Effect of grain size reduction of Nd-Fe-B sintered magnet on temperature coefficient of coercivity.

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1. Introduction

Grain size reduction technique of Nd-Fe-B sintered magnets is well known process to increase a coercivity without substitution of Dy for Nd. We have been developing ultrafine grained Nd-Fe-B sintered magnets using a helium gas jet-mill which can produce smaller particle size of the powder than a conventional nitrogen gas jet-mill[(1)]. Recently, Nakamura *et al*.[(2)] have reported the development of single crystal powders with particle size of under 0.6 μm using a combination of HDDR (hydrogenation-disproportionation-desorption-recombination), hydrogen decrepitation, and the helium gas jet-mill processes. In the present study, we report magnetic properties of ultrafine-grained Nd-Fe-B sintered magnets with grain size of under 1 μm.

2. Experiment

The starting material in this study is the strip-cast (SC) alloy with the nominal composition of $Nd_{27.2}Pr_{4.23}FeB_{0.96}Cu_{0.1}Al_{0.24}Co_{0.95}Fe_{bal.}$(wt%). We prepared 3 kinds of powders with particle sizes of 3, 1 and <1μm. The 3 μm powders and the 1 μm powders were produced by using the nitrogen gas jet-mill and the helium gas jet-mill, respectively. For the <1μm powders, the SC alloys were performed the hydrogen decrepitation followed by HDDR treatment. Subsequently, the HDDR-treated alloys were crushed into ultrafine powders by using the helium gas jet-mill[(2)]. Each powder was filling into a carbon mold and subsequently was aligned with pulse magnetic fields of 5T. Then each powder in the molds was sintered at the optimum temperature in vacuum and annealed at optimum temperature. Magnetic properties were measured by B-H loop tracer from room temperature up to 180℃.

3. Results

Fig.1 shows the variation of the temperature coefficient of the coercivity (β) of the Nd-Fe-B sintered magnet vs a function of temperature interval (T-23℃). The temperature coefficient of the HcJ (β) of the magnets improves from -0.55 to -0.47 %/K between 23 and 180℃ with decreasing the particle size of the starting powders from 3 to under 1 μm.

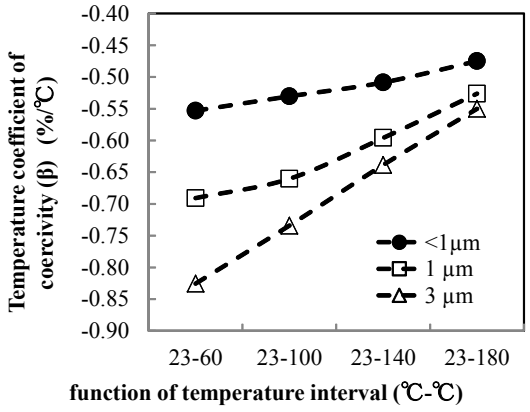

Fig.1 Variation of β of the Nd-Fe-B sintered magnet vs a function of temperature interval.

Reference

1) Y. Une and M. Sagawa, J. Jpan. Inst. Met. **76**, 12(2012) (in Japanese).
2) M. Nakamura *et al*., Appl Phys.Lett. **103**, 022404 (2013).

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