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Sat-Af-Or5-05: Magnetization of Helically Wound ReBCO Cables in Potted and Non-potted Configuration with Analysis of Hysteretic, Eddy Current, and Coupling Contributions

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This study investigates the magnetization of ReBCO cables, utilizing experimental measurements in magnetic fields up to 30 T at 4.2 K. The cable is comprised of 29 ReBCO tapes, with a cable OD of 3.63 mm and cable pitch of 7.16 mm. The tapes were 2 mm wide and had a substrate thickness of 30 μm, and a Cu plating thickness of 5 μm. The cable had an Ic of 1675 A at 77 K and self-field. The ReBCO cables were tested in various configurations, including three-stack ReBCO cables, three-stack with epoxy impregnation, three-stack with solder coating, and three-stack Ni-plated ReBCO cables. We used a susceptibility technique, with the NHMFL' s Bitter (resistive) magnet acting as the primary coil. We constructed a sample holder with a pick-up coil as well as a compensation coil. The ReBCO cables were measured as a three-stack ReBCO, placed with the field perpendicular to the conductor length. Magnetization (M) versus applied magnetic field (μ0H) was measured for field sweeps with amplitudes up to ± 30 T. In the second set of measurements, we utilized a three-stack ReBCO cable with epoxy impregnation, then the third set with a three-stack ReBCO with solder coating, and the final set with Ni-plated three-stack ReBCO cables. We analyzed results breaking out hysteretic, eddy, and coupling components, comparing the performance of these different ReBCO cables. The findings of this study provide valuable insights into the design and optimization of ReBCO cables for high-field applications, such as fusion reactors, particle accelerators, and magnetic resonance imaging (MRI) systems. Understanding all the loss components for these cables could lead to the development of more efficient and reliable devices. Coupling, eddy, and hysteretic currents in ReBCO cables are significant factors that impact their performance in high-field applications.

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