Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Photoinduced Nanodomain Pattern Transformation in Ferroelectric/Dielectric Superlattice Heterostructure YOUNGJUN AHN, JOONKYU PARK, ANASTASIOS PATERAS, MATTHEW RICH, QINGTENG ZHANG, PICE CHEN, Univ of Wisconsin, Madison, MOHAMMED YUSUF, Stony Brook Univ, HAIDAN WEN, Argonne National Lab, MATTHEW DAWBER, Stony Brook Univ, PAUL EVANS, Univ of Wisconsin, Madison — Ultrathin ferroelectric layers in oxide heterostructures can spontaneously form domains with alternating polarization and nanometer-scale periodicity. The formation of the domain pattern is driven by the depolarization field arising from the interfacial discontinuity of the polarization. The mechanism of tuning and screening of the depolarization field and its correlation with the domain morphology is crucial to the physics of nanodomains. We show that a series of above-bandgap optical pulses induce a transformation of the domain pattern to a uniform polarization configuration. The transformation is observed via synchrotron hard x-ray scattering, in which there is a decrease in the intensity of domain diffuse scattering accompanied by a lattice expansion of 0.6%. The threshold optical fluence for the transformation is 1.8 mJ/cm^2 per pulse at a repetition rate of 54 kHz. A thermodynamic model based on Landau-Ginzburg-Devonshire theory shows that the domain transformation and lattice expansion along surface normal can be induced by screening the depolarization field. Above a critical value of the screening parameter in this model the uniform polarization configuration is energetically favored.

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Date submitted: 11 Nov 2016 Electronic form version 1.4