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Epitaxial (001) BiFeO3 thin-films with excellent ferroelectric properties by chemical solution deposition-The role of gelation

High quality phase pure (001) epitaxial bismuth ferrite (BiFeO3; 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. Spin-coating the precursor on a preheated SrTiO3 (001) (STO(001)) substrate (~70℃) and subsequent heating at 90℃ leads to a suitable gel film, which is then heated to 650℃ for crystallization. Pure phase BFO thin films of 150 nm thickness prepared by this route on lanthanum strontium manganite (La0.67Sr0.33MnO3; LSMO) buffered 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 2Pr =97.8 μC/cm2 and a low coercive field of 2Ec=203.5 kV/cm are obtained at room temperature. Frequency-dependent hysteresis loops reveal a switching mechanism that is nucleation dominated. In addition, polarization direction dependent resistive switching behavior is also observed. The findings here thus show it is possible to realize high-quality bismuth ferrite thin films via chemical process techniques.

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