Raman Spectroscopy Characterisation of Large Area 2D materials

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In this work, Renishaw plc used Raman spectroscopy to characterise the quality of large area 2D materials and their 3D precursors. By examining uniformity, strain/stress and defects, we demonstrated that Raman spectroscopy and imaging, with Renishaw's inVia confocal Raman microscope, can be of use for wide scale analysis.
2D materials such as graphene, h-BN and MoS2 have huge potential in a wide range of technologies, however, for this potential to be realized, improvements must be made to enable the growth of high quality large area material. Industrial production of graphene is already underway with some companies growing material over square meter and larger areas. This is challenging because it is hard to maintain quality over these expanses; the material can become highly defective and have may consist of multilayer regions. Our Raman mapping of industrially sourced graphene highlights the variation in material quality that can be seen on large length scales and demonstrates the caution that should be taken when using such material for test device structures.

We will also describe and illustrate the application of the new LiveTrack™ dynamic focus tracking technology, for conducting Raman imaging on Graphene on a Cu foil; a sample that is inherently rough on a micrometre length scale and lies on a non-flat substrate. These measurmetnts not only provides in-focus Raman images of the most challenging samples but also topographic information, allowing three dimensional surface Raman images to be generated.
Other materials, such as h-BN and MoS2, are still in the research stage. For example, although it is possible to mechanically cleave h-BN material in the same way as HOPG to create single layers, bulk high quality h-BN crystals are hard to grow. As a result, it is challenging to get the good quality single layer material for devices. We have used 3D Raman mapping to analyse bulk h-BN crystals grown using a temperature gradient method. By examining the peak position, it was possible to estimate the local strain field, which in turn can be used to better understand the growth mechanism. This enables growth conditions to be optimised and provides information on the suitability of such crystals for the production of single layer h-BN by mechanical cleaving.