

Proximity Effects in $\text{YBa}_2\text{Cu}_3\text{O}_7 / \text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ HeterostructuresJ. G. Lin,^{1,2,*} S. L. Cheng,^{1,2} P. C. Kuo,^{2,3} C. R. Chang,^{2,4} and D. Y. Xing⁵¹*Centre of Condensed Matter Science, National Taiwan University, Taipei 106, Taiwan*²*Nanostorage Research Center, National Taiwan University, Taipei 106, Taiwan*³*Department of Material Sciences and Engineering, National Taiwan University, Taipei 106, Taiwan*⁴*Department of Physics, National Taiwan University, Taipei 106, Taiwan*⁵*National Laboratory of Solid State Microstructures and Department of Physics, Nanjing University, Nanjing 210093, China*

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$\text{YBa}_2\text{Cu}_3\text{O}_7/\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ (YBCO/LSMO) heterostructures with different thicknesses of LSMO (d_{LSMO}) were fabricated, and their electrical transport properties were investigated. It was found that for $d_{\text{LSMO}} \leq 40$ nm the LSMO films are non-magnetic insulators, and the YBCO/LSMO systems remain superconducting; while for $d_{\text{LSMO}} \geq 50$ nm the LSMO films become ferromagnetic metals, and the YBCO/LSMO systems lose their superconductivity, due to the strong proximity effect of ferromagnetism in LSMO. A new approach based on the proximity effect is proposed to measure the intrinsic normal-state resistivity below T_c for high- T_c cuprates.

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Superconductor/ferromagnet (SC/FM) heterostructures were fabricated early in the eighties of the twentieth century [1]. As an SC film was grown on top of an FM film, the proximity effect governs the physical properties of the SC/FM structure [2, 3]. Previous studies [4] showed that a physical condition for the coexistence of ferromagnetism and superconductivity within a bulk material requires comparable magnitudes of the ferromagnetic exchange energy E_{ex} and the superconducting energy gap Δ . However, this condition can not be realized in a bulk FM, where E_{ex} is typically at least 2 orders of magnitude larger than Δ . Recently, it was suggested [5] that this condition could be less critical if Cooper pairs in the SC diffuse across the FM/SC interface into the FM in an FM/SC proximity structure. The density of states with superconducting characteristics has been observed in the FM region near the PdNi/Nb interface [6], implying a coexistence of weak ferromagnetism and *s*-wave superconductivity [6]. On the other hand, the pair-breaking effect, due to the diffusion of spin-polarized electrons from the FM into the SC, will be enhanced with an increase in the spin polarization of the conduction electrons in the FM, which has seldom been discussed. Cuprate/manganite heterostructure research has received much attention, since the discoveries of high temperature superconductivity in doped cuprates and then later the colossal magnetoresistance (CMR) effect