Magnetic Field Dependence of the Transport Critical Current Density in the Superconductor Family $ReBa_2Cu_3O_{7-x}$

The magnetic field dependence of the transport critical current density has been investigated at temperatures of 78K and 68K in bulk polycrystalline samples of the high-temperature superconductor $ReBa_2Cu_3O_{7-x}$, where Re (rare earth) = Y (yttrium), Er (erbium), Yb (ytterbium), Ho (holmium), and Dy (dysprosium). Samples were sintered in ¼ inch pellet form after the conventional ceramic processing techniques, and mechanical pressure contacts were used for these four-probe measurements. A 1.4 – Tesla magnet was used to provide the magnetic field, and a 500W current supply was used to provide steady currents as high as 1A. Onset critical temperatures for these samples were measured as Y (90K), Er (89K), Yb (89K), Ho (88K), and Dy (89K), the transport critical current density increases as we cool them from 78K to 68K.

The use of neutron irradiation to induce structural defects in the crystal lattice leads to enhanced critical current densities and to improved behavior in the presence of a magnetic field in the cuprate superconducting family $(Re)Ba_2Cu_3O_{7-x}$. Several investigations have been completed using a large flux of neutrons, such as from a reactor; this study utilizes a one Curie Am-Be neutron source for the sample irradiation. This is preferable to reactor flux not only because of the cost and availability, but also due to minimal residual radioactivity after removal of the samples. After a two week irradiation period the sample radioactivity level just slightly exceeds background levels, whereas the reactor flux requires a long "cool down" period before sample measurements. A significant increase of the transport critical current density has been measured subsequent to irradiation for some of the samples, such as $YBa_2Cu_3O_{7-x}$ at 78K and 68K.