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Sub-Angstrom Distortions of an Epitaxial Oxide on Silicon (001)

YARON SEGAL, FRED WALKER, J.W. REINER, C.H. AHN, Department of Applied Physics and Center for Research on Interface Structures and Phenomena, Yale University, ZHAN ZHANG, Argonne National Laboratory — As metal oxide semiconductor field effect transistor (MOSFET) devices are reduced to the nanometer length scale, atomistic control of the silicon-oxide interface is needed in order to fabricate optimally functioning devices. In this work, we present synchrotron x-ray diffraction measurements of a model system, barium oxide grown epitaxially on Si (001), with an interface phase of submonolayer strontium on silicon. Diffraction results show that the 2x1 surface phase that promotes epitaxy transforms into an interface phase between the oxide and silicon, which also has a 2x1 symmetry on the Si (001) surface. Quantitative analysis of the diffraction is consistent with three classes of models; these involve a 2x1 arrangement of alkaline earth metal in the interface phase, sub-angstrom distortions of the oxide film, or a combination of both. These measurements demonstrate how this reconstruction is a true interface phase that can be used to test our current understanding of silicon-oxide interface physics.

Yaron Segal
Department of Applied Physics and Center for Research on
Interface Structures and Phenomena

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