

DESCRIPTION

[Title of Invention]

CARRIER FOR POLISHING PROCESSING, METHOD FOR
5 MANUFACTURING CARRIER FOR POLISHING PROCESSING, AND
METHOD FOR MANUFACTURING MAGNETIC-DISK SUBSTRATE

[Technical Field]

[0001] The present invention relates to a carrier for polishing processing that
10 is to be used to polish a substrate, a method for manufacturing a carrier for
polishing processing, and a method for manufacturing a magnetic-disk
substrate.

[Background Art]

[0002] Conventionally, a glass substrate has been preferably used in a
15 magnetic disk used as one type of information recording medium. Nowadays,
in order to meet the demand for an increase in the storage capacity of hard disk
drive devices, attempts have been made to increase the magnetic recording
density. Following this, the magnetic recording information area has been
made smaller by making the flying height of the magnetic head from the
20 magnetic recording surface extremely low. It is preferable that the size and
shape of a glass substrate used in such a magnetic disk are produced with high
precision as intended.

[0003] In order to produce the size and shape of the glass substrate with high
precision, the surface of the glass substrate is ground and polished. In
25 grinding and polishing of the glass substrate, a plate-shaped carrier for
grinding or polishing that is for holding the glass substrate, which is ground or
polished while being sandwiched between two surface plates, during grinding
or polishing is used. This carrier is provided with a holding hole for holding
the glass substrate.

30 Conventionally, from the viewpoint of mechanical strength and cost, a

resin-impregnated material obtained by impregnating glass cloth in which glass fibers are oriented in two different directions with a resin material has been widely used as this carrier. In particular, a carrier having a configuration in which a plurality of layers obtained by impregnating a glass cloth with an epoxy resin are stacked is suitably used. However, there are cases where, when a glass substrate is ground or polished with this carrier, defects occur on an edge surface (outer circumferential side wall surface) of the glass substrate, such as depressed marks, for example. These marks are deeper and longer than other marks formed on the edge surface. There are also cases where abrasive particles in a polishing slurry attach to the depressed portion of these marks, and glass chips caused by the marks attach to the edge surface and become as a source of dust generation. In particular, the abrasive particles in the polishing slurry that is used in final polishing are sandwiched between the edge surface and the carrier, attach inside the depressed marks as minute particles, and are fixed thereto. There are also cases where the minute particles attached in this manner separate from the edge surface of the glass substrate during sputtering that is performed when a magnetic layer is formed on the glass substrate, and get onto main surfaces, resulting in the formation of defects on the magnetic layer. Therefore, the above-described marks are the cause of reducing the yield of manufacturing glass substrates or manufacturing magnetic disks.

[0004] A carrier that protects the glass substrate from fibers such as glass fibers that constitute the above-described carrier in such circumstances is known (Patent Literature 1). This carrier has a configuration in which a plurality of recessed portions are arranged on an inner circumferential wall surface of a holding hole for a glass substrate and that has a holding hole cushioning region that is made of only a resin material on the outside from the inner circumferential wall surface and a holding hole reinforcement region that is made of a composite material on the outside of the holding hole cushioning region. That is, no fibers protrude from the inner circumferential wall surface

of the holding hole for the formed glass substrate, and thus it is possible to prevent the occurrence of marks on the outer circumferential side wall surface of the glass substrate inserted in the holding hole at a polishing process.

Also, a carrier for polishing that can prevent the occurrence of marks on the outer circumferential side surface of a polishing target by the inner circumferential surface of a holding hole of the carrier for polishing and the outer circumferential side surface of the polishing target sliding against each other is known (Patent Literature 2). In this carrier for polishing, a plurality of protrusions that contact the outer circumferential side surface of the polishing target and support the polishing target are provided on the inner circumferential surface of the holding hole, and an interval between these protrusions is set to be larger than the width in the circumferential direction of the protrusions on the inner circumference of the holding hole.

[Citation List]

[Patent Literature]

[0005] [PLT1]: JP 2012-218103A

[PLT2]: JP 2000-288921A

[Summary of Invention]

[Technical Problem]

[0006] However, in the carrier of Patent Literature 1, the inner circumferential wall surface of the holding hole for the glass substrate is a holding hole cushioning region made of only a resin material, and thus the original mechanical strength of the carrier is not obtained and the carrier lacks durability, and thus, if continuous processing is performed, there is a concern that a portion of the resin material that constitutes the holding hole cushioning region will be chipped due to a corner between the outer circumferential side surface and the main surface of the glass substrate abutting against the holding hole cushioning region. The portion of the resin material separated from the holding hole cushioning region at this time easily causes the above-described marks, and may also attach to the main surfaces of the glass

substrate and form a protruding portion, resulting in a defect.

Also, when polishing is performed using the glass substrate as a polishing target, the carrier for polishing described in Patent Literature 2 could not sufficiently suppress marks on the outer circumferential side surface (outer circumferential edge surface) of the glass substrate.

[0007] In view of this, an object of the present invention is to provide a carrier for polishing processing, a method for manufacturing a carrier for polishing processing, and a method for manufacturing a magnetic-disk substrate according to which it is possible to suppress the occurrence of marks on an edge surface of the substrate and to suppress the formation of defects due to minute particles and the like attaching to main surfaces of the substrate (according to which it is possible to avoid adverse effects on the main surfaces of the substrate).

[Solution to Problem]

[0008] A mode of the present invention is a carrier for polishing processing. This carrier has the following aspects.

[0009] Aspect 1

A carrier for polishing processing that is made of a composite material including fibers oriented in at least a certain direction and a resin material, and has a holding hole for holding a disk-shaped substrate when a pair of main surfaces of the substrate are subjected to polishing processing with the substrate sandwiched between an upper surface plate and a lower surface plate, in which

the holding hole has, on a circumference of an inner circumferential wall surface of the holding hole, a first wall portion that is configured such that the substrate is in contact with the fibers in a state in which the substrate is held in the holding hole, and a second wall portion that is configured such that the substrate does not come into contact with the fibers, and

the second wall portion is formed in a portion of the inner circumferential wall surface facing toward an orientation direction of the fibers

that includes the certain direction.

[0010] Aspect 2

The carrier for polishing processing according to Aspect 1, in which the second wall portion is located outside of the first wall portion in a radial direction of the holding hole.

The carrier of Aspect 2, described differently, is a carrier for polishing processing that has a holding hole for holding a disk-shaped glass substrate when glass main surfaces of the glass substrate are subjected to polishing processing with the substrate sandwiched between an upper surface plate and a lower surface plate, in which

the carrier for polishing processing is constituted by a plate obtained by impregnating a glass cloth in which glass fibers are oriented in two directions that are different from each other with a resin material, and

an outline of the holding hole is defined such that, of the inner circumferential wall surface of the holding hole, orientation direction wall surface portions that face in two orientation directions in which the glass fibers are oriented are all located outside of an inscribed circle inscribing the outline of the inner circumferential wall surface of the holding hole.

[0011] Aspect 3

The carrier for polishing processing according to Aspect 2, in which the first wall portion is a first curved surface having a shape protruding inwardly in the radial direction of the holding hole, a flat surface, or a second curved surface having a protruding shape that has a radius of curvature larger than a radius of curvature of an inscribed circle inscribing an outline of the inner circumferential wall surface of the holding hole and protrudes outwardly in the radial direction of the holding hole, and an outer circumferential side wall surface of the substrate abuts against the first curved surface, the flat surface, or the second curved surface.

In other words, the carrier of Aspect 3 is the carrier for polishing processing according to Aspect 2 described differently above, in which wall

surfaces on both sides of the orientation direction wall surface portions of the holding hole along the circumferential direction of the holding hole are first curved surfaces having a shape protruding inwardly of the holding hole, flat surfaces, or second curved surfaces having a shape that protrudes outwardly with respect to the holding hole having the radius of curvature larger than the radius of curvature of the inscribed circle, and the outer circumferential side wall surface of the glass substrate abuts against the first curved surface, the flat surface, or the second curved surface.

Note that in the carrier of Aspect 2 or 3 described differently above, no tips of glass fibers of the glass cloth are present on the first curved surface, the flat surface, or the second curved surface of the holding hole, and the tips of the glass fibers may be located outside of the outline of the holding hole.

[0012] Aspect 4

The carrier for polishing processing according to Aspect 3, in which the circumference of the holding hole is provided with four or more of the first curved surface, the flat surface, or the second curved surface.

In other words, the carrier of Aspect 4 is the carrier for polishing processing according to Aspect 2 or 3 described differently above, in which the circumference of the holding hole is provided with four or more of the first curved surface, the flat surface, or the second curved surface.

[0013] Aspect 5

The carrier for polishing processing according to any one of Aspects 2 to 4, in which a diameter of the inscribed circle inscribing the outline of the inner circumferential wall surface of the holding hole is larger than a diameter of a disk shape of the substrate.

[0014] Aspect 6

The carrier for polishing processing according to Aspect 5, in which the diameter of the inscribed circle is 1.002 to 1.031 times the diameter of the disk shape of the substrate.

In other words, the carrier of Aspect 6 is the carrier for polishing

processing according to any one of Aspects 2 to 5 described differently above, in which the diameter of the inscribed circle is 1.002 to 1.031 times the diameter of the disk shape of the substrate.

[0015] Another mode of the present invention is a method for manufacturing a magnetic-disk substrate. This manufacturing method has the following aspects.

[0016] Aspect 7

A method for manufacturing a magnetic-disk substrate, including:

a step of producing a disk-shaped substrate; and

a step of performing polishing processing on main surfaces of the substrate by sandwiching the substrate between an upper surface plate and a lower surface plate in a state in which the substrate is held in the holding hole provided in the carrier for polishing processing according to any one of aspects 2 to 6, and moving the glass main surfaces and the upper surface plate and the lower surface plate relative to each other.

In other words, the manufacturing method according to Aspect 7 is a method for manufacturing a magnetic-disk glass substrate including polishing processing for polishing the main surfaces of the glass substrate by sandwiching the glass substrate between the an upper surface plate and a lower surface plate in a state in which the glass substrate is held in a holding hole provided in the carrier for polishing processing according to any one of Aspects 2 to 6 described differently above, and moving the glass main surfaces and the upper surface plate and the lower surface plate relative to each other.

[0017] Aspect 8

The method for manufacturing a magnetic-disk substrate according to Aspect 7, in which an outer circumferential side wall surface of the substrate abuts on both sides of the second wall portion during the polishing processing, without abutting against the second wall portion.

In other words, the manufacturing method of Aspect 8 is the method for manufacturing a magnetic-disk glass substrate according to Aspect 7 described

differently above, in which the outer circumferential side wall surface of the glass substrate abuts on both sides of the orientation direction wall surface portion during the polishing processing, without abutting against the orientation direction wall surface portion.

5 [0018] Aspect 9

The method for manufacturing a magnetic-disk substrate according to Aspect 7 or 8, in which the carrier for polishing processing is produced by forming a holding hole in a plate material made of a composite material including fibers oriented in at least a certain direction and a resin material,
10 and etching the plate material after the holding hole is formed.

[0019] Another mode of the present invention is a carrier for polishing processing. This carrier has the following aspects.

[0020] Aspect 10

The carrier for polishing processing according to Aspect 1, in which a
15 fiber absence region that is provided outside in a radial direction of the holding hole with respect to the second wall portion and in which no fibers are present in the orientation direction is arranged in an annular region extending outwardly from the inner circumferential wall surface of the holding hole in the radial direction of the holding hole.

20 In other words, the carrier of Aspect 10 is a carrier having a holding hole for holding a plate-shaped glass substrate when the main surfaces of the glass substrate are subjected to polishing processing with the glass substrate sandwiched between the upper surface plate and the lower surface plate, in which

25 the carrier is constituted by a resin-impregnated base plate obtained by impregnating a glass cloth with a resin material, the carrier being reinforced by the glass cloth in which a plurality of glass fibers are arranged so as to be directed in one of two orientation directions,

first reinforcement regions reinforced with only first glass fibers that
30 are directed in one of the orientation directions and second reinforcement

regions reinforced with only second glass fibers that are directed in another of the orientation directions are disposed alternately at a distance from each other in the circumferential direction in an annular region extending outwardly from the inner wall surface of the holding hole, and

5 the first reinforcement region is provided outside of a first inner wall portion of the inner wall surface of the holding hole that faces in an orientation direction of the second glass fibers, and the second reinforcement region is provided outside of a second inner wall portion of the inner wall surface that faces in an orientation direction of the first glass fibers.

10 [0021] Aspect 11

The carrier for polishing processing according to Aspect 10, in which the fiber absence region is formed by no tips of the fibers that are directed toward the second wall portion reaching the inner circumferential wall surface of the holding hole.

15 In other words, the carrier of Aspect 11 is the carrier according to Aspect 10 described differently above, in which the first reinforcement region is formed such that no tips of the second glass fibers reach the inner wall surface of the holding hole, and the second reinforcement region is formed such that no tips of the first glass fibers reach the inner wall surface of the holding hole.

20 [0022] Another mode of the present invention is a method for manufacturing a carrier for polishing processing. This manufacturing method has the following aspects.

[0023] Aspect 12

25 A method for manufacturing a carrier for polishing processing having a holding hole for holding a disk-shaped substrate when main surfaces of the substrate are subjected to polishing processing with the substrate sandwiched between an upper surface plate and a lower surface plate, the manufacturing method including:

30 a first step of forming the holding hole in a plate material made of a composite material including fibers oriented in at least a certain direction and

a resin material; and

a second step of producing the carrier by at least etching the plate material in which the holding hole is formed, in which

5 in the second step, the fibers are etched in a portion of the inner circumferential wall surface facing toward an orientation direction of the fibers that includes the certain direction.

