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Investigation on thermal and electrical stabilities of REBCO coil insulated by vanadium III oxide under various disturbance environments

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The REBCO coil, which was electrically insulated using a metal-insulator transition (MIT) material between turn-to-turn contact layers, can achieve high stability in the transient operation as well as fast response of magnetic field in the normal operation due to its automatically switched electrical resistivity of MIT material according to the temperature changes. Among of MIT materials, A vanadium III oxide (V₂O₃) has the transition temperature of approximately 150 K to switch from high to low levels in turn-to-turn contact resistance. Thus, the V₂O₃ REBCO coils can be operated as an insulated coil without charge-discharge delay at normal operation below 150 K and as a non-insulated coil with the high stability above 150 K depending on the absence or presence of current bypass phenomenon, respectively. In this paper, a small pancake REBCO coil was co-wound with a V₂O₃ paste between turn-to-turn layers. Then, the normal and transient characteristic tests were performed in a 77 K liquid nitrogen bath to investigate the feasibility and the repeatability of resistivity switching feature of V₂O₃ insulator under the various extreme operational environments, such as internal heat generation, continuous overcurrent and pulse overcurrent, and mechanical vibration.

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