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Direct measurement of the low-temperature spin-state transition in epitaxially strained $LaCoO_3$ thin films ROBERT KLIE, GUANG YANG, YUAN ZHAO, Department of Physics, University of Illinois at Chicago — The perovskite oxide $LaCoO_3$ exhibits an anomaly in its magnetic susceptibility at 80 K associated with a thermally excited transition of the Co^{3+}-ion spin. We will show that atomic-resolution Z-contrast imaging and electron energy-loss spectroscopy in combination with ab-initio first-principles DFT calculations can be utilized to measure the spin-state transition in $LaCoO_3$. In particular, we utilize in-situ cooling experiments in a transmission electron microscope to demonstrate that the O K-edge pre-peak is sensitive to the Co^{3+}-ion spin-state. Our experimental results will be compared to first-principles calculations, and we will conclude that the thermally excited spin-state transition occurs from a low to an intermediate spin state, which can be distinguished from the high-spin state. Next, we will examine the effects of bi-axial strain and point defects in $LaCoO_3$ thin-films on the Co^{3+}-ion spin-state. We will show that a single-crystal pseudo-cubic $LaCoO_3$ (001) film can be successfully grown on $LaAlO_3$ (001). Moreover, we will show that the epitaxially strained $LaCoO_3$ film exhibits a ferro-magnetic transition at low temperature that was not observed in bulk $LaCoO_3$. We will discuss the origin of this transition and the possibility of stabilizing different Co^{3+}-ion spin-states in $LaCoO_3$ using interfacial strain.

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