Contribution ID: **920** Contribution code: **THU-PO3-707-04** Type: **Poster**

Experiment and analysis of spatial electromagnetic and thermal behaviors during quench propagation in no-insulation HTS coil with multi-physics distributed-circuit approach

Thursday, 18 November 2021 10:00 (20 minutes)

Abstract

This work presents an experimental study on electromagnetic and thermal behaviors caused by a quench propagation on a no-insulation (NI) high temperature superconductor (HTS) coil. To observe quench behaviors of NI HTS coil, 25-turn NI single pancake test coil was wound, and an overcurrent experiment was performed in conduction-cooled condition. Since the quench is a local and time-varying phenomenon, an integrated multi-physics distributed-circuit model, which consists of an electric circuit and thermal circuit, was adopted to analyze spatial and transient characteristics. The voltage difference between consecutive turns, the magnetic field at the center of the coil, and the temperature at every five turns were respectively measured by inserted voltage taps, a Hall sensor, and thermocouple taps in order to validate multi-physics distributed-circuit model. Considering not only conduction but also Joule heating computed by local voltage and current distribution, the quench propagation, which can be detected by local temperature variation, was analyzed.

Acknowledgment

This work was supported by Samsung Research Funding & Incubation Center of Samsung Electronics under Project Number SRFC-IT1801-09.

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Session Classification: THU-PO3-707 Quench Analysis I