Parameters for the Fabrication of Large Single Grain YBCO Bulk Superconductors by Top-Seeded Melt Growth Process

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Large single grain $YBa_2Cu_3O_{7-x}$ (Y123) bulk superconductors are used as a frictionless bearing of the levitation application such as a superconducting flywheel energy storage system. Important properties of of the bearing of the levitation rotating device are a levitation force and trapped magnetic field. The levitation force which is caused by Meissner effect of a superconductor is a function of critical current density (J_c) and grain size, while trapped magnetic field is related to the flux pinning capability of a superconducting phase. In order to fabricate an Y123 bulk superconductor with a large levitation force, the grain size, J_c and microstructure regarding the flux pinning should be carefully controlled. In this study, we developed a batch process which can fabricate large single grain YBCO bulk superconductors by a top-seeded melt growth process. Several large bulk YBCO superconductors of 40 x 40 x 15 mm^3 were successfully fabricated in the same time by applying the batch process. The prepared samples are single grain body and involve finely dispersed second particle phases inside an Y123 grain. The Y123 nucleation was controlled by surface coating and the interior microstructure of the Y123 grain was also successfully optimized by addition of CeO_2 which suppresses Y_2BaCuO_5 (Y211) growth in a melt. We report the parameters affecting the mass production of single grain Y123 samples and the characterization of a levitation force of the large bulk samples.

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