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Emergence of complex polar order in asymmetric $PbTiO_3/SrTiO_3$ superlattices MARGARET MCCARTER, Department of Physics, University of California Berkeley, Berkeley, CA, United States, AJAY YADAV, SHANG-LIN HSU, Department of Materials Science and Engineering, University of California Berkeley, Berkeley, CA, United States, ZIJIAN HONG, Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA, United States, ANOOP RAMA DAMODARAN, CHRISTOPHER NELSON, JULIA MUNDY, Department of Materials Science and Engineering, University of California Berkeley, Berkeley, CA, United States, LONG-QING CHEN, Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA, United States, LANE MARTIN, RAMAMOORTHY RAMESH, Department of Materials Science and Engineering, University of California Berkeley, Berkeley, CA, United States — Recent work has shown the formation of three-dimensional polar vortices in ferroelectric/paraelectric $(PbTiO_3)_n/(SrTiO_3)_n$superlattices. This novel phase is stabilized by the interplay of lattice, charge, and orbital degrees of freedom. In this work, we employ a systematic study of the electrical polarization in asymmetric superlattices of $PbTiO_3$ and $SrTiO_3$ grown by pulsed laser deposition. In $(PbTiO_3)_m/(SrTiO_3)_n$ superlattices, phase-field modeling predicts a systemic evolution of the polarization state in the superlattice as a function of $SrTiO_3$ thickness. We will present results of a combined experimental-theoretical study of the emergence of complex topologies of electrical polarization. To study superlattices as a function of $SrTiO_3$ thickness, we map the electrical polarization using high-resolution scanning transmission electron microscopy in conjunction with piezoresponse force microscopy studies of the ferroelectric domain structures.

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