Contribution ID: **36** Type: **Contributed Oral**

Sat-Af-Or5-02: AC loss characteristics of the twisted multi-filamented YBCO tape under alternating magnetic fields

Saturday 5 July 2025 16:45 (15 minutes)

Narrowed high-temperature superconducting (HTS) tapes have much smaller hysteresis loss and eddy current loss per unit tape width according to analytical and experimental data. Multi-filamentary technology is widely recognized as an effectively way of reducing the AC loss of HTS tapes by cutting each tape into multiple narrower filaments while maintaining the whole structure. But the magnetic coupling loss due to the background magnetic field between filaments will become the new obstacle of AC loss reduction when these filaments are fully coupled. In this work, a twisted filamentary HTS tape is simulated by COMSOL to study its AC loss characteristics, comparing to the non-twisted non-filamentary tape, the twisted non-filamentary tape and the non-twisted filamentary tape. 3D multi-layer electromagnetic models of these tapes are simulated to calculate the loss components, such as transporting loss, magnetization loss, magnetic coupling loss, and eddy current loss, in different layers. Varying alternating transporting currents and background fields are applied to discuss the characteristics of these loss components under different working conditions. The influences of the twisting pitch, the number of filaments, and the radius of the twisting axis are also considered. Through simulation results, the mechanism of AC loss reduction of HTS tapes due to the twisting and the filamentary structure are comprehensively studied, which can provide useful references for designing new filamented HTS tapes, cables and magnets.

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Session Classification: Sat-Af-Or5 - AC Loss and Magnetization II