Nucleation and Mesostrain Influence on Percolating Critical Currents of Solution Derived YBa2Cu3O7 Superconducting Thin Films

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Abstract - After briefly reviewing the present understanding of the nucleation process of YBCO films, a new approach is presented to enhance the stability of c-axis nucleation in epitaxial chemical solution deposited YBCO thin films derived from TFA precursors. We show that with silver addition to the TFA precursor c-axis nucleation can be reached in a wide range of temperature thus keeping high percolating Jc. We argue that silver reduces supersaturation and makes more stable the c-axis nuclei without modifying Tc. Additional advantages of silver addition are an enhanced surface smootheness and a reduced porosity of the YBCO films. The second reported topic relates to the discovery of an adverse relationship between percolating Jc and YBCO films mesostrain, as determined through X-ray diffraction line broadening. We show that mesostrain is enhanced in processes leading to inefficient strain healing at grain boundaries, for instance annealing times too short or growth temperatures too low. It is suggested that the strained regions at the low angle grain boundaries lead to a weak link behavior which can be microscopically understood on the basis of pair formation prevention, as proposed by the bond contraction pairing model.

Keywords – HTS, YBCO, thin films, chemical solution deposition, nucleation, grain boundaries, mesoscopic strain, critical currents

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