Recent advances in fast imaging Raman technology for nano materials characterisation

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Raman spectroscopy continues to provide analytical solutions in a variety of material science applications offering chemical specificity on a micrometer scale.

The ability to create chemical and stress images by acquiring Raman spectra from an array of positions and then processing them to reveal the parameter of interest is a powerful technique. Traditionally, these spatially-related data have been collected by raster scanning the sample beneath the incident laser spot, typically in micrometer intervals. New approaches to Raman imaging have been developed that enhance the capabilities of modern Raman instruments that now have the ability to produce images on the nano scale.

The use of either high precision motorised stages or piezoelectric-controlled sample stages permits accurate and repeatable sample movements in intervals significantly smaller than the diffraction limited laser spot size. When used in conjunction with an atomic force microscope tip, feedback can be applied to ensure the sample's surface remains in the plane of the laser focus, optimising efficiency. Topographic images of the surface can be correlated with Raman images as the data are acquired simultaneously. This approach is proving to be most useful in materials research and the study of semiconductor materials, particularly in assessing carbon nanotube structures, graphene film properties and in stress in silicon devices. Other application areas include biological intracellular structure and tissue imaging.

Additionally, a new method of acquiring both 2D and 3D confocal Raman images has been developed – 'Streamline'. Spectra are collected in parallel, rather than in series using the traditional methods. Shorter total acquisition times result, with high quality individual spectra recorded in the order of fifty milliseconds. The method also benefits from 'on the fly' data analysis resulting in real time image creation. This innovative approach allows the technique to succeed where others have failed: producing uncompromised data and images for small or large areas at speeds much greater than possible with competing methods. A number of materials examples will be shown to illustrate the benefits of this method and will demonstrate how information can be achieved on the nanometre scale.