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X-ray Photoelectron Spectroscopy XPS

Overview

X-ray Photoelectron Spectroscopy (XPS) is a surface analytical technique that provides information about the elemental and chemical composition of the top 10 nm of a surface. XPS is also used to determine chemical state information of the detected elements such as distinguishing between SiO_2 and elemental Si; and oxidation states of metals (e.g. Ni^{+2} vs. Ni^0). It is widely used to characterise organic polymer materials as well. Both Kratos AXIS 165 and the latest Kratos AXIS Ultra DLD X-ray photoelectron spectrometers available at Bernal institute are high performing instruments with combined capabilities of conventional spectroscopy, imaging, small spot spectroscopy, Auger electron spectroscopy (AES), Scanning Auger Microscopy (SAM) and in-situ heating/cooling facilities. Sputter depth profiling of thin organic layers are now possible with the state of the art Argon Gas Cluster ion source which can also operate in monoatomic mode for sputtering inorganic materials.

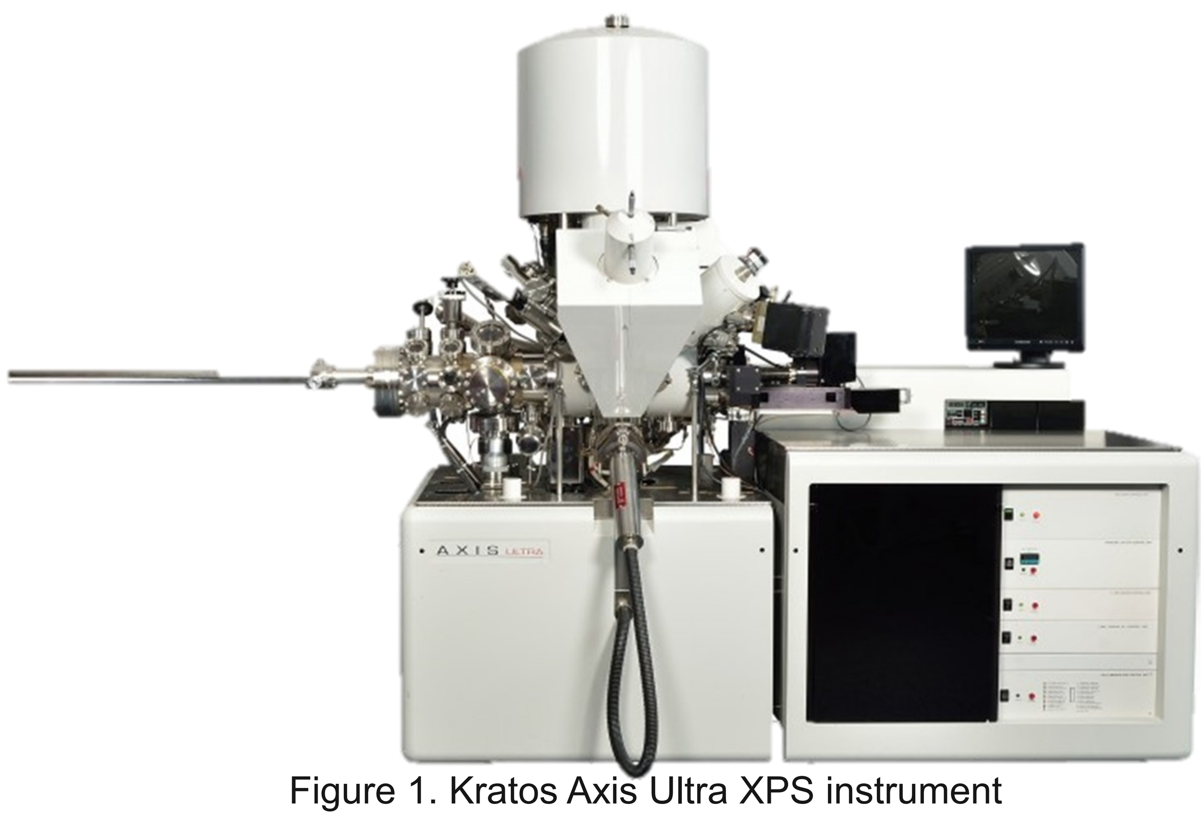


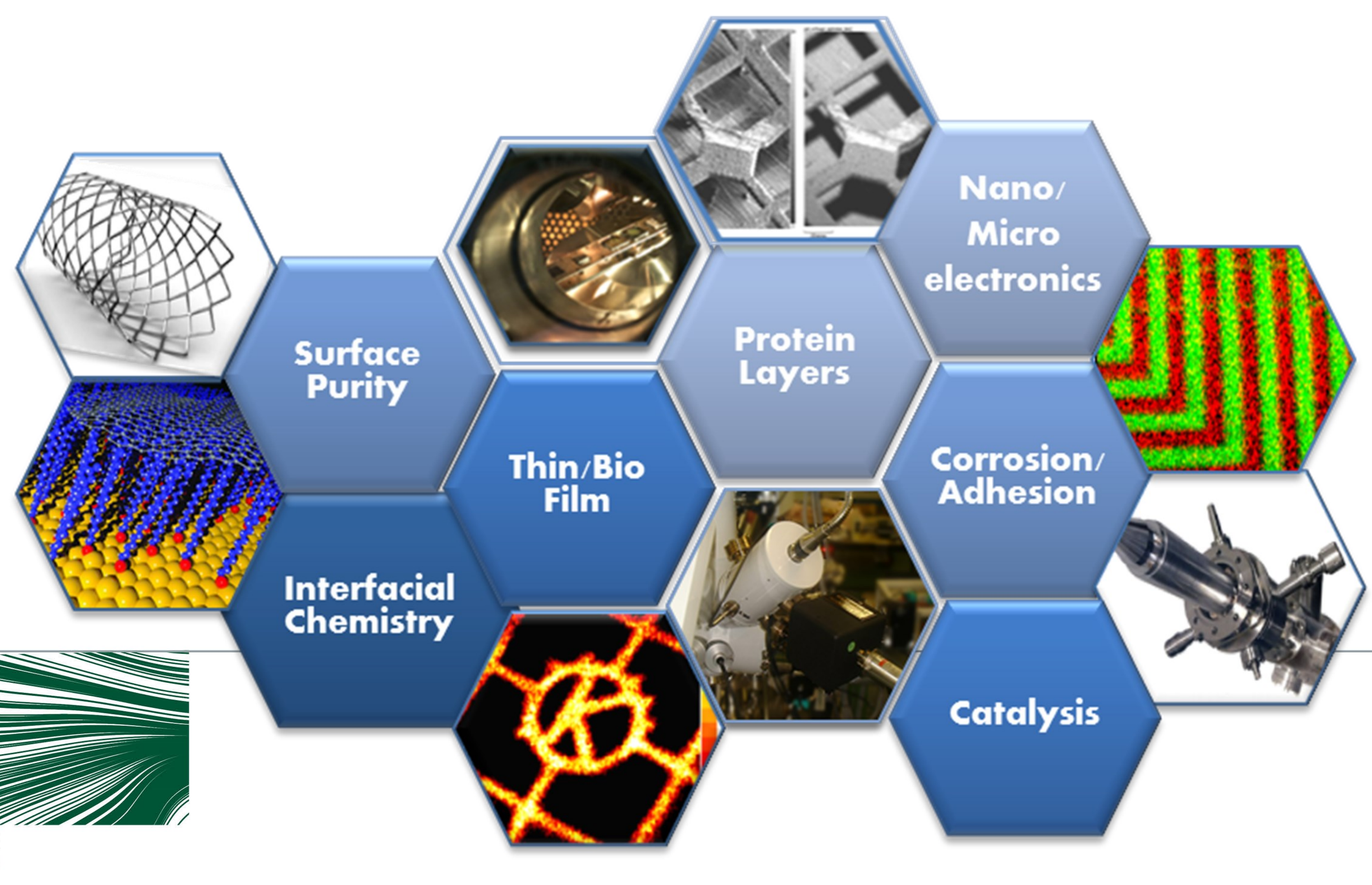
Figure 1. Kratos Axis Ultra XPS instrument

