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Independent determination of depth and energy of electronic trap states in dielectric films by Dynamic Tunneling Force Microscopy JON PAUL JOHNSON, CLAYTON C. WILLIAMS, University of Utah, Physics Department — Dynamic Tunneling Force Microscopy (DTFM) is a new scanning probe technique that images electronic states in completely non-conducting films with sub-nanometer spatial resolution[1]. In DTFM, electrons are shuttled via quantum tunneling between a metallic tip and localized electronic states in an insulating dielectric film, while a lock-in amplifier detects an electrostatic force signal that is proportional to the shuttled charge. The DTFM signal provides a map of the available electronic states within tunneling range of the surface. These states are not observable by STM. The depth of the states can be estimated from the dependence of tunneling rate on the tip/sample gap[2] and also inferred from their apparent lateral size. Images show states below the surface that drop out of the image when the tip/sample gap is increased. A methodology is introduced to independently determine state energy and depth, potentially on a sub-nanometer scale. This work was supported by AFOSR and SRC. [1] J P Johnson and C C Williams, *Nanotechnology* (accepted) [2] N Zheng, et al., *Journ. App. Phys.* **101**, 093702

Jon Paul Johnson
University of Utah, Physics Department

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