Structure of ferroelectric polarization domains written by PFM

REBECCA SICHEL, JI YOUNG JO, RYAN SMITH, PICE CHEN, DONG MIN KIM, CHANG BEOM EOM, Department of Materials Science and Engineering, Univ. of Wisconsin-Madison, MARTIN HOLT, Advanced Photon Source, Argonne National Lab., KENNETH EVANS-LUTTERODT, National Synchrotron Light Source, Brookhaven National Lab., NINA BALKE, SERGEI KALININ, Materials Sciences and Technologies Division, Oak Ridge National Lab., PAUL G. EVANS, Department of Materials Science and Engineering, Univ. of Wisconsin-Madison —

In ferroelectric materials, polarization and atomic structure are intimately coupled. PFM is commonly used to image and write polarization domains in ferroelectric thin films, but the local structure of the resulting domains is unclear due to the uncertainty in depth sensitivity of the PFM imaging process. X-ray nanoprobe diffraction was used to simultaneously probe the structure and image polarization domains patterned by PFM into an 80nm-thick Pb(Zr$_{0.45}$, Ti$_{0.55}$)O$_3$ thin film. The Bragg reflections are broader within the written domains, indicating that regions within the film are strained by the writing process. In addition, atomic planes tilt near the domain walls. This means the PFM writing process creates a more complicated structure than predicted by existing electrostatic models.

Rebecca Sichel
Department of Materials Science and Engineering,
Univ. of Wisconsin-Madison

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