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Tue-Af-Po2.22-06 [79]: Investigation on the correlation between electric and thermal contact resistance of REBCO HTS wires

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No insulation (NI) winding technique using a REBCO wire is considered as a feasible option to develop a high field magnet due to its excellent electric and mechanical stability. A NI magnet shows strong thermal and electromagnetic stability in case of quench, however, it also has charging delay due to leak currents and additional resistive loss through turn-to-turn winding contacts. The stability and the charging delay are strongly related to the electric and the thermal contact resistance between winding turns. To predict the electric and the thermal behavior of the NI magnet, it is necessary to estimate the electric and thermal contact resistance between winding turns. The electric contact resistance can be obtained through charging and discharging test of the magnet or from the measured ones. Yet, the thermal contact resistance is hard to measure because it requires a complicated measurement apparatus. Since the electric and thermal conductivity of metals are correlated to so-called Weidemann-Franz law, the electric and thermal contact resistance between stacked REBCO wires are supposed to have similar relation.
In this study, stacked REBCO wires were installed in a conduction cooled test apparatus to measure the electric and thermal contact resistances in a temperature range of 4 to 90 K. During the experiment, Belleville washers were used to apply designated contact pressures. The measured data shows a meaningful correlation between the electric and the thermal contact resistance, which is similar to Weidemann-Franz law. This correlation will be used to estimate an effective thermal conductance of NI magnet from the measured electric contact resistance. In addition, it can be applied to determine an appropriate operating sequence of initial charging and to simulate a post-quench behavior.

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Author: KIM, Seokho (Changwon National University)

Co-authors: SEO, Geonhang (Changwon National University); KIM, Kyeongdeok (Supergenics.ltd)

Presenter: SEO, Geonhang (Changwon National University)

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