European researchers identify materials at the nanoscale

August 2 2012

Spanish and German researchers have made a new instrumental development that solves a key materials science and nanotechnology question: how to chemically identify materials at the nanometre scale.

One of modern chemistry and materials science's main goals is to achieve the non-invasive chemical mapping of materials with nanometre-scale resolution.

Although a variety of high-resolution imaging techniques currently exist, such as electron microscopy or scanning probe microscopy, their chemical sensitivity cannot meet the demands of modern chemical nano-analytics. And despite the high chemical sensitivity offered by optical spectroscopy, its resolution is limited by diffraction to about half the wavelength, thus preventing nano-scale-resolved chemical mapping.

But now the European team has come up with a new method called Nano-FTIR, as they explain in the journal Nano Letters.

Nano-FTIR is an optical technique that combines scattering-type scanning near-field optical microscopy (s-SNOM) and Fourier Transform infrared (FTIR) spectroscopy.

The team illuminated the metallised tip of an atomic force microscope (AFM) with a broadband infrared laser, and analysed the backscattered light with a specially designed Fourier Transform spectrometer. This meant they could demonstrate local infrared spectroscopy with a spatial resolution of less than 20 nanometres.

Lead study author Florian Huth from Spanish research centre nanoGUNE, based in San Sebastián, comments: 'Nano-FTIR thus allows for fast and reliable chemical identification of virtually any infrared-active material on the nanometer scale.'

To boot, nano-FTIR spectra match extremely well with conventional FTIR spectra. The spatial resolution is increased by more than a factor of 300 compared to conventional infrared spectroscopy.

Rainer Hillenbrand, also from nanoGUNE, says: 'The high sensitivity to chemical composition combined with ultra-high resolution makes nano-FTIR a unique tool for research, development and quality control in polymer chemistry, biomedicine and pharmaceutical industry.'

For example, nano-FTIR can be applied for the chemical identification of nano-scale sample contaminations.

Broadly speaking, nanotechnology is the manipulation of matter on an atomic and molecular scale. Nanotechnology researchers work with materials, devices and other structures that have at least one dimension sized from 1 to 100 nanometres.

It is hoped that nanotechnology will continue to help create new materials and devices that can be applied in a range of fields such as medicine, electronics and biomaterials.

More information: Huth, F., et al. 'Nano-FTIR absorption spectroscopy of molecular fingerprints at 20 nm spatial resolution', *Nano Letters*, 2012. doi:10.1021/nl301159v