PERIODIC FERROELECTRIC HETEROSTRUCTURES WITH BROKEN INVERSION SYMMETRY RESULTING FROM LOCAL COMPOSITION GRADIENTS

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Epitaxial thin films with arbitrary (but precisely controlled) composition gradients can be grown by a modified pulsed-laser deposition method in which the repeated subsequent deposition of sub-monolayer amounts of dissimilar materials leads to direct alloying during the growth. Using this method, periodic structures with either smooth (e.g. sinusoidal) compositional profiles or sharp interfaces (i.e. traditional superlattices) are readily obtained. More importantly, however, sharp interfaces and smooth compositional gradients can be combined in a single heterostructure, making it possible, for example, to grow films with a “saw-tooth” composition profile. Such structures, in which the inversion symmetry is broken, can be regarded as artificial crystals whose properties have not previously been explored. Here, we present results of perovskite structures of composition $(A'_{x}A''_{1-x})(B'_{y}B''_{1-y})O_3$, in which $x$ and/or $y$ vary as function of distance from the substrate surface. The results of electrical characterization as function of temperature and applied field are compared to those of single graded layers and to theoretical predictions for perovskite superlattices with broken inversion symmetry [A.M. George \textit{et al.}, Nature \textbf{413}, 54 (2001), N. Sai \textit{et al.}, Phys. Rev. Lett. \textbf{84}, 5636, (2000)].

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