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# Extending XPS Surface Analysis with Correlative Spectroscopy and Microscopy

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The importance of surface chemistry to understanding a material's performance in a substantial number of application areas is undisputed. From the earliest investigations in the fields of catalysis and metallurgy, to the diverse range of materials investigated today, X-ray photoelectron spectroscopy (XPS) has become established as a core technique for probing the surface chemistry. Where initial studies focused mainly on metals, now polymers, oxides, bio-materials and nano-materials

However, it is becoming increasingly apparent that reliance on a single analytical technique is not supplying a data set that lead to complete understanding of the material under investigation [1]. XPS is able to deliver quantified surface chemistry measurements, and by using depth profiling, an understanding of layer and interface chemistry, but the limit on spatial resolution for XPS prevents it from being viewed as "true" microscopy. Electron microscopy, either SEM or S/TEM, can provide high resolution imaging, with elemental composition provided by energy dispersive X-ray microanalysis, but without the same surface selectivity seen with XPS or Auger electron spectroscopy (AES). Molecular spectroscopy, such as FTIR or Raman, can also provide complementary information to XPS, albeit with different sampling depths, which can be extremely useful, especially for devices based upon 2-dimensional materials such as graphene and molybdenum disulphide.

In this presentation, we will describe some recent work in which utilising correlative methods have led to a greater understanding of the system under investigation. This takes two approaches: either measuring samples in an instrument designed to integrate electron spectroscopy, ion scattering, and Raman spectroscopy, or correlating data from SEM and TEM analysis with data from surface analysis instruments. We will illustrate these methods with examples of analysis from a range of samples from technologically-relevant application areas, including III-V semiconductor materials, Li-ion battery electrodes, 2D-nano-materials, perovskites for solar cell devices, and polymers. For each case, we will consider how to choose an appropriate approach to the problem, and how the understanding of the material in enhanced by using multi-technique or multi-system method.

References

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