surfaces of the pair of dies facing together, and performing press forming to the lump; and temperature adjusting process for adjusting temperature of the lump before the pressing process such that viscosity variation of the lump is reduced with respect to positions over the entirety of the lump in the pressing process.

[0014]

Second aspect of the present invention is a manufacturing method of a glass blank for magnetic disk including a pair of principal surfaces. The method may include: dropping process for dropping a lump of molten glass; temperature adjusting process for heating the lump with temperature higher than the transition temperature of the glass; and pressing process for forming a sheet glass material by sandwiching simultaneously the lump from both sides of the dropping path of the lump with surfaces of the pair of dies facing together, and performing press forming to the lump.

[0015]

Preferably, the temperature adjusting process may heat the lump by use of a heating section, the heating section positioned around dropping path of the lump.

[0016]

Preferably, the temperature adjusting process may heat the lump by use of a holding section. The holding section may hold at least a vertically lower portion of the dropped lump.

[0017]

Preferably, the manufacturing method of a glass blank for magnetic disk may further includes cutting process for cutting molten glass with cutting blades. The temperature adjusting process may heat a cut mark that is formed with the cutting blades in the cutting process.

[0018]

Preferably, difference of the viscosity of the two cut marks formed on the lump may be five million poise or less.

[0019]

Preferably, temperatures of the pair of dies may be lower than a strain point of the glass.

[0020]

Preferably, the glass may contain, as converted based on the oxide, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at lease one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at lease one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at lease one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2.

[0021]

Third aspect of the present invention is a manufacturing method of a glass blank for

magnetic disk. The method may include: cutting process for cutting molten glass to obtain a lump of molten glass; heating process for heating a cut portion of the lump of molten glass; and forming process for preparing a glass blank for magnetic disk of sheet glass material by press forming the lump of molten glass with a pair of dies after the heating process.

[0022]

Preferably, temperature of the molten glass may be 1,000 degree Celsius or higher.

[0023]

Preferably, the heating process may heat the lump with temperature higher than transition temperature of the glass.

[0024]

Preferably, temperatures of the pair of dies at timing when the press forming begins may be lower than a strain point of the glass.

[0025]

Preferably, the glass may contain, as converted based on the oxide, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at lease one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at lease one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at lease one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2.

[0026]

Preferably, the heating process may heat the lump of molten glass while the lump cut in the cutting process drops, and wherein the pair of dies is located on the both sides of the dropping path.

[0027]

Preferably, the heating process may blow out heated gas for at least a cut portion of the lump of molten glass cut in the cutting process.

[0028]

Fourth aspect of the present invention is a manufacturing method of a glass substrate for magnetic disk by use of a glass blank for magnetic disk manufactured by a method of a glass blank for magnetic disk. The method of a glass blank for magnetic disk may include: cutting process for cutting molten glass to obtain a lump of molten glass; heating process for heating a cut portion of the lump of molten glass; and forming process for preparing a glass blank for magnetic disk of sheet glass material by press forming the lump of molten glass with a pair of dies after the heating process.

[0029]

Preferably, the manufacturing method of a glass substrate for magnetic disk may include

CO., LTD. for example.

The roughness of the principal surface Ra may be arithmetic average roughness Ra obtained with a scanning probe microscope (atomic force microscope) manufactured by SII Nano Technology Inc by measuring an area of 1 μm x 1 μm with resolution of 512 x 256 pixels.

[0037]

Aluminosilicate glass, soda-lime glass, and borosilicate glass can be used as a material for the glass substrate 2. Particularly, the aluminosilicate glass can be suitably used in that chemically strengthening can be performed and in that the glass substrate for magnetic disk excellent for the flatness of the principal surface and the strength of the substrate can be prepared.

Aluminosilicate glass is preferably used containing, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at lease one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at lease one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at lease one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2. A glass material containing, denoted as molar percentages: 57 to 74% SiO_2, 0 to 2.8 % ZnO_2, 3 to 15% Al_2O_3, 7 to 16% Li_2O, 4 to 14% Na_2O as the aluminosilicate glass may be also suitably used to perform chemically strengthening.

[0038]

(Manufacturing method of a glass substrate for magnetic disk)

Next, with reference to FIG. 2, a flow of a manufacturing method of a glass substrate for magnetic disk will be explained. FIG. 2 is a view illustrating a flow of an embodiment of a manufacturing method of a glass substrate for magnetic disk.

