Newsletter from the Spectroscopy Products Division

RENISHAW
apply innovation™

Spectroscopy Innovations 10

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

Researchers conceive of new use for Raman

The inability to have children can cause great heartache for many couples, with infertility affecting at least one-in-six couples in Britain and one-in-eight in the United States. The most common cause is male infertility, usually characterised by sperm with little or no mobility.

One treatment commonly used in these cases is *in vitro* fertilisation (IVF). This involves injecting sperm into the egg in a laboratory. The fertilised egg, called a zygote, is then transferred to the mother's uterus with the intent of establishing a successful pregnancy.

However, the genetic material (DNA) in sperm with limited mobility is often damaged. This can affect the success rate of IVF treatment, and has led to concerns amongst the medical community of increased rates of disorder in children conceived by this method. What is needed is a method of non-destructively testing the DNA of sperm and then selecting the best sperm for IVF. Unfortunately most tests that can spot DNA damage require the sperm to be broken open prior to chemical analysis, thereby destroying the sperm.

Joint research by the University of Edinburgh and the University of California – performed using a Renishaw inVia Raman microscope – could one day lead to a new technique that solves this problem. The researchers are using laser light to both trap individual sperm (optical trapping) and analyse the DNA (by Raman spectroscopy). The optical trapping uses a tightly focused laser beam to create enough force to hold the sperm stationary for analysis. Once the wriggling sperm has been trapped, the DNA within it is analysed using Raman spectroscopy: a different colour laser illuminates the sperm and the scattered light is analysed, producing a spectrum that contains information about

the vibrations of the molecules within the sperm, and implicitly the state of the DNA. The researchers are developing a statistical model that can predict the healthiness of the sperm from the Raman results, by analysing sperm of varying degrees of natural healthiness.

It is essential that the IVF sperm are not damaged by the lasers. The researchers will determine laser damage thresholds by performing tests where they compare Raman data from chemically damaged sperm with that from sperm that have been exposed to varying laser powers.

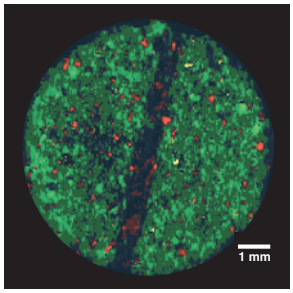
If successful, the final result will be a system that can rapidly give a health report for individual sperm. Of course, the quality of the sperm is only half the story in the making of an embryo; a healthy egg is needed too. In theory Raman spectroscopy could also be used to assess the egg cells, thereby maximising the chances of successful fertilisation. The research continues…

Acknowledgements

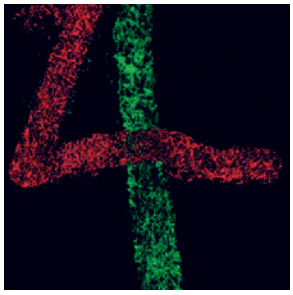
Dr. Alistair Elfick (EPSRC Advanced Fellow) and Ruby Raheem (Graduate student), at The Centre for Biomedical Engineering, School of Engineering and Electronics, University of Edinburgh, United Kingdom.

Dr. Rod Balhorn, Dr. Stuart Myers and Dr. James Chan at NSF Center for Biophotonics Science and Technology, University of California, USA.

Renishaw's inVia Raman microscope; a valuable tool for the forensic scientist



Drug identification
Image of a tablet from a nightclub amnesty bin. Rapid, non-destructive StreamLine Plus analysis identified the complex range of chemicals present in the tablet. The active drug was rapidly categorised using the spectral database; comparison of 'red' component with the electronic database identified it as MDMA ('Ecstasy').



Crossing ink lines
StreamLine Plus has the capacity to determine the sequence of crossing ink lines, and is hence a valuable tool in fraud cases. In the StreamLine Plus image above, the chemical sensitivity of the inVia system has been used to differentiate between optically similar ink lines in a '4' character. The image reveals that a different pen has been used to modify a number one into a four, and reveals the order of the writing. The number one was written first.

Please contact your local Renishaw office or agent for further details or visit www.renishaw.com/raman

Raman spectroscopy is now widely adopted in the forensics industry. Law enforcement agencies and forensic laboratories worldwide rely on the inVia Raman microscope when other less sensitive systems are unable to complete certain difficult forensic investigations.

