Concurrent XPS-UPS Depth Profiling of Thin Films

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X-ray Photoelectron Spectroscopy (XPS) is a long established technique for analysing thin films due to its chemical specificity and surface sensitivity. The closely related technique, Ultraviolet Photoelectron Spectroscopy (UPS), has also been widely utilised to provide detailed valence electronic information with greater surface specificity than XPS, due to the incident radiation being of lower energy.

As the inherent surface sensitivity of XPS is typically less than 10nm, analysis of the underlying substrate has been conventionally achieved through removal of the topmost material by sputtering with monatomic argon ions. The ability to access the valence electronic structure at mixed organic-inorganic interfaces using small argon ion gas clusters is an exciting new development, not previously been possible due to the loss of electronic structure in semiconductors and organic materials on exposure to monatomic argon ion beams.

While useful information is acquired from XPS and UPS in isolation, a more powerful insight into the structure of a material comes from using these two techniques in conjunction, allowing a more complete material characterisation to be performed. Previously, switching between techniques throughout the course of an experiment has been an involved and often laborious process, discouraging more widespread use. Recently the automation of UPS has allowed concurrent acquisition of XPS and UPS data during depth profiling, providing a much sought after insight into the correlation between chemical and electronic structure within a substrate at a depths of several microns.

Additionally the wealth of information that can be acquired from similar materials by performing combined XPS-UPS depth profiles is discussed, along with the increased efficiency with which data can be acquired and processed due to recent developments in instrumentation and software.