In other words, the manufacturing method of Aspect 12 is a method for manufacturing a carrier having a holding hole for holding a disk-shaped glass substrate when main surfaces of the glass substrate are subjected to polishing processing with the glass substrate sandwiched between an upper surface plate and a lower surface plate, the manufacturing method including:

10 a first step of forming the holding hole in a resin-impregnated base plate obtained by impregnating a glass cloth with a resin material, the resin-impregnated base plate being reinforced by the glass cloth in which a plurality of glass fibers are disposed so as to be directed in one of two orientation directions; and

a second step of producing the carrier by etching the resin-impregnated base plate in which the holding hole is formed, in which

20 in the second step, a reinforcement region reinforced with only glass fibers oriented in a direction that differs from the orientation direction of the etched glass fibers is formed in an annular region extending outwardly from the inner wall surface 5 of the holding hole 3 of the carrier by etching the glass fibers that are exposed so as to be directed in the orientation directions.

[0024] Aspect 13

25 The method for manufacturing a carrier for polishing processing according to Aspect 12, in which in the second step, before etching, a masking material is provided on a portion of the plate material that constitutes a portion other than the portion of the inner circumferential wall surface facing toward the orientation direction, and the masking material is removed after etching.

30 In other words, the manufacturing method of Aspect 13 is the method

for manufacturing a carrier according to Aspect 12 described differently above, in which in the second step, the masking material is provided, before etching, in a portion of the annular region excluding the reinforcement region, and the masking material is removed after etching.

5 [0025] Aspect 14

The method for manufacturing a carrier for polishing processing according to Aspect 12 or 13, in which in the second step, etching is performed by applying an etching agent for etching the fibers to a portion of the plate material that constitutes the portion of the inner circumferential wall surface
10 facing toward the orientation direction.

In other words, the manufacturing method of Aspect 14 is the method for manufacturing a carrier according to Aspect 12 or 13 described differently above, in which in the second step, etching is performed by applying an etching agent for etching the glass fibers to a portion that is to form the reinforcement
15 region of the annular region of the resin-impregnated base plate.

[0026] Aspect 15

The method for manufacturing a carrier for polishing processing according to any one of Aspects 12 to 14, in which in the second step, before etching, the plate material and one or more other base plates in which holding
20 holes are formed at positions corresponding to a position at which the holding hole is formed in the plate material are disposed stacked in a substrate thickness direction.

In other words, the manufacturing method of Aspect 15 is the method for manufacturing a carrier according to any one of Aspects 12 to 14 described
25 differently above, in which in the second step, before etching, the resin-impregnated base plate and one or more other base plates in which holding holes are formed at positions corresponding to the position at which the holding hole is formed in the resin-impregnated base plate are disposed stacked in the substrate thickness direction.

30 [0027] Aspect 16

The method for manufacturing a carrier for polishing processing according to Aspect 15, in which the one or more other base plates are made of a composite material including fibers oriented in at least a certain direction and a resin material, and

5 when the plate material is called a first plate material and the one or more other base plates are called second plate materials, in the second step, when the first plate material and the second plate materials are disposed stacked, directions in which the fibers are oriented are matched between the plate materials.

10 In other words, the manufacturing method of Aspect 16 is the method for manufacturing a carrier according to Aspect 15 described differently above, in which the one or more other base plates are reinforced by the glass cloth in which a plurality of glass fibers are disposed so as to be directed in one of two orientation directions are obtained by impregnating a glass cloth with a resin
15 material, and

 when the resin-impregnated base plate is called a first resin-impregnated base plate and the one or more other base plates are called second resin-impregnated base plates, in the second step, when the first resin-impregnated base plate and the second resin-impregnated base plates are
20 disposed stacked, the orientation directions are matched between the resin-impregnated base plates.

[0028] Aspect 17

The method for manufacturing a carrier for polishing processing according to Aspect 15, in which the one or more other base plates are made of a
25 composite material including fibers oriented in at least a certain direction and a resin material, and

 when the plate material is called a first plate material and the one or more other base plates are called second plate materials, in the first step, if the first plate material and the second plate materials are disposed stacked, the
30 holding holes are formed such that directions in which the fibers are oriented

match between the plate materials.

In other words, the manufacturing method of Aspect 17 is the method for manufacturing a carrier according to Aspect 15 described differently above, in which the one or more other base plates are reinforced by a glass cloth in which a plurality of glass fibers are disposed so as to be directed in one of two orientation directions, and the glass cloth is impregnated with a resin material and

when the resin-impregnated base plate is called a first resin-impregnated base plate and the one or more other base plates are called second resin-impregnated base plates, in the first step, if the first resin-impregnated base plate and the second resin-impregnated base plates are disposed stacked, the holding hole is formed such that the orientation directions match between the resin-impregnated base plates.

[0029] Another mode of the present invention is a method for manufacturing a magnetic-disk substrate. This manufacturing method has the following aspects.

[0030] Aspect 18

A method for manufacturing a magnetic-disk substrate, including polishing processing for polishing main surfaces of a substrate in a state in which the substrate is held in the carrier for polishing processing according to any one of Aspects 10 and 11 or the carrier for polishing processing manufactured by the method for manufacturing a carrier for polishing processing according to any one of Aspects 12 to 17.

In other words, the manufacturing processing of Aspect 18 is a method for manufacturing a magnetic-disk glass substrate including

polishing processing for polishing main surfaces of a glass substrate in a state in which the glass substrate is held by the carrier according to Aspect 10 or 11 described differently above or the carrier manufactured by the method for manufacturing a carrier according to any one of Aspects 12 to 17 described differently above.

[Advantageous Effects of the Invention]

[0031] According to a method for manufacturing a magnetic-disk substrate and a carrier for polishing processing of the present invention, it is possible to suppress the occurrence of marks on an edge surface of a substrate and to suppress the formation of defects on main surfaces of the substrate.

Also, according to a carrier for polishing processing of the present invention, in the vicinity of an inner wall portion facing in the orientation direction of the fibers (facing toward the orientation direction), no fibers directed in an orientation direction of the fibers are present and the carrier is reinforced with only fibers oriented in a direction different from the orientation direction of the above fibers, for example. Accordingly, if polishing processing is performed on a substrate, the occurrence of marks on the edge surface of the substrate is prevented and the strength of the carrier is ensured in the vicinity of the inner wall surface of a holding hole, and thus contamination (foreign matter) derived from a resin material is suppressed. According to a method for manufacturing a carrier for polishing processing of the present invention, such a carrier can be obtained. According to a method for manufacturing a magnetic-disk substrate of the present invention, the occurrence of marks on the edge surface of the substrate is prevented when polishing processing is performed and contamination derived from a resin material is suppressed, and thus the occurrence of blemishes or scratches on the main surfaces of the substrate is suppressed.

[Brief Description of Drawings]

[0032] FIG. 1 is an exploded perspective view of an example of a grinding apparatus (double-sided polishing apparatus) in which a carrier of a first embodiment is used.

FIG. 2 is a cross-sectional view of an example of the grinding apparatus shown in FIG. 1.

FIG. 3 is a diagram illustrating an example of a relationship between an inner circumferential wall surface of a holding hole and two orientation

directions in which glass fibers are oriented in the first embodiment.

FIG. 4 is a diagram showing an example of an outline shape of the holding hole of the carrier of the first embodiment.

FIG. 5 is a perspective view showing the carrier shown in FIG. 1, focusing on one holding hole.

FIG. 6 is a diagram illustrating a state in which the inner circumferential wall surface of the holding hole of the carrier of the first embodiment abuts against a glass substrate.

FIGS. 7A and 7B are diagrams showing another example of the outline shape of the holding hole of the carrier of the first embodiment.

FIGS. 8A to 8C are diagrams showing yet another example of the outline shape of a holding hole of the carrier of the first embodiment.

FIG. 9 is a diagram showing yet another example of the outline shape of the holding hole of the carrier of the first embodiment.

FIG. 10 is a plan view of a carrier of a second embodiment.

FIG. 11 is a perspective view showing the carrier shown in FIG. 10, focusing on one holding hole.

FIG. 12 is a diagram showing the carrier in FIG. 1, focusing on an annular region.

FIG. 13 is a diagram showing the carrier in FIG. 1, focusing on an annular region.

[Description of Embodiments]

[0033] First Embodiment

Hereinafter, a carrier for polishing processing and a method for manufacturing a magnetic-disk substrate of a first embodiment will be described in detail. In this embodiment, polishing processing includes grinding a glass substrate, and polishing the glass substrate after grinding so as to reduce the roughness of glass main surfaces of the glass substrate that has been ground. Therefore, the carrier for polishing processing is a carrier that can be used to grind and polish a glass substrate. Although the carrier of

the embodiments described below is used for polishing, it can also be used for grinding.

[0034] In order to resolve conventional problems, the inventor of the present invention conducted intensive studies on a carrier and a glass substrate as a substrate, for example. The carrier is constituted by a plate (plate material) obtained by impregnating a glass cloth in which glass fibers are oriented in two directions that are different from each other, such as two orthogonal directions, for example, with a resin material. In this carrier, glass cloth is stacked in a plurality of layers and glass fibers of each glass cloth are oriented in the same direction. The inventor surmised that in an orientation direction wall surface portion (a second wall portion that will be described later), of an inner circumferential wall surface of a holding hole of a glass substrate, facing in two orientation directions in which the glass fibers are oriented, when tips of the glass fibers abut against an outer circumferential side wall surface of the glass substrate, the tips of the glass fibers slightly protrude (stick out) due to slight bending of the resin material, and these tips of the glass fibers stick into and rub the outer circumferential side wall surface of the glass substrate or glass fibers that protrude from the surface of the resin material stick into or rub the outer circumferential side wall surface of the glass substrate, as a result of which the outer circumferential side wall surface of the glass substrate is marked.

On the other hand, the inventor realized that in the above-described known carrier for polishing (Patent Literature 2), protrusions are provided but the orientation directions of the glass fibers are not considered. Moreover, the inventor found that glass fibers of tips of the protrusions protruding parallel to the orientation directions of the glass fibers marked the outer circumferential edge surface of the glass substrate. Because a force is particularly concentrated on the tips of the protrusions protruding parallel to the orientation directions of the glass fibers, the outer circumferential edge surface of the glass substrate are easily marked. As a result of experiments, a carrier

for polishing processing and a method for manufacturing a substrate having modes described below were invented.

[0035] Although a substrate encompasses an aluminum substrate, a silicon wafer, and the like as well as a glass substrate in this specification, a glass substrate will be described below as a representative example hereinafter. Note that the aluminum substrate includes a substrate made of pure aluminum and an aluminum alloy containing other metal elements such as magnesium. A surface of an aluminum substrate or the like may be provided with a plating film of NiP (nickel nitride) or the like, for example.

Although fibers encompass metal fibers and the like as well as glass fibers in this specification, glass fibers will be described as a representative example hereinafter. Also, in the case of simply referring to fiber, fiber mean a plurality of fibers unless otherwise stated. Moreover, although the number of orientation directions of fibers may be one or more such as two or three, the case in which the number of orientation directions is two will be described as a representative example hereinafter.

In this specification, inside of the holding hole means outside in the radial direction of the holding hole from the central portion of the holding hole or a direction in which the holding hole narrows, whereas outside of the holding hole means inside in the radial direction of the holding hole from the central portion of the holding hole or a direction in which the holding hole widens.

[0036] Polishing Apparatus

An apparatus for polishing a glass substrate using a carrier for polishing processing of the present embodiment will be described with reference to FIGS. 1 and 2. The carrier for polishing processing has a holding hole for holding a disk-shaped glass substrate when glass main surfaces of the glass substrate are subjected to polishing processing with the glass substrate sandwiched between an upper surface plate and a lower surface plate. FIG. 1 is an exploded perspective view of the polishing apparatus (double-sided polishing apparatus). FIG. 2 is a cross-sectional view of the polishing

apparatus. Because a grinding apparatus has a configuration similar to that of the polishing apparatus, description of the grinding apparatus is omitted.

[0037] As shown in FIG. 1, the polishing apparatus has a pair of upper and lower surface plates, that is, an upper surface plate 40 and a lower surface plate 60. An annular glass substrate G is sandwiched between the upper surface plate 40 and the lower surface plate 60, and both main surfaces of this glass substrate G can be polished by moving the glass substrate G and the surface plates relative to each other through movement operation of one or both of the upper surface plate 40 and the lower surface plate 60. Note that a polishing slurry containing polishing abrasive particles is supplied between the glass substrate and the surface plates. Hereinafter, when the upper surface plate 40 and the lower surface plate 60 are described collectively, they are simply called surface plates.

[0038] Specifically, a configuration of the polishing apparatus will be described with reference to FIGS. 1 and 2.

In the polishing apparatus, polishing pads 10 are attached to an upper surface of the lower surface plate 60 and a lower surface of the upper surface plate 40. In FIG. 1, the polishing pads 10 are depicted in the form of a sheet. Urethane resin foam or the like can be used for the polishing pad 10, for example.

