Magnetic Interfaces and Nanostructures
Room: Central Hall - Session MI-ThP

Magnetic Interfaces and Nanostructures Poster Session

MI-ThP1 Magnetic Properties of Ferromagnetic-Antiferromagnetic Bi-Layers with Different Spin Configuration, ***W. Kim***, Korea Research Institute of Standards and Science (KRISS), *G.-E. Yang*, Chungnam National University, Korea, *C. Hwang*, Korea Research Institute of Standards and Science (KRISS), *E. Cho*, Chungnam National University, Korea

We investigated the effect of different spin direction of anti-ferromagnetic(AFM) layer on the magnetic properties of ferromagnetic(FM) layer in Fe-NiO and Fe-CoO bi-layer systems. For Fe-NiO system, we prepared successfully Fe/NiO/Ag(001) and Fe/NiO/MgO(001) systems on a single MgO(001) substrate. We examined magnetic properties of the bi-layer system using the surface magnetic optical Kerr effect(SMOKE) and X-ray magnetic linear dichroism(XMLD). From SMOKE measurement we observed the coercivity enhancement due to the set-up of AFM order of NiO films in both of the Fe/NiO/MgO(001) and Fe/NiO/Ag/MgO(001) system. The most remarkable results in our observation is that the coercivity enhancement of Fe/NiO/Ag/MgO(001) is much larger than that of Fe/NiO/MgO(001). XMLD experiments confirmed the out-of-plane spin direction of NiO layers in Fe/NiO/MgO(001) and in-plane spin-direction of NiO layers in Fe/NiO/Ag/MgO(001), and we concluded that the origin of large enhancement of coercivity is due to the strong parallel coupling between Fe layers and NiO layers. We also confirmed that this strong parallel coupling maintained across the thin Ag layer inserted between Fe and NiO layers. With this Ag inserted Fe/NiO system, we could estimate the Neel temperature of the NiO layers. We also realized different spin configuration in Fe-CoO systems by growing CoO films on theAg(001) and MnO(001) surfaces. We observed much larger coercivity enhancement in Fe/CoO/Ag(001) than in Fe/CoO/MnO(001) below the Neel temperature of CoO films.

MI-ThP2 Spin Dynamics and Exchange Bias in Core-Shell Fe\γ-Fe_2O_3 Nanoparticles, ***S. Chandra***, *H. Khurshid*, University of South Florida, *W. Li, G.C. Hadjipanayis*, University of Delaware, *M.H. Phan, H. Srikanth*, University of South Florida

Exchange bias in core-shell nanoparticles has been an area of intense research. While several research efforts have been devoted in understanding the role of interfacial spins in the nanoparticles that exhibit exchange bias, a clear understanding of the spin dynamics of the core and the shell remains to be investigated. A detailed study has been carried out on the magnetic properties of Fe/γ-Fe2O3 core-shell structured nanoparticles synthesized by thermal decomposition method.Our focus is to understand the spin dynamics of the core and shell independently and their role in triggering exchange bias (EB) phenomenon. The nanoparticles exhibit memory effect and aging associated with a superspin glass state (SSG). We show that the energy barrier distribution shows two maxima that marks the freezing temperatures of the core and shell. Lastly, hysteresis measurements after field cooling reveal a strong EB indicated by a loop shift. The onset of EB is at 35 K when the ferromagnetic core is frozen and the moments in the ferrimagnetic shell begin to block resulting in enhanced exchange coupling.

MI-ThP4 Modeling-assisted Synthesis and Characterization of Epitaxial $NiTiO_3$ Films as New Multiferroics, ***T. Varga***, *T.C. Droubay, M.E. Bowden, S.A. Chambers, B.C. Kabius, E. Apra, W.A. Shelton, V. Shutthanandan*, Pacific Northwest National Laboratory

In a search for new multiferroic materials where the direction of magnetization can be switched by an applied electric field, we have looked for materials in which polarization and magnetization are strongly coupled. Recent theory calculations predicted that the family of compounds $MTiO_3$ (M = Mn, Fe, Ni), in a certain polymorphic structure (acentric *R3c*), are promising candidates where a polar lattice distortion can induce weak ferromagnetism. Guided by these insights, a rhombohedral phase of Ni TiO_3 has been prepared in epitaxial thin film form, whose structure is of the predicted multiferroic. Preliminary physical property measurements suggest a Neel transition also consistent with the R3c structure and SHG imaging shows a polarized lattice. The synthesis of epitaxial $NiTiO_3$ films, their full structural characterization and physical property measurements along with our first-principles DFT calculations to predict the desired $NiTiO_3$ structure, its stability, and the effect of lattice strain on the growth are reported .

MI-ThP5 Nanomechanical Manipulation of the Anomalous Hall Effect in GaMnAs, *J.H. Lee, M.L. Cho*, ***Y.D. Park***, Seoul National University, Republic of Korea

We show an explicit dependence of the anomalous Hall effect (AHE) as well as magnetic anisotropy (MA) on locally induced mechanical strains in low-temperature molecular beam epitaxy (LT-MBE) prepared GaMnAs. LT-MBE GaMnAs (001) epilayers were prepared on AlGaAs layer, which serves (1) to enhance compressive strain in GaMnAs during growth as well as (2) to act as a sacrificial layer. By selective nanopatterning and removal of the AlGaAs layer, we realise free-standing GaMnAs microbeams (along (110),(1$\underline{1}$0), and (100) directions) with multiple lateral probes along the length of the microbeam. Due to the relaxation of the the compressive strain when released, GaMnAs microbeam mechanically buckles. By simultaneous measurements of ρ_{xx} and ρ_{xy} along the length of the buckled GaMnAs microbeam (1.4 K < *T* < 300 K), we probe both AHE and MA as functions of local strain. We find relatively small changes in MA while large suppression of AHE for regions along the microbeam experience the highest mechanical strain. We demonstrate the novelty of such interplay between mechanical strain and AHE by realising simple Hall crosses which mechanical state can be robustly read by the AHE signal - which correspondence between mechanical state and transport properties are well suited for a low-power, non-volatile memory elements. Furthermore, we demonstrate the applicability of above methods beyond GaMnAs to other material systems which are sensitive to small mechanical strains via strong spin-orbit interactions, namely topological insulator Bi_2Se_3.

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