Comparative Study Between Similarly Processed YBa$_2$Cu$_3$O$_{7-x}$ Films with Y$_2$BaCuO$_5$ or BaSnO$_3$ Additions

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Abstract — A special YBa$_2$Cu$_3$O$_{7-x}$ (YBCO) target with a thin sector of second phase material, in this case either Y$_2$BaCuO$_5$ (Y211) or BaSnO$_3$ (BSO), was used to deposit YBCO films with non-layered nanoparticles on single crystal LaAlO$_3$ and biaxially textured Ni-5 wt.% W substrates buffered with CeO$_2$ and YSZ layers (coated conductors). Although identical processing conditions were used, TEM images indicated that random Y211 nanoparticles in the case of YBCO+Y211, and evenly spaced BSO nanocolumns in the case of YBCO+BSO, form in the YBCO films. While YBCO plane buckling was observed at many places in the case of YBCO+Y211, a high density of stacking faults and dislocations were observed in the case of YBCO+BSO near the BSO columns. In transport critical current density ($J_c$) angular dependence measurements, the absence of nanocolumns in YBCO+Y211 films resulted in the absence of a peak at 0°, $J_c$ (H//c), in $J_c$ vs. q plots, as compared to a clear peak at 0° observed in YBCO+BSO films with the nanocolumns. The in-field $J_c$ measurements indicated small low-field $J_c$ enhancements at 77 K in YBCO+Y211 films but more than an order of magnitude improvement in high-field $J_c$ in YBCO+BSO films due to the differences in the microstructures.

Index Terms — BaSnO3, Coated conductors, Flux pinning, Pulsed laser ablation, Y211

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