A carrier 30 has a holding hole for holding the disk-shaped glass substrate G when the main surfaces of the glass substrate G are subjected to polishing processing with the glass substrate G sandwiched between the upper surface plate 40 and the lower surface plate 60. Specifically, the carrier 30 has a tooth portion 31 that is provided on an outer circumferential portion and engages with a sun gear 61 and an internal gear 62, and one or more holding holes 32 for accommodating and holding the glass substrate G. The sun gear 61, the internal gear 62 that is provided at the outer edge, and the disk-shaped carrier 30, as a whole, constitutes a planetary gear mechanism having a central shaft CTR as the center. The disk-shaped carrier 30 engages with the sun

gear 61 on the inner circumferential side, engages with the internal gear 62 on the outer circumferential side, and accommodates and holds one or more glass substrates G. The carrier 30 revolves while rotating as a planet gear on the lower surface plate 60, and the glass substrate G and the lower surface plate 60 are moved relative to each other. For example, if the sun gear 61 rotates in the counterclockwise direction, the carrier 30 rotates in the clockwise direction and the internal gear 62 rotates in the counterclockwise direction. As a result, the lower surface plate 60 and the glass substrate G move relative to each other. Similarly, the glass substrate G and the upper surface plate 40 may be moved relative to each other.

[0039] During the operation of the above-described relative movement, the upper surface plate 40 is pressed against the glass substrate G (that is, in a vertical direction) held by the carrier 30 at a predetermined pressure, and accordingly the polishing pads 10 are pressed against the glass substrate G. Also, as shown in FIG. 2, a polishing slurry is supplied from a supplying tank 71 by a pump (not shown) between the glass substrate G and the polishing pads 10 via one or more pipes 72.

[0040] Carrier

The carrier 30 has a layer structure in which a plurality of pieces of glass cloth (JIS R3414: 2012) are stacked. The reason why the carrier 30 is made to have a layer structure using glass cloth is to ensure flexural rigidity, shear rigidity, and mechanical strength so that the glass substrate G is not marked as a result of the carrier 30 undergoing bending deformation and shear deformation due to a force received from the sun gear 61 and the internal gear 62 during polishing. The glass cloth is manufactured by weaving glass thread (JIS R3413: 2012. Hereinafter, the glass thread is also referred to as glass yarn) made of glass fibers. The carrier 30 is obtained by attaching stacked layers obtained by impregnating the above-described glass cloth with a resin material to each other with pressure. That is, the carrier 30 is constituted by a plate material (hereinafter, also referred to as a resin-impregnated base

plate) in which the glass cloth in which glass fibers are oriented in two directions that are different from each other are disposed in the resin material. A thermoplastic resin such as an epoxy resin and a phenol resin are used as the resin material.

5 [0041] FIG. 3 is a diagram illustrating an example of a relationship between an inner circumferential wall surface 36 of the holding hole 32 of the holding hole 32 of the carrier 30 in the present embodiment and two orientation directions in which glass fibers are oriented. The outline shape of the inner circumferential wall surface 36 shown in FIG. 3 is circular for simplification,
 10 and as described later, has unevenness along the circumference of the holding hole 32. The carrier 30 is constituted by a plate obtained by impregnating a glass cloth in which glass fibers are oriented in two directions (X and Y directions) that are different from each other with a resin material. The orientation directions of the glass fibers in the layers of the glass cloths are
 15 respectively the X direction and the Y direction. The glass cloth is a woven cloth in which glass fibers 33 and 34 having a filament diameter of several μm , for example, are arranged in a density of 200 to 800 glass fibers per unit, for example.

[0042] FIG. 4 is a diagram showing an example of the outline shape of the
 20 holding hole 32 of the carrier 30. FIG. 5 is a perspective view showing the carrier 30 shown in FIG. 1, focusing on one holding hole 32. FIG. 6 is a diagram illustrating a state in which the inner circumferential wall surface 36 of the holding hole 32 of the carrier 30 and the glass substrate G abut against each other.

25 The carrier 30 of the present embodiment is made of a composite material including glass fibers that are oriented in at least a certain direction and a resin material, and has the holding hole 32 for holding a disk-shaped substrate when a pair of main surfaces of the substrate are subjected to polishing processing with the substrate sandwiched between the upper surface
 30 plate and the lower surface plate. The holding hole 32 has, on the

circumference of the inner circumferential wall surface of the holding hole, a first wall portion (a portion excluding a second wall portion of a first curved surface 37, a flat surface 38, and a second curved surface 39, which will be described later) that is configured such that the substrate is in contact with fibers in a state in which the substrate is held in the holding hole 32, and a second wall portion (orientation direction wall surface portion 35, which will be described later) that is configured such that the substrate does not come into contact with the fibers. The second wall portion is formed in a portion, of the inner circumferential wall surface of the holding hole 32, that is directed in orientation directions of the fibers that include the certain direction. The carrier 30 of the first embodiment is characterized by the second wall portion being located outside of the first wall portion in the radial direction of the holding hole. Note that orientation directions of fibers that include the certain direction means all directions in which fibers included in the carrier are oriented. Therefore, the second wall portion is formed on the inner circumferential wall surface of the holding hole in correspondence with all the orientation directions of fibers, and specifically, and the second wall portions are formed on the inner circumferential wall surface, the number of second wall portions being twice the number of orientation directions of the fibers. For example, if the number of the orientation directions of fibers is two, four second wall portions are formed on the inner circumferential wall surface. This point similarly applies to a second embodiment that will be described later.

[0043] The outline of the holding hole 32 is defined such that orientation direction wall surface portions 35 of the side wall surface of the holding hole 32 shown in FIG. 4 are all located outside of an inscribed circle inscribing the outline of the inner circumferential wall surface of the holding hole 32, the orientation direction wall surface portion 35 facing in two orientation directions (X direction, Y direction) in which glass fibers are oriented. Accordingly, the outer circumferential side wall surface of the glass substrate G during polishing processing abuts on both sides of the orientation direction wall

surface portion 35 without abutting against the orientation direction wall surface portion 35.

Here, as shown in FIG. 3, assuming an inscribed circle C inscribing the outline of the inner circumferential wall surface of the holding hole 32, the orientation direction wall surface portion 35 refers to a portion on the inscribed circle such that a normal line direction (direction orthogonal to the tangent line of the inscribed circle) of the inscribed circle matches the orientation direction of the glass fibers 33 and 34, that is, a portion (a portion indicated by the thick solid line in FIG. 3) of the inner circumferential wall surface of the holding hole 32, the portion being located in an azimuth direction viewed from the central point of the inscribed circle. At this time, as shown in FIG. 3, the normal line direction matching the orientation direction encompasses that a wall surface portion having a range of $\theta=40$ degrees (± 20 degrees with respect to the center line in FIG. 3) where a portion that completely matches the direction is the center is an allowable range for the orientation direction wall surface portion 35. An example of such an allowable range includes $\theta=22.5$ degrees (± 11.25 degrees with respect to the center line in FIG. 3.), for example. The holding hole 32 is provided to have a substantially circular shape, and thus four orientation direction wall surface portions 35 that respectively have centers at $\theta = 0$ degrees, 90 degrees, 180 degrees, and 270 degrees where the azimuth angle of the X direction is 0 degrees are provided. The orientation direction wall surface portion 35 of the inner circumferential wall surface 36 of the holding hole 32 shown in FIG. 4 is located outside of the inscribed circle (indicated by dotted line in FIG. 4) inscribing the outline of the inner circumferential wall surface of the holding hole 32. Specifically, in the example shown in FIG. 4, the wall surface of the orientation direction wall surface portion 35 on both sides along the circumferential direction of the holding hole 32 forms a first curved surface 37 having a shape protruding inwardly of the holding hole 32. The first curved surface 37 having a protruding shape inscribes the inscribed circle. Therefore, as shown in FIG. 6,

the outer circumferential side wall surface of the glass substrate G abuts on both sides of the orientation direction wall surface portion 35 without abutting against the orientation direction wall surface portion 35. In this manner, the orientation direction wall surface portions 35 facing in the orientation

5 directions of the glass fibers 33 and 34 are located outside of the inscribed circle inscribing the outline of the inner circumferential wall surface of the holding hole 32, and do not abut against the outer circumferential side wall surface of the glass substrate G. Thus, even if the glass fibers 33 and 34 are exposed from the resin material in the orientation direction wall surface portions 35, the

10 ends of the glass fibers 33 and 34 do not come into contact with the outer circumferential side wall surface of the glass substrate G, and thus it is possible to prevent the outer circumferential side wall surface of the glass substrate G from being marked. Accordingly, it is possible to suppress the formation of defects due to attachment of minute particles and the like to the main surfaces

15 of the glass substrate G. Note that side wall surfaces orthogonal to the main surfaces and chamfered surfaces (interposing surfaces) that link a side wall surface and the main surfaces may be formed by chamfering, on the edge surfaces on the inner circumferential side and the outer circumferential side of the glass substrate G, and in this case, particularly, the side wall surfaces of

20 the edge surfaces (outer circumferential side wall surface) on the outer circumferential side of the glass substrate G are prevented from being marked.

Also, two first curved surfaces 37 having a shape protruding inwardly of the holding hole 32 abut against the glass substrate G and disperse a force that the glass substrate G applies to the outer circumferential side wall surface, the

25 first curved surfaces being located on both sides of the orientation direction wall surface portion 35 in the circumferential direction of the inner circumferential wall surface of the holding hole 32, and thus it is possible to inhibit two first curved surfaces 37 that have a protruding shape from abutting against and marking the outer circumferential side wall surface of the glass

30 substrate G. On the other hand, if the shape of the holding hole 32 is a simple

circle as is conventionally the case, the glass substrate comes into contact with the carrier at one location and a force is concentrated, as a result of which marks are easily made.

Note that if a plurality of holding holes 32 are provided in one carrier 30, it is preferable to provide the first curved surfaces 37 having a shape protruding inwardly of the holding hole 32, in consideration of the orientation directions of the glass fibers of all the holding holes 32. The first curved surface 37 having a protruding shape needs to be formed in consideration of the directions of glass fibers included in the carrier 30 in all the holding holes 32 formed in one carrier 30. In the conventional carrier for polishing having a protrusion (notch) having a protruding shape, as shown in the drawings in Patent Literature 2, for example, attention was not paid to the orientation of the notch, and thus if a plurality of holding holes are formed in one carrier, there were cases where glass fibers protruded in the perpendicular direction in a substrate supporting portion of a notch end portion. Thus, if polishing or processing is performed using a carrier having a plurality of holding holes, all substrates in the batch were not prevented from coming into contact with glass fibers protruding in the perpendicular direction.

A maximum protruding amount, in the radial direction of a virtual circle, of the first curved surface 37 from the virtual circle toward the center of the virtual circle is preferably 0.3 to 5 mm, and is more preferably 1 to 3 mm, the first curved surface having a protruding shape and the portion of the virtual circle being defined by the wall surface portion of the orientation direction wall surface portion 35. Note that it is sufficient that the first curved surface 37 having a protruding shape has a curved surface, and as shown in the drawings, the first curved surface 37 may have a curved surface curving so as to bulge outwardly from an inner portion of the first curved surface 37 having a protruding shape, or as shown in FIG. 1 in Patent Literature 2, may have a curved surface curving so as to bulge inwardly from the first curved surface having a protruding shape, or may have a flat surface. If the first curved

surface 37 having a protruding shape has a curved surface curving so as to bulge outwardly from the inner portion of the first curved surface 37 having a protruding shape, a radius of curvature R of the curved surface is preferably 5 to 150 mm, and is more preferably 10 to 50 mm. The number of first curved surfaces having a protruding shape is preferably at least four, and is more preferably at least eight.

[0044] Although eight first curved surfaces 37 having a shape protruding inwardly of the holding hole 32 are provided in the example shown in FIG. 4, the number of first curved surfaces 37 arranged on the circumference is not limited to eight. FIGS. 7A and 7B are diagrams showing another example of an outline shape of the holding hole 32 of the carrier 30. As shown in FIG. 7A and 7B, the number of arrangement may be six, ten, or the like. In this manner, there is no limitation on the above-described number of arrangement as long as the first curved surface 37 having a protruding shape is provided on wall surfaces on both side of the orientation direction wall surface portion 35 that faces in two orientation directions (X direction, Y direction) in which the glass fibers 33 and 34 are oriented.

[0045] Moreover, instead of the first curved surface 37 having a protruding shape being provided on the wall surfaces on both sides of the orientation direction wall surface portion 35, the flat surface 38 may be provided. FIGS. 8A to 8C are diagrams showing yet another example of an outline shape of the holding hole 32 of the carrier 30. As shown in FIGS. 8A to 8C, with regard to the outline shape of the holding hole 32, the wall surfaces on both sides of the orientation direction wall surface portion 35 facing in two orientation directions (X direction, Y direction) in which the glass fibers 33 and 34 are oriented are the flat surfaces 38 as long as the outer circumferential side wall surface of the glass substrate G abuts on both sides of the orientation direction wall surface portion 35 without abutting against the orientation direction wall surface portion 35. The flat surface 38 is in contact with the inscribed circle C. That is, the outline shape of the holding hole 32 may be a regular polygon such as a

regular hexagon, a regular octagon, or a regular decagon, or may be a polygon. Four positions of the orientation direction wall surface portions 35 cannot be matched to the apex positions of the regular hexagon in the example of a regular hexagon shown in FIG. 8A, and thus, as shown in FIG. 8A, the orientation of the regular hexagon with respect to two orientation directions (X direction, Y direction) in which the glass fibers 33 and 34 are oriented is adjusted such that the positions of the orientation direction wall surface portions 35 are located at positions deviating from the apex positions of the regular hexagon. Similarly, in the example of a regular octagon as shown in FIG. 8C as well, four positions of the orientation direction wall surface portions 35 cannot be matched to the apex positions of the regular decagon, the orientation of the regular decagon with respect to two orientation directions (X direction, Y direction) in which the glass fibers 33 and 34 are oriented is adjusted such that the positions of the orientation direction wall surface portions 35 are located at positions deviating from the apex positions of the regular decagon.

