

CLAIMS

1. An annular substrate used for a magnetic-disk substrate, the annular substrate having a circular hole at a center, the annular substrate comprising a pair of main surfaces and an edge surface, wherein

the edge surface has a side wall surface and chamfered surfaces interposed between the side wall surface and the main surfaces,

a roundness of the edge surface on an outer circumferential side is $1.5\text{ }\mu\text{m}$ or less,

when outlines in a circumferential direction are respectively obtained at two positions spaced apart by $200\text{ }\mu\text{m}$ in a substrate thickness direction on the side wall surface on the outer circumferential side, and a midpoint between centers of two least square circles respectively derived from the outlines is given as a midpoint A, and

when outlines in the circumferential direction are respectively obtained at positions that are located at centers of the two chamfered surfaces on the outer circumferential side in the substrate thickness direction, and among centers of least square circles derived from the outlines, a center derived from one chamfered surface is given as a center B, and a center derived from the other chamfered surface is given as a center C, and

a sum of a distance between the midpoint A and the center B and a distance between the midpoint A and the center C is $1\text{ }\mu\text{m}$ or less.

2. The annular substrate according to claim 1, wherein surface roughness of the side wall surface on the outer circumferential side has a maximum height Rz of $0.2\text{ }\mu\text{m}$ or less.

3. The annular substrate according to claim 1 or 2, wherein the sum is $0.5\text{ }\mu\text{m}$ or less.

4. The annular substrate according to any one of claims 1 to 3, wherein in a case where, with regard to a surface roughness of the side wall surface on the outer circumferential side, a maximum height in the substrate thickness direction is $Rz(t)$ and a maximum height in the circumferential direction is $Rz(c)$, $Rz(t)/Rz(c)$ is 1.2 or less.

5. The annular substrate according to any one of claims 1 to 4, wherein when a measurement point is provided every 30 degrees in the circumferential direction, referenced on the center of the glass substrate, and a radius of curvature of a shape of a portion between the side wall surface and the chamfered surface on the outer circumferential side at the measurement point is derived, a difference in the radius of curvature between adjacent measurement points is 0.01 mm or less.

6. The annular substrate according to any one of claims 1 to 5, wherein outlines of the side wall surface in the circumferential direction are respectively obtained at a plurality of different positions in the substrate thickness direction, including at least three positions spaced apart by 100 μm in the substrate thickness direction on the side wall surface on the outer circumferential side, an inscribed circle and a circumscribed circle of each outline are obtained, and a difference in the radius between a smallest inscribed circle and a largest circumscribed circle is 5 μm or less.

7. The annular substrate according to any one of claims 1 to 6, wherein the substrate thickness is 0.635 mm or less.

8. A method of manufacturing a magnetic-disk substrate including a step of polishing the pair of main surfaces of the annular substrate according to any one of claims 1 to 7.

9. A method of manufacturing a magnetic-disk including a step of forming a magnetic layer on the magnetic-disk substrate manufactured by the method according to claim 8.

10. A magnetic-disk substrate having a circular hole at a center, the magnetic-disk substrate comprising a pair of main surfaces and an edge surface, wherein
the edge surface has a side wall surface and chamfered surfaces interposed between the side wall surface and the main surfaces,

a roundness of the edge surface on an outer circumferential side is $1.5\text{ }\mu\text{m}$ or less,
 when outlines in a circumferential direction are respectively obtained at two positions spaced apart by $200\text{ }\mu\text{m}$ in a substrate thickness direction on the side wall surface on the outer circumferential side, and a midpoint between centers of two least square circles respectively derived from the outlines is given as a midpoint A, and

when outlines in the circumferential direction are respectively obtained at positions that are located at centers of the two chamfered surfaces on the outer circumferential side in the substrate thickness direction, and among centers of least square circles derived from the outlines, a center derived from one chamfered surface is given as a center B, and a center derived from the other chamfered surface is given as a center C,

a sum of a distance between the midpoint A and the center B and a distance between the midpoint A and the center C is $1\text{ }\mu\text{m}$ or less, and

surface roughness of the side wall surface on the outer circumferential side has a maximum height R_z of $0.2\text{ }\mu\text{m}$ or less.

11. The magnetic-disk substrate according to claim 10, wherein the main surface on the outer circumferential side edge portion of the main surface has nanowaviness of $0.5\text{ }\text{\AA}$ or less.

12. The magnetic-disk substrate according to claim 10 or 11, wherein a dub off value of the outer circumferential edge portion on the main surface is 30 nm or less.

13. The magnetic-disk substrate according to any one of claims 10 to 12, wherein the sum is $0.5\text{ }\mu\text{m}$ or less.

14. The magnetic-disk substrate according to any one of claims 10 to 13, wherein in a case where, with regard to a surface roughness of the side wall surface on the outer circumferential side, a maximum height in the substrate thickness direction is $R_z(t)$ and a maximum height in the circumferential direction is $R_z(c)$, $R_z(t)/R_z(c)$ is 1.2 or less.

15. The magnetic-disk substrate according to any one of claims 10 to 14, wherein when a measurement point is provided every 30 degrees in the circumferential direction, referenced on the center of the glass substrate, and a radius of curvature of a shape of a portion between the side wall surface and the chamfered surface on the outer circumferential side at the measurement point is derived, a difference in the radius of curvature between adjacent measurement points is 0.01 mm or less.

16. The magnetic-disk substrate according to any one of claims 10 to 15, wherein outlines of the side wall surface in the circumferential direction are respectively obtained at a plurality of different positions in the substrate thickness direction, including at least three positions spaced apart by 100 μm in the substrate thickness direction on the side wall surface on the outer circumferential side, an inscribed circle and a circumscribed circle of each outline are obtained, and a difference in the radius between a smallest inscribed circle and a largest circumscribed circle is 5 μm or less.

17. The magnetic-disk substrate according to any one of claims 10 to 16, wherein the substrate thickness is 0.5 mm or less.

18. The magnetic-disk substrate according to any one of claims 10 to 17, the magnetic-disk substrate used for a magnetic-disk for shingle write system or energy-assisted magnetic recording.

19. A magnetic disk comprising:
the magnetic-disk substrate according to any one of claims 10 to 18; and
a magnetic layer formed on the main surface of the magnetic-disk substrate.

20. A hard disk drive apparatus wherein the magnetic-disk according to claim 19 is used.