

Also, in the present embodiment as well, the cleaning liquid preferably has a pH of 10 or more, more preferably 11 or more, and even more preferably 12 or more. According to the present invention, even if a cleaning liquid having a high level of pH (strongly alkaline) is used in order to enhance the effect of removing extraneous matter produced by etching, because the increase in the surface roughness of the substrate is small, cleaning that provides a high level of cleanliness can be carried out. Note that if the cleaning liquid has a pH greater than 13, care needs to be taken to handle the cleaning liquid, and it is therefore preferable that the pH is 13 or less.

10 [0066]

Generally, the polishing processing is usually performed in two stages: first polishing processing for removing cracks or distortion remaining on the substrate surface after the lapping step described above; and second polishing processing for polishing the main surface of the glass substrate into a smooth mirror-finished surface while maintaining the flat surface obtained through the first polishing processing (note that the polishing processing may be performed in multiple stages of 3 or more). In this case, it is preferable to perform the cleaning processing of the present invention as cleaning processing that is performed after at least the second polishing processing performed in the latter stage, or in other words, the final polishing processing of the multiple-stage polishing processing. According to the present invention, cleaning that provides a high level of cleanliness can be performed without compromising a smooth mirror-finished surface obtained through the final polishing processing as much as possible.

[0067]

25 In the present invention, it is preferable that glass (the type of glass) constituting the glass substrate is aluminosilicate glass, and more preferably amorphous aluminosilicate glass. Mirror-polishing the surface of such a glass substrate can yield a smooth mirror-finished surface, and the post-processing strength is favorable. As such aluminosilicate glass, it is possible to use

Specifically, the sun gear and the internal gear of the grinding machine were rotated while supplying a coolant between the glass substrate and the surface plates, so as to grind both main surfaces of the glass substrate accommodated in the carrier.

5 [0079]

(4) End face polishing processing

Next, the end faces (inner and outer circumferential end faces) of the glass substrate were brush-polished to a mirror finish while the glass substrate was rotated.

10 [0080]

(5) First main surface polishing processing

Next, first polishing processing was performed using a double-side polishing machine as described above with reference to FIG. 3. In the double-side polishing machine, the glass substrate that was held by a carrier 4 was tightly placed
15 between upper and lower surface plates 5 and 6 each having a polishing pad 7 attached thereto, the carrier 4 was engaged with a sun gear 2 and an internal gear 3, and the glass substrate was pressed between the upper and lower surface plates 5 and 6. After that, the carrier 4 was rotated while supplying a polishing liquid between the polishing pads and the surfaces of the glass substrate to be polished,
20 and thereby the glass substrate made an orbital motion while rotating on its axis on the surface plates 5 and 6 so that both main surfaces of the glass substrate were polished simultaneously. Specifically, the first polishing processing was performed using a hard polisher (hard urethane foam) as a polisher. As the polishing liquid, a polishing liquid prepared by dispersing cerium oxide (average particle size (D50) of
25 1 μm) serving as an abrasive in water was used.

[0081]

(6) Chemical strengthening processing

Next, chemical strengthening was performed on the glass substrate that had undergone the aforementioned cleaning. Chemical strengthening processing

First, a disk-shaped glass substrate made of aluminosilicate glass and having a diameter of 66 mm and a thickness of 1.0 mm was obtained from molten glass by direct pressing using upper, lower, and drum molds. Other than using such direct pressing, a glass substrate may also be obtained by cutting plate glass that has been produced by a downdraw method or a float method into a glass substrate with a predetermined size. As this aluminosilicate glass for chemical strengthening containing SiO_2 in an amount of 58 to 75 wt%, Al_2O_3 in an amount of 5 to 23 wt%, Li_2O in an amount of 3 to 10 wt%, and Na_2O in an amount of 4 to 13 wt% was used.

10 [0094]

Then, rough grinding processing was performed on this glass substrate to improve the dimensional accuracy and shape accuracy. This grinding processing was performed using a double-side grinding machine and loose abrasive particles made of alumina. Specifically, the glass substrate that was held by a carrier was tightly placed between the upper and lower surface plates, the load was set as appropriate, the sun gear and the internal gear of the lapping machine were rotated, and thus both main surfaces of the glass substrate accommodated in the carrier were roughly ground.

