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M2Or2E-03: [Invited] Electromagnetic and Mechanical Simulation of REBCO Pancake Coils Considering Screening Currents

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Ultrahigh field high-temperature superconducting (HTS) magnets beyond 20 T have been developed worldwide. Rare-earth barium copper oxide (REBCO) coils are promising in terms of their high-field specifications as insert coils. However, mechanical damages of REBCO tapes are getting critical in spite of high stiffness of Hastelloy substrates. Plastic deformations have been frequently observed after ultrahigh field generation, nevertheless simulated stresses are lower than yield stresses of Hastelloy substrates.

It was pointed out that screening currents enhanced stresses of insert REBCO coils inside high fields generated by outsert coils. Some simulation results showed higher stresses than expected. In recent years, a REBCO tape rotation effect was proposed, and simulated screening current induced fields agreed with measurements. Hence, it was confirmed that the screening currents largely affected the coil deformations. In addition, it was reported that the coil deformations also affected the electromagnetic phenomenon due to the change of the self-/mutual inductances. The screening currents and the coil deformations influence each other, and excessive stresses due to screening currents damages insert REBCO coils.

In the presentation, we will show the screening current simulation results considering the REBCO tape rotation effect and the inductance change effect. We will also discuss the stress of REBCO coils. In addition, the azimuthal deformation of no-insulation (NI) REBCO tapes is simulated considering the individual turn movement. It reduces the hoop stress of NI REBCO coils.

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