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

The present disclosure relates to subject matters contained in Japanese Patent Application No. 2007-336281 filed on December 27, 2007, which are expressly incorporated herein by reference in its entireties.

## 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 and a manufacturing method of a magnetic disc.

### 2.Description of the Related Art

[0002]

As an information recording medium used as a recording medium of an information processing equipment, a magnetic disc has been known. The magnetic disc is configured by forming a thin film such as a magnetic layer on a substrate and as the substrate, an aluminum or a glass substrate has been used.

[0003]

However, in recent years, along with the demand for high recording density, a glass substrate which can allow a narrower space between a magnetic head and a magnetic disc has been

rapidly developed. In case of using a glass substrate, high smoothness of the glass substrate is required so that required low flying height can be achieved. However, it is becoming difficult to obtain sufficiently high smoothness only by polishing the glass substrate surface with high precision. That is, no matter how precisely polished, high smoothness cannot be obtained if a foreign matter adheres on the glass substrate surface and therefore cleansing method after precise polishing becomes very important.

[0004]

Conventionally, scrub cleansing has been known as a cleansing method (e.g., Patent Document 1). According to this cleansing method, for example, a cleansing sponge (scrub pad) is operated in a rotating manner, a cleansing liquid is supplied, and the sponge is pressed to a spinning glass substrate to forcibly cleanse the glass substrate surface.

[Patent Document 1] Japanese Unexamined Patent Publication No. 2002-74653

[0005]

In a conventional cleansing step using a scrub pad, cleansing liquid is directly sent to the scrub pad to remove dirt on the glass substrate surface during cleansing. However, part of the dirt is sucked into inside of the pad from the surface of the pad.

[0006]

Therefore, if a large amount of foreign matter or the like adheres on the glass substrate before cleansing, the foreign

matter which must be washed away by cleansing readheres on the surface or inside of the scrub pad. Then, if the dirt readheres on the surface or inside of the scrub pad, a dirtied scrub pad is to be used and therefore there is a possibility that the glass substrate surface cannot be appropriately cleansed. Moreover, there is a possibility that the glass substrate surface may be damaged due to the dirt readhering on the scrub pad.

[0007]

For example, if scrub cleansing is to be carried out as a cleansing method after a polishing step such as precise polishing, a glass substrate with a surface on which a great amount of polishing sludge, loose grain of a polishing step, or the like adheres is to be cleansed. Therefore, there is a possibility that a great amount of polishing sludge, loose grain, or the like adheres on the scrub pad. Therefore, in this case, the problem of dirt which readheres on the scrub pad becomes especially important.

[0008]

Here, as a means to solve the problem of the readhesion of dirt on a scrub pad, for example, exchange of the scrub pad is conceivable. However, even if the glass substrate is cleansed by an unused scrub pad, the problem of readhesion of dirt on the scrub pad begins once the cleansing is started. Especially, in a case where the scrub cleansing is carried out after a polishing step, the scrub pad becomes dirty at an early stage by a great amount of polishing sludge, loose grain, or the like and as a result, instead of cleansing the glass

substrate surface, the substrate surface may be damaged.

[0009]

Moreover, exchange of the scrub pad must be carried out manually while a cleansing apparatus is stopped for example. Therefore, there is a possibility that workability is greatly lowered. Further, there is a possibility that the scrub pad is broken when exchanged.

## SUMMARY OF THE INVENTION

[0010]

Therefore, it has been conventionally requested to solve the problem of readhesion of dirt on a scrub pad by a more appropriate method. Therefore, the present invention is aimed at providing a manufacturing method of a glass substrate for a magnetic disc and a manufacturing method of a magnetic disc which can solve the above mentioned problems.

[0011]

To solve the above problems, the present invention includes following configurations.

