Thermal and Electrical Behaviors of an MI HTS Insert Comprised of THEVA-SuperPowerCoils under High Background Magnetic Fields at 4.2 K

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In this study, two metal-as-insulation (MI) REBCO double-pancake (DP) coils comprised of THEVA and SuperPower REBCO single pancake (SP) coils were constructed and assembled. A sapphire plate was inserted in between the two single pancake (SP) assembled as a DP, while copper plates insulated by G10 were inserted between the DPs to enhance the cooling of the MI insert. The thermal and electrical characteristics were investigated under an applied external field in the range of 0 to 19 T at 4.2 K. The insert was pushed up to the quench at each field, defining its real operating limit without damage. Its thermal stability was checked up to 10 A/s in self-field (SF) at 4.2 K. Characteristic resistance change, current-carrying performance, quench behavior, thermal stability of the MI insert is discussed.

Abstract

The electrical parameters of the MI insert with respect to temperature and fields are measured. In order to determine whether or not the MI insert can work in high fields, the MI insert is pushed up to the quench at each field, defining its real operating limit. Its thermal stability was checked up to 10 A/s in self-field (SF) at 4.2 K. Characteristic resistance change, current-carrying performance, and quench behavior are studied to determine the stability of the MI insert.

Winding and 77 K Test of two THEVA(TV)-SuperPower(SP) DP coils

Metal-as-insulation (MI) winding technique

To use self-protection feature of no insulation winding technique
To mitigate charging-discharging delay of Ni magnet
To reinforce mechanical strength of REBCO coils

Assembly of an MI insert

Charging test of the MI TV-SPo insert under various current ramp rates

In the previous study, the only SPo insert without sapphire and copper plates experienced a near-null event at a ramp rate of 2 A/s due to poor cooling condition [1].

Quench of the TV-SPo insert did not occur even at the high current ramp rate of 10 A/s.

This is probably because the sapphire and copper plates acted as a good heat exchanger between the inside of the coils and the Life outside.

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