Session LC04 - Magnetic Nanostructures V: Heussler Alloys and Half-Metallic Ferromagnets.
ORAL session, Tuesday afternoon, March 23
Room 368W, GWCC

[LC04.05] Non-equilibrium Superconductivity and Magnetic Pair Breaking in Perovskite Half-Metallic Ferromagnet-Insulator-Superconductor (F-I-S) Heterostructures

C.-C. Fu, N.-C. Yeh, A.V. Samoilov, K. Vakili, Y. Li (Department of Physics, California Institute of Technology, Pasadena, CA 91125), R.P. Vasquez (Center for Space Microelectronics Technology, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109)

The effect of spin-polarized quasiparticle currents on the critical current density ($J_c$) of cuprate superconductors is studied in perovskite F-I-S heterostructures as a function of insulator thickness and of underlying magnetic materials. A pulsed current technique is employed to minimize extraneous Joule heating on the superconductor. At temperatures near $T_c$, F-I-S samples with insulator thicknesses $\leq 2\text{nm}$ show precipitous decrease in $J_c$ as current injection ($I_m$) is increased. In contrast, $J_c$ in a controlled sample with a substituted non-magnetic material (N-I-S) exhibit no dependence on $I_m$. Similarly, a F-I-S sample with a 10nm insulating barrier also show little $J_c$ effect versus $I_m$. At low temperatures with $I_m=0$, significant suppression of $J_c$ is observed only in the thin barrier F-I-S samples, although $T_c$ and the normal-state resistivity of all samples are comparable. These phenomena can be attributed to the Cooper pair breaking induced by externally-injected and internally-reflected spin-polarized quasiparticle currents. We estimate an order of magnitude range for the spin diffusion length of 100nm to 100umum.