

Critical Current Anisotropy in Nd-1111 Single Crystals and the Influence of Neutron Irradiation

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Abstract - We report on angle-resolved magnetization measurements on Nd-1111 single crystals. The field dependence of the critical current density, J_c , is non-monotonous in these crystals at all orientations and temperatures due to the fishtail effect, which strongly influences the angular dependence of J_c . The currents decrease as the field is tilted from the crystallographic c-axis at low fields, but increase at high fields. A peak occurs in the angular dependence of J_c at intermediate fields. The critical currents are significantly enhanced after irradiation with fast neutrons and the fishtail disappears. The different current anisotropies at low and high fields, however, persist. We discuss the data in the framework of the anisotropic scaling approach and propose a transition from dominant pinning by large defects of low density at low fields to pinning by small defects of high density at high fields in the pristine crystal. Strong pinning dominates at all fields after the irradiation, and the angular dependence of J_c can be described by anisotropic scaling only after an appropriate extension to this pinning regime.

Keywords - iron-based superconductors, Nd-1111 single crystals, critical current density, fishtail effect, neutron irradiation, vortex pinning

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