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Electrical Characteristics of a High-Temperature Superconducting Coil Insulated with Doped Smart Materials

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V2O3 has been studied as a smart insulation material for 2G high-temperature superconducting (HTS) coils owing to its remarkable metal-to-insulator transition (MIT) upon heating or cooling via a critical temperature (Tc) of ˜160 K. The smart insulated (SI) coil regulates its function according to the MIT properties of V2O3. At temperatures below Tc, V2O3 acts as an insulator, whereas it becomes a conductor above Tc. Under steady-state conditions, the SI coil operates normally as an insulation coil and when quenching causes the coil temperature to rise, the turn-to-turn resistance is lowered, and the current bypasses between the turns as in a no-insulation coil. However, V2O3 has a high critical temperature and low conductivity compared to GdBCO tape, resulting in a small amount of current bypassing the layers of the coil; consequently, this affects the stability and protection of the coil against quenching. Dopants can be incorporated in V2O3 to reduce the critical temperature and improve the electrical conductivity. In this study, we investigated the electrical characteristics of the GdBCO coil, insulated with V2O3 doped with Mo ((V1-x Mox)2O3), by carrying out charging/discharging and overcurrent tests. Additionally, we analyzed the elemental composition and surface morphology of the (V1-x Mox)2O3 paste using EDS and SEM, respectively.

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