Newsletter from the Spectroscopy Products Division

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Spectroscopy Innovations 11

Spectroscopy Innovations is a newsletter published by Renishaw plc. It brings you the latest information about new Raman products, new applications, and forthcoming events.

Inside

Viki Lacey
Editor,
Spectroscopy
Innovations

I would like to hear about exciting work you are doing with your Renishaw Raman system, for publication in future newsletters. Please contact me with details!

viki.lacey@renishaw.com
+44 (0) 1453 523815

Whether it's large area profiling or nano-scale interrogation, inVia's got it covered

In Spectroscopy Innovations 9 we showed you how StreamLine Plus™ has changed user expectations of image quality and collection speeds. It has also been responsible for the development of many novel application areas.

In this issue we highlight how the inVia Raman microscope is further pushing the boundaries of what can be achieved by producing images with the very highest spatial resolution possible.

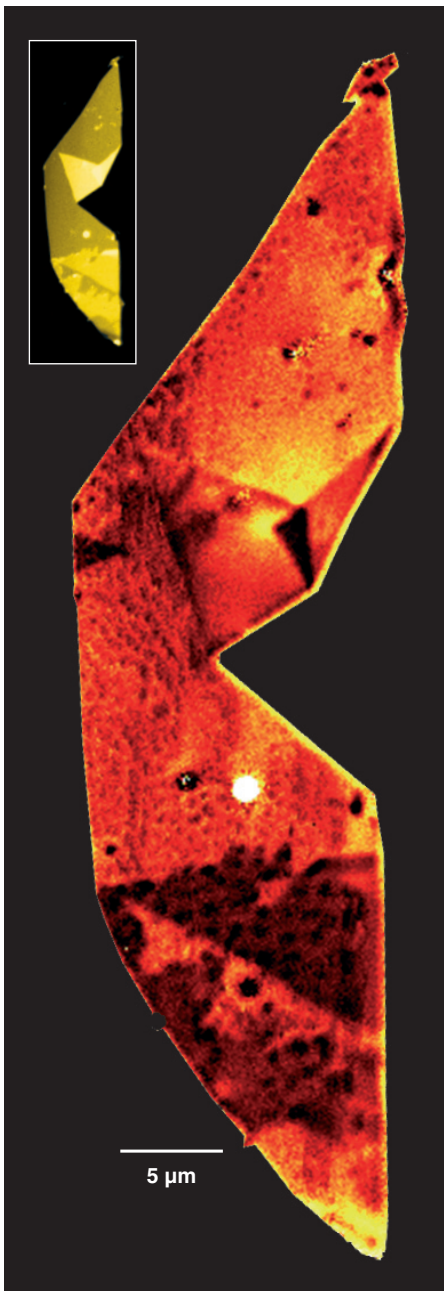
See chemical and structural detail like never before - down to 250 nm.

inVia's imaging capability allows fast, high resolution scans over several cm^2 to **ultra high resolution** at nm scale.

Ultra high resolution imaging has already been used to investigate a range of challenging samples such as single carbon nanotubes, graphene monolayers, and semiconductor devices.

As your research needs grow, inVia evolves to meet your demands.

Contact your local Renishaw representative to discover how inVia with StreamLine Plus™ can work for you.



Ultra high resolution graphene image, by Renishaw inVia, revealing sub-layer graphene growth defects (G band position image). Inset image (G band area) reveals single and multiple graphene layers.

Sample fabricated at the Centre for Graphene Science, University of Exeter, UK.

Raman and atomic force microscopy (AFM)

Current applications of Raman/AFM include:

- Life sciences
- Semiconductor
- Polymers
- Composite materials
- Data storage
- Novel materials for electronics, display and solar technology
- Quantum dots and nanowires
- Carbon nanotubes and graphene
- Pharmaceutical

Renishaw prides itself on innovation and can count many 'firsts' in the fields of engineering, metrology and Raman spectroscopy. Renishaw identified and pioneered the combination of atomic force microscopy with Raman scattering on a single platform and now celebrates its 10th year supplying combined Raman/AFM systems to the research and academic communities.

The efficiency and stability at the core of the inVia Raman microscope makes it the perfect platform for integration with atomic force microscopes (AFMs). Developed in 1986 at IBM in Switzerland, the AFM is a class of scanning probe microscope (SPM). Very sharp tips made from materials such as silicon, silicon nitride and glass are scanned over a sample's surface with a very sensitive feedback loop to record physical changes in the sample.

Crucially, the resolution of these instruments lies in the nanometre range. Under certain conditions, AFMs can achieve atomic resolution. Raman spectroscopy provides the perfect complement for AFM measurements as it provides detailed chemical information about the sample; something that is missing from the array of imaging modes of AFMs.

Renishaw was the first to realise the power of an integrated Raman/AFM instrument. 1999 saw the first combination of a Nanonics SPM with a Renishaw Raman microscope at Chalmers University of Technology, Sweden.

Professor Shen's group at the National University of Singapore soon followed; this was the first true collaboration of Renishaw with Nanonics Imaging Ltd (Jerusalem, Israel). This ground-breaking integration of the two companies' instruments was awarded the prestigious Photonics Circle of Excellence in 2002.

Since then Renishaw's inVia has become the Raman microscope of choice for those wishing to combine the benefits of AFM and Raman. Simultaneous measurements are optimised by efficient coupling of the laser directly to the AFM.

Dr Harold Chong of the University of Southampton's Nano Research Group describes the integration between the inVia Raman microscope with the Nanonics MV4000 multiprobe AFM and CryoView CV2000 as "flawless". He also highlights the direct optical coupling between the instruments and states how "the high efficiency Raman spectrometer allows us to probe nanostructures like quantum dots and nanowires to extract vital material compositions".

