Ferroelasticity in Organolead Halide Perovskite $MAPbI_3$

T. Li[1], E. Strelcov[2, 3], Q. Dong[4], J. Chae[2, 3], Y. Shao[4], Y. Deng[4], A. Centrone[2], J. Huang[4], and A. Gruverman[1, *]

[1]Department of Physics and Astronomy, University of Nebraska-Lincoln, NE 68588, USA

[2]Center for Nanoscale Science and Technology, National Institute of Standards and Technology, Gaithersburg, MD 20899, USA

[3]Maryland Nanocenter, University of Maryland, College Park, MD 20742 USA

[4]Department of Mechanical and Materials Engineering, University of Nebraska, Lincoln, NE 68588, USA

*Alexei Gruverman: alexei_gruverman@unl.edu

Hybrid organic-inorganic perovskites $CH_3NH_3PbI_3$ ($MAPbI_3$) are promising materials for the next generation of solar cells as they show high power conversion efficiency and low cost fabrications. Ferroelectricity has been proposed as a plausible mechanism to explain the high efficiency of the hybrid organic-inorganic perovskites. However, inconsistent results were published among different research groups. There are still questions regarding to whether these hybrid perovskites are intrinsically ferroelectric.

To address these questions, we performed Piezoresponse Force Microscopy studies of pristine and stressed polycrystalline films and single crystals of $MAPbI_3$, which provided solid evidence for the ferroelastic behavior of this material. The ferroelastic domains can be manipulated by externally applied mechanical stress, suggesting that strain engineering may be used to tune the properties of these materials. No evidence of concomitant ferroelectricity was observed. Observation of the ferroelastic behavior of $MAPbI_3$ may shed new light on the unique photovoltaic properties of the hybrid organic-inorganic perovskites.