

MANUFACTURING METHOD OF GLASS SUBSTRATE FOR MAGNETIC DISC,
GLASS SUBSTRATE FOR MAGNETIC DISC,
AND MAGNETIC DISC

The present disclosure relates to subject matters contained in Japanese Patent Application No. 2007-340827 filed on December 28, 2007, which are expressly incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001]

The present invention relates to a manufacturing method of a glass substrate for a magnetic disc, a glass substrate for a magnetic disc, and a magnetic disc used as a recording medium of computer or the like.

2. Description of the Prior Art

[0002]

Along with advancement of information technology, information recording technology, especially magnetic recording technology has been significantly improving. A glass substrate which can achieve space saving, flattening, and high density recording and has superior flatness of the substrate surface and substrate strength to those of an aluminum substrate, which has been conventionally used, is replacing the aluminum substrate as a substrate for a magnetic recording medium such as a hard disc drive (HDD).

[0003]

Moreover, as density growth of magnetic recording

technology is progressed, a magnetic head has changed from a thin film head to a magnetoresistance head (MR head) to a giant magnetoresistance head (GMR head). Further, floating amount of a magnetic head from a substrate has been narrowed from 8nm to about 6 nm. In a magnetic head mounting such a magnetoresistance element, there may be a case where a head crash or thermal asperity occurs as a trouble unique to such a head.

[0004]

Thermal asperity is a trouble which causes a reading error when a magnetoresistance element is heated by adiabatic compression of air or by contact by a magnetic head when the magnetic head is in float flight and passes above minute convexity or concave portion on a magnetic disc surface. Therefore, extremely high-level smoothness and flatness are required on the surface of a magnetic disc for a magnetic head mounting a magnetoresistance element. Moreover, if a magnetic layer is formed while dust or a foreign matter adheres on the glass substrate surface, a convex portion is formed. Therefore, high level cleaning to prevent dust and to remove a foreign matter so that a convex or a concave portion is prevented is required for the glass substrate.

[0005]

Under the above-mentioned circumstance, importance of smoothness on a substrate edge surface has been recognized. As an inspection method for smoothness of a glass substrate, there is known a method using an automatic optical inspection apparatus (AOI), an optical surface analyzer (OSA) or the like to judge whether or not there is an extraneous matter or concave or convex problem by irradiating light on the surface of the

glass substrate. The existence of the problem is detected by strength or displacement of reflected light or the like (e.g., refer to the Patent Document 1).

[Patent Document 1] Japanese Unexamined Patent Publication No. 2007-256133

[0006]

There may be a case where a foam, unmolten glass component, inclusion such as platinum or zirconium is included inside a glass substrate in a manufacturing process. Because the inclusion exists inside the glass substrate and does not exist on the surface of the substrate, the inclusion does not influence the smoothness of the surface of the glass substrate. Therefore, the inclusion does not influence the quality of the glass substrate and does not cause a head crash or a thermal asperity.

[0007]

However, according to a technique described in the Patent Document 1, it is not possible to distinguish between a concave or convex problem included in the surface and inclusion. Therefore, the inclusion which does not influence the quality of a glass substrate was misjudged as defective and a glass substrate including the inclusion was discarded as a defective item having a possibility to cause a head crash or a thermal asperity.

SUMMARY OF THE INVENTION

[0008]

Therefore, the present invention aims at providing a manufacturing method of a glass substrate for a magnetic disc, a glass substrate for a magnetic disc, and a magnetic disc which

can improve yield of a glass substrate by distinguishing between an inclusion generated in a manufacturing process of a glass substrate and a concave or convex problem included in the surface of a substrate.

[0009]

To solve the above-mentioned problem, a typical configuration of a manufacturing method of a glass substrate for a magnetic disc according to the present invention is a manufacturing method of a discotic glass substrate for a magnetic disc having an inner hole at the center including: a substrate condition measuring step for irradiating light to a substrate and measuring either or both of strength and displacement of a light reflected from the substrate; a defect inner surface position specifying step for specifying an inner surface position of a defect included in the substrate on the basis of either or both of the measured strength and displacement of the light; a surface defect judging step for judging whether or not a defect with specified inner surface position is on the surface of the substrate on the basis of the number of images formed at an inner surface position by an image forming means; and a non-defective judging step for judging whether or not the substrate is non-defective on the basis of a result of the surface defect judging step.

