MAR17-2016-020303

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Tailoring non-collinear magnetism in oxide heterostructures, a path to novel memory[1]

ANAND BHATTACHARYA, Materials Science Division and Nanoscience and Technology Division, Argonne National Laboratory

We report upon the discovery of a non-collinear magnetic structure in superlattices of the ferromagnetic metallic oxide $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) and the correlated metal $LaNiO_3$ (LNO). The exchange interaction between LSMO layers is mediated by the intervening LNO, such that the angle between the magnetization of neighboring LSMO layers varies in an oscillatory manner with the thickness of the LNO layer. The magnetic field, temperature, and spacer thickness dependence of the non-collinear structure are inconsistent with the bilinear and biquadratic interactions that are used to model the magnetic structure in conventional metallic multilayers. A model that couples the LSMO layers to a helical spin state within the LNO fits the observed behavior. We propose that the spin-helix results from the interaction between a spatially varying spin susceptibility within the LNO and interfacial charge transfer that creates localized Ni^{2+} states. Furthermore, using a combination of the anomalous Nernst effect and anisotropic magnetoresistance measurements, we are able to map out the dependence of the magnetic structure on the angle and magnitude of the applied magnetic field. We are able to switch the orientation of the nearly anti-ferromagnetically aligned LSMO layers between different angular positions using a small magnetic field, and read out the different configurations using resistive measurements. Our findings suggest a pathway to a novel memory device that combines advantageous features of both antiferromagnetic and ferromagnetic memories.\pard[1] J. Hoffman et al., "Oscillatory Non-collinear Magnetism Induced by Interfacial Charge Transfer in Metallic Oxide Superlattices", *Phys. Rev.* X., *accepted* (2016).2] J. Hoffman et al., "Tunable Non-collinear Antiferromagnetic Resistive Memory through Oxide Superlattice Design" (submitted).

[1]US Department of Energy, BES, Division of Materials Science and Engineering; Center for Nanoscale Materials, Argonne National Laboratory; US Dept. of Commerce, NIST