A complimentary approach to the chemical and structural characterisation graphene with Raman and X-ray photoelectron spectroscopy

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The application potential of graphene is currently being extensively explored by the materials science commuinity. Its immediate potential as a transparent conductive electrode for the microelectronics industry is already being exploited and it is speculated that the unique combination of electronic, chemical and structural properties exhibited by graphene will imapct the development of thin film transistor development. Further applications for the development of graphene based molecular sensors are underway. In all stages of application development there is a requirement for materials characterization and analysis; from the initial research stages, through to testing of the finished devices. Most materials need to be analyzed for compositional homogeneity across the sample surface and thickness through the sample. It is rare that a single technique can achieve these testing requirements, and therefore a complementary approach involving several techniques is often required.

In this presentation we will discuss how a multi-technique approach using Raman and XPS can address the problems associated with the analysis of ultra thin film materials. This approach will be illustrated by examples from graphene and other carbon nanomaterials, comparing and contrasting the complementary chemical and structural information offered by each technique.

Raman microscopy is an analytical technique that is well suited for the characterization of graphene. Raman microscopy is a vibrational technique that that is very sensitive to small changes in a molecule's geometric structure and or its environment. This sensitivity allows Raman to be used as a probe for a number of properties important to a specific graphene samples. These properties include but are not limited to the determination layer thickness, the presence or absence of defects and for measuring local strain on a sample. Results from Raman investigations will be presented which will demonstrate Raman microscopy's usefulness in graphene and graphene based device characterization.

X-ray photoelectron spectroscopy (XPS) is ideally suited to the determination of the surface chemistry and the way in which that chemistry changes in the surface and near-surface region. The technique provides quantitative elemental and chemical information with extremely high surface specificity and is ideal for comprehensively and quantitatively characterising the elemental composition and chemical bonding states at surfaces and interfaces.