

DESCRIPTION

TITLE OF INVENTION

Method of Manufacturing Information Recording Medium Glass Substrate

5 TECHNICAL FIELD

The present invention relates to a method of manufacturing an information recording medium glass substrate.

BACKGROUND ART

10 An information recording device such as an HDD (Hard Disk Drive) contains a disk-shaped information recording medium such as a magnetic disk or an opto-magnetic disk. A disk-shaped information recording medium glass substrate is used for the information recording medium. A magnetic thin film layer including a recording layer having magnetic, optical, or opto-magnetic properties is formed on a main surface of the information recording medium glass substrate. The magnetic thin
15 film layer is magnetized by a magnetic head whereby prescribed information is recorded in the information recording medium.

The information recording medium rotates at high speed in the inside of the information recording device such as an HDD. To record and reproduce information into/from the information recording medium, the magnetic head flies over the magnetic
20 thin film layer formed on the main surface of the information recording medium glass substrate. A DFH (Dynamic Flying Height) mechanism is employed in information recording devices in order to increase the recording density.

The distance (hereinafter referred to as "floating height") between the magnetic head and the outermost surface (the surface of the magnetic thin film layer) of the
25 information recording medium has been over 10 nm. Letting the radius length from the center of the information recording medium to the outer edge in the radial direction be 100%, even when the head travel region is extended to a region over 97% from the center, there has been no problem in write and read of information into/from the information recording medium by the magnetic head.

With the recent increasing recording density, there has been a tendency for the floating height to be smaller. Reducing the floating height can improve the S/N ratio of a received signal at the magnetic head and increase the recording density in the information recording medium.

5 With the floating height of 5 nm or less, demand for smoothness and flatness of the main surface of the information recording medium glass substrate is increasing in order to prevent the contact between the outermost surface of the information recording medium and the magnetic head (this phenomenon is called a head crash). When entering the recording surface of the information recording medium from the retracted
10 position, the magnetic head is likely to be affected by air flow disturbance resulting from the shape of the outer peripheral end surface of the information recording medium, possibly leading to unstable floating of the magnetic head (glide avalanche).

 The unstable floating of the magnetic head during transition from the retracted position to the travel position on the recording surface of the information recording
15 medium has adverse effects on the floating of the magnetic head during travel on the recording surface. Consequently, the recording density on the information recording medium cannot be increased efficiently.

 Recent information recording media employed in portable electronic terminal devices typically such as laptop personal computers require improvements in
20 temperature environment change and shock resistant performance. For example, in the server application in which information recording media are assembled, stable operation is desired even when the temperature of information recording medium rises. It is in particular necessary to prevent write and read errors and head damage resulting from a head crash caused by deformation of the information recording medium due to
25 temperature environment.

 An information recording medium glass substrata that is chemically strengthened over its entire surface suffers local minute deformation in the submicron level when a thermal shock is applied, resulting in an error in the neighboring region of the outer peripheral end surface of the information recording medium glass substrate

(glide error).

Japanese Laid-Open Patent Publication No. 2011-000704 (Patent Document 1) discloses a technique relating to a method of manufacturing a magnetic recording medium glass substrate and a magnetic recording medium in which warpage of the glass substrate is prevented by controlling the polishing amount of the main surface of the chemically strengthened glass substrate.

CITATION LIST

PATENT DOCUMENT

PTD 1: Japanese Laid-Open Patent Publication No. 2011-000704

10 SUMMARY OF INVENTION

TECHNICAL PROBLEM

The problem to be solved by the invention lies in write and read errors, a head crash, and head damage caused by deformation of the magnetic recording medium resulting from a change in temperature environment.

15 The present invention is made in view of the foregoing situations and aims to provide a method of manufacturing a magnetic recording medium glass substrate which can provide a magnetic recording medium glass substrate that allows an information recording medium to operate stably even when the temperature thereof rises.

SOLUTION TO PROBLEM

20 In a method of manufacturing an information recording medium glass substrate, the information recording medium glass substrate is in the form of a disk having a rotation center and including a first main surface, a second main surface, and an outer peripheral end surface.

The method includes the steps of: forming a first surface strengthening layer of 10 μm to 200 μm on the first main surface and a second surface strengthening layer of 10 μm to 200 μm on the second main surface through a chemical strengthening process; and polishing the first surface strengthening layer and the second surface strengthening layer.

