WBP7-4

Enhanced pinning properties by refining Gd_2O_3 particles trapped in the $GdBa_2Cu_3O_{7-\delta}$ films via RCE-DR

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The pinning properties of $GdBa_2Cu_3O_{7-d}$ (GdBCO) coated conductors(CCs) fabricated by reactive co-evaporation by deposition and reaction (RCE-DR) should be further improved because in-field critical current densities (J_c) properties of GdBCO CCs are relatively lower than those of REBCO CCs produced by other processes such as metal-organic deposition (MOD), pulsed laser deposition (PLD), metal-organic chemical vapor deposition (MOCVD). To improve in-field J_c of GdBCO CCs fabricated by the RCE-DR process, employing the nominal composition of Gd:Ba:Cu=1:1:2.5, we tried to refine the Gd_2O_3 particles trapped in the GdBCO superconducting matrix by controlling nucleation and growth rates of Gd_2O_3 in the liquid phase before crystallization of GdBCO. For this purpose, the processing conditions were carefully selected from the GdBCO stability phase diagram experimentally determined for the nominal composition of Gd:Ba:cu=1:1:2.5. By lowering the nucleation and growth temperature of Gd_2O_3 in the liquid from 860 to 800°C in the oxygen pressure of 20, 30 mTorr, the average particle size of Gd_2O_3 particles trapped in the GdBCO matrix could be refined from 137 ± 52 to 73 ± 31 nm, respectively. The pinning properties could be significantly improved by the refinement of Gd_2O_3 so that the refinement strategy might be applied to the RCE-DR process. Details will be presented for a discussion.

This work (Grants No.S2660496) was supported by project for Cooperative R&D between Industry, Academy, and Research Institute funded Korea Ministry of SMEs and Startups in 2018.

Keywords: GdBCO, Gd2O3, Pinning properties, stabilitty phase diagram