[0095]

20 (2) Shaping processing

Next, a cylindrical grindstone was used to create a hole in the center of the glass substrate, and the outer circumferential end face was ground so as to obtain a diameter of 65 mm. After that, predetermined chamfering processing was performed on the outer circumferential end face and the inner circumferential end face. Generally, a magnetic disk with an outer diameter of 65 mm is used in a 2.5-inch HDD (hard disk drive).

25 [0096]

(3) Precision grinding processing

Using a double-side grinding machine, this precision grinding processing

Next, chemical strengthening was performed on the glass substrate that had undergone the aforementioned cleaning. Chemical strengthening processing was performed by providing a chemical strengthening solution in which potassium nitrate and sodium nitrate were mixed and molten, and immersing the glass substrate in the chemical strengthening solution.

[0100]

(7) Second main surface polishing processing

Next, second polishing processing was performed using the same double-side polishing machine as used in the first polishing processing, but polishing pads with a soft polisher (suede) (polyurethane foam with an Asker C hardness of 72) was used. This second polishing processing is mirror-polishing processing to finish the main surfaces of the glass substrate into smooth mirror surfaces with a surface roughness of, for example, about 0.2 nm or less in Ra and 2 nm or less in Rmax while maintaining the flat surfaces obtained in the first polishing processing described above. As the polishing liquid, a polishing liquid prepared by dispersing colloidal silica (average particle size of 15 nm) serving as an abrasive in pure water and adjusted to be acidic (pH = 2) was used.

[0101]

(8) Cleaning processing

Next, cleaning processing of the glass substrate that had undergone the second polishing processing was carried out. Specifically, the glass substrate was immersed for 600 seconds in a cleaning bath (liquid temperature: room temperature) accommodating a cleaning liquid (pH of 12.6) prepared by adding TMAH serving as an alkaline cleaning agent to pure water at a concentration of 0.3 mol/L. After that, the glass substrate was immersed in another cleaning bath (pure water, room temperature) so as to perform ultrasonic cleaning at 80 kHz for 300 seconds, and dried.

At this time, as the TMAH, TMAH containing no Na ions and K ions (not greater than the detection limit) was used. The cleaning liquid was sampled so

CLAIMS

1. A method for manufacturing a glass substrate for a magnetic disk comprising glass substrate cleaning processing,
wherein the glass substrate contains at least one component of sodium
5 and potassium in a glass component; and
cleaning processing is performed on a plurality of the glass substrates having a main surface polished into a mirror-finished surface by using a cleaning liquid containing an alkaline agent that is free of sodium and potassium, and maintaining a condition in which a total concentration of sodium ions and
10 potassium ions in the cleaning liquid is 4.00×10^{-3} mol/L or less.
2. The method for manufacturing a glass substrate for a magnetic disk according to claim 1, wherein the mirror-finished surface refers to the main surface of the glass substrate having a surface roughness Ra of 0.15 nm or less.
15
3. The method for manufacturing a glass substrate for a magnetic disk according to claim 1 or 2, wherein a difference between the surface roughness (Ra) of the main surface of the glass substrate after being subjected to the cleaning processing and the surface roughness (Ra) of the main surface of the
20 glass substrate immediately before being subjected to the cleaning processing is within 0.06 nm.
4. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 3, wherein a total concentration of sodium ions
25 and potassium ions in the cleaning liquid is 2.00×10^{-3} mol/L or less.
5. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 4, wherein the alkaline agent is tetraalkyl ammonium hydroxide.
30
6. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 5, wherein the cleaning liquid further contains

a surfactant that is free of sodium and potassium.

7. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 6, wherein glass constituting the glass
5 substrate is aluminosilicate glass containing at least one of Na_2O and K_2O .

8. A method for manufacturing a glass substrate for a magnetic disk comprising glass substrate cleaning processing,
wherein a relationship between an amount of increase in surface
10 roughness (Ra) of a main surface of the glass substrate after being subjected to the cleaning processing with respect to that before being subjected to the cleaning processing and a total concentration of sodium ions and potassium ions in a cleaning liquid used in the cleaning processing is obtained in advance,
the total concentration of sodium ions and potassium ions in the cleaning
15 liquid is determined based on the obtained relationship such that the amount of increase in the surface roughness (Ra) is 0.06 nm or less, and
the cleaning processing is performed on the glass substrate having a main surface polished into a mirror-finished surface by maintaining a condition in which the total concentration of sodium ions and potassium ions in the cleaning liquid is
20 less than or equal to the determined concentration.

