DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering,
PhD Proposal

June 1, 2015 at 3:00PM
Curtis 162 (MEM Seminar Room)

"Controlling Electronic Phase Transitions in $La_{1/3}Sr_{2/3}FeO_3$ Perovskite Oxides"

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Advisor: Dr. Steven May

Abstract

For nearly 5 decades, the global semiconductor industry has followed Moore's law, which has successfully employed the iterative concept of transistor scaling in silicon-based technology. This approach, however, is approaching its physical limitations due to confinement effects where the functionality of the transistor can become compromised. In recent years, a growing effort has been adopted to pursue new materials and technologies as an alternative solution to this problem. Complex oxides are a potential candidate material system for next generation electronic devices due to their rich material properties such as metal-insulator transitions, high-T_c superconductivity, and colossal magnetoresistance. In particular, there is growing interest to control metal-insulator transitions for applications in transistor-like devices.

This proposal focuses on growth, characterization and application of $La_{1/3}Sr_{2/3}FeO_3$ (LSFO) thin films, which are known to exhibit an abrupt electronic phase transitions (EPT) at 190 K. This phase transition is accompanied by an order of magnitude increase in resistivity going from a conductive to insulating state as well as the spontaneous ordering of charge and antiferromagnetic spin along the [111] direction. The proposed work aims to address the following three questions: How does cation ordering alter the EPT in LSFO superlattices, can electrostatic gating be used to dynamically tune the charge disproportionated state in three terminal LSFO devices, and can ionic gating via solid state electrolytes be used to dynamically tuned the oxygen vacancy concentration in LSFO and $SrFeO_3$ (SFO)? This research will develop fundamental understanding of new methods for controlling EPTs in complex oxides.

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