Size-controlled Spontaneously Segregated Ba_2YTaO_6 Nanoparticles in $YBa_2Cu_3O_7$ Nanocomposites by Chemical Solution Deposition

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Abstract - We present a thorough study of the nucleation and growth process of the solution-based $YBa_2Cu_3O_7$-Ba_2YTaO_6 (YBCO-BYTO) system to control the characteristics of the BYTO phase to meet the requirements for specific power applications. Scanning transmission electron microscopy and X-ray diffraction have been used to characterize the BYTO nucleation and phase evolution during the YBCO-BYTO conversion. At high BYTO loads (>10%M), the nanoparticles tend to aggregate being much less efficient for generating nanostrained areas in the YBCO matrix and enhancing the vortex pinning. Our experiments show that by modifying the nucleation kinetics and thermodynamics of the BYTO, the nucleation mode (homogeneous versus heterogeneous), the particle size and their orientation can be controlled. We demonstrate that YBCO-BYTO nanocomposites with high concentration of nanoparticles can be prepared obtaining small and randomly oriented nanoparticles (i.e. high incoherent interface) generating highly strained nanoareas in the YBCO with an enhancement on the vortex pinning. We have also observed that the incoherent interface is not the only parameter that controls the nanostrain. The Cu-O intergrowths characteristics must be a key factor to also control the nanostrain for future tuning the YBCO vortex pinning.

Keywords - YBCO, chemical solution deposition, nanoparticles, nanostrain, vortex pinning

IEEE/CSC & ESAS SUPERCONDUCTIVITY NEWS FORUM (global edition), October 2013
Received October 17 / 24, 2013; Accepted October 24, 2013. Reference No. ST354; Category 2, 5.
This manuscript was published by *Superconductor Science & Technology* (SuST, IOP) 27, No. 4, 044008, (2014).