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Thermal Quench Characteristics of 2G HTS Race Track Field Coil with Kapton Polyimide Insulation and Smart Insulation Materials

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As a turn-to-turn insulation material on second generation high-temperature superconducting (2G HTS) coils, the smart insulation (SI) with a metal-insulator transition (MIT) materials, which have a resistivity variability on temperature, i.e., resistivity of MIT materials is decreased with temperature increase, may enhance not only the thermal stability but also current control performance of 2G HTS coils. Thus, it is expected to redeem No-insulation winding technique which has a delay of target magnetic field by bypassed current. This paper presents thermal quench characteristics of 2G HTS race track coil insulated with Kapton polyimide insulation (KPI) and SI materials, respectively for the rotor field winding of 1-HP-Class HTS rotating machine integrated with a contactless HTS excitation device. The constant-current experiment with heater activation and an over-current experiment with pulse current were performed to investigate thermal behaviors in quench state of respective 2G HTS coil insulated with KPI and SI materials and to verify the standout thermal performance of SI material as a turn-to-turn insulation. Finally, the applicability of SI material on 2G HTS coil system was discussed on the basis of above experimental results.

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