EDINBURGH INSTRUMENTS

BENCHTOP CONFOCAL

RAMAN MICROSCOPE

RM5

EDINBURGH INSTRUMENTS

Edinburgh Instruments has been providing high performance instrumentation in the Molecular Spectroscopy market for more than 50 years.

Our commitment to offering the highest quality, highest sensitivity instruments for our customers has now expanded to include the best Raman microscopes for all research and analytical requirements.

As always, Edinburgh Instruments provides world-class customer support and service throughout the lifetime of our instruments.

MOLECULAR SPECTROSCOPY SINCE 1971 ● Photoluminescence ● Raman ● UV-Vis ● FTIR ● Transient Absorption

BIOSCIENCES PHARMACEUTICALS CHEMICALS POLYMERS NANO-MATERIALS

RM5 RAMAN MICROSCOPE

A compact benchtop Raman microscope with automation and ease of use at is core. Combining robust and proven building blocks with modern optical design considerations results in an instrument with uncompromised spectral resolution, spatial resolution, and sensitivity.

KEY FEATURES

- **Truly Confocal –** with variable slit and multiple position adjustable pinhole for higher image definition, better fluorescence rejection and application optimisation
- **Integrated Narrowband Raman Lasers –** up to 3 computer-controlled lasers for ease of use, enhanced stability and reduced footprint
- **5-Position Grating Turret –** for unrivalled spectral resolution of 1.4 cm^{-1} (FWHM) and optimisation over the full spectral range 50 cm^{-1} - 4000 cm^{-1}
- **Integrated Detectors –** up to 2, including high efficiency CCD, EMCCD and InGaAs arrays for low noise, increased speed, high sensitivity and wide spectral range
- **Internal Standards and Auto-Calibration –** to ensure the highest quality data at all times
- **4-Position Raman Filter Turret –** fully automated notch and edge filters to match the Raman range to excitation laser wavelength
- **Ramacle® Software –** one powerful software package for complete system control, data acquisition, analysis and ease of upgrade
- **Upgradeable –** easy to upgrade as your research needs develop

A MODERN RAMAN MICROSCOPE THAT STANDS ALONE IN BOTH SPECIFICATIONS AND EASE OF USE.

The RM5 Raman Microscope strikes a perfect balance between user-friendliness and functionality. Its compact and efficient design guarantees a dependable, high-performance instrument that delivers data of the highest quality.

COSMETICS | SEMICONDUCTORS | ART & MUSEUM | FORENSICS | GEOLOGY

RM5
DESIGN FEATURES

Laser excitation, from one of three possible lasers (1), is directed to the microscope and sample stage via a series of motorised mirrors with laser power at the sample controlled through an adjustable attenuator. The beam is focussed onto the sample that sits on an XYZ-movable stage (3) through a microscope objective, and can be viewed live on screen thanks to an integrated CMOS camera (4). The scattered light produced is then collected by the same objective before being passed through a filter to remove unwanted laser light. The Raman scattered light passes through an adjustable confocal pinhole (5) before entering the spectrograph. One of five possible diffraction gratings splits the light into its constituent wavelengths (6) which are then focussed onto the detector(s) (7) and displayed to the user as a spectrum.

DESIGN FEATURES

1 Multiple Lasers

Up to 3 integrated and computer-controlled lasers with choice of wavelengths, combined with a computer-controlled continuous laser beam attenuator to allow control over laser power at the sample position.

2 Automated Calibration

For recalibration and validation, the RM5 comes with integrated Raman reference materials. Internal standards are included for spectrograph calibration and for laser wavelength calibration and adjustment.

All calibration and validation routines are part of the instrument's operating software, Ramacle®, and allow for complete ease-of-use and user-friendliness.

3 High Performance Microscope

The latest generation research-grade upright microscope, allows the RM5 to benefit from all modern sample visualisation and contrast enhancement techniques available including brightfield, darkfield, polarised light, Nomarski differential interference contrast (DIC) and fluorescence. A manual or computer-controlled XYZ stage provides movement to locate and map areas of interest on the sample.

4 Live Sample Viewing

An embedded high resolution CMOS camera for field-of-view visualisation, sample set-up and laser beam alignment is included as standard. A second camera can be attached to the trinocular head of the microscope for higher resolution and image stitching of Raman mapping.

