Graphene Analysis Using Coincident XPS- Raman

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The tremendous progress nowadays in advanced materials has enabled a wide range of opportunities in various applications. Furthermore, materials characterisation capabilities are becoming an important contributor to foster and support this progress.

Ultra-thin film, 2D, and functionalised materials exhibit usually complex chemistries, which requires a thorough characterization involving multiple analytical methods. To assure confidence in the results from several different analysis methods, it is advantageous to be able to perform experiments on the same platform. Moreover, it is ideal to perform multiple analysis without moving the sample, this will guarantee that the measurements are conducted at the same position.

It is quite conventional to have multiple techniques attached to the same equipment in surface analysis. For example, X-ray photoelectron spectroscopy (XPS) systems, which provide elemental and chemical information from the top ~10nm of samples, have other complementary accessories, such as UV light sources to facilitate investigation of additional properties of materials via ultra-violet photoelectron spectroscopy (UPS). The ion source that is typically used for sample cleaning and depth profiling can also be used for low energy ion scattering (LEIS or ISS), providing more surface sensitive elemental composition information than can be delivered from XPS alone. The addition of a focused electron source enables Auger electron spectroscopy (AES), which provides surface sensitive composition at higher spatial resolution than XPS can offer. With the exception of ISS, all these routine additional analysis techniques are electron spectroscopy based, and offer similar information.

To obtain further information from samples, from the surface into the bulk, in addition to adding complementary chemical characterisation of materials, we have recently integrated further instrumentation onto two of our standard XPS systems. The integrated system has a combined Raman spectrometer accompanying the micro-focused, monochromated X-ray source for XPS. The focal points are aligned such that data can be acquired from the same point simultaneously, and that the sizes of the analysis areas are comparable in size. Chemical modifications of the material can be easily determined and quantified with XPS. Raman offers a fast way of determining the quality and conformity of the material, and direct compound identification. We found that the combined results from XPS and Raman can provide a better understanding of 2D materials, particularly for Graphene materials.

In this presentation we will discuss the strengths of this combined, in-situ approach to surface analysis, illustrated with examples from a range of applications.