Note that in the example of a regular octagon shown in FIG. 8B, four positions of the orientation direction wall surface portions 35 can be matched to the apex positions of the regular octagon, and thus the orientation of the regular hexagon with respect to two orientation directions (X direction, Y direction) in which the glass fibers 33 and 34 are oriented is adjusted such that the positions of the orientation direction wall surface portions 35 are located at the apex positions of the regular hexagon.

[0046] In the examples shown in FIGS. 8A to 8C as well, the flat surfaces 38 of the inner circumferential wall surface of the holding hole 32 are in contact with the inscribed circle C. By defining the outline of the holding hole 32 such that the orientation direction wall surface portions 35 are all located outside of the inscribed circle C inscribing the outline of the inner circumferential wall surface of the holding hole 32, the outer circumferential side wall surface of the glass substrate G during polishing processing abuts on both sides of the

orientation direction wall surface portions 35 without abutting against the orientation direction wall surface portions 35. That is, the wall surfaces on both sides of the orientation direction wall surface portions 35 of the holding hole 32 along the circumferential direction of the holding hole 32 are flat surfaces 38, and the outer circumferential side wall surface of the glass substrate G during polishing processing abuts against a portion of the above-described flat surface 38. Thus, even if the glass fibers 33 and 34 are exposed from the resin material in the orientation direction wall surface portions 35, the ends of the glass fibers 33 and 34 do not come into contact with the outer circumferential side wall surface of the glass substrate G, and thus it is possible to prevent the outer circumferential side wall surface of the glass substrate G from being marked. Accordingly, it is possible to suppress the formation of defects due to attachment of minute particles and the like to the main surfaces of the glass substrate G.

[0047] Also, the wall surfaces on both sides of the orientation direction wall surface portions 35 of the holding hole 32 along the circumferential direction of the holding hole 32 may not be the flat surfaces 38. FIG. 9 is a diagram showing yet another example of the outline shape of the holding hole of the carrier 30. Instead of the flat surface 38, a second curved surface 39 having a radius of curvature larger than the radius of curvature of the inscribed circle C inscribing the outline of the inner circumferential wall surface of the holding hole 30 can be used. The second curved surface 39 has a shape protruding toward the outside of the holding hole 32 (a shape recessed with respect to the inside of the holding hole 32). The second curved surface 39 is in contact with the inscribed circle C. In this case, as shown in FIG. 9, the outline of the holding hole 32 is defined such that the orientation direction wall surface portions 35 of the inner circumferential wall surface of the holding hole 32 are all located outside of the inscribed circle C inscribing the outline of the inner circumferential wall surface of the holding hole 32. Accordingly, the outer circumferential side wall surface of the glass substrate G during polishing

processing abuts against the second curved surfaces 39 on both sides of the orientation direction wall surface portions 35 without abutting against the orientation direction wall surface portions 35. Thus, even if the glass fibers 33 and 34 are exposed from the resin material in the orientation direction wall surface portions 35, the ends of the glass fibers 33 and 34 do not come into contact with the outer circumferential side wall surface of the glass substrate G, and thus it is possible to prevent the outer circumferential side wall surface of the glass substrate G from being marked. Accordingly, it is possible to suppress the formation of defects due to attachment of minute particles and the like to the main surfaces of the glass substrate G.

[0048] In order to increase the mechanical strength of the carrier 30, it is preferable that the tips of the glass fibers 33 and 34 are located on the inner circumferential wall surface 36 of the holding hole 32. That is, it is preferable that the tips of the glass fibers 33 and 34 are located on the first curved surfaces 37, the flat surfaces 38, or the second curved surfaces 39.

However, in order to further prevent the outer circumferential side wall surface of the glass substrate G from being marked, it is preferable that no tips of the glass fibers 33 and 34 of the glass cloth are present on the first curved surfaces 37, the flat surfaces 38, or the second curved surface 39, which are located on both sides of the orientation direction wall surface portions 35, and the tips of the glass fibers 33 and 34 are located outside of the outline of the holding hole 32. Since the first curved surfaces 37, the flat surfaces 38, or the second curved surfaces 39, which are located on both sides of the orientation direction wall surface portions 35, are not the orientation direction wall surface portions 35, even if the tips of the glass fibers 33 and 34 are located on the first curved surfaces 37, the flat surfaces 38, or the second curved surfaces 39, the outer circumferential side wall surface of the glass substrate G is unlikely to be marked. However, even if the glass fibers 33 and 34 are not exposed from the resin material in the orientation direction wall surface portions 35, there are cases where the glass fibers 33 and 34 protrude from the resin material due to

reception of a slight compression when the resin material surrounding the glass fibers 33 and 34 abuts against the glass substrate G during polishing. Also, there are cases where the glass fibers 33 and 34 are exposed due to the above-described resin material rubbing the glass substrate G and the resin material being worn away during polishing processing. In such a case, in order to inhibit the outer circumferential side wall surface of the glass substrate G from being marked, it is preferable that the tips of the glass fibers 33 and 34 are located outside of the outline of the holding hole 32. In this case, in order to ensure the mechanical strength of the carrier 30, it is preferable that the distance between the tips of the glass fibers 33 and 34 and the outline of the holding hole 32 is less than 2 μm . The glass fibers 33 and 34 whose tips do not reach the inner circumferential wall surface 36 of the holding hole 32 can be obtained by etching the glass fibers 33 and 34 exposed at the first curved surfaces 37, the flat surfaces 38, or the second curved surfaces 39 of the carrier 30, using an etching solution containing hydrofluoric acid. That is, it is preferable that the carrier is produced by forming the holding hole 32 in a resin-impregnated base plate obtained by impregnating a glass cloth with a resin material, the resin-impregnated base plate being reinforced by the glass cloth in which a plurality of glass fibers are disposed so as to be directed in one of two orientation directions, and etching the resulting resin-impregnated base plate after the formation of the holding hole 32.

[0049] Note that removal processing for removing, with an acidic electrolyte solution containing metal ions, alkali salts of fluoroaluminate produced by etching processing after the glass fibers 33 and 34 are subjected to the etching processing with an etching liquid containing hydrofluoric acid may be performed on the first curved surface 37, the flat surface 38, or the second curved surface 39 of the inner circumferential wall surface of the holding hole 32 of the carrier 30. The probability of the outer circumferential edge surface of the glass substrate being marked can be reduced by first performing this etching processing. Furthermore, since minute particles of alkali salts of

fluoroaluminate remaining on the carrier 30 are removed by performing the above-described removal processing after the etching processing, it is possible to prevent the main surfaces of the glass substrate G from being marked due to minute particles of alkali salt of fluoroaluminate entering between the glass substrate G and the upper surface plate 40 or the lower surface plate 60 during polishing, and to prevent the formation of defects on a magnetic layer due to the above-described minute particles getting on the main surfaces of the glass substrate during sputtering performed when the magnetic layer is formed on the glass substrate G.

[0050] It is preferable that four or more first curved surfaces 37, four or more flat surfaces 38, or four or more second curved surfaces 39 are provided on the circumference of the holding hole 32, the first curved surface 37, the flat surfaces 38, or the second curved surfaces 39 being located on both sides of the orientation direction wall surface portion, because a force generated when the inner circumferential wall surface 36 of the holding hole 32 and the outer circumferential side wall surface of the glass substrate G abut against each other is dispersed. If the above-described abutting force is concentrated without dispersion, there is a concern that the carrier 30 will locally deform due to reception of a large local force, and the carrier 30 will be damaged, or the glass substrate G or the polishing pads will be damaged during polishing due to the glass substrate G advancing into a gap resulting from the carrier 30 deforming and bending.

Also, the diameter of the inscribed circle C inscribing the outline of the inner circumferential wall surface of the holding hole 32 is substantially equal to or is slightly larger than the disk shape of the glass substrate G to be polished, and is preferably 1.002 to 1.031 times the diameter of the disk shape of the glass substrate G, because the outer circumferential side wall surface of the glass substrate G reliably abuts against the wall surfaces on both sides of the orientation direction wall surface portions 35 without abutting against the orientation direction wall surface portion 35. If the diameter thereof is

smaller than this range, there are cases where it is difficult to cause the glass substrate to be held in the holding hole or to remove the glass substrate from the holding hole. Also, if the diameter is larger than this range, there are cases where the glass substrate easily comes into sudden contact with the inner
5 circumferential wall surface of the holding hole during processing, and the edge surface is easily marked.

[0051] Although a polishing pad is attached to the upper surface plate 40 or the lower surface plate 60 in the polishing apparatus shown in FIGS. 1 and 2, fixed abrasive particles may be provided on the upper surface plate 40 or the
10 lower surface plate 60 and a coolant may be supplied between the glass substrate G and the upper surface plate 40 or the lower surface plate 60. Also, the carrier 30 may be used in a grinding apparatus that grinds the glass substrate G, in addition to the polishing apparatus.

Such a carrier 30 can be used in a grinding apparatus having a
15 configuration that is substantially similar to that of this polishing apparatus as well as in the polishing apparatus, and can be suitably used to manufacture a magnetic-disk glass substrate as shown below. With grinding using the apparatus for grinding a glass substrate, a roughness Ra of a main surface of the glass substrate after grinding is larger than with polishing. In such
20 grinding, the main surfaces of the glass substrate may be ground with a grinding liquid supplied between the upper surface plate and the lower surface plate and the glass substrate. Alternatively, the upper surface plate and the lower surface plate may be provided with fixed abrasive particles and the main surfaces of the glass substrate may be ground with a lubricating liquid supplied
25 between these fixed abrasive particles and the glass substrate.

[0052] Method for manufacturing magnetic-disk substrate

In a manufacturing method of the present embodiment, processing for molding a glass blank, which is a material for a plate-shaped magnetic-disk glass substrate having a pair of main surfaces, is first performed. Next,
30 processing for rough-grinding this glass blank is performed. After this, shape

processing and edge surface polishing processing are performed on the glass blank. Thereafter, precision grinding processing using fixed abrasive particles is performed on the glass substrate obtained from the glass blank. First polishing processing, chemical strengthening processing, and second polishing processing are then performed on the glass substrate. Note that although the above-described processes are performed in the above-described flow in the present embodiment, all of the above-described processes need not be performed and some of these processes may not be performed as appropriate. Also, the order of processes can be changed as appropriate. Hereinafter, each processing will be described.

[0053] (a) Molding glass blank

A press molding method may be used to mold a glass blank, for example. A circular glass blank can be obtained by a press molding method. Moreover, a glass blank can be manufactured using a known manufacturing method such as a downdraw method, a redraw method, a fusion method, or a float method. A disk-shaped glass blank, which is the base of a magnetic-disk glass substrate, can be obtained by appropriately performing shape processing on the plate-like glass blank produced with these known manufacturing methods.

[0054] (b) Rough grinding

In rough grinding, specifically, main surfaces on both sides of the glass blank are ground while the glass blank is held in a holding hole provided in a holding member (carrier) mounted on a known double-sided grinding apparatus provided with a planetary gear mechanism that is similar to that of the apparatus shown in FIGS. 1 and 2. At this time, the above-described carrier 30 can be used. Loose abrasive particles are used as a grinding agent, for example. In rough grinding, grinding is performed such that the glass blank is brought approximately closer to a target substrate thickness and a target flatness of the main surfaces. Note that rough grinding is performed in accordance with the dimensional accuracy or the surface roughness of the molded glass blank, and may be omitted in some cases.

[0055] (c) Shape processing

Next, shape processing is performed. In the shape processing, after the glass blank is molded, a circular hole is formed in the center of the glass blank using a known processing method to obtain a disk-shaped glass substrate having the circular hole. Thereafter, chamfering is performed on edge surfaces of the glass substrate. That is, a disk-shaped glass substrate is produced by performing processing (a) to (c) on the glass blank.

[0056] (d) Edge surface polishing

Next, edge surfaces of the glass substrate are polished. The edge surface polishing is processing for performing polishing by supplying a polishing liquid containing loose abrasive particles between a polishing brush and the edge surfaces of the glass substrate and moving the polishing brush and the glass substrate relative to each other. In edge surface polishing, an inner circumferential side wall surface and an outer circumferential side wall surface of the glass substrate are polishing targets, and the inner circumferential side wall surface and the outer circumferential side wall surface are formed into mirror surfaces.

[0057] (e) Precision grinding

Next, precision grinding is performed on the main surfaces of the glass substrate. It is preferable that in precision grinding, the main surfaces of the glass substrate are ground using surface plates to which fixed abrasive particles are attached and a double-sided grinding apparatus having a planetary gear mechanism similar to that of the polishing apparatus shown in FIGS. 1 and 2,. In this case, it is preferable to use a combination of the surface plates to which fixed abrasive particles are provided and a coolant, instead of a combination of loose abrasive particles and polishing pads. Specifically, the main surfaces on both sides of the glass substrate are ground with fixed abrasive particles while the glass substrate is held in a holding hole provided in the above-described carrier 30, which is the holding member of the double-sided grinding apparatus. A machining allowance amount by grinding is about 10

μm to 200 μm , for example. A load that is applied by the surface plates to the substrate is preferably 100 to 250 g/cm^2 .

Although the main surfaces of the glass substrate are ground by bringing grinding surfaces containing the fixed abrasive particles and the main surfaces of the glass substrate into contact with each other in precision grinding of the present embodiment, grinding using loose abrasive particles may be performed.

