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Atomic-scale characterization of oxygen vacancy ordering in $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ thin films on $SrTiO_3$ via in-situ cooling experiments[1]
XUE RUI, University of Illinois at Chicago, JEFF WALTER, CHRIS LEIGHTON, University of Minnesota, ROBERT KLIE, University of Illinois at Chicago
— $La_{1-x}Sr_xCoO_{3-\delta}$ thin films have been studied extensively due to their rich magnetic phase behavior and interesting interplay between strain, defects, and magnetism. At x = 0, ferromagnetic order is observed under tensile strain (in sharp contrast to bulk), whereas at higher x strain can stabilize oxygen vacancy ordering, with profound effects on transport and magnetism. For $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ films grown on $SrTiO_3$ substrates, the phase transition of $SrTiO_3$ from cubic to tetragonal at around 105 K can further modify the magnetic/transport properties of the films due to the coupling of the out-of-phase tilt of TiO_6 octahedral with the CoO_6 octahedral network. In this contribution, we utilize atomic-resolution imaging and spectroscopies in a scanning transmission electron microscope to study the coupling between the TiO_6 octahedral tilt in the $SrTiO_3$ substrate and the oxygen vacancy ordering in the $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ thin films using in-situ cooling experiments. The structural analysis will be compared to films grown on $LaAlO_3$, and the formation of magnetic domains will be studied using angular resolved electron energy-loss spectroscopy.

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Xue Rui
University of Illinois at Chicago

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