Ambient Pressure XPS as a Tool to Probe Metal-Oxide Catalyst Behaviour

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Ambient Pressure X-ray Photoelectron Spectroscopy (AP-XPS) has provided numerous important insights into the behaviour of materials under conditions out of reach of traditional surface science experiments. In the first part of this talk I will highlight the application of AP-XPS to a number of model heterogeneous catalyst systems based on TiO$_2$ and CeO$_2$. Catalysts composed of metal-oxide supported nanoparticles have wide ranging industrial uses with particular energy-related applications including alternative fuel synthesis. I will demonstrate how AP-XPS plays a vital role as part of a multi-technique approach into investigating the reactions that occur at the surface of such materials.

Figure 1. Cartoon depiction of the interrogation of a model supported catalyst by AP-XPS, and C1s AP-XPS spectra from a Ni/CeO2 catalyst under methane dry reforming conditions.

The second part of my talk will cover the development and recent science commissioning experiments at the newest beamline at Diamond Light Source (UK) – B07 VERSOX (Versatile Soft X-ray). The VERSOX beamline is designed to provide synchrotron radiation soft X-rays between 50 and 2800 eV for studying atomic structures and the electronic/chemical properties of surfaces and interfaces by Photoelectron Spectroscopy (XPS) and Near-Edge X-ray Absorption Spectroscopy (NEXAFS) under wide-ranging pressures ($10^{-10}$ to 1000 mbar) and temperatures (100-1200 K). The beamline is designed to have separate sources and optical components that will allow independent and parallel operation of two soft X-ray branch lines; B07-C (Ambient Pressure) and B07-B (High Throughput).

Figure 2. Beamline layout of B07 VERSOX, and C K-edge XAS spectra from a diamond (001) surface.