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Analysis of Current Distirbution during Quench in a Pancake coil wound with REBCO Roebel cable

Roebel cables assembled with HTS tapes are a promising technology for several AC and DC applications. The continuous transposition of strands, the ability to efficiently redistribute current, combined with the capability of REBCO tapes to operate at high magnetic fields allow Roebel-based devices to carry large transport currents with reduced AC losses. These features make them suitable for application to intense magnetic fields, such as in accelerator and fusion magnets.

This paper presents an electro-thermal 1D model for the analysis of quench initiation and propagation in REBCO Roebel cables. The model is based on a homogenization procedure over the strand cross section, and describes the non-uniform distributed thermal and electrical contacts between strands, thus allowing to compute consistently the heat and current redistribution during quench. The dependence of the critical current density on the magnetic field intensity and angle and on temperature is taken into account. The simulation results are compared with experimental data obtained in quench tests of a 7-turn pancake coil wound with a 2-m long, 15-strand Roebel cable. The experiments were carried out at the University of Southampton (UK) in the frame of the EuCARD-2 European project. The quench decision time, the temperature and electric potential evolution and the current and heat redistribution between strands during the quench event are analysed in this study. Given the reduced dimensionality of this 1D approach, the computational burden is reduced relative to 2D or 3D models, still retaining an accurate description of the main physical phenomena.

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