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Microscopic Analysis of Bulk, High-TC Superconductors by Transmission Kikuchi Diffraction

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Abstract : In this contribution, the transmission-Kikuchi diffrac-tion (TKD, or sometimes called t-EBSD) is applied to bulk, melt-grown YBa2Cu3O7 (YBCO) superconductors prepared by the MTMG (melt-textured melt-grown) technique and the infiltration (IG) growth technique. TEM slices required for the analysis were prepared by means of focused ion-beam (FIB) milling using mechanically polished sample surfaces, which enable a proper selection of the in-teresting regions for investigations. The required optical transparency was reached by an additional polishing step of the resulting surfaces using FIB-Ga-ion and Ar-ion milling. The improved spatial resolution of TKD enabled the investigation of the tiny Y2BaCuO5 (Y-211) particles having a diameter of about 50-100 nm embedded within the YBCO matrix and of other added secondary phase particles. With the TKD technique, the microstructural properties of the YBCO matrix are studied in detail. It is observed that the matrix shows effects of stress/strain, depending on the size and distribution of the embedded particles, which are important for providing additional flux pinning centers in such superconducting bulk samples. Using the Kernel average misorientation (KAM) maps, the strain induced in the superconducting matrix around the particles, which increases the flux pinning effectivity, can be clearly revealed. This type of analysis of the EBSD/TKD data is, therefore, also important for other material systems, where nanoparticles are embedded in a matrix.

Keywords : electron backscatter Diffraction, transmission Kikuchi diffraction, SEM, YBCO, microstructure, nanoparticles
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