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M3Or4P-05: Magnetization ac losses, magnetization measurement, and creep analysis of Ni-plated Roebel Cable for particle accelerator applications

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Rare-earth barium copper oxide (REBCO) coated conductor can be fabricated into Roebel cable for the realization of larger stored energy high field magnets. There are two factors, current sharing and ac losses, that are critical to the stability and quench protection of the high field magnets and cables. Those two factors are strongly dependent on inter-strand contact resistance (ICR) of the cable. The ICR for as received cable/tapes can be as high as 17076 Ω*cm2. By applying different treatments, such as compression, heat treatment, and surface modifications, we are able to achieve the ICR value from 100* Ωcm2 to 2.7 Ω*cm2 to allow better current sharing. On the other side, lower ICR leads to higher AC loss. In this work, magnetization ac loss of a Ni-plated Roebel cable which has an ICR of 2.7* Ωcm2 is measured using an M-H loop method in a liquid nitrogen environment (77 K). The magnetic field is generated with a race-track copper magnet with magnetic field amplitude ranging from 4-70 mT and frequency range of 50-200 Hz. We compared this to analysis to explore the role of the cable and conductor magnetic permeability on the extracted resistivity. Then the cable magnetization was measured under 4.2 K with a 12 T magnet system which has a maximum ramp rate of 3.77 mT/s. Then the flux creep analyses were performed by holding the applied field at 1 T for 1800 s. Results from magnetization analyses can be used in error field correction of high field HTS magnets for particle accelerator applications.

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