Contribution ID: **925** Contribution code: **TUE-PO1-615-05** Type: **Poster**

Thermal resistance between metallic surfaces of copper and stainless steel at different temperatures and contact pressures for high current HTS Cable-in-Conduit Conductors

Tuesday 16 November 2021 13:15 (20 minutes)

High Temperature Superconductors (HTS) is a promising option for high current Cable-In-Conduit Conductors (CICC) for large high-field magnets. CICC are often constructed from several HTS strands which themselves are formed from individual HTS tapes. Quench propagation is CICCs is currently under intensive investigation, and it can be predicted by modelling the entire structure. However, for the modelling heat transfer problems, along with thermal material properties, the thermal properties of contact interfaces between structural materials are highly needed. So far, a lack of such data in the literature made the analysis of quench propagation very difficult.
Thermal resistance of copper-copper and copper-stainless steel interfaces were characterized for different pressure and temperature ranges. Therefore, thermal conductivity was measured with the axial heat flow method within the Physical Property Measurement System (PPMS) of Quantum Design using a Thermal Transport Option (TTO) in the steady-state measurement mode in the temperature range from 4 K to 300 K. For the required investigation, the TTO option was extended: the TTO sample puck was equipped with additional copper frame allowing measuring a thermal conductivity of stack of metallic plates pressurized by a screw. The method was further extended to allow the measurement of thermal conductivity at different pressure values. For this, the copper frame was equipped with strain gauges, and calibrated for measuring the pressure applied to the stack at different temperatures. Further step included the systematic measurement of thermal conductivity versus temperature of the stacks for a range of contact pressure values in PPMS. Different stacks geometries and different compositions were investigated.

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Session Classification: TUE-PO1-615 Structural Materials for Magnets