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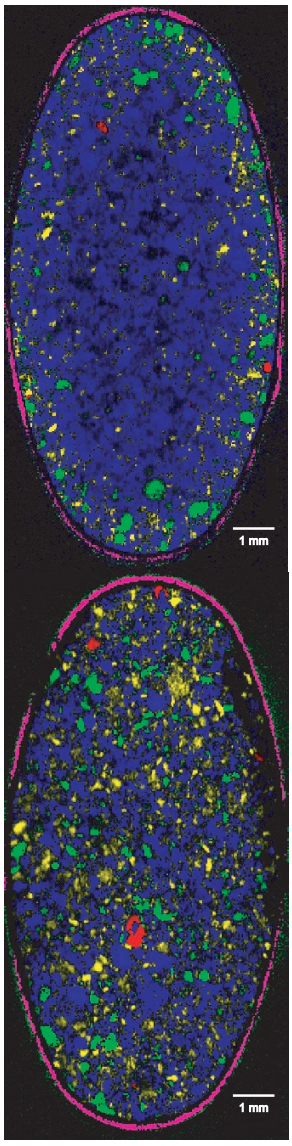
Spectroscopy Innovations 9

NEW!



Two tablets with identical nominal bulk composition showing different distributions of APIs and excipients (each image, comprising 82,000 spectra, only took 36 minutes to collect)

Please contact your local Renishaw office or agent for further details or download a product note from: www.renishaw.com/Raman

StreamLine™ Plus - fast chemical imaging from Renishaw

Fast chemical imaging has always been high on Raman users' wish-lists. Now Renishaw delivers this with StreamLine™ Plus – the fastest fully-scaleable Raman imaging system available in the marketplace today.

Streamline™ Plus demonstrates what can be achieved when hardware, software, optics, mechanics and electronics work together in perfect harmony.

Whether chemical image information is needed over centimetres, or fractions of a micrometre, StreamLine™ Plus provides the solution.

A new range of applications

Fast chemical imaging opens up new applications for Raman spectroscopy that would never have been contemplated with slower systems. Large-scale survey scans, which can visit every point on the sample, reveal spatial variations and identify regions of interest for examination at higher resolution.

New software solutions

WiRE 3 software is optimised for StreamLine™ Plus and offers new imaging solutions:

White light image montages

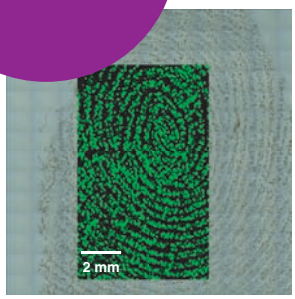
- Experiment set-up becomes intuitive
- Collect and queue multiple images (e.g. variable areas and spatial resolutions) to maximise productivity

Enhanced handling and visualisation of spectral datacubes

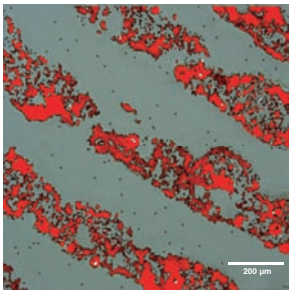
- Live spectral imaging during measurement
- Multiple spectral layers for visualising chemical images

Advanced chemometrics

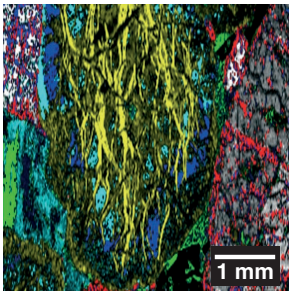
- DCLS (direct classical least squares) component analysis – identifies materials using reference spectra
- Principal component analysis, and multivariate curve resolution (Empty Modelling™) – identifies materials even when no reference data is available
- Automatic cosmic ray removal and noise filtering improve data quality



This is the first ever large Raman image of a fingerprint – an example of fast wide-field chemical imaging. Measured at 66 µm resolution, the image contains 16,564 spectra, and took just 12.5 minutes to acquire. Multivariate component analysis clearly distinguishes between the signal and fluorescent background



This image shows a fingerprint residue (red) with cocaine particles (white). StreamLine™ Plus maintains high spatial resolution (5 µm) at high speeds (55,000 spectra in 34 minutes)



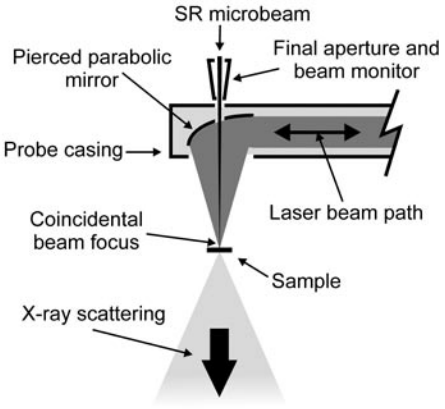
A Raman image of igneous rock from Tibet illustrates the benefits of our new software solutions. Using DCLS and library data it was possible to resolve clearly six different phases

Beamline Raman systems

Research using radiation from particle accelerators is at the forefront of experimental physics

Synchrotron sources can be thought of as a kind of 'super microscope' capable of observing objects at the atomic and molecular level. Light is replaced by a very 'bright' x-ray (or particle) beam – 10 µm to several cm diameter, and a thousand billion times more intense than the beam produced by a hospital x-ray machine. The radiation source intensity allows the organisation of atoms in materials to be probed far faster than with conventional equipment.

