

DESCRIPTION

TITLE OF THE INVENTION:

METHOD FOR PRODUCING MAGNETIC DISK AND GLASS SUBSTRATE FOR
5 INFORMATION RECORDING MEDIA

TECHNICAL FIELD

[0001]

The present invention relates to a method for producing a magnetic disk and a
10 glass substrate for an information recording medium, and particularly relates to a
method for producing a magnetic disk, including forming a magnetic recording layer at
high temperature, and a glass substrate suitable for such a production method.

BACKGROUND ART

15 [0002]

In recent years, with the increase in recording capacity of a hard disk drive,
high recording density is progressing in quick pace. However, with high recording
density, micronization of magnetic particles damages thermal stability, and decrease in
crosstalk or SN ratio of regenerative signal becomes a problem.

20 [0003]

Therefore, a heat assist magnetic recording technology is gathering attention as
a fusion technology of optics and magnetism. This is a technology in which external
magnetic field is applied and recorded in the state that a magnetic recording layer is
irradiated with laser light or near-field light and coercive force of a part locally heated is
25 decreased, and recorded magnetization is read out by GMR element or the like. Since

it can be recorded in a medium having high coercive force, it makes possible to micronize magnetic particles while maintaining thermal stability.

[0004]

However, in order to film-form a medium having high coercive force in a form
5 of a multilayer film, a substrate is required to be sufficiently heated, and high heat-resistant substrate is required.

[0005]

Furthermore, in a perpendicular magnetic recording system, a magnetic
recoding layer different from the conventional magnetic recording layer is proposed in
10 order to respond to the requirement of high recording density. However, formation of such a magnetic recording layer is frequently required to be conducted by maintaining a substrate at high temperature.

[0006]

By the way, a silicon substrate is proposed as a substrate capable of responding
15 to the above-described heat assist magnetic recording technology (see Patent Document 1).

BACKGROUND ART DOCUMENT

PATENT DOCUMENT

20 [0007]

Patent Document 1: JP-A-2009-199633

SUMMARY OF THE INVENTION

PROBLEMS THAT THE INVENTION IS TO SOLVE

25 [0008]

However, the silicon substrate generally has a concern in point of strength as compared with a glass substrate. Therefore, it is preferred that a glass substrate is used even in the production of a magnetic disk in which a magnetic recording layer is formed on a substrate at high temperature.

5 [0009]

Therefore, the present invention has an object to provide a method for producing a magnetic disk, and a method for producing a glass substrate for an information recording medium suitable for such a production method.

10 MEANS FOR SOLVING THE PROBLEMS

[0010]

The present invention provides a method for producing a magnetic disk, the method comprising a step of forming a magnetic recording layer on a glass substrate having a temperature of 550°C or higher,

15 [0011]

wherein the glass substrate contains, in terms of mol%, from 60 to 75% of SiO₂; from 7 to 17% of Al₂O₃; 0% or more and less than 2% of B₂O₃; more than 18% and 26% or less in total of any one or more components of MgO, CaO, SrO and BaO, provided that a total content of the seven components is 95% or more, and further
20 contains less than 1% in total of any one or more components of Li₂O, Na₂O and K₂O or does not contain these three components.

[0012]

The above-mentioned method for producing a magnetic disk, wherein the glass substrate contains, in terms of mol%, from 10.5 to 20% in total of any one or more
25 components of MgO and CaO, is further provided.

[0013]

The above-mentioned method for producing a magnetic disk, wherein the glass substrate contains, in terms of mol%, 6% or more of MgO, is further provided.

[0014]

The above-mentioned method for producing a magnetic disk, wherein the glass substrate contains, in terms of mass%, more than 18% of Al₂O₃, is further provided.

[0015]

The above-mentioned method for producing a magnetic disk, wherein the glass substrate has a value obtained by dividing the content (mol%) of SiO₂ by a total amount RO of contents (mol%) of MgO, CaO, SrO and BaO of 4.3 or less, is further provided.

10 [0016]

The above-mentioned method for producing a magnetic disk, wherein a temperature T₂ at which a viscosity of the glass substrate is 10² dPa·s is 1,710°C or lower, is further provided.

