RENISHAW

Spectroscopy Innovations

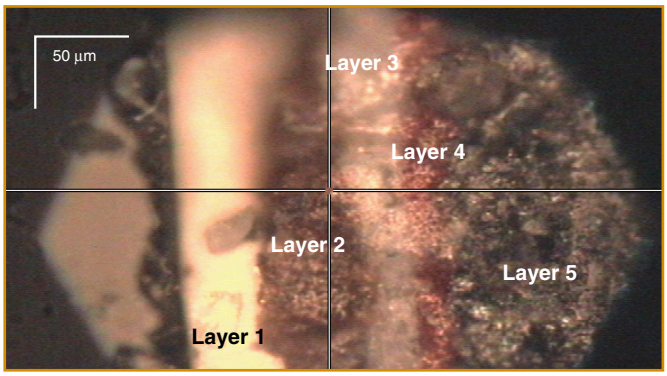
Issue 5

News from the Spectroscopy Products Division

LAPD demonstrates the power of Raman in forensics

The ability to identify paint chips is a valuable asset in many forensic applications. A typical example is the linking of tiny paint particles to a vehicle involved in a road accident. IR reflectance spectroscopy is the main analytical technique in current usage and provides spectra that can be matched to standard materials in the literature. However, the spatial resolution (10 µm - 20 µm) is often insufficient to permit a direct analysis of the separate layers in a cross-section of a multi-layered paint particle. Thus examination by IR reflectance spectroscopy is routinely achieved by the successive removal and analysis of each layer, which destroys valuable evidence and takes 1 - 2 days to complete. In contrast, Renishaw Raman microscopy is non-destructive and offers high spatial resolution of about 1 µm, allowing direct analysis of the all the layers in a multi-layered cross-section in a few minutes. The Raman spectrum of a material depends on its composition and structure, so that spectra from different paints differ widely and can be distinguished according to type and manufacturer.

Renishaw has recently installed a System 1000 Raman microscope in the Scientific Investigations Division of the Los Angeles Police Department, USA. In this example the instrument has been used in conjunction with the new Renishaw inorganics library* to identify separate layers in a 5–layer paint chip. Such an analysis is made possible with Renishaw's "easy" confocal capability, which allows the selective collection of data from small sample volumes. The image below shows a side view of the paint chip, with scale bars to indicate its dimensions (video images were captured using



Video image of the 5-layer paint chip.

the standard camera, mounted above the Leica microscope as part of the imaging capabilities of the spectrometer). Each of the layers can be clearly distinguished in the image and have been numbered 1-5 from left to right (the left-most layer is the glass slide used to immobilize the sample). The number of

*see page 2 for details

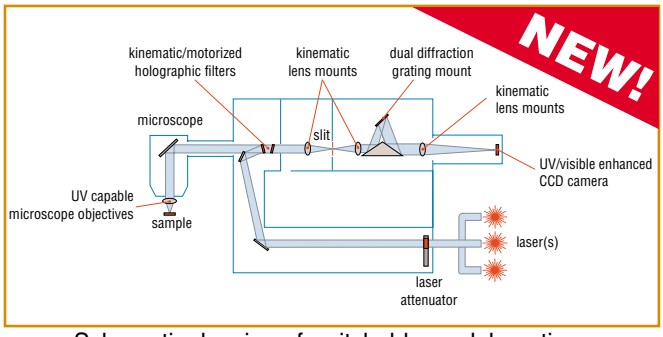
continued on next page...

UV-to-NIR Raman systems

Renishaw announces a new option for Raman users needing the highest performance at multiple excitation wavelengths. Renishaw's new optics system for the RM series of Raman microscopes eliminates the need to compromize on optical efficiency, spectral resolution, or ease of use when selecting a spectrometer for Raman excitation wavelengths from the ultraviolet through to the near infrared.

Renishaw engineers have designed a range of innovative kinematically mounted, pre-aligned modules that allow key optical elements to be swapped very rapidly.