The step of polishing the first surface strengthening layer and the second

surface strengthening layer polishes the first surface strengthening layer and the second surface strengthening layer so that both of a first polishing amount difference and a second polishing amount difference are not more than $0.10\text{ }\mu\text{m}$, where the first polishing amount difference is a difference between a polishing amount of the first surface strengthening layer and a polishing amount of the second surface strengthening layer in a first circumferential region where a distance in a radial direction from the outer peripheral end surface toward the rotation center is 2.5 mm , and the second polishing amount difference is a difference between a polishing amount of the first surface strengthening layer and a polishing amount of the second surface strengthening layer in a second circumferential region where a distance in a radial direction from the outer peripheral end surface toward the rotation center is 6.5 mm .

In another fashion, the step of polishing the first surface strengthening layer and the second surface strengthening layer simultaneously polishes a plurality of the information recording medium glass substrates in which a thickness difference is not more than $0.5\text{ }\mu\text{m}$.

In another fashion, the step of polishing the first surface strengthening layer and the second surface strengthening layer simultaneously polishes a plurality of the information recording medium glass substrates in which an entire surface flatness of the first main surface and the second main surface is not more than $0.5\text{ }\mu\text{m}$.

In another fashion, the step of polishing the first surface strengthening layer and the second surface strengthening layer polishes the first surface strengthening layer and the second surface strengthening layer using a double-side polisher having a pair of polishing pads for holding the information recording medium glass substrate therebetween. The double-side polisher holds a control parameter in advance such that polishing rates of the first surface strengthening layer and the second surface strengthening layer of the information recording medium glass substrate are approximately equal. The polishing amounts of the first surface strengthening layer and the second surface strengthening layer are adjusted based on the parameter so that both of the first polishing amount difference and the second polishing amount

difference are not more than 0.10 μm .

5 In another fashion, the step of polishing the first surface strengthening layer and the second surface strengthening layer has a first polishing step and a second polishing step, in which the first surface strengthening layer and the second surface strengthening layer are polished using a double-side polisher having a pair of polishing pads for holding the information recording medium glass substrate therebetween. The second polishing step is performed by reversing the first main surface and the second main surface of the information recording medium glass substrate after the first polishing step so that both of the first polishing amount difference and the second polishing amount difference are not more than 0.10 μm .

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ADVANTAGEOUS EFFECTS OF INVENTION

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The method of manufacturing a magnetic recording medium glass substrate according to the present invention can provide a magnetic recording medium glass substrate that allows an information recording medium to operate stably even when the temperature thereof rises

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a diagram schematically showing a configuration of an information recording device in an embodiment.

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Fig. 2 is a perspective view of an information recording medium glass substrate in the embodiment.

Fig. 3 is a perspective view of an information recording medium in the embodiment.

Fig. 4 is a flowchart showing a method of manufacturing an information recording medium in the embodiment.

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Fig. 5 shows a partially enlarged cross-section of the information recording medium glass substrate in the embodiment.

Fig. 6 shows a partially enlarged cross-section as viewed from arrow VI in Fig. 2.

Fig. 7 is a diagram schematically showing a configuration of a single-side

polisher.

Fig. 8 is a table showing a first polishing amount difference (P1), a second polishing amount difference (P2), the difference between the first polishing amount difference (P1) and the second polishing amount difference (P2), the result of a floating test (1), the result of a floating test (2), and the result of a floating test (3) in Example 1 and Comparative Examples 1 to 4.

Fig. 9 is a diagram schematically showing a configuration of a double-side polisher.

DESCRIPTION OF EMBODIMENTS

Embodiments and examples based on the present invention will be described below with reference to the drawings. The scope of the present invention is not limited to the number and quantity referred to in the description of the embodiments and examples, if any, unless otherwise specified. In the description of the embodiments and examples, the same and corresponding parts are denoted with the same reference numerals, and an overlapping description may not be repeated.

(Schematic Configuration of Information Recording Device 2)

Referring to Fig. 1, an example of the schematic configuration of an information recording device 2 will be described. Fig. 1 is a diagram schematically showing a configuration of information recording device 2 in an embodiment.

As shown in Fig. 1, information recording device 2 has a magnetic head 2D arranged so as to be opposed to an information recording medium 1 rotatably driven in the direction of arrow DR1. The shape of information recording medium 1 will be described later with reference to Fig. 2 and Fig. 3. Information recording medium 1 rotates at high speed about a rotation center CP.

