Surface Study of Infinite Layer Superconductor $Sr_{1-x}La_xCuO_2$ Thin Films: Electric Transport across Planar Tunnel Junctions and X-ray Photo-/Auger-Electron Spectroscopy

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We report on thin film planar tunnel junctions made from the electron-doped infinite layer superconductor $Sr_{1-x}La_xCuO_2$ (SLCO) with $x \sim 0.15$ as bottom electrode, a thin Au interlayer and Nb as top electrode. Experimental data on electric transport provide information on the interface and surface properties of our SLCO thin films. No Cooper pair tunneling is observed; however, nonlinear current-voltage characteristics give evidence for quasiparticle (QP) tunneling across a thin insulating SLCO barrier at the SLCO/Au interface, with a single gap value $\sim 1.4\,\mathrm{meV}$, originating from superconducting Nb. The absence of a superconducting SLCO gap in the QP conductance curves indicates a thin normal conducting SLCO layer below the insulating SLCO barrier. To examine its origin, X-ray photoelectron spectroscopy (XPS) and X-ray Auger-electron spectroscopy (XAES) on SLCO thin films was performed. We observe a Cu valence of 1+ in the SLCO surface layer (within $\sim 3\,\mathrm{nm}$ thickness) and of 2+ in deeper regions, as expected for fully oxidized CuO_2 planes in the bulk. Hence, the XPS and XAES results for the SLCO films are consistent with the QP tunneling spectra observed for our planar SLCO/Au/Nb junctions.