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Electronic Asymmetry by Compositionally Braking Inversion Symmetry MAITRI WARUSAWITHANA, H. CHEN, J. ZUO, M. B. WEISSMAN, J. N. ECKSTEIN, Dept of Physics and Materials Research Lab, University of Illinois at Urbana-Champaign — By stacking molecular layers of 3 different perovskite titanate phases, BaTiO3, SrTiO3 and CaTiO3 with atomic layer control, we construct nanostructures where global inversion symmetry is broken. With the structures clamped to the substrate, the stacking order gives rise to asymmetric strain fields. The dielectric response show asymmetric field tuning consistent with the symmetry of the stacking order. By analyzing the temperature and frequency dependence of the complex dielectric constant, we show that the response comes from activated switching of dipoles between two asymmetric states separated by an energy barrier. We find the size of average dipole units from the temperature dependence of the linewidth of field tuning curves to be around 10 unit cells in all the different nanostructures we investigate. At low temperatures we observe a deviation from the kinetic response suggesting a further growth in correlations. Pyrocurrent measurements confirm this observation indicating a phase transition to a ferro-like state. We explain the high temperature dipoles as single unit cell cross sectional columns correlated via the strain fields in the stacking direction, with the height somewhat short of the film thickness possibly due to some form of weak disorder.

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