

Description

Title of Invention:

POLISHING PAD AND METHOD FOR PRODUCING THE SAME, AND
METHOD FOR PRODUCING POLISHING-PROCESSED PRODUCT

Technical Field

[0001]

The present invention relates to a polishing pad and a method for producing the same, and a method for producing a polishing-processed product.

Background Art

[0002]

In recent years, materials such as silicon carbide (SiC), gallium nitride (GaN), diamond, sapphire (Al₂O₃), and aluminum nitride (AlN), which are wide band-gap semiconductors, have attracted attention as next-generation power semiconductor element materials. For example, silicon carbide (SiC) has excellent physical property values such as a band gap 3 times and a breakdown electric field strength about 7 times those of silicon (Si) semiconductors, and is excellent in high-temperature operability and also small in size and high in energy-saving effect as compared with current silicon semiconductors. In addition, sapphire wafers are increasingly of importance in electronic equipment having

optical elements, such as components for high-performance overhead projectors, due to their chemical stability, optical characteristics (transparency), mechanical strength, thermal characteristics (heat conductivity), and the like. In order to really spread such next-generation power devices, an increase in the substrate diameter and the mass production of substrates are promoted, and the importance of substrate processing techniques is also increased along therewith. In a process for processing such a substrate, a cylindrical single crystal (ingot) for use in wafers is first sliced and thus cut out into a disc shape, as in silicon (Si). Next, the surface of the disc-shaped single crystal obtained by slicing is flattened by, first, performing lapping processing by use of a lapping platen for rough flattening of the surface. Thereafter, polishing processing is performed for a further enhancement in the flatness of the surface of the disc-shaped single crystal and for removal of fine scratches on the surface for mirror finishing.

[0003]

In such polishing processing, there are known methods in which used is a polishing sheet obtained by printing a polishing layer composition containing polishing particles on one surface of a substrate film by a screen printing method and curing the composition by ionizing radiation (see, e.g., Patent Literature 1) and a

method in which polishing is performed not using free abrasive grains, but using a polishing sheet in which a plurality of polishing structures are formed, the polishing structures each including polishing particles (fixed abrasive grains) having a primary particle size of less than 3 μm dispersed in a saturated copolymerized polyester resin (see, e.g., Patent Literature 2).

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Patent Laid-Open No. 2003-145433

Patent Literature 2: Japanese Patent Laid-Open No. 2009-72832

Summary of Invention

Technical Problem

[0005]

In the polishing sheets described in Patent Literatures 1 and 2, however, only the polishing particles exposed on the polishing layer (polishing structure) surface function as fixed abrasive grains, and the polishing particles buried in the polishing layer do not serve as abrasive grains. Thus, the polishing rate may decrease over time. Whenever the polishing rate varies over time, the polishing conditions are required

to be changed. Accordingly, in the conventional arts, further consideration is required with respect to the stability of the polishing rate.

[0006]

In this respect, in order to improve the stability of the polishing rate, it is contemplated that a polishing layer has a desired disintegratability, and the surface of the polishing layer is gradually abraded at a desired rate as polishing proceeds to thereby newly expose polishing particles buried in the polishing layer. It is conceived that the disintegratability of the polishing layer depends on the volume ratio of the polishing particles in the polishing layer and that the disintegratability is enhanced with a higher volume ratio of the polishing particles.

[0007]

However, simply increasing the volume ratio of the polishing particles in the polishing layer leads to a problem of an excessive increase in the disintegratability and excessive shortening of the lifetime of a polishing pad. Conceivably, this is because the polishing particles are freed from the polishing layer disintegrated due to polishing and the freed polishing particles function so as to facilitate the disintegration of the polishing layer. In the case where relatively expensive particles, such as diamond, are used as the polishing particles from the viewpoint of

the polishing rate, even if the volume ratio of the polishing particles is increased from the viewpoint of improving the disintegratability, the life time of the polishing pad is shortened because of an excessive increase in the disintegratability, which is an unacceptable problem from the viewpoint of costs. In contrast, there occurs a problem in that simply lowering the volume ratio of the polishing particles leads to changes in the viscosity of a composition for use in production of the polishing layer, which causes difficulty in production by screen printing, and moreover, the disintegratability and the polishing rate also decrease.

[0008]

The present invention has been made in view of the above circumstances, and an object thereof is to provide a polishing pad having appropriate disintegratability and thus capable of maintaining a stable polishing rate, a method for producing the polishing pad, and a method for producing a polishing-processed product by use of the polishing pad.

Solution to Problem

[0009]

The present inventors have made intensive studies in order to solve the above problems. As a result, the inventors have found that the above problems can be

solved by use of a filler not substantially contributing to polishing of a workpiece to be polished besides the fixed abrasive grains, thereby leading to completion of the present invention.

[0010]

That is, the present invention is as follows.