[0017]

15 The above-mentioned method for producing a magnetic disk, wherein the glass substrate has an annealing point of 650°C or higher, is further provided.

[0018]

The above-mentioned method for producing a magnetic disk, wherein the glass substrate has a specific elastic modulus of 32 MNm·kg or more, is further provided.

20 [0019]

The above-mentioned method for producing a magnetic disk, wherein the glass substrate has an acid resistance index A of 0.025 nm/h or less, is further provided.

[0020]

25 The above-mentioned method for producing a magnetic disk, wherein the glass substrate has an alkali resistance index B of 0.28 nm/h or less, is further provided.

[0021]

Additionally, the present invention provides a glass substrate for an information recording medium, containing, in terms of mol%, from 60 to 75% of SiO_2 , from 7 to 17% of Al_2O_3 , 0% or more and less than 2% of B_2O_3 , and more than 18% and 26% or less in total of any one or more components of MgO , CaO , SrO and BaO ,
5 provided that a total content of the seven components is 95% or more, and further containing less than 1% in total of any one or more components of Li_2O , Na_2O and K_2O or not containing these three components.

[0022]

The above-mentioned glass substrate for an information recording medium,
10 wherein the glass substrate contains, in terms of mol%, from 10.5 to 20% in total of any one or more components of MgO and CaO , is further provided.

[0023]

The above-mentioned glass substrate for an information recording medium,
wherein the glass substrate contains, in terms of mol%, 6% or more of MgO , is further
15 provided.

[0024]

The above-mentioned glass substrate for an information recording medium,
wherein the glass substrate contains, in terms of mass%, more than 18% of Al_2O_3 , is
further provided.

20 [0025]

The above-mentioned glass substrate for an information recording medium,
wherein the glass substrate has a value obtained by dividing the content (mol%) of SiO_2
by a total amount RO of contents (mol%) of MgO , CaO , SrO and BaO of 4.3 or less, is
further provided.

25 [0026]

The above-mentioned glass substrate for an information recording medium, wherein the information recording medium is a magnetic disk, is further provided.

[0027]

Of the present invention, the inventions relating to those glass substrates have
5 an object that not only the substrate can have high temperature in the production of a magnetic disk on which a magnetic recording layer is formed, but also the production can be easy as described below.

[0028]

A composition of a glass having excellent heat resistance is disclosed in WO
10 2011/136027. However, since the glass of the composition shown in Example 14 thereof has high temperature T_2 at which a viscosity thereof is 10^2 dPa·s, it has become clear that melting character is poor and defects such as bubbles are difficult to remove.

[0029]

Furthermore, the glass of the composition shown in Example 14 of WO
15 2011/136027 has low specific elastic modulus as 31.2 MNm·kg, and it has become clear that fluttering phenomenon is easy to occur during high speed rotation of a disk and the glass cannot respond to high recording density. It has further become clear that in the glass having the composition, acid resistance is insufficient, phenomenon such as surface roughing is easy to occur after a polishing step or the like, and the glass cannot
20 respond to high recording density. Moreover, it has become clear that in the glass having the composition, alkali resistance is insufficient, phenomenon such as surface roughing is easy to occur after a cleaning step or the like, and the glass cannot respond to high recording density.

[0030]

25 The present inventors have found the facts described above, and have reached to complete the invention of the glass substrate of the present invention, which has an

object to provide a glass substrate having excellent heat resistance capable of applying to a heat assist magnetic recording technology, having excellent mechanical characteristics and further having excellent melting character while having excellent chemical durability.

5 [0031]

The present invention further provide a method for producing a glass substrate for an information recording medium, the method including: a circular plate processing step of processing a glass sheet into a circular glass plate; a lapping step of lapping a main surface of the circular glass plate; a main surface polishing step of polishing the
10 lapped main surface of the circular glass plate; and a cleaning step of cleaning the circular glass plate between these steps, in these steps, or after these steps, wherein the glass sheet contains, in terms of mol%, from 60 to 75% of SiO_2 ; from 7 to 17% of Al_2O_3 ; 0% or more and less than 2% of B_2O_3 ; more than 18% and 26% or less in total of any one or more components of MgO , CaO , SrO and BaO , provided that a total content
15 of the seven components is 95% or more, and further contains less than 1% in total of any one or more components of Li_2O , Na_2O and K_2O or does not contain these three components.