Previously, users had to choose between a UV and a visible Raman microscope at the time of purchase. For the first time, with the use of Renishaw's proprietary kinematic modules, changing wavelengths takes only a matter of seconds and offers optimum performance at any wavelength selected.



Schematic drawing of switchable module options

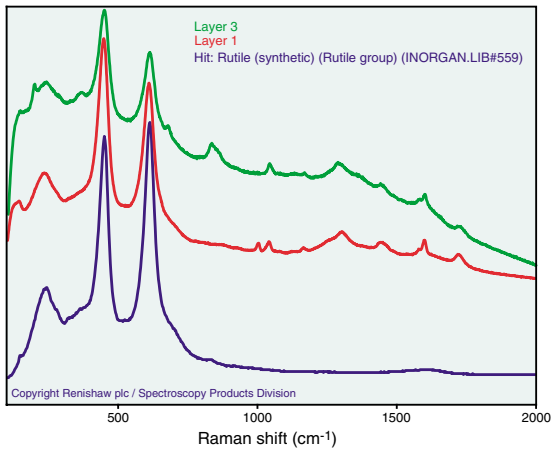
This major advance is also available to existing customers as an in field upgrade to RM series Raman microscopes already installed.

For more details please contact your local Renishaw representative.

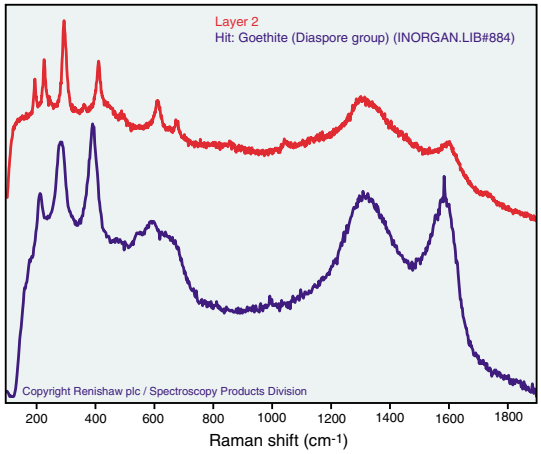
New! Microscope enclosure - see inside for details

NEW PRODUCTS

LAPD demonstrates the power of Raman in forensics



Raman spectra from layer 1 and layer 3, showing matching rutile spectrum from the Renishaw inorganics library.



Raman spectra from layer 2, showing matching goethite spectrum from the Renishaw inorganics library.

different layers in the chip is indicative of a car that has been repainted, and determination of these paint layers is vital if the car is to be identified. Raman spectra from each of the layers were obtained using 780 nm excitation and a 50x objective lens. Layers 1 and 3 produced rather similar Raman spectra with well resolved and intense peaks. However, some subtle differences were observed and, in particular, the spectrum of layer 1 had a band at 1005 cm^{-1}, which was not present in that of layer 3. It is likely that these differences are due to slight changes in composition, and a search of the Renishaw inorganics library showed that they both matched well with the spectrum of the rutile form of TiO_2, which is the most commonly used white paint pigment. The Raman spectrum from layer 2 also had a number of well-resolved and intense peaks which were useful for spectral interpretation. Analysis of these with the Renishaw inorganics library suggested a goethite structure, associated with red pigments and corrosion inhibitors.

Layer 4 was found to be molybdate orange, a common red paint pigment, which was only used in the US through the early 90's, although it is currently still used on UK cars.

Layer 5 was suspected to be the top coat, probably a silicate-based paint overcoat. It was expected to provide a weaker Raman spectrum than the other layers because, in general, silicates are weak Raman scatterers. This was found to be the case and it was concluded that this compound was likely to be a silicate.

