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MAGNETIC PROPERTIES AND THERMAL STABILITY OF CoNiFe ALLOY FILMS

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CoNiFe 합금박막의 자기적 성질과 열적 안정성에 대한 연구

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1. INTRODUCTION

Soft magnetic thin films with high saturation magnetization ($4\pi M_s$) are strongly required as a pole material of write head for high magnetic recording density. Recently, Co-Ni-Fe based soft magnetic films with high saturation magnetization greater than 20 kG were reported to be able to fabricate by the electroplating method [1]. However, this method has some difficulties in the control of the composition and the magnetic properties of films. A sputtering method is known to be adequate to control the film composition and magnetic properties. In this study, the dependence of magnetic properties of as-sputtered CoNiFe films on the content of Co, Ni and Fe were investigated. We also investigated the thermal stability of these films using the TFA(transverse field annealing) method.

2. EXPERIMENTAL

First, we investigated of magnetic properties of CoNiFe films. CoNiFe films with the thickness of about 1 μm were fabricated over a wide composition range of 17.4~76.4 at.% Co, 5.8~30.9 at.% Ni and 16.2~70.5 at.% Fe by an rf magnetron sputtering using the composite target, which consists of an Fe(or Co) plate and Co(or Fe), Ni chips. The input power density and the Ar pressure were 5.7 W/cm^2 and 1m Torr, respectively. The structure of the films was analyzed by XRD and the composition was by EPMA. $4\pi M_s$ and coercivity(H_c) were measured by an vibrating sample magnetometer. The electrical resistivity

was measured by four-point probe method. The next stage, TFA were performed at the annealing temperature of 150℃ with 100 Oe field applied along the hard axis as a function of annealing time for 30 90, 180, 300 and 480 min.

3. RESULTS AND CONSIDERATIONS

As-sputtered CoNiFe thin films have the saturation magnetization of 18～21 kG, the coercivity of 1.5～2.5 Oe . Especially, the effective permeability of $Co_{23.8}Ni_{29.3}Fe_{46.9}$ and $Co_{57.8}Ni_{14.6}Fe_{27.6}$ film is 1,040 and 850, respectively, and maintain up to 100 MHz. Therefore, these films exhibit better high frequency characteristics than those of electroplated $Co_{65}Ni_{12}Fe_{23}$ film which permeability is 600 at 1 MHz [1].

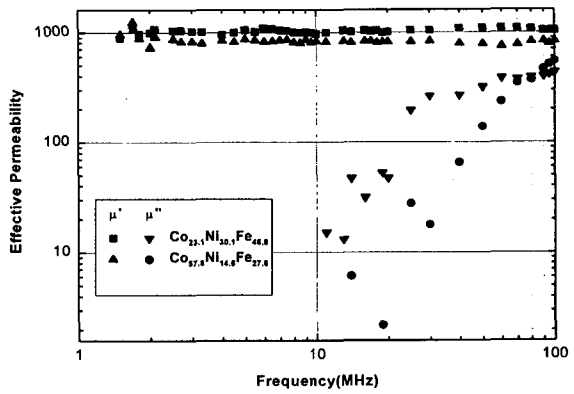

Fig. 1 The frequency dependencies of effective permeability for $Co_{23.8}Ni_{29.3}Fe_{46.9}$ and $Co_{57.8}Ni_{14.6}Fe_{27.6}$ films.

In thermal stability experiments, the hard axis of CoNiFe films did not rotate until the annealing time of 90 min., and further annealing rotated the hard axis about 10～20 degree. The saturation magnetization, and the resistivity of annealed CoNiFe films were maintained to be almost the same as before.

4. REFERENCES

[1] Tetsuya Osaka, Madoka Takai, Katsuyoshi Hayashi and Yoshimichi Sogawa, " IEEE Trans. Magn. **34**, 1432 ~ 1434(1998).