S-9

Interdiffusion Effect of Inserted Nanolayer in Excange-biased NiFe/FeMn/NiFe Multilayer

Dankook University S. W. KIM*, J. K. KIM, K. A. LEE

Sangji University B. K. KIM, J. H. KIM, J.Y.Lee, S. S. LEE, D. G. HWANG

1. INTRODUCTION

One problem in giant magnetoresistance(GMR) spin valves and magnetic tunneling junctions(MTJ) exchange biased by Mn-based antiferromagnets is the Mn diffusion into the ferromagnetic layer and other layers upon annealing.[1-3] It seems that Mn diffusion that may occur during annealing has a key role in the exchange biasing. We have fabricated multilayers inserting the nanolayer(NL) between antiferromagnet and ferromagent using ion-beam deposition system to study the diffusion effect for the exchange bias.

2. EXPERIMENTAL

The samples consisting of Ta(10 nm)/NiFe(11 nm)/NL/FeMn(16 nm)/NL/NiFe(6 nm)/Ta(5 nm) were deposited using ion beam sputtering system at room temperature on Corning glass 7059, where the NL is Mn and Cr. The NL thickness was changed form zero to 1.4 nm. The samples were annealed in vacuum below 5 x 10^{-6} Torr at 300 ℃ for 1 hour under applied field of 500 Oe. The magnetic properties of samples were measured by dc-four point probe method at room temperature. The texture of the multiplayer samples were determined using X-ray diffraction (XRD).

3. RESULTS AND DISCUSSION

Fig. 1 shows magnetoresistance (MR) for the inserted at the bottom interface (a) Cr and (b) Mn as a function of the NL thickness. The exchange bias field (H_{ex}) is more rapidly reduced for the Cr inserted sample than that of Mn inserted one. The H_{ex} (top) for the 0.6 nm Cr inserted sample vanished even if the top interface did not inserted the Cr layer. Fig. 2 shows the (a) $\boldsymbol{H_{ex}}$ and (b) coercive field($\boldsymbol{H_c}$) at the top(open) and bottom(solid) interfaces as a function of NL thickness, where the circles and squares are the Mn and Cr inserted samples, respectively. The dependence of $\boldsymbol{H_c}$ on the NL thickness is not clearer than that of H_{ex}. Fig. 3 shows X-ray scans for for no inserted samples (a)before and (b) after annealing at 300 ℃ for 1 h, and (c) the 0.1 Cr inserted one as annealed. The relative peak intensity of γ-FeMn(111) and

NiFe(111) in as-deposited samples did not changed up to 1.4 nm. However, the intensity of γ-FeMn(111) increased as annealing at 300 ℃ for 1 hour.

4. CONCLUSIONS

We have inserted a very thin layer in NiFe/FeMn/NiFe trilayers to understand the interdiffusion effect on exchange biasing. There are different tendeccies of exchange biasing at the top and bottom interfaces. In particularly, we have found that the H_{ex}(bottom) did not changed as the NL thickness was increased up to 1.4 nm.

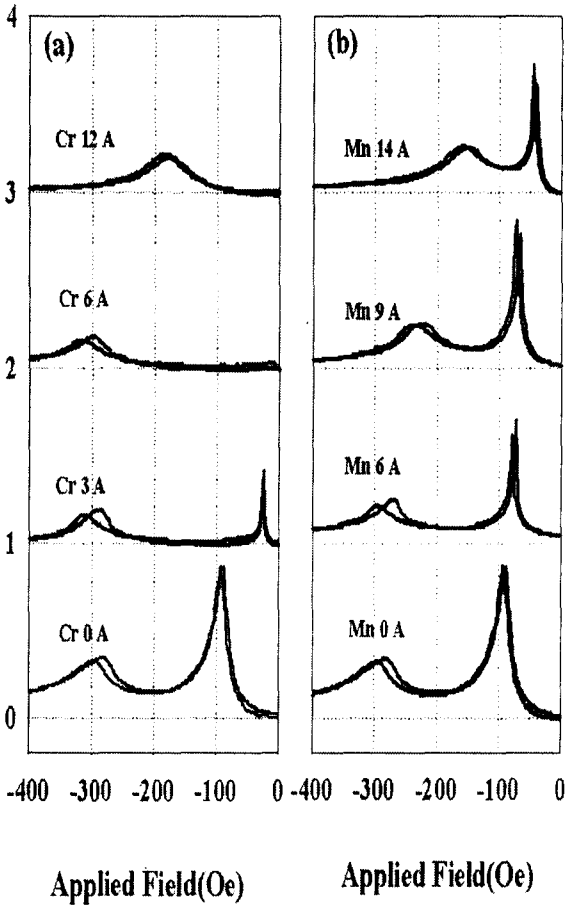

Fig. 1. Magnetoresistance curves as a function of the inserted NL thickness.

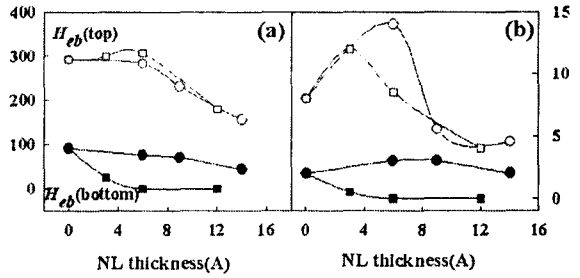

Fig. 2. The (a) H_{ex} and (b)H_c at the top(open) and bottom(solid) inter faces as a function of NL thickness, where the circles are the Mn inserted samples, and the squares are the Cr inserted samples.

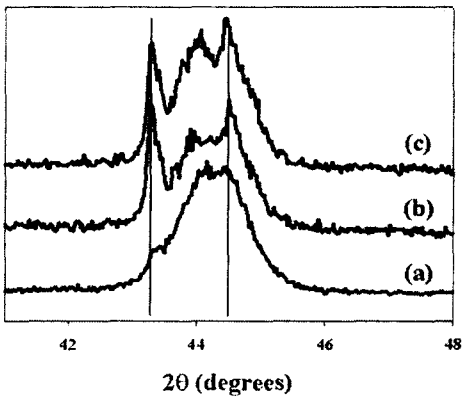

Fig. 3. X-ray scans for no inserted samples (a) before and (b) after annealing at 300 ℃ for 1 h, and (c) the 0.1 Cr inserted one as annealed.

5. REFERENCES

[1] J. H. Lee, H. D. Jeong, C. S. Yoon, C. K. Kim, B. G. Park, and T. D. Lee, *J. Appl. Phys.***91**, 1431 (2002)

[2] J. H. Lee, C. S. Yoon, C. K. Kim, J. H. Yuh, and Y. W. Kim, *J. Appl. Phys.* **91**, 7472 (2002)

[3] H. G. Cho, Y. K. Kim and S. R. Lee, *IEEE Trans. on Magn.*, **38**(5), 1 (2002).