(Configuration 1)

A manufacturing method of a glass substrate for a magnetic disc includes a polishing step for polishing a main surface of a glass substrate and a cleansing step for carrying out scrub cleansing of the glass substrate having the main surface which was polished in the polishing step, wherein the cleansing step includes a contacting rotation step for causing a pair of scrub pads for cleansing and a glass substrate to be in contact with

each other and rotating the scrub pads and a non-contacting rotation step for rotating the scrub pads in a rotation speed faster than that in the contacting rotation step without causing the scrub pads and the glass substrate to be in contact with each other. In the contacting rotation step, a pair of scrub pads are rotated while the scrub pads and a glass substrate are in contact. In the non-contacting rotation step, for example, the glass substrate which was in contact with the scrub pads in the contacting rotation step is pulled out from the scrub pads and subsequently while the pair of scrub pads and the glass substrate are not in contact, the scrub pads are rotated.

[0012]

With such a configuration, it becomes possible to appropriately carry out scrub cleansing of a glass substrate in the contacting rotation step. Moreover, in the non-contacting rotation step, the scrub pads are caused to rotate in high speed so that dirt such as polishing sludge or loose grain which adheres on the scrub pads can be removed by centrifugal force. Therefore, in a subsequent contacting rotation step carried out after the non-contacting rotation step, scrub cleansing can be carried out by use of the scrub pads from which dirt is removed.

[0013]

Therefore, it becomes possible to suppress readhesion of dirt on the scrub pads and to appropriately carry out scrub cleansing. Further, with such a configuration, it becomes possible to suppress readhesion of dirt on the scrub pads and

to appropriately carry out scrub cleansing of the glass substrate even right after polishing where a lot of polishing sludge, loose grain, or the like adheres on the substrate.

[0014]

Here, the polishing sludge, loose grain, or the like which is a foreign matter generated in the polishing step adheres strongly on the glass substrate surface as time elapses. Therefore, with such a configuration, for example, carrying out scrub cleansing right after the polishing step enables to more appropriately remove such foreign matters in a stage before the foreign matter strongly adheres on the glass substrate. Moreover, it becomes possible to appropriately carry out cleansing after the polishing step with the precision that is required in a case where a high recording density of 160GB or more per one $inch^2$ is to be realized.

[0015]

Further, with such a configuration, dirt on the scrub pads can be removed without detaching the pads from a cleansing apparatus. Therefore, with such a configuration, frequency for exchanging the scrub pads can be reduced and life of the scrub pads can be lengthened. Further, this enables to appropriately reduce manufacturing cost of the glass substrate.

[0016]

Here, the rotation speed of the scrub pads in the contacting rotation step is, for example, between 400 and 500 rpm. Thus, it becomes possible to appropriately carry out scrub cleansing of the glass substrate. The rotation speed of the

scrub pads in the non-contacting rotation step is, for example, between 800 and 2000 rpm. Thus, it becomes possible to appropriately remove dirt on the scrub pads by centrifugal force.

[0017]

It is preferable that the contacting rotation step in the cleansing step is a step for firstly cleansing the glass substrate after the polishing step. Thus, it becomes possible to appropriately carry out scrub cleansing in an early stage before a foreign matter strongly adheres. Moreover, this enables to carry out scrub cleansing of the glass substrate with high precision.

[0018]

(Configuration 2)

The polishing step includes a precise polishing step which is the final polishing step of the glass substrate and in the cleansing step, scrub cleansing is carried out to the glass substrate in a condition where the main surface of the glass substrate is kept wet after the precise polishing step.

[0019]

If the surface of the glass substrate is dried after polishing, a foreign matter strongly adheres on the surface of the glass substrate. With the above configuration, it becomes possible to appropriately prevent desiccation of the glass substrate after the polishing step. Moreover, it also becomes possible to appropriately carry out scrub cleansing in a condition where a foreign matter does not strongly adhere on

the surface.

[0020]

Here, the glass substrate taken out from the polishing apparatus after polishing step is, for example, temporarily kept in water. Thus, it becomes possible to appropriately reduce foreign matters such as the polishing sludge or loose grain on the glass substrate before scrub cleansing is carried out in the cleansing step. Moreover, it becomes possible to more appropriately carry out scrub cleansing.

