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Structural and Electronic Properties of Epitaxial Complex Oxide-Silicon Interfaces[1]

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Following the discovery of a method to deposit a crystalline complex oxide, $SrTiO_3$, directly on Si, a significant effort has been devoted to understand the nature of crystalline oxide-semiconductor interfaces. This research has in part been motivated by the desire to find a suitable high dielectric constant (high-k) insulator to replace SiO_2 in Si-based field effect transistors. In this talk, we present results on the detailed structural and electronic properties of epitaxial $SrTiO_3$-Si and $LaAlO_3$-$SrTiO_3$-Si heterostructures grown by oxide molecular beam epitaxy. Using synchrotron crystal truncation rod analysis and reflection high energy electron diffraction, we place constraints on the detailed positions of the atoms at the oxide-semiconductor interface. These results are compared with predictions based on first-principles calculations of the interface. We also discuss capacitance-voltage and inelastic tunneling spectroscopy measurements of the electronic and dielectric properties of these high-k oxide-semiconductor systems.

[1]This work has been carried out in collaboration with J.W. Reiner, F.J. Walker, A. Posadas, Y. Segal, K. Garrity, and S. Ismail-Beigi.