NanoPrime

Understanding Your XPS Instrument workshop

14th and 15th November 2018

Hosted by:

Nanoscale and Microscale Research Centre (NMRC), University of Nottingham

As part of the NanoPrime initiative.

Day 1:

Introduction from Dr Karen Alvey, NMRC.

Data processing workshops with CasaXPS

and understanding instrument limitations

Day 2:

AM Optimising your instrument – what the engineer does and what you can do.

PM Demonstration on Kratos Axis instrument by Vincent Fernandez.

Tutors: Dr Vincent Fernandez,

Dr Neal Fairley, Dr John Walton, Dr David Morgan, Dr Emily Smith

Limited to 20 places, registration is free.

Contact: neal@casaxps.com

University of Nottingham
Nanoscale and Microscale Research Centre

Wednesday 14th November 2018

AM: Data Treatment Workshop (Neal Fairley)

A review of software features required to report quantification by XPS.

Application of Relative Sensitivity Factors, Escape Depth and Transmission

Quantification perspective from survey data

Quantification and Chemical State perspective from high resolution narrow scan data

Annotation tables and verification steps to support quantification

PM: Background to the role of XPS Instrumentation in XPS Quantification

A Review of Quantification Procedures for Instruments Supported by Harwell XPS (David Morgan, University of Cardiff)

Ambient Pressure XPS Instrumentation (Rob Temperton, University of Nottingham)

Review of Axis Ultra Lens and Aperture System (Vincent Fernandez, IMN Nantes)

Energy Filters, Detectors and Lineshapes (Neal Fairley)

Thursday 15th November 2018

AM: Groundwork for Tuning for Optimum Instrument Response

Charge Compensation and Quantification by XPS (John Walton, TSTC)

Methods for Characterisation of Lens Performance (Vincent Fernandez, IMN Nantes)

PM: Practical Demonstration of Tuning an Axis Ultra for Optimum Transmission Characteristics (Vincent Fernandez, IMN Nantes)

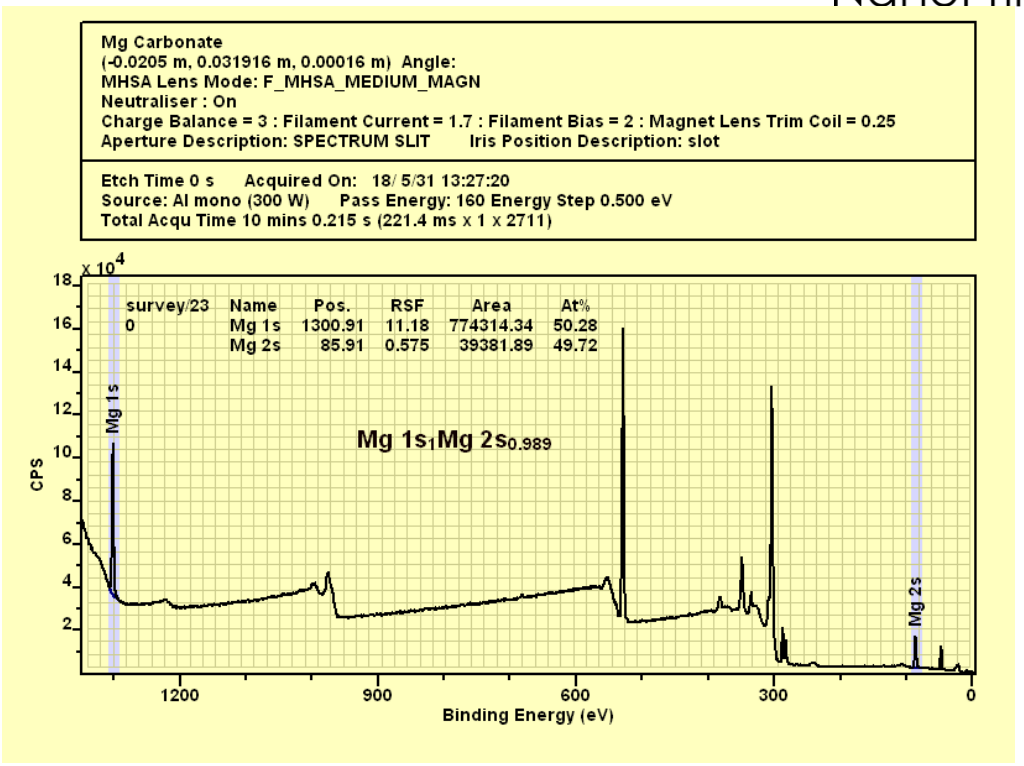
Workshop on XPS Instruments and Quantification by XPS