The inVia, Renishaw's flagship research-grade Raman microscope, can be applied to a number of forensic applications. The impressive sensitivity and versatility of the inVia system permits analysis of an array of samples which could not be tackled by routine or hand-held instruments.

Why Raman spectroscopy and Renishaw?

- **Chemical identification**: Raman spectroscopy provides crucial chemical information which cannot be obtained by other techniques.
- **Vital evidence preserved**: Raman is non-contacting, preventing sample contamination. Solids or liquids can be analysed through transparent material, allowing analysis through evidence bags, a major advantage in forensics.
- **Rapid analysis**: the latest inVia innovations have made StreamLine™ Plus the fastest Raman imaging technique for large samples. Ease of use and automation along with little or no sample preparation means that set-up and analysis time is minimised.
- **Versatility**: inVia's impressive spatial resolution (< 1 µm) allows characterisation of small particles (like individual fibres). Larger samples (such as whole tablets) can be rapidly analysed using StreamLine Plus. SEM-SCA, our integrated SEM-Raman system, uniquely combines the imaging and analytical capabilities of SEMs with the chemical and structural characterisation provided by Raman spectroscopy.

Forthcoming 'forensic' exhibitions

Come and view Renishaw Raman at its best!

EAFS 2009 - European Academy of Forensic Science
Strathclyde University, Glasgow, UK.
8-11 September 2009
Booth: Leica/Renishaw

RAA 2009 - 5th International Congress on the Application of Raman Spectroscopy in Art and Archaeology
Fine Arts Museum of Bilbao,
Northern Spain.
14-18 September 2009

For more details about where you can see Renishaw exhibiting, please visit: www.renishaw.com/ramanevents

The Renishaw inVia system is used for a wide range of forensic applications, including document forgery investigation, counter terrorism, and identifying illegal drugs and explosives. The ability to detect and analyse trace elements, along with unparalleled versatility make inVia the system of choice for many forensic laboratories around the globe.

RENISHAW
apply innovation™

inVia – the road to success

Renishaw's inVia is the world's best selling research-grade Raman microscope. Its popularity stems from its unique combination of great performance, great flexibility, and great reliability. These qualities are a result of both revolutionary and evolutionary change.

In the early 1990s Raman spectrometers were large, slow, and expensive. Renishaw, working closely with Prof. David Batchelder of the University of Leeds, UK, applied its innovative approach to Raman spectroscopy and developed the RM series of Raman microscopes. From the outset the whole optical path was designed to analyse efficiently the light scattered from the tiny laser spot under the microscope, without introducing any optical aberrations that would degrade spatial resolution, spectral resolution, or optical efficiency. New technologies were introduced, such as holographic filters for laser light rejection (instead of inefficient multiple diffraction gratings), and sensitive charge-coupled device detectors (rather than delicate and electronically-noisy photomultipliers). The resulting instrument not only offered dramatically faster performance – spectra could be acquired in seconds, rather than tens of minutes – but required much less laboratory space, less maintenance, and cost significantly less than other systems on the market.

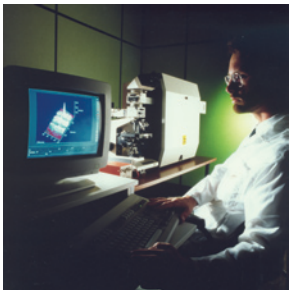
Production of RM microscopes began in 1992, with the first installation being in Ascot, UK, at De Beers Industrial Diamond Division. This prestigious company (now titled Element Six, www.e6.com) uses Raman spectroscopy to aid the development of supermaterials, such as synthetic diamond, for a diverse range of applications including abrasives, protective windows, and advanced electronics. RM microscope installations then spread rapidly worldwide to other organisations involved with synthetic diamonds. The versatility of Raman spectroscopy ensured other markets soon followed: fine chemicals, polymers, semiconductors, and many more.

Presentation of the Prince of Wales Award in 1993. Left to right: David Pitt and Brian Smith (Renishaw plc), HRH The Prince of Wales, Simon Webster and David Batchelder (University of Leeds).

