Contribution ID : **64** Type : **Oral Presentation**

Hidden complex magnetic interaction at La0.67Sr0.33O3/SrTiO3:Nb (111) interface

Monday, 13 August 2018 17:15 (15)

One of the major goals in condensed matter physics is to search for materials with multifunctionality at the quantum level. Strongly correlated oxides seem to be one of the most attractive candidates due to the collective behaviors emerged from strong interactions and correlations among their degrees of freedoms. Incorporating strongly correlated oxides into epitaxial heterostructures expands the space of new phenomena possible due to dimensional confinement and interfacial coupling. La0.67Sr0.33MnO3 (LSMO) is a key example of a strongly correlated perovskite oxide material in which a subtle balance of competing interactions gives rise to a ferromagnetic metallic ground state. This balance, however, can be easily tuned at interfaces. By constructing a strong polar interface between [111]-oriented LSMO and SrTiO3:Nb, the electronic and structural symmetry mismatch leads to lattice and charge modification which changes the magnetic interaction at the interface. An antiferromagnetic interaction stabilized at the interface results in spontaneous magnetic moment reversal and inverted hysteresis effects, which demonstrate that intimate competition in electronic, spin and lattice degrees of freedom in transition metal oxides can lead to new functionality.

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Session Classification : Speaker Sessions and Seminars

Track Classification : Magnetic Surfaces, Interfaces and Nanostructures