



Contribution ID: 499 Contribution code: THU-PO3-710-03

Type: Poster

Enhanced Thermal and Electrical Properties of GdBCO Magnets Impregnated with Epoxy Composites Containing Various Fillers

Thursday 18 November 2021 10:00 (20 minutes)

In general, the field coils of a superconducting motor or generator need to be impregnated with epoxy resin to protect the coils from mechanical stress occurring during rotation. Recently, various studies that have been conducted to optimize the epoxy impregnation method revealed that coils impregnated by the vacuum pressure impregnation (VPI) method have superior thermal and electrical properties. However, epoxy impregnation can either introduce a difference in the thermal contraction between the superconducting tape and epoxy resin or degrade the thermal conductivity. Therefore, the selection of an appropriate filler material is important. In recent years, we suggested the use of various filler materials with high thermal conductivity and superior mechanical strength with the aim of supplementing and enhancing the low thermal conductivity of epoxy resin. In this study, we investigated the effects of the addition of various fillers such as carbon nanotubes, boron nitride, and silver on the thermal and electrical properties of GdBCO coils. Using these epoxy composites, GdBCO coils were impregnated by the VPI method. In addition, cool-down tests, repetitive-cooling tests, and over-current tests were performed to evaluate the thermal and electrical stabilities of the coils.

< Acknowledgment >

This work was supported by the Korea Basic Science Institute under Grant D110200

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Session Classification: THU-PO3-710 Stability