9. A method for manufacturing a glass substrate for a magnetic disk comprising glass substrate cleaning processing,
wherein the glass substrate contains at least one component of sodium
25 and potassium in a glass component, and
cleaning processing is performed on the glass substrate having a main surface polished into a mirror-finished surface by using a cleaning liquid containing an alkaline agent that is free of sodium and potassium, and performing replacement of the cleaning liquid if a total concentration of sodium ions and
30 potassium ions in the cleaning liquid exceeds 4.00×10^{-3} mol/L.

10. A method for manufacturing a glass substrate for a magnetic disk

comprising glass substrate cleaning processing,

wherein the cleaning processing comprises processing of bringing the glass substrate into contact with a cleaning liquid containing tetramethyl ammonium ions, and

5 the cleaning processing is performed while suppressing a total amount of sodium ions and potassium ions in the cleaning liquid to less than 200 ppm.

11. The method for manufacturing a glass substrate for a magnetic disk according to claim 10, wherein the glass substrate contains at least one
10 component of sodium and potassium in a glass component.

12. The method for manufacturing a glass substrate for a magnetic disk according to claim 10 or 11, wherein the cleaning liquid further contains at least one substance of a surfactant, a chelating agent and a dispersing agent, and
15 the cleaning processing is performed while suppressing the total amount of sodium ions and potassium ions in the cleaning liquid to less than 200 ppm.

13. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 10 to 12, wherein a difference between surface
20 roughness (Ra) of a main surface of the glass substrate after being subjected to the cleaning processing and the surface roughness (Ra) of the main surface of the glass substrate immediately before being subjected to the cleaning processing is within 0.06 nm.

25 14. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 10 to 13, wherein the surface roughness (Ra) of the main surface of the glass substrate immediately before being subjected to the cleaning processing is 0.13 nm or less.

30 15. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 10 to 14, wherein the cleaning liquid has a pH of 10 or more.

16. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 10 to 15, wherein the cleaning processing is cleaning processing that is performed after a final polishing step among polishing
5 steps of polishing the main surface of the glass substrate by using polishing abrasive grains.

17. A cleaning liquid for cleaning a glass substrate for a magnetic disk, which is used in cleaning processing for cleaning the glass substrate for a
10 magnetic disk,

wherein the cleaning liquid contains at least tetramethyl ammonium hydroxide and a surfactant that is free of sodium and potassium.

18. A method for manufacturing a magnetic disk, comprising forming at
15 least a magnetic recording layer on the glass substrate for a magnetic disk obtained by the method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 16.

Also, in the present embodiment as well, the cleaning liquid preferably has a pH of 10 or more, more preferably 11 or more, and even more preferably 12 or more. According to the present invention, even if a cleaning liquid having a high level of pH (strongly alkaline) is used in order to enhance the effect of removing extraneous matter produced by etching, because the increase in the surface roughness of the substrate is small, cleaning that provides a high level of cleanliness can be carried out. Note that if the cleaning liquid has a pH greater than 13, care needs to be taken to handle the cleaning liquid, and it is therefore preferable that the pH is 13 or less.

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Generally, the polishing processing is usually performed in two stages: first polishing processing for removing cracks or distortion remaining on the substrate surface after the grinding step described above; and second polishing processing for polishing the main surface of the glass substrate into a smooth mirror-finished surface while maintaining the flat surface obtained through the first polishing processing (note that the polishing processing may be performed in multiple stages of 3 or more). In this case, it is preferable to perform the cleaning processing of the present invention as cleaning processing that is performed after at least the second polishing processing performed in the latter stage, or in other words, the final polishing processing of the multiple-stage polishing processing. According to the present invention, cleaning that provides a high level of cleanliness can be performed without compromising a smooth mirror-finished surface obtained through the final polishing processing as much as possible.

