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Optimization of the superconducting properties of laser ablated $YBa_2Cu_3O_{7-\delta}$ films on CeO_2-buffered sapphire

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In this presentation we show results of our recent study on the growth, using pulsed laser deposition, of CeO_2 buffers on R-cut sapphire, followed by $YBa_2Cu_3O_{7-\delta}$ films. CeO_2 buffer layers, of thickness ranging between 30 nm to 200 nm, are re-crystallized at high temperatures in the range 800-1200^{O}C. Using the atomic force microscopy (AFM), X-ray diffractometry and results of transport measurements we determine an optimal temperature for recrystallization (1000^{O}C) and the optimal buffer thickness (30nm). Thereafter $YBa_2Cu_3O_{7-\delta}$ films of different thickness are deposited on the top of the optimized CeO_2 buffer layers. Magneto-optic investigation of these films shows that the penetration of the magnetic flux into the films is homogeneous, while AFM data indicates that the film roughness increases with the increasing film thickness. The critical temperature (T_c) and critical current density (j_c) of the films are studied by transport measurements, and compared to similar parameters for $YBa_2Cu_3O_{7-\delta}$ films deposited on monocrystalline substrates. We find that in the films grown on CeO_2 the T_c is only slightly lower, but the j_c is changed in large range from sample to sample depending on superconducting film thickness. Further studies will be conducted to enhance the j_c by several different methods.

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