[0032]

In the method for producing a glass substrate for an information recording
20 medium, the circular glass plate may be a so-called donut-shaped plate having a hole at a center thereof and may be a plate having no hole. Regarding an edge surface thereof, chamfering is generally conducted, and an etching treatment or mirror polishing is sometimes conducted.

[0033]

The present invention further provides the method for producing a glass substrate for an information recording medium, in which an annealing point of the glass substrate is 650°C or higher.

[0034]

- 5 The present invention further provides the method for producing a glass substrate for an information recording medium, which produces the glass substrate using a float process or a downdraw process. Examples of the downdraw process include a fusion process and a slit downdraw process.

[0035]

- 10 The present invention further provides the method for producing the glass substrate for an information recording medium, in which the information recording medium is a magnetic disk.

ADVANTAGE OF THE INVENTION

- 15 [0036]

According to the method for producing a magnetic disk of the present invention, since the magnetic recording layer can be formed on the glass substrate at high temperature, high recording density of the magnetic disk becomes possible. Furthermore, according to the method for producing a magnetic disk of the present invention, since a specific elastic modulus of the glass substrate on which the magnetic recording layer is to be formed is high and surface roughing is difficult to occur in a polishing step or a cleaning step, a magnetic disk capable of responding to high recording density can be obtained.

[0037]

The glass substrate for an information recording medium of the present invention is a glass substrate on which the magnetic recording layer can be formed at high temperature and that enables high density of a magnetic disk.

[0038]

5 Furthermore, the glass substrate for an information recording medium of the present invention is difficult to cause surface roughing to an acidic polishing slurry liquid (hereinafter referred to as an "acid liquid") in a polishing step or the like of the glass substrate, and makes it possible to produce an information recording medium having high recording density in good productivity by using the glass substrate for an
10 information recording medium of the present invention. In the case where surface roughing to an acid liquid is easy to occur, the acid liquid is required to substitute with an acid liquid having large pH. In the polishing of the glass substrate using an acid liquid having large pH, a polishing rate is lowered and time required in a predetermined removal volume is increased, whereby productivity is decreased. Alternatively, a
15 polishing time until surface roughing occurs becomes short, and it is not possible to reach a predetermined surface roughness.

[0039]

 Furthermore, the glass substrate for an information recording medium of the present invention is difficult to cause surface roughing to an alkali liquid in a cleaning
20 step and the like of the glass substrate, and it becomes possible to produce an information recording medium having high recording density in good productivity by using the glass substrate for an information recording medium of the present invention. In the case where the glass substrate is easy to cause surface roughing to an alkali liquid, the alkali liquid is required to substitute with an alkali liquid having small pH.
25 In the cleaning of the glass substrate using an alkali liquid having small pH, cleaning ability is lowered, and time required until having a predetermined cleanness is

increased, thereby lowering productivity. Alternatively, time until surface roughing occurs becomes short, and it is not possible to reach a predetermined cleanness.

[0040]

Moreover, the glass substrate for an information recording medium of the present invention is a glass substrate for an information recording medium, that not only
5 can form a magnetic recording medium thereon at high temperature but also has excellent melting character, that is, mass productivity.

MODE FOR CARRYING OUT THE INVENTION

10 [0041]

Material of the magnetic recording layer used in the method for producing a magnetic disk of the present invention is typically FePt or SmCo₅.

[0042]

The magnetic recording layer is typically formed on the glass substrate having
15 a temperature of 550°C or higher. The temperature of the glass substrate is preferably, for example, 600°C or higher or 650°C or higher as necessary. The temperature of the glass substrate is generally 800°C or lower.

[0043]

In the method for producing a magnetic disk of the present invention, a layer
20 such as a ground layer is formed between the glass substrate and the magnetic recording layer as necessary, and a layer such as a protective layer is formed on the magnetic recording layer as necessary.

[0044]

An annealing point of T_A of a glass constituting the glass substrate used in the
25 method for producing a magnetic disk of the present invention (hereinafter referred to as "substrate glass" or "glass of the present invention") and the glass substrate of the

present invention is preferably 650°C or higher such that deformation of the glass during formation of the magnetic recording layer is suppressed and the magnetic disk can normally read and write. The annealing point thereof is more preferably 700°C or higher, and particularly preferably 750°C or higher, and is typically 800°C or lower.

