Fe-Co-B/Ni-Fe thin film with high magnetic anisotropy field for soft magnetic underlayer of perpendicular magnetic recording media

S.H. Kong, S. Ito, T. Okamoto and S. Nakagawa*

Department of Physical Electronics, Tokyo Institute of Technology, 2-12-1 O-okayama, Meguro Gu, Tokyo, 152-8552, Japan

*Corresponding author: e-mail: nakagawa@pe.titech.ac.jp, Phone: +81 3 5734 3564, Fax: +81 3 5734 2513

Introduction

It has been reported that the high in-plane uniaxial magnetic anisotropy field H_k in soft magnetic underlayer (SUL) of perpendicular magnetic recording media played an important role to increase a signal to noise ratio by setting the easy axis orientation to the cross track direction[1]. In this study, we introduce Fe-Co-B/Ni-Fe SUL with high H_k as well as high saturation magnetization $4\pi M_s$. Furthermore, the origin and the thermal stability of the high H_k in the SUL were also investigated.

Experiment

$Fe_{67}Co_{29}B_4/Ni_{79}Fe_{21}$ SUL was prepared on Si wafer using facing targets sputtering apparatus at room temperature. A post-deposition thermal annealing was performed at the annealing temperature of 300, 400 and 500 °C for 1 hour in vacuum below 3×10^{-6} Torr.

Results and discussion

Ni-Fe seedlayer was so effective for Fe-Co-B films to decrease coercivity in hard axis direction from 59 Oe for 160 nm-thick Fe-Co-B single layer to 1 Oe for Fe-Co-B(200 nm)/Ni-Fe(3 nm). Furthermore, Fe-Co-B layer deposited on Ni-Fe seedlayer showed a very high in-plane uniaxial H_k of about 280 Oe. In-plane XRD study clarified that the lattice spacing of the planes along the easy axis direction is expanded than that along the hard axis direction in the Fe-Co-B/Ni-Fe SUL. The lattice spacing of (110) planes along the easy axis was 2.028 Å, while that of the planes along hard axis direction exhibited 2.020 Å. The estimated in-plane H_k of Fe-Co-B/Ni-Fe SUL using the change of lattice spacing of planes along the easy axis and saturation magnetostriction λ_s of 1.7×10^{-5} was about 250 Oe, which was almost agreement with the value from M-H loop. Moreover, the high H_k in the Fe-Co-B/Ni-Fe SUL was also maintained until 300 °C annealing temperature, as shown in Fig.1. 500 °C annealing temperature leads the magnetic anisotropy direction to change 90 degree with respect to the previous direction of the SUL.

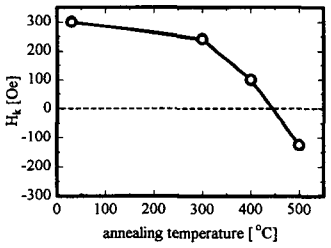

Fig.1 Dependence of H_k on annealing temperature in FeCoB(200nm)/NiFe(3nm).

References

[1] Y. Nakatani, N. Hayashi, Y. Uesaka and H. Hukushima, J. appl. phys. 93, 7744 (2003).