CLAIMS

1. A method for manufacturing a magnetic-disk glass substrate comprising a step of performing end surface polishing on a glass substrate,

the step of performing end surface polishing including:

forming magnetic field lines that extend in a thickness direction of the glass substrate, using a magnetism generating means;

disposing a magnetic slurry containing polishing abrasive particles and a magnetic functional fluid in the magnetic field lines to hold the magnetic slurry along the magnetic field lines; and

polishing an end surface of the glass substrate by moving the end surface and the magnetic slurry relative to each other, the end surface of the glass substrate being brought into contact with the magnetic slurry held by the magnetic field lines.

2. The method for manufacturing a magnetic-disk glass substrate according to claim 1,

wherein the magnetic slurry forms a mass along the magnetic field lines, and

the end surface of the glass substrate is pressed against an ~~the~~ inside of the mass in a direction orthogonal to the magnetic field lines, and the end surface of the glass substrate is polished.

3. The method for manufacturing a magnetic-disk glass substrate according to claim 1 or 2,

wherein the end surface of the glass substrate includes a side wall surface that extends in the direction orthogonal to both main surfaces of the glass substrate and chamfered surfaces that connect the side wall surface and both main surfaces and that are inclined with respect to the main surfaces, and

when the end surface of the glass substrate is polished, the side wall surface and the chamfered surfaces are simultaneously polished.

4. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 to 3,

wherein the magnetism generating means includes a pair of magnets that are disposed in a separated state in the thickness direction of the glass substrate such that a surface on an N-pole side and a surface on an S-pole side are opposed to each other.

5. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 to 3,

wherein the magnetism generating means includes a pair of magnets that are disposed in a separated state in the thickness direction of the glass substrate such that a surface on an N-pole side and a surface on an S-pole side are opposed to each other, and

the end surface of the glass substrate is pressed against an inside of the magnetic slurry so as to come into contact with a portion inside the magnetic slurry held by the magnetic field lines that connect the N-pole and the S-pole.

6. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 to 5,

wherein a spacer made of a non-magnetic substance is provided between the surface on the N-pole side and the surface on the S-pole side of the pair of magnets.

7. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 to 6,

wherein the glass substrate has a disc shape that has a circular through hole having a central point at the center of the glass substrate,

the magnetism generating means includes an inner circumferential side means that is provided in the through hole of the glass substrate and forms magnetic field lines on the inner circumferential side that extend in the thickness direction of the glass substrate around the end surface on the inner circumferential side that is a side wall surface of the through hole, and

the end surface on the inner circumferential side of the glass substrate is brought into contact with the magnetic slurry held by the magnetic field lines on the inner circumferential side formed by the inner circumferential side means, and the end surface and the magnetic slurry are moved relative to each other in the contacting state to polish the end surface on the inner circumferential side.

8. The method for manufacturing a magnetic-disk glass substrate according to claim 7,

wherein the magnetic slurry is formed in an annular shape on a surface of a rotation body that has a central axis and is rotatable about the central axis, and

when the end surface on the inner circumferential side of the glass substrate is polished, the magnetic slurry is rotated due to the rotation of the rotation body, and the entire circumference of the end surface on the inner circumferential side of the glass substrate and the entire circumference of the magnetic slurry are brought into contact and the glass substrate is rotated in an opposite direction to a direction in which the magnetic slurry is rotated.

9. The method for manufacturing a magnetic-disk glass substrate according to claim 7 or 8,

wherein the magnetism generating means includes an outer circumferential side means that is provided on the outer circumferential side of the glass substrate and forms magnetic field lines on the outer circumferential side that extend in a thickness direction of the glass substrate around the end

surface on the outer circumferential side of the glass substrate, and

the end surface on the outer circumferential side of the glass substrate is brought into contact with the magnetic slurry held by the magnetic field lines on the outer circumferential side formed by the outer circumferential side means, and the end surface and the magnetic slurry are moved relative to each other in the contacting state to polish both the end surface on the inner circumferential side and the end surface on the outer circumferential side.

10. A method for manufacturing a plurality of magnetic-disk glass substrate comprising: a step of stacking a plurality of glass substrates to form a stack of glass substrates, and performing end surface polishing on each of the glass substrates in the stack,

the step of performing end surface polishing including:

forming magnetic field lines that extend in a stacking direction of the stack at a plurality of positions using a magnetism generating means;

disposing a magnetic slurry containing polishing abrasive particles and a magnetic functional fluid at the plurality of positions to hold the magnetic slurry along the magnetic field lines; and

polishing, at each of the plurality of positions, an end surface of the glass substrate in the stack by moving the end surface in the stack and the magnetic slurry relative to each other, the end surface of the glass substrate being brought into contact with the magnetic slurry held by the magnetic field lines.