As illustrated in FIG. 2, a sheet glass material is manufactured by the press forming (Step S10). Next, the formed sheet glass material is scribed (Step S20). Next, the scribed sheet glass material is shape-processed (Step S30). Next, grinding is performed to the sheet glass material using fixed abrasive grains (Step S40). Then, edge polishing is performed to the sheet glass material (Step S50). First polishing is performed to the principal surface of the sheet glass material (Step S60). Next, after the first polishing, the sheet glass material is chemically strengthened (Step S70). Then, the second polishing is performed to the chemically strengthened sheet glass material (Step S80).

The detail of each process will be explained below.

[0039]

(a) Press Forming Process

Referring now to FIG. 3, the press forming process (Step S10) will be explained. FIG.

What is claimed is:

1. A manufacturing method of a glass blank for magnetic disk including a pair of principal surfaces, the method comprising:

dropping process for dropping a lump of molten glass;

pressing process for forming a sheet glass material by sandwiching simultaneously the lump from both sides of the dropping path of the lump with surfaces of the pair of dies facing together, and performing press forming to the lump; and

temperature adjusting process for adjusting temperature of the lump before the pressing process such that viscosity variation of the lump is reduced with respect to positions over the entirety of the lump in the pressing process.

2. A manufacturing method of a glass blank for magnetic disk including a pair of principal surfaces, the method comprising:

dropping process for dropping a lump of molten glass;

temperature adjusting process for heating the lump with temperature higher than the transition temperature of the glass; and

pressing process for forming a sheet glass material by sandwiching simultaneously the lump from both sides of the dropping path of the lump with surfaces of the pair of dies facing together, and performing press forming to the lump.

3. A manufacturing method of a glass blank for magnetic disk according to the claim 1, wherein the temperature adjusting process heats the lump by use of a heating section, the heating section positioned around dropping path of the lump.

4. A manufacturing method of a glass blank for magnetic disk according to the claim 1, wherein the temperature adjusting process heats the lump by use of a holding section, the holding section holding at least a vertically lower portion of the dropped lump.

5. A manufacturing method of a glass blank for magnetic disk according to the claim 1, further comprising cutting process for cutting molten glass with cutting blades, wherein the temperature adjusting process heats a cut mark that is formed with the cutting blades in the cutting process.

6. A manufacturing method of a glass blank for magnetic disk according to the claim 1,

wherein difference of the viscosity of the two cut marks formed on the lump is five million poise or less.

7. A manufacturing method of a glass blank for magnetic disk according to the claim 1, wherein temperatures of the pair of dies are lower than a strain point of the glass.

8. A manufacturing method of a glass blank for magnetic disk according to the claim 1, wherein the glass contains, as converted based on the oxide, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at lease one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at lease one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at lease one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2.

9. A manufacturing method of a glass blank for magnetic disk, the method comprising:

cutting process for cutting molten glass to obtain a lump of molten glass;

heating process for heating a cut portion of the lump of molten glass; and

forming process for preparing a glass blank for magnetic disk of sheet glass material by press forming the lump of molten glass with a pair of dies after the heating process.

10. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein temperature of the molten glass is 1,000 degree Celsius or higher.

11. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein heating process heats the lump with temperature higher than transition temperature of the glass.

12. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein temperatures of the pair of dies at timing when the press forming begins are lower than a strain point of the glass.

13. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein the glass contains, as converted based on the oxide, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at lease one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at lease one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at lease one component selected from the group

of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2.

14. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein the heating process heats the lump of molten glass while the lump cut in the cutting process drops, and wherein the pair of dies is located on the both sides of the dropping path.

15. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein the heating process blows out heated gas for at least a cut portion of the lump of molten glass cut in the cutting process.

16. A manufacturing method of a glass substrate for magnetic disk by use of a glass blank for magnetic disk manufactured by a method of a glass blank for magnetic disk, the method of a glass blank for magnetic disk comprising:

cutting process for cutting molten glass to obtain a lump of molten glass;

heating process for heating a cut portion of the lump of molten glass; and

forming process for preparing a glass blank for magnetic disk of sheet glass material by press forming the lump of molten glass with a pair of dies after the heating process.

17. A manufacturing method of a glass substrate for magnetic disk according to the claim 16, the method comprising a machining process for machining a principal surface of the glass blank for magnetic disk with removal stock of 50 μm or less.

surfaces of the pair of dies facing together, and performing press forming to the lump; and temperature adjusting process for adjusting temperature of the lump before the pressing process such that viscosity variation of the lump is reduced with respect to positions over the entirety of the lump in the pressing process.

