



Contribution ID: 852 Contribution code: TUE-PO1-722-07

Type: Poster

Experimental Study on the Accuracy of the Proposed LFAC Method for Measuring the Contact Resistance of NI HTS Coils

Tuesday 16 November 2021 13:15 (20 minutes)

The no-insulation (NI) winding technique provides high stability of HTS pancake coils and a high magnetic field NI HTS magnet was developed. On the other hand, the balance between the turn-to-turn contact resistance and the coil inductance is an important factor to characterize the thermal stability and charging delay of NI HTS coils. So, it is very important to accurately measure and evaluate the contact resistance of NI HTS coils. Although the conventional sudden-discharging method is widely used to measure the turn-to-turn contact resistance, it is not applicable to various conditions and its use is limited. Therefore, we have previously proposed a low-frequency-AC-current (LFAC) method to measure the turn-to-turn contact resistance of the NI HTS coils. In the LFCA method, the contact resistance and inductance of the HTS coil were measured at the total voltage of the NI HTS coil using a lock-in amplifier, and the phase of the AC current was detected by the Rogowski coil. In the proposed LFCA method, the contact resistance between windings is accurately evaluated when all AC currents flow in the radial direction in the NI HTS coil. However, the distribution ratio of the AC current between the radial direction and the circumferential direction in the NI HTS coil is expected to depend on the contact conditions between the windings and the frequency and magnitude of the transported AC current. In this study, in order to demonstrate the measurement accuracy of the proposed LFCA method, we prepared several test coils with slightly different contact resistance between windings. Specifically, several test coils wound with REBCO wire with different surface roughness and different winding tensions were prepared, and the accuracy of the proposed LFCA method will be reported.

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Session Classification: TUE-PO1-722 Model Coil I