5 Automated Optical Routing

This compartment contains a 4-position turret of dichroic laser rejection filters, computer-controlled beam splitter and an adjustable confocal pinhole. Auto-alignment of the instrument is achieved by two embedded piezo-controlled mirrors. An optional polariser and analyser accessory is available for advanced analysis of polarised Raman scattering.

6 High Resolution Spectrograph

A high resolution 225 mm focal length spectrograph of asymmetric Czerny-Turner design is integrated. This includes a continuously adjustable precision slit and a grating turret with up to 5 pre-aligned gratings for wide spectral coverage. The spectrograph undergoes comprehensive calibration and validation procedures at the factory.

7 Multiple Detector Ports

Thermo-electrically cooled spectroscopic CCD cameras are used for low noise and fast image detection. A second detector port is available for a camera with complementary spectral coverage, increased speed, higher spectral sampling or sensitivity, pushing the flexibility of the RM5.

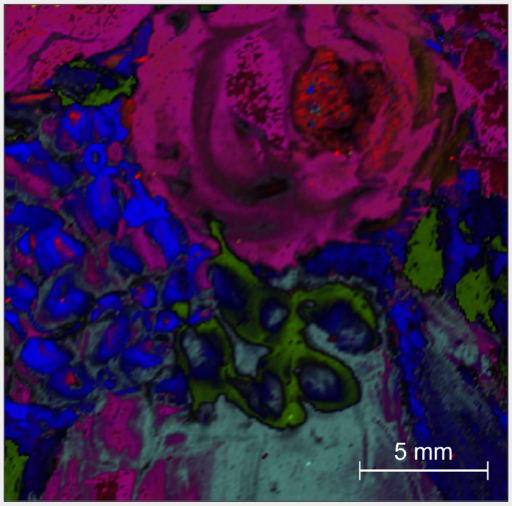
MAPPING EXAMPLES

The RM5 generates Raman maps using a motorised stage for sample scanning, which permits finely controlled movement in the X, Y, and Z directions. 2D, plane maps, surface maps, and volume maps can be created.

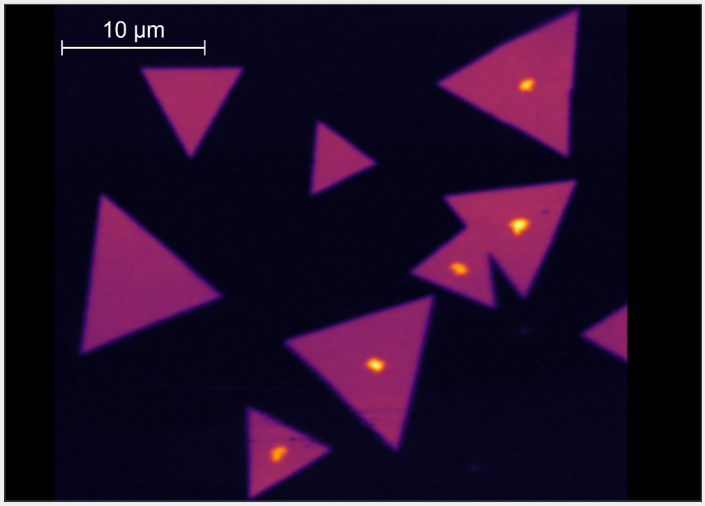
2D MAPPING

Using Ramacle the area of interest to be mapped is defined, including areas larger than the field of view using stitched images. On the microscope image the map dimensions and step size are set for XY measurements.

Mapping across the XY plane of your sample reveals information such as distribution of pigments or identify mono- and multi-layer areas in 2D materials.



Raman map of a painting with different pigments.

