EPSRC Centre for innovative manufacturing in ultra precision

Raman microscopy in ultra-precision manufacturing

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Abstract
Raman spectroscopy is a non-destructive optical technique that reveals chemical and structural information about materials. The material is illuminated with monochromatic light and the inelastically scattered light is analysed. The material can be identified, the amount of it quantified, and stress levels measured. A Raman microscope enables this analysis to be undertaken with sub-micrometre resolution. 2D and 3D maps, that show spatial variations, can also be generated. Raman spectroscopy has been applied to a wide range of materials that are used in ultra-precision manufacturing. This will be illustrated with examples: measuring the quality and thickness of protective coatings on hard disc drive platters (diamond-like carbon); analysing the layer thicknesses and stress within graphene films; detecting defects in advanced semiconductors (SiC); and determining stress levels in silicon.

The spatial resolution of Raman microscopy is normally limited by the wavelength of light to about 200 nm. Details will be given of the TERS technique, where the tip of an atomic force microscope is used to locally enhance the Raman scattering and give much higher spatial resolutions. Examples of Raman measurements at the nanoscale will be presented.