Vortex Dynamics of Heavy-Ion Irradiated $YBa_2Cu_3O_{7-\delta}$: Experimental Evidence for a Reduced Vortex Mobility at the Matching Field

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Abstract

Electrical transport measurements in heavy-ion irradiated $YBa_2Cu_3O_{7-\delta}$ thick films reveal a clear maximum of the critical current when the applied magnetic field is approximately equal to the magnetic field at which all columnar defects are occupied. This result directly indicates that vortex mobility is greatly reduced when no vacant columns are available. We suggest that this result is a vestige of the Mott insulator phase predicted for the vortex system at zero temperatures.

Experimental Comparison of the Effect that Bulk Pinning and Surface Barriers Have on Vortex Motion in the Vortex Liquid State of $Bi_2Sr_2CaCu_2O_8$ Single Crystals

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Abstract

We perform electrical transport measurements in the mixed state of $Bi_2Sr_2CaCu_2O_8$ single crystals by using a Corbino disk geometry. In this configuration, vortices are forced to move in closed circular trajectories, without crossing the sample's edge. By comparison with conventional four-probe transport experiments we can contrast the role that bulk pinning and surface barriers have on vortex motion in the vortex liquid state of this material. Our Corbino and conventional experiments give the same temperature and field dependence for the electrical resistivity in the vortex liquid state, activation energies for vortex motion and irreversibility lines. Thus, we conclude that flux motion in the vortex liquid region of the magnetic phase diagram is governed by bulk effects.