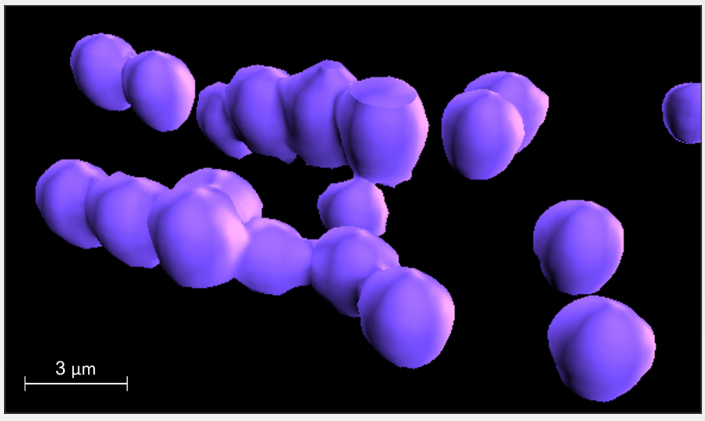


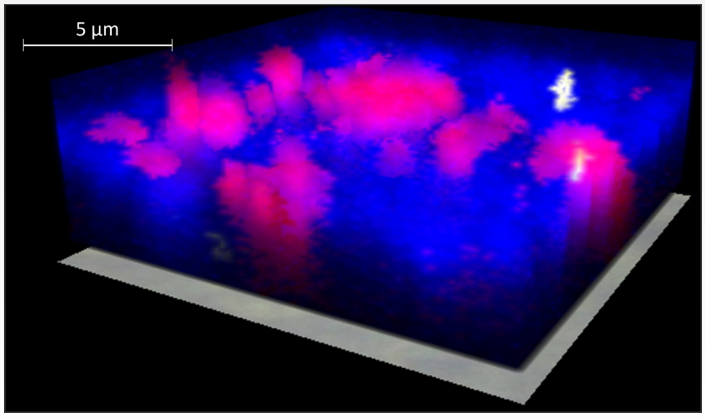
Raman map of MoS_2 crystals revealing information on layer number.

3D MAPPING

Using the confocal nature of the RM5, Raman mapping in X, Y, and Z allows the user to probe into their sample and observe its properties volumetrically. This takes Raman mapping beyond surface level constructing a 3D chemical image on the micron scale.

In Ramacle the area to be mapped and the step size can now be set up in all three dimensions. The resulting map can be viewed as a collection of 3D stacks in XY, or it can be displayed as a volumetric representation.





Top: 3D Raman map of polystyrene beads

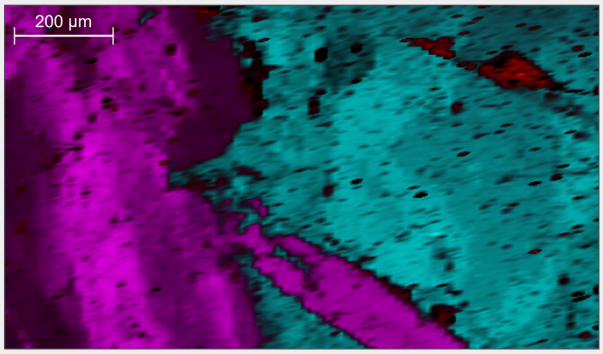
Bottom: 3D Raman map of an emulsion. Oil is shown in red, water in blue, and titanium dioxide in white.

Mapping the Raman spectrum within a sample area provides previously unavailable information about the chemical and physical differences across a sample. This can confirm the identity of specific components and reveal their distribution.

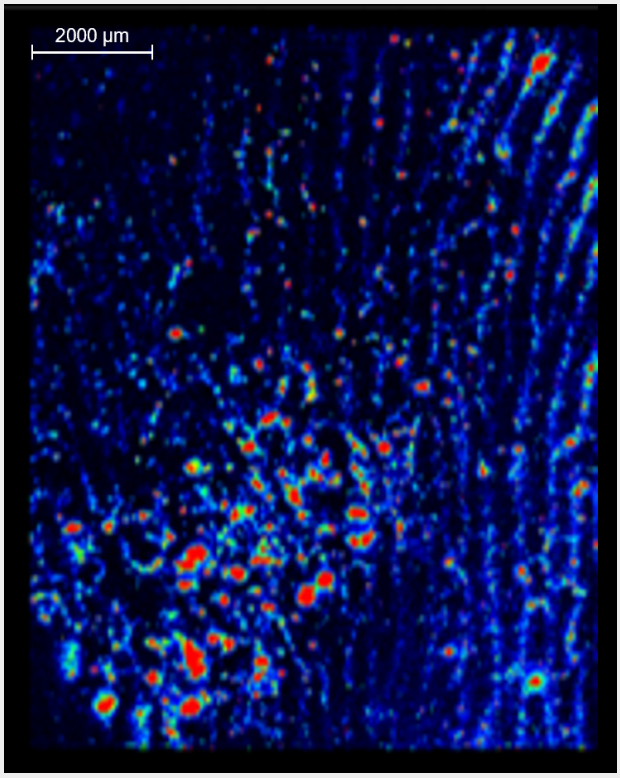
FastMAP®

When using short exposure times FastMAP® reduces 2D and 3D mapping times. This technique offers faster results via intelligent stage movement and utilising the CCD to its highest capability meaning shorter exposure times can be used.

