Preparation and Magnetic Properties of BaFe12-2xCox-ySnxNiyO19 Particles

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Abstract. $BaFe_{12-2x}Co_{x-y}Sn_xNi_yO_{19}$ hexagonal-plated-shaped barium ferrite powders were prepared by chemical pricipitation and subsequent heat treatment to investigate the effects of Ni ion on the magnetic properties of the barium ferrite powders. Experimental results indicates that if the y value in the chemical formula is varied and the x value is maintained constant, i.e. the partial replacement of Co ion by Ni ion, the particle size and σ_s of the powders were reduced; furthermore, the H_c value of the powders would be maximized at a certain y value. If the x value is varied and maintained y=0.5x, the large the addition of $(Co_{x/2}Ni_{x/2}Sn_x)$ ions causes the more of a decrease in the σ value, H_c value, and curie temperature.

INTRODUCTION

Hexagonal-plated-shaped barium ferrites are a highly promising material for perpendicular recording media, if its H_c can be reduced for easier writing by the magnetic head. The H_c of barium ferrites can be reduced by simultaneously adding Co and Sn ions [1] to replace some Fe_2O_3. Since Ni ion is a component of Ni-Zn soft ferrites, adding Ni ions to replace some Co ions may affect the H_c value of barium ferrites. In this report, the effects of magnetic properties of barium ferrites are examined by (1) partially replacing Ni ion for Co ion at a fixed Sn ion, i.e. changing y value and maintaining the x value constant in $BaFe_{12-2x}Co_{x-y}Sn_xNi_yO_{19}$, and (2) varying the x value and maintaining at y=0.5x.

EXPERIMENTAL

Acidic aqueous solutions containing $BaCl_2\cdot 2H_2O$, $FeCl_3\cdot 6H_2O$, $CoCl_2\cdot H_2O$, $SnCl_4\cdot 5H_2O$, and $NiCl_2\cdot 6H_2O$ were precipitated by adding Na_2CO_3 solution. Hexagonal-plated-shaped $BaFe_{12-2x}Co_{x-y}Sn_xNi_yO_{19}$ particles were obtained by washing, drying, and finally heating the precipates at 600-900°C for various times.

RESULTS AND DISCUSSION

XRD analysis in Figure 1 indicates that the major phases of the precipitates after the heat treatment at 650°C is α-Fe_2O_3; barium ferrite phase starts forming at 750°C. Electron micrographs in Figure 2 reveal that the particle shape of the ferrite powders is hexagonal-plated. When the ferrite powders are heat treated at 850°C for 1hr, the particle size of the ferrite powders ranges between 0.4μm to 0.25μm when the y value (Ni ion content) is between 0.2 to 0.8, while maintaining at x=1.0. Moreover adding Ni ion decreases the particle size. While maintaining at x=0.8, adding Ni ion to partially replace Co ion, causes the σ value of the powders to decrease with the Ni ion concentration (Figure 3). However, adding Ni ion maximizes the H_c value of the ferrite powders at y=0.4. Furthermore partially replacing Co ion by Ni ion does not significantly affect the powders' magnetic properties. If the replacement of Co ion by Ni ion is maintained at 50%, i.e. the formula is $BaFe_{12-2x}Co_{x/2}Ni_{x/2}Sn_xO_{19}$, the σ value and H_c value (Figure 4) decrease with the x value, i.e. the concentration of (Co, Ni, Sn) ions. In particular the H_c value decrease more sharply than the σ value. Figures 5 and 6 also reveal that the σ value and H_c value not only decrease with the x value, but also decrease with the measuring temperatures. The curie temperature of the ferrite powders are found about 450°C for x=0 and 350°C for x=0.8.

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References

[1] K. Sueto, H. Sakumoto, A. Suzuki, and M. Sugimoto, "Ferrites," p. 964. Proc. 6th International Conf. on Ferrites, Tokyo, 1992.

