Are REBCO Coated Conductors Ready for High-Field Magnet Construction?

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This talk presents a comprehensive comparative study of the angular dependence of the critical current, I , in REBCO coated conductors under extreme magnetic fields up to 45 T, enabled by torque magnetometry (US Patent 12,187,540). While the very high I of REBCO tapes severely limits conventional transport measurements at low temperatures and high fields—precisely the regime of greatest relevance for high-field magnet applications—torque magnetometry provides a powerful and efficient alternative. The method enables rapid mapping of $I(B,T,\theta)$ over the full angular range, with good agreement to transport data where direct comparisons are possible. Drawing on measurements from more than 300 commercial and developmental conductors, the talk highlights the surprisingly large diversity in angular I behavior, even among tapes produced using nominally identical fabrication routes. Distinct angular regimes are identified, with exponential and stretched-exponential field dependences emerging near the ab plane and power-law or simple exponential behavior dominating at larger angles. These trends provide clear insight into the relative roles of weak and strong vortex pinning.

The presentation further addresses lengthwise nonuniformities of I , which are found to be significantly larger in samples cut from the edges of 12-mm-wide production tapes than in those taken from the center, particularly for fields near the ab plane. The implications of these variations for magnet reliability are discussed, along with the development of a non-destructive, reel-to-reel torque-based characterization concept for low temperature assessment. Finally, observations of flux jumps in conductors with thick REBCO layers and thin stabilizers are presented, underscoring potential thermal stability limits. Overall, these results provide important insights into REBCO tape performance in extreme magnetic fields and reinforce their relevance for high-field magnet and nuclear fusion applications. The recent advances in both experimental results and characterization techniques increase confidence in the viability of REBCO CCs for such applications, although substantial further development is still required before their progress approaches the scaling trends exemplified by Wright-Moore law in the semiconductor industry.

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