Shape Optimization of a Powder Aligning System for a Four Pole Anisotropic Bonded Nd-Fe-B Ring Magnet

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1. Introduction

It is well known that the degree of alignment of anisotropic magnetic powders is a major determinant of magnetic properties in anisotropic PMs. However, in applications to ring-type PMs of small size, for example radial anisotropic or multi-polar anisotropic PMs, all the anisotropic magnetic powder are not expected to be oriented exactly along the applied field direction unless sufficient aligning field is applied.

In this paper, the magnetic properties under various aligning fields are experimentally measured and a powder-aligning-fixture for a 4-Pole anisotropic bonded Nd-Fe-B ring-type PM is optimally designed. Finally, an anisotropic bonded Nd-Fe-B PM is realized by using the optimally designed powder-aligning-fixture.

2. Experimental

A ring type 4-pole polar anisotropic PM for a commercial seat-moving-motor is selected as a design target. Fig. 1 shows the basic design of powder-aligning-fixture for a thin cylindrical magnet as shown in Table I. The design parameters, thickness of the outer insert (T) and angle between poles (β) which are difficult to optimize with the equivalent magnetic circuit method, were optimized by using a commercial finite element analysis software (Maxwell 2-D, Ansoft Corporation). In the optimization, the insert thickness T and angle β are allowed to change from 1.0 to 2.0 mm, and from 0 to 36 degree, respectively, to check the influence on the flux distribution and field intensity.

3. Results

Fig. 2 (a) compares the variations of the normal and tangential components of the magnetic flux density, B_{NOR} and B_{TAN}, respectively, according to the thickness of the outer insert T. It is shown that the normal component B_{NOR} reaches to 1.52 T, 1.64 T and 1.77 T when T has its value of 2.0 mm, 1.5 mm and 1.0 mm, respectively. However, the tangential component B_{TAN} does not have considerable change. as shown in the Fig. 2 (b), the normal component of the magnetic flux density, B_{NOR}, reaches to 1.52 T, 1.85 T and 2.1 T for the pole angles of 0°, 18° and 36°, respectively.

4. Conclusion

2-D finite element analysis was carried out to investigate the influence of the various design parameters on the performance of the powder-aligning-fixture for a 4-pole anisotropic Nd-Fe-B bonded PM. In order to achieve the required magnitude and direction of the aligning field inside the mold cavity, the proposed design method by adjusting the taper poles was very favorable.

5. References

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Table I Dimensions of Ring-type PM and Mold Tool

Description	Dimension(mm)
Inner radius of cavity(*r1*)	16
Outer radius of cavity(*r2*)	17
Axle length of mold toll	100

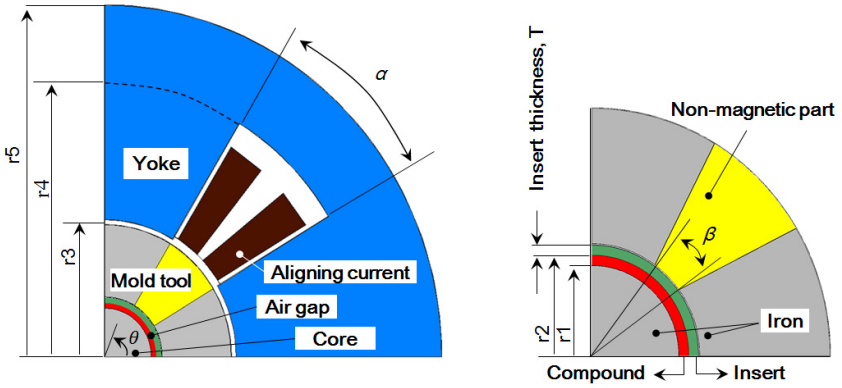

Fig. 1. Schematic drawing of powder-aligning-fixture.

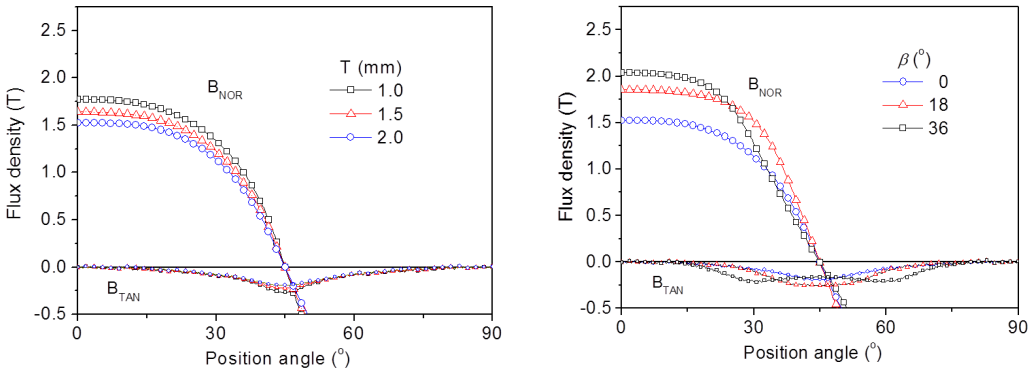

Fig. 2. Distribution of B_{NOR} and B_{TAN} at the air-gap at different (a) insert thickness and (b) pole angle.