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ROLE OF MAGNETOELASTIC ANISOTROPY IN Ni/Pt MULTILAYERS

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Ni/Pt 다층박막에서 자기탄성이방성의 역할

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I. INTRODUCTION

One of the most interesting issues relating magnetism is to understand the magnetic anisotropy. There has been particular interest in searching for magnetic thin films having room-temperature perpendicular magnetic anisotropy (PMA). Most Co/X multilayers have shown to exhibit a strong perpendicular magnetic anisotropy and similar observations have been reported in Fe/X multilayers. Possible explanations for a strong PMA in these multilayers include the Neel's surface anisotropy due to lowered symmetry at an interface. However, most Ni-based multilayers have been reported to exhibit in-plane anisotropy, even though Krishnan *et al.* have reported the PMA in Ni/Pt multilayers at very low temperatures of 5 K. Recently, we firstly report room-temperature perpendicular magnetic anisotropy in Ni/Pt multilayers[1]. Here we report the origin of PMA in this sytem by careful *in situ* stress and *ex situ* magnetostriction coefficient measurements.

II. EXPERIMENT

Ni/Pt multilayers were prepared by sequential dc magnetron sputtering deposited onto glass substrates under a base vacuum of 8 $\times 10^{-7}$ Torr and a sputter pressure of 7 mTorr. The deposition rates achieved under these process conditions were 1.0 Å/sec for Ni and 3.25 Å /sec for Pt. The number of multilayer repeats was fixed at 30. Stress of Ni/Pt multilayers was measured *in situ* during the deposition and magnetostriction coefficient was measured *ex situ* using a homemade optical displacement detector[2].

III. RESULTS AND DISCUSSION

PMA at room temperature in Ni/Pt multilayer thin films were obtained for the samples of constant 3-Å Pt and 9~30 Å Ni sublayer thicknesses. With the phenomenological model, we have found that PMA was due to a positive volume anisotropy contribution, rather than a positive surface anisotropy contribution as Co-based multilayers. In Fig.1, the stress in Ni sublayer was tensile and inversely proportional to Ni sublayer thickness, which could be interpreted by incoherent growth of a multilayer resulting from a lattice misfit of 10.2 % between Ni and Pt. With increasing the Ni sublayer thickness, the magnetostriction coefficient was observed to change sign from positive to negative at a 7-Å-thick Ni sublayer. From the measurements of stress and magnetostriction coefficient, we have estimated the magnetoelastic anisotropy of $2.88 \sim 4.72 \times 10^5$ erg/cm^3, which is decipited in Fig.2, and found that it was large enough to overcome the negative contributions from the surface and shape anisotropy. Thus, it could be concluded that the magnetoelastic anisotropy plays a major role to have PMA in this system.

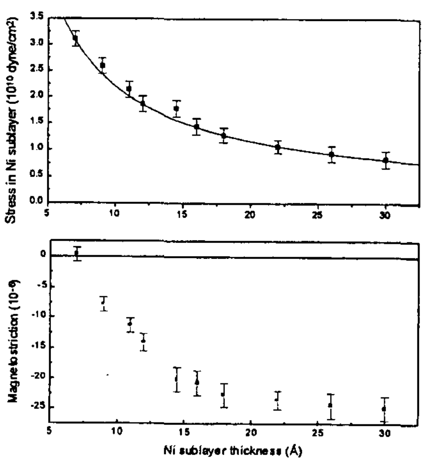

Fig. 1 Stress and Magnetostriction

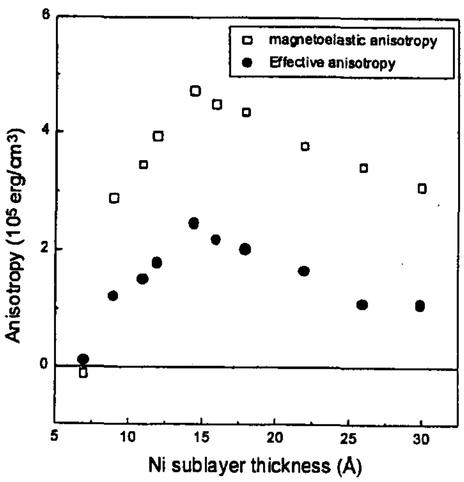

Fig.2 Magnetoelastic and effective anisotropy

Reference

[1] Sung-Chul Shin, G. Srinivas, Young-Seok kim, and Mu-Gyeom Kim, APL 73(3), 393(1998)

[2] Young-Seok Kim and Sung-Chul Shin, to be published in J. Magn.Magn. Mater. (1998).