[0058] (f) First polishing

Next, first polishing is performed on the main surfaces of the glass substrate. Specifically, the main surfaces on both sides of the glass substrate G are polished while an outer circumferential side wall surface of the glass substrate is held in the holding hole 32 provided in the carrier 30 of the polishing apparatus shown in FIGS. 1 and 2. In first polishing, loose abrasive particles and polishing pads attached to the surface plates are used. First polishing removes cracks and warping remaining on the main surfaces in the case where grinding is performed with fixed abrasive particles, for example. In first polishing, it is possible to reduce the surface roughness of the main surfaces, that is, an arithmetic average roughness R_a , for example, while preventing the shape of the end portions of the main surfaces from excessively recessing or protruding. The main surfaces are thus formed into mirror surfaces.

Although there is no particular limitation on the loose abrasive particles used in first polishing, cerium oxide abrasive particles, zirconia abrasive particles, or the like are used, for example.

Although there is no particular limitation on the type of polishing pad, for example, a hard urethane resin foam polisher is used.

[0059] (g) Chemical strengthening

The glass substrate is subjected to chemical strengthening using a known method, as appropriate. The time at which the chemical strengthening is performed is determined as appropriate. Chemical strengthening may be

performed as needed, and may not be performed.

[0060] (h) Second polishing (final polishing)

Next, second polishing is performed on the glass substrate that has undergone the chemical strengthening processing. Second polishing is for further reducing roughness and waviness of the main surfaces. A double-sided polishing apparatus provided with a planetary gear mechanism having a configuration similar to that of the double-sided polishing apparatus used in first polishing is also used in second polishing. Specifically, the main surfaces on both sides of the glass substrate G are polished while the outer circumferential side wall surface of the glass substrate is held in the holding hole 32 provided in the carrier 30 of the polishing apparatus shown in FIGS. 1 to 3. Doing so makes it possible to reduce the roughness of the main surfaces while preventing the shape of end portions of the main surfaces from excessively recessing or protruding. Second polishing differs from the first polishing in terms of the type of loose abrasive particles, the particle size of the loose abrasive particles, and the hardness of a resin polisher of the polishing pad.

[0061] Minute particles of colloidal silica or the like, for example, are used as the loose abrasive particles used in second polishing. A magnetic-disk glass substrate can be obtained by cleaning the polished glass substrate.

Although second polishing is not required, it is preferable to perform second polishing because the level of surface unevenness of the main surfaces of the glass substrate can be made more favorable. The glass substrate on which second polishing is performed in this manner serves as a magnetic-disk glass substrate.

[0062] In at least one polishing processing of rough grinding, precision grinding, first polishing, and second polishing, which are performed with a grinding apparatus or a polishing apparatus, an upper surface plate and a lower surface plate, which sandwich the glass substrate G in the up-down direction, are used. A configuration is such that the outer circumferential side

wall surface of the glass substrate G during the polishing processing abuts on both sides of each of the orientation direction wall surface portions 35 along the circumferential direction of the holding hole 32 without abutting against the orientation direction wall surface portions 35 by defining the outline of the holding hole 32 such that the orientation direction wall surface portions 35 of the side wall surfaces of the holding hole 32 that holds the glass substrate G used in polishing processing are all located outside of an arc shape inscribing the outline of the inner circumferential wall surface of the holding hole 32. As preferable modes, wall surfaces on both sides of the orientation direction wall surface portions 35 of the holding hole 32 along the circumferential direction of the holding hole 32 are first curved surfaces 37 having a protruding shape as shown in FIG. 4, flat surfaces 38 as shown in FIGS. 8A to 8C, or second curved surfaces 39 as shown in FIG. 9. The outer circumferential side wall surfaces of the glass substrate G during the polishing processing abut against the first curved surfaces 37, the flat surfaces 38, or the second curved surfaces 39, but do not abut against the orientation direction wall surface portions 35. Thus, it is possible to suppress the occurrence of marks on the outer circumferential side wall surface of the glass substrate, and to suppress the formation of defects on the main surfaces of the glass substrate G.

[0063] Second Embodiment

Next, a carrier for polishing processing, a method for manufacturing a carrier for polishing processing, and a method for manufacturing a magnetic-disk substrate according to a second embodiment will be described in detail.

[0064] According to the research conducted by the inventor of the present invention, if polishing processing is performed using the carrier described in Patent Literature 1, it was found that the glass substrate was blemished due to attachment of foreign matter to the main surfaces of the glass substrate, or scratches (minute marks) formed thereon. Specifically, it was found that there were cases where when polishing processing was performed using the

carrier in which the above-described holding hole cushioning regions were formed, a portion of the resin material constituting the carrier fell off (was lost) due to a decrease in the strength in the vicinity of the inner wall surface of the holding hole, and foreign matter attached to the main surfaces of the glass substrate after polishing processing and the glass substrate was blemished. Also, it was found that there were cases where scratches formed on the main surfaces of the glass substrate. Intensive studies conducted by the inventor of the present invention revealed that this is caused by the fact that glass fibers were completely removed from an annular region outside of the inner wall surface of the holding hole, the strength in the vicinity of the inner wall surface of the holding hole decreased due to the loss of the reinforcement effect of the glass cloth, and a portion of the resin material constituting the holding hole cushioning region fell off due to the glass substrate colliding or pressing against the holding hole cushioning region of the carrier during polishing processing, the portion entering between the glass substrate and the surface plates as contamination, as a result of which the main surfaces of the glass substrate were blemished or scratches formed. As a result of repetitive experiments, a carrier for polishing processing, a method for manufacturing a carrier for polishing processing, and a method for manufacturing a magnetic-disk substrate, which have modes described below were invented.

[0065] Carrier for polishing processing

FIG. 10 shows a carrier 1 of the present embodiment.

The carrier 1 is for holding a glass substrate, which is a grinding target or a polishing target in grinding processing (rough grinding processing and precision grinding processing) and polishing processing (first polishing processing and second polishing processing), which will be described later. Note that simply referring to polishing processing is to be understood as the concept encompassing grinding processing in the present embodiment. The carrier 1 has a plurality of holding holes 3 for holding a glass substrate.

[0066] The carrier 1 includes a resin-impregnated base plate including a glass

cloth in which a plurality of glass fibers are disposed so as to be directed in one of two orientation directions and that reinforces the carrier 1, and a resin material with which the glass cloth is impregnated.

There is no particular limitation on the glass cloth, a known glass cloth
5 can be used, and a glass cloth obtained by plain weaving using a plurality of glass yarn, which is the bundle of glass fibers. In the plain woven glass cloth, the plurality of glass yarn are directed in two orientation directions that are orthogonal to each other. Note that in the present embodiment, orthogonal encompasses the case where two orientation directions having an angle of 90
10 degrees, and also includes the case of two orientation directions having an angle of substantially 90 degrees (for example, 70 to 110 degrees, 78.75 to 101.25 degrees, and 80 to 100 degrees). Also, the two orientation directions may be orientation directions that are orthogonal to each other, or may be orientation directions that are not orthogonal to each other (for example,
15 directions having an angle of 60 degrees or 120 degrees with respect to each other). There is no particular limitation on the material of the glass fiber, and aluminosilicate glass is used, for example.

[0067] Although the glass cloth is impregnated with the resin material such that the glass fibers are surrounded by the resin material in the
20 resin-impregnated base plate, portions of the glass fibers may be in direct contact with each other. There is no particular limitation on the resin material, and a thermosetting resin such as an epoxy resin or a phenol resin is used, for example. The resin-impregnated base plate is produced by a known method, and a plurality of prepregs (five prepregs, for example) obtained by
25 impregnating the glass cloth with a resin material and then drying the resin material, are stacked such that the orientation directions of the glass fibers match between the prepregs and are attached to each other with pressure, for example. There is no particular limitation on the diameter of the glass fiber, and the diameter is 5 to 10 μm , for example. In the plain woven glass cloth,
30 although not particularly limited thereto, the thickness of a glass yarn (the

width of a glass yarn along the surface direction of the carrier) is 200 to 700 μm , for example, the thickness of a glass yarn (the width of a glass yarn along the thickness direction of the carrier) is 40 to 90 μm , for example, and an interval (pitch) of glass yarns is 300 to 700 μm , for example.

5 [0068] Similarly to the carrier 30 of the first embodiment, the carrier 1 of the present embodiment is made of a composite material including glass fibers in which glass fibers are oriented in at least a certain direction and a resin material, and has a holding hole 3 for holding a substrate when a pair of main surfaces of a disk-shaped substrate are subjected to polishing processing with
10 the substrate sandwiched between the upper surface plate and the lower surface plate. The holding hole 3 has, on the circumference of the inner wall surface (inner circumferential wall surface) 5 of the holding hole 3, a first wall portion configured such that the substrate is in contact with fibers in a state in which the substrate is held in the holding hole 3, and a second wall portion
15 (first inner wall surface 5a and a second inner wall surface 5b) configured such that the substrate does not come into contact with fibers. The second wall portion is formed in a portion of the inner circumferential wall surface of the holding hole 3, the portion facing toward an orientation direction of the fibers that includes the certain direction. The carrier 30 of the second embodiment
20 is characterized by a fiber absence region (a first reinforcement region 11 and a second reinforcement region 13, which will be described later) that is provided outside in the radial direction of the holding hole with respect to the second wall portion and in which no fibers are present in the orientation direction is arranged in an annular region 7 extending outwardly from the inner
25 circumferential wall surface of the holding hole 3 in the radial direction of the holding hole 3.

[0069] As shown in FIG. 12, in the carrier 1, the first reinforcement regions 11 and the second reinforcement regions 13 are arranged alternately in the circumferential direction of the holding hole 3 at a distance from each other in
30 the annular region 7 extending outwardly from the inner wall surface 5 of the

holding hole 3. FIG. 12 is a diagram showing the holding hole 3 of the carrier 1, focusing on the annular region 7. Note that in FIG. 12, for simple depiction, one glass fiber that indicates one glass yarn is expressed instead of expressing glass yarns constituting the glass cloth and the width of the annular region 7 (a length along the radial direction of the holding hole 3) is shown in a large size. In the present embodiment, the inner wall surface of the holding hole means the inner wall surface defining the holding hole, unless otherwise stated. Also, located outside of the inner wall surface or extending outwardly from the inner wall surface encompasses extending along the surface direction of the carrier 1 in a portion of the composite material constituting the carrier, the portion being located from the inner wall surface in a direction directed outwardly from the central portion of the holding hole 3 in the radial direction of the holding hole 3, or in other words, encompasses extending from the inner wall surface outside in the radial direction of the holding hole 3 over a predetermined width.

[0070] Although there is no particular limitation on the width of the annular region 7 (a length along the radial direction of the holding hole 3), the width thereof is 2 to 10 μm , for example. The first reinforcement region 11 is reinforced with only first glass fibers 21 that are directed in a certain direction (X direction) of two orientation directions (X direction and Y direction shown in FIG. 12). On the other hand, the second reinforcement region 13 is reinforced with only second glass fibers that are directed in the other direction (Y direction) of the orientation directions. In other words, only the second glass fibers 23 are removed in the first reinforcement region 11 and only the first glass fibers 21 are removed in the second reinforcement region 13. Note that the glass fibers 21 and 23 that reinforce the reinforcement regions 11 and 13 are not limited to the modes shown in FIG. 12 respectively in the reinforcement regions 11 and 13, and one or more glass fibers 21 and 23 are present in accordance with the diameter of the glass fiber. A portion made of a resin material including multiple recessed portions (not shown) that have a shape

extending in an orientation direction (a direction substantially perpendicular to the inner wall surface) in which the second glass fibers 23 is directed is formed in the first reinforcement region 11 because the second glass fibers 23 are removed therefrom. Also, similarly, a portion made of a resin material including multiple recessed portions (not shown) is formed in the second reinforcement region 13 because the first glass fibers 21 are removed therefrom. Note that in the present embodiment, reinforced with only the second glass fibers also encompasses second glass fibers being present in a state in which a portion of the second glass fibers is missing in the first reinforcement region. Similarly, reinforced with only the first glass fibers also encompasses first glass fibers being present in a state in which a portion of the first glass fibers is missing in the second reinforcement region. Several dozens to several thousands of glass fibers are bundled into a yarn. In the present embodiment, if a yarn that is directed in the latitudinal direction (direction substantially perpendicular to the orientation direction of glass fibers) is present on the inner wall surface, even if filaments (one glass fiber) on the surface thereof are partially etched, a majority of the filaments remain. Therefore, the strength of the carrier is mostly maintained.

[0071] As shown in FIG. 13, it is preferable that positions of the first reinforcement region 11 and the second reinforcement region 13 in the annular region 7 are preferably arranged at intervals substantially equal to each other in the circumferential direction, the positions are determined so as to include directions having an angle of 0 degrees, 90 degrees, 180 degrees, and 270 degrees about the center (about the central portion) of the holding hole 3 using either one of four reinforcement regions 11 and 13 as a reference, and the positions are determined in a range of ± 20 degrees (for example, ± 11.25 degrees, ± 10 degrees) with respect to the directions having an angle of 0 degrees, 90 degrees, 180 degrees, and 270 degrees about the center of the holding hole 3. Accordingly, the glass fibers substantially orthogonal to the inner wall surface of the holding hole 3 can be reliably removed from the reinforcement regions

11 and 13, and glass fibers can be secured in other annular regions 7 (a region of the annular region 7 excluding the reinforcement regions 11 and 13). FIG. 13 is a diagram showing the holding hole 3 of the carrier 1, focusing on the annular region 7.

Although two first reinforcement regions 11 and two second reinforcement regions 13 are included in the annular region 7 in the present embodiment, the number of first reinforcement regions and the number of second reinforcement regions are determined by an angle formed by two orientation directions. Note that, similarly to a portion of the carrier 3 that is located outside of the annular region 7, portions 15 of the annular region 7 excluding the first reinforcement regions 11 and the second reinforcement regions 13, the portions 15 being included in one annular region, are reinforced by both a first glass yarn and a second glass yarn.