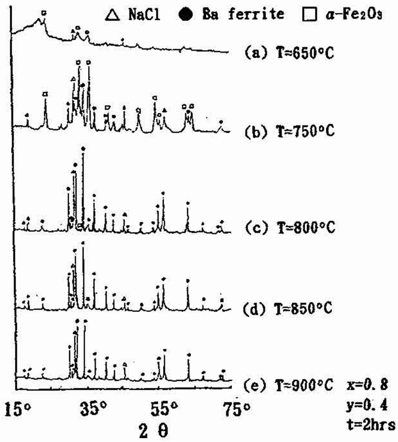

Figure 1 X-ray diffraction patterns of powders heat treated at various temperatures

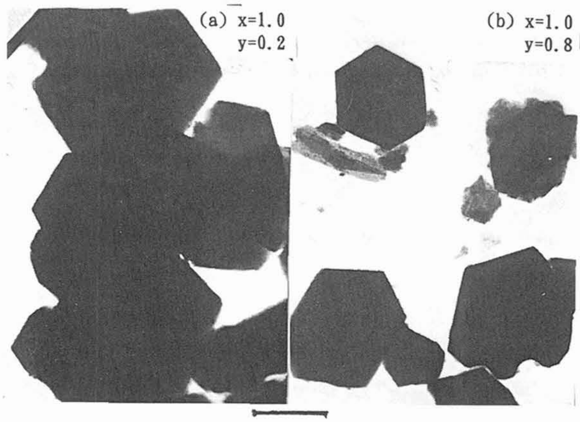

Figure 2 Electron micrographs of powders at various x values (Ni contents)

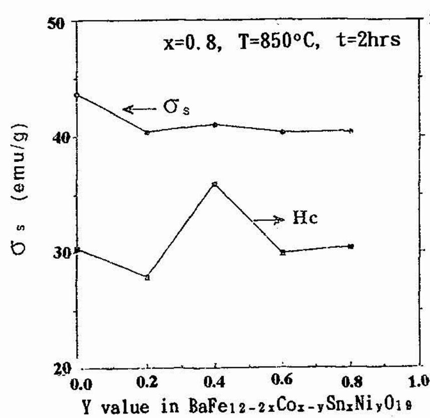

Figure 3 σ_s and H_c values of powders at various y values

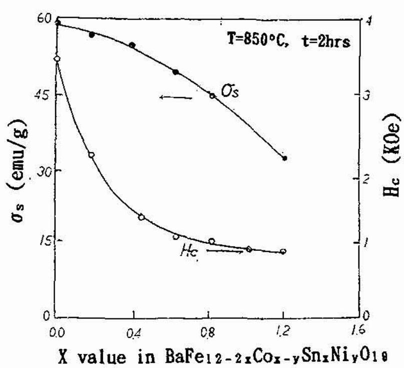

Figure 4 σ_s and H_c values of powders at various x values

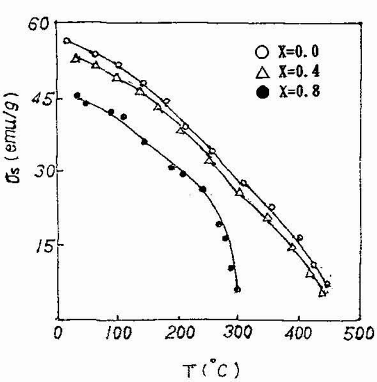

Figure 5 σ_s values of powders at various temperatures

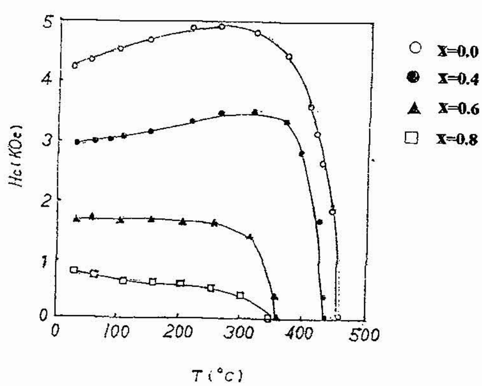

Figure 6 H_c values of powders at various temperatures