



Contribution ID: 846 Contribution code: WED-OR2-302-05

Type: Oral

Hoop stress test of four-stacked two-ply REBCO pancake coils

Wednesday, November 17, 2021 9:30 AM (15 minutes)

We have succeeded in operating a 25 T cryogen-free superconducting magnet (25T-CSM), which consists of LTS outsert coils and Bi2223 insert pancake coils. As a next step, an upgrading of 25T-CSM to 30T-class CSM is considered by replacing the Bi2223 insert coils with REBCO coils, since REBCO tapes have better mechanical and in-field critical current properties. In a design of the 30T-CSM, the two-ply co-winding with a face-to-back configuration will be adopted so that current sharing is expected in the event of local degradation. In order to confirm the validity of our coil design, we investigate electromagnetic and mechanical properties of four-stacked two-ply REBCO pancake coils. The coils were fabricated with a Fujikura EuBCO tape with artificial pinning centers, which had a dimension of 4 mm width and 0.15 mm thickness. The inner and outer diameters of each coil were 68 and 268 mm, respectively. Several strain gauges were attached to the innermost and outermost surface of the windings to measure the hoop strain. The coil voltages and strains were measured at about 20 K cooled by the GM cryocooler under a background field of 11 T generated by the large-bore superconducting magnet at the HFLSM, IMR, Tohoku University. The maxim hoop stress was estimated to be about 480 MPa by the BJR relation for the operating current of 500 A in 11 T. Observed averaged strains on the outermost winding of each coil were approximately 0.2-0.3%. In the presentation, the I-V properties, measured strains, and the stress distribution in the coils by an FEM analysis will be reported and discussed.

This work was supported by JSPS KAKENHI Grant Number 18H05248.

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Session Classification: WED-OR2-302 HTS coil I