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A study on the electrical contact resistance and thermal conductivity of soldered-metal insulation coil with conduction cooling

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No-insulation (NI) winding method has been widely used in the fabrication of superconducting coils due to its excellent thermal stability and mechanical stiffness. In the NI coil, there is a charging delay and heat loss due to leakage current and metal insulated (MI) winding method has been proposed to reduce the charging delay and the heat loss by the leakage current due to the increased contact resistance by the metal tape. However, it is difficult to quantify the contact resistance between turns of the coil at the design stage. To resolve this problem, a new winding method named as SMI (Soldered Metal Insulation) was proposed by the authors, the electrical properties were evaluated in the bath of liquid nitrogen.
As a follow-up to the previous research, experimental investigations are conducted in a conduction cooling test apparatus to investigate electrical and thermal characteristics of the SMI coil below 77 K. The electric contact resistances are evaluated through sudden discharging experiments. Then, the thermal contact resistances are also measured using a heater installed on the outer turn of the coil. The experimental results are compared with that of the expected values and the discrepancy is investigated through a precise inspection of the cutting cross section of the SMI coil. It is believed that the SMI winding technique can be applied to fabricate REBCO coils with the predictable contact resistance.

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