

The RamanStation 400 with RamanMicro 300 System

A unique macro-micro Raman analysis system



Introduction

The combination of the PerkinElmer® RamanStation™ 400 with the RamanMicro™ 300 provides an easy-to-use macro-micro sampling system designed to give the analyst high quality, reproducible results in seconds. The additional fiber optic functionality further extends the range of sample types that can be analyzed.

Raman spectroscopy offers the analyst the benefits of the high specificity normally associated with Mid-IR spectroscopy with the ease of sampling of Near-IR spectroscopy. The Raman spectrum of any particular material is unique and can therefore act as a fingerprint for that material. Raman analyses normally require no sample preparation and analyses can be carried out through sample containers such as plastic bags and glass or plastic bottles.

Key Features

- ▶ Combined macro-micro sampling functionality in a single system
- ▶ Ease of use – the permanently aligned optics for both macro and micro sampling ensure optimum performance for all modes of operation. Changing modes is as simple as a mouse click; no changing of optics required.
- ▶ A full range of macro and micro sampling options available
- ▶ Add a fiber optic probe for remote sampling or reaction monitoring
- ▶ No Raman expertise required to acquire high quality Raman data.
- ▶ A full suite of application software, including Library Search and Imaging, ensures that the maximum amount of useful information can be derived from the spectral data.

The Raman spectra obtained from the PerkinElmer system are complete, full-range, high resolution spectra. This means that the maximum amount of information-rich data about the molecular structure of a sample is obtained.

Raman spectroscopy can stand alone as an analytical technique or can give complementary information to that obtained from Mid- and Near-IR spectroscopy.

Macro sampling

The macro compartment of the RamanStation 400 is equipped with a software controlled, motorized X, Y, Z sample stage, designed for easy sample manipulation, that can automatically align your sample in all three coordinates. A video camera enables autofocus of both the visible image and the Raman spectrum.

The versatile sample holder accommodates single samples in capillary tubes, vials or cuvettes, or on microscope slides, while the X, Y, Z stage can hold all standard multiwell plates. Multi-tablet and powder-holding kits are also available.



Figure 1. A wide range of macro sampling options is available.

The automated, software-controlled stage also allows the analyst to perform both line-scans and area mapping on either individual samples or multiple samples. Software control of the Z-axis allows data collection as a sequence of spectra through the sample, starting on the surface and penetrating several millimeters into the bulk of the sample. The depth of penetration depends on the nature of the sample.

The imaging data in Figure 2 was obtained from a glucosamine sulfate healthcare tablet. These tablets contain a range of ingredients such as acacia powder, cellulose, silica, etc. in addition to the glucosamine sulfate. The first image shows the total intensity image. The red color indicates areas of high Raman intensity, the blue areas of lower Raman intensity. This variation in color can be due to variation in chemical composition across the sample. From this initial image it is straightforward to generate an image that shows only the distribution of the glucosamine sulfate in the sample. This is shown in the second image. In this case the red color indicates a higher concentration of the glucosamine sulfate. This study shows that the tablet is relatively non-homogeneous with relatively large aggregates of the glucosamine sulfate particles.

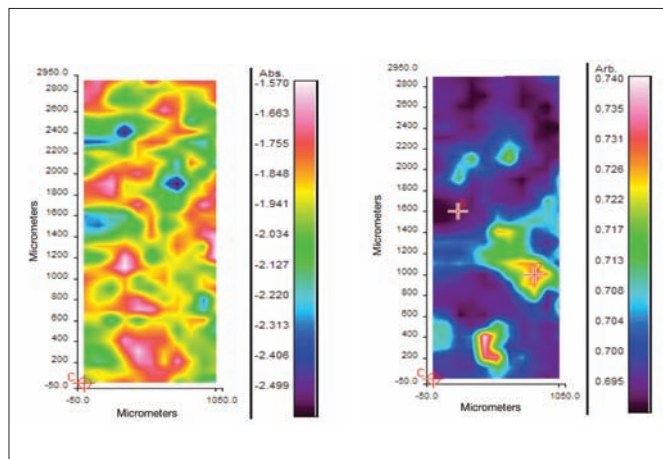


Figure 2. Raman images of glucosamine sulfate tablet.

