

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

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Abstract : In this contribution, the Transmission-Kikuchi Diffraction (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 growth (IG) 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 interesting 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 YBa₂Cu₃O₅ (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 the 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 : transmission Kikuchi diffraction, EBSD, TKD, embedded particles, superconductors YBa₂Cu₃O₇

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