[0021]

(Configuration 3)

A manufacturing method of a glass substrate for a magnetic disc includes a polishing step for polishing a main surface of a glass substrate, a chemical strengthening step after the polishing step for strengthening the strength of the glass substrate, and a cleansing step after the chemical strengthening step for carrying out scrub cleansing of the glass substrate having the main surface which was strengthened in the chemical strengthening step, wherein the cleansing step includes a contacting rotation step for causing a pair of scrub pads for cleansing and a glass substrate to be in contact with each other and rotating the scrub pads and a non-contacting rotation step for rotating the scrub pads in a rotation speed faster than that in the contacting rotation step without causing the scrub pads and the glass substrate to be in contact with each other.

[0022]

Thus, it becomes possible to suppress readhesion of dirt on the scrub pads and to appropriately carry out scrub cleansing. Therefore, it becomes possible to appropriately carry out scrub cleansing for a glass substrate after chemical strengthening. Here, it is preferable that the manufacturing method of a glass substrate for a magnetic disc includes a cleansing step after the polishing step and the chemical strengthening step respectively. In this case, the cleansing step after the polishing step includes, for example, the above-mentioned contacting rotation step and the non-contacting rotation step.

[0023]

(Configuration 4)

In the non-contacting rotation step, the scrub pads are rotated while a cleansing liquid is supplied to the scrub pads. The cleansing liquid is, for example, detergent, pure water, or the like. Thus, it becomes possible to more appropriately remove dirt adhering on the scrub pad in the non-contacting step.

[0024]

(Configuration 5)

In the non-contacting rotation step, the pair of scrub pads are pressed to each other while the glass substrate and the scrub pads are not in contact. In the non-contacting rotation step, for example, distance between rotation axes of the pair of scrub pads are caused to become smaller than the distance in the contacting rotation step so that the pair of scrub pads are pressed to each other.

[0025]

Thus, it becomes possible to appropriately push out, for example, the dirt intruded inside of the scrub pads. Moreover, the above-mentioned configuration enables to more appropriately remove dirt of the scrub pads.

[0026]

(Configuration 6)

A manufacturing method of a magnetic disc includes a step of forming at least a magnetic recording layer on a glass substrate manufactured by the manufacturing method of a glass substrate for a magnetic disc described in any of the configurations 1 to 5. According to this, for example, it becomes possible to provide a magnetic disc suitable for realization of high recording density.

[0027]

According to the present invention, it becomes possible to appropriately remove dirt adhering on a scrub pad used in, for example, scrub cleansing. Moreover, it becomes possible to appropriately carry out scrub cleansing after, for example, the polishing step.

## 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] A flowchart showing an example of a manufacturing method of a glass substrate for a magnetic disc according to an embodiment of the present invention.

[FIG. 2] A view showing a configuration example of a scrub cleansing apparatus 10 for carrying out scrub cleansing in a cleansing step. FIG. 2 (a) is a perspective view showing a principal part of the scrub cleansing apparatus 10. FIG. 2 (b) is a top view of the scrub cleansing apparatus 10.

[FIG. 3] A view explaining setting of rotation speed of scrub pads 11a and 11b. FIG. 3 (a) is a graph explaining rotation speed in a contacting rotation step. FIG. 3 (b) is a graph explaining rotation speed in a non-contacting rotation step.

## The Best Mode for Carrying Out the Claimed Invention

[0028]

Hereinafter, embodiments according to the present invention will be explained with reference to figures. FIG. 1 is a flowchart showing an example of a manufacturing method of a glass substrate for a magnetic disc according to an embodiment of the present invention. The manufacturing method of a glass substrate for a magnetic disc of the present example includes a cutting step S102, a polishing step S104, a cleansing step S106, and a chemical strengthening step S108.

[0029]

The cutting step S102 is a step for carrying out cutting processing such as wrapping and shape processing of a glass substrate. For example, a main surface of a disc-shaped glass substrate having a hole at the center thereof is wrapped to have a predetermined surface roughness by a heretofore known cutting method. Here in the present example, an inner circumference edge surface and an outer circumference edge surface of the glass substrate are mirror polished by brush polishing in the cutting step S102. Moreover, the wrapped glass substrate is sequentially dipped into cleansing tanks of neutral detergent and water for ultrasonic cleansing in each of the tanks.

