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Network model for REBCO pancake coils with heat transfer

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High-temperature superconducting REBCO coated conductor is one of the main candidates for next-generation high field magnets in fusion reactors and particle accelerators owing to their high current-carrying capability. While these materials can operate at higher temperatures and generate higher magnetic fields than their counterparts with lower critical temperatures, protecting the REBCO magnet against quench is challenging. A variety of candidate technologies that may be able to enable self-protection, including no-insulation technology and insulative coatings with temperature-dependent resistance, are in development. In order to understand the current sharing and thermal processes during a quench, we model a REBCO pancake coil as an electrical circuit, and simulate current distribution using NGSPICE, considering the power generation and heat transfer between conductor turns. The magnetic field and coil terminal voltage predicted by the simulation was compared to published experimental results. Our results provide useful insights into how current sharing occurs and the impact of electrical contact contact resistances between conductor turns.

Primary authors: WEBB-MACK, Zoe (Lawrence Berkeley National Laboratory); WANG, Xiaorong (Lawrence Berkeley National Laboratory); JI, Qing (Lawrence Berkeley National Laboratory)

Presenters: WEBB-MACK, Zoe (Lawrence Berkeley National Laboratory); WANG, Xiaorong (Lawrence Berkeley National Laboratory); JI, Qing (Lawrence Berkeley National Laboratory)

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