[1]

A polishing pad comprising a substrate and a resin portion provided on the substrate,

the resin portion comprising a resin, a rosin-based compound, and fixed abrasive grains contributing to polishing of a workpiece to be polished.

[2]

The polishing pad according to [1], wherein the rosin-based compound has an acid value of 50 to 200 KOHmg/g.

[3]

The polishing pad according to [1] or [2], wherein the resin comprises an acrylic phenolic resin.

[4]

The polishing pad according to any one of [1] to [3], wherein

the fixed abrasive grains comprise at least one selected from the group consisting of diamond abrasive grains, cerium oxide abrasive grains, alumina abrasive grains, silicon carbide abrasive grains, silicon oxide abrasive grains, zirconia abrasive grains, iron oxide

abrasive grains, manganese oxide abrasive grains, magnesium oxide abrasive grains, calcium oxide abrasive grains, barium oxide abrasive grains, zinc oxide abrasive grains, barium carbonate abrasive grains, and calcium carbonate abrasive grains.

[5]

The polishing pad according to any one of [1] to [4], wherein

a content of the resin is 5 to 45% by mass based on the total amount of the resin portion.

[6]

The polishing pad according to any one of [1] to [5], wherein

a content of the rosin-based compound is 2.5 to 50% by mass based on the total amount of the resin portion.

[7]

The polishing pad according to any one of [1] to [6], wherein

a content of the fixed abrasive grains is 30 to 60% by mass based on the total amount of the resin portion.

[8]

The polishing pad according to any one of [1] to [7], wherein

the substrate comprises a polyester-based film.

[9]

The polishing pad according to any one of [1] to [8], further comprising

an adhesive layer on a side of the substrate opposite to the resin portion.

[10]

A method for producing a polishing pad, comprising:
an adhering step of adhering a curable composition onto a substrate, the curable composition comprising a resin, a rosin-based compound, and fixed abrasive grains contributing to polishing of a workpiece to be polished; and

a curing step of curing the adhered curable composition to obtain a resin portion.

[11]

A method for producing a polishing-processed product, comprising

a polishing step of polishing a workpiece to be polished by use of the polishing pad according to any one of [1] to [9].

Advantageous Effects of Invention

[0011]

The present invention can provide a polishing pad having appropriate disintegratability and thus capable of maintaining a stable polishing rate, a method for producing the polishing pad, and a method for producing a polishing-processed product by use of the polishing pad.

Brief Description of Drawings

[0012]

[Figure 1] Figure 1 is a schematic front view illustrating one exemplary polishing pad of the present embodiment.

Description of Embodiments

[0013]

Hereinafter, an embodiment (hereinafter, simply referred to as "the present embodiment") for carrying out the present invention will be described in detail, if necessary, with reference to the drawing. In the drawing, like elements are denoted by like reference numerals, and the duplicated description thereof is omitted. In addition, the positional relationship among up and down, left and right, and the like is based on the positional relationship illustrated in the drawings, unless particularly noted. Furthermore, the dimensional ratio in the drawings is not limited to the ratio illustrated.

[0014]

[Polishing Pad]

The polishing pad of the present embodiment includes a substrate and a resin portion provided on the substrate, and the resin portion has a rosin-based compound and fixed abrasive grains contributing to polishing of a workpiece to be polished.

[0015]

In Figure 1, a schematic front view illustrating one exemplary polishing pad of the present embodiment is shown. As shown in Figure 1, this polishing pad 10 includes a substrate 12 and a resin portion 11 provided on the substrate 12. In Figure 1, a plurality of dots of the resin portion 11 are disposed on the surface of the substrate 12 to form a concavo-convex pattern (positive pattern). In this case, the resin portion 11 may constitute, along with the substrate 12, a concavo-convex pattern as shown in Figure 1 or may be a uniform layer formed on the substrate surface. Alternatively, the concavo-convex pattern may be a pattern of the resin portion 11 formed by punching out a uniform layer in a dotted form (negative pattern). Note that the polishing pad of the present embodiment may have an adhesive layer mentioned below, as required.

[0016]

As shown in Figure 1, in the polishing pad of the present embodiment, the presence of a rosin-based compound (not shown) allows the disintegratability of the resin portion to be controlled. The polishing surface of the resin portion 11 is gradually abraded as the polishing proceeds, and formed is a new polishing surface on which fixed abrasive grains 13 buried in the resin portion 11 are exposed.

[0017]

When the resin portion has fixed abrasive grains and no rosin-based compound and the disintegratability of the resin itself is low, the fixed abrasive grains protruding from the surface contribute to polishing. However, the fixed abrasive grains inside are unlikely to be exposed on the surface because the disintegratability of the resin portion is inhibited, and the polishing rate may be lowered over time. In contrast, when the resin portion has fixed abrasive grains and no rosin-based compound and the disintegratability of the resin itself is high, exposure and releasing of the fixed abrasive grains progress due to collapse of the resin portion. Abrasion of the resin by the released (freed) fixed abrasive grains further promotes the collapse of the resin portion, and accelerated progress of the collapse shortens the life of the polishing pad.

