Modelling of Bulk Superconductor Magnetisation: A Review

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Bulk superconducting materials can be used as 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 high-temperature superconductors. As a result, there is great interest in using these materials as TFMs to provide an alternative to permanent magnets in several engineering applications, including rotating machines, magnetic bearings, nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI) spectrometers and magnetic separation.

In this presentation, a review of the current state-of-the-art in modelling the magnetisation of bulk superconductors is given, including bulk (RE)BCO (where RE = rare earth or Y), MgB2 and iron-pnictide materials. Such numerical modelling is a powerful and cost-effective tool to understand the physical mechanisms of bulk superconductor magnetisation, to assist in interpretation of experimental results, and to predict the performance of practical bulk superconductor-based devices, which is particularly important as many superconducting applications head towards the commercialisation stage of their development in the coming years. The presentation highlights the differences between simulating the different magnetizing techniques – zero field cooling (ZFC), field cooling (FC) and pulsed field magnetisation (PFM) – as well as the differences and similarities in the assumptions made for the numerical simulation related to different bulk materials.