Poster-2-1

Critical Current Anisotropy and Electromechanical Limits of REBCO Coated Conductors for Ultra-High-Field Magnets

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REBCO (Rare-Earth Barium Copper Oxide) coated conductors (CCs), consisting of textured REBCO thin films deposited on flexible metallic tapes, are key enabling materials for next-generation ultra-high-field magnets, promising transformative applications in fusion energy, particle accelerators, and healthcare applications. At the University of Geneva, an experimental campaign was conducted to address the intrinsic and structural anisotropies of REBCO CCs that currently limit their performance. Mechanical anisotropy, arising from the layered architecture, increases susceptibility to delamination under stress, while superconducting anisotropy causes strong variations of the critical current (I_c) with temperature, magnetic field magnitude, and orientation. To optimize magnet design, three commercial REBCO CCs were characterized in collaboration with Tohoku University over 5-55 K and 1-24 T, linking the differences in their performance to nanostructure and flux pinning. Scaling laws were derived from the datasets to aid practical design. Additionally, in partnership with CERN, a novel approach assessed delamination strength under electromagnetic loading, simulating magnet operating conditions. Transverse stresses as low as 5 MPa were found to cause irreversible I_c degradation, with SEM/EDX analyses identifying the failure initiation site. These findings provide essential insights for the reliable design of REBCO-based ultra-high-field magnets, supporting their role in advancing future technological developments.