[0010]

According to the above-mentioned configuration, inner surface position of a defect can be specified, whether or not the specified defect is on the surface can be judged on the basis of the number of images obtained by the image forming means, and it becomes possible to judge whether or not the defect is a true defect. Therefore, a substrate including an inclusion

which has been judged as defective will not discarded and it becomes possible to improve the yield.

[0011]

Another typical configuration of a manufacturing method of a glass substrate for a magnetic disc according to the present invention is a manufacturing method of a discotic glass substrate for a magnetic disc having an inner hole at the center including: a substrate condition measuring step for irradiating light to a substrate and measuring either or both of strength and displacement of a light reflected from the substrate; a defect inner surface position specifying step for specifying an inner surface position of a defect included in the substrate on the basis of either or both of the measured strength and displacement of the light; a surface defect judging step for judging whether or not a defect with specified inner surface position is on the surface of the substrate on the basis of the distance to the defect measured by a distance measuring means at the inner surface position; and a non-defective judging step for judging whether or not the substrate is non-defective on the basis of a result of the surface defect judging step.

[0012]

According to the above-mentioned configuration, inner surface position of a defect can be specified and whether or not the specified defect is on the surface can be judged on the basis of the distance to the defect obtained by the distance measuring means and it becomes possible to judge whether or not the defect is a true defect. Therefore, a substrate including an inclusion which has been judged as defective will not discarded and it becomes possible to improve the yield.

[0013]

The image forming means may be an optical microscope.
[0014]

Thus, it becomes possible to easily judge whether the defect is included in the surface of the glass substrate or is an inclusion by counting the number of images, that is, number of focal points. For example, if there is a defect on the surface, number of the focal points is two whereas the number is four in case of the inclusion.

[0015]

The distance measuring means may be a focal point type ultrasonic sensor.

[0016]

Detecting reflected wave in the focal point type ultrasonic sensor enables to measure distance from a bottom surface to an upper surface (surface) of the glass substrate. That is, if the defect is included in the surface of the glass substrate, distance from the bottom surface to the upper surface exceeds a range of a predetermined value and if the defect is an inclusion, the distance is within the range of the predetermined value. Therefore, it becomes possible to easily distinguish whether the defect is included in the surface of the glass substrate or is an inclusion.

[0017]

The light reflected from the substrate in the substrate condition measuring step may be either or both of a scattering light and a diffracted light.

[0018]

If either or both of the scattering light and the diffracted light are measured, it becomes possible to detect a defect or an inclusion of $0.1 \mu\text{m}^2$ or so.

[0019]

To solve the above-mentioned problem, a glass substrate for a magnetic disc according to the present invention is manufactured by the above-mentioned manufacturing method of a glass substrate for a magnetic disc.

[0020]

To solve the above-mentioned problem, a magnetic disc according to the present invention includes at least a magnetic layer formed on a surface of a glass substrate obtained by the above-mentioned manufacturing method of a glass substrate for a magnetic disc.

[0021]

A configuration element on the basis of a technical idea of the above-mentioned manufacturing method of a glass substrate for a magnetic disc and explanation thereof can be applied to the glass substrate for a magnetic disc and the magnetic disc.

[0022]

According to the present invention, it becomes possible to improve yield of a glass substrate by distinguishing between an inclusion generated in a manufacturing process of a glass substrate and concave or convex defect included in a surface.

BRIEF DESCRIPTION OF THE DRAWINGS

The various features of novelty which characterize the invention are pointed out with particularity in the claims attached to and forming a part of this specification. For a better understanding of the invention, its operating advantages, and specific objects attained by its use, reference should be had to the accompanying drawing and descriptive matter in which

there is illustrated and described a preferred embodiment of the invention.

[FIG. 1]

An explanatory view explaining a defect on a main surface of a glass substrate for a magnetic disc.

[FIG. 2]

A flowchart for explaining a flow of a manufacturing method of a glass substrate for a magnetic disc according to an embodiment.

[FIG. 3]

An explanatory view for explaining a measuring method in a substrate condition measuring step.

[FIG. 4]

An explanatory view for explaining a defect which can be detected by a detector unit of a surface defect detection unit.

[FIG. 5]

An explanatory view for explaining a measuring method in a surface defect judging step.

