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Fabrication of grain aligned Bi2223 thick films with high critical current properties

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The Ag-sheathed Bi2223 tapes have been extensively used for practical applications, while it is thought that the J_c properties of the Bi2223 polycrystalline materials were severely limited by the weak grain coupling originated in short coherence length with large anisotropy. Although control of the microstructure is known to be effective to improve critical current properties, J_c of the tapes is approximately two order of magnitude lower than that of the single crystalline film. In our previous studies, the grain coupling of the Bi2223 materials was found to be improved by introduction of post-annealing process under moderately reducing atmosphere to control the nonstoichiometric cation compositions. Recent our studies revealed that sintering in reducing atmospheres with low oxygen pressure (P_{O2}) below 5 kPa enabled us to obtain Bi2223 with almost single phase by sintering for a short time less than 10 hours, resulting in small grains of Bi2223 and impurity phases. In Bi2223 thick film materials, the grains easily form well-aligned microstructure and high J_c properties can be achieved by integration of these guidelines. Based on these backgrounds, we have attempted to fabricate grain aligned Bi2223 thick film materials with high critical current properties. In addition to the investigation of heat treatment conditions, we have optimized the fabricating processes including the constituent phases of the precursor powder and the designed film thickness in terms of enhancement in J_c. Thus far, intergrain-J_c at 77 K has been improved up to approximately 5 kA cm⁻². Applications of thick film materials as for current leads and magnetic shielding will be discussed.

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