

Exploration of variations in the properties of coated conductors of nominally identical manufacture

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Abstract: Use of coated conductors for high field magnets operating at 4 K poses many questions concerning the properties of the coated conductors themselves, especially because properties are generally specified by the manufacturer at self-field and 77 K, whereas magnet performance is dominated by >10 T properties with the field vector significantly misoriented with respect to the tape axes. To address this issue, we here report on the properties of 5 nominally identical conductors taken from recent SuperPower production, evaluating the conductors by means of continuous transport (77K) and continuous magnetization (77 and 4 K), correlating variations in $I_c(x)$ to more detailed angular and high field measurements of J_c at both 77 and 4 K on short samples extracted from the long tapes. We found that the longitudinal I_c variation is controlled both by cross-sectional variations and what appear to be longitudinal pinning center density variations within individual tapes and in larger amounts from tape to tape. We find that correlations between SF, 77 K properties and the 4K, multi-Tesla, off-axis properties important for magnet builders are poor. However, correlation from high field, 4 K to 0.5 T, 77K properties is much better, probably because the 77K, 0.5 T properties are determined by the strong pinning effects of BZO nanocolumns which also play a large role in controlling the low temperature J_c in strong fields. Of course such variations are even larger when tapes from different sources are compared, suggesting the need to establish performance metrics for coated conductors that are relevant to magnet applications.