Using FastMAP® the fingerprint map shown on the right-hand side took under 30 minutes, reduced from 20 hours under standard conditions, without losing any spectral or spatial quality.



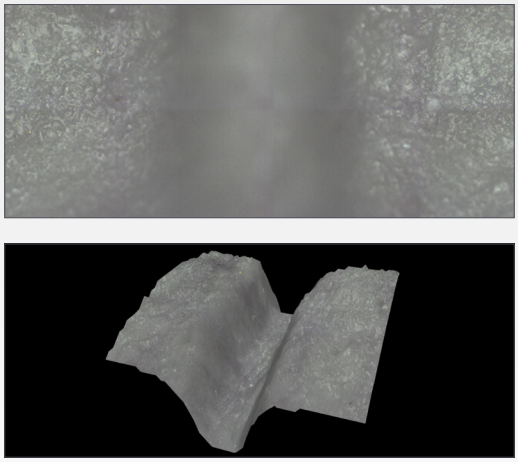
Raman FastMAP® showing distribution of different minerals across a geology cross-section.



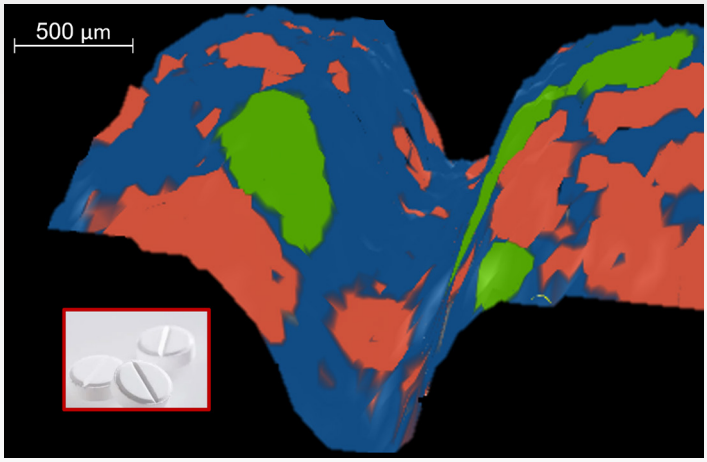
Raman FastMAP® revealing trace amounts of paracetamol (red) deposited in a fingerprint on aluminum foil.

SurfMAP®

The SurfMAP® feature of Ramacle enables the user to analyse difficult samples with rough and uneven surfaces. This is done by adjusting the Z-axis to ensure the laser remains in perfect focus across the sample surface. Without this feature non-flat surfaces cannot be accurately mapped due to variation in signal caused by the laser moving out of focus to the sample.



Top: Standard 2D image of tablet surface.
Bottom: Surface image of tablet surface.



Raman SurfMAP® with distribution analysis,.
Paracetamol is shown in blue, aspirin in coral, and caffeine in green.

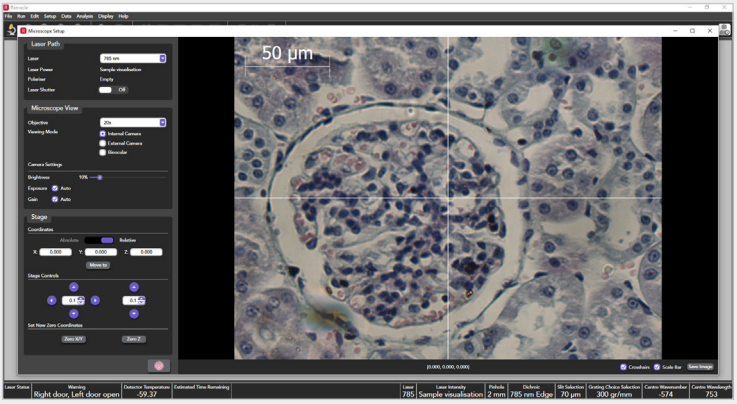
A series of white light images are taken at user-defined points to create a surface image. This allows the user to see features in their sample surface in a 3D topography view. Spectral measurements are then taken with the final Raman map also presented as a topographic surface.