The Best Mode for Carrying Out the Claimed Invention

[0023]

Hereinafter, a preferred embodiment of the present invention will be explained in detail with reference to attached figures. Dimension, material, and other specific numeric values are just examples for ease of understanding of the invention and the present invention is not limited thereto if not otherwise specified. Here, in the present application and drawings, same reference numerals are denoted to elements having substantially same function or configuration to omit redundant explanation thereof and an element which is not

directly related to the present invention is not shown in the drawings.

[0024]

As a result of a keen discussion by the inventors of the present invention on a defect detected by a conventionally carried out inspection method to inspect smoothness of a glass substrate for a magnetic disc, the inventors found out that the defects included a defect which influenced the smoothness and a defect which did not influence the smoothness and it became possible to improve yield by judging whether or not the defect influenced the smoothness to carry out defective/non-defective product checking and completed the present invention.

[0025]

That is, conventionally, before a glass substrate was shipped, a light was irradiated on a main surface of the glass substrate for inspection to judge whether or not the glass substrate was a defective product. However, when a defect of a glass substrate, which was judged as defective by the checking to irradiate light, was checked in detail, it was found out that the defect did not exist on the main surface.

[0026]

Then, the inventors made a research on a spot judged as defective by the inspection in which light was irradiated and found out that an inclusion existing in a glass substrate was also regarded as defective in the inspection in which light was irradiated. The inventors also found out that an inclusion judged as defective by the inspection in which light was irradiated did not actually influence the smoothness of the main surface of the glass substrate.

[0027]

Therefore, the present embodiment includes a surface defect judging step for further inspecting a spot judged as a defect in an inspection in which a light was irradiated, and non-defective judging step for judging whether or not the glass substrate is non-defective on the basis of a result of the surface defect judging step. Explanation thereof will be given below.

[0028]

First, a glass substrate for a magnetic disc according to the present embodiment will be explained. FIG. 1 is an explanatory view explaining a defect on a main surface of a glass substrate for a magnetic disc.

[0029]

The above-mentioned glass substrate for a magnetic disc has a discotic shape and an inner hole is formed at the center thereof. Then a glass substrate 100 for a magnetic disc includes a main surface 110 which becomes a recording and replaying area of information, an edge surface 120 orthogonal to the main surface 110, and a chamfering surface 130 intervening between the main surface 110 and the edge surface 120. Here, because there may be a case where a boundary between the edge surface 120 and the chamfering surface 130 becomes vague in the later-described edge surface polishing step, it is assumed that the present invention includes a case where the edge surface 120 and the chamfering surface 130 are integrated to configure one curved surface.

[0030]

The main surface 110 is an area for recording and replaying information and therefore is substantially smooth so that a recording head can float and run. However, in a process of

manufacturing the glass substrate 100, a convex defect (by a foreign matter) 140 (FIG. 1 (a)), a concave defect (by a damage or a flaw) 142 (FIG. 1 (b)), or an inclusion 150 (FIG. 1 (c)) may be formed on the main surface 110. Otherwise, an extraneous matter (particle) may adhere on the main surface of the glass substrate 100 for a magnetic disc in the manufacturing process of the glass substrate 100.

[0031]

Next, a manufacturing method of a glass substrate for a magnetic disc according to the present embodiment will be explained.

[0032]

FIG. 2 is a flowchart for explaining a flow of a manufacturing method of a glass substrate for a magnetic disc according to the present embodiment.

[0033]

First, a light is irradiated to the flat, smooth, and highly rigid glass substrate 100 for a magnetic disc manufactured by later-described first wrapping step, cutting step, edge surface polishing step, second wrapping step, first and second wrapping steps, and chemical strengthening step to measure either or both of strength and displacement of the light reflected from the glass substrate 100 for a magnetic disc (S200: substrate condition measuring step).

[0034]

FIG. 3 is an explanatory view for explaining a measuring method in the substrate condition measuring step S200. As shown in FIG. 3, the substrate condition measuring step S200 is carried out by use of a surface defect detection apparatus (AOI) 300. The surface defect detection apparatus 300 includes two

types of laser 302 (302a and 302b), four types of detectors 304 (304a, 304b, 304c, and 304d), and a half mirror (or a beam splitter) 306.

