Preparation and Characterization of Y doped $Bi_2Sr_2CaCu_2O_8$+d Films Grown by IR PLD

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Abstract

Yttrium doped BSCCO (Bi-22Y2) films on MgO (100) were fabricated by infrared Nd: YAG pulsed laser deposition (IR-PLD) with ex-situ post heat treatments. Chunks or blocks of Bi-22Y2 arrive on the substrate surface as clusters of spheroids. The size of the spheroids decreases with higher doping concentration. Highly c-axis oriented, smooth and homogeneous films were obtained after heat treatment. Partial substitution of yttrium on Bi-2212 exhibits the expected increase in the superconducting critical temperature due to reduction of doping level. This property of the film is due to fact that the material transfer using infrared (1064 nm) Nd: YAG pulsed laser is block-by-block and not atomized.

Key words: Pulsed laser deposition, BSCCO, oxide thin films

Introduction

Pulsed laser deposition (PLD) has been successful in the fabrication of ceramic thin films with complex stoichiometry such as high temperature superconductors [1-5]. Common pulsed laser deposition system uses an ultraviolet (UV) laser excites the target to provide deposition flux, substrate at high temperature and deposition in an oxidizing environment. Excimer and solid state lasers were used for this purpose. Also, incorporation of oxygen and heat on the arrival site are implemented to resolve inhomogeneities in the composition of the deposited films [2, 5-10]. The resulting films are thin and smooth [1-5]. However, the high UV photon energy can result to undesirable effects such as photochemical reactions in the ablated area that alters the stoichiometry of the target and sputtering of the previously deposited material on the substrate by the energetic plasma plume [1, 2].

Films deposited at infrared (1064 nm) wavelength, green (532 nm) wavelength, and ultraviolet (355 nm) wavelength have been reported to have different morphologies [1,3-4,12]. In UV PLD of YBa_2Cu3O7-x, the transfer of maerial is regarded as a result of photofragmentation in which the high photon energy of the laser pulse is strongly absorbed by a small volume of the target material [1, 2]. This allows the ablation plume to consist primarily of atomic, diatomic and other low mass species. In fact for Bi-Sr-Ca-Cu-O it is revealed as a unit-cell by unit-cell material transfer [1-2, 6-7].