

Investigating the Electromechanical Performance of REBCO Tapes for High-Field Magnet Applications

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Rare-earth barium copper oxide (REBCO) coated conductor tapes hold immense promise for high-field magnet applications due to their exceptional critical current (I_c) at cryogenic temperatures. However, during magnet manufacturing and operation, REBCO tapes experience strain and fatigue, potentially affecting their I_c and compromising performance. This study investigates the interplay between I_c , strain, and fatigue in REBCO tapes at cryogenic temperature to optimize their usage in magnet design and construction. Various REBCO tapes from different manufacturers are subjected to controlled tensile strain at 77 K in a dedicated cryogenic testing setup. I_c will be measured simultaneously using a four-probe technique. I_c variations under controlled tensile strain are measured and analyzed at 77 K. Identification of the critical strain limits beyond which I_c degradation becomes irreversible are reported. REBCO tapes are also exposed to cyclic tensile loads at 77 K and their I_c is monitored over extended cycles to evaluate fatigue resistance and potential degradation. This study develops a comprehensive understanding of how strain and fatigue influence I_c in REBCO tapes at cryogenic temperatures. The results will also provide valuable data for magnet designers to optimize coil winding procedures and mitigate I_c losses. This study will contribute significantly to advancing the application of REBCO tapes in high-field magnets for various scientific and technological applications.

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