17 years have now passed since the launch of the simple single-laser RM Raman system. Today its descendant, the inVia, is a highly sensitive, fully-automated, multiple-laser Raman system. The name has changed to inVia (Italian: 'on the road') to reflect the microscope becoming a flexible system that can be upgraded by customers to match their changing analytical needs. Rather than just 633 nm excitation, the inVia can now support excitation wavelengths from the near-infrared (1064 nm) to the deep ultraviolet (229 nm), with software controlled automatic switching between wavelengths. This full automation not only simplifies day-to-day use but also enables remote diagnostics, allowing troubleshooting and rapid servicing by Renishaw, irrespective of where the instrument is in the world.

Novel patented technologies, such as StreamLine™ Plus, enable samples to be mapped rapidly at sub-micrometer spatial resolution to provide detailed chemical information about the morphology of materials. When Raman spectroscopy is not enough, inVia variants integrate with other technologies (like scanning electron microscopy and atomic force microscopy) to provide users with the data they need for their research.

Renishaw's Raman microscopes have been honoured with many awards, including: Prince of Wales Award for Innovation finalist; the Worshipful Company of Scientific Instrument Makers Award; and the Photonics Circle of Excellence Award for the Nanonics/ Renishaw AFM/Raman. However, our greatest satisfaction comes not from these awards, but from seeing the excellent work produced by our Raman microscope customers in laboratories worldwide.



The first publicity shot of the Renishaw Raman microscope.

Photonics Circle of Excellence Award for the Nanonics/ Renishaw AFM/Raman (2002).

Advanced low birefringence diamond windows from Element Six, one of the first users of Renishaw's Raman microscopes.

The inVia Raman microscope constantly evolves to match the needs of pioneering scientists, with upgrade paths that enable users of older systems to benefit from the latest technological advances.

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

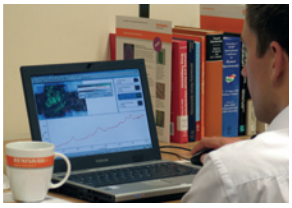
T +44 1453 524524
F +44 1453 523901
E raman@renishaw.com

www.renishaw.com/raman

RENISHAW
apply innovation™

Renishaw's easy-to-use Raman solutions ensure that everyone, from new to expert users, can enjoy the benefits of the inVia Raman microscope.

An inVia Raman microscope…



…and its operator, controlling it from his office, whilst having a coffee!

Please contact your local Renishaw office or agent for further details.

High performance, automation and remote capabilities: inVia has the recipe for success

The recent surge in popularity of Raman spectroscopy as an analytical tool has brought the technique to an increasing number of users, with many systems now installed in multi-disciplinary centres. The requirement for high performance, flexible, Raman systems that are easy-to-use, with high automation levels, is therefore greater than ever.

Renishaw research

Research by Renishaw scientists succeeded in pinpointing the system functions used most frequently by expert users to complete successful Raman analysis on a wide-range of samples. Using this information, we set about enhancing the capabilities of our inVia Raman microscope to deliver an intuitive, easy-to-use Raman system for all users.

Maximising productivity through automation

The latest version of the inVia Raman microscope has succeeded in maximising system productivity for all levels of expertise. Whilst new users can take advantage of the full automation and ease-of-use of the inVia, the practised Raman analyst can (if desired) use largely manual system operation with wide-ranging remote access and control features. This flexibility sets the inVia Raman microscope apart amongst research-grade Raman microscopes.

Remote use features

All key instrument functions and settings can be controlled remotely, enabling monitoring and set-up of experiments, in addition to a rapid response to user queries (without having to be in front of the instrument). Some key remote use features offered by the inVia, depending on configuration, include:

- Run measurements; move samples
- System validation and optimization
- Define multiple map experiments; queue measurements
- Change laser wavelengths; switch between laser and sample view; change microscope objective without opening enclosure

The benefits of automation

With remote control and access to all key system functions, the ability to queue multiple experiments, and experimental templates that enable users to apply identical conditions time after time, the inVia is breaking new ground in simplifying the operation of Raman systems.

Contacting us

Full contact details for Renishaw and your local representative can be found here:

www.**renishaw.com/contacts**

L-9836-3736-01-A August 2009