Electron Correlation and Charge Transfer in (Ba$_{0.9}$Nd$_{0.1}$)CuO$_{2+\delta}$/CaCuO$_2$ Superconducting Superlattices Observed with Resonant Inelastic X-ray Scattering

BYRON FREELON, LBL — In-plane CuO$_2$ physics of the 2×2 high-Tc superlattice (Ba$_{0.9}$Nd$_{0.1}$CuO$_{2+\delta}$)/CaCuO$_2$ was investigated by applying x-ray emission/absorption spectroscopy. The superlattices are fabricated by pulsed-laser molecular beam epitaxy (MBE) in a layer-by-layer fashion. The superlattices consist of two layers: an infinite layer (IL) and the charge reservoir (CR). Each insulating layer is alternately deposited to produce superlattices exhibiting a $T_c$ of 80K. We measure the O 1s density of states to be insulating for the component layers and metallic for the superlattice. Using resonant inelastic scattering (RIXS) we make the first direct observation of Zhang-Rice singlets in artificial high-temperature superconducting heteroepitaxial structures. Zhang-Rice singlet polarization dependent studies are performed, and the absorption and emission results are compared to local-density approximation theory. X-ray emission spectra of the superlattice and its component layers gives evidence of charge transport from the charge reservoir to the infinite layer. Cu-edge resonant x-ray emission is performed to probe $dd$ excitations in the component layers and superlattice.