Epitaxial thick films by spray pyrolysis for coated conductors

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Abstract

Spray pyrolysis has been successfully used to synthesize many oxides, like transparent conducting films (SnO_2, ZnO and InO_3) or cuprate-based superconducting films. The technique has a high deposition rate and uses cheap raw materials in non-vacuum environment. In our work spray pyrolysis has been used to grow superconducting epitaxial thick films of $YBa_2Cu_3O_{7-\delta}$ (YBCO) on textured substrates. A precursor nitrate solution is atomized and carried towards a substrate which is heated between 800°C and 900°C. After growth, oxygenation is carried out by cooling under oxygen flow. YBCO films deposited on a single-crystal ($SrTiO_3$) exhibit a very good c-axis orientation ($\Delta\omega$=0.4°) as well as an in-plane texture ($\Delta\varphi$=0.6°). Transport measurement has given Ic value close to 10A (77K, sf) on a 5 mm wide tape. First YBCO depositions on technical substrates made by ion beam assisted deposition (IBAD) display a quite good out-of-plane texture ($\Delta\omega$=7°) and a Tc_{onset} of 90K. Furthermore, prospective work on buffer layers (Y_2O_3, CeO_2, CuO) synthesis has been carried out. Despite the high potential of spray pyrolysis, the mechanisms involved in the deposition are quite unknown. It has been evidenced a narrow relationship between the precursor decomposition and the properties of the deposition. In particular an important difference

between the decomposition temperatures of the precursors implies a modification of the stoichiometry in the film. In certain cases NO_2 outgassing can be problematic as it can induce cracks or foam morphology.