WB1-4

Effectiveness of flux pinning by ion-beam induced defects at low temperatures

*Nicholas J. Long[1], Nicholas M. Strickland[1], Stuart C. Wimbush[1,2], John V. Kennedy[2,3], Patrick Kluth[4]

Robinson Research Institute, Victoria University of Wellington, Lower Hutt, New Zealand[1]
MacDiarmid Institute for Advanced Materials and Nanotechnology, New Zealand[2]
National Isotope Centre, GNS Science, Lower Hutt, New Zealand[3]
Electronic Materials Engineering, Research School of Physics and Engineering, Australian National University, Canberra, Australia[4]

Columnar defect tracks created by the passage of high-energy ions are well known to contribute strongly to flux pinning at 77K when the applied magnetic field is parallel to the tracks. A large and distinct peak can be observed in the angle dependence of the critical current (I_c) corresponding to the overlap of vortices and columnar defects. This is often offset though by a decrease of I_c at other angles due to reduced transition temperature T_c or reduced current percolation. When measured at lower temperatures, these peaks change significantly in shape and tend to broaden out approaching 20K. Coupled with being less sensitive to the reduced T_c this can lead to an enhancement of I_c over a wide angular range.

We have irradiated (Y,Dy)BCO coated conductor tapes from AMSC with 185 MeV Au ions or 50 MeV to 100 MeV Ag ions, and measured the magnetic anisotropy of I_c at temperatures from 20 K to 77 K and fields up to 8 T. We have seen that annealing at 200°C to 500°C following irradiation is generally beneficial, which we interpret as the restoration of oxygen order, but without the recrystallisation of the ion tracks.

The maximum entropy approach can be used to decompose the magnetic anisotropy into contributions from populations of pinning centres. We use this tool to track the evolution of peaks arising from ion irradiation over the available range of temperatures to understand how they combine with the background pinning landscape in different regimes.

Keywords: ion irradiation, flux pinning, critical currents, maximum entropy