[0035]

The laser 302a is a semi-conductor laser having a wave length of 780 ± 15 nm and beam diameter of $120 \mu\text{m} \times 15 \mu\text{m}$ and the laser 302b is a semi-conductor laser having a wave length of 670 ± 10 nm and beam diameter of $2000 \mu\text{m} \times 7005 \mu\text{m}$. The detector 304 includes photodetectors.

[0036]

FIG. 4 is an explanatory view for explaining a defect which can be detected by the detector 304 of the surface defect detection apparatus 300.

[0037]

In a case where inspection is carried out by the detector 304a using the laser 302a, a scattering light reflected from a defect included on the main surface of the glass substrate 100 for a magnetic disc is detected. Thus, the detector 304a can detect an extraneous matter or a concave defect of $0.1 \mu\text{m}^2$ or so. In a case where inspection is carried out by the detector 304b using the laser 302a, change in amount of a scattering diffracted light having directionality which is reflected from a defect included on the main surface of the glass substrate 100 for a magnetic disc is detected. Thus, the detector 304b can detect an extraneous matter, a concave defect of $0.1 \mu\text{m}^2$ or so or an inclusion. In a case where inspection is carried out by the detector 304c using the laser 302a, an increase or decrease of a specular reflection light from a defect included on the main surface of the glass substrate 100 for a magnetic disc is detected. Thus, the detector 304c can

detect a convex defect which does not easily cause scattering or diffraction, a concave defect, a concave defect of $1\ \mu\text{m}^2$ or more or an inclusion.

[0038]

In a case where inspection is carried out by the detector 304d using the laser 302b, an increase or decrease of a specular reflection light from a defect included on the main surface of the glass substrate 100 for a magnetic disc is detected. Thus, the detector 304d can detect a mild convex defect or a mild concave defect which does not easily cause scattering or diffraction.

[0039]

Next, inner surface position of the defect included in the glass substrate 100 for a magnetic disc is specified on the basis of either or both of strength and displacement of the light measured in S200 (S202: defect inner surface position specifying step). It is judged whether or not the defect with specified inner surface position is on the surface of the glass substrate 100 for a magnetic disc (S204: surface defect judging step).

[0040]

FIG. 5 is an explanatory view for explaining a measuring method in the surface defect judging step S204. In the present embodiment, an image forming means in the surface defect judging step S204 includes an optical microscope. As shown in FIG. 5 (a), in a case where the defect detected in the measurement in the substrate condition measuring step S200 is the convex defect 140, number of images formed by the optical microscope, that is, number of focal points (indicated by $\times$ in FIG. 5) is two. On the other hand, if the defect is the inclusion 150 (FIG. 5

(b)), the number of focal points by measurement by the optical microscope is three.

[0041]

Therefore, it becomes possible to easily judge whether or the defect is included in the surface of the glass substrate 100 or is an inclusion 150 by the number of focal points.

[0042]

In the present embodiment, the optical microscope is used as the image forming means in the surface defect judging step S204. However, the step may be carried out on the basis of distance to the defect measured by a distance measuring means. A focal point type ultrasonic sensor may be used as the distance measuring means, for example.

[0043]

In a case where the focal point type ultrasonic sensor is used, whether the defect is included in the surface of the glass substrate 100 or is an inclusion 150 is judged on the basis of a reflected wave. That is, it becomes possible to measure distance between the bottom surface and the main surface 110 (upper surface) of the glass substrate 100 by detecting the reflected wave of the focal point type ultrasonic sensor. Therefore, if the defect is the convex defect 140, the distance between the bottom surface and the main surface 110 becomes larger than a predetermined value and if the defect is the concave defect 142, the distance between the bottom surface and the main surface 110 becomes smaller than a predetermined value. Moreover, if the defect is the inclusion 150, the distance between the bottom surface and the main surface 110 becomes within a range of a predetermined value. Thus, it becomes possible to easily judge whether the defect is included in the

surface of the glass substrate 100 or is an inclusion.

[0044]

Here, since the glass substrate 100 is a discotic rotationally symmetric shape, specified position of the defect may be easily lost when the glass substrate 100 is transferred from the surface defect detection apparatus 300 to the image forming means such as an optical microscope after the position is specified in the defect inner surface position specifying step (S202). However, if the glass substrate 100 itself is marked, the mark itself becomes a defect of the glass substrate 100. Therefore, to maintain the position of the defect of the glass substrate 100, it is preferable that the two detection steps are carried out while the glass substrate 100 is retained. For example, each of the detection steps may be carried out while the substrate 100 is retained by a manipulator which can move between two apparatuses or may be carried out by substantially integrating the surface defect detection apparatus 300 and the optical microscope.

