30°C)	C1	91	72	72	72
	C2	122	106	81	81
Creep amount (μm , @60°C)	C1'	131	98	98	98
	C2'	303	154	115	115
Creep amount ratio	C1 / C2	0.75	0.68	0.89	0.89
	C1' / C2'	0.43	0.64	0.85	0.85
Kerf change (μm)		12.8	19.2	16.7	15.4
Crack occurrence percentage (%)		1.6	1.3	0.8	0.7
Curl		○	○	○	○

[00132] 'PI' and 'PEN' in Tables 1 and 2 mean polyimide and polyethylene naphthalate, respectively.

[00133] [Table 3]

		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
Type and thickness [μm] of first adhesive layer	A1	30	30	30	30	
	A2					60
Type and thickness [μm] of second adhesive layer	B1	50	50	50		50
	B2				120	
Type and thickness [μm] of upper base layer		PET (50)	PET (50)	PE (50)	PET (50)	PET (50)
Type and thickness [μm] of lower base layer		EVA (25)	PE (25)	PET (25)	PET (50)	PET (25)
Tensile modulus [MPa] of upper base layer		3000	3000	350	3000	3000

Tensile modulus [MPa] of lower base layer		100	350	3000	3000	3000
Shear storage modulus [MPa] of second adhesive layer	30°C	0.19	0.19	0.19	0.08	0.19
	60°C	0.1	0.1	0.1	0.02	0.1
Tensile strength [MPa]		49	53	50	95	79
Creep amount (μm, @30°C)	C1	72	72	72	72	123
	C2	81	81	81	216	81
Creep amount (μm, @60°C)	C1'	98	98	98	98	275
	C2'	115	115	115	681	115
Creep amount ratio	C1 / C2	0.89	0.89	0.89	0.33	1.52
	C1' / C2'	0.85	0.85	0.85	0.14	2.39
Kerf change (μm)		31.9	34.2	36.0	40.1	32.8
Crack occurrence percentage (%)		3.4	4.1	4.9	6.7	4.8
Curl		×	×	×	○	○

[00134] 'EVA' and 'PE' in Table 3 mean ethylene vinyl acetate and polyethylene, respectively.

[00135] 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 wafer treatment, 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 first adhesive layer and the second adhesive layer satisfy both a following Relationship 1 and a following Relationship 2,

wherein a tensile strength of the adhesive film is in a range of 70 to 150 MPa:

[Relationship 1] $0.2 \leq C1/C2 \leq 1.4$

in the Relationship 1, C1 is a creep amount (μm) at 30 °C of the first adhesive layer, and C2 is a creep amount (μm) at 30 °C of the second adhesive layer,

[Relationship 2] $0.2 \leq C1'/C2' \leq 1.4$

in the Relationship 2, C1' is a creep amount (μm) at 60 °C of the first adhesive layer, and C2' is a creep amount (μm) at 60 °C of the second adhesive layer.
2. The adhesive film of claim 1, wherein each of the C1 and the C1' is in a range of 30 to 200 μm .
3. The adhesive film of claim 1, wherein each of the C2 and the C2' is in a range of 50 to 350 μm .
4. The adhesive film of claim 1, wherein a sum of thicknesses of the first adhesive layer and the second adhesive layer is in a range of 20 to 150 μm .

5. 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.
6. The adhesive film of claim 5, wherein each of the lower base layer and the upper base layer is made of the polyethylene terephthalate.
7. The adhesive film of claim 1, wherein the first adhesive layer is made of a UV-curable adhesive composition.
8. The adhesive film of claim 1, wherein the second adhesive layer is made of a thermosetting adhesive composition.
9. The adhesive film of claim 1, wherein the adhesive film further includes a primer layer disposed on at least one of the top face of the upper base layer, a bottom face of the upper base layer, or a top face of the lower base layer.
10. The adhesive film of claim 1, wherein a shear storage modulus at temperatures of 30 °C and 60 °C of the second adhesive layer is in a range of 0.02 to 1.0 MPa.