RAMACLE® SOFTWARE

Ramacle is an exceptional software package written for complete instrument control and data handling on the RM5 system.

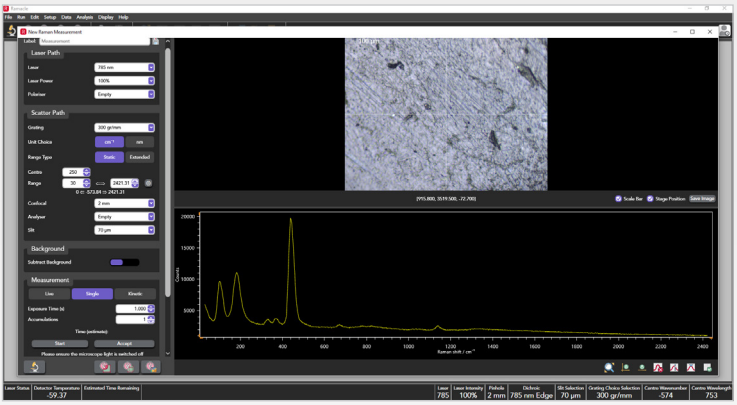
It focuses on all modern Raman spectroscopy applications, while at the same time, providing a user-friendly interface with 'ready to publish' outputs.

The software provides control, visualisation, data acquisition, analysis and presentation of results whether it is used for generating Raman spectra or with advanced upgrades such as Raman mapping.



Ramacle enables sample visualisation, live signal monitoring and parameter optimisation before every measurement. The instrument status and signal are displayed and constantly updated during measurements.

Data generated by Ramacle have a proprietary file format. This contains all measurement and instrumental properties, allowing the user to retrieve important information whenever needed and ensures data traceability. Simple input and output functions provide the required compatibility with third party data analysis or presentation packages.



KnowItAll® Raman Identification Pro spectral library is available for material identification and advanced analysis. Data acquisition methods such as single measurements, multiple and accumulated scans, kinetic scans and generation of maps (accessory dependent) are implemented by intuitive and in user-friendly wizards.

RAMACLE KEY FEATURES

- Selection of laser and scatter optical pathways
- Selection of excitation wavelength, gratings and exposure time
- Sample and laser focus visualisation
- Programmed attenuator and shutter
- Single, accumulated and kinetic spectral acquisitions
- Spectral correction
- Selection and scans of internal calibration standards and automated calibration correction
- Data operations such as arithmetic, scaling, normalisation and baseline subtraction
- Cosmic ray removal, cropping, smoothing
- Automated laser alignment
- ASCII / CSV data import / export function
- Paste options for presentations and publications

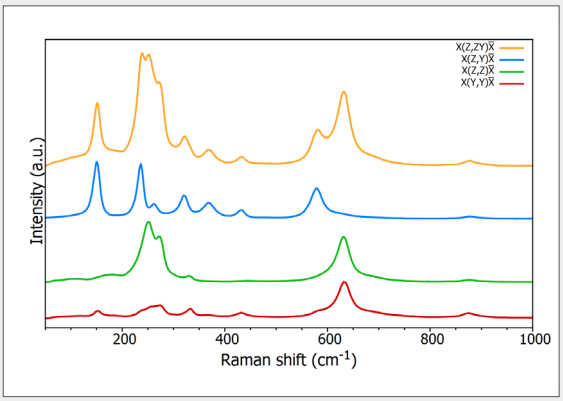
FEATURES INCLUDED WITH UPGRADES

- Mapping features - map setup, collection and data analysis
- Fully motorised stage - XYZ control through joystick and software
- Polariser and analyser selection and control
- Detectors selection
- Laser rejection filter selection
- External camera selection and visualisation
- Advanced mapping features: SurfMAP®, 3D map
- Autofocus
- Temperature-dependent measurements

POLARISED RAMAN SPECTROSCOPY

Optional accessories allow the user to control the polarisation of the excitation light and analyse different Raman scattering polarisations. Ramacle automatically moves polarisers in and out of light and scatter paths as needed.

Examining spectral information obtained by polarised Raman spectroscopy can provide insights into the symmetry of vibrational modes, as well as the orientation of samples such as single crystals, polycrystalline samples, and anisotropic materials.

