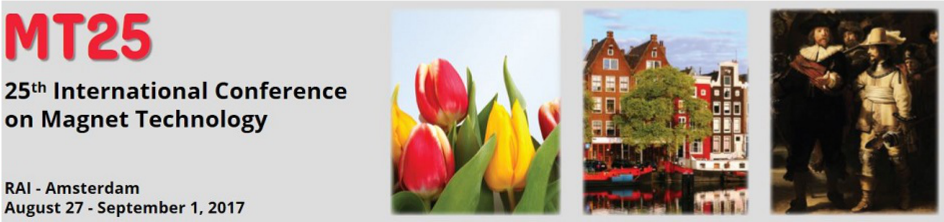

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Numerical modelling of iron-pnictide bulk superconductor magnetization

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The discovery of superconductivity in iron-pnictide compounds in 2008 raised the prospect of finding high-temperature superconductivity in materials other than cuprates and a great deal of research has been carried out towards practical implementation in thin film, wire and bulk forms. Bulk superconducting materials, in particular, can be used as super-strength, trapped field magnets (TFMs) and magnetic fields greater than 17 T have been achieved in large, single-grain (RE)BCO (where RE = rare earth or Y) bulk superconductors. This makes them attractive for a number of engineering applications that rely on high magnetic fields, including compact and energy-efficient electrical machines, magnetic separation and magnetic drug delivery systems. The iron-based superconductors exhibit a number of properties attractive for applications, including low anisotropy, high upper critical magnetic fields (Hc2) in excess of 90 T and intrinsic critical current densities above 1 MA/cm2 (0 T, 4.2 K). It was shown recently that bulk iron-pnictide superconducting magnets capable of trapping over 1 T (5 K) and 0.5 T (20 K) can be fabricated with fine-grain polycrystalline Ba0.6K0.4Fe2As2 (Ba122). These Ba122 magnets were processed by a scalable, versatile and low-cost method using common industrial ceramic processing techniques. In this paper, a standard numerical modelling technique, based on a 2D axisymmetric finite-element model implementing the H-formulation, is used to investigate the magnetization properties of such iron-pnictide bulk superconductors. Using the measured Jc(B, T) characteristics of small specimens taken from bulk Ba122 samples, the experimentally measured trapped fields previously published are reproduced to good effect. Additionally, the influence of the geometric dimensions (thickness and diameter) on the trapped field is analysed, with a view of fabricating larger samples to increase the magnetic field available from such TFMs.

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