9th International Workshop on Numerical Modelling of High Temperature Superconductors - HTS 2024

Contribution ID: **49** Type: **Oral**

Critical current numerical characterization of 6-layers CORC® cables

Tuesday, 11 June 2024 10:55 (20 minutes)

In perspective of 20 T+ field magnet and more compact layouts for fusion reactors, the high temperature superconductors are the alternative which can allow high transport current at very high field, guaranteeing at the same time a higher stability. Among them, the Rare-Earth Barium Copper Oxide (ReBCO) coated conductors are a promising option due to their high critical temperature and the extremely high critical current density. The CORC® cable concept, based on ReBCO HTS tapes wound around a copper former, is of particular interest for these high-field magnet applications due to its round cross-section and electrical and mechanical isotropy. However, these cables can degrade as a result of the winding process and operating conditions. Thus, a comprehensive characterization of their performances is necessary. The complex geometry and shape of the CORC® cable makes tricky to numerically reproduce the correct current distribution among tapes, which strongly affect the cable behavior, especially co of number of layers (>3 layers). This work presents a 3D multi-physics numerical model for characterizing the critical current (Ic) of more complex CORC® cable layouts, based on a T-A formulation model in COMSOL Multiphysics coupled with a thermal model of a straight cable, already validated against experimental results. For the first time, a self-consistent boundary condition allowed the computation of the current distribution in a 6-layers CORC® (12-tapes total), aimed to the replication of the Ic. The tape is approximated as a thin shell, taking advantage of its high aspect ratio, and the Ic scaling for the tape accounts for the temperature, magnetic field and local strain due to the winding on the copper core. The assessment of the voltage-current curve for the conductor has been performed against experimental and numerical data present in literature.

Topic

Coupled and uncoupled multiphysics problems

Primary author: VIARENGO, Sofia (Politecnico di Torino, Turin, Italy)

Co-authors: Prof. SAVOLDI, Laura (Politecnico di Torino, Turin, Italy); Prof. FRESCHI, Fabio (Politecnico di Torino, Turin, Italy)

Presenter: VIARENGO, Sofia (Politecnico di Torino, Turin, Italy)

Session Classification: Session 1: Coupled & Uncoupled Multiphysics Problems