[0030]

The polishing step S104 is a step for carrying out polishing on the main surface of the glass substrate and includes a first and a second polishing steps. The first polishing step is aimed at removing a defect or warping which remains after the cutting step. Both of the main surfaces of the glass substrate are polished by a both surface polishing apparatus using, for example, a hard polisher and an abrasive compound including cerium oxide grain. The second polishing step is a precise polishing step which is the final polishing step for the glass substrate. The second polishing step is aimed at reducing the surface roughness of the main surface of the glass substrate to be a predetermined value or less while maintaining a flat surface obtained in the first polishing step. Both of the main surfaces of the glass substrate are polished

by a both surface polishing apparatus using, for example, a soft polisher and abrasive compound including cerium oxide grain.

[0031]

Here in the second polishing step, the main surfaces of the glass substrate are polished to have an arithmetic mean surface roughness Ra of 0.5 nm or less, preferably 0.4 nm or less, more preferably 0.3 nm or less. Moreover, the main surfaces of the glass substrate are polished to have a maximum height Rmax of 5 nm or less, preferably 4 nm or less, more preferably 3 nm or less. The arithmetic mean surface roughness Ra and the maximum height Rmax are calculated in accordance with, for example, the arithmetic mean surface roughness Ra and the maximum height Rmax of the Japan Industrial Standards JIS B0601.

[0032]

In the cleansing step S106, the glass substrate having main surfaces which were polished in the polishing step S104 is cleansed. In the present example, the glass substrate taken out from the both surfaces polishing apparatus after the second polishing step is firstly kept in water temporarily in the cleansing step S106. Thus, while preventing the glass substrate surface from being dried after polishing, the glass substrate is rinsed to reduce foreign matter such as polishing sludge or loose grain which adheres on the glass substrate after polishing. Then, in the cleansing step S106, the glass substrate kept in water is moved to a scrub cleansing apparatus and scrub cleansing for the glass substrate is started.

[0033]

Thus, in the cleansing step S106, scrub cleansing for the glass substrate is carried out while the main surfaces of the glass substrate after the polishing step S104 are kept in a wet condition. In this case, because a foreign matter does not strongly adhere due to desiccation on the surface of the glass substrate, it becomes possible to improve the effect of scrub cleansing. Moreover, in the present example, the scrub cleansing is carried out right after the polishing step without carrying out other cleansing such as ultrasonic cleansing between the polishing step and the scrub cleansing. Thus, the scrub cleansing can be carried out before a foreign matter adheres strongly on the glass substrate due to elapsed time and foreign matters can be removed with high accuracy according to the present example.

[0034]

In the cleansing step S106, the scrub cleansing using cleansing liquid such as detergent or pure water is carried out. In the cleansing step S106, scrub cleansing using detergent and scrub cleansing using pure water may be carried out. Thus, it becomes possible to more appropriately cleanse the glass substrate. Moreover, in the cleansing step, the glass substrate may be rinsed by pure water between scrub cleansing using detergent and scrub cleansing using pure water.

[0035]

Here, a method for the scrub cleansing will be explained in detail later. In the cleansing step S106, for example, an ultrasonic cleansing or the like may be carried out after the

scrub cleansing. In the cleansing step S106, for example, ultrasonic cleansing using a chemical such as sulfuric acid aqueous solution, ultrasonic cleansing using pure water, ultrasonic cleansing using detergent, ultrasonic cleansing using IPA, and steam drying by IPA may be further carried out after scrub cleansing using detergent and pure water.

[0036]

In the chemical strengthening step S108, the glass substrate after the cleansing step S106 is chemically strengthened by, for example, a heretofore known method. Moreover, in the chemical strengthening step S108, the glass substrate after the chemical strengthening is, for example, cleansed. For example, in the chemical strengthening step S108, the glass substrate is sequentially dipped into tanks of sulfuric acid, neutral detergent, pure water, and IPA for cleansing. Further, subsequently, steam drying by IPA is carried out. Here, cleansing after the chemical strengthening step S108 may be carried out as the same or similar cleansing step as the cleansing step S106. In this case in the cleansing step, scrub cleansing for the glass substrate is carried out by the same or similar method as in the cleansing step S106. Thus, it becomes possible to more appropriately cleanse the glass substrate after chemical strengthening.