11. The method for manufacturing a magnetic-disk glass substrate according to claim 10,

wherein the magnetism generating means includes a plurality of pairs of magnets, each pair disposed in a separated state in a stacking direction of the stack such that a surface on an N-pole side and a surface on an S-pole side are opposed to each other, and the plurality of magnets are provided at a

plurality of positions in the stacking direction of the stack.

12. The method for manufacturing a magnetic-disk glass substrate according to claim 10 or 11,

wherein a spacer made of a non-magnetic substance is provided between the surface on the N-pole side and the surface on the S-pole side of each pair of magnets.

13. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 10 to 12,

wherein the magnetism generating means and the stack are oscillated relative to the stacking direction during polishing.

14. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 10 to 13,

wherein the glass substrate has a disc shape having a circular through hole,

the magnetism generating means includes an inner circumferential side means that is provided in the through holes of the glass substrates in the stack and forms magnetic field lines on the inner circumferential side that extend in a thickness direction of the glass substrates around the end surfaces on the inner circumferential side that are side wall surfaces of the through holes, and

the end surface on the inner circumferential side of each glass substrate is brought into contact with the magnetic slurry held by the magnetic field lines on the inner circumferential side formed by the inner circumferential side means, and the end surface and the magnetic slurry are moved relative to each other in the contacting state to polish the end surfaces on the inner circumferential side.

15. A method for manufacturing a magnetic-disk glass substrate

comprising: a step of performing end surface polishing on a glass substrate,

the step of performing end surface polishing including:

holding a magnetic slurry containing polishing abrasive particles and a magnetic functional fluid by magnetic field lines formed by a magnetism generating means including a pair of magnets that are disposed in a separated state in a thickness direction of the glass substrate such that a surface on an N-pole side and a surface on an S-pole side are opposed to each other; and

polishing an end surface of the glass substrate by moving the end surface and the magnetic slurry relative to each other, the end surface of the glass substrate being brought into contact with the magnetic slurry held by the magnetic field lines.

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

wherein the magnetic slurry has a viscosity of 1000 to 2000 [mPa·second] at a temperature of 20°C.

17 The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 to 16,

wherein the magnetism generating means has a magnetic flux density of 0.3 to 0.8 [tesla].

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

wherein a yield stress of the magnetic slurry is 30 to 60 kPa in a state in which a magnetic field of 0.4 [tesla] is applied.

CLAIMS

1. A method for manufacturing a magnetic-disk glass substrate comprising a step of forming a side wall surface and chamfered surfaces on an end surface of the glass substrate and a step of performing end surface polishing on a glass substrate,

the step of performing end surface polishing including:

forming magnetic field lines that extend in a thickness direction of the glass substrate, using a magnetism generating means, the magnetism generating means including a pair of magnets disposed in a separated state in the thickness direction of the glass substrate such that a surface on an N-pole side and a surface on an S-pole side are opposed to each other;

disposing a magnetic slurry containing polishing abrasive particles and a magnetic functional fluid in the magnetic field lines to hold the magnetic slurry along the magnetic field lines, the magnetic slurry forming a mass; and

polishing, simultaneously, the side wall surface and the chamfered surfaces of the glass substrate by moving the end surface and the magnetic slurry relative to each other, the end surface of the glass substrate being pressed against the mass in a direction orthogonal to the magnetic field lines and brought into contact with the magnetic slurry held by the magnetic field lines.

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

wherein the end surface of the glass substrate is pressed against an inside of the magnetic slurry so as to come into contact with a portion inside the magnetic slurry held by the magnetic field lines that connect the N-pole and the S-pole.

3. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 or 2,

wherein a spacer made of a non-magnetic substance is provided between the surface on the N-pole side and the surface on the S-pole side of the pair of magnets.

4. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 to 3,

wherein the glass substrate has a disc shape that has a circular through hole having a central point at the center of the glass substrate,

the magnetism generating means includes an inner circumferential side means that is provided in the through hole of the glass substrate and forms magnetic field lines on the inner circumferential side that extend in the thickness direction of the glass substrate around the end surface on the inner circumferential side that is a side wall surface of the through hole, and

the end surface on the inner circumferential side of the glass substrate is brought into contact with the magnetic slurry held by the magnetic field lines on the inner circumferential side formed by the inner circumferential side means, and the end surface and the magnetic slurry are moved relative to each other in the contacting state to polish the end surface on the inner circumferential side.