[0018]

As a method for controlling the disintegratability of the resin portion, methods of physically controlling collapse are contemplated, such as a method in which the hardness and brittleness are changed by selection of a resin to be used in the resin portion or the like, a method in which the content of fixed abrasive grains to be used in the resin portion is increased to change the brittleness of the resin portion, a method in which a filler unlikely to contribute to polishing is mixed in the resin portion to change the brittleness of the resin

portion, and a method in which a component contributing (not to polishing of a workpiece to be polished but) to collapse of the resin, such as white alumina, is added into a lubricant to be caused to flow during polishing.
[0019]

In contrast, in the polishing pad of the present embodiment, a rosin-based compound is mixed in the resin portion in order to chemically control collapse of the resin portion. Thus, the disintegratability is moderately controlled without changing the properties of a resin required on production such as screen printing. Particularly, in a method of making the resin portion more likely to physically collapse, it is necessary to change a resin, abrasive grains, or a filler, which directly affects the polishing rate. In contrast, in the polishing pad of the present embodiment, which chemically controls collapse of the resin portion, it is possible to control the disintegratability without lowering the polishing rate.

[0020]

[Substrate]

Examples of the substrate include, but are not particularly limited to, polyester-based films such as a polyethylene terephthalate film, polypropylene terephthalate film, and polybutylene terephthalate film; polyolefin-based films such as a polyethylene (PE) film, polypropylene (PP) film, and ethylene-propylene copolymer

film; a polyether ether ketone (PEEK) film, and a polyphenylene sulfide (PPS) film. The substrate is not particularly limited as long as a resin mentioned below can be formed on the upper surface thereof, and polyester-based films are preferable from the viewpoint of chemical resistance, heat resistance, economic efficiency, and the like.

[0021]

[Resin Portion]

The resin portion is disposed on the substrate and has a rosin-based compound and fixed abrasive grains contributing to polishing of a workpiece to be polished. The resin portion may also include a resin of a rosin-based compound and a filler unlikely to contribute to polishing, as required.

[0022]

[Fixed Abrasive Grains]

Examples of the fixed abrasive grains include, but are not particularly limited to, at least one selected from the group consisting of diamond abrasive grains, cerium oxide abrasive grains, alumina abrasive grains, silicon carbide abrasive grains, silicon oxide abrasive grains, zirconia abrasive grains, iron oxide abrasive grains, manganese oxide abrasive grains, magnesium oxide abrasive grains, calcium oxide abrasive grains, barium oxide abrasive grains, zinc oxide abrasive grains, barium oxide abrasive grains, and calcium carbonate abrasive

grains. In particular, diamond abrasive grains are preferred. When such fixed abrasive grains are used, the polishing rate tends to be more enhanced.

[0023]

The content of the fixed abrasive grains is preferably 30 to 60% by mass, more preferably 35 to 55% by mass, further preferably 40 to 50% by mass based on the total amount of the resin portion. When the content of the fixed abrasive grains is 30% by mass or more, the polishing rate tends to be more enhanced. When the content of the fixed abrasive grains is 60% by mass or less, the stability of the polishing rate tends to be more enhanced.

[0024]

[Rosin-based Compound]

Examples of the rosin-based compound include, but are not particularly limited to, rosin acids such as abietic acid, neoabietic acid, palustric acid, pimaric acid, isopimaric acid, and dehydroabietic acid; rosin derivatives such as hydrogenated rosin, maleated rosin, formylated rosin, and polymerized rosin; and rosin metal salts such as zinc rosinate, calcium rosinate, copper rosinate, and magnesium rosinate. Of these, a rosin acid is more preferred. Rosin acids are roughly classified into tall rosin, gum rosin, and wood rosin, depending on methods of collection. The main component of rosin acids is a mixture of abietic acid, which has a three-ring

structure, a conjugated double bond, and a carboxyl group, with isomers thereof, having a highly reactive and bulky structure. When such a rosin-based compound is used, the disintegratability is adjusted and the stability of the polishing rate tends to be more enhanced.

[0025]

The composition of the rosin-based compound can be specified also by an acid value. The acid value of the rosin-based compound is preferably 50 to 200 KOHmg/g, more preferably 80 to 150 KOHmg/g, further preferably 90 to 110 KOHmg/g. When the acid value of the rosin-based compound is 50 KOHmg/g or more, the drying property of the resin portion is more enhanced, and when the acid value is 200 KOHmg/g or less, occurrence of cracks in the resin portion tends to be able to be more suppressed.

[0026]

The content of the rosin-based compound is preferably 2.5 to 50% by mass, more preferably 5 to 45% by mass, further preferably 7.5 to 35% by mass, particularly preferably 10 to 25% by mass based on the total amount of the resin portion. When the content of the rosin-based compound is 2.5% by mass or more, the stability of the polishing rate tends to be more enhanced. When the content of the rosin-based compound is 50% by mass or less, the polishing rate tends to be more enhanced.