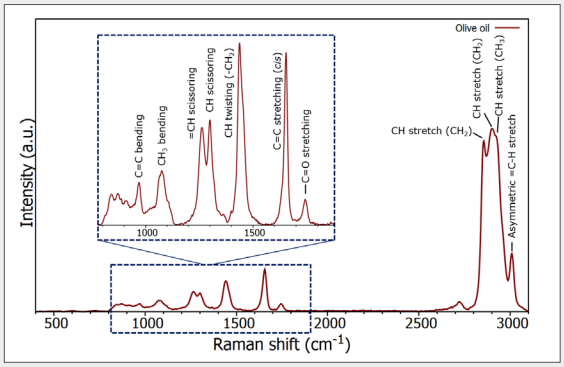


Lithium niobate polarised Raman spectra using four different polarisation configurations

CUVETTE HOLDER

Liquids can be measured directly in a cuvette with the specifically designed RM5 cuvette attachment. Including a 10x objective the laser is perfectly focused onto the cuvette providing easy and reliable measurements of liquids.

Standard and micro-cuvettes can be used, which can be quartz or plastic. Thanks to the optical design of the cuvette holder no interference is seen in the Raman spectrum from the cuvette material.

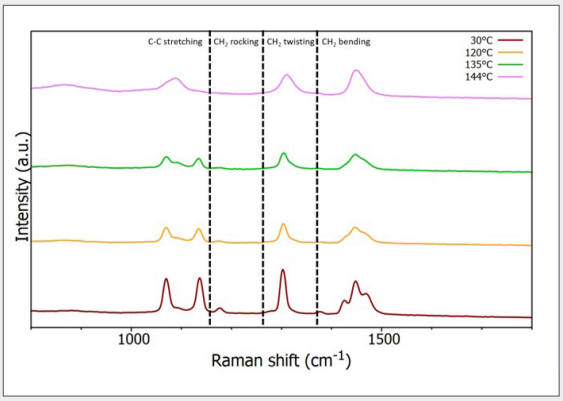


Raman spectrum of olive oil using the cuvette holder

TEMPERATURE STAGE

Whether you sample requires heating or cooling the system can be supplied with a temperature stage to suit your needs. Conditions can be set in Ramacle allowing temperature dependent studies to be automatically performed.

The temperature stage is securely held on the microscope stage for both manual and motorised stages. Long working distance objectives are configured with the temperature stage so that no compromise is required between working distance and magnification.

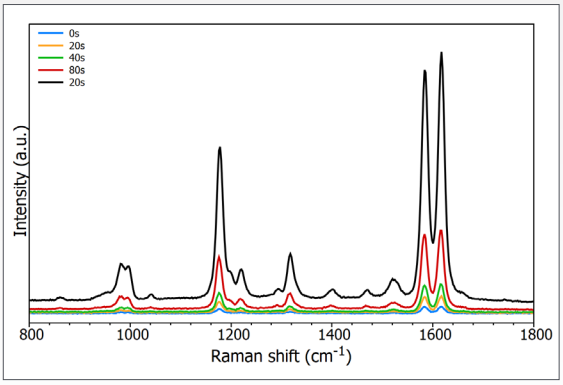


Raman spectra of polyethylene at increasing temperatures indicating phase transitions

KINETIC MEASUREMENTS USING SERS

Surface-Enhanced Raman Scattering (SERS) is a method for enhancing Raman signals. Samples of interest are brought in proximity or attached to a roughened metal surface with nanoscale features. The excitation laser interacts with plasmons on the surface of the metal, resulting in significantly increased Raman signals.

The enhancement of SERS is the roughened surface meaning no complicated system upgrades are required to achieve these measurements.

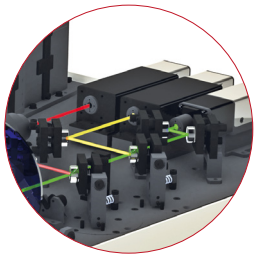


1,2(4-pyridyl)ethylene Raman spectra recorded over time to show effect of time on SERS enhancement

UPGRADE OPTIONS

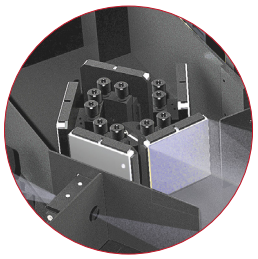
LASERS

A choice of excitation lasers and associated laser rejection filters (both edge and notch) are available depending on application requirements.



