

Bulk Superconductors and Their Applications, Present and Future

John Durrell

Department of Engineering, University of Cambridge

Email: jhd25@cam.ac.uk

Abstract—The obvious application of superconducting materials is in the form of wires, and this has been the subject of much materials research effort. However, it is also possible to employ superconductors in bulk form. Just as superconductors in wire and tape form can replace conventional copper conductors, bulk superconductors can be used as replacements for rare-earth permanent magnets, but with trapped magnetic fields an order of magnitude larger. In addition, bulk superconductors can be used to provide passively stable magnetic levitation, by exploiting their flux pinning properties.

In this plenary I will outline the significant advances that have taken place over the last ten or so years in the materials science of bulk superconductors in both the REBa₂Cu₃O₇ based and MgB₂ systems. I will address the key challenges to practical application, in particular that of charging, and discuss the approaches being taken around the world to solve them. In parallel with rapid materials development, a range of innovative applications for Bulk Superconductors have appeared. I will outline some of these applications which are currently being explored in domains as diverse as non-destructive testing, energy storage and medicine. I will conclude by discussing prospects for future applications of bulk superconductors.

Keywords (Index Terms) — bulk superconductors; YBa₂Cu₃O₇; MgB₂; permanent magnet; motor; levitation

IEEE CSC & SUPERCONDUCTIVITY NEWS FORUM (global edition), July 2022.

This plenary presentation was given at the virtual EUCAS 2021, September 5-10, 2021.