IEEE-CSC, ESAS and CSSJ SUPERCONDUCTIVITY NEWS FORUM (global edition), Issue No. 54, October 2023

Understanding In-Field Performance of REBCO Conductor with Artificial Pinning Centers by Scanning Raman Spectroscopy and 2D-XRD

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***Abstract*—We present progress in development and understanding of the in-field performance of REBCO conductor with Artificial Pinning Centers (APCs) in the form of BMO nanorods (M = Zr, Hf, Sn, etc.). First, we present TEM findings on in-plane strain accommodation mechanisms between BMO and REBCO matrix, where the interfaces have been found to never be fully coherent, and that the degree of semi-coherency drives the equilibrium nanorod diameter, which is found to assume discrete values. Second, we present findings on the in-field performance as a function of operating field and temperature *(B, T)* and the degree of correlation between different operating regimes. We address the high level of statistical fluctuations of in-field performance found in both production and research conductors and analyze the features behind pairs of $J_c(B_1, T_1)$ and $J_c(B_2, T_2)$ that show high level of correlation. Third, we present results on the feasibility of using indirect, non-destructive characterization methods to predict $J_c(B, T)$ performance over a wide range of fields and temperatures, as high temperature performance (65-77 K) is found to be poorly correlated to low-temperature (4.2 – 40 K), intermediate-to-high field (~3-30 T) performance of interest for applications. We present an in-depth study of scanning Raman spectroscopy and 2D-XRD features and their effect on the resulting in-field performance over 4.2-77 K and measured fields of 0-14 T. The main identified features that correlate to in-field performance are analyzed both in terms of level of correlation and in terms of the underlying microstructural features.**

This work was funded by award DE-SC0016220 from the U.S. Department of Energy, Office of Science–High Energy Physics and award DE-AR0001374 from Advanced Research Projects Agency–Energy.

***Keywords (Index Terms)*— Flux pinning, REBCO, Artificial Pinning Centers, strain, Raman spectroscopy, 2D-XRD**

IEEE-CSC, ESAS and CSSJ SUPERCONDUCTIVITY NEWS FORUM (global edition), October, 2023. Invited presentation given at CEC-ICMC, July 9-13, 2023, Honolulu, Hawaii, USA