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**Strain, composition tuning and size effect in $Pb_xSr_{1-x}TiO_3$ piezoelectric thin films and nanostructures** SYLVIA MATZEN, OLEKSIY NESTEROV, JEROEN HEUVER, Zernike Institute for Advanced Materials, University of Groningen, The Netherlands, GIJSBERT RISPENS, DPMC, University of Geneva, Switzerland, MICHAEL BIEGALSKI, HANS M. CHRISTEN, CNMS, Oak Ridge Nat. Lab, Tennessee -USA, BEATRIZ NOHEDA, Zernike Institute for Advanced Materials, University of Groningen, The Netherlands — Optimizing the piezoelectric performance at the nanoscale is one of the main challenges for future piezoelectric applications, especially in the field of vibrational energy harvesting. In this work, we have investigated the combined influence of epitaxial strain, compositional variation and size reduction on the crystallographic structure, ferroelectric domain configuration and piezoelectric properties of $Pb_xSr_{1-x}TiO_3$ thin films and nanostructures epitaxially grown by Pulsed Laser Deposition on $SrRuO_3$-buffered (110)-$DyScO_3$ substrates. Theoretical predictions on the $PbTiO_3$-$SrTiO_3$ solid solution show an interesting phase transition, expected to give rise to enhanced piezoelectric properties, as a function of composition when the films are grown under strain on (110)-$DyScO_3$. A series of high quality epitaxial thin films has been grown with various Pb/Sr ratios. We have experimentally confirmed the predicted phase transition. Highly periodic domains with purely in-plane polarization have been observed by both X-ray diffraction and piezoresponse force microscopy. The piezoelectric properties have then been studied as a function of composition and of the lateral dimensions of nano-objects defined by Electron Beam Lithography.

Sylvia Matzen
Zernike Institute for Advanced Materials

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