[0014]

Second aspect of the present invention is a manufacturing method of a glass blank for magnetic disk including a pair of principal surfaces. The method may include: dropping process for dropping a lump of molten glass; temperature adjusting process for heating the lump with temperature higher than the transition temperature of the glass; and pressing process for forming a sheet glass material by sandwiching simultaneously the lump from both sides of the dropping path of the lump with surfaces of the pair of dies facing together, and performing press forming to the lump.

[0015]

Preferably, the temperature adjusting process may heat the lump by use of a heating section, the heating section positioned around dropping path of the lump.

[0016]

Preferably, the temperature adjusting process may heat the lump by use of a holding section. The holding section may hold at least a vertically lower portion of the dropped lump.

[0017]

Preferably, the manufacturing method of a glass blank for magnetic disk may further includes cutting process for cutting molten glass with cutting blades. The temperature adjusting process may heat a cut mark that is formed with the cutting blades in the cutting process.

[0018]

Preferably, difference of the viscosity of the two cut marks formed on the lump may be five million poise or less.

[0019]

Preferably, temperatures of the pair of dies may be lower than a strain point of the glass.

[0020]

Preferably, the glass may contain, as converted based on the oxide, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at least one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at least one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at least one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2.

[0021]

Third aspect of the present invention is a manufacturing method of a glass blank for

magnetic disk. The method may include: cutting process for cutting molten glass to obtain a lump of molten glass; heating process for heating a cut portion of the lump of molten glass; and forming process for preparing a glass blank for magnetic disk of sheet glass material by press forming the lump of molten glass with a pair of dies after the heating process.

[0022]

Preferably, temperature of the molten glass may be 1,000 degree Celsius or higher.

[0023]

Preferably, the heating process may heat the lump with temperature higher than transition temperature of the glass.

[0024]

Preferably, temperatures of the pair of dies at timing when the press forming begins may be lower than a strain point of the glass.

[0025]

Preferably, the glass may contain, as converted based on the oxide, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at least one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at least one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at least one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2.

[0026]

Preferably, the heating process may heat the lump of molten glass while the lump cut in the cutting process drops, and wherein the pair of dies is located on the both sides of the dropping path.

[0027]

Preferably, the heating process may blow out heated gas for at least a cut portion of the lump of molten glass cut in the cutting process.

[0028]

Fourth aspect of the present invention is a manufacturing method of a glass substrate for magnetic disk by use of a glass blank for magnetic disk manufactured by a method of a glass blank for magnetic disk. The method of a glass blank for magnetic disk may include: cutting process for cutting molten glass to obtain a lump of molten glass; heating process for heating a cut portion of the lump of molten glass; and forming process for preparing a glass blank for magnetic disk of sheet glass material by press forming the lump of molten glass with a pair of dies after the heating process.

[0029]

Preferably, the manufacturing method of a glass substrate for magnetic disk may include

CO., LTD. for example.

The roughness of the principal surface Ra may be arithmetic average roughness Ra obtained with a scanning probe microscope (atomic force microscope) manufactured by SII Nano Technology Inc by measuring an area of 1 μm x 1 μm with resolution of 512 x 256 pixels.

[0037]

Aluminosilicate glass, soda-lime glass, and borosilicate glass can be used as a material for the glass substrate 2. Particularly, the aluminosilicate glass can be suitably used in that chemically strengthening can be performed and in that the glass substrate for magnetic disk excellent for the flatness of the principal surface and the strength of the substrate can be prepared.

Aluminosilicate glass is preferably used containing, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at least one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at least one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at least one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2. A glass material containing, denoted as molar percentages: 57 to 74% SiO_2, 0 to 2.8 % ZnO_2, 3 to 15% Al_2O_3, 7 to 16% Li_2O, 4 to 14% Na_2O as the aluminosilicate glass may be also suitably used to perform chemically strengthening.

[0038]

(Manufacturing method of a glass substrate for magnetic disk)

Next, with reference to FIG. 2, a flow of a manufacturing method of a glass substrate for magnetic disk will be explained. FIG. 2 is a view illustrating a flow of an embodiment of a manufacturing method of a glass substrate for magnetic disk.

As illustrated in FIG. 2, a sheet glass material is manufactured by the press forming (Step S10). Next, the formed sheet glass material is scribed (Step S20). Next, the scribed sheet glass material is shape-processed (Step S30). Next, grinding is performed to the sheet glass material using fixed abrasive grains (Step S40). Then, edge polishing is performed to the sheet glass material (Step S50). First polishing is performed to the principal surface of the sheet glass material (Step S60). Next, after the first polishing, the sheet glass material is chemically strengthened (Step S70). Then, the second polishing is performed to the chemically strengthened sheet glass material (Step S80).

The detail of each process will be explained below.

