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Josephson junctions with a synthetic antiferromagnetic interlayer
MAZIN A. KHASAWNEH, WILLIAM P. PRATT JR., NORMAN O. BIRGE, Dept. of Physics and Astronomy, Michigan State University, East Lansing, Mi 48824 — We have measured the critical current of Josephson junctions of the form Nb/Co/Ru/Co/Nb, where the two Co layers are exchange-coupled antiferromagnetically by the thin (0.6 nm) Ru interlayer. The antiferromagnetic coupling causes nearly complete cancellation of the intrinsic magnetic flux produced by the Co domains, and allows us to study large-area junctions with total Co thicknesses ranging from 2 to 20 nm – four times thicker than in previous studies of Nb/Co/Nb Josephson junctions [1]. The dependence of the critical current on an in-plane external magnetic field results in a nearly perfect Fraunhofer pattern, due to the intrinsic flux cancellation. The junctions were fabricated by sputtering the S/F/N/F/S multilayer onto a Si substrate, followed by subtractive patterning by photolithography and ion milling into circular junctions ranging in diameter from 10-80 microns. The critical current density of the junctions decays exponentially with Co thickness, with a characteristic decay length of $\xi_F = 2.2$ nm. There is no sign of a crossover to a slower decay at large Co thicknesses, which, if observed, might be a signature of the predicted long-range spin triplet state [2]. [1] Robinson et al., Phys. Rev. Lett. 68, 177003, 2006. [2] Bergeret et al., Rev. Mod. Phys. 77, 1321, 2005. [Work Supported by US DOE under grant DE-FG02-06ER4634]

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