[0072] The first reinforcement regions 11 are provided outside of the first inner wall portions 5a of the inner wall surface 5 of the holding hole 3, the first inner wall portions 5a facing in the orientation direction (facing toward the orientation direction) of the second glass fibers 23. On the other hand, the second reinforcement regions 13 are provided outside of the second inner wall portions 5b of the inner wall surface 5, the second inner wall portions 5b facing in the orientation direction (facing toward the orientation direction) of the first glass fibers 21. Note that the portions of the inner wall surface 5 of the holding hole 3 excluding the first inner wall portions 5a and the second inner wall portions 5b (all of these are the second wall portion) are the first wall portion. In other words, the first inner wall portions 5a and the second inner wall portions 5b of the inner wall surface 5 of the holding hole 3 are fiber contact surface configured such that the glass substrate is not in contact with glass fibers in a state in which the glass substrate is held in the holding hole 3, whereas a portion excluding the first inner wall portions 5a and the second inner wall portions 5b is a fiber contact surface configured such that the glass substrate is in contact with glass fibers in the above-described state.

In the present embodiment, the inner wall portion facing in the orientation direction refers to the inner wall portion facing toward the orientation direction, or in other words, the inner wall portion facing toward the orientation direction, the normal line direction of the inner wall portion facing toward the orientation direction, fibers being exposed from the inner wall portion of the plate material in the perpendicular direction or protrude (stick out) in the perpendicular direction in the process of manufacturing a carrier. The perpendicular direction herein refers to a direction in a range of ± 20 degrees (for example, ± 11.25 degrees, ± 10 degrees) in the surface direction of the carrier with respect to the normal line direction of the inner wall portion. The inner wall portion facing in the orientation direction encompasses the tangent line direction of the inner wall portion at a position of the inner wall portion that intersects the orientation direction being orthogonal to the orientation direction (the center line) and intersecting the orientation direction in an angle range of ± 20 degrees (for example, ± 11.25 degrees) about the orthogonal direction. In other words, the normal line direction of the inner wall portion at the position of the inner wall portion that intersects the orientation direction matching the orientation direction and matching the orientation direction in the above-described angle range about the orientation direction are also encompassed. Also, the orientation direction of glass fibers that the inner wall portion faces means a direction in which the glass fibers protrude substantially perpendicular to the tangent line direction of the inner wall portion.

[0073] In the carrier 1, the first reinforcement regions 11 are formed such that the tips of the second glass fibers 23 do not reach the inner wall surface 5 of the holding hole, and the second reinforcement regions 13 are formed such that the tips of the first glass fibers 21 do not reach the inner wall surface 5 of the holding hole 3. In other words, a portion of the range of the first reinforcement regions 11 is determined by the tips of the second glass fibers 23, and a portion of the range of the second reinforcement regions 13 is determined by the tips of

the first glass fibers 21.

[0074] If processing for polishing the glass substrate is performed using the carrier 1 described above, no glass fibers that protrude (stick out) in a direction substantially perpendicular to the inner wall surface 5 of the holding hole 3 are present, and thus the occurrence of marks on the edge surface of the glass substrate is prevented during the polishing processing. On the other hand, glass fibers directed in a direction different from that of the glass fibers directed in a direction substantially perpendicular to the inner wall surface 5 are present in the first reinforcement regions 11 and the second reinforcement regions 13, and thus the strength in the vicinity of the inner wall surface 5 of the holding hole 3 is assured. Thus, a portion in the vicinity of the inner wall surface 5 made of a resin material having multiple recessed portions is prevented from separating from the carrier resulting from peeling off therefrom due to reception of an external force (collision, pressing, rubbing, or the like against the inner wall surface of the glass substrate) during the polishing processing. Therefore, the resin material is inhibited from entering between the glass substrate and the surface plates as contamination, attaching to the main surfaces of the glass substrate, and causing scratches on the main surfaces of the glass substrate.

[0075] Also, the glass fibers present in the first reinforcement regions and the second reinforcement regions are directed in the direction substantially perpendicular to the inner wall surface (for example, a substantially parallel direction), and thus even if the edge surface of the glass substrate comes into contact therewith during the polishing processing, the edge surface of the glass substrate rotates in contact therewith so as to slide on the glass fibers, as a result of which marks are unlikely to occur.

The first reinforcement regions 11 and the second reinforcement regions 13 may not be provided on the inner wall surfaces 5 of all the holding holes 3 included in the carrier 1, or may be provided on the inner wall surfaces 5 of a portion of the holding holes 3. In this case, it is possible to perform

polishing processing with the glass substrate held only in the holding holes 3 in which the first reinforcement regions 11 and the second reinforcement regions 13 are provided.

[0076] Method for manufacturing carrier for polishing processing

5 Next, a method for manufacturing a carrier for polishing processing will be described.

A method for manufacturing a carrier for polishing processing of the present embodiment includes grinding processing (first step) and etching processing (second step).

10 In the grinding processing, a holding hole 3 is formed in the above-described resin-impregnated base plate. Specifically, a resin-impregnated base plate is subjected to grind processing with an end mill, and the outer circumferential shape and the holding hole of the carrier as shown in FIG. 10 are produced. FIG. 11 is a perspective view showing the carrier shown in FIG. 10, focusing on one holding hole. Note that in FIG. 10, for simple depiction, the outer shape of the carrier is shown in a form different from in FIG. 11. At this time, in the resin-impregnated base plate, the glass fibers of the glass cloth are cut along the outer circumferential shape of the carrier and the holding hole. Because if a plurality of resin-impregnated base plates are disposed stacked in etching processing, a masking material, which will be described later, can be easily provided and an etching agent can be easily applied, in grinding processing, the holding holes 3 are preferably formed such that the orientation directions of the glass fibers between the resin-impregnated base plates match each other. For example, it is sufficient that after the resin-impregnated base plate (plate material) are stacked with the orientation directions matched, holding holes are formed so as to pass through the plurality of resin-impregnated base plates. In this manner, the productivity can be increased. After the grinding processing, deburring processing may be performed.

30 [0077] In the etching processing, a carrier is produced by at least etching the

resin-impregnated base plate in which the holding holes 3 are formed. For example, the carrier may be produced by performing cleaning, drying, and the like after etching. Specifically, in the etching processing, reinforcement regions reinforced with only glass fibers having an orientation direction different from the orientation direction of the etched glass fibers are formed in an annular region 7 extending outwardly from the inner wall surface 5 of the holding hole 3 of the carrier by etching the glass fibers that are exposed so as to be directed in the orientation directions, the inner wall portion (a portion of the inner wall surface indicated by reference numerals 5a and 5b in the carrier shown in FIG. 12) of the inner wall surface 5 of the holding hole 3, the inner wall portion facing toward any one of the orientation directions of the glass fibers. In short, as shown in FIG. 12, the first reinforcement regions 11 and the second reinforcement regions 13 are formed by etching the second glass fibers 23 exposed at the first inner wall portions 5a and the first glass fibers 21 exposed at the second inner wall portions 5b. Note that in the present embodiment, simply referring to exposing encompasses the tip of a glass fiber being located on the inner wall surface and the tip thereof protruding inwardly from the inner wall surface.

[0078] In the etching processing, the resin-impregnated base plate that has been subjected to grinding processing is immersed in an etching agent, for example, and the exposed glass fibers are etched by grinding processing. In the present embodiment, only fibers protruding (sticking out) in the perpendicular direction at a portion of the inner wall surface (a portion that will form the second wall portion) of fibers included in the resin-impregnated base plate are removed, fibers are woven in a majority of the inner wall surface, that is, fibers directed in any one of directions remain, and the strength of the carrier can be prevented from decreasing. There is no particular limitation on the etching agent used to perform the etching processing by immersion as long as the etching agent has an etching capability on fibers. If glass fibers are etched, an etching agent containing hydrofluoric acid or a fluorine compound is

suitable, for example. Examples of the etching agent containing hydrofluoric acid include hydrofluoric acid and hydrofluosilicic acid. Examples of the fluorine compound include ammonium fluoride (NH_4F) and ammonium bifluoride (NH_5F_2). A mixed acid obtained by mixing hydrofluoric acid and a strong acid such as sulfuric acid or nitric acid may be used as an etching agent, and a viscosity adjustment agent, a solvent, and the like may be included. Also, the above-described substances may be mixed and used as appropriate. If etching is performed by immersing the resin-impregnated material in the etching agent, an etching agent containing hydrofluoric acid and sulfuric acid is used, for example. In this case, the concentration of hydrofluoric acid is preferably 0.01 to 2.0%, and the concentration of sulfuric acid is preferably about 0.02 to 4.0%. Note that % means a mass percentage in the present embodiment. The immersion time needs to be determined in accordance with an amount of glass fibers to be etched (lengths in the radial direction of the first reinforcement region 11 and the second reinforcement region 13) or the concentration of the etching agent, and is preferably less than 60 minutes, for example. If the concentration of the etching agent is excessively high or the leaving time is excessively long, there are cases where the strength of the inner wall surface of the holding hole decreases and the resin on the inner wall surface easily peels off therefrom during polishing or grinding processing due to excessive amounts of fibers being removed than required, a resin portion being damaged by etching, or the like.

The etching processing is not limited to being performed by immersion, and etching may be performed by applying the etching agent to the resin-impregnated material, for example. The application may be performed using an applying means such as a brush, may be performed with a spray by spraying, or the like. Examples of the etching agent in this case include hydrofluoric acid, and an aqueous solution of ammonium bifluoride or sodium hydrogen fluoride. The concentration of the etching agent and the time for leaving the resin-impregnated material after the application needs only be

determined as appropriate, and from the viewpoint of maintaining the strength of the inner wall surface of the above-described holding hole, the concentration of the etching agent is preferably 0.1 to 20 wt%. Also, the leaving time after the application is preferably less than 60 minutes.

- 5 The etching processing may be performed by showering, or the like, in addition to the above-described immersion and application.
- [0079] In the etching processing, before etching, a masking material (not shown) may be provided on the portions 15 (see FIG. 12) of the annular region 7 excluding the portions that will form the reinforcement regions, and the
- 10 masking material may be removed after etching. Accordingly, the portion other than the portions that will form the reinforcement regions can be protected from the etching agent, and the glass fibers can be prevented from being etched in the portions. Also, using a masking agent makes it possible to produce the carrier 1 by immersion, or showering, for example. Tape, or a
- 15 resin layer is used as the masking material, for example. Polytetrafluoroethylene, an epoxy resin, and the like are used as a resin in the resin layer. Note that the position on the inner wall surface on which the masking material is provided can be usually determined by visually checking these directions because stripes corresponding to the orientation directions of
- 20 the glass fibers appear on the main surfaces of the carrier. In the case of immersion, it is preferable to mask the main surfaces of the carrier with a resin or the like. Also, a plate material (resin-impregnated base plate) made of other composite material may be stacked thereon as masking. Staking makes it possible to increase the carrier manufacturing efficiency and reduce the cost.
- 25 [0080] In the etching processing, instead of immersing the resin-impregnated base plate in the above-described etching agent, etching may be performed by applying the above-described etching agent to a portion that is to form the reinforcement region of the annular region 7 of the resin-impregnated base plate. Accordingly, it is possible to etch glass fibers only in a region, of the
- 30 annular region 7 of the carrier, that is to be a reinforcement region. Note

that similarly to checking the position at which the masking material is provided, the position to which the etching agent is applied can be determined by checking the orientation direction of glass fibers by visually checking the stripes appearing on the main surfaces of the carrier.

5 [0081] In the etching processing, before etching, the resin-impregnated base plate (first plate material) and one or more other base plates in which holding holes are formed at positions corresponding to the positions at which the holding holes 3 of the resin-impregnated base plate are formed are disposed stacked in the thickness direction. Accordingly, during etching, the main
10 surfaces of the resin-impregnated base plate can be prevented from being exposed to the etching agent and a decrease in the strength of the carrier due to the glass fibers of the main surfaces of the resin-impregnated base plate being etched can be avoided. The other base plates may be a resin-impregnated base plate (second plate material) for producing a carrier similar to the
15 above-described carrier 1, or may be a dummy base plate for use to protect the main surfaces of the first plate material. The dummy base plates may be disposed on both sides of the first plate material, or the first plate materials may be disposed on both sides. The other base plate and the first plate material may be adhered by a temporarily fixing agent for temporarily being
20 fixed to each other during etching.

When a plurality of resin-impregnated base plates are disposed stacked (first plate material and second plate material), the orientation directions of the glass fibers preferably match between the resin-impregnated base plates. If the positions at which the holding holes 3 are formed with respect to the
25 orientation directions of the glass fibers are similar among the plurality of resin-impregnated base plates, providing the above-described masking material and applying the etching agent in the stacked state can be easily performed.

[0082] The carrier for polishing processing or a carrier manufactured by the
30 method for manufacturing a carrier for polishing processing according to the

above-described embodiments may be used in a method for manufacturing a magnetic-disk substrate, which will be described later, for example, and may be used to manufacture a substrate other than glass substrates, such as an aluminum substrate or a silicon wafer, for example.

5 Also, the carrier for polishing processing or the carrier manufactured by a method for manufacturing a carrier for polishing processing, which have been described above, may be used in not only the polishing processing but also the grinding processing. For example, in the method for manufacturing a magnetic-disk substrate, which will be described later, the above-described
10 carriers can be used in all processes in which the main surfaces are ground or polished by a planet gear movement, such as rough grinding, precision grinding, first polishing, and second polishing.