Magnetic head 2D is mounted on a tip end of a suspension 2C. Suspension 2C is provided pivotably about a support shaft 2A in the direction of arrow DR2 (tracking direction). A tracking actuator 2B is attached to support shaft 2A.

Magnetic head 2D moves between a retracted position out of information recording medium 1 and a tracking (recording surface) position where it floats over

information recording medium 1.

(Configuration of Information Recording Medium 1)

Referring to Fig. 2 and Fig. 3, a configuration of an information recording medium glass substrate 1G and information recording medium 1 will be described.

5 Fig. 2 is a perspective view of information recording medium glass substrate 1G, and Fig. 3 is a perspective view of information recording medium 1.

As shown in Fig. 2, information recording medium glass substrate 1G for use in information recording medium 1 (hereinafter referred to as “glass substrate 1G”) has the shape of an annular disk having a hole 11 at the center. Glass substrate 1G has an
10 outer peripheral end surface 12, an inner peripheral end surface 13, a front main surface 14, and a back main surface 15. Amorphous glass is used as glass substrate 1G with an outer diameter of about 65 mm, an inner diameter of about 20 mm, and a thickness of about 0.8 mm.

As shown in Fig. 3, information recording medium 1 has a magnetic thin film
15 layer 23 on front main surface 14 of glass substrate 1G described above. Although magnetic thin film layer 23 is formed only on front main surface 14 in the figure, magnetic thin film layer 23 may be provided on back main surface 15.

Conventionally known methods can be used as a method for forming magnetic thin film layer 23. Examples of the method include forming a thermosetting resin
20 including magnetic particles dispersed therein on a substrate by spin coating, forming by sputtering, and forming by electroless plating.

The film thickness by spin coating is about 0.3 to 1.2 μm , the film thickness by sputtering is about 0.04 to 0.08 μm , and the film thickness by electroless plating is about 0.05 to 0.1 μm . The film is preferably formed by sputtering or by electroless
25 plating in view of reducing the thickness and increasing the density.

The magnetic material for use in magnetic thin film layer 23 may be those conventionally known, although not limited thereto. Preferable examples include Co alloys, which are based on Co having high crystal anisotropy for obtaining a high coercive force and include addition of Ni, Cr for the purpose of adjusting residual

magnetic flux density. FePt-based materials have recently been used as a preferable magnetic layer material for heat-assisted recording.

5 A thin coating of a lubricant may be applied on the surface of magnetic thin film layer 23 in order to improve sliding of the magnetic head. Examples of the lubricant include perfluoropolyether (PFPE) which is a liquid lubricant diluted with a Freon-based solvent or other solvents.

10 An underlayer and a protective layer may be provided as necessary. The underlayer in information recording medium 1 is selected depending on the magnetic film. Examples of the material of the underlayer include at least one selected from non-magnetic metals such as Cr, Mo, Ta, Ti, W, V, B, Al, and Ni.

The underlayer may not be a single layer but may be of a multilayer structure in which the same or different kinds of layers are stacked. For example, a multilayered underlayer such as Cr/Cr, Cr/CrMo, Cr/CrV, NiAl/Cr, NiAl/CrMo, and NiAl/CrV can be used.

15 Examples of the protective layer for preventing wear and corrosion of magnetic thin film layer 23 include a Cr layer, a Cr alloy layer, a carbon layer, a hydrogenated carbon layer, a zirconia layer, and a silica layer. The protective layer can be formed successively together with the underlayer, the magnetic film, or other layers by an in-line sputtering system. The protective layer may be a single layer or may be of a
20 multilayer structure including the same or different kinds of layers.

Another protective layer may be formed on the above-noted protective layer or in place of the above-noted protective layer. For example, a silicon oxide (SiO₂) layer may be formed in place of the above-noted protective layer by applying colloidal silica fine particles dispersed in tetraalkoxysilane diluted with an alcohol-based solvent
25 on the Cr layer, followed by baking.

(Manufacturing Process of Glass Substrate 1G)

Referring now to Fig. 4 and Fig. 5, a method of manufacturing information recording medium 1 according to the present embodiment will be described. Fig. 4 is a flowchart showing the method of manufacturing information recording medium 1,

and Fig. 5 shows a partially enlarged cross-section of information recording medium glass substrate 1G.