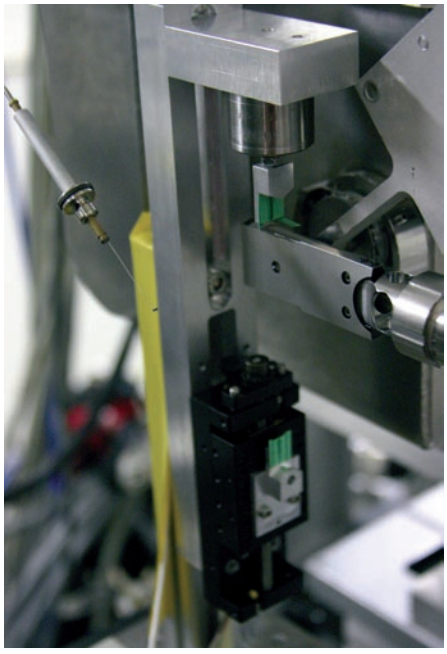
Simultaneous Raman and WAXS/SAXS at the ESRF microfocus beamline (ID13)



A system based on Renishaw's unique SEM-Raman technology[1] allows in-situ and ex-situ micro Raman spectroscopy facilities to complement the X-ray techniques of microfocus WAXS/SAXS (wide and small angle x-ray scattering respectively).

The installation features the following elements:

- An inVia system capable of operating offline, to select and map regions of interest before and after in-beam X-ray and Raman data collection –valuable for investigating damage mechanisms
- A remote probe that can be inserted into the beam line and has its focus coincident with the synchrotron radiation – simultaneous collection of chemical and crystallographic data enables in-situ experiments to be carried out
- A 100 metre fibre-coupling of the remote probe to the laser and spectrometer allows it to be used with both the micro- and nano-focus beamline facilities, increasing versatility and reducing cost



ESRF microfocus beamline (ID13) setup for simultaneous Raman and WAXS/SAXS of a Kevlar fibre sample under deformation conditions

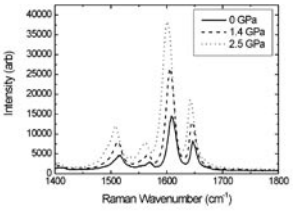
Raman and WAXS/SAXS data are both collected at micrometre-order resolution[2]. The system has examined molecular changes experienced by Kevlar (poly-paraphenylene terephthalamide) under tension.

More information, and details of publications are available at the ID13 Raman Spectroscopy[3] website.

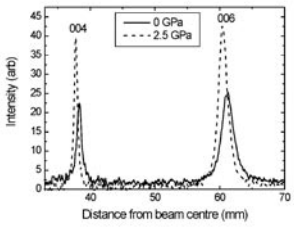
[1] Download SPD096PN from www.renishaw.com/raman

[2] R.J.Davies, M.Burghammer and C.Riekel, **Applied Physics Letters**, 87(26), 264105 **2005**

[3] http://www.esrf.eu/UsersAndScience/Experiments/SCMatter/ID13/microramanpage



The 1610 cm^{-1} Raman peak shifts to lower wavenumbers as the load increases – the shift is proportional to polymer chain stretching



The 004 and 006 meridional reflections shift nearer to the beam centre because of extension of the crystal lattice in the fibre axis direction (c-spacing).

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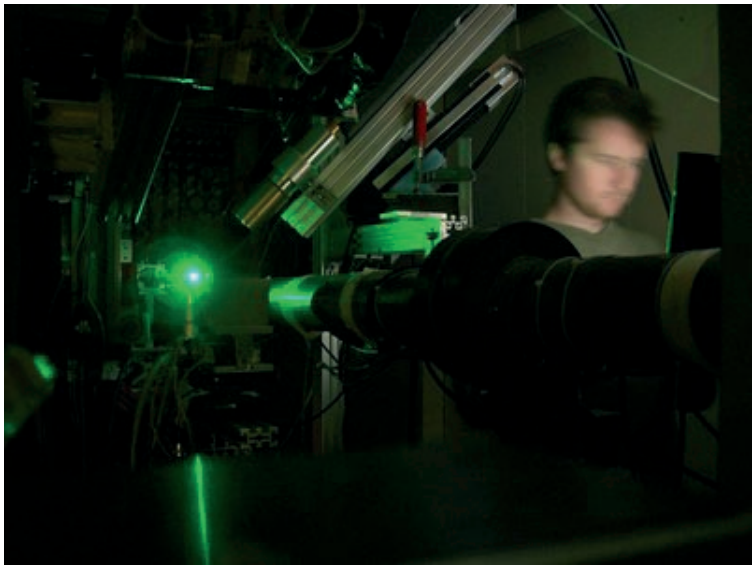
Simultaneous Raman and HRPD/XAS at the ESRF Swiss-Norwegian beam line (SNBL)



High resolution powder diffraction (HRPD) and X-ray absorption spectroscopy (XAS) are used to study the short and long-range order of atoms and molecules in the solid state. These are not micro techniques (the x-ray beam is typically > 100 µm diameter) and samples are usually in powder form and rotated. Combined in-situ studies, however, are meaningful when samples are subjected to external stimuli (e.g. temperature, pressure, corrosive gases).

