



Contribution ID: 25

Type: **not specified**

Electromechanical analysis of REBCO pancake coils reinforced by an outer-shell structure

Tuesday, 12 December 2017 14:20 (30 minutes)

We have developed the REBCO pancake coils reinforced by an outer-shell structure, which consists of outer/inner rings and a circular disc, so called “YOROI” structure. In this case, the circular disc reinforces the coil together with the outer ring. The stress distribution in the coil, the outer ring and the circular disc can be calculated analytically if the infinite cylinder structure is assumed. We made a REBCO coil reinforced by the outer-shell made of stainless steel and test in 11 T and 4.2 K. The double pancake REBCO coil is 250 mm in inner and 265 mm in outer diameters. Each pancake is reinforced by 5 mm thick outer and inner rings and 0.5 mm thick cover plates. The operation current was applied up to 360 A in a 11 T and 4.2 K. The maximum induced strain on the coil inner surface measured by strain gauges reached about 0.4% at the operation current of 360 A, which is slightly higher than the strain limit of the REBCO tape. However, no anomalous voltage appeared. The analytical calculation indicates that the maximum stress is reduced due to the reinforce structure. In addition, a thermal compressive stress is also induced from the outer-shell. The analytical calculation result is compared to the experimental result and the FEM calculation.

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Session Classification: Session VI