Properties," Proceedings of the 2004 Spring Meeting of the Powder & Powder Metallurgy Society, p.202

SUMMARY OF INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0015]

Embodiments~~An object~~ of the invention~~, which addresses the prior art problems discussed above, is~~ seek to provide a sintered Nd base magnet which includes a demagnetization-susceptible region having a high coercive force and has mass productivity so that it may be~~is~~ suited for use in permanent magnet rotary machines, and a method for preparing the same.

MEANS FOR SOLVING THE PROBLEMS

[0016]

As described above, the permanent magnet used in a permanent magnet rotary machine includes a demagnetization-susceptible region which is localized. It would be desirable if the demagnetization-susceptible region of the permanent magnet used in a permanent magnet rotary machine is improved in coercive force.

[0017]

The inventors have found that by providing a sintered Nd base magnet block (sintered rare earth magnet, typically $Nd_2Fe_{14}B$ system) having a sufficient thickness in a magnetization direction, effecting diffusion reaction of Dy or Tb inward from the surfaces of the magnet block excluding the surfaces perpendicular to the magnetization direction, thereby producing the magnet block in which the coercive force near the surfaces is higher than in the interior, and cutting the magnet block in a direction perpendicular to the magnetization direction by means of a cutter blade, wire saw or the like, a plurality of magnet segments of predetermined size can be manufactured from one magnet block; that when the magnet block subject to diffusion treatment is preferably dimensioned to a maximum dimension in a direction

perpendicular to the magnetization direction (where diffusion reaction of Dy or Tb takes place) of up to 100 mm, more preferably up to 50 mm, even more preferably up to 10 mm, and a maximum length in the magnetization direction (where diffusion reaction does not take place) of at least 30 mm, more preferably at least 100 mm, absorption treatment with Dy or Tb can be effected on the magnet block of such large size, whereby the throughput of the process is improved.

[0018]

~~The invention provides a sintered Nd base magnet and a preparation method as defined below.~~

~~Claim 1:~~

~~A method for preparing a sintered Nd base magnet comprising the steps of:~~

~~providing a sintered Nd base magnet block having surfaces and a magnetization direction,~~

~~coating the surfaces of the magnet block excluding the surface perpendicular to the magnetization direction with a Dy or Tb oxide powder, a Dy or Tb fluoride powder, or a Dy or Tb-containing alloy powder,~~

~~treating the coated block at a high temperature for causing Dy or Tb to diffuse into the block, and~~

~~cutting the block in a plane perpendicular to the magnetization direction into a magnet segment having a coercive force distribution on the cut section that the coercive force is high at the periphery and lower toward the inside and a constant coercive force distribution in the magnetization direction.~~

~~Claim 2:~~

~~A method for preparing a sintered Nd base magnet according to claim 1, further comprising the step of machining the magnet segment on its surface perpendicular to the magnetization direction into a C or D shape.~~

~~Claim 3:~~

~~A method for preparing a sintered Nd base magnet according to claim 1 or 2 wherein the magnet block has a maximum dimension of up to 100 mm in a Dy or Tb diffusing~~

According to a first aspect of the present invention, there is provided a method for preparing a sintered Nd base magnet comprising the steps of: providing a sintered Nd base magnet block of rectangular shape having surfaces perpendicular to a magnetization direction and extending to the magnetization direction, coating the surfaces of the magnet block excluding the surface perpendicular to the magnetization direction with a Dy or Tb oxide powder, a Dy or Tb fluoride powder, or a Dy or Tb-containing alloy powder by dispersing the powder in water or an organic solvent and dipping the magnetic block in the dispersion or spraying the dispersion to the magnetic block, heating the coated block so as to cause Dy or Tb in the Dy or Tb oxide powder, the Dy or Tb fluoride powder, or the Dy or Tb-containing alloy powder to diffuse into the block, and cutting the block in a plane perpendicular to the magnetization direction into a magnet segment having a coercive force distribution on the cut section that the coercive force is high at the periphery and lower toward the inside and a constant coercive force distribution in the magnetization direction.

According to a second aspect of the present invention, there is provided a sintered Nd base magnet segment obtained by the method as defined in the first aspect, having a coercive force distribution on the cut section that the coercive force is high at the periphery and lower toward the inside and a constant coercive force distribution in the magnetization direction.

~~direction perpendicular to the magnetization direction and a maximum length of at least 30 mm in the magnetization direction.~~

~~Claim 4:~~

~~A sintered Nd base magnet segment obtained by the method of claim 1, having a coercive force distribution on the cut section that the coercive force is high at the periphery and lower toward the inside and a constant coercive force distribution in the magnetization direction.~~

~~Claim 5:~~

~~A sintered Nd base magnet segment according to claim 4 which is machined on its surface perpendicular to the magnetization direction into a C or D shape.~~

~~Claim 6:~~

~~A sintered Nd base magnet segment according to claim 4 or 5 which is used as permanent magnet in a permanent magnet rotary machine.~~

ADVANTAGEOUS EFFECTS OF INVENTION

[0019]

According to embodiments of the invention, the sintered Nd base magnet may be~~is~~ free of a decline of remanence, may have~~has~~ a high coercive force, especially at the edges thereof, and may be~~is~~ unsusceptible to demagnetization even at high temperature. The magnet may be~~is~~ suited for use in permanent magnet rotary machines.

BRIEF DESCRIPTION OF DRAWINGS

[0020]

FIG. 1 is a perspective view of a magnet block in one embodiment of the invention, FIG. 1A showing the block during diffusion treatment, and FIG. 1B showing the block being cut.

FIG. 2 illustrates the coercive force distribution of the magnet segment in one embodiment of the invention, FIG. 2A being a cross section taken perpendicular to the magnetization direction, and FIG. 2B being a cross section taken at the center in the magnetization direction.