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Precise tuning of the built-in bias in $PbTiO_3$ based superlattice thin films.[1] GREG HSIANG-CHUN HSING, SIMON DIVILOV, MOHAMMED YUSUF, Dept of Physics and Astronomy, Stony Brook University, JOSEPH GARLOW, YIMEI ZHU, Condensed Matter Physics Materials Science, Brookhaven National Lab, JOHN BONINI, JOE BENNETT, PREMALA CHANDRA, KARIN RABE, Dept of Physics and Astronomy, Rutgers University, XU DU, MARIVI FERNANDEZ SERRA, MATTHEW DAWBER, Dept of Physics and Astronomy, Stony Brook University — The artificial layering in ferroelectric superlattices is a potential source of polarization asymmetry that results in a built-in bias which shifts polarization hysteresis loops. Here, we studied the origin of polarization asymmetry for ferroelectric $PbTiO_3$ based superlattice films. Using off-axis RF sputtering, we prepared several compositions of $PbTiO_3/SrTiO_3$ (PTO/STO) superlattice thin films; and for comparison $PbTiO_3/SrRuO_3$ (PTO/SRO) superlattices, which have an additional intrinsic compositional asymmetry at the interface. From theoretical modeling and experiments such as heat treatment and repetitive electrical cycling on the samples, we were able to identify and study the impact of Pb-O vacancy defect dipoles on the built-in bias. In addition, we were able to detect the presence of vacancies at the interfaces in the superlattice with STEM-EELS. Finally, we show the ability to tune this built-in bias by depositing a hybrid superlattice that combines PTO/STO and PTO/SRO superlattices. By tuning the composition of the PTO/STO/PTO/SRO superlattice, the built-in bias in this combo-superlattice can be reduced to zero.

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