Transport in ultrathin Mott materials

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This talk will discuss *d*-band transport in two very different complex oxide thin film systems, namely ultrathin films of a Mott material, $LaNiO_3$, and the two-dimensional electron gas in delta-doped $SrTiO_3$, respectively. Bulk $LaNiO_3$ is a paramagnetic metal with properties characteristic for strong electron correlations. In contrast to other rare earth nickelates, $LaNiO_3$ does not undergo a metal-insulator transition. Ultrathin films of $LaNiO_3$ have attracted interest because of theoretical predictions of antiferromagnetism and high-temperature superconductivity in confined superlattices. In this presentation, we investigate metal-insulator transitions in ultrathin (2 – 30 nm) epitaxial $LaNiO_3$ thin films. Films were grown on different substrates to obtain $LaNiO_3$ films that are coherently strained, with different signs and magnitude of film strain. It is shown that *d*-band transport is inhibited as the layers progress from compression to tension. Increasing tensile strain causes the film resistivity to increase, causing strong localization to appear below a critical thickness. We discuss the possibility of an enhancement of the transport mass that depends on strain. The second part of the talk focuses on epitaxial $SrTiO_3$ thin films grown by molecular beam epitaxy (MBE). We show that MBE allows for excellent stoichiometry control and low intrinsic defect concentrations, as evidenced by record electron mobilities that exceed those of single crystals. We discuss the nature of the two-dimensional electron gas in delta-doped $SrTiO_3$ films grown by MBE by analyzing Shubnikov-de Haas oscillations. Despite the inherent complexity of a sub-band that is derived from four *d*-band states near the conduction band minimum, we show that the quantum oscillations can be modeled quantitatively.