Technical Details

X-ray Photoelectron Spectroscopy and Imaging
Quantitative chemical state analysis, all elements except H and He detected, 10 nm analysis depth, minimum 15 µm spot size, 3 µm lateral resolution, detection limit of 0.1 atomic %, charge compensation system for analysing insulators and semi conductors

Auger Electron Spectroscopy /Scanning Auger Microscopy (AES/SAM)
Surface compositional, defect, particle analysis, 1-5 nm analysis depth, Schotty field emission electron gun with 100 nm lateral resolution

Novel Argon Gas Cluster Ion Source for Depth Profiling
Depth profiling of organic and inorganic materials, improved interlayer resolution of multilayers



Example Outputs

- Identifying contaminants and stains on materials
- Determining chemical composition of powders and unknown materials
- Identifying the degree of surface oxidation/segregation in metals and alloys (Figure 3)

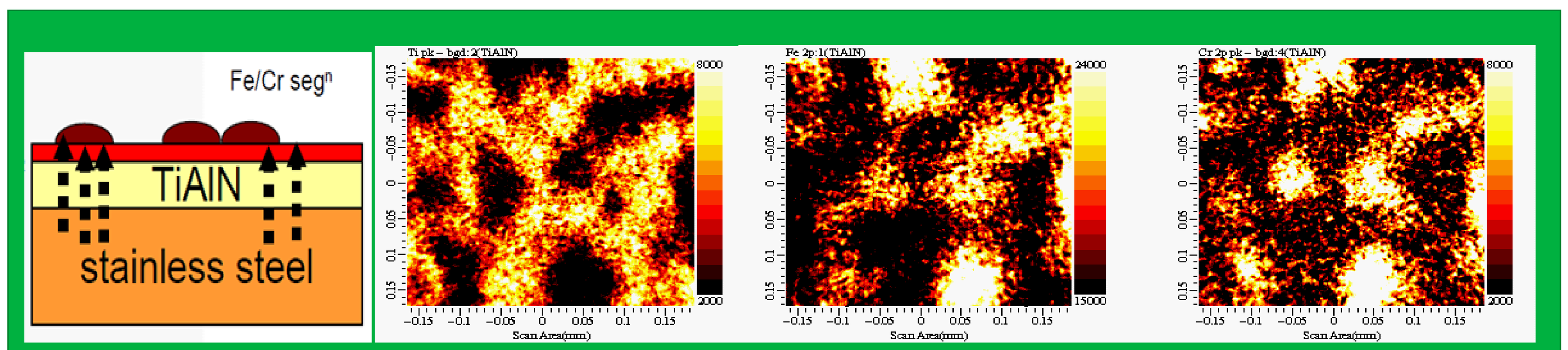


Figure 2: Evidence of surface segregation of Fe and Cr when a plasma deposited TiAlN on a steel substrate is heated in air at >900 °C

- Determining Surface chemical composition of biomedical components such as stents, catheters, etc.
- Fe mapping for possible contamination in an artificial joint
- Examining oxygen spectra in vacuum cleaved bio glass for influence of added network modifiers/formers
- Examining changes in functional groups in polymers/ composites before and after processing
- Surface characterisation of bi/tri metallic catalysts (Figure 3)

