Effect of magnetic field on the c-axis critical current of Bi-2212 single crystals.

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Abstract

The normal and superconducting state c-axis transport properties of $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi-2212) single crystals have been measured as a function of doping and magnetic fields parallel and perpendicular to the CuO_2 planes, using mesa structures containing a small number of atomic unit-cell layers. A large field-dependent peak in the c-axis resistance, inversely proportional to the doping-dependent, zero-field, c-axis critical current is observed. In the superconducting state multibranched current-voltage characteristics are observed, in witness to intrinsic Josephson effects in Bi-2212. The critical current I_c is strongly dependent on temperature and the field B perpendicular to the CuO_2 planes, which we relate to the magnetic phase diagram and correlation of flux pancakes across adjacent pairs of superconducting CuO_2 planes. Over an appreciable region of the phase diagram the critical current $I_c(B) \propto 1/B^{\mu}$, with $\mu = 0.8 - 0.9$. In a parallel field, $I_c(B) \propto exp(-B/B_0)$, consistent with the pinning of Josephson vortices in the small bundle regime.