5 [0045]

Regarding the viscosity of the substrate glass, in order to improve melting character, the temperature T_2 at which the viscosity thereof is 10^2 dPa·s is preferably 1,710°C or lower, more preferably 1,700°C or lower, and still more preferably 1,680°C or lower.

10 [0046]

In order to stabilize rotation of a motor, reduce load of a rotary motor, decrease consumed power and decrease load of waste heat by the generation of heat of a motor, and additionally improve scratch resistance of a glass, the density of the glass of the present invention is preferably 2.7 g/cm³ or less, and typically 2.62 g/cm³ or less.

15 [0047]

In order to make fluttering phenomenon during high speed rotation difficult to occur and respond to high recording density, the specific elastic modulus of the substrate glass is preferably 32 MNm/kg or more, more preferably 32.5 MNm/kg or more, and still more preferably 33 MNm/kg or more.

20 [0048]

In order to respond to high recording density without occurrence of phenomenon such as surface roughing in the polishing step and the like, an acid resistance index A of the substrate glass is preferably 0.025 nm/h or less, and more preferably 0.02 nm/h or less.

25 [0049]

In order to respond to high recording density without occurrence of phenomenon such as surface roughing in the cleaning step and the like, an alkali resistance index B of the substrate glass is preferably 0.28 nm/h or less, and more preferably 0.27 nm/h or less.

5 [0050]

The acid resistance index A is determined by the following measurement method.

Both surfaces of a glass sheet having a thickness of from 1 to 2 mm and a size of 4 cm square are mirror polished with colloidal silica, and the edge surface thereof is
10 mirror polished with cerium oxide abrasive. The glass sheet thus obtained is used as a measurement sample. The sample is dipped in a HNO_3 aqueous solution having pH of 2 (0.01 mol/liter) maintained at room temperature for 3 hours. Elution Si amount eluted in the aqueous solution is analyzed with ICP mass spectrometry to obtain a measurement value. Etching rate of a glass is calculated from the elution Si amount,
15 SiO_2 content in the glass and a density of the glass by the following formula.

Acid resistance index $A = 1000 \times L1 / [d \times P \times (\text{atomic weight of Si} = 28) / (\text{molecular weight of SiO}_2 = 60)] / 3$

Unit of the acid resistance index A is nm/h; L1 is the elution Si amount per unit area of a glass sheet and the unit thereof is $\mu\text{g}/\text{cm}^2$; d is a density of a glass and the unit
20 thereof is g/cm^3 ; and P is the content of SiO_2 in a glass in terms of mass% and the unit thereof is mass%.

[0051]

The alkali resistance index B is determined by the following measurement method.

25 Both surfaces of a glass sheet having a thickness of from 1 to 2 mm and a size of 4 cm square are mirror polished with colloidal silica, and the edge surface thereof is

mirror polished with cerium oxide abrasive. The glass sheet thus obtained is used as a measurement sample. The sample is dipped in an NaOH aqueous solution having pH of 12 (0.01 mol/liter) maintained at room temperature for 3 hours while applying ultrasonic waves of 100 kHz. Elution Si amount eluted in the aqueous solution is analyzed with ICP mass spectrometry to obtain a measurement value. Etching rate of a glass is calculated from the elution Si amount, SiO₂ content in the glass and a density of the glass by the following formula.

Alkali resistance index $B = 1000 \times L2 / [d \times P \times (\text{atomic weight of Si} = 28) / (\text{molecular weight of SiO}_2 = 60)] / 3$

Unit of the alkali resistance index B is nm/h; L2 is the elution Si amount per unit area of a glass sheet and the unit thereof is $\mu\text{g}/\text{cm}^2$; d is a density of a glass and the unit thereof is g/cm^3 ; and P is the content of SiO₂ in a glass in terms of mass% and the unit thereof is mass%.

[0052]

The composition of the glass of the present invention is described below using the content in terms of mol% unless otherwise indicated.

