C-2

MAGNETIC PROPERTIES AND MICROSTRUCTURES OF $Sm_yGd_{2-y}Fe_{17-x}Si_x$ COMPOUNDS

Institute of Advanced Materials, Inha University Joong-Hee Nam*
School of Materials Science and Engineering, Inha University Jae-Hee Oh

$Sm_yGd_{2-y}Fe_{17-x}Si_x$의 자기 특성 및 미세구조

인하대학교 소재연구소 남중희*
인하대학교 재료공학부 오재희

Ⅰ. INTRODUCTION

Among various properties a good candidate for a permanent magnetic material must have are ; a) high energy product, b) large anisotropy field, and c) high Curie temperature [1]. Presently, all leading candidates belong to the family of rare earth-transition metal (R-T) intermetallics. Unfortunately, existing theoretical models that describe the magnetic behavior of these materials are unable to predict the magnetic properties of a given intermetallic. The present study is expected to contribute to the existing data base on the magnetic properties of these intermetallics. In order to investigate the combined effects of mixing rare earths, partially substituting the iron sublattice and insertion of interstitial atoms, the magnetic and microstructural properties of $Sm_yGd_{2-y}Fe_{17-x}Si_x$ ($0 \leq x \leq 3$, $y=0 \sim 1.67$) were studied.

Ⅱ. EXPERIMENT

The samples were synthesized as ingots by induction melting stoichiometric amounts of elements of purity 99.99% or better in a copper cold boat. Sample compositions are shown in Table 1. The excess amount of samarium was 10% in weight percent and a weight allowance($\pm 3\%$) was made for possible loss of samarium during melting. The ingots were wrapped in tantalum foil and annealed at 950℃ for 7 days under flowing argon. The phase purity was verified by x-ray diffraction using a SCINTAG diffractometer with Cu K_α radiation. The lattice parameters were obtained by Rietveld analysis[2] of powder XRD patterns.

The thermo-magnetic behavior was investigated using a vibrating sample magnetometer with Faraday-type balance. The magnetization vs. applied field curves were obtained by extraction between 10 and 14.5 Tesla, at decreasing field, at 1.5 K using a magnetometer. The saturation magnetization at infinte field was obtained by extrapolation from the M vs. $1/H^2$ plots using a second order polynomial.

Ⅲ. RESULTS AND DISCUSSION

The XRD data suggest that all of the parent samples crystallized in the rhombohedral Th_2Zn_{17}-type structure. It is interesting to note that the unit cell of $SmGdFe_{17}$ is smaller than that of Sm_2Fe_{17} and Gd_2Fe_{17}. However, in contrast to most $R_2Fe_{17-x}Si_x$ intermetallics for which the unit cell contracts with increasing silicon content[3, 4], the unit cell of $SmGdFe_{17-x}Si_x$ samples is larger than that of $SmGdFe_{17}$. In the case of $Sm_yGd_{2-y}Fe_{17-x}Si_x$ samples, however, the cell volume increases very slightly with increasing samarium content.

The dependence of the Curie temperature of $Sm_yGd_{2-y}Fe_{15}Si_2$ on the samarium content is similar to that for $Sm_yGd_{2-y}Fe_{17}$ as shown in Fig. 1. It appears that the Curie temperature of $Sm_yGd_{2-y}Fe_{17}$ intermetallics may vary through a maximum as the samarium content is increased. In contrast to other $R_2Fe_{17-x}Si_x$ intermetallics[3,4], partial substitution of iron by silicon in $SmGdFe_{17-x}Si_x$ does not have a significant effect on the Curie temperature. In order to investigated that the effect of silicon on the variation of crystallographic and magnetic properties of $Sm_yGd_{2-y}Fe_{17-x}Si_x$ alloys, XRD patterns and lattice parameters with composition (x=0, 2 and y=0.33～1.67) were presented in this study and compared between two compounds.

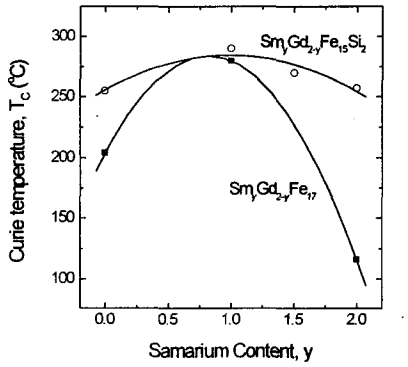

Fig. 1. Dependence of the Curie temperature of $Sm_yGd_{2-y}Fe_{17}$ and $Sm_yGd_{2-y}Fe_{15}Si_2$ on the samarium content.

REFERENCES

[1] K. H. J. Buschow, in Interstitial Intermetallic Alloys (edited by F. Grandjean, G. J. Long, and K. H. J. Buschow), Kluwer Academic Publishers, Boston, pp. 349～369 (1995).

[2] H. M. Rietveld, J. Appl. Crystallogr., **2,** 65 (1969).

[3] G. K. Marasinghe, O. A. Pringle, G. J. Long, W. B. Yelon, and F. Grandjean, J. Appl. Phys., **76,** 2960 (1994).

[4] M. Valeanu and M. Plugaru, Mater. Lett., **18,** 331 (1994).