Abstract Submitted
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Oxide films imaged on a nanometer-scale by single-electron tunneling force microscopy[1] CLAYTON C. WILLIAMS, EZRA BUSSMANN, NING ZHENG, University of Utah — Recently, we reported a scanning probe technique to manipulate a single electron to and from states in a nonconducting surface by electron tunneling. Each electron is detected by electrostatic force as it tunnels between a scanning probe and the surface. Electrons are manipulated by tuning the probe Fermi level with respect to the states by a dc voltage. This manipulation serves as the mechanism for imaging and for performing electronic spectroscopy of states in dielectric films. The energy distribution of the states is measured by counting the electrons tunneling to the surface at incrementally varied voltages. The spatial distribution of states is imaged on a nanometer-scale by counting each electron tunneling on a 2-D grid. We present spectroscopic and imaging results from silicon dioxide and hafnium oxide. The density and spatial distribution of states is compared for various growth parameters. The measurements reveal evidence for energy relaxation and charge movement in the states. This new nanometer-scale approach provides the means to locate and identify electronic states in nonconducting surfaces, opening for exploration a whole class of materials not accessible to the STM.
[1] E. Bussmann, N. Zheng & C. C. Williams, *Appl. Phys. Lett.* **86**, 163109 (2005).

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