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Conductivity enhancement of ultrathin $LaNiO_3$ films in superlattices JUNWOO SON, JAMES M. LEBEAU, S. JAMES ALLEN, SUSANNE STEMMER, University of California, Santa Barbara — The transport properties of heterostructures with Mott materials, such as $LaNiO_3$, have been predicted to exhibit unusual phenomena not present in the bulk. Prior studies have shown that ultrathin $LaNiO_3$ films exhibit strongly localized behavior, whereas thicker films remain metallic. Here, we report on epitaxial $[SrTiO_3(3\text{ u.c.})/LaNiO_3(4\text{ u.c.})]_n$ superlattices on (001) $(LaAlO_3)_{0.3}(Sr_2AlTaO_6)_{0.7}$ (LSAT) substrates (u.c. = unit cell). X-ray diffraction and Z-contrast imaging confirm sharp interfaces. The sheet resistance of the superlattices is explored as a function of temperature and number of bilayers. All superlattices with more than 2 layers were metallic whereas 4 u.c. $LaNiO_3$ films and a single 4 u.c. $LaNiO_3$/3 u.c. $SrTiO_3$ bilayer were both insulating. The sheet resistance of superlattices decreases with n. Possible models for the electrical characteristics will be discussed. The first model attempts to describe the sheet resistance with conduction through parallel-connected $LaNiO_3$ layers and conductive interfacial layers. The second model is based on coupling of layers, each of which is near the percolation threshold for a metal-insulator transition, and explains the difference in conductivity of single layers and superlattices without invoking interfacial layers.

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