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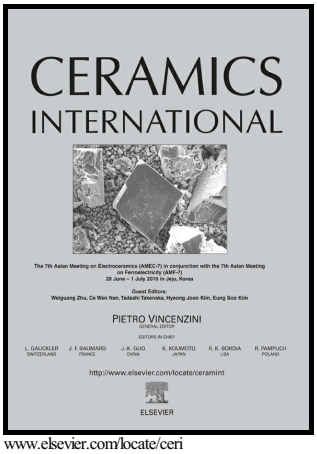

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MOCVD-derived GdYBCO tapes with smooth surface and low R_s based on a new self-heating technology

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Abstract

The metal organic chemical vapor deposition (MOCVD) method was used to prepare GdYBCO films on $LaMnO_3$/ homo epitaxial-MgO/ ion-beam-assisted-deposition-MgO/ solution-deposition-planarization-Y_2O_3 buffered Hastelloy tapes. By adopting a simple self-heating technique, the substrates were heated by the joule effect after applying a heating current (I_h) through Hastelloy metal tapes. The effects of substrate temperature and (Gd, Y)/Ba ratio (r_c) in the precursor on the biaxial texture, surface morphology and superconducting performance of GdYBCO films were systematically investigated by varying the values of I_h and r_c. Needle-like outgrowths formed on the substrate surface were characterized using a scanning electron microscope, energy dispersive spectrometer and X-ray diffraction system. The results show that a high I_h or r_c leads to the formation of needle-like outgrowths. Therefore, I_h and r_c are crucial process parameters that control the growth of needle-like outgrowths on the surface of GdYBCO films. Three hundred nanometer thick GdYBCO films were prepared at different I_h and r_c by the MOCVD process. At an I_h of 27.0 A and an r_c of 0.6, the surface of the GdYBCO film was very smooth and dense, which can provide a good template for multiple depositions of GdYBCO films. The critical current density of the deposited 300 nm-thick GdYBCO film was 4.4 MA/cm^2 (77 K, 0 T), which is attributed to good biaxial texture and appropriate film composition. Furthermore, the microwave surface resistance (77 K, 10 GHz) of the GdYBCO film was merely 0.581 mΩ.

Keywords: smooth surface; self-heating; GdYBCO; MOCVD; critical current density; microwave surface resistance

1. Introduction

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