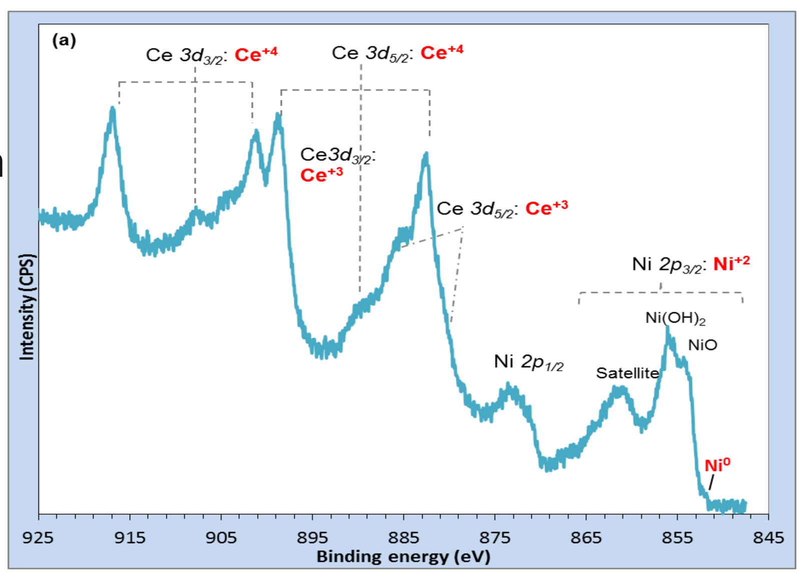


Figure 3: High resolution Ce 3d and Ni 2p core level spectra obtained from catalyst used for partial methane oxidation

- Compositional analysis of mud, clay and ash minerals
- Depth profiling of NiTi alloy to characterise surface oxide layer
- Chemistry of organic surfactant capped Nanomaterials undergoing various treatments
- (Figure 4)
- Oscillatory anodic film growth on III-V compound semiconductors
- Molecular interconnect for nanotechnology
- Surface analysis of electro grafted polymers on carbon

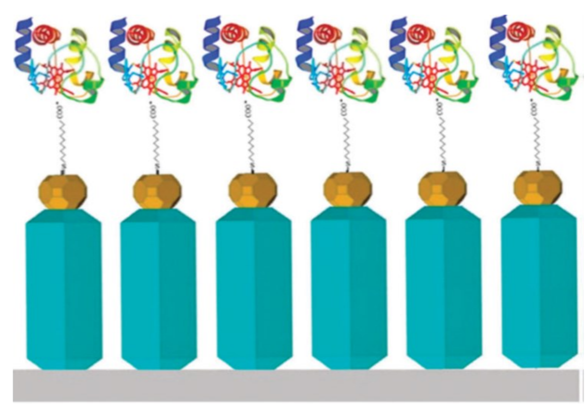
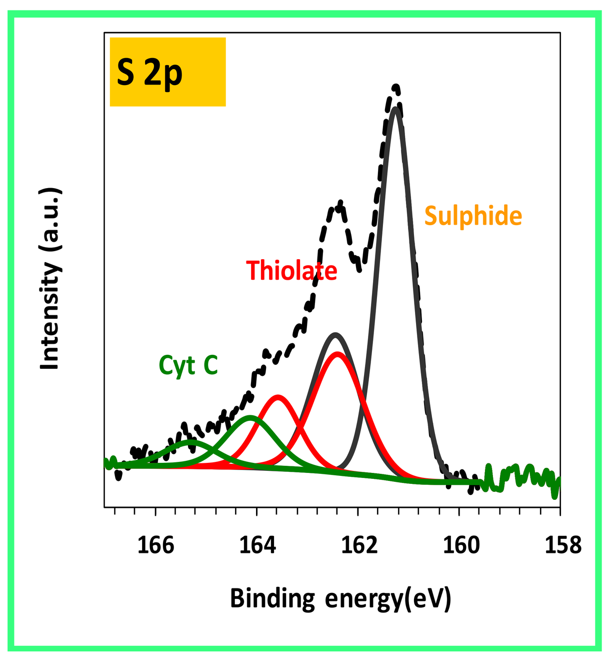


Figure 4: (a) schematic showing the bottom up assembly process consisting of a protein on gold tipped CdS nanorods on an ITO substrate.(b) XSP spectra of S 2p following the systematic construction of the assembly of gold tipped CdS nanorods with the thiol linkage and S-containing Cyt C protein



Potential Collaboration

X-ray Photoelectron Spectrometer is part of the Surface Analysis laboratory in Bernal Institute. XPS is an essential analytical tool for investigating surface chemistry of materials and is applicable to biomedical, composites, materials for energy and environment, nanomaterials and also more recently in pharma fields. Many national and international academic institutions and industry access our XPS facility for their research needs.

Contact

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