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A Morphotropic Phase Boundary in Samarium-modified Bismuth Ferrite Thin Films

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Interfacial control of a polar (rhombohedral)-to-non-polar (orthorhombic) phase transition in (001) oriented epitaxial BiFeO3/(Bi1-xSmx)FeO3 superlattices is presented. We demonstrate controlling the composition at which a polar phase transformation takes place by tuning the strength of the interlayer interactions while holding the average composition constant. It is shown that the thickness of the superlattice layers have a strong influence on the interlayer polar coupling, which in turn changes the phase transition. For shortest periods studied (layers 5 and 10 nm thick) the onset of the phase transition is suppressed along with a significant broadening (as a function of Sm3+ concentration) of an incommensurately modulated phase, determined by two-dimensional x-ray diffraction mapping. Consequently, ferroelectric character with robust polarization hysteresis and enhanced dielectric constant, is observed even for substitution concentration of Sm3+ which would otherwise lead to a leaky paraelectric in single-layer (Bi1-xSmx)FeO3 films. The experimental results are fully consistent with a mean-field thermodynamic theory which reveals that the strength of the interlayer coupling is strongly affected by the polar-polar interaction across the interface. Part of this work appears in Phys. Rev. B 90, 245131(2014).

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