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20 and thereby the glass substrate made an orbital motion while rotating on its axis on the surface plates 5 and 6 so that both main surfaces of the glass substrate were polished simultaneously. Specifically, the first polishing processing was performed using a hard polisher (hard urethane foam) as a polisher. As the polishing liquid, a polishing liquid prepared by dispersing cerium oxide (average particle size (D50) of
25 1 μm) serving as an abrasive in water was used.

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(6) Chemical strengthening processing

Next, chemical strengthening was performed on the glass substrate that had undergone cleaning. Chemical strengthening processing

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Then, rough grinding processing was performed on this glass substrate to improve the dimensional accuracy and shape accuracy. This grinding processing was performed using a double-side grinding machine and loose abrasive particles made of alumina. Specifically, the glass substrate that was held by a carrier was tightly placed between the upper and lower surface plates, the load was set as appropriate, the sun gear and the internal gear of the grinding machine were rotated, and thus both main surfaces of the glass substrate accommodated in the carrier were roughly ground.

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20 (2) Shaping processing

Next, a cylindrical grindstone was used to create a hole in the center of the glass substrate, and the outer circumferential end face was ground so as to obtain a diameter of 65 mm. After that, predetermined chamfering processing was performed on the outer circumferential end face and the inner circumferential end face. Generally, a magnetic disk with an outer diameter of 65 mm is used in a 2.5-inch HDD (hard disk drive).

[0096]

(3) Precision grinding processing

Using a double-side grinding machine, this precision grinding processing

Next, chemical strengthening was performed on the glass substrate that had undergone cleaning. Chemical strengthening processing was performed by providing a chemical strengthening solution in which potassium nitrate and sodium nitrate were mixed and molten, and immersing the glass substrate in the chemical strengthening solution.

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(7) Second main surface polishing processing

Next, second polishing processing was performed using the same double-side polishing machine as used in the first polishing processing, but polishing pads with a soft polisher (suede) (polyurethane foam with an Asker C hardness of 72) was used. This second polishing processing is mirror-polishing processing to finish the main surfaces of the glass substrate into smooth mirror surfaces with a surface roughness of, for example, about 0.2 nm or less in Ra and 2 nm or less in Rmax while maintaining the flat surfaces obtained in the first polishing processing described above. As the polishing liquid, a polishing liquid prepared by dispersing colloidal silica (average particle size of 15 nm) serving as an abrasive in pure water and adjusted to be acidic (pH = 2) was used.

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Next, cleaning processing of the glass substrate that had undergone the second polishing processing was carried out. Specifically, the glass substrate was immersed for 600 seconds in a cleaning bath (liquid temperature: room temperature) accommodating a cleaning liquid (pH of 12.6) prepared by adding TMAH serving as an alkaline cleaning agent to pure water at a concentration of 0.3 mol/L. After that, the glass substrate was immersed in another cleaning bath (pure water, room temperature) so as to perform ultrasonic cleaning at 80 kHz for 300 seconds, and dried.

At this time, as the TMAH, TMAH containing no Na ions and K ions (not greater than the detection limit) was used. The cleaning liquid was sampled so

Claims

1. A method for manufacturing a glass substrate for a magnetic disk,

wherein cleaning processing is performed by sequentially cleaning a plurality of glass substrates after polishing processing of polishing main surfaces of the glass substrate containing at least one component of sodium and potassium in a glass component; and

wherein the cleaning processing is performed on the plurality of the glass substrates by using a cleaning liquid containing an alkaline agent that is free of sodium and potassium, and maintaining a condition in which a total concentration of sodium ions and potassium ions in the cleaning liquid is 4.00×10^{-3} mol/L or less.
2. The method for manufacturing a glass substrate for a magnetic disk according to claim 1, wherein the main surface of the glass substrate has a surface roughness Ra of 0.15 nm or less.
3. The method for manufacturing a glass substrate for a magnetic disk according to claim 1 or 2, wherein a difference between the surface roughness (Ra) of the main surface of the glass substrate after being subjected to the cleaning processing and the surface roughness (Ra) of the main surface of the glass substrate immediately before being subjected to the cleaning processing is within 0.06 nm.
4. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 3, wherein a total concentration of sodium ions and potassium ions in the cleaning liquid is 2.00×10^{-3} mol/L or less.
5. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 4, wherein the alkaline agent is tetraalkyl ammonium hydroxide.
6. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 5, wherein the cleaning liquid further contains a surfactant that is free of sodium and potassium.
7. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 6, wherein glass constituting the glass substrate is aluminosilicate glass containing at least one of Na_2O and K_2O .
8. A method for manufacturing a glass substrate for a magnetic disk,

