

Characterization of Electromechanical Properties of Striated REBCO CC Tapes for TORT Cables with Reduced Magnetization AC Losses

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Abstract—REBCO CC (Rare-earth barium copper oxide coated conductors) are the best candidate materials for superconducting TORT (tapes on round tube) cables and high-field magnets due to their excellent mechanical strength, high current-carrying capacity, and magnetic strength. It is currently known that the AC (alternating current) losses can be decreased when TORT cables are constructed using REBCO multi-filamentary tapes. However, when winding such geometrically adjusted tapes into cables, their mechanical robustness is equally crucial. The objective of this study was to understand the effects of the mechanical loading on the I_c (critical current) of the striated tapes and, therefore, determine the safe stress limits. This work involved the preparation of various types of 2 mm wide REBCO striated tapes through chemo-mechanical striating, followed with deposition of thermal and chemical stabilization multilayers. Subsequently, the striated tapes were bent at a lay angle of 45° over bending diameters from 13 mm to 1 mm and current-carrying performance under self-field conditions at 77 K were measured. Electrical measurements demonstrated that up to 2 mm of bending diameter, the striated tapes did not exhibit any I_c deterioration. Conversely, at 3 mm bending diameter, non-striated tapes started to deteriorate. The SEM FIB observation proved that the adhesion of additional stabilization layers in the filaments was not disrupted. The filament edges marked the key zone in terms of delamination or crack formation. Finally, the effect of groove geometrical irregularities on the mechanical performance of striated REBCO tapes were supported by FE (finite element) analysis and correlated with experimental results.

Keywords (Index Terms)—REBCO Films, HTS Cable, AC losses, Strain Effect, Thin Films / Multilayers