[0037]

Through the above-mentioned steps, the glass substrate is manufactured. Then, the glass substrate thus manufactured is used for manufacturing a magnetic disc. In the manufacturing

step of a magnetic disc, at least a magnetic recording layer is formed on the glass substrate.

[0038]

FIG. 2 is a view showing a configuration example of a scrub cleansing apparatus 10 for carrying out scrub cleansing in the cleansing step. FIG. 2 (a) is a perspective view showing a principal part of the scrub cleansing apparatus 10. FIG. 2 (b) is a top view of the scrub cleansing apparatus 10. In the present example, the scrub cleansing apparatus 10 includes a pair of axes 16a and 16b, a pair of scrub pads for cleansing 11a and 11b, a support roller 13, a nozzle 14, and a pad controller 15. Here, the scrub cleansing apparatus 10 includes, for example, a rotary drive means for pad for rotary driving the axes 16a and 16b, a rotary drive means for support roller for rotary driving the support roller 13, a cleansing liquid supplying mechanism for supplying cleansing liquid from the nozzle 14, and the like (not shown).

[0039]

The pair of axes 16a and 16b are rotation axes to which the pair of scrub pads 11a and 11b are attached. The pair of axes 16a and 16b are retained to be parallel to each other and are rotated in response to control by the pad controller 15. Moreover, in the present example, the pair of axes 16a and 16b change the distance therebetween in response to control by the pad controller 15.

[0040]

The pair of scrub pads 11a and 11b are cylindrical

cleansing pads and are attached to the pair of axes 16a and 16b so that the pads are placed opposite to each other in a manner that a glass substrate 20 to be a polishing target is sandwiched therebetween. Moreover, the pair of scrub pads 11a and 11b are rotated in opposite directions and brought into contact with the top and back surfaces of the glass substrate 20 to carry out scrub cleansing for the glass substrate 20.

[0041]

Here in the present example, the pair of scrub pads 11a and 11b carry out scrub cleansing for two glass substrates 20 sandwiching the two glass substrates 20 between the pads. In a modified example of the scrub cleansing apparatus 10, the pair of scrub pads 11a and 11b may carry out scrub cleansing of one or three or more glass substrates 20 by sandwiching the glass substrates 20 between the pads.

[0042]

The support roller 13 is a roller which supports the glass substrate 20 while rotary driving the glass substrate 20. The support roller 13 rotary drives the glass substrate 20 and along with rotation of the scrub pads 11a and 11b, the whole of the top and back surfaces of the glass substrate 20 are brought into contact with the scrub pads 11a and 11b. According to the present example, it becomes possible to appropriately scrub cleanse the whole of the top and back surfaces of the glass substrate 20. The nozzle 14 supplies cleansing liquid to the scrub pads 11a and 11b or to the glass substrate 20. The cleansing liquid is, for example, detergent, pure water, or the

like. The pad controller 15 controls operation of the axes 16a and 16b so that operation of the scrub pads 11a and 11b in the cleansing step is controlled.

[0043]

Hereinafter, operation of the scrub pads 11a and 11b in the cleansing step will be explained. In the present example, the cleansing step includes the contacting rotation step and the non-contacting rotation step. The contacting rotation step is a step in which the pair of scrub pads 11a and 11b for cleansing are brought into contact with the glass substrate 20 to carry out scrub cleansing for the glass substrate 20. In the contacting rotation step of the present example, the pad controller 15 causes the pair of scrub pads 11a and 11b to rotate in, for example, the rotation speed of 400 to 500 rpm while the pair of scrub pads 11a and 11b are in contact with the glass substrate 20.

[0044]

The non-contacting rotation step is a step in which the scrub pads 11a and 11b are rotated in a condition where scrub cleansing is not carried out. For example, after the glass substrate 20 is pulled out after the contacting rotation step, the scrub pads 11a and 11b are rotated in the speed faster than that in the contacting rotation step without being in contact with the glass substrate 20. In the non-contacting rotation step, dirt such as polishing sludge or loose grain adhering on the scrub pads 11a and 11b is removed by the centrifugal force caused by the high speed rotation. In the non-contacting

rotation step of the present example, the pad controller 15 rotates the scrub pads 11a and 11b in the rotation speed of 800 to 2000 rpm while the pair of scrub pads 11a and 11b are not in contact with the glass substrate 20.