wherein cleaning processing is performed by sequentially cleaning a plurality of glass substrates after polishing processing of polishing main surface of the glass substrate containing at least one component of sodium and potassium in a glass component,

wherein a relationship between an amount of increase in surface roughness (Ra) of a main surface of the glass substrate after being subjected to the cleaning processing with respect to that before being subjected to the cleaning processing and a total concentration of sodium ions and potassium ions in a cleaning liquid used in the cleaning processing is obtained in advance,

the total concentration of sodium ions and potassium ions in the cleaning liquid is determined based on the obtained relationship such that the amount of increase in the surface roughness (Ra) is 0.06 nm or less, and

the cleaning processing is performed on the glass substrate by maintaining a condition in which the total concentration of sodium ions and potassium ions in the cleaning liquid is less than or equal to the determined concentration.

9. A method for manufacturing a glass substrate for a magnetic disk,

wherein cleaning processing is performed by sequentially cleaning a plurality of glass substrates after polishing processing of polishing main surface of the glass substrate containing at least one component of sodium and potassium in a glass component, and

wherein the cleaning processing is performed on the glass substrate by using a cleaning liquid containing an alkaline agent that is free of sodium and potassium, and performing replacement of the cleaning liquid if a total concentration of sodium ions and potassium ions in the cleaning liquid exceeds 4.00×10^{-3} mol/L.

10. A method for manufacturing a glass substrate for a magnetic disk,

wherein cleaning processing is performed by sequentially cleaning a plurality of glass substrates after polishing processing of polishing main surfaces of the glass substrate containing at least one component of sodium and potassium in a glass component; and

wherein the cleaning processing comprises processing of bringing the glass substrate into contact with a cleaning liquid containing tetramethyl ammonium ions, and

the cleaning processing is performed while suppressing a total amount of sodium ions and potassium ions in the cleaning liquid to less than 200 ppm.

11. The method for manufacturing a glass substrate for a magnetic disk according to claim 10, wherein the cleaning liquid further contains at least one substance of a surfactant, a chelating agent and a dispersing agent, and

the cleaning processing is performed while suppressing the total amount of sodium ions and potassium ions in the cleaning liquid to less than 200 ppm.

12. The method for manufacturing a glass substrate for a magnetic disk according to claim 10 or 11, wherein a difference between surface roughness (Ra) of a main surface of the glass substrate after being subjected to the cleaning processing and the surface roughness (Ra) of the main surface of the glass substrate immediately before being subjected to the cleaning processing is within 0.06 nm.

13. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 10 to 12, wherein the surface roughness (Ra) of the main surface of the glass substrate immediately before being subjected to the cleaning processing is 0.13 nm or less.

14. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 10 to 13, wherein the cleaning liquid has a pH of 10 or more.

15. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 10 to 14, wherein the cleaning processing is cleaning processing that is performed after a final polishing step among polishing steps of polishing the main surface of the glass substrate by using polishing abrasive grains.

16. A method for manufacturing a magnetic disk, comprising forming at least a magnetic recording layer on the glass substrate for a magnetic disk obtained by the method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 15.

17. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 15,

wherein the polishing processing is performed using a polishing liquid prepared by dispersing colloidal silica serving as an abrasive adjusted to be acidic;

wherein cleaning processing is performed by sequentially immersing the

plurality of glass substrates after polishing processing in a cleaning bath holding the cleaning liquid containing an organic alkaline agent.

18. The method for manufacturing a glass substrate for a magnetic disk according to any one of claims 1 to 8 and claims 10 to 15,

wherein the cleaning liquid is replaced if a total concentration of sodium ions and potassium ions in the cleaning liquid exceeds 4.00×10^{-3} mol/L by increasing of the concentration of sodium ions or potassium ions in the cleaning liquid due to be eluted from the glass substrates.