Effect of structural modifications on Exchange coupling in FeCo/FePt multilayers

Garima Vashisht[1], C. L. Dong[2], K. Asokan[3], S. Annapoorni[1]

[1]Department of Physics and Astrophysics, University of Delhi, Delhi. India
[2]Department of Physics, Tamkang University, Tamsui, Taiwan, Republic of China
[3]Material Science Division, Inter University Accelerator Centre, Aruna Asaf Ali Marg,
New Delhi-110 067, India
garimavashisht7@gmail.com

The effect of structural modifications in FeCo and FePt on varying substrates or buffer layer for FeCo/FePt multilayers is studied and its effect of exchange coupling between the layers is analyzed. These hard/soft magnetic multilayers are being exploited for latest advancements of technology in magnetic data storage and rare earth free permanent magnets. The high Curie temperature of these materials makes them suitable for high temperature magnet applications. An attempt is made to enhance the exchange coupling between the two layers by varying the thickness of each layer and the structural modification by changing the substrate of each layer.
FeCo/FePt/Si and FePt/FeCo/Si bilayers have been deposited on Si <100> using DC magnetron sputtering technique with varying thickness of individual layers and were annealed at 500 ˚C in $Ar+H_2$ atmosphere to remove oxides. Synchrotron X-Ray Diffractometer (XRD), Rutherford Backscattering (RBS) and Vibrating Sample Magnetometer (VSM) were performed to study the structural modifications, depth profile and magnetic properties for these multilayers. Micromagnetic Simulations were additionally performed to understand the magnetization reversal phenomenon. XRD pattern confirms the formation of $L1_0$-FePt over Si substrate and retaining its A1 phase for Si/FeCo/FePt even after annealing. Depth profile obtained from the simulated RBS spectrum does not show any signature of diffusion at the interface of FePt and FeCo even after annealing at 500 ˚C, thereby indicating a sharp boundary between the two layers. The bulk magnetic properties were studied experimentally by hysteresis loop and recoil curves obtained by VSM. Si/FeCo/FePt system after annealing at 500 ˚C shows low coercivity with a pinch in the hysteresis loop, revealing magnetic phases with two different anisotropies weakly coupled with each other. On the other hand, Si/FePt/FeCo shows a broad hysteresis loop with high $(BH)_{max}$ of 47 MGOe. The recoil curves of Si/FePt(27 nm)/FeCo(6 nm) shows strong exchange coupling between the two layers. Micromagnetic simulations using OOMMF were performed to have depth analysis of the magnetization reversal and domain analysis.

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