First, in the “glass fusion step” in step 10 (hereinafter abbreviated as “S10”, which is applicable to step 20 and subsequent steps), a glass material for forming a
5 substrate is fused. In the next “press forming step” in S20, the fused glass is charged into a lower die and press-formed with an upper die. An annular disk-shaped glass substrate 1G is thus prepared.

Preferable examples of the glass material include, but not limited to, amorphous glasses such as aluminosilicate glass, soda lime glass, and borosilicate glass.
10 Crystallized glass may be used.

The glass substrate is shaped into a flat shape in the “lap step” in S25 and subjected to inner diameter processing, outer diameter processing, end surface processing, and other processing not shown in the flow. The surface of the press-formed glass substrate is thereafter polished in the “coarse polishing step” in S30 so
15 that the flatness and other properties of the glass substrate are preliminarily adjusted. In the next “chemical strengthening step” in S40, surface strengthening layers are formed on the two main surfaces of glass substrate 1G.

Specifically, in the “chemical strengthening step”, for example, a mixed solution of potassium nitrate (60%) and sodium nitrate (40%) is used as a chemical
20 strengthening liquid. The chemical strengthening liquid is heated to 300°C or more, and glass substrate 1G is preheated and soaked in the chemical strengthening solution for about three to four hours. Although mixed salts are used here, a single salt of potassium nitrate may be used for strengthening.

Referring to Fig. 5, with the soaking process in the chemical strengthening
25 solution, lithium ions and sodium ions in the surface layer of glass substrate 1G are substituted with sodium ions and potassium ions having a relatively large ion radius in the chemical strengthening solution, whereby the surface of glass substrate 1G is strengthened.

Surface strengthening layers 101A, 101B each having a thickness (t1) of about

30 μm are formed on the two main surfaces of glass substrate 1G through the “chemical strengthening step (S40)”. Aluminosilicate glass is preferably used as glass substrate 1G in order to obtain excellent characteristics of flatness and strength of the main surface of glass substrate 1G.

5 Referring to Fig. 4 again, in the “fine polishing step” in S50, glass substrate 1G is polished. In the next “cleaning process” in S60, glass substrate 1G is cleaned. Glass substrate 1G applicable to information recording medium 1 is thus obtained through the steps described above.

10 As shown in Fig. 6, glass substrate 1G formed through the steps above has the form of a disk having rotation center CP and including front main surface 14, back main surface 15, and outer peripheral end surface 12. Inclined surface 1t having a width (R2) of 0.1 mm in the radial direction from outer peripheral end surface 12 is provided in a region where front main surface 14, back main surface 15, and outer peripheral end surface 12 intersect.

15 In the “deposition step” in S70, magnetic thin film layer 23 is formed on the main surface of glass substrate 1G. In the final “post-heat treatment step” in S80, a heating process is performed for improving crystal magnetic field anisotropy. The heating temperature is about 600°C. Information recording medium 1 is thus completed.

20 In the “deposition step” in S70, magnetic thin film layer 23 may be deposited on each of the two main surfaces (first main surface 14, second main surface 15) of glass substrate 1G.

(Examples)

25 The details of the “fine polishing step (S50)” performed after the “chemical strengthening step (S40)” in the present embodiment will now be described as Examples below. In the “fine polishing step (S50)”, the first main surface and the second main surface of the glass substrate are polished. If a difference in polishing amount occurs between the first main surface and the second main surface, a stress difference is produced between the first main surface and the second main surface.

If a stress difference is produced between the first main surface and the second main surface, local minute deformation in the submicron level is likely to occur when a thermal shock is applied. In addition, deformation (warpage) of the glass substrate increases, so that an error (glide error) is likely to occur in the neighboring region of the outer peripheral end surface of the glass substrate.

In Examples described below, the polishing amount difference (P1) at an outer peripheral position and the polishing amount difference (P2) at an inner peripheral position between the first main surface and the second main surface of the glass substrate were measured, and a floating test (glide test) in the use as an information recording medium was performed.

