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Charge transfer at the interface between ferromagnetic $La_{0.7}Sr_{0.3}MnO_3$ and superconducting $EuBa_2Cu_3O_7$ probed by STM/STS
YINGHAO LIU, JIE XIONG, JASON HARALDSEN(2), LI YAN, ALEXANDER BALATSKY(2), QUANXI JIA, ANTOINETTE TAYLOR, DMITRY YAROTSKI, MPA-CINT and Theoretical Division(2), Los Alamos National Laboratory, NM 87545 — $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) is a ferromagnetic half-metallic compound with nearly 100% spin polarization at room temperature, making it an ideal candidate for applications in spintronic devices. However, this useful functionality disappears when the thickness of LSMO film grown on $SrTiO_3$substrate is reduced to below 4 nm, limiting its application in nanoscale devices. Here, we show that metallic and ferromagnetic properties of ultrathin ($<$ 4nm) LSMO film can be restored by interfacing it with a superconductor $EuBa_2Cu_3O_{7-\delta}$ (EBCO). We use scanning tunneling microscopy and spectroscopy to probe the evolution of the electronic structure of LSMO film grown on EBCO as functions of LSMO layer thickness and aging of bilayer LSMO/EBCO. Our results reveal that the charge (hole) transfer at LSMO/EBCO interface is responsible for driving LSMO film (of only five-unit-cell thickness) to metallic state. The conductive behavior of aged LSMO/EBCO bilayers varies systematically with the thickness of LSMO layer, allowing us to estimate the charge-transfer depth to be 4$\sim$5 nm on the LSMO side.

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