[0027]

[Resin]

The resin portion may further contain a resin other than the rosin-based compound. Examples of the resin include, but are not particularly limited to, polyurethane-based resins such as polyurethane having an ether or ester bond in the molecule, polyurethane polyurea, and polyurethane acrylate; acrylic resins such as polyacrylate, acrylic phenolic resins, and polyacrylonitrile; vinyl resins such as polyvinyl chloride, polyvinyl acetate, and polyvinylidene fluoride; polysulfone-based resins such as polysulfone and polyethersulfone; acylated cellulose-based resins such as acetylated cellulose and butyrylated cellulose; polyamide-based resins; and polystyrene-based resins. Of these, acrylic resins and polyurethane-based resins are preferred, acrylic phenolic resins and/or polyurethane acrylate are more preferred, and acrylic phenolic resins are further preferred. When such a resin is used, the polishing rate tends to be more enhanced. Note that one of resins constituting the resin portion may be used singly or two or more of the resins may be used in combination.

[0028]

The content of the resin other than the rosin-based compound is preferably 0 to 50% by mass, more preferably 5 to 45% by mass, further preferably 10 to 40% by mass, particularly preferably 15 to 35% by mass based on the

total amount of the resin portion. When the content of the resin is 0% by mass or more, the polishing rate tends to be more enhanced. When the content of the resin is 50% by mass or less, the stability of the polishing rate tends to be more enhanced.

[0029]

[Filler Unlikely to Contribute to Polishing]

The resin portion may further contain a filler unlikely to contribute to polishing (hereinafter, simply also referred to as the "filler"). The filler is not particularly limited as long as it can be said to be "unlikely to contribute to polishing" in connection with the fixed abrasive grains, and examples thereof include at least one selected from the group consisting of silica and titanium oxide. When such a filler is used, the disintegratability of the resin portion tends to be more enhanced. The phrase "contribute to polishing" or "unlikely to contribute to polishing" herein refers to a relationship between a polishing rate A in the case of using a slurry containing abrasive grains contributing to polishing as free abrasive grains and a polishing rate B in the case of using a slurry containing a filler unlikely to contribute to polishing as free abrasive grains, wherein, in comparison of the polishing rate A with the polishing rate B, setting the polishing rate A to 1 causes the polishing rate B to be 0.1 or less. Herein, the measurement conditions of the polishing rate

A and those of the polishing rate B are the same, including the content of the free abrasive grains (mass basis) in the slurry, except that the free abrasive grains used are different.

[0030]

The content of the filler is preferably 5 to 35% by mass, more preferably 7.5 to 30% by mass, further preferably 10 to 25% by mass based on the total amount of the resin portion. When the content of the filler is 5% by mass or more, the disintegratability of the resin portion is more enhanced, and the stability of the polishing rate tends to be more enhanced. When the content of the filler is 35% by mass or less, the polishing rate tends to be more enhanced because the fixed abrasive grains are relatively increased, and additionally, the life of the polishing pad tends to be more extended.

[0031]

The content of the filler is preferably 10 to 70% by volume, more preferably 20 to 60% by volume, further preferably 25 to 50% by volume based on the total volume of the fixed abrasive grains and the filler, taken as 100% by volume. When the content of the filler is 10% by volume or more, the disintegratability of the resin portion is more enhanced, and the stability of the polishing rate tends to be more enhanced. When the content of the content of the filler is 70% by volume or

less, the polishing rate tends to be more enhanced because the fixed abrasive grains are relatively increased. Note that the viscosity and the like of a curable composition mentioned below tend to be dependent on the total volume of the fixed abrasive grains and the filler rather than the total mass thereof.

[0032]

[Pattern of Resin Portion]

The resin portion may be formed on the substrate surface as a uniform layer or may be formed so as to constitute a concavo-convex pattern singly or in combination with the substrate (see Figure 1). Of these, from the viewpoint of supplying or discharging a liquid component for use in polishing, such as a lubricant, onto or from a polishing surface, the resin portion preferably forms a regular concavo-convex pattern. Having a regular pattern can achieve even polishing and may achieve polishing excellent in surface quality. Note that a "regular pattern" refers to a pattern obtained by arranging a plurality of smaller unit patterns. The surface of the resin portion opposite to the substrate serves as a polishing surface to polish a workpiece to be polished.

