Product note: SEM-Raman imaging system
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Co-located SEM-Raman imaging system

Renishaw's SEM-Raman system provides truly co-located analysis

Renishaw's SEM-Raman system is unique. You can simultaneously acquire both SEM (scanning electron microscope) and Raman data from the same area on the sample. You do not have to transfer the sample to a different measurement location or instrument; this ensures rapid truly correlative analysis. You will avoid the sample registration issues that can occur when moving samples between measurement locations.

One combined system, many benefits

- Simultaneously acquire co-located Raman and SEM data without having to relocate your sample
- Both Raman point measurements and mapping in-SEM
- Perform *in situ* not only Raman, but also CL, PL and EL measurements
- Retain full use of the SEM and Raman systems; the installation does not compromise the performance of either
- Compatible with SEMs from the world's leading vendors

Comprehensive co-located sample characterisation in a single system

Renishaw's structural and chemical analyser (SCA) interface brings the Raman analysis capabilities of Renishaw's inVia™ confocal Raman microscope to your scanning electron microscope. You can supplement your SEM data with complementary chemical ID, molecular, structural and electronic information and superimpose your Raman and SEM images.

True co-located correlative microscopy

The SCA interface uses retractable optics to position the Raman analysis point in the centre of the SEM. You can be confident that you are analysing the same sample region with both the SEM and Raman, as you can make both measurements simultaneously.

You can also use the interface and optional in-SEM mapping stage to obtain not only Raman images but also cathodoluminescence, photoluminescence, and electroluminescence images.

The retractable Raman optics allow other in-SEM techniques direct access to the sample, thereby enabling the direct co-location of data; you do not need to move your sample to another location in the SEM.

Flexibility

You can operate both the inVia and SEM as stand-alone systems, simultaneously, without any compromised performance. In effect, you have three systems: a Raman system; a SEM system; and a combined Raman-SEM system. This gives you an extremely flexible analytical combination that can be used across a wide range of applications.

Ease of installation

The SEM-SCA interface simply attaches to an unused vacuum port of the SEM. The SEM does not need to have a large or custom chamber. This gives you a much greater choice of SEMs to which you can attach the SCA.

Why Raman + SEM?

inVia and the SCA interface provide an in-SEM analytical technique that complements both light microscope-based Raman spectroscopy and energy-dispersive x-ray spectroscopy (EDS). With Renishaw's SEM-Raman imaging system, you benefit from co-located morphological, elemental, chemical, physical and electronic analysis.

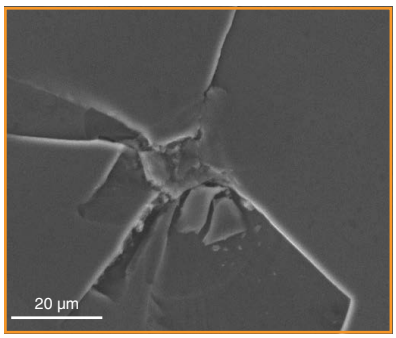
Use the SEM to generate high-resolution images of your sample and perform elemental analysis. Add the power of Raman to obtain chemical information and images. Identify materials and non-metals, even when they have the same stoichiometry.

SEM-Raman imaging

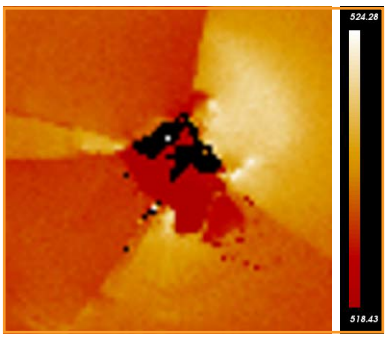
You can determine the spatial variations in stress/strain and characterise defects by using the SEM-SCAs optional in-SEM mapping stage. With this you can image the molecular and crystalline properties of complex materials.

Example: indented silicon.

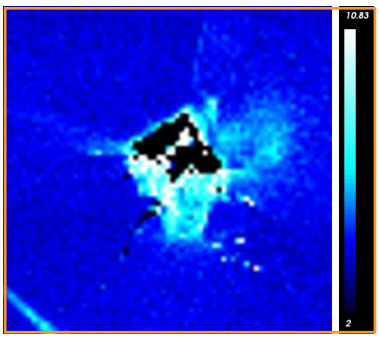
In-SEM Raman mapping of indented silicon reveals residual stresses in the morphologically unchanged material surrounding the indentation.



Secondary electron image of the indented Si wafer.

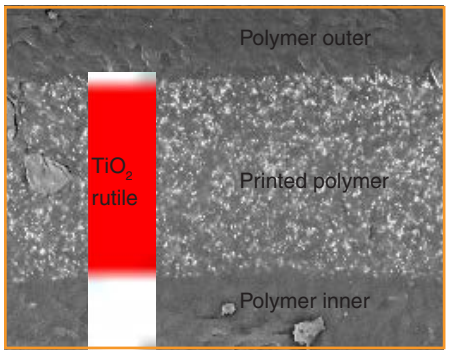


A Raman image of the indent, showing the shift of the Si Raman band. Compressive stresses are shown as yellow/white, tensile stresses are shown as darker red.



