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Study of the effects of Zr-substitution on the HDDR characteristics of Nd-Fe-B-type magnetic alloy

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Nd-Fe-B-TYPE 자성합금의 HDDR 특성에 미치는 Zr 치환의 효과에 관한 연구

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1. INTRODUCTION

It is well known that Nd-Fe-B-type cast alloys can be converted into a highly coercive powder material by means of the HDDR (hydrogenation, disproportionation, desorption, and recombination) process [1-3]. The high coercivity of the HDDR processed material is believed to be attributed to the recombined fine grain size of the material. The HDDR materials produced from a standard Nd-Fe-B-type alloy show an isotropic character, that is, the recombined fine crystals orient in a random manner without any relation with the crystal orientation of their parent grain. It has been also known that an anisotropic HDDR material, in which the recombined fine crystals keep their orientation parallel to that of their parent grain, can be produced by alloy modification. Substitutions of certain element such as Zr, Ga, or Hf for Fe in the Nd-Fe-Co-B-type alloy has been found to cause an anisotropic HDDR character. In the present contribution, alloys with compositions based on $Nd_{16}Fe_{76-x}B_8Zr_x$ (where x = 0 - 2.0) have been studied in order to see the effects of alloy composition (in particular, the Zr content) on the HDDR characteristics and the magnetic properties of the HDDR processed materials.

2. EXPERIMENTALS

Cast alloys with chemical compositions of $Nd_{16}Fe_{76-x}B_8Zr_x$ (where x = 0 - 2.0) were prepared using an induction furnace. DTA (differential thermal analysis) and TPA (thermopiezic analysis) were carried out for the annealed alloys under hydrogen gas to see the hydrogenation, disproportionation, and desorption characteristics. The recombination characteristics of the disproportionated material were examined by measuring the coercivity of recombined material. The annealed alloys were roughly crushed (around 5x5x5 mm^3), and then subjected to a standard HDDR process. Magnetic properties of the HDDR processed materials were characterised by

means of VSM.

3. RESULTS AND DISCUSSION

It has been found that the Zr-substitution influences not significantly the hydrogenation behaviour of the alloys. The effect of Zr-substitution on the disproportionation kinetics appears to depend on the content of Zr. The alloy with small amount of Zr (0.1 at%) showed retarded disproportionation kinetics. For the alloy with larger amount of Zr, however, the disproportionation kinetics were found to be enhanced by the Zr-substitution. Desorption characteristics of the disproportionated material appears not to be affected significantly by the Zr-substitution. For the recombination reaction, the Zr-substitution has been found to facilitate the kinetics of the reaction. The intrinsic coercivity of HDDR processed material was found to be enhanced by the Zr substitution.

4. REFERENCES

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