GRATINGS

Gratings are chosen for optimum resolution for each laser excitation, with up to a maximum of five gratings per system.



DETECTORS

A choice of CCD, EMCCD and InGaAs detectors are also available dependent on requirements, with a maximum of two detectors being integrated per system.

ACCESSORIES AND LASER SAFETY

Other accessories such as a polarisation kit and a Class I laser safety enclosure are also available to further expand the capabilities, flexibility and safety of your system.

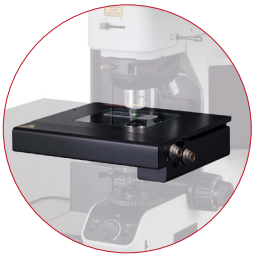
MICROSCOPE

The RM5 uses one of the most modern microscopes on the market for first class Raman microscopy, you can use the microscope beyond pure Raman microscopy.

Brightfield, darkfield, polarised light, differential interference contrast (DIC) and fluorescence are all available. Alongside a choice of high quality microscope objectives, a high performance camera can be added to the microscope to ensure pictures of your samples (and associated Raman maps) are captured with excellent quality and resolution.

SAMPLE STAGES

A choice of microscope stages, including manual and an XYZ motorised stage which allows ease of navigation around your samples and stage area. Automated Raman maps can be obtained and generated through Ramacle. Heating/cooling of stages is also available.



SPECIFICATIONS – RM5

LASERS		Up to 3 narrow-band lasers including: 532 nm, 638 nm, 785 nm Other wavelengths available on request Laser selection is fully computer-controlled
LASER REJECTION FILTERS		Up to 3 laser rejection filters included Filter exchange is fully computer-controlled
LASER ATTENUATION		4 orders of magnitude, continuous Fully computer-controlled
SPECTRAL RESOLUTION		From <0.3 cm^{-1} *
SPECTRAL RANGE		50 cm^{-1} - 4000 cm^{-1} *
SPECTROGRAPH	Type	Asymmetric Czerny-Turner
	Focal Length	225 mm
	Gratings	5-position grating turret, fully computer-controlled
	Slits	Continuously adjustable, fully computer-controlled
CONFOCAL IMAGING		Adjustable confocal pinhole, fully computer-controlled
DETECTORS	Standard Detector	High sensitivity ultra low noise CCD Front illuminated CCD for standard use and optimisation in the NIR Back illuminated CCD for enhanced sensitivity and spectral range
	Optional Second Detector	EMCCD detector, InGaAs and others available on request Selection of detectors, fully computer-controlled
RAMAN POLARISATION	Optional	Polarisation kit available, fully computer-controlled
INTERNAL CALIBRATION		Wavelength calibration standard (Neon) Raman shift standard (Silicon) Sensitivity validation standard (Silicon) Automated laser alignment
MICROSCOPE SYSTEM	Functionality	Full upright microscope with brightfield and darkfield illuminator
	Optional	Polarisation, Differential Interference Contrast (DIC) capability and fluorescence imaging
	Objective(s)	10x and 100x objective included as standard; up to 5 can be included
	Sample Viewing	Trinocular eyepiece, embedded CMOS video camera, second video camera optional
	Sample Stage	XY manual stage
	Optional	XYZ motorised stage, for confocal Raman mapping Temperature-controlled sample stages available
SOFTWARE	Ramacle®	Comprehensive all-in-one, intuitive software package
	Operating System	Windows®
	Functionality	Data acquisition, spectrograph control, graphical display, data processing
	Optional	Chemometric, spectral library packages - KnowItAll™
LASER SAFETY	Without Laser Enclosure	Class 3B
	With Laser Enclosure	Class 1
DIMENSIONS	W x D x H †	600 mm x 800 mm x 600 mm
	Weight †	63 kg

* depending on grating, laser and CCD selection
† without laser enclosure

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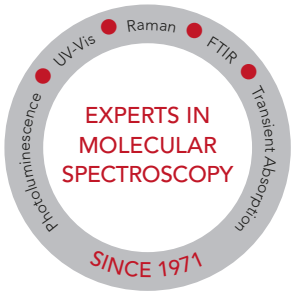

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