[0045]

Moreover, in the non-contacting rotation step, the pad controller 15 causes the distance between the pair of axes 16a and 16b to be, for example, smaller than that in the contacting rotation step. Thus, the pad controller 15 causes the pair of scrub pads 11a and 11b to be pressed to each other in the non-contacting rotation step. Thus, it becomes possible to appropriately push out, for example, the dirt intruded inside of the scrub pads 11a and 11b. Moreover, the above-mentioned configuration enables to more appropriately remove dirt of the scrub pads 11a and 11b.

[0046]

Here, the pad controller 15, for example, temporarily causes the distance between the axes 16a and 16b to be smaller and resets the distance to the same one as that in the contacting rotation step again to carry out high speed rotation of the scrub pads 11a and 11b. Thus, it becomes possible to appropriately carry out high speed rotation of the scrub pads 11a and 11b. The pad controller 15 may carry out the high speed rotation of the scrub pads 11a and 11b while the scrub pads 11a and 11b are pressed to each other.

[0047]

According to the present example, it becomes possible to,

for example, suppress readhesion of dirt on the scrub pads 11a and 11b and to appropriately carry out scrub cleansing. Therefore, even if cleansing is carried out immediately after polishing and a lot of polishing sludge, loose grain, or the like adheres on the glass substrate, it becomes possible to appropriately carry out scrub cleansing for the glass substrate 20.

[0048]

Moreover, according to the present example, it becomes possible to appropriately carry our cleansing after the polishing step with the precision that is required in a case where a high recording density of 160GB or more per one $inch^2$ is to be realized. Further, according to the present example, dirt on the scrub pads 11a and 11b can be removed without detaching the pads from a cleansing apparatus. Therefore, frequency for exchanging the scrub pads 11a and 11b can be reduced and life of the scrub pads 11a and 11b can be lengthened. Further, this enables to appropriately reduce manufacturing cost of the glass substrate 20.

[0049]

Here, the non-contacting rotation step is periodically carried out when, for example, scrub cleansing is carried out for a previously set amount of glass substrates 20 in the contacting rotation step. Thus, it becomes possible to appropriately remove dirt which readheres on the scrub pads 11a and 11b. The non-contacting rotation step may be carried out every time the glass substrate 20 cleansed in the contacting

rotation step is exchanged. Thus, it becomes possible to appropriately remove dirt which readheres on the scrub pads 11a and 11b.

[0050]

Material of the scrub pads 11a and 11b includes, for example, polyvinyl alcohol, polyurethane, vinyl alcohol, polypropylene, nylon, and the like. As surface shape of the scrub pads 11a and 11b, a shape that includes a protrusion on the whole surface or a part thereof or a flat shape can be used. In case of using the scrub pads 11a and 11b having a shape that includes a protrusion, because a foreign matter easily falls through the gap generated by the protrusion, it becomes possible to more appropriately suppress readhesion of a foreign matter to the scrub pads 11a and 11b. Meanwhile, in case of using the flat-shaped pads, a foreign matter does not easily fall but easily adheres. Therefore, in this case, the effect of removing dirt in the non-contacting rotation step becomes especially significant.

[0051]

FIG. 3 is a view explaining setting of rotation speed of the scrub pads 11a and 11b. FIG. 3 (a) is a graph explaining rotation speed in the contacting rotation step and shows an overview of relationship between rotation speed and reject ratio after cleansing.

[0052]

The reject ratio is the one in a case where scrub cleansing is carried out for a glass substrate which has passed the

polishing step and the cleansing result is checked. This check is carried out by use of, for example, an optical surface analyzer (OSA). Then, a foreign matter and defect of the glass substrate having a predetermined size or more are counted and if the number of foreign matters and defects is equal to or less than a predetermined number, the glass substrate passes the check. As a standard for the size and number of the foreign matter and defect, for example, a standard corresponding to the precision required if recording density of 160GB or more per one $inch^2$ is to be realized is used. This standard is a standard which passes a glass substrate if, for example, there are 50 or less foreign matter and defect having a size of 0.3 μm or more.

