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**Atomic-Scale Imaging and Control of Interface Magnetic States in Vacancy Ordered Cobaltite Thin Films**[1] ALBINA BORISEVICH, YOUNG-MIN KIM, MICHAEL BIEGALSKI, Oak Ridge National Laboratory, JUN HE, Vanderbilt University, HANS CHRISTEN, Oak Ridge National Laboratory, SOKRATES PANTELIDES, Vanderbilt University, STEPHEN PENNYCOOK, Oak Ridge National Laboratory — Magnetic properties of complex oxide thin films are strongly affected by strain, chemical composition, and octahedral tilt of the substrate. Here, we study lanthanum/strontium cobaltite ($La_{0.5}Sr_{0.5}CoO_{3-x,}$ LSCO) thin films via quantitative aberration-corrected scanning transmission electron microscopy and Electron Energy Loss Spectroscopy (EELS) to explore the coupling between magnetic properties, ionic behavior, and oxygen octahedral tilts. LSCO films were grown by PLD in identical conditions on two different substrates, LSAT (cubic) and NGO (orthorhombic). These substrates have nearly identical lattice parameters, but different octahedral tilts. The film on NGO appears to be $La_{0.5}Sr_{0.5}CoO_{2.5}$, while the film on LSAT is less oxygen deficient. Comparison of measured lattice parameters with the first-principles calculations allows us to determine oxygen content in the film. In $La_{0.5}Sr_{0.5}CoO_{2.5}$/NGO films, EELS reveals different valence states of Co at the interface depending on termination, resulting in different magnetic states. Therefore changes in octahedral tilts can induce changes in oxygen stoichiometry and interface magnetic states of the vacancy ordered structures.

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