(Example 1)

Amorphous glass having an outer diameter of 65 mm, an inner diameter of 20 mm, and a thickness of 0.8 mm was used as a glass substrate used as Example 1. The first main surface and the second main surface of the glass substrate underwent the coarse polishing step for shaping surface flatness using an abrasive liquid including Ce grain, followed by the “chemical strengthening step (S40)” as described above to form a surface strengthening layer (compressive surface strengthening layer) having a thickness (t_1) of 30 μm . Two glass substrates manufactured in the foregoing manner were used in each of Example 1 and Comparative Examples 1 to 4 shown below.

Here, in the coarse polishing step, a double-side polisher capable of processing a batch of 100 substrates was used for polishing. The two glass substrates in Example 1 shown below were selected from the coarsely polished two batches of 200 substrates with a thickness difference of not more than 2 μm and a flatness of not more than 2 μm at most selected in a preliminary stage before the coarse polishing step. The two glass substrates in Comparative Examples 1 to 4 were selected from the coarsely polished two batches of randomly selected 200 substrates with a thickness difference of 12 μm at most and a flatness of 3 to 7 μm .

The thicknesses were measured on the circumference in a first circumferential region C1 where the distance in the radial direction from outer peripheral end surface

12 toward rotation center CP was 2.5 mm and in a second circumferential region C2 where the distance in the radial direction from outer peripheral end surface 12 toward rotation center CP was 6.5 mm.

5 In both of the first main surface and the second main surface, the polishing amounts were measured in orthogonal four directions passing through rotation center CP on the circumference in first circumferential region C1. The polishing amounts were also measured in orthogonal four directions passing through rotation center CP on the circumference in second circumferential region C2.

10 The thickness variation in each disk of the two glass substrates used as Example 1 was 0.4 μm or less, the thickness difference of the two glass substrates 1G was 0.3 μm (the difference of the mean values at eight positions), and the flatness of the main surface of each disk was 0.4 μm .

15 Two glass substrates used as Comparative Example 1 had a thickness variation of 0.6 μm , the thickness difference was 0.5 μm , and the flatness of the main surface was 0.7 μm .

Two glass substrates used as Comparative Example 2 had a thickness variation of 0.8 μm , the thickness difference was 0.7 μm , and the flatness of the main surface was 1.3 μm .

20 Two glass substrates used as Comparative Example 3 had a thickness variation of 1.2 μm , the thickness difference was 1.1 μm , and the flatness of the main surface was 2.1 μm .

Two glass substrates used as Comparative Example 4 had a thickness variation of 1.3 μm , the thickness difference was 2.0 μm , and the flatness of the main surface was 3.3 μm .

25 In the fine polishing step, a single-side polisher 100 shown in Fig. 7 was used, and a pair of two glass substrates underwent polishing in each of Example 1 and Comparative Examples 1 to 4.

Single-side polisher 100 includes a surface plate 102 having a polishing pad 101

fixed thereto, a polishing head 103 for holding a glass substrate, and an abrasive supply device 104. Surface plate 102 and polishing head 103 are rotated by a drive source (not shown), so that glass substrate 1G is brought into sliding contact with polishing pad 101, and the main surface of glass substrate 1G is polished. During polishing, an abrasive is supplied from abrasive supply device 104. After the polishing of the first main surface was finished, the second main surface was polished by switching the main surfaces of glass substrate 1G.

A line-shaped groove having a predetermined depth was formed in advance in one of two glass substrates, and the difference between the groove depths before and after polishing was determined after polishing with a laser microscope and set as the polishing amount. The polishing amounts were measured at positions (in total, eight positions) in orthogonal four directions passing through rotation center CP on the circumference in the first circumferential region C1 and on the circumference in the second circumferential region C2.

After the fine polishing step of the glass substrates of Example 1 and Comparative Examples 1 to 4 was finished, the cleaning step was performed. The polishing amount of one of the glass substrate having a groove was thereafter measured in Example 1 and Comparative Examples 1 to 4. Magnetic thin film layers were deposited on the first main surface and the second main surface of the other glass substrate to obtain an information recording medium. The floating test of the information recording medium was thereafter performed using an information recording device.

The floating test includes (i) a floating test under an environment at a room temperature 25°C and (ii) a floating test under an environment at 70°C after three heat cycles of room temperatures 25°C to 85°C.

Fig. 8 shows the first polishing amount difference (P1), the second polishing amount difference (P2), the difference between the first polishing amount difference (P1) and the second polishing amount difference (P2), the result of the floating test (1), the result of the floating test (2), and the result of the floating test (3) in Example 1 and

Comparative Examples 1 to 4.

