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High temperature properties of NdFeB magnet fabricated by SSHD process

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1. Introduction

The single stage hot deformation (SSHD) is a method fabricating anisotropic NdFeB magnets. It simplifies the traditional die-upsetting process by replacing a high temperature die by a consumable Cu tube [1].

In this work, the high temperature properties of an anisotropic NdFeB magnet fabricated by SSHD method is reported.

2. Experimental

The isotropic NdFeB powder (MQPA, Magnequench Co.) was used as raw materials in this experiment. The raw powder was filled into a copper tube by hand pressing then hot-pressed in an Ar atmosphere at 650 ℃. The initial deformation rate was about 0.7 mm/s and applied pressure was 1950 psi.

A rectangular specimen with the size of 6.4×6.4×2.5 mm^3 was cut from SSHD processed block and the hysteresis loops at various temperature in the range from room temperature to 160 ℃ were measured by a pulsed field magnetometer (PFM) with the maximum field of 90 kOe. The pulsed field generated by a 18 kJ capacitor was damped oscillation with the period of 10.12 ms. During the measurement, the specimen was heated by flowing hot N_2 gas.

3. Results and discussion

Fig. 1 shows the magnetization curves of the anisotropic NdFeB magnet measured at various temperatures. Fig. 2 shows the dependence of the temperature coefficients of B_r (α) and ${}_iH_c$(β) as a function of temperature.

The temperature coefficients of B_r and ${}_iH_c$, α and β , were calculated using the equations:

$$\alpha\,(\mathrm{T}) = \frac{B_r(T) - B_r(298)}{B_r(298) \times (\mathrm{T}-298)} \times 100\ \%$$

$$\beta(T) = \frac{H_{ci}(T) - H_{ci}(298)}{H_{ci}(298) \times (T-298)} \times 100\ \%$$

The temperature coefficient B_r of -0.12 %/℃ is similar to those of isotropic MQPA powder and Nd-Fe-Co-B die-upset and sintered magnets [3]. The temperature coefficient of $_iH_c$ for our specimen is α =-0.72 %/℃. It is about twice of isotropic MQPA (α =–0.38 %/℃) slightly higher than those of sintered or die-upset Nd-Fe-Co-B magnets[3].

Reference

1. Y. Li, Y. B. Kim, et al, J. Magn. Magn. Mater., 223(2001), 279-283
2. M. S. Song, Y. B. Kim, C. S. Kim, and T. K. Kim, *IEEE Trans. On Magn., in press*
3. Takayuki Nishio, Yasuaki Kasai, IEEE Trans. On Magn., MAG-28(5), 2853

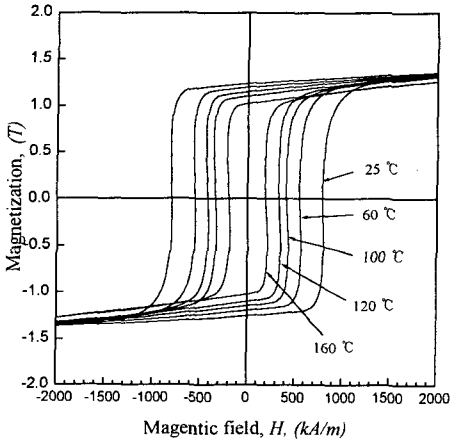

Fig. 1 The magnetization curves at the various temperatures for the anisotropic NdFeB magnets made by SSHDmethod

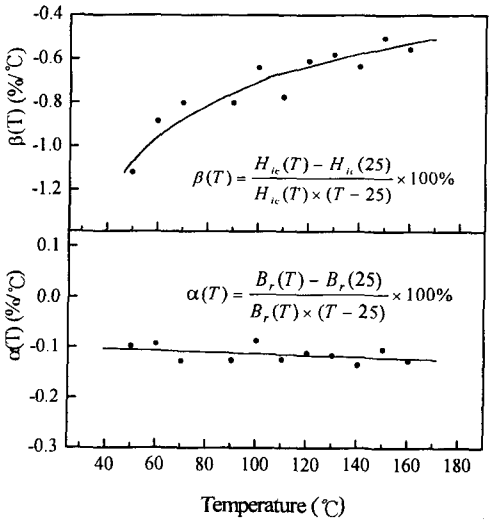

Fig. 2 Temperature coefficients of α and β as a function of temperature