Thickness Issues for Oxide Buffer and Superconducting Layers in REBaCuO Coated Conductors

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It is well known that thicknesses are of critical issues in the secondary-generation high-T_c superconducting coated conductors, not only for oxide buffers, but also for REBaCuO (RE=Y, Gd etc rare earths) superconducting layers. In the view of industrialization, the buffer structure needs to be developed with the layer thickness as thin as possible, while the simple buffers are commonly insufficient to ensure the diffusion barrier and texture template well. On the other hand, the performance-cost and then scale-up development of coated conductors are subject to the effective thickness of REBaCuO superconducting films. In the past decade, extensive effort has been made, implying significant information and solution regarding the critical current density (J_c) with the increase of thickness. The mechanism leading to the degradation in thick REBaCuO films are commonly addressed with the grain misorientation, the formation of non-superconducting phases, or surface roughness, as well as the residual stress near the growth interface. In the present work, we firstly discuss several oxide buffers and their thickness effects, which are prepared by physical vapor deposition or chemical solution deposition. A simplified $Gd_2Zr_2O_7$(GZO)-based buffer architecture is particularly investigated with and without the seeding layer of CeO_2 or Y_2O_3, . It is demonstrated that single buffer of GZO is applicable for coated conductors, while its processing window can be broaden effectively after introducing seeding layer. Moreover, we look into the thickness effect in a distinct superconducting film consisting of the periodic architectures of YBaCuO/GdBaCuO, with the resultant thicknesses up to 3 μm. It is revealed that such an intermittent superconducting layer is effective to avoid the degradation of biaxially texture as well as the microcracks, which are frequently observed in those films with the monolayer of REBaCuO. The characteristic patterns of Raman spectrum and their shifting with increasing the thickness, suggest that the excellent texture is achievable in thick periodic films due to the evolution of stress dominated by the compressive stress.