Towards the development of superconducting joints between REBCO coated conductors: a thermomechanical study

Celia Lucas,[1] Pablo Cayado,[1] Hannes Rijckaert,[2] Davide Nardelli,[3] Konstantina Konstantopoulou,[3] and Carmine Senatore[1,4]

[1] *Department of Quantum Matter Physics, University of Geneva, Switzerland*
[2] *Department of Chemistry, Ghent University, Krijgslaan 281-S3, 9000 Ghent, Belgium*
[3] *Bruker BioSpin, Industriestrasse 26, 8117 Fällanden, Switzerland*
[4] *Department of Nuclear and Particle Physics, University of Geneva, Switzerland*

High-Temperature Superconductors (HTS), particularly Rare Earth Barium Copper Oxides (REBCO), are pivotal in high field applications due to their exceptional properties, notably surpassing conventional superconductors in the upper critical magnetic field (Bc2). REBCO Coated Conductors (CCs) enable the creation of superconducting solenoids generating magnetic fields exceeding 30T. This technological advancement is crucial for Nuclear Magnetic Resonance (NMR), where resolution scales with magnetic field intensity. NMR magnets must operate in persistent mode, with current flowing in a continuous superconducting loop, to ensure necessary field stability. Achieving this requires superconducting joints to address limitations stemming from the available unit lengths of CCs, which are challenging to produce beyond 100-200 meters. However, the complex process of producing superconducting joints in REBCO entails simultaneous temperature and pressure application. The fragility of CCs and the need for controlled oxygen doping in REBCO diminish CCs performance post-thermomechanical cycles. Understanding the effects of temperature and pressure combinations on the critical current (Ic) achievable after joint procedures is crucial. We investigated the effects of temperature and pressure combinations ranging between 600-850°C and 50-80 MPa, respectively, on commercial CCs' Ic at 77K. Complementary TEM and EDX studies were conducted to correlate changes in the REBCO microstructure with Ic alterations.