Synthesis and Electronic Characterization of $Nd_{2-x}Sr_xNiO_4$ thin films ($0 \leq x \leq 1.4$)

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Layered nickelates have been studied extensively over the last three decades due to their structural similarities to the high-T_c superconducting cuprates. Using reactive oxide molecular beam epitaxy (MBE), we synthesize $Nd_{2-x}Sr_xNiO_4$ thin films for $x = 0 - 1.4$ to probe the properties and electronic structure as a function of hole doping. The samples with lower doping show semiconducting behavior across the temperatures probed with an onset of metallic conductivity at $x = 1.4$. We also present polarization-dependent O K and Ni $L_{2,3}$ x-ray absorption spectra to track the evolution of the oxygen-nickel hybridization, distribution of holes between O $2p$ and Ni $3d$ states and the nickel oxidation state across the series. Angle-resolved photoemission spectroscopy (ARPES) measurements reveal a Fermi surface that comprises a cuprate-like hole-pocket of $d_{x^2-y^2}$ character with an additional electron pocket of $d_{3z^2-r^2}$ character at Γ. The emergence of a quasiparticle peak at the Fermi vector for $x = 1.4$ corroborates the insulator-to-metal transition at $x \sim 1$. Finally, observe a fully two-dimensional Fermi surface with no momentum-dependent pseudogap, in contrast to measurements of the related bulk compound, $Eu_{0.9}Sr_{1.1}NiO_4$.

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