Quantification by XPS requires correction factors applied to photoemission intensity. These correction factors include adjustment for Relative Sensitivity (RSF) of photoemission response for different electron configurations and atoms, sample dependent escape depth corrections and instrumental sensitivity response over the range of kinetic energies used to collect signal from photoemission peaks. Quantification by XPS requires all three of these mechanisms to be well characterised and consistently applied.

Physics dictates the need for RSF and escape depth correction however instrumental response is subject to instrumental design, tuning of lens modes and aperture settings.

Spectra from most modern instruments are accompanied by an instrument response function, the so called transmission function. The purpose of this transmission function is to correct measured peak intensity for variation in count rate due to variation in efficiency caused by scanning lens voltages when collecting signal from photoemission at different binding energies. This approach of correcting for, what is essentially, an error induced by instrument design is an established practice placing the burden on a calibration procedure involving measurement and mathematical interpretation of measured signal. From a mathematical perspective a flat instrumental response to kinetic energy would be ideal, but if not flat then smooth and predictable would be a second choice.

The workshop led by Vincent Fernandez from IMN Nantes is designed to illustrate procedures developed at Nantes for an Axis Nova and an Axis Ultra which create at least one near ideal operating mode for which the transmission function is practically flat over an extended range of kinetic energies. Results from the Nantes Axis Nova are shown in Figure 1 where two examples of spectra measured from an Axis Nova illustrate results from a flat transmission response mode. Quantification shown in Figure 1 is performed for different photoemission peaks using Scofield cross-sections corrected for escape depth using a universal formula (Martin Seah) for escape depth over a range of kinetic energies only. No transmission correction is involved in computing these results.



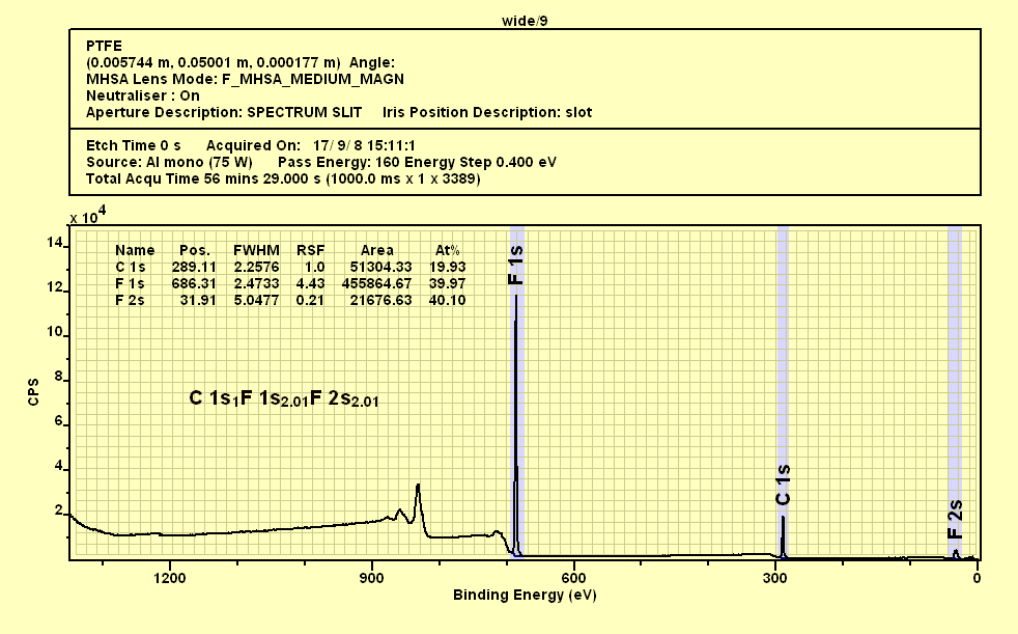


Figure 1: Comparison of photoemission peaks from s-orbitals measured from Mg carbonate and PTFE $(CF_2)_n$. Relative peak intensity is reported for peak areas corrected using Scofield cross-sections and escape depth correction only.