Special requirements for this application include:

- A standalone inVia system to examine samples before and after they are placed in the beamline and to collect reference spectra; this allows optimisation of acquisition parameters thus making best use of expensive beamline time
- Multiple laser wavelengths for Raman and photoluminescence; this enables the maximum amount of information to be collected
- Long working distance, and variable spot size (100 µm to 800 µm) remote probes; these are essential for in-situ experiments where conditions would damage conventional probes, and also allow operation at four separate locations
- An easy to use system (200+ experimentalists use the facility annually, few are Raman experts!)
- Software for remote control and synchronisation with beamline hardware and safety equipment

To satisfy the requirement for multiple laser excitation wavelengths and techniques at multiple locations, Renishaw provided an inVia spectrometer with connections to eight fibre optic probes. Each probe has white light imaging for easy alignment and sample viewing, and can collect data in-beam and offline.

This system has been used to observe the kinetics of various solid state transformations[4,5]. Further information is also available from the SNBL website[6].

[4] E.Boccaleri et al., **J. Appl. Cryst.**, 2007, **40**, 684-693

[5] J.A.Beukes et al., **Phys. Chem. Chem. Phys.**, 2007, **9**, 4709-4720

[6] http://www.snbl.eu/

Custom Raman solutions from Renishaw

Renishaw has been manufacturing research and industrial spectrometers since 1992, and is recognised as a world leader in Raman spectroscopy instrumentation and technology.

The inVia Raman microscope offers more versatility than any other instrument in its class, but some users' applications still require custom solutions. Applications are often at the cutting-edge of scientific research and typically involve integrating Renishaw's Raman systems with complex state-of-the-art hardware and software.

Three decades of metrology experience has led to Renishaw being selected to provide special Raman solutions for many beamline users including:

- The European Synchrotron Radiation Facility (ESRF) – three systems
- Daresbury Synchrotron Radiation Source (SRS)
- Rutherford Appleton Laboratory neutron/ muon source (ISIS) and Diamond synchrotron source

Other examples of special systems

The Renishaw team has completed more than one hundred customised systems, many of which are now available as products. Here are some examples:

- 8" and 12" semiconductor wafer inspection stations
- Flat panel display inspection station
- Optical gantry for analysis of art work
- Portable Raman analyser
- Second detector systems – UV to NIR
- Inverted Raman microscope
- Free space Raman microscope
- Microplate reader
- Forensic document analysis system
- Remote microscope system
- Sample micro-manipulator

Please contact your local Renishaw office or Agent to discuss your particular requirements.

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NEW!

Raman image of nano-wire

Fully-integrated Raman-AFM – a new probe for the nano-world

Renishaw has worked with acclaimed SPM manufacturer NT-MDT to create an integrated Raman-SPM solution to investigate the nano world. This new combined instrument offers the following:

- Simultaneous Raman and AFM imaging, with image overlay enabling easy visualisation of sample chemistry
- The AFM (ultra-low-noise NT-MDT NTEGRA) provides high spatial resolution images, with multiple imaging modes to maximise the information that can be obtained from the sample
- Renishaw's versatile inVia Raman microscope provides unambiguous chemical identification of features located using the AFM
- TERS (tip-enhanced Raman scattering) capability offers site-specific chemistry at nano-scale
- Highly efficient direct optical coupling (no optical fibres) minimises Raman measurement times
- inVia supports a wide range of Raman excitation wavelengths, enabling analysis of the most challenging materials
- Available with upright and inverted microscope geometries to accommodate multiple applications
- Convenient and space-efficient integrated software control from a single computer

For additional information on Renishaw's AFM-Raman solution, please go to: www.renishaw.com/AFMRaman, or contact your local Renishaw office or Agent to discuss your particular requirements.

Open house - University of Arizona

An open house was held at the University of Arizona (UAZ) in Tucson to publicise new capabilities within the University Spectroscopy and Imaging Facility (USIF) - including their SEM-SCA (structural and chemical analyser for SEM). Although not the first SCA installation in the US, the system installed at UAZ is the first in an American University.

Renishaw's application specialists provided technical support to UAZ, combining the open house with general and application-specific SEM-SCA training for academic and technical staff and students.

Approximately 80 people attended, hearing eight talks; one of which, 'Optical spectroscopy in the SEM', was presented by Renishaw. A demonstration of TaiPAN followed – an innovative remote access utility that enables the UAZ SEM, EDS, and Raman systems to be used from anywhere in the world!

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