Angular Dependence of the Latent Heat of Vortex-Lattice Melting in Untwinned $YBa_2Cu_3O_{7-\delta}$

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Abstract

We measured the latent heat of vortex-lattice melting for varying angles θ between the external magnetic field H and the c-axis of an untwinned $YBa_2Cu_3O_{7-\delta}$ single crystal. The melting lines $H_m(T,\theta)$, as defined by these thermal experiments, scale perfectly according to recent scaling rules for anisotropic superconductors, with an anisotropy parameter $\gamma = 7.7$. In the temperature range 81 K $< T < T_c = 92$ K and for any choice of θ, the discontinuity in entropy at melting, $\delta S[T,H_m(T,\theta),\theta]$ per unit volume of sample, depends solely on the temperature T where melting occurs, but does not depend on θ and the corresponding applied magnetic field $H_m(T,\theta)$, which is in full agreement with these scaling rules. The temperature dependence of $\delta S(T)$, near the critical temperature T_c, can be quantitatively explained by a recently developed theory that accounts for the strong T dependence of the model parameters near T_c for the London model describing the thermodynamics of the vortex system.