Mixed State $c$–axis Resistivity of Y$_{0.54}$Pr$_{0.46}$Ba$_2$Cu$_3$O$_{7-\delta}$ Single Crystals

T. KATUWAL, V. SANDU, C.C. ALMASAN, Kent State University, B.J. TAYLOR, M.B. MAPLE, University of California at San Diego — We report temperature $T$, magnetic field $H$, and angle $\theta$ dependent out-of-plane resistivity $\rho_c$ measurements on Y$_{0.54}$Pr$_{0.46}$Ba$_2$Cu$_3$O$_{7-\delta}$ single crystals. We performed these measurements in order to investigate the origin of the large $\rho_c$ of layered superconductors like cuprates and of its $T$, $H$, and $\theta$ dependence. The $\rho_c(T, H, \theta)$ data are very well fitted by the Ambegaokar–Halperin expression [V. Ambegaokar and B. I. Halperin, Phys. Rev. Lett. 22, 1364 (1969)] for temperatures up to the critical temperature $T_c$ and applied magnetic field up to 14 T. This implies that in the underdoped cuprates the layered structure can be depicted as stacks of Josephson junctions. We calculated the value of the critical current density $J_c$ at different temperatures by using the above model and the values of the fitting parameters. Both the magnitude and $T$ dependence of $J_c$ are consistent with previous reports. This result supports the applicability of the model and indicates that the mixed state $c$–axis dissipation is mainly due to the Josephson effect.

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