[0053]

SiO₂ is an essential component. To reduce the weight of a substrate, to improve scratch resistance of a substrate and to maintain fundamental chemical durability of a substrate, the content of SiO₂ is 60% or more, preferably 63% or more, more preferably 65% or more, and still more preferably 66% or more. On the other hand, to decrease a viscosity of a glass, to enhance melting character and to improve chemical durability in the composition near the present invention, the content thereof is 75% or less, preferably 71% or less, more preferably 70% or less, and still more preferably 69% or less.

[0054]

Al_2O_3 is an essential component. To improve heat resistance, to suppress phase separation, to maintain smoothness of a substrate surface after polishing and cleaning the substrate and to maintain scratch resistance, the content of Al_2O_3 is 7% or more, preferably 9% or more, more preferably 11% or more, still more preferably more than 12%, and still further more preferably more than 12.5%. On the other hand, to enhance melting character, the content of Al_2O_3 is 17% or less, more preferably 16% or less, still more preferably 15% or less, and still further more preferably 14% or less. The content of Al_2O_3 is preferably more than 18 mass%.

[0055]

B_2O_3 is not an essential component, but has the effect for improving melting character and easiness to damage of a glass and therefore may be contained. To maintain acid resistance and to improve T_A , the content thereof is less than 2%, preferably 1.5% or less, more preferably 1.0% or less, and still more preferably 0.5% or less.

[0056]

MgO , CaO , SrO and BaO are components for improving melting character of a glass and enhancing acid resistance and alkali resistance, and any one or more of those must be contained in the total (RO) amount of more than 18%, preferably 18.5% or more, and more preferably 19% or more. On the other hand, to improve devitrification characteristic and to enhance scratch resistance, the RO amount is 26% or less, preferably 24% or less, and more preferably 22% or less.

[0057]

Of those four components, any one or more components of MgO and CaO is preferably contained in an amount of 10.5% or more. To enhance melting character, to decrease T_2 and to enhance scratch resistance, the total content of MgO and CaO ($\text{MgO}+\text{CaO}$) is preferably 10.5% or more, more preferably 11% or more, and still more

preferably 12% or more. To decrease a devitrification temperature and to facilitate forming, MgO+CaO is preferably 20% or less, and more preferably 18% or less.

[0058]

To increase the specific elastic modulus, to enhance acid resistance and alkali resistance and to decrease the temperature T_2 at which a viscosity is 10^2 dPa·s, a value obtained by dividing the content (mol%) of SiO_2 by the total amount RO of contents of MgO, CaO, SrO and BaO is preferably 4.3 or less, more preferably 4.1 or less, and still more preferably 3.9 or less.

[0059]

MgO is a component that increases Young's modulus and has the effect for increasing rigidity of a glass. Therefore, MgO is contained in an amount of preferably 6% or more, and more preferably 7% or more.

[0060]

The glass of the present invention substantially comprises the seven components described above, but other components may be contained within a range that does not impair the object of the present invention. However, in such a case, to maintain scratch resistance, to maintain acid resistance and alkali resistance and to maintain specific elastic modulus, the total content of those components is less than 5%. Components other than the above-described seven components are illustratively described below.

[0061]

ZnO is a component that exhibits the same effect as MgO, CaO, SrO and BaO, and may be contained in a range of less than 5%. The total content of ZnO and RO is preferably more than 18% and 26% or less.

[0062]

Li_2O , Na_2O and K_2O decrease T_A . Therefore, it is preferred that the total content of these three components is less than 1%, or these three components are not substantially contained.

[0063]

- 5 There is a concern that oxides of an atom having large atomic number greater than Ti, such as V, make the glass brittle. Therefore, in the case of containing those oxides, the total content of those is preferably 3% or less, more preferably 2% or less, particularly preferably 1% or less, and most preferably 0.3% or less.

[0064]

- 10 SO_3 , F, Cl, As_2O_3 , Sb_2O_3 and SnO_2 are representative components as a refining agent.

