Intrinsic pinning in layered superconductors with very low anisotropy

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Abstract

The intrinsic pinning model predicts a $1/\sqrt{\sin\theta}$ dependence on field angle to the copper-oxide layer plane when the formation of flux-line kinks (pancakes) overcome the lock-in alignment of flux lines to the intervening nonsuperconducting layers. The kinks are thought to arise due to weak coupling between the superconducting layers, as described in the Lawrence-Doniach framework for instance. However, we present evidence that the predicted angular dependence exists even for very low anisotropy in strongly-coupled superconducting multilayers of Nb-Ti. The sharp angular dependence of J_c moreover does not depend on the upper critical field anisotropy of the multilayer, which we vary by changing the proximity length of the pin layers and the multilayer wavelength. This suggests that the depinning of flux-line kinks determines J_c for most layered superconductors. We also note that the irreversibility field for our multilayers is very close to the resistive upper critical field, which would be expected if the kinks are strongly bound to the parallel segments of the flux lines pinned by the nonsuperconducting layers because of low anisotropy.

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