In Fig. 8, the floating test (1) indicates a floating test at a position where the distance in the radial direction from the outer peripheral end surface toward the rotation center is 6.5 mm, where the floating height of the magnetic head is 20 nm. The floating test (2) indicates a floating test (2) at a position in the second circumferential region C2 where the distance in the radial direction from the outer peripheral end surface toward the rotation center is 6.5 mm, where the floating height of the magnetic head is 5 nm. The floating test (3) indicates a floating test at a position in the first circumferential region C1 where the distance in the radial direction from the outer peripheral end surface toward the rotation center is 2.5 mm, where the floating height of the magnetic head is 5 nm.

In Fig. 8, evaluation “A” indicates passing in both of (i) the floating test under an environment at a room temperature 25°C and (ii) the floating test under an environment at a room temperature 70°C. Evaluation “B” indicates passing in (i) the floating test under an environment at a room temperature 25°C and failing in (ii) the floating test under an environment at a room temperature 70°C. Evaluation “C” indicates failing in both of (i) the floating test under an environment at a room temperature 25°C and (ii) the floating test under an environment at a room temperature 70°C.

In the floating test, the test was performed using a glide test head with a picoslider in RQ7800 evaluation system manufactured by Hitachi High-Technologies Corporation. Passing in the floating test means that magnetic head 2D passed through without colliding with or touching projections on the magnetic disk surface without causing air flow disturbance.

In Example 1, the difference between the first polishing amount difference (P1) and the second polishing amount difference (P2) was 0.01 μm , and Example 1 passed in all of the floating tests (1) to (3). In Comparative Example 1, the evaluation was “B” in the floating test (3). In Comparative Example 2, the evaluation was “C” in the floating test (3). In Comparative Example 4, the difference between the first polishing

amount difference (P1) and the second polishing amount difference (P2) was 0.01 μm , which was the same as in Example 1, but the evaluation was “C” in all the floating tests (1) to (3) since Comparative Example 4 had already failed in the floating test (1).

5 As described above, in the glass substrate using Example 1, the difference between the first polishing amount difference P1 and the second polishing amount difference P2 is 0.01 μm or less, so that the stress difference between the first main surface and the second main surface is suppressed. In addition, occurrence of local minute deformation in the submicron level can be prevented even when a thermal shock is applied. In addition, occurrence of deformation (warpage) of the glass
10 substrate can be prevented, so that an error (glide error) in the neighboring region of the outer peripheral end surface of the glass substrate can also be prevented.

The flatness of each of the first main surface and the second main surface of the glass substrate is not more than 0.4 μm . Accordingly, the load from the polishing pad of the single-side polisher can be applied uniformly on the polished surface of the glass
15 substrate, thereby preventing uneven polishing in the surface.

The thickness difference between the two glass substrates is 0.3 μm , so that the load from the polishing pad of the single-side polisher can be applied uniformly on the two glass substrates, thereby suppressing the polishing amount difference resulting from the thickness difference between the glass substrates and the resulting uneven
20 polishing amount in the surface.

(Example 2)

Amorphous glass having an outer diameter of 65 mm, an inner diameter of 20 mm, and a thickness of 0.8 mm was used as a glass substrate in the same manner as in Example 1. In Example 2, a double-side polisher 200 shown in Fig. 9 was used as a
25 polisher for fine polishing. Double-side polisher 200 includes a lower surface plate 201 and an upper surface plate 202 provided so as to be opposed to each other in the vertical direction. Polishing pads 203, 204 are fixed to the opposing surfaces of lower surface plate 201 and upper surface plate 202, respectively.

The glass substrate 1G is held in a holding hole of a carrier 205 and sandwiched

between lower surface plate 201 and upper surface plate 202. Lower surface plate 201 and upper surface plate 202 are rotated by a drive source (not shown). The rotation drive of lower surface plate 201 and upper surface plate 202 is controlled by a control device 210. With glass substrate 1G held in the holding hole of carrier 205, the first main surface and the second main surface of glass substrate 1G are simultaneously polished with upper and lower polishing pads 203, 204. During polishing, an abrasive is supplied from an abrasive supply device 206. Although abrasive supply device 206 is provided at one place in Fig. 9, the position and number thereof is not limited thereto and can be set as desired.

