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M3Or3B-04: AC-loss Analysis in Stacks of Non-insulated REBCO Tapes

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High-current HTS cables made of stacked REBCO tapes are being considered for large superconducting magnet systems for fusion and other applications. AC losses are critical when analyzing a stack of non-insulated tapes. Using finite element software such as COMSOL, it is possible to model a 3D stack of non-insulated REBCO tapes and assess how AC losses vary, depending on factors such as the stack's width, length or the number of tapes it contains. Each REBCO tape was modeled as a high-temperature superconductor (HTS) layer, surrounded by two copper layers. Stacks were formed by adding several tapes into the model. The stack sample is exposed to an external, time-varying magnetic field, applied to its outer surface. To model the superconducting behavior of the HTS layers, the well-established H-formulation (derived from Maxwell's equations) and the E-J Power law have been used. A key input parameter to the AC loss model is the transverse resistivity among the superconducting tapes. This parameter has been experimentally measured at liquid nitrogen temperature for stack samples of bare REBCO tapes, and of REBCO tapes alternated with stainless steel ribbons of various thicknesses. The measurements were performed at Fermilab's Superconducting R&D lab as a function of transverse pressure using a modified transverse pressure insert (TPI). These experimental data were used in the COMSOL model. This paper describes the COMSOL model and presents the results of the AC loss studies in various REBCO stacks.

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