5. The method for manufacturing a magnetic-disk glass substrate according to claim 4,

wherein the magnetic slurry is formed in an annular shape on a surface of a rotation body that has a central axis and is rotatable about the central axis, and

when the end surface on the inner circumferential side of the glass substrate is polished, the magnetic slurry is rotated due to the rotation of the rotation body, and the entire circumference of the end surface on the inner

circumferential side of the glass substrate and the entire circumference of the magnetic slurry are brought into contact and the glass substrate is rotated in an opposite direction to a direction in which the magnetic slurry is rotated.

6. The method for manufacturing a magnetic-disk glass substrate according to claim 4 or 5,

wherein the magnetism generating means includes an outer circumferential side means that is provided on the outer circumferential side of the glass substrate and forms magnetic field lines on the outer circumferential side that extend in a thickness direction of the glass substrate around the end surface on the outer circumferential side of the glass substrate, and

the end surface on the outer circumferential side of the glass substrate is brought into contact with the magnetic slurry held by the magnetic field lines on the outer circumferential side formed by the outer circumferential side means, and the end surface and the magnetic slurry are moved relative to each other in the contacting state to polish both the end surface on the inner circumferential side and the end surface on the outer circumferential side.

7. A method for manufacturing a plurality of magnetic-disk glass substrate comprising a step of forming a side wall surface and chamfered surfaces on an end surface of the glass substrate and a step of stacking a plurality of glass substrates to form a stack of glass substrates, and performing end surface polishing on each of the glass substrates in the stack,

the step of performing end surface polishing including:

forming magnetic field lines that extend in a stacking direction of the stack at a plurality of positions using a magnetism generating means, the magnetism generating means including a pair of magnets disposed in a separated state in the thickness direction of the glass substrate such that a surface on an N-pole side and a surface on an S-pole side are opposed to each other;

disposing a magnetic slurry containing polishing abrasive particles and a magnetic functional fluid in the magnetic field lines formed at the plurality of positions to hold the magnetic slurry along the magnetic field lines, the magnetic slurry forming a mass; and

polishing, simultaneously and at each of the plurality of positions, the side wall surface and the chamfered surfaces of the glass substrate in the stack by moving the end surface in the stack and the magnetic slurry relative to each other, the end surface of the glass substrate being pressed against the mass in a direction orthogonal to the magnetic field lines and brought into contact with the magnetic slurry held by the magnetic field lines.

8. The method for manufacturing a magnetic-disk glass substrate according to claim 7,

wherein a spacer made of a non-magnetic substance is provided between the surface on the N-pole side and the surface on the S-pole side of each pair of magnets.

9. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 7 or 8,

wherein the magnetism generating means and the stack are oscillated relative to the stacking direction during polishing.

10. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 7 to 9,

wherein the glass substrate has a disc shape having a circular through hole,

the magnetism generating means includes an inner circumferential side means that is provided in the through holes of the glass substrates in the stack and forms magnetic field lines on the inner circumferential side that extend in a thickness direction of the glass substrates around the end surfaces on the

inner circumferential side that are side wall surfaces of the through holes, and

the end surface on the inner circumferential side of each glass substrate is brought into contact with the magnetic slurry held by the magnetic field lines on the inner circumferential side formed by the inner circumferential side means, and the end surface and the magnetic slurry are moved relative to each other in the contacting state to polish the end surfaces on the inner circumferential side.

11. A method for manufacturing a magnetic-disk glass substrate comprising a step of forming a side wall surface and chamfered surfaces on an end surface of the glass substrate and a step of performing end surface polishing on a glass substrate,

the step of performing end surface polishing including:

holding a magnetic slurry with a viscosity of 1000 to 2000 [mPa • second] at a temperature of 20°C containing polishing abrasive particles and a magnetorheological fluid by magnetic field lines formed by a magnetism generating means including a pair of magnets that are disposed in a separated state in a thickness direction of the glass substrate such that a surface on an N-pole side and a surface on an S-pole side are opposed to each other, the magnetic slurry forming a mass; and

polishing, simultaneously, the side wall surface and the chamfered surfaces of the glass substrate by moving the end surface and the magnetic slurry relative to each other, the end surface of the glass substrate being pressed against the mass in a direction orthogonal to the magnetic field lines and brought into contact with the magnetic slurry held by the magnetic field lines.

12. The method for manufacturing a glass substrate according to claim 11, wherein the glass substrate is a magnetic-disk glass substrate that has a disc shape having a circular through hole.

13. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 to 12,

wherein the magnetism generating means has a magnetic flux density of 0.3 to 0.8 [tesla].

14. The method for manufacturing a magnetic-disk glass substrate according to any one of claims 1 to 13,

wherein a yield stress of the magnetic slurry is 30 to 60 kPa in a state in which a magnetic field of 0.4 [tesla] is applied.