[0053]

In case such a check is conducted, if the rotation speed is small, the reject ratio rises. It is assumed that this is because if the rotation speed is small, cleansing is not sufficient and foreign matters such as a polishing sludge or loose grain which adhered in the polishing step cannot be sufficiently removed. Therefore, if the rotation speed is too small, scrub cleansing cannot be appropriately carried out.

[0054]

Further, if the rotation speed is too large, reject ratio rises. It is assumed that this is because if the rotation speed is large, even if foreign matters can be removed, the glass substrate is damaged and new causes of defect are generated. Therefore, if the rotation speed is too large, scrub cleansing

cannot be appropriately carried out. In the present example, it is preferable that the rotation speed of the scrub pads 11a and 11b in the contacting rotation step is, for example, between 400 and 500 rpm.

[0055]

FIG. 3 (b) is a graph explaining rotation speed in a non-contacting rotation step and shows an overview of relationship between rotation speed and removal ratio of dirt. For the evaluation of removal ratio, glass substrates and scrub pads 11a and 11b under the equal conditions are prepared first. As the glass substrates, glass substrates kept in, for example, water after the polishing step are prepared. Moreover, as the scrub pads 11a and 11b, for example, the scrub pads 11a and 11b which have just finished scrub cleansing for a predetermined number (e.g., 100) of glass substrates are prepared. Further, to be used as a comparison example of the removal ratio, check using the optical surface analyzer is conducted to a part of the prepared glass substrates to count the number of foreign matters and defects of the glass substrate having a predetermined size or larger size. As a standard for the size and number of the foreign matter and defect, for example, a standard corresponding to the precision required if recording density of 160GB or more per one $inch^2$ is to be realized is used.

[0056]

Then, rotation speed of the scrub pads 11a and 11b are set for each of the scrub pads to carry out the non-contacting rotation step and to remove dirt of the scrub pads 11a and 11b.

Subsequently, same rotation speed (e.g., 500 rpm) is set for all the scrub pads to carry out the contacting rotation step and scrub cleansing is carried out again for a predetermined number (e.g., 10) of glass substrates. Then, check using the optical surface analyzer is conducted to the glass substrates after the scrub cleansing to count the number of foreign matters and defects of the glass substrate having a predetermined size or larger size. Subsequently, by comparing the number to the removal ratio of the comparison target which was previously counted as above, removal ratio is calculated.

[0057]

As shown in the graph, the smaller the rotation speed becomes, the smaller the removal ratio becomes. It is assumed that this is because dirt cannot be sufficiently removed in the non-contacting rotation step and scrub cleansing is carried out by use of the dirty scrub pads 11a and 11b. For example, dirt of the scrub pads 11a and 11b cannot be sufficiently removed by the rotation speed which is equivalent to the rotation speed of the contacting rotation step. In the present example, it is preferable that the rotation speed of the scrub pads 11a and 11b in the non-contacting rotation step is, for example, between 500 and 2000 rpm.

[0058]

Hereinafter, an embodiment and a comparison example regarding the cleansing step will be shown to explain the present invention in a more detailed manner.

(Embodiment 1)

Scrub cleansing was carried out for a glass substrate after the polishing step using the scrub cleansing apparatus 10 explained by use of FIG. 2. The rotation speed of the scrub pads 11a and 11b in the contacting rotation step of the cleansing step was set to 500 rpm. Moreover, two glass substrates were cleansed in one scrub cleansing.

[0059]

Further, the non-contacting rotation step was carried out every 50 times (100 substrates) of scrub cleansing by the contacting rotation step to remove dirt of the scrub pads 11a and 11b. The rotation speed of the scrub pads 11a and 11b in the non-contacting rotation step of the cleansing step was set to 1000 rpm. In the Embodiment 1, a total of 300 glass substrates were scrub cleansed by this cleansing method.

