MAR11-2010-020019

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Emergent phenomena at the heterointerface of multiferroic $BiFeO_3$ and ferromagnetic $La_{0.7}Sr_{0.3}MnO_3$[1]

PU YU, Department of Physics, University of California, Berkeley

Novel phenomena and functionalities at the heteroepitaxial complex oxide heterostructures have been attracting much scientific attention from the fundamental physics as well as the technological applications. Essentially, the charge and spin reconstruction at the interface could lead to exotic, totally unexpected state of matters at the interface, such as conductive interface between insulating materials and interfacial ferromagnetism at the proximity of antiferromagnet. In this talk, I will present a systematic study of the electronic (charge) and magnetic (spin) interactions in an all-oxide model heterostructure system consisting of the ferromagnet (FM) $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) and the multiferroic (ferroelectric (FE) and antiferromagnetic (AFM)) $BiFeO_3$(BFO). The study has demonstrated the existence of magnetic coupling at this interface, manifested in the form of an enhanced coercive field as well as an exchange bias. Using x-ray magnetic circular dichroism, the origin of the significant exchange bias has been attributed to a novel ferromagnetic state in the antiferromagnetic BFO sublattice at the interface with LSMO. Based on this finding, the electrical control of magnetic coupling has been explored in the field effect geometry. The magneto-transport measurement clearly demonstrates a reversible switch/control between two distinct exchange bias states by isothermally switching the FE polarization of BFO. This is an important step towards controlling magnetization with electric fields, which may enable a new class of electrically controllable spintronic devices and provide a new basis for producing electrically controllable spin polarized currents. Finally, at the end of the talk, a generic interpretation will be proposed for the understanding of magnetoelectric coupling in the current model system.

[1]The author thanks the support from the Semiconductor Research Corporation-Nanoelectronics Research Initiative-Western Institute of Nanoelectrics program as well as U.S. Department of Energy under contract No. DE-AC02-05CH11231.