Magnetoresistive properties and thermal stability of CoNbZr-based spin valves with $Co_{80}Fe_{20}$ ferromagnet

Min Kyung Chung, Young Keun Kim , and Seong-Rae Lee*,

Division of Materials Science and Engineering, Korea University, Seoul 136-701, Korea
*Corresponding author: e-mail: kumesrl@korea.ac.kr, Phone: +82 02 3290 3270, Fax: +82 02 928 3584

CoNbZr (CNZ)-based spin valves (SV) possess superior thermal stability over traditional Ta-based SVs because they possess smoother interfaces, fine and dense microstructures [1]. We investigated the dependence of CoFe composition on the magnetoresistance and thermal stability behaviour of the CNZ-based SV. CNZ /$Co_{80}Fe_{20}$ /Cu /$Co_{80}Fe_{20}$ /IrMn /CNZ stacks were sputter-deposited on Si /SiO_2 substrates. A comparison was also made with SV using a $Co_{90}Fe_{10}$ ferromagnet. MR ratio, exchange bias field (H_{ex}) and $\Delta\rho$ of a $Co_{80}Fe_{20}$ SV increased up to about 51 % (3.5 %→5.6 %), 52 % (280 Oe→348 Oe) and 19 % (0.5 μΩcm →0.59 μΩcm) respectively. The MR ratio of the $Co_{80}Fe_{20}$ SV was enhanced because of higher spin polarization of the $Co_{80}Fe_{20}$ than that of the $Co_{90}Fe_{10}$. When the samples were annealed at 300℃ for 10 min, MR ratio and H_{ex} of $Co_{80}Fe_{20}$ SV increased about 48 % (from 5.6 % to 8.1 %) and 52 % (from 346 Oe to 536 Oe), respectively. The $Co_{80}Fe_{20}$ SV is thermally more stable than that of the $Co_{90}Fe_{10}$ SV as shown in Fig. 1. According to the AES depth profile, Mn diffused outward direction (surface) predominantly in the $Co_{80}Fe_{20}$ SV and to form Mn-oxides [2]. By contrast, Mn diffused both inward and outward directions for the $Co_{90}Fe_{10}$ SV. The grain size difference between the $Co_{80}Fe_{20}$ and the $Co_{90}Fe_{10}$ layers may be the primary reason for the different diffusion and thermal behavior of the SV.

References

[1] H. G. Cho, Y. K. Kim, and S. R. Lee, J. Appl. Phys. (91) 10, 8581 (2002).
[2] H. G. Cho, Y. K. Kim, and S. R. Lee, IEEE Trans. Magn. (38) 5, 2685 (2002).

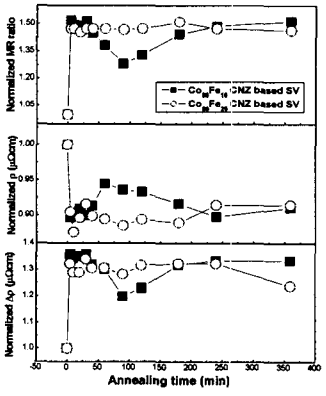

Fig. 1 Normalized MR ratio, ρ and Δ ρ changes of $Co_{90}Fe_{10}$ and $Co_{80}Fe_{20}$ spin valves as a function of annealing time. Samples were annealed at 300℃.