Visible image autofocus ensures crisp visual images while Raman autofocus attains the best possible Raman spectra.

The Visible Image Survey facility offers the advantage of collecting visible images that are bigger than the immediate field of view of the camera (Figure 3). This can be very useful when deciding which particular parts of a large sample should be analyzed and also gives a better understanding of the spatial significance of the data being collected. The inclusion of these larger visible images in reports also leads to a better understanding of the analysis by third parties.

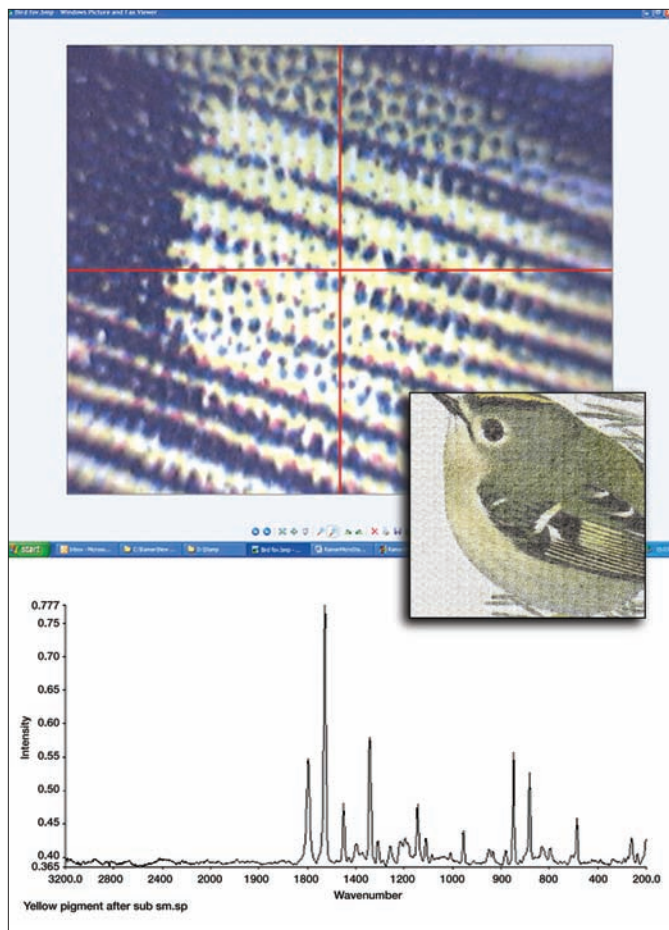


Figure 3. Data from image of bird on postage stamp. The first image is the normal field of view showing detail of the bird's wing. The second image shows the Visible Image Survey of the whole bird and the spectrum is of the yellow pigment on the bird's wing after subtraction of the paper contribution.

An optional polarization accessory (Figure 4) allows Raman spectra to be collected in both the parallel and perpendicular orientation relative to the laser excitation.

These polarization measurements aid understanding of symmetric and non-symmetric vibrations and are a powerful tool for the analysis of samples such as crystals and polymers that have an oriented macromolecular structure.

The macro enclosure is interlocked, light-proof and laser safety class 1, making it suitable for use in any environment including teaching laboratories.

Micro sampling

Switching from the macro-sampling compartment to the microscope is done with a simple click of the mouse.

The microscope is based on the research grade Olympus BX51 frame equipped with a video camera for sample positioning. This provides both excellent visible and Raman data while maintaining a universally-accepted platform for additional microscope attachments.



Figure 4. Showing polarization accessory and Raman spectra of cyclohexane arising from analysis Parallel (blue) and Perpendicular (black) to the excitation laser polarization. The large changes in peaks A-D signifies that these peaks arise from totally symmetric vibrations.

The microscope is available with a range of stages, including manual and motorized options that can accommodate a very wide range of sample holders (Table 1). These include multi-well plates. Z axis stage-control provides both visual and Raman autofocus. Combined with a full range of software options, these stages allow the analysis of single small samples or line-scanning and mapping of larger areas.