Further details about the University of Southampton Nano Research Group's system can be found here: http://www.southampton-nanofab.com /spmraman.php

Veeco BioScope II AFM coupled to an inVia Raman microscope.

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One of the most exciting developments in Raman spectroscopy has been TERS, tip enhanced Raman scattering. And here, Renishaw can claim another first. In 2001 Z.X. Shen and W.X. Sun published TERS data from a semiconductor device.

The technique has evolved and a lateral spatial resolution of 20 nm has been shown, a significant improvement over conventional far-field Raman measurements which are limited by diffraction to around 250 nm. By holding a specially-prepared sharp probe a few nms from the sample's surface in the AFM, highly-localised enhanced Raman signals can be generated by increasing the strength of the electromagnetic field through surface plasmons supported at the apex of the tip. Etched gold wires, Ag- and Au-coated Si and glass AFMs have all been used to generate TERS signals.

The mechanism is analogous to SERS (Surface Enhanced Raman Scattering) but is confined to the region of tip/sample interaction which can be as small as a few nanometres. Dr Chong has used TERS to identify the stress in SiGe semiconductors "more clearly and accurately". All Renishaw's integrations with AFMs are suited to collecting TERS signals.

The inVia Raman microscope can now be combined with instruments from all the major vendors, realising the potential that their products have to offer. Users of SPMs from world leaders including Veeco, NT-MDT, and JPK have all chosen to couple Renishaw's inVia to their cutting-edge systems.

Physical measurements from the sample determined from the AFM are collected simultaneously with Raman spectra on one platform so data can be directly correlated.

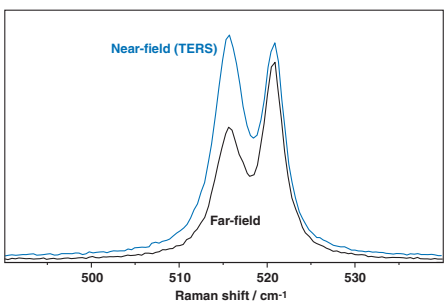
inVia Raman microscope with a Nanonics MV4000 AFM system housed in a custom acoustic enclosure.

"The combination of NTEGRA (NT-MDT) with inVia (Renishaw) gives an opportunity to obtain TERS chemical images with a very high spatial resolution of the range of materials, such as nanocomposites and membranes, carbon nanotubes and graphene, to study transport phenomena in nanostructured membranes and in biological samples".

An NT-MDT NTEGRA AFM system with direct optical coupling to an inVia Raman microscope.

"Direct optical coupling of NTEGRA with inVia system provides reliability and stability for the challenging research with TERS. This, combined with the relative ease of use of inVia system and expertise of Renishaw, promotes our confidence in performing these experiments".

**Prof Sergei Kazarian,
Imperial College London, UK.**



Near-field (TERS) spectrum and far-field spectrum of strained Si on SiGe. The surface sensitivity of TERS exhibits more of the stressed surface Si component.

"The high efficiency Raman spectrometer allows us to probe nanostructures like quantum dots and nanowires to extract vital material compositions".

**Dr Harold Chong,
Nano Research Group,
University of Southampton, UK.**

Contact your local Renishaw office to find out how combined Raman/AFM could help you get in touch with your samples, or visit http://www.renishaw.com/ramanafm for further information.

Renishaw plc
Spectroscopy Products Division
Old Town, Wotton-under-Edge,
Gloucestershire GL12 7DW
United Kingdom

T +44 1453 524524
F +44 1453 523901
E raman@renishaw.com

www.renishaw.com/raman

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2010 exhibitions and conferences

Every year Renishaw attends a range of 'premier' events worldwide. Please come and talk to your local Renishaw representative at one of the following events.

UK	**SPEC 2010** University of Manchester	12 to 17 June
Europe	**Analytica 2010** Munich, Germany	23 to 26 March
	Het Instruments Amsterdam, Netherlands	28 Sep to 1 Oct
Asia	**PV Expo 2010** Tokyo, Japan	3 to 5 March
	Semicon 2010 Chiba, Japan	2 to 4 December
USA	**Pittcon 2010** Orlando, Florida	1 to 5 March
	SPIE 2010 Orlando, Florida	5 to 9 April
	ICORS 2010 Boston, Massachusetts	8 to 13 August

2010 seminars and workshops

Renishaw will also be hosting a series of spectroscopy seminars and workshops, focusing on the latest innovations and combined technologies.

The first of these seminars will be held in the Czech Republic on 27 January 2010.

For details of all forthcoming events, please visit our website http://www.renishaw.com/ramanevents

We look forward to seeing you there!

Renishaw, your local Raman company

One of the secrets of Renishaw's success has been a commitment to supporting customers with local expertise, in their own local language.

Exports from the UK account for 93% of Renishaw's business: a testament to the success of our 'local support' initiative. Although English remains the most common language used in the international scientific community, customers appreciate advice and support that can be understood by all people, at all levels of the organisation.

With over 50 wholly owned offices in 31 countries, complemented by specialist agents in many other countries, Renishaw can claim to have the Raman world covered!

We speak your language

This commitment to our customers is exemplified by our website www.renishaw.com, which is now available in 20 different language versions, including Slovene, Russian, Turkish and both the simplified and traditional Chinese scripts.

The creation and maintenance of these sites is a major undertaking, but are part of our commitment to make it easy to work with Renishaw, wherever you are in the world. **Flexibility and upgradeability from the only Raman system you'll ever need.**

Contact your local Renishaw representative to discover how Renishaw's inVia speaks your language.

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