Theoretical Simulation Studies of Pulsed Field Magnetisation of (RE)BCO Bulk Superconductors

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Abstract - The magnetisation of bulk high temperature superconductors (HTS), such as RE-Ba-Cu-O [(RE)BCO, where RE is a rare earth element or Y], by a practical technique is essential for their application in high field, permanent magnet-like devices. Research to-date into the pulsed field magnetisation (PFM) of these materials, however, has been limited generally to experimental techniques, with relatively little progress in the development of theoretical models. This is because not only is a multi-physics approach needed to take account of the heating of the samples but also the high electric fields generated are well above the regime in which there are reliable experimental results. This paper describes a framework of theoretical simulation using the finite element method (FEM) that is applicable to both single- and multi- pulse magnetisation processes of (RE)BCO bulk superconductors. The model incorporates the heat equation and provides a convenient way of determining the distribution of trapped field, current density and temperature change within a bulk superconductor at each stage of the magnetisation process. An example of the single-pulse magnetisation of a (RE)BCO bulk is described. Potentially, the model may serve as a cost-effective tool for the optimisation of the bulk geometry and the magnetisation profile in multi-pulse magnetisation processes.