As standard, the microscope is equipped with a range of microscope objective lenses and a lens-centering nose-piece. Moving from lens to lens with a standard nose-piece may cause the sample to appear to move in the field of view. In extreme cases, it may even appear that the sample is lost. A lens-centering nose-piece is a must for micro analysis because it lets you zoom on the sample while avoiding its lateral displacement in the field of view (Figure 5).

A light-proof, fully interlocked enclosure in accordance with laser safety class 1 regulations is available for the microscope. When the enclosure is closed, the microscope's Z-axis focus control is still accessible for real time sample focusing and optimum Raman spectral collection.

Table 1. Choice of Manual or Motorized Stages.

	Manual Stage	Motorized Stage
X-Travel	76 mm	114 mm
Y-Travel	52 mm	75 mm
Z-Travel	25 mm	25 mm
Accuracy	n/a	0.1 μm
Accept microscope slides	Yes	Yes
Accept tablet and powder holder	No	Yes
Accept multi-well plates	No	Yes

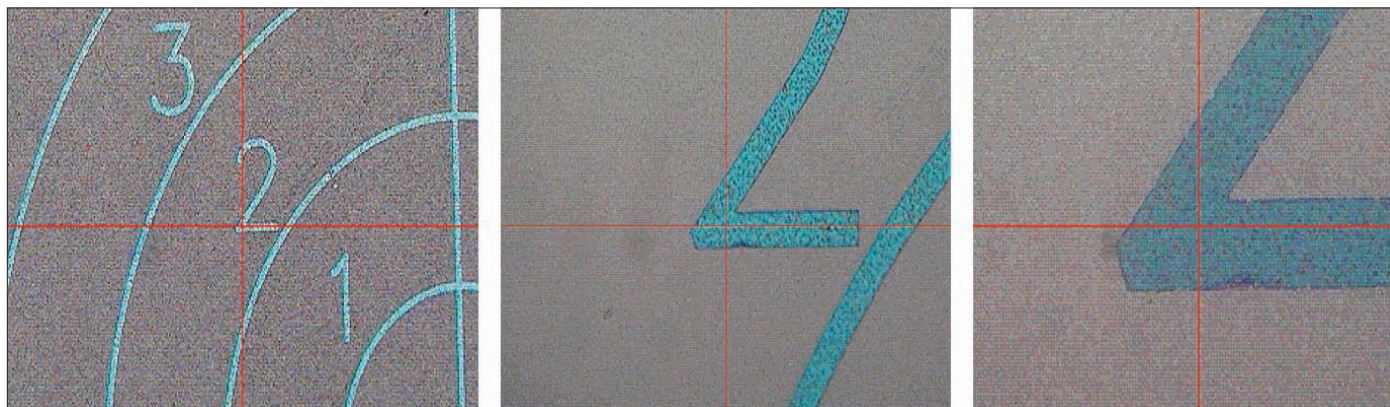


Figure 5. x5, x20 and x50 visible images using the lens-centering nose-piece.

Remote analysis

The RamanStation 400 can accommodate a choice of fiber optic probes for remote analyses. These probes can be used for reaction monitoring or remote analysis of bulk samples. In reaction monitoring, the probe is either immersed into the reaction solution or focused through an observation window in the reaction vessel. When immersed in solution, the optional immersion sleeve is used (Figure 6). These probes are designed to operate within a wide range of temperatures and pressures and are ideal for analysis of large samples or samples in vessels, fume cupboards or enclosures.

The triggered probe (see picture on Page 1) is particularly useful for analysis of materials in a QC/QA or warehouse environment where the samples can be analyzed while still in their plastic or glass container. The standard cable length is 5 meters, with extension cables available.

