Second Phase ($BaGeO_3$, $BaSiO_3$) Nanocolumns in $YBa_2Cu_3O_{7-x}$ Films

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Abstract - $YBa_2Cu_3O_{7-x}$ (YBCO) films with $BaGeO_3$ (BGeO), $BaSiO_3$ (BSiO) second phase additions were processed by pulsed laser deposition. Sectored targets with BGO or BSiO wedges as well as pre-mixed targets of YBCO, BGeO or BSiO with appropriate compositions were used to deposit YBCO+BGeO and YBCO+BSiO films on (100) single crystal $LaAlO_3$ substrates. The cross-sectional transmission electron micrographs showed the presence of 20 nm diameter nanocolumns in the YBCO films of both the compositions. However, the critical transition temperature (T_c) of the films was found to significantly decrease. As a result, the critical current density (J_c) in applied magnetic fields was suppressed. The YBCO+BGeO and YBCO+BSiO films made with lower concentrations of additions showed slight improvement in T_c indicating that the substitution of Ge and Si in the lattice is possibly responsible for the T_c depression. This study shows that in addition to the ability to form nanocolumns, the chemical compatibility of $BaSnO_3$ (BSO) and $BaZrO_3$ (BZO) as observed in YBCO+BSO and YBCO+BZO is critical to process high J_c YBCO films

Keywords - Flux pinning, BaSnO3, BaGeO3, BaSiO3, YBa2Cu3O7-x, coated conductors, pulsed laser deposition

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