# Abstract

Metallic Multilayer Thin Films and Nanowires containing magnetic layers of Ni, Fe, Co or their Alloys, separated by non-magnetic spacer layer of Cu or Pt were prepared by Magnetron Sputter Deposition and Electrodeposition Techniques. The Fe/Cu/Ni trilayers were fabricated using RF Magnetron Sputter Deposition Technique. The XRD analysis exhibited crytalline behavior with cubic crystal structure and a new phase corresponding to cubic plane FeCuO was observed with increasing Cu spacer layer thickness. Thus roughness and interface diffusion of layers enhanced. The Magnetic analysis showed a trend of decreasing coercivity with increasing in Cu layer thickness and soft magnetic behavior. The resistivity of the samples measured by I-V plot was also increased with increasing Cu layer thickness. A Giant Magnetoresistance (GMR) value of 16% was observed for minimum Cu layer thickness.

Then Multilayer (ML) Thin Film Structures of N[Fe/Cu/Ni] were Electrodeposited for GMR measurements. The XRD analysis for structural studies revealed that all peaks were well matched with Ni (face-centered cubic) being the top most layer during ML deposition and a shifting of preferred orientation was observed with variation in the layer thickness of Cu. Refined structural parameters were calculated and details of fittings have been discussed with reference to layers' thicknesses. Crystallite size, dislocation density, Stacking Fault Probability and strain all showed oscillatory behavior with variation in thicknesses. Magnetic properties investigated using VSM showed strong dependence of magnetization on layer thicknesses. Increasing Fe and Ni layer thicknesses enhanced the Saturation Magnetization whereas oscillatory behavior of magnetization was observed with variations in Cu layer thickness. Magnetotransport measurements showed Oscillatory Giant Magnetoresistance (GMR) behavior as a function of intervening layer thickness. Highest value of GMR ~12% was observed with a Cu layer thickness of 9.6 nm.

Template-Assissted Single and Multilayered Nanowires of Ni, Ni/Cu/Ni, NiCo/Cu/NiCo and NiCoFe/Cu/NiCoFe were fabricated using Potentiostatic Electrodeposition Method. Stacks were repeated throughout the length of Nanowires. Polycarbonate track etched membrane was used to prepare nanowires with 30 nm diameter (pore diameter) and 6 μm length. A Hexagonal closed packed (hcp) crystal structure was observed from XRD

results. Texturing of c-axis of nanowires was in the direction perpendicular to the NWs' long axis and remained same for all Nanowire Samples. Crystallite size of Ni, NiCo/Cu/NiCo and NiCoFe/Cu/NiCoFe was found comparable to the pore diameter of polycarbonate template i.e. ~ 30nm thus showing c-axis in the direction perpendicular to the NWs' long axis. The low coercivity but a ver high value of GMR i.e. 70.84% was observed for NiCoFe/Cu/NiCoFe Multilayer Nanowires.

Finally, different structures of $Co_{1-x}Pt_x(0\leq x\leq 1)$ alloys in the form of thin films and nanowires were also prepared using Electrochemical Deposition Method. Thin films containing lower Co content exhibited hard magnetic behavior whereas soft magnetic properties were observed for thin films with high Co content. Ordered $L1_0$fct structure was obtained for all the samples at room temperature. In case of $Co_{1-x}Pt_x$ Nanowires, the similar trend of hard magnetization was exhibited for lower Co content, whereas soft behavior for all the rest of the compositions. For nanowires containing lower Pt content, the easy axis lied parallel to the wire axis and crossover was observed for higher Pt content. Switching mechanism of the magnetization occurs by localized coherent rotation for lower Pt values and by curling rotation for higher Pt values in $Co_{1-x}Pt_x$ nanowires.