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Influence of Zr addition on J¬c and flux creep in (Gd,Y)BCO tape

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Pinning centers have been introduced into (Gd,Y)BCO to increase critical current density, Jc, for applications. However, in addition to generating high magnetic fields (by possessing high Jc in the magnet windings), magnets used in accelerators should generate homogeneous and time-invariant magnetic fields. Flux creep has been shown to be significant in high temperature superconductors even at low temperatures, and thus it may cause the magnetic field of the magnet to drift with time. In this work, the influence of Zr additions, to YBCO tape, on the magnetic Jc and flux creep were studied. Magnetic Jc at 4.2 K, determined by measuring the M-H out to 14 T, and flux creep was studied in three different (Gd,Y)BCO tape samples. The samples had Zr additions of 0, 7.5, and 25 mol.%. The addition of Zr increased magnetic Jc, and also decreased the amount of creep in the samples. The decreased creep result suggests that the Zr addition creates pins with deep potential wells, as compared to creating many pins with shallower potential wells. Pinning potential vs current density (U(J) vs J) curves were generated using creep results at 8 different temperatures: 4.2, 10, 20, 30, 40, 50, 60, and 77 K. The creep was measured over 1800 seconds at 7 different fields: 12, 10, 8, 6, 4, 2, and 1 T. The pinning potential was compared to pinning potentials determined in previous YBCO experiments which studied other pinning center additions. Transmission electron microscopy was used to study the size and distribution of the pinning centers.

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