After the polishing amounts of the first main surface and the second main surface of glass substrate 1G were determined experimentally in advance with the double-side polisher for fine polishing, setting parameters of the polisher that affected the polishing rate of each of the first main surface and the second main surface, such as the rotation speed, load, and abrasive flow rate of each of lower surface plate 201 and upper surface plate 202, were adjusted to obtain a parameter set such that the polishing amounts of the first main surface and the second main surface were uniform. Here, a parameter set was obtained by adjusting the rotation speeds of the upper surface plate and the lower surface plate as appropriate and by decreasing the rotation speed of the surface plate having a higher polishing rate so that the polishing rates of the first main surface and the second main surface were approximately equal. The parameter set was set in control device 210, and the glass substrate chemically strengthened with a thickness variation of not more than 0.5 μm and an entire surface flatness of not more than 0.5 μm was set in double-side polisher 200 and then polished. A slurry of colloidal silica including Si particles with a mean particle diameter of 50 nm was used as an abrasive liquid.

The polishing amount in the surface is generally uniform because of the entire surface flatness of not more than 0.5 μm and the thickness variation of not more than 0.5 μm . In addition, the processing rates of the first surface strengthening layer and the second surface strengthening layer are approximately equal, thereby preventing

occurrence of a difference between the polishing amounts over the entire surface.

The polishing amount of the first main surface and the polishing amount of the second main surface were determined in 50 out of 100 glass substrates processed by the method in this Example. In 47 glass substrates, the difference between the first
5 polishing amount difference P1 and the second polishing amount difference P2 was not more than 0.10 μm at the position of 2.5 mm from the outer peripheral end surface and at the position of 6.5 mm from the outer peripheral end surface.

(Example 3)

Amorphous glass having an outer diameter of 65 mm, an inner diameter of 20
10 mm, and a thickness of 0.8 mm was used as a glass substrate in the same manner as in Example 1. Double-side polisher 200 was used to simultaneously process 100 glass substrates in the same manner as in Example 2. The fine polishing step in this Example has a first polishing step and a second polishing step. The second polishing step is performed by reversing the first main surface and the second main surface of the
15 glass substrate after the first polishing step.

The glass substrate chemically strengthened with a thickness variation of not more than 0.5 μm and an entire surface flatness of not more than 0.5 μm was set in double-side polisher 200 and finely polished in the same manner as in Example 2.

The fine polishing step has the first polishing step and the second polishing step.
20 The second polishing step is performed by reversing the first main surface and the second main surface of the glass substrate after the first polishing step. In anticipation of occurrence of a difference in polishing amount between the first main surface and the second main surface due to the machine difference of the double-side polisher, the first main surface and the second main surface are reserved during the course of the
25 fine polishing step, thereby preventing occurrence of a difference in polishing amount between the first main surface and the second main surface.

Here, specifically, the polishing amounts in the first polishing step and the second polishing step are set by adjusting the processing rate and the processing times before and after the reversal so that the difference between the sum of polishing

amounts of the first main surface in the first polishing step and the second step and the sum of polishing amounts of the second main surface in the first polishing step and the second polishing step is almost zero. Accordingly, occurrence of a difference in polishing amount between the first surface strengthening layer and the second surface strengthening layer can be prevented in the fine polishing step.

The polishing amount of the first main surface and the polishing amount of the second main surface were determined in 50 out of 100 glass substrates. In 45 glass substrates, both of the first polishing amount difference P1 and the second polishing amount difference P2 were not more than 0.10 μm .

Although information recording medium 1 having a diameter of 65 mm (2.5 inches) has been described above, different sizes (1.8 inches, 3.5 inches, 5.25 inches) can also achieve the same effects.

The method of manufacturing an information recording medium glass substrate in the present embodiment can provide a magnetic recording medium glass substrate that allows an information recording medium to operate stably even when the temperature thereof rises.

Accordingly, in the information recording device with the DFH mechanism in which the floating amount of the magnetic head is 5 nm or less, information can be stably written and read by the magnetic head into/from a high-density information recording medium with a recording density on a single side as high as 500 Gbit/inch² or more.

The embodiment disclosed here should be understood as being illustrative rather than being limitative in all respects. The scope of the present invention is shown not in the foregoing description but in the claims, and it is intended that all modifications that come within the meaning and range of equivalence to the claims are embraced here.