[0045]

In a case where it is judged that the defect is not included in the surface, that is, the defect is judged as an inclusion as a result of the surface defect judging step S204, the substrate is judged as non-defective (S206: non-defective judging step) and becomes a non-defective product (S208: non-defective determination step). If it is judged that the defect is included in the surface as a result of the surface defect judging step S204, it is judged whether or not the defect exceeds permissible threshold (S210: threshold judging step). If the defect does not exceed the threshold, the substrate is judged as non-defective (S206). If the defect exceeds the

threshold, the substrate is judged as defective (S212: defective determination step).

[0046]

By the manufacturing method of the glass substrate 100 for a magnetic disc according to the present embodiment, yield which was conventionally 93% is improved to around 95%.

[0047]

As mentioned above, according to the manufacturing method of the glass substrate 100 for a magnetic disc according to the present embodiment, inner surface position of a defect is specified in the defect inner surface position specifying step S202 and whether or not the defect thus specified is on the surface in the surface defect judging step S204 and it becomes possible to judge whether or not the defect is a true defect. Therefore, a glass substrate including an inclusion which has been conventionally regarded as a defect is not discarded and yield can be improved.

[0048]

(Embodiment)

Hereinafter, an embodiment of a manufacturing method of a glass substrate for a magnetic disc, a glass substrate for a magnetic disc, and a magnetic disc to which the present invention is applied will be explained. The glass substrate for a magnetic disc and the magnetic disc are manufactured as a magnetic disc having a predetermined shape such as a 0.8-inch disc (inner diameter 6mm, outside diameter 21.6mm, thickness of plate 0.381mm), a 1.0-inch disc (inner diameter 7mm, outside diameter 27.4mm, thickness of plate 0.381mm), or a 1.8-inch disc (inner diameter 12mm, outside diameter 48mm, thickness of plate 0.508mm). Moreover, the glass substrate and the disc may be

manufactured as a 2.5-inch disc or a 3.5-inch disc.

[0049]

(1) Shaping step and first wrapping step

As a material of the glass substrate 100, soda lime glass, aluminosilicate glass, boronsilicate glass, crystallized glass, or the like can be used in the present embodiment. Especially, the aluminosilicate glass can be preferably used. Because the aluminosilicate glass is smooth and has high rigidity, magnetic spacing, especially floating amount of a magnetic head, can be stably reduced. Moreover, it is possible for the aluminosilicate glass to obtain high rigidity by chemical strengthening.

[0050]

First, molten aluminosilicate glass was cast into disc-shape by direct press using upper, lower, and body molds to obtain a plate-shaped amorphous glass. Here, as the aluminosilicate glass, a glass for chemical strengthening was used. The discotic glass substrate 100 for a magnetic disc may be obtained by cutting by use of a grinding stone from a sheet glass formed by, other than the direct press, down draw method or float method. Here, as the aluminosilicate glass, chemical strengthening glass including; 58 to 75 percent by weight of SiO_2 ; 5 to 23 percent by weight of Al_2O_3 ; 3 to 10 percent by weight of Li_2O , and 4 to 13 percent by weight of Na_2O as a main component, was used.

[0051]

Next, both main surfaces of the plate glass was wrapping processed to make a disc-shaped base glass material. The wrapping process was carried out by an apparatus for both surfaces wrapping using planetary gear mechanism and alumina

system loose grain. Specifically, wrapping platen was pressed both from top and bottom of the plate glass, grinding fluid containing loose grain was supplied on the main surface of the plate glass, and they were relatively moved to carry out the wrapping process. By this wrapping process, a glass base material having smooth main surface was obtained.

[0052]

(2) Cutting step (coring, forming)

Next, using a diamond cutter, the glass base material was cut and a disc-shaped glass substrate was cut out from the glass base material. Next, using a cylindrical diamond drill, an inner hole was formed in the center of the glass substrate to form a discotic glass substrate 100 (coring). Then, an inner circumference edge surface and an outer circumference edge surface 120 were ground by a diamond grinder to carry out predetermined chamfering process (forming).