[0033]

The concavo-convex pattern is not particularly limited as long as the pattern has a portion to be in contact with a workpiece to be polished (convex portion)

and a portion not to be in contact with a workpiece to be polished (concave portion). Examples thereof include a positive pattern in which a resin portion 11 is independently formed on a substrate 12 as shown in Figure 1 (a pattern having a dot-like convex portion); a negative pattern in which a resin portion is continuously formed on a substrate (a pattern having a dot-like concave portion); a pattern having a doughnut-like convex portion; a pattern having a substantially C-shaped convex portion; a pattern having a portion to be in contact with a workpiece to be polished and a portion not to be in contact with a workpiece to be polished disposed concentrically; a pattern having a portion to be in contact with a workpiece to be polished and a portion not to be in contact with a workpiece to be polished disposed in a grid; a pattern having a portion to be in contact with a workpiece to be polished and a portion not to be in contact with a workpiece to be polished disposed radially; a pattern having a portion to be in contact with a workpiece to be polished and a portion not to be in contact with a workpiece to be polished disposed spirally; or a pattern constituted by combining these. Of these, preferred is a pattern having a dot-like convex portion or a pattern having a dot-like concave portion. When such a concavo-convex pattern is provided, the polishing rate tends to be more enhanced.

[0034]

Note that examples of the three-dimensional shape of dots in a pattern having a dot-like convex portion include, but are not particularly limited to, semispherical, substantially semispherical, spherical cap-shaped, substantially spherical-cap shaped, spherical band-shaped, substantially spherical band-shaped, semielliptical, substantially semielliptical, columnar (cylindrical, substantially cylindrical, elliptical cylindrical, substantially elliptical cylindrical, and polygonal columnar), and frustum-shaped (truncated conical, substantially truncated conical, elliptic conical, elliptic truncated conical, and truncated polygonal pyramidal). Of these described above, a frustum-shaped dot may be one extending from the substrate side toward the polishing surface side or may one extending from the polishing surface side to the substrate side. Also as the three-dimensional shape of the space in a concave portion in the case of a pattern having a dot-like concave portion, three-dimensional shapes similar to the three-dimensional shape in the case of the pattern having a dot-like convex portion can be exemplified.

[0035]

[Adhesive Layer]

The polishing pad of the present embodiment may further include, on the side of the substrate opposite to the resin portion, an adhesive layer for adhering the

polishing pad on the polishing platen of a polishing machine. The adhesive layer may contain an adhesive or tackifier used in conventionally known polishing pads. Examples of materials for the adhesive layer include various thermoplastic adhesives such as acrylic adhesives, nitrile-based adhesives, nitrile rubber-based adhesives, polyamide-based adhesives, polyurethane-based adhesives, polyester-based adhesives, and silicone-based adhesives. The adhesive layer may be double-sided tape, for example.

[0036]

[Anchor Layer]

The polishing pad of the present embodiment may have an anchor layer between the substrate and the resin portion. When the anchor layer is provided, the contactability of the substrate and the resin portion tends to be more enhanced. Examples of materials constituting the anchor layer include, but are not particularly limited to, acrylic resin coating agents.

[0037]

[Method for Producing Polishing Pad]

A method for producing a polishing pad of the present embodiment has an adhering step of adhering a curable composition onto a substrate, the curable composition including a rosin-based compound and fixed abrasive grains contributing to polishing of a workpiece to be polished, and a curing step of curing the adhered curable composition to obtain a resin portion.

[0038]

[Adhering Step]

In the adhering step, a curable composition including a rosin-based compound and fixed abrasive grains contributing to polishing of a workpiece to be polished is adhered onto a substrate. In this case, the curable composition may be adhered onto the substrate such that the resin portion forms a desired concavo-convex pattern. The curable composition may also include a resin of a rosin-based compound and a filler unlikely to contribute to polishing of a workpiece to be polished.

[0039]

Examples of a method for adhering the curable composition onto the substrate include, but are not particularly limited to, a gravure coater method, a small-diameter gravure coater method, a reverse roll coater method, a transfer roll coater method, a kiss coater method, a die coater method, a screen printing method, and a spray coating method. In particular, from the viewpoint of the ease of forming a complex concavo-convex pattern, the screen printing method is preferred.

[0040]

(Curable Composition)

The curable composition is not particularly limited as long as the composition includes a rosin-based compound and fixed abrasive grains contributing to polishing of a workpiece to be polished. In addition to

these, the curable composition may include a filler not contributing to polishing of the resin and a workpiece to be polished. Furthermore, the curable composition may be a photocurable composition containing a photopolymerization initiator and a polymerizable compound, a thermal curable composition containing a thermal polymerization initiator and a polymerizable compound, a curable composition containing a thermosetting resin, a UV curing resin, or a two-liquid mixing type curing resin, or the like. The curable composition may contain a crosslinking agent having two or more polymerizable functional groups, as required.

[0041]

Examples of the polymerizable compound include, but are not particularly limited to, (meth)acrylate, epoxy (meth)acrylate, urethane (meth)acrylate, and polyester (meth)acrylate.

[0042]

Examples of the photopolymerization initiator include, but are not particularly limited to, benzophenone-based compounds, acetophenone-based compounds, and thioxanthone-based compounds. Examples of the thermal polymerization initiator include, but are not particularly limited to, azo compounds such as 2,2'-azobisbutyronitrile and peroxides such as benzoyl peroxide (BPO).

