Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Development of Electronic and Topographic Structure of the Vacuum-cleaved $SrTiO_3$ (001) Surface as a Function of Annealing WATTAKA SITAPUTRA, MAREK SKOWRONSKI, Department of Materials Science and Engineering, Carnegie Mellon University, NIKHIL SIVADAS, DI XIAO, RANDALL FEENSTRA, Department of Physics, Carnegie Mellon University — A progressive disappearance of the conductance stripes along with emergence of new surface electronic states were observed at a vacuum-cleaved $SrTiO_3$ (001) surface upon annealing at $150 - 375°C$. This disappearance started with an expansion of the TiO_2 stripe, as seen in conductance mapping of scanning tunneling microscopy, and progressed as the annealing time increases until the TiO_2 stripes dominate most of the surface. Such development can be associated with a topographic evolution from the initial alternating TiO_2/SrO surface termination into a step-terrace structure with mainly TiO_2 termination, which is more thermodynamically favorable during ultra-high vacuum annealing. The completeness of the TiO_2 terrace after the annealing was found to depend significantly on the original surface structure and, thus, vary across the surface. This different degree of TiO_2 coverage resulted in different emerging electronic states, in which several were found within the range of 0.6-1.7 eV above the Fermi level on both TiO_2 and the remaining SrO terminated surface. Interestingly, it was found that a short annealing at $150°C$ could produce a significant change in electronic structure where states can be found within 1 eV above and below the Fermi level.

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Date submitted: 15 Nov 2013 Electronic form version 1.4