- **Standard Raman Probe** Stainless-steel probe, 7.5 mm working distance, 5 meter cabling.
- **Raman Probe – Long**, Stainless-steel probe, 350 mm long, suitable for non-contact and liquid immersion, and for use at elevated temperature/pressure, 5 meter cabling.
- **Raman Probe – Max**, Stainless-steel probe, suitable for non-contact and liquid immersion, and for use at very high temperature/high pressure, 5 meter cabling.
- **Triggered Probe** – complete with nosepiece and 5 meter cable

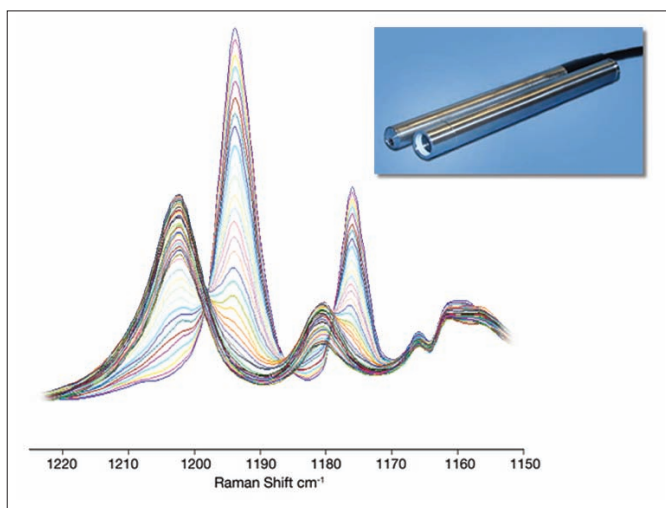


Figure 6. When performing reaction monitoring with fiber optic probe, an optional immersion sleeve can be added

Powerful software

Whether you are analyzing a single spectrum or thousands of spectra from a macro or micro chemical image, or performing quantitative analysis or monitoring reactions, there's a comprehensive suite of software packages available for the Raman instrument platform.

The **PerkinElmer Spectrum™** Software package allows easy control of the spectrometers and of data collection, and functions seamlessly with the other PerkinElmer software packages.

Spectrum Search comes as standard. A sample spectrum can be taken and searched against user-generated or commercially available libraries. Available libraries include those for narcotics, forensics, inorganics, minerals, pharmaceuticals and polymers.

For sample mapping on the motorized stage of the RamanMicro 300 or the RamanStation 400, **SpectrumImage™** software allows full data collection and processing on the resultant images. Optimum chemical images can be generated with the click of a button using the unique 'show structure' function.

Spectrum Insight™ is designed for convenient measurement of high throughput analyses and reaction monitoring. It generates easy-to-interpret visual images of the large amounts of data that can be generated in these experiments (Figure 7).

Spectrum software allows spectral peak height and peak area measurements, but for more rigorous quantitative analyses, Quant+™, a quantitative chemometrics-based package, is recommended. Chemometric models generated in Quant+ can be used for data analysis in Spectrum, SpectrumImage and SpectrumInsight.

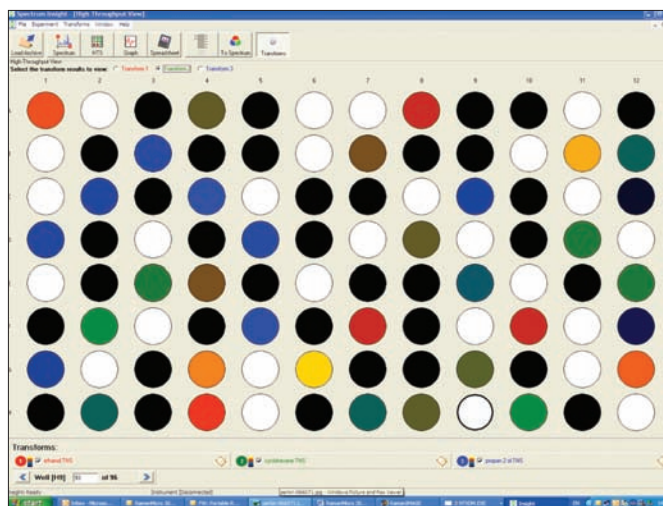
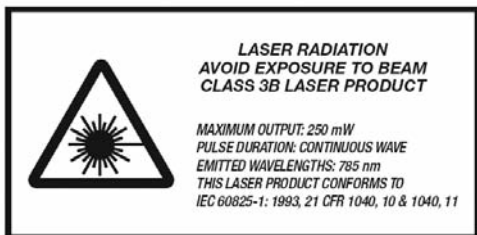


Figure 7. Multi-well plate where different colors are material specific.



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