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Two dimensional Mott physics in the rare earth nickelates ANKIT DISA, DIVINE KUMAH, JOSEPH NGAI, JARRETT MOYER, FRED WALKER, CHARLES AHN, Center for Research on Interface Structures and Phenomena and Department of Applied Physics, Yale University — The strong electron correlations inherent in the rare-earth nickelate system ($RNiO_3$) lead to a metal-insulator transition, the temperature of which can be tuned by changing the rare-earth ion, R. Bulk $LaNiO_3$ is metallic at all temperatures, and $NdNiO_3$ undergoes a metal-insulator transition at 150 K. However, reducing the thickness of both $LaNiO_3$ and $NdNiO_3$ strongly affects the transport behavior, where $LaNiO_3$ undergoes a thickness-driven metal-insulator transition below $\sim$4 unit cells. Here, we identify the physics of this transition and demonstrate two-dimensional metallic behavior in thin films. We show that by direct chemical doping of $LaNiO_3$ thin films we can restore metallic behavior and tune the conductivity. We apply the same technique to thin films of $NdNiO_3$ and control the metal-insulator transition temperature. Finally, combining artificial confinement and doping, we observe metallicity in nickelate layers as thin as two unit cells. The effects of both structural and charge-carrier modifications on the transport properties of the thin films will be discussed.

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