Raman spectroscopy was easily able to provide high quality Raman spectra from four out of the five layers within a single paint chip in under two minutes. These four layers either provided hits in the Renishaw standard libraries or provided spectra of sufficiently high quality so that hits could be expected from standard Raman paint libraries currently under development at Renishaw. All measurements were performed *in situ* and non-destructively, with a minimum of sample preparation needed.

Figures are displayed courtesy of the Scientific Investigations Division of the Los Angeles Police Department, USA.

We gratefully acknowledge Ed Suzuki, Washington State Patrol, for help in spectral interpretation.

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New! *(continued from front cover)*

A microscope enclosure accessory for the Renishaw RM series of Raman microscopes.

The chamber encloses the lower part of the microscope, facilitating the use of the instrument in brightly lit surroundings by excluding extraneous light, and increasing safety in busy environments by shielding personnel from any laser light scattered from samples. The enclosure is large enough to accommodate a wide range of accessories and is fitted with a revolving door for easy sample loading.

Features

- light-tight
- laser safety interlocks (optional)
- class 1 variant available
- large door for easy sample loading
- accommodates a wide range of accessories (xyz stages, hot/cold cells, etc.)

Suitability

- busy environments where all personnel cannot use laser goggles
- brightly lit surroundings
- fits all RM series Raman systems equipped with Leica microscopes - retrofittable

For more details please contact your local Renishaw representative.

Raman spectral libraries

Renishaw's spectral libraries continue to simplify Raman spectroscopy by allowing automated, computer-aided spectral analysis of unknowns.

General features:

- multiple search algorithms for spectral-sample identification
- multi-library search capability and customizable libraries
- fully integrable with existing spectral analysis software

The following libraries now exist:

Forensic:
spectra from a large range of fully traceable samples consisting of drugs, drugs precursors, and explosives.

Fibers:
including varieties of polymer fibers with a comprehensive sample description. Developed in collaboration with Queensland University of Technology (Australia).

Polymers and contaminants:
spectral information from a wide range of fully traceable rubbers and polymers, incorporating orientation and structural effects. Developed in collaboration with Analytical Services Group (Santa Clara, California, USA).

Inorganic materials:
spectra from a large range of fully traceable samples including minerals, oxides, gemstones (synthetic and natural), and various polymorphs of materials. Gives chemical formula and related compound information.

We are continually developing new libraries. Please contact Renishaw for further information or if the library you require is not mentioned here.

Renishaw- the only choice for fully upgradeable Raman systems

This new brochure details the expanded range of options and upgrades available for the Renishaw RM series Raman microscopes, providing a revolution in Raman instrument flexibility and customization.

Renishaw is the only vendor to offer a low-cost basic Raman unit that can be fully upgraded to a high resolution spectroscopy and imaging system.

The versatility of the RM series systems enables them to be used for a wide variety of spectroscopic studies. Full upgrade routes are laid out in clear, easy to follow charts, summarizing the options and accessories used for some of the more common tasks.

Please contact your local Renishaw representative to get a copy of the brochure and the associated information request sheet.

RENISHAW Spectroscopy Innovations

Conferences

Some of the many conferences we will be attending throughout 2000:

August 20 - 25

International Conference on Raman Spectroscopy (ICORS)
Beijing, China.
http://icors.pku.edu.cn

September 3 - 8

European Conference on Diamond and Related Materials (Diamond 2000)
Porto, Portugal.
http://www.elsevier.nl/homepage/sag/diamond00/

September 22 - 30

Federation of Analytical Chemistry and Spectroscopy Societies (FACSS)
Nashville, Tenessee, USA.
http://facss.org/info.html

Microscope and sample handling accessories

Renishaw spectrometers can be fitted with a wide range of microscope and sample handling accessories, providing maximum flexibility and adaptability.

Please see our options and upgrades brochure for details.

Renishaw worldwide companies with spectroscopy support

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If you or any of your colleagues would like to be added to our mailing list or if you have any queries or comments about the contents of this newsletter, please contact us at any of the addresses above or simply email us at raman@renishaw.com.

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