REFERENCE SIGNS LIST

1 information recording medium, 1G information recording medium glass substrate, 1t inclined surface, 2 information recording device, 2A support shaft, 2B

tracking actuator, 2C suspension, 2D magnetic head, 11 hole, 12 outer peripheral end surface, 13 inner peripheral end surface, 14 front main surface, 15 back main surface, 23 magnetic thin film layer, 100 single-side polisher, 101, 203, 204 polishing pad, 102 surface plate, 103 polishing head, 104 abrasive supply device, 200 double-side polisher, 5 201 lower surface plate, 202 upper surface plate, 206 abrasive supply device, 210 control device.

CLAIMS

1. A method of manufacturing an information recording medium glass substrate,

5 said information recording medium glass substrate (1G) is in the form of a disk having a rotation center (CP) and including a first main surface (14), a second main surface (15), and an outer peripheral end surface (12),
the method comprising the steps of:
forming a first surface strengthening layer (101A) of 10 μm to 200 μm on said
10 first main surface (14) and a second surface strengthening layer (101B) of 10 μm to 200 μm on said second main surface (15) through a chemical strengthening process; and
polishing said first surface strengthening layer (101A) and said second surface strengthening layer (101B), wherein
said step of polishing said first surface strengthening layer (101A) and said
15 second surface strengthening layer (101B) polishes said first surface strengthening layer (101A) and said second surface strengthening layer (101B) so that both of a first polishing amount difference (P1) and a second polishing amount difference (P2) are not more than 0.10 μm ,
where said first polishing amount difference (P1) is a difference between a
20 polishing amount of said first surface strengthening layer (101A) and a polishing amount of said second surface strengthening layer (101B) in a first circumferential region (C1) where a distance in a radial direction from said outer peripheral end surface (12) toward said rotation center (CP) is 2.5 mm, and
said second polishing amount difference (P2) is a difference between a
25 polishing amount of said first surface strengthening layer (101A) and a polishing amount of said second surface strengthening layer (101B) in a second circumferential region (C2) where a distance in a radial direction from said outer peripheral end surface (12) toward said rotation center (CP) is 6.5 mm.

2. The method of manufacturing an information recording medium glass substrate according to claim 1, wherein said step of polishing said first surface strengthening layer (101A) and said second surface strengthening layer (101B) simultaneously polishes a plurality of said information recording medium glass
5 substrates (1G) in which a thickness difference is not more than 0.5 μm .

3. The method of manufacturing an information recording medium glass substrate according to claim 1, wherein said step of polishing said first surface strengthening layer (101A) and said second surface strengthening layer (101B)
10 simultaneously polishes a plurality of said information recording medium glass substrates (1G) in which an entire surface flatness of said first main surface (14) and said second main surface (15) is not more than 0.5 μm .

4. The method of manufacturing an information recording medium glass
15 substrate according to any one of claims 1 to 3, wherein

said step of polishing said first surface strengthening layer (101A) and said second surface strengthening layer (101B) polishes said first surface strengthening layer (101A) and said second surface strengthening layer (101B) using a double-side polisher having a pair of polishing pads (203, 204) for holding said information
20 recording medium glass substrate (1G) therebetween,

said double-side polisher holds a control parameter in advance such that polishing rates of said first surface strengthening layer (101A) and said second surface strengthening layer (101B) of said information recording medium glass substrate (1G) are approximately equal, and

25 the polishing amounts of said first surface strengthening layer (101A) and said second surface strengthening layer (101B) are adjusted based on said parameter so that both of said first polishing amount difference (P1) and said second polishing amount difference (P2) are not more than 0.10 μm .

5. The method of manufacturing an information recording medium glass substrate according to any one of claims 1 to 3, wherein

5 said step of polishing said first surface strengthening layer (101A) and said second surface strengthening layer (101B) has a first polishing step and a second polishing step, in which said first surface strengthening layer (101A) and said second surface strengthening layer (101B) are polished using a double-side polisher having a pair of polishing pads (203, 204) for holding said information recording medium glass substrate (1G) therebetween, and

10 said second polishing step is performed by reversing said first main surface (14) and said second main surface (15) of said information recording medium glass substrate (1G) after said first polishing step so that both of said first polishing amount difference (P1) and said second polishing amount difference (P2) are not more than 0.10 μm .