Epitaxial (001) $BiFeO_3$ thin-films with excellent ferroelectric properties by chemical solution deposition

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High quality phase pure (001) epitaxial bismuth ferrite ($BiFeO_3$; BFO) thin films have been realized by chemical solution deposition. A thorough chemical investigation of the precursor molecular changes during gelation reveals that control of the delicate balance between gelation and metal nitrate precipitation through solvent evaporation is the key to a homogenous gel, necessary to ultimately obtain high-quality films. Pure phase BFO thin films of up to 150 nm thickness prepared by this route on lanthanum strontium manganite ($La_{0.67}Sr_{0.33}MnO_3$; LSMO) buffered strontium titanate-STO(001) substrates are shown to have not only epitaxial nature, but also robust ferroelectric properties with low coercive field. Critically we show that these films can be achieved using stoichiometric 0.25 M precursors (with no Bi excess), thus obviating complexities typically arising from secondary phases associated with precursors having excess Bi. Square hysteresis loops with a high remanent polarization of $2P_r$ =97.8 μC/cm^2 and a low coercive field of $2E_c$=203.5 kV/cm are obtained at room temperature. Further, via this method, mixed phase BFO thin film has also been realized on lanthanum aluminate ($LaAlO_3$, LAO) with coexistence of rhombohedral-like (R) phase and tetragonal-like (T) phase homogeneously mixed at the nanoscale. This homogenously mixed-phase demonstrates the well-known morphotropic phase boundary effect, which offers considerable promise in thin film applications.