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Investigation of the formation mechanism of a-axis oriented grains in GdBa2Cu3Oy coated conductors deposited by pulsed laser deposition

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GdBa2Cu3Oy (GdBCO) coated conductors is one of the most promising candidates due to its high critical temperature over 90 K and high critical current density of the order of 1 ⊠ 106 A/cm2 at 77 K. The presences of a-axis-oriented grains has been known to cause the worsening current characteristics, so that it is important to investigate the formation mechanism of a-axis-oriented grains. In this study, the influence of film growth factor on a-axis grains in the GdBCO film was investigated. GdBCO films were deposited on CeO2/Gd2Zr2O7/Hastelloy substrates by a pulsed laser deposition (PLD) technique. Substrate temperature was varied from 700⊠C to 800⊠C at a constant oxygen pressure condition. The proportions of a-axis grains were estimated by the peak intensity ratio in XRD measurement. It was found that the proportions of a-axis grains were influenced greatly by the substrate temperature, 71% at 700⊠C and 3.0% at 760⊠C. Furthermore, XRD analysis revealed the presence of Gd2CuO4 (Gd214) in the film with high proportions of a-axis grains. Then, we assumed that GdBCO grain grows on Gd214 grain in the film and considered the orientation of GdBCO crystal grains in viewpoint of Gibbs free energy for the nucleation. As a result, a-axis grains tend to form at any substrate temperature when GdBCO grain grows on Gd214 grain. Also, a-axis grains tend to form at lower temperature than 740⊠C when GdBCO grain grows on GdBCO grain. It was found that it is essential to suppress the formation of Gd214 to prevent the formation of a-axis grains of GdBCO.

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