[0043]

Examples of the thermosetting resin include, but are not particularly limited to, phenol resins, epoxy resins, acryl resins, urea resins, and formaldehyde resins.

[0044]

Preferred examples of the UV curing resin include, but are not particularly limited to, prepolymers having a number average molecule weight of about 1,000 to 10,000. Examples of a material thereof include acrylic (methacrylic) esters, urethane-modified products thereof, and thiokol-based materials. Depending on applications, a reactive diluent or organic solvent can be used, as appropriate. Examples of the two-liquid mixing type curing resin that can be used include, but are not particularly limited to, prepolymers of different physical properties.

[0045]

[Curing Step]

The curing step is a step of curing the adhered curable composition to obtain a resin portion. Examples of the curing method include, but are not particularly limited to, photocuring and thermal curing. In a resulting resin portion, some of the fixed abrasive grains and the filler are exposed on the surface, and the other fixed abrasive grains are buried in the resin.

[0046]

[Other Steps]

The method for producing a polishing pad of the present embodiment may have other steps, as required. For example, the method may have a step of removing at least a portion of the volatile component in the curable composition by volatilization before the adhering step and after the curing step, for example. Alternatively, the method may have a step of removing a portion of the curable composition or the resin portion in order to form a desired concavo-convex pattern after the adhering step and before the curing step, and/or after the curing step. An example of the removing method is cutting.

[0047]

[Method for Producing Polishing-processed Product]

A method for producing a polishing-processed product of the present embodiment is not particularly limited as long as it is a method for producing a polished product, including a polishing step of polishing a workpiece to be polished by use of the polishing pad. The polishing step may be primary lapping polishing (rough lapping), may be secondary lapping (finishing lapping), may be polishing, or may serve as a plurality of these polishing steps.

[0048]

Examples of the workpiece to be polished include, but are not particularly limited to, a semiconductor device, a material for electronic components and the like, in particular, a Si substrate (silicon wafer), a SiC (silicon carbide) substrate, a GaAs (gallium arsenide)

substrate, glass, and a thin substrate (workpiece to be polished) such as a substrate for hard disc or LCD (liquid crystal display). Of these, the method for producing a polishing-processed product of the present embodiment can be suitably used as a production method of producing a material that may be applied for a power device, LED, and the like, for example, a difficult-to-process material which has a difficulty in polishing processing, such as sapphire, SiC, GaN, and diamond. Of these, from the viewpoint that the function effect of the polishing pad of the present embodiment can be more effectively utilized, a semiconductor wafer is preferable, and a SiC substrate, a sapphire substrate or a GaN substrate is preferable. The material therefor is preferably a difficult-to-cut material such as a SiC single crystal and a GaN single crystal, and it may be a single crystal of sapphire, silicon nitride, aluminum nitride, or the like.

[0049]

[Polishing Step]

The polishing step is a step of polishing a workpiece to be polished using the polishing pad described above. A conventionally known method can be used as the polishing method, and is not particularly limited. The pH of a coolant liquid for use in the polishing step is preferably more than 7, more preferably 7.5 to 11, further preferably 8 to 10. When the pH of

the coolant liquid is within the range, both the polishing rate and the stability of the polishing rate can be achieved. The pH of the coolant liquid is adjusted by the amount of potassium hydroxide (KOH) to be dissolved in pure water.

[0050]

In the polishing method, first, a polishing pad is mounted on a predetermined position of a polishing machine. During this mounting, the polishing pad is mounted via the adhesive layer mentioned above so as to be fixed on the polishing machine. A workpiece to be polished retained on a retaining platen, which workpiece is disposed so as to be opposite to the polishing pad as a polishing platen, is then pressed on the polishing surface, and also the polishing pad and/or the retaining platen are/is rotated with a coolant liquid externally supplied. Accordingly, polishing processing is applied to a surface to be processed of the workpiece to be polished (surface to be polished) by the action of the abrasive grains supplied between the polishing pad and the workpiece to be polished.

[0051]

Examples of a dispersion medium for a lubricant include water and an organic solvent. From the viewpoint of more suppressing deterioration of the workpiece to be polished, an organic solvent is preferred. As the organic solvent, an organic solvent having a boiling

point of about 110 to 300°C is generally suitable. For the type of the organic solvent, commercially available organic solvents such as aliphatic, aromatic, and cyclic hydrocarbons, esters, ethers, amines, amides, and ketones can be selected depending on the resin and suitability to the work. Such solvents may be used singly or two or more thereof may be used in combination. The solvent may also contain other additives as required. Examples of such other additives include polar compounds, and specific examples thereof include a nonionic surfactant, anionic surfactant, carboxylate, carboxylic acid amide, and carboxylic acid. Additionally, various silicones and inorganic powders can be added as an antifoaming agent, a dispersant, a leveling agent, and a viscosity improver.