EXAMPLES

[0065]

- 15 Seven kinds of glasses having compositions in terms of mol% shown in the columns of SiO_2 to BaO in Table 1 were provided. In Table 1, "MgCa" is the total content of MgO and CaO, and "RO" is the total content of MgO, CaO, SrO and BaO. With respect to those glasses, a density d (unit: g/cm^3), an annealing point T_A (unit: $^\circ\text{C}$), a Young's modulus E (unit: GPa), a specific elastic modulus E/d (unit: MNm/kg), a
20 temperature T_4 at which a viscosity is 10^4 dPa·s (unit: $^\circ\text{C}$), a temperature T_2 at which a viscosity is 10^2 dPa·s (unit: $^\circ\text{C}$), a devitrification temperature (unit: $^\circ\text{C}$), an acid resistance index A and an alkali resistance index B were measured.

[0066]

The above measurements were conducted as follows.

- 25 Density: A density of from 20 to 50 g of a glass containing no bubbles was measured by Archimedes method.

Annealing point: An annealing point was measured according to JIS R3103 (2001).

Young' modulus: A Young's modulus of a glass sheet having a thickness of from 5 to 10 mm and a size of 3 cm × 3 cm was measured by an ultrasonic pulse
5 method.

Specific elastic modulus: A specific elastic modulus was obtained by dividing the Young's modulus obtained above by the density obtained above.

T₄ and T₂: T₄ and T₂ were measured with a rotary viscometer.

Devitrification temperature: A glass was pulverized into glass particles of
10 about 2 mm in a mortar, and the glass particles were placed side by side on a platinum board and heat-treated for 24 hours in a temperature gradient furnace. A maximum value of a temperature of the glass particles at which crystals precipitate was defined as a devitrification temperature.

[0067]

15 The acid resistance index A was determined by the following measurement method.

Both surfaces of a glass sheet having a thickness of from 1 to 2 mm and a size of 4 cm square were mirror polished with colloidal silica, and the edge surface thereof was mirror polished with cerium oxide abrasive. The glass sheet thus obtained was
20 used as a measurement sample. The sample was dipped in a HNO₃ aqueous solution having pH of 2 (0.01 mol/liter) maintained at room temperature for 3 hours. Elution Si amount eluted in the aqueous solution was analyzed with ICP mass spectrometry to obtain a measurement value. Etching rate of a glass was calculated from the elution Si amount, the SiO₂ content in the glass and the density of the glass by the following
25 formula.

Acid resistance index $A=1000 \times L1/[d \times P \times (\text{atomic weight of Si}=28)/(\text{molecular weight of SiO}_2=60)]/3$

Unit of the acid resistance index A is nm/h; L1 is the elution Si amount per unit area of a glass sheet and the unit thereof is $\mu\text{g}/\text{cm}^2$; d is a density of a glass and the unit thereof is g/cm^3 ; and P is the content of SiO₂ in a glass in terms of mass% and the unit thereof is mass%.

[0068]

The alkali resistance index B was determined by the following measurement method.

Both surfaces of a glass sheet having a thickness of from 1 to 2 mm and a size of 4 cm square were mirror polished with colloidal silica, and the edge surface thereof was mirror polished with cerium oxide abrasive. The glass sheet thus obtained was used as a measurement sample. The sample was dipped in an NaOH aqueous solution having pH of 12 (0.01 mol/liter) maintained at room temperature for 3 hours while applying ultrasonic waves of 100 kHz. Elution Si amount eluted in the aqueous solution was analyzed with ICP mass spectrometry to obtain a measurement value. Etching rate of a glass was calculated from the elution Si amount, the SiO₂ content in the glass and the density of the glass by the following formula.

Alkali resistance index $B=1000 \times L2/[d \times P \times (\text{atomic weight of Si}=28)/(\text{molecular weight of SiO}_2=60)]/3$

Unit of the alkali resistance index B is nm/h; L2 is the elution Si amount per unit area of a glass sheet and the unit thereof is $\mu\text{g}/\text{cm}^2$; d is a density of a glass and the unit thereof is g/cm^3 ; and P is the content of SiO₂ in a glass in terms of mass% and the unit thereof is mass%.

[0069]

Examples 1 to 6 are working examples of the substrate glasses used in the present invention. Example 7 is a substrate glass for comparison.