A Raman image of the indent, showing the width of the Si Raman band. Broadening (lighter blue and white) is caused by non-isotropic stresses and plastic deformation. The black region is very highly deformed material.

Example: polymer food packaging.



A BSE image of a laminated polymer packaging cross section. The overlaid Raman image identifies the TiO_2 polymorph rutile (red) and polyethylene (white).

Increase your analytical capabilities

Renishaw's SEM interface enhances the functionality of the SEM without compromising the performance of either the SEM or the Renishaw inVia confocal Raman microscope.

With the inVia's included microscope-based Raman system you have the flexibility to analyse the widest range of samples outside the SEM. inVia supports a broad range of advanced Raman imaging techniques, complementing the power of the SEM.

For example, inVia's rapid imaging StreamLine™ mode uses line illumination. This maximises total laser power whilst minimising power density. You can use it to rapidly analyse delicate samples which may be damaged inside the vacuum conditions of your SEM. With inVia Qontor's LiveTrack™, you can also study uneven and rough samples with ease.

Exceptional performance you can rely on

Researchers worldwide have been benefiting from the unique capabilities of Renishaw's SEM-Raman system for over 15 years. Renishaw has installed the SCA interface on SEMs from all the major vendors, including FEI, Hitachi, JEOL, TESCAN, and Zeiss.

Renishaw plc

Spectroscopy Products Division
New Mills, Wotton-under-Edge,
Gloucestershire GL12 8JR
United Kingdom

T +44 (0) 1453 524524
F +44 (0) 1453 524901
E raman@renishaw.com

www.renishaw.com

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Get more out of correlative SEM-Raman analysis with Renishaw

Dr Elizabeth Carter and Gemma Roberts, University of Sydney

Dr Sergey Prikhodko from UCLA with his SEM-SCA

Dr Elizabeth Carter is Manager of the Vibrational Spectroscopy Core Facility (VSCF) at the University of Sydney. Her research interests focus on biological materials. The facility users at the VSCF use Renishaw's SEM-SCA to perform *in situ* co-located Raman and SEM measurements.

Dr Carter describes the motivation for using the SEM-SCA interface: "We like using this technique because of the ability to obtain morphological, elemental, chemical, physical and electronic information from the same region of a sample without relocating it between the two instruments, i.e. the Raman spectrometer and the SEM. Typically we prefer to use a multi-modal approach to spectroscopy and we encourage our users to also use infrared (IR), x-ray fluorescence (XRF), particle-induced x-ray emission (PIXE) and synchrotron radiation based techniques. These techniques are not on an integrated platform therefore the major benefit offered by the SEM-SCA is the ability to collect a vast amount of complementary data from two analytical techniques."

The flexibility of SEM-SCA interface is further demonstrated by the University of California, Los Angeles (UCLA), USA, which combines Raman microscopy with SEM to study archaeological textiles and fibres. Dr Prikhodko is the lead author of a paper joint-authored by scientists from UCLA, the Los Angeles County Museum of Art, the Cotsen Institute of Archaeology and Renishaw plc[1].

The paper describes how a SEM may be interfaced with Raman Spectromicroscopy (μRS) to provide a means of non-destructively identifying organic compounds in complex samples, such as single fibres, by extractionless analysis. This enables the characterisation of dyes from reference collections and archaeological textiles. Dr Prikhodko said, "*in situ* morphological characterization, elemental identification and structural analysis integrates μRS with SEM and energy dispersive X-ray spectroscopy (EDS) in the 'hyphenated' SEM-EDS-μRS system, at UCLA. This vital capability was brought together with the Renishaw SEM-SCA interface, where a SEM is coupled to the Renishaw inVia confocal Raman microscope to provide structural and chemical analysis *in situ*."

Reference
1 Prikhodko, S. V., Rambaldi, D. C., King, A., Burr, E., Muros, V., and Kakoulli, I. (2015), New advancements in SERS dye detection using interfaced SEM and Raman spectromicroscopy (μRS). J. Raman Spectrosc., doi: 10.1002/jrs.4710.

Renishaw. The Raman innovators

Renishaw manufactures a wide range of high performance optical spectroscopy products, including confocal Raman microscopes with high speed chemical imaging technology, dedicated Raman analysers, interfaces for scanning electron and atomic force microscopes, solid state lasers for spectroscopy and state-of-the-art cooled CCD detectors.

Offering the highest levels of performance, sensitivity and reliability across a diverse range of fields and applications, the instruments are designed to meet your needs, so you can tackle even the most challenging analytical problems with confidence.

A worldwide network of subsidiary companies and distributors provides exceptional service and support for its customers.

Please visit www.renishaw.com/SEM for more information.