Contribution ID: **647** Type: **Poster**

M2Po2B-07: A hierarchical delamination model for epoxy-impregnated REBCO superconducting pancake winding

Tuesday 11 July 2023 14:00 (2 hours)

Rare-earth barium copper oxide (REBCO) coated conductor (CC) tapes are promising for high-energy and high-field applications. In epoxy-impregnated REBCO superconducting windings, due to the weak c-axial strength of REBCO CC tapes, delamination induced by thermal mismatch stress and Lorentz force significantly threatens stable operation. As the epoxy-impregnated REBCO superconducting magnets are composed of multi-layer components with different material properties, however, the stress state of each constituent material is quite different during extremely low temperature and strong electromagnetic field condition. At present, the commonly used numerical modeling methods mainly include the homogeneous orthotropic model and the real fine model. The former can realize the efficient calculation of the overall physical field but lose the local details including interfacial delamination bebavior, while the latter can realize the fine calculation of all the physical fields in the whole domain but cost massive calculation. In this study, delamination behaviour of an epoxy-impregnated REBCO pancake winding under cryogenics and high magnetic field was investigated through a hierarchical axisymmetric finite element model with main layers of the coated conductor and insulation materials. Firstly, the homogenized superconducting magnets was constructed to estimate the electromagnetic-thermal-mechanical properties at macro scale, and the 'dangerous regions'in the macro scale was recognized; secondly, the mechanical response including interfacial delamination described by the cohesive zone model of each turn coil was reconstructed in the micro scale in the 'dangerous regions', and homogenized properties was still adopted in the other regions. The accuracy and efficiency of the hierarchical delamination mothed were validated by the refined numerical model. The discussions indicated that the potential risk for delamination failure during cooling increased with the decrease of temperature. If delamination did not appear after cooling, the winding will not be damaged owing to interfacial debonding under self-field. However, the risk of delamination failure increased upon increasing the transport current under a strong background field. The presented hierarchical numerical modeling method is promising for evaluating the risk of failure in large scale HTS magnets.

Authors: GAO, Peifeng (Lanzhou University); Dr GUO, Hanxiao (Lanzhou University)

Presenter: Dr GUO, Hanxiao (Lanzhou University)

Session Classification: M2Po2B: Modelling and AC Losses