

Adventures with Cobaltite Heterostructures



Yayoi Takamura

August 27th 2024

3:00 PM – 4:00 PM

DA442

**IEEE Magnetics Society
Boston Chapter**



Abstract:

In this talk, I will discuss two recent scientific adventures with cobaltite heterostructures. In the first adventure, magnetic exchange interactions at the interface between two ferromagnetic oxides, $\text{La}_{0.67}\text{Sr}_{0.33}\text{CoO}_3$ (LSCO) and $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$ (LSMO) were investigated.[1] The LSCO/LSMO interface was characterized by a soft LSCO layer with magnetically active Co^{2+} ions which formed due to the combined effect of the formation of oxygen vacancies and interfacial charge transfer. As a result, a magnetic soft/hard interface formed in the interior of the LSCO layer which led to an exchange bias effect. The nature of the exchange bias effect could be carefully controlled with factors such as the LSCO layer thickness, epitaxial strain, and the layer stacking order. In the second adventure, I will discuss the evolution of the structural and functional properties of LSCO thin films in which their oxygen vacancy concentration was controlled through exposure to high temperature anneals under highly reducing environments.[2] A series of topotactic transformations from the equilibrium perovskite structure to the metastable brownmillerite structure and finally the rare $\text{La}_{1.4}\text{Sr}_{0.6}\text{Co}_{1+u}\text{O}_{4-\delta}$ Ruddlesden-Popper phase (where $0 < u < 1$ and $0 < \delta < 1$) through the loss of both oxygen and cobalt ions. The corresponding magnetic properties were tunable between various ferromagnetic and antiferromagnetic phases, and the room temperature resistivity spanned eight orders of magnitude. These adventures demonstrate the potential for cobaltite-based magneto-ionics for next generation device applications.

This work was supported by the National Science Foundation (DMR-1745450) and the Quantum Materials for Energy Efficient Neuromorphic Computing, an Energy Frontier Research Center funded by the U.S. Department of Energy, Office of Science, Basic Energy Sciences under Award No. DE-SC0019273.

Bio:

Yayoi Takamura received her B.S. from Cornell University in 1998 and her M.S. and Ph.D. degrees from Stanford University in 2000 and 2004, respectively, all in the field of Materials Science and Engineering. She was a postdoctoral researcher at UC Berkeley with Prof. Yuri Suzuki in the Dept. of Materials Science and Engineering before joining the Dept. of Materials Science and Engineering at UC Davis in July 2006. Since July 2020, she has been serving as Department Chair. Her research focuses on the growth of complex oxide thin films, heterostructures, and nanostructures and the characterization of the novel functional properties associated with their interfaces. Prof. Takamura is a recipient of the NSF CAREER Award, the DARPA Young Faculty Award, and the 2020 College of Engineering Mid-Career Research Award.