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Pinning Mechanisms, Lengthwise Fluctuations, and Flux Jumps in REBCO Coated Conductors: A Torque Magnetometry Study up to B = 45 T

This study explores the angular (θ) dependence of the critical current $I_c(B, T, \theta)$ in REBCO coated conductors using a torque magnetometer (US Patent) optimized for high magnetic fields (B) and low temperatures (T)—a critical regime for magnet development and pinning mechanism studies, where high I_c complicates transport measurements.
Data from over 200 samples reveal significant I_c variations, even among samples fabricated to the same specifications. When B is near the ab-plane,
strong pinning dominates and I_c exhibits exponential and stretched exponential decays ($I_c \propto \exp(-B)\exp[-(T)^s]$, $s \approx 2$). When B is away from the ab plane, I_c shows power-law and simple exponential decays ($I_c \propto B^{-\alpha}\exp(-T)$, α
$lesssim1$) This enables clear assessment of different pinning contributions into $I_c(B, T, \theta)$.
Additionally, lengthwise I_c variations are prominent in tapes cut from the sides of 12 mm-wide production tapes, especially when the magnetic field aligns with the ab-plane. In contrast, tapes cut from the center exhibit stable I_c. Flux jumps are observed in samples with thick REBCO layers and thin Cu stabilizers, suggesting potential thermal instabilities. These findings provide crucial insights into the performance of CC tapes in high-field magnet and nuclear fusion applications. A. Francis, G. Bradford, A. Xu, R. Ries, D. Larbalestier contributed. NHMFL is funded by NSF DMR2128556 and the State of Florida.

Session

Conductor Material Research

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