[0053]

(3) Second wrapping step

Next, on both main surfaces 110 of the glass substrate 100 thus obtained, second wrapping process was carried out in a similar manner as the first wrapping process. By carrying out the second wrapping process, it is possible to remove minute convex or concave shape formed on the main surface in the cutting step or edge surface polishing step, which are precedent steps, in advance and it becomes possible to finish following polishing step of the main surface in a short period of time.

[0054]

(4) Edge surface polishing step

Next, the outer circumference edge surface of the glass substrate 100 was polished. Polishing of the edge surface 120

was carried out independently before a chamfering surface 130. Polishing may be carried out by use of, for example, a brush to polish a plurality of glass substrates 100 simultaneously. However, in this case, chamfering amount is increased. Therefore, for example, a single wafer polishing method may be used.

[0055]

Subsequently, mirror polishing was carried out on the chamfering surface 130. Thus, difference in surface roughness of the chamfering surface 130 of one glass substrate 100 in the whole of the outer circumference is set within a range of 0.001 μm or less. Then, the glass substrate 100 after the edge surface polishing step was cleansed by water. By this edge surface polishing step, the edge surface 120 of the glass substrate 100 was processed to have a mirror surface condition where generation of separated out sodium or potassium could be prevented.

[0056]

Here in the present embodiment, the chamfering surface 130 was polished after the edge surface was polished. However, the order may be arbitrarily changed and polishing of the chamfering surface 130 may be followed by polishing of the edge surface 120.

[0057]

Next, regarding the inner circumference edge surface, a glass substrate block in which a plurality of glass substrates are laminated may be formed so that the chamfered inner circumference edge surface can be simultaneously polished by a brush roll. At this time, a slurry (loose grain) including cerium oxide grain was used as the abrasive grain.

[0058]

(5) Main surface polishing step

As a main surface polishing step, the first polishing step was performed. The first polishing step is mainly aimed at removing crack or distortion remaining on the main surface 110 after the wrapping step. In the first polishing step, main surface 110 was polished by the both surface polishing apparatus which included a planetary gear mechanism, using a hard resin polisher. Cerium oxide grain was used as the abrasive agent.

[0059]

The glass substrate 100 after the first polishing step was sequentially dipped in cleansing tanks of neutral detergent, pure water, and isopropyl alcohol (IPA) to be cleansed.

[0060]

Next, second polishing step was performed as the main surface polishing step. The second polishing step was aimed at finishing the main surface 110 to have a mirror surface. In the second polishing step, main surface 110 was mirror polished by the both surface polishing apparatus which included a planetary gear mechanism, using a soft foam resin polisher. Cerium oxide grain which was smaller than cerium oxide grain used in the first polishing step was used as the abrasive agent.

[0061]

The glass substrate after the first polishing step was sequentially dipped in cleansing tanks of neutral detergent, pure water, and isopropyl alcohol (IPA) to be cleansed. Here, ultrasonic wave was applied to the tanks.

[0062]

(6) Chemical strengthening step

Next, chemical strengthening was conducted to the glass

substrate 100 after the above-mentioned wrapping and polishing steps. The chemical strengthening was conducted by preparing chemical strengthening solution in which 60% of potassium nitrate and 40% of sodium nitrate were mixed. The chemical solution was heated to 400°C and the cleansed glass substrate 100 was heated to 300°C. Then, the glass substrate 100 was dipped into the chemical strengthening solution for about 3 hours. To chemically strengthen the whole surfaces of the glass substrate 100, the dipping was conducted while the glass substrate 100 was placed in a holder so that a plurality of glass substrates 100 were retained by their edge surface 120.

[0063]

By dipping the glass substrate into the chemical strengthening solution, lithium ion and sodium ion on the surface layer of the glass substrate 100 were replaced by sodium ion and potassium ion in the chemical strengthening solution and the glass substrate 100 was strengthened. Thickness of compression stress layer formed on the surface layer of the glass substrate 100 was between about 100 μm and 200 μm .

