Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Simultaneous electromechanical and capacitance characterization of top-gated $LaAlO_3/SrTiO_3$ heterostructures[1] FENG BI, MENGCHEN HUNG, University of Pittsburgh, CHUNG WUNG BARK[2], SANGWOO RYU, CHANG-BEOM EOM, University of Wisconsin-Madison, JEREMY LEVY, University of Pittsburgh — $LaAlO_3/SrTiO_3$ (LAO/STO) heterostructures exhibit a sharp, hysteretic metal-insulator transition (MIT) with enhanced capacitance beyond the geometric limit when the interface is tuned by a biased top gate. To understand the physical origin of these behaviors, we investigate the electromechanical response and capacitance spectroscopy of top-gated LAO/STO heterostructures. Piezoelectric Force Microscopy (PFM) measurements demonstrate local variations in the hysteretic response, and capacitance measurements show carrier density changes at the LAO/STO interface as the top gate bias is varied. A strong correlation between PFM signals and capacitance signals is established by doing simultaneous measurements. The enhanced capacitance at the MIT is correlated with charging/discharging dynamics of nanoscale conducting islands at the interface, which can be imaged by spatially-resolved PFM.

[1]We acknowledge support from National Science Foundation through grants DMR-1104191(J. L) and DMR-1234096 (C. -B. E.)
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Date submitted: 09 Nov 2012 Electronic form version 1.4