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Surface Modified Target: A Novel Approach Towards Controlling the Microstructure and Critical Current Properties of YBCO Thin Film

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Increased critical current density (J_C) in higher applied magnetic fields is desired for $YBa_2Cu_3O_{7-\delta}$ (YBCO) thin films to be used in widespread technological applications [1]. Many methods have been employed successfully to improve the flux pinning properties of YBCO thin films and majority of these methods essentially aim to incorporate nanoscale secondary phase inclusions into YBCO superconducting film matrix which generate artificial pinning centers (APCs). A novel approach for introducing nanoscale secondary phase inclusions in YBCO film using pulsed laser deposition technique is to use surface modified target in which a thin sectored/rectangular shaped piece of secondary phase material is attached on the top of YBCO target using silver paste. There are several advantages of this approach over others, one of which is the content of secondary phase material can be finely tuned by changing the size of the sectored/rectangular shaped piece of secondary phase material and/or by changing the rotation speed of the target during the ablation process [2, 3].

In this paper we discuss the structural, microstructural and transport properties of YBCO thin films with varying concentration of $BaSnO_3$ (BSO) and $YBaNbO_6$ (YBNO) nanoscale inclusions. The concentration of secondary phase nanoinclusions is optimized by varying the size of the rectangular BSO/YBNO piece on the YBCO disc and then varying the target rotation speed during laser ablation. The XRD patterns of the YBCO+BSO nanocomposite thin films showed systematic variation in the intensity of the peak corresponding to BSO (appearing around 2Θ = 43°). At 77 K and an applied magnetic field of 4 T, J_C of the nanocomposite thin films is ~ 2×10^5 A/cm^2 and $F_{p\max}$. ~ 10 GN/m^3 which can be improved further by fine-tuning the parameters. By further changing the other deposition parameters such as deposition temperature, the length and diameter of the BSO/YBNO nanocolumns are expected to be controlled. Controlling the microstructure in a desired manner is expected to result in much better critical current density performance of YBCO thin films.

References:

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