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Increase of thermal stability caused by high thermal conduction VFRPs in conduction-cooled HTS coils

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When a hotspot occurs in a conduction-cooled HTS superconducting winding, decrease of heating at the hotspot and decrease of local temperature rise are necessary. In order to do that, good thermal conduction around the heat-source materials such as an electric-insulation film on the HTS tape and a non-metallic structural material is important. The electric insulation materials are generally not only low electric conductivity but also low thermal conductivity. If the material having both high thermal conduction and low electric conduction properties is used in the HTS superconducting winding, the hot-spot temperature can be effectively decreased. We have been developing the Vectran fiber reinforced plastic (VFRP) which has the property of high thermal conductivity. Vectran is the trademark of Kuraray Co., Ltd., Japan. First, we fabricated some round bars made of VFRPs, and measured thermal conductivity of the bars at cryogenic temperature. According to the measured results, the thermal conductivity of the VFRP bars was more than twice of that of the glass fiber reinforced plastic (GFRP). Next, the thermal contraction of the VFRP bars was experimentally obtained at cryogenic temperature; the bars expanded along the Vectran fibers, and contracted conversely around the bars during the temperature decrease. Finally, we brought sheets made of the Vectran fibers into contact with a winding pack in which some short-YBCO tapes were stacked, and made heating the winding pack with a local heater. In spite that the heating was same, the temperature rise under the contacting of VFRP sheets were lower than that under the contacting of GFRP sheets. From those experimental data, we think thermal stability of the conduction-cooled HTS coils increases as the result of use of high thermal FRPs and sheets made of Vectran fibers.

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