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

Ca-repaired $BaZrO_3$ Nanorods/$YBa_2Cu_3O_{7-x}$ Interface for Enhanced Pinning in $YBa_2Cu_3O_{7-x}$ Nanocomposites with 2-8% $BaZrO_3$ Doping

Judy Wu[1], Mohan Panth[1], Victor Ogunjimi[1], Mary Ann Sebastian[2], Di Zhang[3], Bibek Gautam[1], Jijie Huan[3], Yifan Zhang[3], Timothy Haugan[2], and HaiyanWang[3]

[1]Department of Physics and Astronomy, University of Kansas, KS, USA
[2]U.S. Air Force Research Laboratory, Propulsion Directorate, WPAFB, OH, USA
[3]School of Materials Engineering, Purdue University, IN, USA

E-mail: jwu@ku.edu

***Abstract*—C-axis aligned $BaZrO_3$ (BZO) nanorods formed via strain-mediated self-assembly in BZO- doped $YaBa_2Cu_3O_{7-x}$ (BZO/YBCO) nanocomposite films can provide strong pinning to the quantized magnetic vortices. While the strain initiated from the BZO/YBCO lattice mismatch plays a critical role in nucleation and evolution of the BZO nanorods, it also leads to a highly defective BZO/YBCO interface and hence reduced pinning efficiency of BZO nanorods. This work reports a recent study in probing the effect of BZO/YBCO interface on the pinning efficiency of the BZO nanorods as the interface is repaired dynamically during the BZO nanorod growth using Ca doping. Within the BZO doping range of 2-8 vol.%, significantly enhanced pinning efficiency of the BZO nanorods have been observed. A peak enhancement up to five-fold of critical current density at 9.0 T and 65-77 K has been obtained in the 6 vol.% BZO/YBCO nanocomposites after the interface repair. This result not only illustrates the critical importance of the BZO/YBCO interface in the pinning efficiency, but also provides a facile scheme to achieve such an interface to restore the pristine pinning efficiency of the BZO nanorods.**

***Keywords (Index Terms)*—YBCO nanocomposite film, artificial pinning center, vortex pinning efficiency, coherent interface, dynamic lattice enlargement**

Acknowledgements
This research was supported in part by NSF contracts Nos: NSF-DMR-1909292, the AFRL Aerospace Systems Directorate, the Air Force Office of Scientific Research (AFOSR), and the U.S. National Science Foundation DMR-2016453 for TEM characterization.