[0064]

The glass substrate 100 after the chemical strengthening process was dipped into a water tank of 20°C to be rapidly cooled down and was kept in the tank for about 10 minutes. Then, the glass substrate 100 after the rapid cool down was dipped in concentrated sulfuric acid heated to about 40°C to be cleansed. Moreover, the glass substrate 100 after cleansing by the concentrated sulfuric acid was sequentially dipped into tanks of pure water and IPA to be cleansed. Here, ultrasonic wave was applied to the tanks.

[0065]

As mentioned above, by carrying out the first wrapping step, the cutting step, the edge surface polishing step, the second wrapping step, the first and second polishing steps, and the chemical strengthening step, a flat and smooth glass substrate 110 for a magnetic disc having high rigidity was obtained.

[0066]

(7) Inspection step

The main surface 110 of the glass substrate 100 for a magnetic disc thus obtained was inspected. As shown in FIG. 2, the inspection step includes the substrate condition measuring step S200 for irradiating light to the glass substrate 100 for a magnetic disc and measuring either or both of strength and displacement of a light reflected from the glass substrate 100 for a magnetic disc; the defect inner surface position specifying step S202 for specifying an inner surface position of a defect included in the glass substrate 100 on the basis of either or both of the measured strength and displacement of the light; the surface defect judging step S204 for judging whether or not a defect with specified inner surface position is on the surface of the glass substrate 100; and the non-defective judging step S206 for judging whether or not the glass substrate 100 for a magnetic disc is non-defective on the basis of a result of the surface defect judging step S204.

[0067]

(8) Magnetic disc manufacturing step

An adherent layer including Cr alloy, a soft magnetic layer including CoTaZr base alloy, a foundation layer including Ru, a perpendicular magnetic recording layer including CoCrPt base alloy, a protection layer including carbon hydroxide, and

a lubrication layer including perfluoropolyether were sequentially deposited on both surfaces of a glass substrate 100 obtained through the above procedures to manufacture a perpendicular magnetic disc. Here, the present configuration is an example of a configuration of a perpendicular magnetic disc. However, the above example may include a magnetic layer or the like as a longitudinal magnetic disc.

[0068]

The present invention can be used as a manufacturing method of a glass substrate for a magnetic disc, a glass substrate for a magnetic disc, and a magnetic disc.

What is claimed is:

1. A manufacturing method of a glass substrate for a magnetic disc which is a manufacturing method of a discotic glass substrate for a magnetic disc having an inner hole at the center comprising:

a substrate condition measuring step for irradiating light to the substrate and measuring either or both of strength and displacement of a light reflected from the substrate;

a defect inner surface position specifying step for specifying an inner surface position of a defect included in the substrate on the basis of either or both of the measured strength and displacement of the light;

a surface defect judging step for judging whether or not a defect with specified inner surface position is on the surface of the substrate on the basis of the number of images formed at an inner surface position by an image forming means;

and a non-defective judging step for judging whether or not the substrate is non-defective on the basis of a result of the surface defect judging step.

2. A manufacturing method of a glass substrate for a magnetic disc which is a manufacturing method of a discotic glass substrate for a magnetic disc having an inner hole at the center comprising:

a substrate condition measuring step for irradiating light to the substrate and measuring either or both of strength and displacement of a light reflected from the substrate;

a defect inner surface position specifying step for specifying an inner surface position of a defect included in

the substrate on the basis of either or both of the measured strength and displacement of the light;

a surface defect judging step for judging whether or not a defect with specified inner surface position is on the surface of the substrate on the basis of the distance to the defect measured by a distance measuring means at the inner surface position; and

a non-defective judging step for judging whether or not the substrate is non-defective on the basis of a result of the surface defect judging step.

3. The manufacturing method of a glass substrate for a magnetic disc according to claim 1, wherein the image forming means is an optical microscope.

4. The manufacturing method of a glass substrate for a magnetic disc according to claim 2, wherein the distance measuring means is a focal point type ultrasonic sensor.

5. The manufacturing method of a glass substrate for a magnetic disc according to any one of claims 1 to 4, wherein a light reflected from the substrate in the substrate condition measuring step is either or both of a scattering light and a diffracted light.

6. A glass substrate for a magnetic disc manufactured by the manufacturing method of a glass substrate for a magnetic disc according to any one of claims 1 to 5.

7. A magnetic disc comprising at least a magnetic layer

formed on a surface of the glass substrate obtained by the manufacturing method of a glass substrate for a magnetic disc according to any one of claims 1 to 6.