[0052]

Note that a solvent that contains no abrasive grains and may contain additives may be supplied onto the polishing surface of the polishing pad from the viewpoint of suppressing an increase in the temperature caused by friction between the polishing pad and the workpiece to be polished during polishing processing. Examples of the solvent and additives include those described above.

Examples

[0053]

The present invention will be described more specifically hereinbelow using Examples and Comparative

Examples. The present invention is not intended to be limited to the following Examples.

[0054]

[Polishing test 1]

A polishing pad was mounted via double-sided tape on a predetermined position of a polishing machine, and a 2-inch silicon wafer as a workpiece to be polished was subjected to a polishing test, in which polishing was applied under the following conditions. In the polishing test 1, a polishing rate was calculated at each polishing time: 10 minutes, 20 minutes, 30 minutes, 40 minutes, 50 minutes, 60 minutes, 70 minutes, 80 minutes, 90 minutes, 100 minutes, and 110 minutes.

(Polishing Conditions)

Number of rotations of platen: 60 rpm

Surface pressure: 150 gf/cm²

Flow rate of coolant liquid: 100 cc/min

Coolant liquid: pH was adjusted by adding KOH to the solvent pure water.

[0055]

(Polishing Rate)

The polishing rate (unit: $\mu\text{m}/\text{h}$) was evaluated as a thickness removed per hour by calculating a thickness removed by polishing from the amount of polishing determined from a decrease in the mass of the workpiece to be polished before and after polishing of the polishing tests 1 and 2 above and the polishing area and

the specific gravity of the workpiece to be polished. The thickness was calculated by using the amount of polishing determined from decrease in the mass of the workpiece to be polished before and after processing and the polishing area and the specific gravity of the workpiece to be polished. The polishing test was conducted on three silicon wafers, and the weighted average thereof was taken as the polishing rate.

[0056]

[Example 1]

A curable composition was prepared by mixing 60 parts by mass of diamond abrasive grains (manufactured by TRUSTWELL CO., LTD, average particle size: 9 μm) as fixed abrasive grains and 40 parts by mass of maleated rosin (manufactured by Arakawa Chemical Industries, Ltd., acid value: 90 to 110 KOHmg/g).

[0057]

The curable composition was applied by screen printing on a polyethylene terephthalate film (manufactured by TOYOCO CO., LTD., product name: COSMOSHINE A4300, thickness: 250 μm) as a substrate such that substantially semispherical dots, as a dot-like convex portion, were regularly arranged in a concavo-convex pattern. Thereafter, the curable composition was cured by heating to form a resin portion.

[0058]

In the end, double-sided tape (manufactured by 3M Company, product name: film substrate double-sided pressure-sensitive adhesive tape 442JS) was adhered as an adhesive layer to the side of the substrate opposite to the resin portion to obtain a polishing pad of Example 1. In the obtained polishing pad, the diameter of each dot was 2 mm, and the shortest distance between adjacent dots was 0.5 mm.

[0059]

In Example 1, the polishing test was performed with the pH of a coolant liquid kept at 7 for the first 20 minutes, at 9 for the subsequent 40 minutes, and at 11 for the last 10 minutes.

[0060]

[Example 2]

A curable composition was prepared by mixing 60 parts by mass of diamond abrasive grains (manufactured by TRUSTWELL CO., LTD, average particle size: 9 μm) as fixed abrasive grains, 20 parts by mass of maleated rosin (manufactured by Arakawa Chemical Industries, Ltd., acid value: 90 to 110 KOHmg/g), and 20 parts by mass of an acryl phenol resin (manufactured by Arakawa Chemical Industries, Ltd.). The other steps were performed in the same manner as in Example 1 to obtain a polishing pad of Example 2.

[0061]

In Example 2, the polishing test was performed with the pH of a coolant liquid kept constant at 10.

[0062]

[Example 3]

A curable composition was prepared by mixing 60 parts by mass of diamond abrasive grains (manufactured by TRUSTWELL CO., LTD, average particle size: 9 μm) as fixed abrasive grains, 12 parts by mass of maleated rosin (manufactured by Arakawa Chemical Industries, Ltd., acid value: 90 to 110 KOHmg/g), and 28 parts by mass of an acryl phenol resin (manufactured by Arakawa Chemical Industries, Ltd.). The other steps were performed in the same manner as in Example 1 to obtain a polishing pad of Example 3.

[0063]

In Example 3, the polishing test was performed with the pH of a coolant liquid kept constant at 9 or with the pH kept constant at 10.

[0064]

[Comparative Example 1]

A curable composition was prepared by mixing 60 parts by mass of diamond abrasive grains (manufactured by TRUSTWELL CO., LTD, average particle size: 9 μm) as fixed abrasive grains and 40 parts by mass of an acryl phenol resin (manufactured by Arakawa Chemical Industries, Ltd.). The other steps were performed in the same manner as in

Example 1 to obtain a polishing pad of Comparative

Example 1.

