CLAIMS

1. An annular substrate made of glass, the annular substrate being used for a magnetic-disk substrate, the magnetic-disk substrate having a circular hole at a center, and comprising a pair of main surfaces and a side wall surface orthogonal to the main surfaces, wherein
   a roundness of the circular hole is 1.5 μm or less, and
   a difference between a maximum value and a minimum value of radii of three inscribed circles is 3.5 μm or less, the three inscribed circles being respectively derived from three outlines on a side wall surface of the circular hole, the three outlines including: a circumferential outline of a central position in the substrate thickness direction, and two circumferential outlines of positions spaced apart from the central position in the opposite directions by a predetermined distance respectively,
   the predetermined distance being 200 μm in the case where the positions spaced apart from the central position in the opposite directions by 200 μm respectively are present on the side wall surface, and the predetermined distance being 100 μm in the case where the positions spaced apart from the central position in the opposite directions by 200 μm respectively are not present on the side wall surface.

2. The annular substrate according to claim 1, wherein an annular region in each of the pair of main surfaces has a diameter that is 128% of the diameter of the circular hole, and the annular region has flatness of 1 μm or less, the annular region being on the central portion side of the circumference of a concentric circle with the circular hole.

3. The annular substrate according to claim 1 or 2, wherein a substrate thickness is 0.635 mm or less.

4. The annular substrate according to any one of claims 1 to 3, wherein a surface roughness Rz of the side wall surface of the circular hole is 0.2 μm or less.

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

6. The annular substrate according to any one of claims 1 to 5, wherein

when a measurement point is provided every 30 degrees in the circumferential direction referenced on the center of the annular substrate, and a radius of curvature of a shape of a portion between the side wall surface and a chamfered surface of the circular hole at the measurement point is derived, a difference in the radius of curvature between adjacent measurement points is 0.01 mm or less.

7. The annular substrate according to any one of claims 1 to 6, wherein the difference between a maximum value and a minimum value of radii of the three inscribed circles is 2.5 μm or less.

8. A method for manufacturing a magnetic-disk substrate comprising performing at least polishing each of the main surfaces of the annular substrate according to any one of claims 1 to 7.

9. A method for manufacturing a magnetic disk comprising forming at least a magnetic layer on each of the main surfaces of the magnetic-disk substrate obtained by the method according to claim 8.

10. A magnetic-disk substrate made of glass, the magnetic-disk substrate having a circular hole at a center, and comprising a pair of main surfaces and a side wall surface orthogonal to the main surfaces,
wherein an annular region in each of the pair of main surfaces has a diameter that is 128% of the diameter of the circular hole, and the annular region has flatness of 1 μm or less, the annular region being on the central portion side of the circumference of a concentric circle with the circular hole,
a roundness of the circular hole is 1.5 μm or less, and
a difference between a maximum value and a minimum value of radii of three inscribed circles is 3.5 μm or less, the three inscribed circles being respectively derived from three outlines on a side wall surface of the circular hole, the three outlines including: a circumferential outline of a central position in the substrate thickness direction, and two circumferential outlines of positions spaced apart from the central position in the opposite directions by a predetermined distance respectively,
the predetermined distance being 200 μm in the case where the positions spaced apart from the central position in the opposite directions by 200 μm respectively are present on the side wall surface, and the predetermined distance being 100 μm in the case where the positions spaced apart from the central position in the opposite directions by 200 μm respectively are not present on the side wall surface.

11. The magnetic-disk substrate according to claim 10, wherein a substrate thickness is 0.635 mm or less.

12. The magnetic-disk substrate according to claim 10 or 11, wherein a surface roughness Rz of the side wall surface of the circular hole is 0.2 μm or less.

13. The magnetic-disk substrate according to any one of claims 10 to 12, wherein
Rz(t)/Rz(c) is 1.2 or less with regard to the surface roughness of the side wall surface of the circular hole, where a maximum height in the substrate thickness direction is Rz(t) and a maximum height in the circumferential direction is Rz(c).

14. The magnetic-disk substrate according to any one of claims 10 to 13, wherein
when a measurement point is provided every 30 degrees in the circumferential direction referenced on the center of the substrate, and a radius of curvature of a shape of a portion between the side wall surface and a chamfered surface of the circular hole at the measurement point is derived, a difference in the radius of curvature between adjacent measurement points is 0.01 mm or less.

15. The magnetic-disk substrate according to any one of claims 10 to 14, wherein the difference between a maximum value and a minimum value of radii of the three inscribed circles is 2.5 μm or less.

16. The magnetic-disk substrate according to claim 15, the substrate being used for a magnetic disk for energy-assisted magnetic recording or shingle writing magnetic recording.

17. A magnetic disk comprising:
the magnetic-disk substrate according to any one of claims 10 to 16, and
a magnetic layer formed on each of the pair of main surfaces of the magnetic-disk substrate.

18. A hard disk apparatus in which the magnetic disk according to claim 17 is used.