Templated ordering of molecules and atoms using oxide nanostructures and ultra-thin films

Professor Martin R. Castell
Department of Materials
University of Oxford

Abstract

The surface structure and origin of reconstructions of SrTiO3 crystals is an unusual system in that there are such a large variety of stable surface structures whose evolution depends on the temperature and oxidizing / reducing environment during sample preparation which in turn determines the near-surface stoichiometry and hence the surface crystallography. With an increasingly Ti-rich surface environment there is an evolution of epitaxial titanate nanostructures that eventually result in epitaxial TiO2 anatase thin films on the surface. The reconstructed and nanostructured perovskite surfaces can be used as templates to self-assemble molecules such as fullerenes into patterns that differ significantly from the close-packed structures that are usually observed on metal surfaces.

Some results of epitaxial film growth of TiOx on Au (111) will be shown. This work demonstrates that due to the variable oxidation states of titanium, and the nature of the interface, it is possible to create titanate structures in an ultra-thin film form that are not stable as a bulk termination. When Ba is deposited on these ultra-thin films they act to order the individual Ba atoms into particular patterns depending on coverage.

The main experimental technique that is used to produce the results shown in this presentation is variable temperature UHV scanning tunnelling microscopy (STM). However, results from high resolution X-ray photoemission (XPS) and Auger spectroscopy (AES) will also be shown. UHV scanning electron microscopy (SEM) is also used to follow dynamical surface processes at elevated temperatures. Modelling the surface structures and STM image simulation is performed with density functional theory (DFT)

Biography

Martin R. Castell completed his PhD in Physics in 1994 at the University of Cambridge. He then moved as a Junior Research Fellow to the Department of Materials at the University of Oxford. From 1999 he held a Royal Society University Research Fellowship, followed in 2005 by a University Lectureship, and was made a Professor in 2010. He has held visiting positions at the University of Toronto, Queen’s University Belfast, and is currently visiting the University of New South Wales. His main research activity is using UHV scanning tunneling microscopy to investigate the atomic structure of oxide crystal surfaces, ultra-thin films, and nanostructures.