Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

XPS measurements of interface dipole switching at the a-Al2O3/Si interface STEPHANIE FERNANDEZ-PENA, Geneva University, D.P. KUMAH, Yale University, Z. ZHANG, Argonne National Laborator, A.M. KOLPAK, MIT, S. ISMAIL-BEIGI, C.H. AHN, F.J. WALKER, Yale University — In this work, we describe work on polarization switching at a high-k oxide-silicon interface. The procedure involves inserting a monolayer (ML) of ZrO2 in-between an amorphous-Al2O3 and Si. Theoretical calculations using density functional theory (DFT) predict that the ZrO2 should display two stable configurations of the polarization. Deposition of the ZrO2 in UHV is used to avoid SiO2 formation. The device is transferred in vacuum and the interface chemistry analyzed using x-ray photoelectron spectroscopy (XPS) to determine the oxidation state of the Si. When the ZrO2 is in direct contact with the Si, chemical shifts as large as 0.58 [eV] are observed, implying a polar interface. In addition, XPS measurements on devices under applied voltage, along with electron transport measurements, show a switching of the interface dipole of 0.25 [eV]. These voltage dependent XPS results are consistent with the magnitude and direction of hysteresis loops observed in Capacitance-Voltage measurements. Finally, the microscopic structure has been investigated using extended x-ray absorption fine structure (EXAFS) at the Zr K-edge. The results are compared to DFT-calculated atomic positions.

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Date submitted: 11 Nov 2011

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