[0083] Method for manufacturing magnetic-disk substrate

15 Next, a method for manufacturing a magnetic-disk substrate of the present embodiment will be described.

 This manufacturing method includes polishing processing for polishing main surfaces of a substrate in a state in which a glass substrate is held in the carrier for polishing processing or the carrier for polishing processing manufactured by the method for manufacturing a carrier for polishing
20 processing, which have been described above. In description below, a carrier indicates the carrier for polishing processing or the carrier manufactured by the method for manufacturing a carrier for polishing processing, which have been described above.

25 [0084] When the outline of the manufacturing processes performed in the present embodiment are described, first molding processing for forming a plate-shaped glass blank having a pair of main surfaces is performed. The glass blank serves as a raw material for a magnetic-disk glass substrate. Next, rough-grinding processing is performed on this glass blank. Thereafter, shape processing is performed on the glass blank to form a glass substrate, and edge
30 surface polishing processing is performed thereon. Then, precision grinding

processing is performed on the glass substrate using fixed abrasive particles. Thereafter, first polishing processing and second polishing processing are performed on the glass substrate. Note that although the above-described processes are performed in the above-described flow in the present embodiment, 5 the present embodiment is not limited to the above flow or type of processes, and these processes may be omitted as appropriate. Hereinafter, each of the processes will be described.

[0085] (a) Processing for molding glass blank

In molding processing, molding is performed with a press molding 10 method, for example. A disk-shaped glass blank can be obtained by a press molding method. The glass blank may be manufactured using a known molding method such as a downdraw method, a redraw method, or a fusion method, instead of the pressing method. A disk-shaped glass substrate, which is the base of a magnetic-disk glass substrate, can be obtained by appropriately 15 performing shape processing, which will be described later, on the plate-like glass blank produced with these methods.

[0086] (b) Rough grinding processing

Next, rough grinding processing is performed. In the rough grinding processing, main surfaces on both sides of the glass blank are ground while the 20 glass blank is held in a carrier of a double-sided grinding apparatus. Specifically, the glass blank, which is held in the holding hole of the carrier, is held between the upper surface plate and the lower surface plate, and the glass substrate and the surface plates are moved relative to each other by moving one or both of the upper surface plate and the lower surface plate while a grinding 25 liquid containing a grinding agent is supplied, and thereby both main surfaces of the glass substrate are ground. Loose abrasive particles are used as a grinding agent, for example. In rough grinding processing, grinding is performed such that the glass blank is brought approximately closer to have a target substrate thickness and a target flatness of the main surfaces. Note 30 that although the rough grinding processing is performed in accordance with

the dimensional accuracy or the surface roughness of the molded glass blank, it can be omitted as appropriate.

[0087] (c) Shape processing

Next, shape processing is performed. In the shape processing, a
 5 circular hole is formed in the glass blank using a known processing method to obtain a disk-shaped glass substrate having the circular hole. Thereafter, chamfering is performed on edge surfaces of the glass substrate. Chamfering is performed on the edge surfaces on the inner circumferential side and the outer circumferential side of the glass substrate. Chamfering forms side wall
 10 surfaces orthogonal to the main surfaces and chamfered surfaces (interposing surfaces) that connect the side wall surfaces and the main surfaces on the edge surfaces of the glass substrate.

[0088] (d) Edge surface polishing processing

Next, processing for polishing edge surfaces of the glass substrate is
 15 performed. In the edge surface polishing processing, polishing is performed by supplying a polishing liquid containing loose abrasive particles between a polishing brush and the edge surfaces of the glass substrate and moving the polishing brush and the glass substrate relative to each other in the thickness direction of the glass substrate. The inner circumferential side edge surface
 20 and the outer circumferential side edge surface of the glass substrate are polished and formed into mirror surfaces by edge surface polishing processing.

[0089] (e) Precision grinding processing

Next, precision grinding processing is performed on the main surfaces of the glass substrate. In the precision grinding processing, grinding is
 25 preferably performed on the main surfaces of the glass substrate using a double-sided grinding apparatus in which fixed abrasive particles are attached to the surface plates. Specifically, both main surfaces of the glass substrate are ground similarly to the above-described rough grinding processing, except that grinding is performed using fixed abrasive particles instead of the
 30 above-described loose abrasive particles. The glass substrate is held by the

carrier of the above-described embodiment and is ground while undergoing a planet gear movement in the double-sided grinding apparatus. No glass fibers directed in the orientation direction are present in the vicinity of the inner wall portion facing in the orientation direction of the glass fibers in this carrier, and thus the occurrence of marks on the edge surfaces of the glass substrate is prevented in the precision grinding processing. Also, since the carrier is reinforced by the glass fibers having an orientation direction different from that of the glass fibers, the strength in the vicinity of the inner wall surface of the holding hole is assured, and accordingly contamination derived from the resin material is suppressed. Although the main surfaces of the glass substrate are ground by bringing grinding surfaces of the surface plates to which the fixed abrasive particles are attached and the main surfaces of the glass substrate into contact with each other in the grinding processing, grinding using loose abrasive particles may be performed instead.

[0090] (f) First polishing processing

Next, first polishing processing is performed on the main surfaces of the glass substrate. In the first polishing processing, the main surfaces on both sides of the glass substrate are polished using a known double-sided polishing apparatus while the glass substrate is held by the carrier. In first polishing processing, polishing is performed by bringing the main surfaces of the glass substrate into contact with polishing pads attached to the surface plates using loose abrasive particles. Although there is no particular limitation on the loose abrasive particles, cerium oxide abrasive particles, zirconia abrasive particles, or the like are used, for example. The first polishing processing removes cracks and warping remaining on the main surfaces in the case where grinding is performed with fixed abrasive particles, or removes minute surface unevenness of the main surfaces resulting from crystallization processing, for example. Appropriately adjusting the machining allowance amount makes it possible to reduce the surface roughness of the main surfaces, for example, an arithmetic average roughness R_a while preventing the shape of the edge

portions of the main surfaces from excessively recessing or protruding.

[0091] (g) Second polishing (mirror surface polishing) processing

Next, second polishing processing is performed. Second polishing processing is for mirror-polishing the main surfaces. Although in the second polishing processing, a double-sided polishing apparatus and a polishing method that are similar to those in the first polishing processing, it is preferable that the size of the polishing abrasive particles is smaller than that of the polishing abrasive particles used in the first polishing processing. Doing so makes it possible to reduce the roughness of the main surfaces while preventing the shape of end portions of the main surfaces from excessively recessing or protruding.

[0092] A known apparatus can be used as a double-sided polishing apparatus for performing the second polishing processing. The apparatus include a pair of upper and lower surface plates, an internal gear that is sandwiched between the upper and lower surface plates, a sun gear provided on the lower surface plate, and a plurality of carriers that engage with the internal gear and the sun gear. Polishing pads are attached to the surface plates. The glass substrate is sandwiched between the upper and lower surface plates, and the upper and lower surface plates are rotated in opposite directions relative to each other, and thereby the carrier that holds the glass substrate revolves while rotating, as a result of which this apparatus performs a planet gear movement. Accordingly, the glass substrate and the polishing pads are moved relative to each other, and the main surfaces of the glass substrate are polished. Note that the above-described processing apparatus and processing mechanism can be used similarly in grinding and polishing described above.

[0093] After the second polishing processing, the glass substrate is removed from the double-sided polishing apparatus together with the carrier, is cleaned, and the manufacturing processes end. The same polishing liquid is used in the second polishing processing while the above-described manufacturing processes are repeated.

[0094] Since the polishing processing is performed using the above-described carrier in the method for manufacturing a magnetic-disk substrate of the present embodiment, the occurrence of marks on the edge surfaces of the glass substrate is prevented when the polishing processing is performed, and the occurrence of blemishes and scratches on the main surfaces of the glass substrate is suppressed due to suppression of the contamination derived from the resin material.

[0095] Working Examples corresponding to first embodiment

Carriers having the specification described in the first embodiment except that the specification of the first wall portion is as follows were produced (Working Examples 1 to 4, Comparative Examples 1 and 2).

Working Example 1: as shown in FIG. 4, one holding hole has eight first curved surfaces (notches) having a protruding shape

Working Example 2: one holding hole has six notches

Working Example 3: as shown in FIG. 6A, one holding hole has ten notches

Working Example 4: as shown in FIG. 8B, one holding hole has eight flat surfaces

Comparative Example 1: no first wall portions are provided (a simple circular holding hole was produced without performing etching processing)

Comparative Example 2: no glass fibers are present on the entire circumference of the holding hole due to, in Comparative Example 1, etching processing being performed on the entire circumference of a plate material of a portion that will form the holding hole

With regard to the notches of Working Examples 1 to 3, the maximum protruding amount was 2 mm, a radius of curvature R was 30 mm, the maximum protruding amount of the flat surface of Working Example 4 (an amount protruding from the virtual circle partially formed by a wall surface portion of the orientation direction wall surface portion in the central direction of the virtual circle, in the radial direction of the virtual circle) was 2 mm. The

etching processing of Comparative Example 2 was performed similarly to Comparative Example 5, which will be described later.

[0096] Polishing experiment

Magnetic-disk glass substrates were manufactured based on the
5 above-described first embodiment except that the second polishing processing
of the above-described first embodiment was performed on the glass substrates
under polishing conditions whereby the load to the substrates was 100 g/cm²,
the surface plate rotation rate was 25 rpm, and the polishing time was 60
minutes, using the carriers of Working Examples 1 to 4 and Comparative
10 Examples 1 and 2 and a double-sided polishing apparatus provided with a
planetary gear mechanism. Aluminosilicate glass substrates having an outer
diameter of 2.5 inches were used as the glass substrates, and the final
thickness was adjusted to 0.653 mm.

The glass substrates were cleaned and dried after the second polishing
15 processing was performed, and defects on the main surfaces of the glass
substrates were then detected using a laser surface inspection apparatus, and
with regard to 20 defects per substrate that was selected at random, SEM
observations and element analysis were performed to measure the number of
pieces of resin-based foreign matter (the number of defects). It is considered
20 that if the number of pieces of resin foreign matter is not more than one per
substrate, such a substrate has no practical problems. Also, marks (depressed
defects) on the side wall surfaces of the edge surfaces were visually observed
using a condensing lamp in a black curtain and were observed with a
microscope. If marks are present on an edge surface, continuous bright spots
25 are observed over the entire circumference at a fixed interval of not more than
about 1 mm. The results are shown in Table 1.

[Table 1]

	Marks on side wall surface	Number of pieces of resin foreign matter on main surface (pieces)
Work. Ex. 1	none	0
Work. Ex. 2	none	1
Work. Ex. 3	none	0
Work. Ex. 4	none	1
Comp. Ex. 1	present	(not evaluated)
Comp. Ex. 2	none	14

[0097] As shown in Table 1, it was found that if the polishing processing was performed using the carrier (Working Examples 1 to 4) having the first wall portions described in the first embodiment, the number of defects on the main surfaces was smaller than in the case where the polishing processing was performed using the carrier (Comparative Examples 1 and 2) that had no first wall portions.

Also, as a result of the visual observations on the side wall surfaces, marks resulting from rubbing with the carrier were not recognized in any glass substrates, except for Comparative Example 1.

[0098] Grinding experiment

Next, magnetic-disk glass substrates were manufactured based on the above-described first embodiment except that precision grinding was performed using the carriers of Working Examples 1 to 4 and Comparative Examples 1 and 2 and a double-sided grinding apparatus provided with a planetary gear mechanism. Using surface plates to which grinding pads with fixed abrasive particles were attached, processing was performed on 100 batches under the conditions that a load applied to the substrates was 150 g/cm², a surface plate rotation rate was 25 rpm, and the processing time was 60 minutes, and the carriers were not replaced but the substrates were replaced with new substrates (Working Examples 5 to 8 and Comparative Examples 3 and 4), and

with regard to the glass substrates in the 1st batch and the 100th batch, marks on the side wall surfaces thereof after cleaning were studied. Note that 100 substrates were processed in one batch, and five carriers that could hold 20 substrates were used in one batch, and thus 10000 glass substrates were manufactured in total for each working example.

[0099] [Table 2]

	Marks on side wall surface (1st batch)	Marks on side wall surface (100th batch)
Work. Ex. 5	none	none
Work. Ex. 6	none	none
Work. Ex. 7	none	none
Work. Ex. 8	none	none
Comp. Ex. 3	present	present
Comp. Ex. 4	none	present

[0100] With Comparative Examples 3 and 4, marks were observed in the 100th batch. Also, as a result of studies on the inner wall surface of the holding hole of the carrier that had been used to perform processing on 100 batches, glass fibers protruding perpendicularly were observed. That is, it is conceivable that a portion made of only a resin material in a portion including the inner wall of the holding hole peeled off therefrom during grinding, glass fibers protruding perpendicularly were exposed, and the edge surfaces of the glass substrates were marked. In contrast, with Working Examples 5 to 8, the side wall surfaces of the glass substrates were not marked in the 1st batch and the 100 batch.