[0070]

[Table 1]

(mol%)	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7
SiO ₂	69.5	67.0	67.0	66.5	68.4	66.8	70.8
Al ₂ O ₃	12.0	13.5	13.0	13.0	13.5	13.6	12.5
B ₂ O ₃	0.0	0.0	1.0	0.0	0.0	1.2	1.3
MgO	7.0	10.0	9.0	12.7	7.6	6.2	5.0
CaO	6.0	5.0	5.5	4.7	7.1	9.3	5.2
SrO	2.5	4.5	4.5	3.1	3.4	2.9	1.5
BaO	3.0	0.0	0.0	0.0	0.0	0.0	3.7
MgO+CaO	13.0	15.0	14.5	17.4	14.7	15.5	10.2
RO	18.5	19.5	19.0	20.5	18.1	18.4	15.4
SiO ₂ /RO	3.76	3.44	3.53	3.24	3.78	3.63	4.60
D	2.60	2.59	2.59	2.58	2.57	2.62	2.63
T _A	810	785	780	795	795	790	786
E	84	88	87	91	91	85	82
E/d	32.3	34.0	33.6	35.3	35.4	32.4	31.2
T ₂	1700	1650	1650	1650	1700	1660	1720
T ₄	1320	1300	1300	1295	1320	1300	1350
Devitrification temperature	1220	1285	1280	1310	1295	1310	1215
Acid resistance index A			0.018				0.029
Alkali resistance index B			0.26				0.29

5 [0071]

Although the present invention has been described in detail and by reference to the specific embodiments, it is apparent to one skilled in the art that various modifications or changes can be made without departing the spirit and scope of the present invention. This application is based on Japanese Patent Application No. 2012-10 127872 filed on June 5, 2012, the disclosure of which is incorporated herein by reference in its entity.

INDUSTRIAL APPLICABILITY

[0072]

The present invention can be utilized in the production of a magnetic disk and a glass substrate for an information recording medium.

[Claim 1]

A method for producing a magnetic disk, the method comprising a step of forming a magnetic recording layer on a glass substrate having a temperature of 550°C or higher,

wherein the glass substrate contains, in terms of mol%, 63% or more and less than 71% of SiO_2 ; from 11 to 14% of Al_2O_3 ; 0% or more and less than 2% of B_2O_3 ; more than 18% and 26% or less in total of any one or more components of MgO , CaO , SrO and BaO , provided that a total content of the seven components is 95% or more, and further contains less than 1% in total of any one or more components of Li_2O , Na_2O and K_2O or does not contain these three components.

[Claim 2]

The method for producing a magnetic disk according to claim 1, wherein the glass substrate contains, in terms of mol%, from 10.5 to 20% in total of any one or more components of MgO and CaO .

[Claim 3]

The method for producing a magnetic disk according to claim 1 or 2, wherein the glass substrate contains, in terms of mol%, 6% or more of MgO .

[Claim 4]

The method for producing a magnetic disk according to any one of claims 1 to 3, wherein the glass substrate contains, in terms of mass%, more than 18% of Al_2O_3 .

[Claim 5]

The method for producing a magnetic disk according to any one of claims 1 to 4, wherein the glass substrate has a specific elastic modulus of 32 MNm²/kg or more.

[Claim 6]

The method for producing a magnetic disk according to any one of claims 1 to 5, wherein the glass substrate has an acid resistance index A of 0.025 nm/h or less.

[Claim 7]

The method for producing a magnetic disk according to any one of claims 1 to 6, wherein the glass substrate has an alkali resistance index B of 0.28 nm/h or less.

[Claim 8]

The method for producing a magnetic disk according to any one of claims 1 to 7, wherein a temperature T_2 at which a viscosity of the glass substrate is 10^2 dPa·s is 1,710°C or lower.

[Claim 9]

The method for producing a magnetic disk according to any one of claims 1 to 8, wherein the glass substrate has an annealing point of 650°C or higher.

[Claim 10]

A glass substrate for an information recording medium, containing, in terms of mol%, 63% or more and less than 71% of SiO_2 , from 11 to 14% of Al_2O_3 , 0% or more and less than 2% of B_2O_3 , and more than 18% and 26% or less in total of any one or more components of MgO , CaO , SrO and BaO , provided that a total content of the seven components is 95% or more, and further containing less than 1% in total of any one or more components of Li_2O , Na_2O and K_2O or not containing these three components.

[Claim 11]

The glass substrate for an information recording medium according to claim 10, wherein the information recording medium is a magnetic disk.