[0065]

In Comparative Example 1, the polishing test was performed with the pH of a coolant liquid kept constant at 7.

[0066]

[Table 1]

	Coolant pH	Polishing rate (μm/hr)											
		10 minutes	20 minutes	30 minutes	40 minutes	50 minutes	60 minutes	70 minutes	80 minutes	90 minutes	100 minutes	110 minutes	
Example 1	7 (20 minutes) → 9 (40 minutes) → 11 (10 minutes)	69	32	23.2	31.6	19	4.8	70.4	*1				
Example 2	10	98	65	42	28	*1							
Example 3	9	88.8		59.6		59.6		43.2		45.2		*1	
	10	85	53	39.2	43.2	54	46	*1					
Comparative Example 1	7	84.6	49.8	*2									

*1 Dots disappeared.

*2 Dots remained, but the polishing rate decreased to 15 μm/hr or less.

[0067]

In Comparative Example 1, the resin portion contained no rosin compound, and thus, the disintegratability was low, and a decrease in the polishing rate was immediately observed. After 20 minutes or later, no improvement in the polishing rate was observed whether the dots of the resin portion remained or not.

[0068]

In contrast, in Example 1, when the disintegratability was checked while the pH was varied, a tendency similar to Comparative Example 1 was observed in

the first 20 minutes under neutral conditions (pH 7). However, when the pH was raised to 9 thereafter, the disintegratability was enhanced, and the polishing rate exceeded 15 $\mu\text{m/hr}$. When polishing was continued until 60 minutes, a decrease in the polishing rate was observed. Then, raising the pH up to 11 further enhanced the disintegratability. A high polishing rate was observed as well as the dots in the resin portion disappeared.

[0069]

In Example 2, when the pH was set at 10 and the disintegratability was checked, the polishing rate gradually decreased. However, it was possible to retain the polishing rate for a longer period than in Comparative Example 1, and the dots in the resin portion disappeared.

[0070]

In Example 3, when the pH was set at 9 and 10 and the disintegratability was checked, it was possible to retain a high polishing rate for a further long period.

Industrial Applicability

[0071]

The polishing pad of the present invention has industrial applicability to polishing pads for use in lapping and polishing of optical materials, semiconductor devices, glass substrates for hard disks and the like, in

particular, in lapping and polishing of sapphire, SiC, and the like.

Reference Signs List

[0072]

10 ... polishing pad, 11 ... resin portion, 12 ... substrate, 13 ... fixed abrasive grain

Claims

[Claim 1]

A polishing pad comprising a substrate and a resin portion provided on the substrate,

the resin portion comprising a rosin-based compound and fixed abrasive grains contributing to polishing of a workpiece to be polished,

the rosin-based compound has an acid value of 50 to 150 KOHmg/g.

[Claim 2]

The polishing pad according to claim 1, wherein
the resin portion further comprises a resin other than a rosin-based compound, and
the resin comprises an acrylic phenolic resin.

[Claim 3]

The polishing pad according to claim 1 or 2, wherein
the fixed abrasive grains comprise at least one selected from the group consisting of diamond abrasive grains, cerium oxide abrasive grains, alumina abrasive grains, silicon carbide abrasive grains, silicon oxide abrasive grains, zirconia abrasive grains, iron oxide abrasive grains, manganese oxide abrasive grains, magnesium oxide abrasive grains, calcium oxide abrasive grains, barium oxide abrasive grains, zinc oxide abrasive

grains, barium carbonate abrasive grains, and calcium carbonate abrasive grains.

[Claim 4]

The polishing pad according to claim 2 or 3, wherein
a content of the resin other than the rosin-based
compound is 5 to 45% by mass based on the total amount of
the resin portion.

[Claim 5]

The polishing pad according to any one of claims 1
to 4, wherein
a content of the rosin-based compound is 2.5 to 50%
by mass based on the total amount of the resin portion.

[Claim 6]

The polishing pad according to any one of claims 1
to 5, wherein
a content of the fixed abrasive grains is 30 to 60%
by mass based on the total amount of the resin portion.

[Claim 7]

The polishing pad according to any one of claims 1
to 6, wherein
the substrate comprises a polyester-based film.

[Claim 8]

The polishing pad according to any one of claims 1 to 7, further comprising

an adhesive layer on a side of the substrate opposite to the resin portion.

[Claim 9]

A method for producing a polishing pad, comprising:
an adhering step of adhering a curable composition onto a substrate, the curable composition comprising a rosin-based compound having an acid value of 50 to 150 KOHmg/g and fixed abrasive grains contributing to polishing of a workpiece to be polished; and

a curing step of curing the adhered curable composition to obtain a resin portion.

[Claim 10]

A method for producing a polishing-processed product, comprising

a polishing step of polishing a workpiece to be polished by use of the polishing pad according to any one of claims 1 to 8.