UNIVERSITÄT OSNABRÜCK

NanoScience Seminar

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Epitaxial Growth of Ultra-Thin Ceria Films on Chlorine-Passivated Si(111)

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The growth of high-quality, epitaxial thin oxide films on silicon is a longstanding goal in semiconductor technology. Among its other multiple possible applications, ceria is one of the most promising candidates for the realization of the so-called "high-k" dielectrics due to its predicted high thermodynamic stability and its almost vanishing lattice mismatch (~0.35%) to silicon. However, growth of high-quality ultra-thin films has so far been considerably impeded by Ce-promoted Si oxidation at the interface, resulting in subsequent silicate formation. Here, we present an extensive study of epitaxial ceria films grown on chlorine-passivated Si(111) by reactive molecular beam epitaxy under ultrahigh-vacuum conditions using x-ray photoelectron spectroscopy, low-energy electron diffraction, and x-ray standing waves to elucidate the structural and chemical properties of the ultra-thin oxide layer. In addition, x-ray diffraction data and results from transmission electron microscopy acquired for film thicknesses exceeding a few nanometres allow to quantitatively characterize the sample morphology, the strain state of the film as well as the structure and composition of the interface.