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Fri-Mo-Or27-08: Screening current effect on the stress/strain distribution of REBCO high-field magnets: experimental verification and numerical analysis

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The screening current in REBCO coils has been proved to have an important impact on the field quality, which is critical for applications with high field homogeneity requirement, such as MRI and NMR. As demonstrated in 'Little Big Coil'experiments by NHMFL, the screening current in REBCO coils may also have a huge influence on its strain distribution, especially for high-field operations. A 9-T insert coil with a 34-mm outer diameter wound with 4-mm wide REBCO tapes was developed and tested. In standalone test, the SCF was found to be prominent with a 173-mT remanent field on the coil top when the coil was discharged from 9 T to 0. In order to study the strain distribution along the tape width, a 3-T insert coil with a 60-mm outer diameter wound with 12-mm wide REBCO tapes was designed and fabricated. Under a 15-T background magnetic field, the testing coil was charged up and down at 4.2 K, when strain gauges and hall sensors were setup to measure the local hoop strain in the outermost turns and the screening current field (SCF), respectively. Corresponding electromagnetic models and mechanical models were developed and compared against SCF and strain measurements, which also provided an insight into the mechanism of the effect of screening current. It is found that the screening current has a strong influence on both magnetic field and strain/stress distributions, which should be taken into account for the strain/stress estimation of high-field HTS magnets.

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