[0039]

(a) Press Forming Process

Referring now to FIG. 3, the press forming process (Step S10) will be explained. FIG.

What is claimed is:

1. A manufacturing method of a glass blank for magnetic disk including a pair of principal surfaces, the method comprising:

dropping process for dropping a lump of molten glass;

pressing process for forming a sheet glass material by sandwiching simultaneously the lump from both sides of the dropping path of the lump with surfaces of the pair of dies facing together, and performing press forming to the lump; and

temperature adjusting process for adjusting temperature of the lump before the pressing process such that viscosity variation of the lump is reduced with respect to positions over the entirety of the lump in the pressing process,

wherein the temperature adjusting process is performed before the dropped lump of molten glass contacts the surfaces of the pair of dies.

2. A manufacturing method of a glass blank for magnetic disk including a pair of principal surfaces, the method comprising:

dropping process for dropping a lump of molten glass;

temperature adjusting process for heating the lump with temperature higher than the transition temperature of the glass; and

pressing process for forming a sheet glass material by sandwiching simultaneously the lump from both sides of the dropping path of the lump with surfaces of the pair of dies facing together, and performing press forming to the lump,

wherein the temperature adjusting process is performed before the dropped lump of molten glass contacts the surfaces of the pair of dies.

3. A manufacturing method of a glass blank for magnetic disk according to the claim 1, wherein the temperature adjusting process heats the lump by use of a heating section, the heating section positioned around dropping path of the lump.

4. A manufacturing method of a glass blank for magnetic disk according to the claim 1, wherein the temperature adjusting process heats the lump by use of a holding section, the holding section holding at least a vertically lower portion of the dropped lump.

5. A manufacturing method of a glass blank for magnetic disk according to the claim 1, further comprising cutting process for cutting molten glass with cutting blades, wherein the

temperature adjusting process heats a cut mark that is formed with the cutting blades in the cutting process.

6. A manufacturing method of a glass blank for magnetic disk according to the claim 5, wherein difference of the viscosity of the two cut marks formed on the lump is five million poise or less.

7. A manufacturing method of a glass blank for magnetic disk according to the claim 1, wherein temperatures of the pair of dies are lower than a strain point of the glass.

8. A manufacturing method of a glass blank for magnetic disk according to the claim 1, wherein the glass contains, as converted based on the oxide, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at least one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at least one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at least one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2.

9. A manufacturing method of a glass blank for magnetic disk, the method comprising:

cutting process for cutting molten glass to obtain a lump of molten glass;

heating process for heating a cut portion of the lump of molten glass; and

forming process for preparing a glass blank for magnetic disk of sheet glass material by press forming the lump of molten glass with a pair of dies after the heating process,

wherein the heating process is performed before the lump of molten glass contacts at least one die of the pair of dies.

10. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein temperature of the molten glass is 1,000 degree Celsius or higher.

11. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein heating process heats the lump with temperature higher than transition temperature of the glass.

12. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein temperatures of the pair of dies at timing when the press forming begins are lower than a strain point of the glass.

13. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein the glass contains, as converted based on the oxide, denoted as molar percentages: 50 to 75% SiO_2, 1 to 15% Al_2O_3, totally 5 to 35% at least one component selected from the group of Li_2O, Na_2O, and K_2O, totally 0 to 20% at least one component selected from the group of MgO, CaO, SrO, BaO, and ZnO, and totally 0 to 10% at least one component selected from the group of ZrO_2, TiO_2, La_2O_3, Y_2O_3, Ta_2O_5, Nb_2O_5, and HfO_2.

14. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein the heating process heats the lump of molten glass while the lump cut in the cutting process drops, and wherein the pair of dies is located on the both sides of the dropping path.

15. A manufacturing method of a glass blank for magnetic disk according to the claim 9, wherein the heating process blows out heated gas for at least a cut portion of the lump of molten glass cut in the cutting process.

16. A manufacturing method of a glass substrate for magnetic disk by use of a glass blank for magnetic disk manufactured by a method of a glass blank for magnetic disk, the method of a glass blank for magnetic disk comprising:

cutting process for cutting molten glass to obtain a lump of molten glass;

heating process for heating a cut portion of the lump of molten glass; and

forming process for preparing a glass blank for magnetic disk of sheet glass material by press forming the lump of molten glass with a pair of dies after the heating process,

wherein the heating process is performed before the lump of molten glass contacts at least one die of the pair of dies.

17. A manufacturing method of a glass substrate for magnetic disk according to the claim 16, the method comprising a machining process for machining a principal surface of the glass blank for magnetic disk with removal stock of 50 μm or less.