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Critical currents of $ex-situ$ YBCO thin films on "RABiTS" substrates: thickness, field and temperature dependencies A.O. IJADUOLA, Dept. of Physics, Univ. of Tennessee, Knoxville, TN, J.R. THOMPSON, Dept. of Physics, Univ. of Tennessee, Knoxville, TN and Oak Ridge Nat'l Lab, Oak Ridge, TN, R. FEENSTRA, D. K. CHRISTEN, A. A. GAPUD, Oak Ridge Nat'l Lab, Oak Ridge, TN — The critical current density J_c flowing in thin $YBa_2Cu_3O_{7-\delta}$ (YBCO) films of various thicknesses d has been studied magnetometrically, both as a function of applied field H and temperature T. The films, grown by a BaF_2 $ex-situ$ process and deposited on buffered "RABiTS" substrates of Ni-5%W, have thicknesses d ranging from 28 nm to 1.5 μm. Isothermal magnetization loops $M(H;T)$ and remanent magnetization $M_{rem}(T)$ in $H=0$ were measured with $H \parallel$ c-axis (i.e., normal to film plane). The $J_c(d)$ values, which were obtained from a modified critical state model, increase with thickness d, peak near $d \sim 150$ nm, and thereafter decrease as the films get thicker. For a range of temperatures and intermediate fields, we find $J_c \propto H^{-\alpha}$ with $\alpha \sim (0.56-0.69)$ for all materials. This feature can be attributed to pinning by large random defects. At higher fields approaching the irreversibility line, $J_c(H)$ decreases faster. The J_c at self field varies as $J_c(T,sf) \sim (1-T/T_c)^n$ with $n \sim$ 1.2 - 1.4. This points to "δT_c pinning" (pinning that suppresses T_c locally) in these YBCO materials. Work at UTK was supported by AFOSR Grant F49620-02-1-0182. ORNL is managed by UT-Battelle, LLC for the USDOE.

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