Sketched ferroelectric single-electron transistor\textsuperscript{1} GUANGLEI CHENG, U. of Pittsburgh, PABLO SILES, Laboratório Nacional de Luz Síncrotron, Brazil, FENG BI, CHENG CEN, DANIELA BOGORIN, U. of Pittsburgh, CHUNG WUNG BARK, CHAD FOLKMAN, JAE-WAN PARK, CHANG-BEOM EOM, U. of Wisconsin-madison, GILBERTO MEDEIROS-RIBEIRO, HP labs, JEREMY LEVY, U. of Pittsburgh — Oxide heterostructures formed from ultrathin layers of LaAlO\textsubscript{3} grown on TiO\textsubscript{2}-terminated SrTiO\textsubscript{3}, combined with a reversible nanoscale patterning technique, provide a versatile platform for nanoscale control at the single-electron limit. Here we demonstrate the creation and characterization of “sketched” single-electron transistors made from ultrasmall (1-2 nm) quantum dots. Shell filling from $N=0$ up to $N=2$ electrons by single-electron tunneling is observed. Resonant tunneling can be controlled in a deterministic and non-volatile fashion by altering the ferroelectric polarization within the SrTiO\textsubscript{3} tunnel barrier. These single-electron devices may find use as nanoscale hybrid piezoelectric/charge sensors, and as elemental building blocks for solid-state quantum computation and quantum simulation platforms.

\textsuperscript{1}This work was supported by NSF DMR-0704022 (JL), DARPA (W911NF-09-10258, JL), ARO (W911NF-08-1-0317, JL), The Fine Foundation (JL), AFOSR (FA9550-10-1-0524, J.L. and C.B.E), NSF DMR-0906443 (CBE), a David and Lucile Packard Fellowship (CBE).

Guanglei Cheng
U. of Pittsburgh

Date submitted: 13 Dec 2010

Electronic form version 1.4