What is claimed is:

1. A magnetron having a rotation center, the magnetron comprising a first outer magnetic pole and a first inner magnetic pole of opposite polarities, wherein:

the first outer magnetic pole has an annular structure around the rotation center;

the first inner magnetic pole is located on an inner side of the first outer magnetic pole, and a first magnetic field track is formed between the first inner magnetic pole and the first outer magnetic pole;

the first inner magnetic pole has an arc shape;

a straight line starting from the rotation center and along one of radial directions passes through the first magnetic field track at least twice in succession, and magnetic-field directions at two positions of the first magnetic field track that the straight line passes through twice in succession are opposite to each other; and

a number of times that the straight line passes through the first magnetic field track is an even number.

2. The magnetron according to claim 1, wherein the magnetron further includes a second outer magnetic pole and a second inner magnetic pole of opposite polarities, wherein:

a second magnetic field track is formed between the second outer magnetic pole and the second inner magnetic pole, and the rotation center is located inside the second magnetic field track; and

the first magnetic field track is disposed around the second magnetic field track.

3. The magnetron according to claim 2, wherein the first outer magnetic pole includes a first sub-magnetic pole having an arc shape and two second sub-magnetic poles with each having an arc shape, wherein,

two ends of the first sub-magnetic pole are respectively connected to one end of each of the two second sub-magnetic poles, other end of each of the two second sub-magnetic poles extends toward a center of the first sub-magnetic pole, the two second sub-magnetic poles are located on a same circle, and other ends of the two second sub-magnetic poles are not connected; and

centers of the first sub-magnetic pole, the two second sub-magnetic poles, and the first inner magnetic pole coincide with the rotation center.

4. The magnetron according to claim 3, wherein:

the second outer magnetic pole has an arc shape, and two ends of the second outer magnetic pole are respectively connected to the other ends of the two second sub-magnetic poles with joint positions located at one side of the rotation center, and a

portion of the second outer magnetic pole closed to a middle located on the other side of the rotation center; and

the second inner magnetic pole is disposed between the first inner magnetic pole and the second outer magnetic pole.

5. The magnetron according to claim 4, wherein the second inner magnetic pole is connected to the first inner magnetic pole.

6. The magnetron according to claim 3, wherein:

the second outer magnetic pole is not connected to the first outer magnetic pole; and

the second inner magnetic pole is not connected to the first inner magnetic pole.

7. The magnetron according to claim 4, wherein:

a shape of the second inner magnetic pole includes: a V shape, a U shape, or a Y shape, and an opening of the V shape or the U shape faces away from the rotation center.

8. The magnetron according to claim 3, wherein:

a central angle of the first sub-magnetic pole is angle α; an angle between two lines that respectively connect the other ends of the two second sub-magnetic poles to the rotation center is angle β; and

a ratio of angle α to angle β is greater than 3.5.

9. The magnetron according to claim 1, wherein:

the first outer magnetic pole includes a third sub-magnetic pole having an arc shape and a fourth sub-magnetic pole having an arc shape, wherein,

the fourth sub-magnetic pole is located on an inner side of the third sub-magnetic pole, and centers of the third sub-magnetic pole and the fourth sub-magnetic pole coincide with the rotation center, and two ends of the fourth sub-magnetic pole are respectively connected to two ends of the third sub-magnetic pole; and

a center of the first inner magnetic pole coincides with the rotation center.

10. The magnetron according to claim 1, wherein:

the first magnetic field track has a same width in a direction of the straight line.

11. The magnetron according to claim 10, wherein:

a width of the first magnetic field track ranges from 10 to 60 mm.

12. The magnetron according to claim 11, wherein:

the width of the first magnetic field track ranges from 15 mm to 35 mm.

13. The magnetron according to claim 2, wherein:

a width of the second magnetic field track ranges from 10mm to 60 mm.

14. A magnetron sputtering chamber, configured to deposit magnetic thin films, and comprising the magnetron according to any one of claims 1-13, wherein:

the magnetron rotates around the rotation center to scan a surface of a target; and

a bias magnetic field device for forming a horizontal magnetic field is disposed in the magnetron sputtering chamber.

15. A magnetron sputtering apparatus, comprising a magnetic sputtering chamber, wherein the magnetic sputtering chamber adopts the magnetic sputtering chamber according to claim 14.