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Electron Correlation and Charge Transfer in $(Ba_{0.9}Nd_{0.1})CuO_{2+\delta}/(CaCuO_2)_2$ Superconducting Superlattices B. FREELON, J.-H. GUO, ANDREAS AUGUSTSSON, Lawrence Berkeley Lab, P. G. MEDAGLIA, A. TEBANO, G. BALESTRINO, INFM and Universita' di Roma Tor Vergata, PLD XRAY COLLABORATION — The mechanism of high-temperature superconductivity (HTSC) among cuprates is still highly controversial. Although it is widely accepted that HTSC occurs primarily within Cu-O planes of cuprates, there is contention concerning the low-energy physics of these planes. It was recognized shortly after the discovery of HTSC that the fundamental planar character of superconducting superlattices (SL) could be used to investigate the physics of atomic planes in HTSC compounds. Using the artificial 2×2 HTSC SL $(Ba_{0.9}Nd_{0.1}CuO_{2+x})_2/(CaCuO_2)_2$, we investigate in-plane CuO_2 physics by applying x-ray emission/absorption spectroscopy. The superlattices are fabricated by pulsed-laser deposited molecular beam epitaxy (MBE) in an atomic layer-by-layer fashion.[i] $(Ba_{0.9}Nd_{0.1}CuO_{2+x})_2/(CaCuO_2)_2$consists of two layers. Each layer, separately, being an insulator. By alternately depositing the insulators, superlattices exhibiting a Tc of 80K can be fabricated. It has been shown that superconduction occurs exclusively within the infinite layer (IL) and not the charge reservoir[ii] (CR)of the superlattices. We demonstrate resonant x-ray emission and absorption to be insightful tools for studying the IL, CR and superlattice structures. We measure the O 1s density of state 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. Such low-energy singlets are thought to give rise to the superconducting state. A comparison of the x-ray emission spectra of the superlattice and its component layers gives evidence of charge transport from the so-called charge reservoir layer to the superconducting infinite layer. [i]G. Balestrino, S. Lavanga, P. G. Medaglia, P. Origiani, A. Paoletti, G. Pasquini, A. Tebano, and A. Tucciarone, Appl. Phys. Lett. **79**, 99 (2001). [ii]G. Balestrino, P. G. Medaglia, P. Origiana, A. Tebano, C. Aruta, S. Lavanga, and A. A. Varlamov, Phys. Rev. Lett. **89,** 156402 (2002).

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