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Role of asymmetric critical current on magnetization loss characteristics of REBCO coated conductors at various temperatures

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Commercial HTS coated conductors exhibit asymmetric Ic (B,θ) characteristics, where θ is defined as the angle between the applied magnetic field and normal component of the superconductor plane. Previous works reported influence of Ic (B, θ) characteristics on dynamic resistance in a coated conductor and AC loss of coil windings wound with coated conductors. However, the influence of asymmetric Ic (B, θ) characteristics on magnetization loss of HTS coated conductors has not been previously reported.
Here, we present experimental Ic (B, θ) and magnetization loss results in a 12mm-wide REBCO commercial coated conductor at 77 K, 70 K, and 65 K. In Ic (B, θ) measurement, θ was varied from 0° to 360° and B is up to 0.2 T. In the magnetization loss measurement, the applied magnetic field amplitude is up to 100 mT and field angle varies from 0° to 180° with 15° resolution. At each temperature, the magnetization loss values at various field angles vary and are dominated by the perpendicular magnetic field component as reported in previous works. Furthermore, we observed difference in magnetization loss values for θ and 180°-θ, which are in mirror symmetry relative to the superconductor plane. We attribute the difference to asymmetric Ic (B, θ) characteristics of the conductor. The difference in magnetization loss values becomes greater with decreasing operating temperatures. 2D FEM (finite element method) simulation using H-formulation was carried out by directly interpolating the measured Ic (B, θ) data and the simulation results reproduce the trend of the experimental results. Our results provide a valuable reference for the magnetization loss behaviors in REBCO coated conductors in various field orientations and temperatures.

Primary author: SUN, Yueming (Robinson Research Institute, Victoria University of Wellington)

Co-authors: Prof. JIN, Fang (Beijing Jiaotong University); PANTOJA, Andres (Victoria University of Wellington); BADCOCK, Rod (Victoria University of Wellington); Prof. LONG, Nicholas J. (Robinson Research Institute, Victoria University of Wellington, PO Box 33436, Lower Hutt 5046, New Zealand); JIANG, Zhenan (Victoria University of Wellington)

Presenter: SUN, Yueming (Robinson Research Institute, Victoria University of Wellington)

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