[0060]

(Comparison example 1)

The comparison example which follows the same procedures as the Embodiment 1 except that dirt of the scrub pads 11a and 11b is not removed by the non-contacting rotation step was used to carry out scrub cleansing of the glass substrate. By the comparison example 1, by this cleansing method, a total of 300 glass substrates were scrub cleansed.

[0061]

(Evaluation)

Check after cleansing by use of the optical surface analyzer was conducted to the glass substrates which were cleansed by the methods of the Embodiment 1 and the comparison

example 1. By this check, foreign matters and defects of the glass substrate having a predetermined size or more are counted and if the number of foreign matters and defects is equal to or less than a predetermined number, the glass substrate passes the check. As a standard for the size and number of the foreign matter and defect a standard corresponding to the precision required if recording density of 160GB or more per one $inch^2$ is to be realized was used.

[0062]

In the Embodiment 1, pass ratio was 100%. Therefore, it was confirmed that the glass substrates were appropriately scrub cleansed by the Embodiment 1.

[0063]

On the other hand, in the comparison example 1, the pass ratio was about 60%. Moreover, even if a glass substrate satisfied the standard, the number of foreign matters and defects increased as the number of scrub cleansed glass substrate increased. Further, when the number of cleansed substrates exceeded 200, dirt of the scrub pads 11a and 11b became significant and pass ratio dropped especially. Therefore, in case of the comparison example 1, there was a case where a glass substrate could not be appropriately scrub cleansed if the number of the glass substrates increased.

[0064]

The present invention has been explained by use of the embodiment. However, the technical scope of the present invention is not limited to the above described embodiments.

As will be understood by the skilled persons, various modifications or variations can be applied to the above embodiments, and the embodiments with such modifications and variations fall within the technical scope of the present invention.

[0065]

The present invention can be utilized for, for example, a manufacturing method of a glass substrate for a magnetic disc.

What is claimed is:

1. A manufacturing method of a glass substrate for a magnetic disc comprising:

a polishing step for polishing a main surface of a glass substrate; and

a cleansing step for carrying put scrub cleansing of the glass substrate having the main surface which was polished in the polishing step, wherein

the cleansing step includes a contacting rotation step for causing a pair of scrub pads for cleansing and a glass substrate to be in contact with each other and rotating the scrub pads; and

a non-contacting rotation step for rotating the scrub pads in a rotation speed faster than that in the contacting rotation step without causing the scrub pads and the glass substrate to be in contact with each other.

2. The manufacturing method of a glass substrate for a magnetic disc according to claim 1, wherein

the polishing step includes a precise polishing step which is the final polishing step of the glass substrate; and scrub cleansing is carried out to the glass substrate in a condition where the main surface of the glass substrate is kept wet after the precise polishing step in the cleansing step.

3. A manufacturing method of a glass substrate for a magnetic disc comprising:

a polishing step for polishing a main surface of a glass substrate;

a chemical strengthening step after the polishing step for strengthening the strength of the glass substrate; and

a cleansing step after the chemical strengthening step for carrying out scrub cleansing of the glass substrate having the main surface which was strengthened in the chemical strengthening step, wherein

the cleansing step includes a contacting rotation step for causing a pair of scrub pads for cleansing and a glass substrate to be in contact with each other and rotating the scrub pads; and

a non-contacting rotation step for rotating the scrub pads with a rotation speed faster than that in the contacting rotation step without causing the scrub pads and the glass substrate to be in contact with each other.

4. The manufacturing method of a glass substrate for a magnetic disc according to any of claims 1 to 3, wherein the scrub pads are rotated while a cleansing liquid is supplied to the scrub pads in the non-contacting rotation step.

5. The manufacturing method of a glass substrate for a magnetic disc according to any of claims 1 to 4, wherein the pair of scrub pads are pressed to each other while the glass substrate and the scrub pads are not in contact in the non-contacting rotation step.

6. A manufacturing method of a magnetic disc comprising a step of forming at least a magnetic recording layer on a glass substrate manufactured by the manufacturing method of a glass substrate for a magnetic disc described in any of the claims 1 to 5.