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The influence of the powder size on the anisotropic NdFeB magnet by single stroke hot deformation

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1. Introduction

The high effective method of imparting anisotropic properties to isotropic powders is hot deformation. Generally, hot deformation consists of two processes of hot pressing and die-upsetting, successively[1-6]. The method what is called single stroke hot deformation (SSHD method) is different with the general hot deformation. That is a one-touch hot pressing process that was described in detail in elsewhere [1,2]. In order to improve the magnetic properties, MQPA powders were screened to various grade of particle size. The effect of MQPA powder size for the anisotropic properties of NdFeB magnets were carried out and reported as follows. For comparison, same experiments were conducted for MQPB and MQPB+.

2. Experiment

Commercial isotropic MQPA, MQPB and MQPB+ powders were used as starting materials. All powders were screened to five particle size groups referred as Grade 1 to Grade 5, as shown in Table 1.

The screened powders were filled into a copper tube and then pressed under Ar atmosphere at temperature of 650℃with the initial pressing rate of 0.7 mm/s. The magnetic properties were measured by a hysteresisgraph system with the maximum field of 1600 kA/m (~20 kOe) after premagnetization at 7200 kA/m (~90 kOe). X-ray diffraction patterns were detected by RIGAKU X-ray analyzer using CuKα radiation and 1.54Å wavelength. The diffraction angle 2θ was from 20 to 70 degree.

3. Results and discussion

Fig. 1 shows the influence of particle size of raw materials on the hard magnetic properties, coercivity *iHc*, ramanence *Br*, and maximum energy product (*BH*)max of magnets made from MQPA, MQPB and MQPB+ powder by single stroke hot deformation. It exhibits that, for MQPB and MQPB+ powders, the magnetic properties are low and the magnetic anisotropy was not formed. Also, the magnetic properties change little with the powder size. For MQPA powder, good anisotropy have been formed under the same condition and the magnetic properties change remarkably with the particle size. This was due to the composition of the MQ powders. The Nd content in MQPA is much higher than that in the stoichiometric $Nd_2Fe_{14}B$ and that in MQPB or MQPB+ . When the powder is pressed at a certain temperature, Nd-rich

liquid phase is formed and promoted alignment and grain rotation[6]. However, for MQPB or MQPB+ powder, very a little additional Nd was available to form Nd-rich phase.

4. Conclusion

The particle size influences the anisotropic properties of the Nd-Fe-B magnet in the fabrication method of the single stroke hot deformation. The optimum particle size range of MQPA powder is in the range of 45~100μm. Obtained hard magnetic properties are coercivity of 597 kA/m, remanance of 1.22 T and (BH)max of 262.6 kJ/m^3. At the same condition, MQPB and MQPB+ powder could not form anisotropic magnets.

Acknowledgement

This work was supported by the Korea Science and Engineering Foundation (KOSEF) through the Research Center For Advanced Magnetic Materials at Chungnam National University.

Reference

1 Li Ying, Yoonbae Kim, et al, J. Materials science & Technology, 2000(3) (in press)

2 Ying Li, Y. B. Kim, et al, Intermag2000, (accepted)

3 R. W. Lee, Appl. Phys. Lett., 46(1985)799

4 R. W. Gao, J. C. Zhang, D. H. Zhang, et al., J. Magn. Magn Mater., 191(1999)9

5 X. Fang, Y. Shi, D. C. Jiles, IEEE Transactions on Magnetics, 34(1998)1291

6 R.W. Lee, E. G. Brewer, and N. A. Schaffel, Processing o neodymium-iron-boron melt-spun ribbons to fully dense magnets, IEEE Transaction on Magnetics, 31(1985)1958

Table 1 The grades of the particle size after screening

Grade	1	2	3	4	5
Size range(μm)	<45	45~100	100~200	200~300	300~425

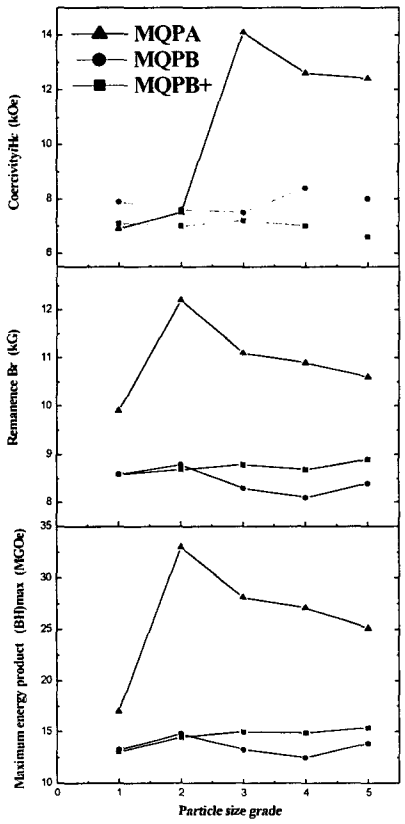

Fig. 1 The hard magnetic properties [iHc, Br, and (BH)max] vs. particle