[0101] Working Examples corresponding to second embodiment

A resin-impregnated base plate having a thickness of 0.5 mm obtained by stacking and pressing five prepregs such that the orientation directions of glass fibers match was prepared, the prepreg having a thickness of 0.1 mm

being obtained by impregnating a plain-woven glass cloth with an epoxy resin, and then subjecting the resulting glass cloth to drying and curing. After this resin-impregnated base plate was subjected to cutting processing using an end mill and was subjected to deburring processing, the resulting
5 resin-impregnated base plate was formed into a shape as shown in FIG. 10. A liquid (etching agent) obtained by blending ammonium bifluoride having a concentration of 20 % and glycerin for adjusting viscosity was applied thereto such that circumferential direction regions that are to form the first reinforcement regions 11 and the second reinforcement regions 13 of the inner
10 wall surface of the holding hole of the cut resin-impregnated base plate were formed in a region that included positions in the circumferential direction that have an angle of 0 degrees, 90 degrees, 180 degrees, and 270 degrees about the center of the holding hole 3 using any one of reinforcement regions as a reference and that had a range of ± 11.25 degrees, and then the resulting
15 resin-impregnated base plate was left to stand for 10 minutes so as to etch only the applied portion of the glass. After the etching processing, the resin-impregnated base plate was cleaned with water to obtain a carrier (Working Example 9). Also, a carrier was produced similarly to Working Example 9 except that the leaving time (etching time) after the etching liquid
20 was applied was 20 minutes (Working Example 10).

Comparative Example

On the other hand, a carrier was obtained similarly to Working Example 9 except that in the etching processing, the cut resin-impregnated base plate was immersed for 15 minutes in an etching agent containing
25 hydrofluoric acid in a concentration of 1.3% and sulfuric acid in a concentration of 2.6% (Comparative Example 5). Also, a carrier was obtained similarly to Working Example 9 except that an etching agent was applied in the entire region in the circumferential direction of the inner wall surface of the holding hole (Comparative Example 6).

30 [0102] Observation of annular region

When the inner wall surfaces of the holding holes of the carriers of Working Example 9 and Comparative Examples 5 and 6 were observed with an optical microscope and a laser microscope, regions from which only the first glass fibers were removed and in which the second glass fibers remained and regions from which only the second glass fibers were removed and in which the first glass fibers remained were formed with a distance from each other in the circumferential direction in the annular region of the carrier of Working Example 9, the regions being formed on the inner wall surface at a substantially 90-degree interval in the circumferential direction. On the other hand, regions from which the first glass fibers and the second glass fibers were removed were formed over the entire circumference in the annular regions of the carriers of Comparative Examples 5 and 6.

[0103] Polishing experiment

Magnetic-disk glass substrates were manufactured based on the above-described second embodiment except that using the carriers of Working Examples 9 and 10 and Comparative Examples 5 and 6 and a double-sided polishing apparatus provided with a planetary gear mechanism, the second polishing processing of the above-described second embodiment was performed on the glass substrates under polishing conditions whereby the load to the substrate was 100 g/cm², the surface plate rotation rate was 25 rpm, and the polishing time was 60 minutes. Aluminosilicate glass substrates having an outer diameter of 2.5 inches were used as the glass substrates, and the final thickness was adjusted to 0.653 mm.

The glass substrates were cleaned and dried after the second polishing processing was performed, and defects on the main surfaces of the glass substrates were then detected using a laser surface inspection apparatus, and with regard to 20 defects per substrate that was selected at random, SEM observations and element analysis were performed to measure the number of pieces of resin-based foreign matter (the number of defects). It is considered that if the number of pieces of resin foreign matter is not more than one per

substrate, such a substrate has no practical problems. Also, marks (depressed defects) on the side wall surfaces of the edge surfaces were visually observed using a condensing lamp in a black curtain and were observed with a microscope. If marks are present on an edge surface, continuous bright spots are observed over the entire circumference at a fixed interval of not more than about 1 mm. The results are shown in Table 3.

[0104] [Table 3]

	Marks on side wall surface	Number of pieces of resin foreign matter on main surface (pieces)
Work. Ex. 9	none	0
Work. Ex. 10	none	1
Comp. Ex. 5	none	15
Comp. Ex. 6	none	13

[0105] As shown in Table 3, it was found that if polishing processing was performed using the carriers (Working Examples 9 and 10) having a reinforcement region that was reinforced with only one type of glass fibers directed in two orientation directions, the number of defects on the main surfaces were smaller than in the case where polishing processing was performed using the carriers (Comparative Examples 5 and 6) having a region from which both types of glass fibers directed in two directions were removed, and adverse effects on the main surfaces of the glass substrates could be avoided.

Also, as a result of the visual observations on the side wall surfaces, marks resulting from rubbing with the carriers were not recognized in any glass substrates, but as a result of observing the side wall surfaces using a laser surface inspection apparatus, if the polishing processing was performed using the carriers of Working Examples 9 and 10, no marks on the side wall surfaces were recognized, whereas if the polishing processing was performed using the carriers of Comparative Examples 5 and 6, marks on the side wall surfaces

were recognized.

Note that as a result of observing the first reinforcement region and the second reinforcement region of the carrier of Working Example 10 using a laser microscope, portions of the first glass fibers and the second glass fibers were etched. Note that it was found that when the polishing processing was performed using the carrier of Working Example 10 under the above-described conditions, the side wall surface and the main surfaces had a small number of defects, and adverse affects on the glass substrate could be avoided.

[0106] Grinding experiment

Next, magnetic-disk glass substrates were manufactured based on the above-described second embodiment except that precision grinding was performed using the carriers of Working Examples 9 and 10 and Comparative Examples 5 and 6 and a double-sided grinding apparatus provided with a planetary gear mechanism. Using surface plates to which grinding pads with fixed abrasive particles were attached, processing was performed on 100 batches under the conditions that a load applied to the substrates was 150 g/cm², a surface plate rotation rate was 25 rpm, and the processing time was 60 minutes, and the carriers were not replaced but the substrates were replaced with new substrates (Working Examples 11 and 12 and Comparative Examples 7 and 8), and with regard to the glass substrates in the 1st batch and the 100th batch, marks on the side wall surfaces thereof after cleaning were studied. Note that 100 substrates were processed in one batch, five carriers that could hold 20 substrates were used in one batch, and thus 10000 glass substrates were manufactured in total for each working example.

[0107] [Table 4]

	Marks on side wall surface (1st batch)	Marks on side wall surface (100th batch)
Work. Ex. 11	none	none
Work. Ex. 12	none	none
Comp. Ex. 7	none	present
Comp. Ex. 8	none	present

[0108] Although no marks on the side wall surfaces of the glass substrates were observed in the 1st batch of Comparative Examples 7 and 8, marks were
5 observed in the 100 batch. Also, as a result of studies on the inner wall surface of the holding hole of the carrier that had been used to perform processing on 100 batches, glass fibers protruding perpendicularly were observed. That is, it is conceivable that a portion made of only a resin material in a portion including the inner wall of the holding hole peeled off
10 therefrom during grinding, glass fibers protruding perpendicularly were exposed, and the edge surfaces of the glass substrates were marked. In contrast, no marks on the side wall surface of the glass substrates were observed in the 1st batch and the 100th batch of Working Examples 11 and 12.

The evaluation on the main surfaces of the glass substrates with a laser
15 microscope was not performed because of difficulty due to the high roughness of the surfaces of the substrates. Note that marks on the side wall surfaces of Comparative Examples 7 and 8 were more clearly observed than in Comparative Examples 5 and 6 due to a large applied load.

[0109] As described above, although a carrier for polishing processing, a
20 method for manufacturing a carrier for polishing processing, and a method for manufacturing a magnetic-disk substrate according to the present invention have been described in detail, the present invention is not limited to the above-described embodiments, and it will be appreciated that various improvements and modifications can be made without departing from the gist

of the present invention.

[Descriptions of Reference Numerals]

5	[0110] 1, 30	Carrier
	3, 32	Holding hole
	5, 36	Inner wall surface (inner circumferential wall surface)
	5a	First inner wall surface
	5b	Second inner wall surface
10	7	Annular region
	10	Polishing pad
	11	First reinforcement region
	13	Second reinforcement region
	15	Portion other than annular region
15	21	First glass fiber
	23	Second glass fiber
	31	Tooth portion
	3, 34	Glass fiber
	35	Orientation direction wall surface portion
20	37	First curved surface
	38	Flat surface
	39	Second curved surface
	40	Upper surface plate
	60	Lower surface plate
25	61	Sun gear
	62	Internal gear
	71	Supplying tank
	72	Pipe

CLAIMS

1. A carrier for polishing processing that is made of a composite material including fibers oriented in at least a certain direction and a resin material,
5 and has a holding hole for holding a disk-shaped substrate when a pair of main surfaces of the substrate are subjected to polishing processing with the substrate sandwiched between an upper surface plate and a lower surface plate, wherein

the holding hole has, on a circumference of an inner circumferential
10 wall surface of the holding hole, a first wall portion that is configured such that the substrate is in contact with the fibers in a state in which the substrate is held in the holding hole, and a second wall portion that is configured such that the substrate does not come into contact with the fibers, and

the second wall portion is formed in a portion of the inner
15 circumferential wall surface facing toward an orientation direction of the fibers that includes the certain direction.

2. The carrier for polishing processing according to claim 1, wherein
the second wall portion is located outside of the first wall portion in a
20 radial direction of the holding hole.

3. The carrier for polishing processing according to claim 2, wherein
the first wall portion is a first curved surface having a shape protruding inwardly in the radial direction of the holding hole, a flat surface, or a second
25 curved surface having a protruding shape that has a radius of curvature larger than a radius of curvature of an inscribed circle inscribing an outline of the inner circumferential wall surface of the holding hole and protrudes outwardly in the radial direction of the holding hole, and an outer circumferential side wall surface of the substrate abuts against the first curved surface, the flat
30 surface, or the second curved surface.

4. The carrier for polishing processing according to claim 3, wherein the circumference of the holding hole is provided with four or more of the first curved surface, the flat surface, or the second curved surface.

5

5. The carrier for polishing processing according to any one of claims 2 to 4, wherein

a diameter of the inscribed circle inscribing the outline of the inner circumferential wall surface of the holding hole is larger than a diameter of a disk shape of the substrate.

10

6. The carrier for polishing processing according to claim 5, wherein the diameter of the inscribed circle is 1.002 to 1.031 times the diameter of the disk shape of the substrate.

15

7. A method for manufacturing a magnetic-disk substrate, comprising:
a step of producing a disk-shaped substrate; and

a step of performing polishing processing on main surfaces of the substrate by sandwiching the substrate between an upper surface plate and a lower surface plate in a state in which the substrate is held in the holding hole provided in the carrier for polishing processing according to any one of claims 2 to 6, and moving the glass main surfaces and the upper surface plate and the lower surface plate relative to each other.

20

8. The method for manufacturing a magnetic-disk substrate according to claim 7, wherein

an outer circumferential side wall surface of the substrate abuts on both sides of the second wall portion during the polishing processing, without abutting against the second wall portion.

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9. The method for manufacturing a magnetic-disk substrate according to claim 7 or 8, wherein

the carrier for polishing processing is produced by forming a holding hole in a plate material made of a composite material including fibers oriented in at least a certain direction and a resin material, and etching the plate material after the holding hole is formed.

10. The carrier for polishing processing according to claim 1, wherein

a fiber absence region that is provided outside in a radial direction of the holding hole with respect to the second wall portion and in which no fibers are present in the orientation direction is arranged in an annular region extending outwardly from the inner circumferential wall surface of the holding hole in the radial direction of the holding hole.

11. The carrier for polishing processing according to claim 10, wherein

the fiber absence region is formed by no tips of the fibers that are directed toward the second wall portion reaching the inner circumferential wall surface of the holding hole.

12. A method for manufacturing a carrier for polishing processing having a holding hole for holding a disk-shaped substrate when main surfaces of the substrate are subjected to polishing processing with the substrate sandwiched between an upper surface plate and a lower surface plate, the manufacturing method comprising:

a first step of forming the holding hole in a plate material made of a composite material including fibers oriented in at least a certain direction and a resin material; and

a second step of producing the carrier by at least etching the plate material in which the holding hole is formed, wherein

in the second step, the fibers are etched in a portion of the inner

circumferential wall surface facing toward an orientation direction of the fibers that includes the certain direction.

13. The method for manufacturing a carrier for polishing processing according to claim 12, wherein

in the second step, before etching, a masking material is provided on a portion of the plate material that constitutes a portion other than the portion of the inner circumferential wall surface facing toward the orientation direction, and the masking material is removed after etching.

14. The method for manufacturing a carrier for polishing processing according to claim 12 or 13, wherein

in the second step, etching is performed by applying an etching agent for etching the fibers to a portion of the plate material that constitutes the portion of the inner circumferential wall surface facing toward the orientation direction.

15. The method for manufacturing a carrier for polishing processing according to any one of claims 12 to 14, wherein

in the second step, before etching, the plate material and one or more other base plates in which holding holes are formed at positions corresponding to a position at which the holding hole is formed in the plate material are disposed stacked in a substrate thickness direction.

16. The method for manufacturing a carrier for polishing processing according to claim 15, wherein

the one or more other base plates are made of a composite material including fibers oriented in at least a certain direction and a resin material, and

when the plate material is called a first plate material and the one or

more other base plates are called second plate materials, in the second step, when the first plate material and the second plate materials are disposed stacked, directions in which the fibers are oriented are matched between the plate materials.

5

17. The method for manufacturing a carrier for polishing processing according to claim 15, wherein

the one or more other base plates are made of a composite material including fibers oriented in at least a certain direction and a resin material,
10 and

when the plate material is called a first plate material and the one or more other base plates are called second plate materials, in the first step, if the first plate material and the second plate materials are disposed stacked, the holding holes are formed such that directions in which the fibers are oriented
15 match between the plate materials.

18. A method for manufacturing a magnetic-disk substrate, comprising

polishing processing for polishing main surfaces of a substrate in a state in which the substrate is held in the carrier for polishing processing according
20 to any one of claims 10 and 11 or the carrier for polishing processing manufactured by the method for manufacturing a carrier for polishing processing according to any one of claims 12 to 17.