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Sat-Mo-Po.08-12: Experimental study of current sharing behavior of PANI-CNT coating ReBCO cables for use in accelerator magnets.

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Rare-earth barium copper oxide (ReBCO) coated conductors (CCs) are considered promising materials for high-performance cables and high-field accelerator magnet design. ReBCO tape-wound magnets with no insulation between tapes were designed to protect themselves from thermal instability through a current-sharing mechanism. However, they face challenges such as insufficient mechanical support and potentially high coupling loss due to electrical conductivity between tapes. In contrast, the epoxy-potted design provides mechanical support and reduces loss and field error but is not preferable for quench protection. To address these trade-offs, a novel technique involving polyaniline (PANI) and carbon nanotube (CNT) coatings has been developed. This conductive polymer coating offers mechanical support and adjustable conductivity (modulated by doping materials) between tapes to introduce flexibility in balancing mechanical support, quench protection, and coupling loss. In this study, we used a three-layer ReBCO tape stack, with an artificial defect in the middle layer, to demonstrate the current-sharing behavior of PANI-CNT-coated tape stacks. Three tape stacks were prepared with different surface treatments between tapes: (i) no treatment but with pressing, (ii) PANI-CNT coating, and (iii) Stycast 2850 FT. We measured critical current (Ic) values for these three middle-layer-defective tape stacks at 77.2 K and demonstrated that PANI-CNT coating can share the current between tapes when there is a defect among the tapes, although the sharing ability is not as strong as non-insulation direct pressing. This study is funded by DOE.

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