EDINBURGH INSTRUMENTS

MULTIMODAL CONFOCAL

RAMAN MICROSCOPE

RMS1000

EDINBURGH INSTRUMENTS

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

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

As always, Edinburgh Instruments delivers 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 NANOMATERIALS

RMS1000 RAMAN MICROSCOPE

The RMS1000 is a multimodal open architecture confocal microscope. It has been designed so it can be adapted to almost any modern state-of the-art Raman application and beyond; including Photoluminescence Microscopy, Fluorescence Lifetime Imaging (FLIM) and more.

KEY FEATURES

- **Multimodal Measurements –** multimodal imaging techniques to take your research beyond Raman such as FLIM, PLIM, SHG, and more
- **Integrated and External Lasers –** up to 5 internal computer-controlled lasers for ease of use and reduced footprint. External laser integration for advanced Raman and Fluorescence measurements
- **Two Spectrograph Options –** standard compact and long focal length spectrographs available for ultimate resolution, sensitivity, and stray light rejection
- **Four Simultaneous Detectors –** up to 4 detectors can be installed, including high efficiency TE-cooled CCDs, EMCCDs, InGaAs, PMTs and more
- **Truly Confocal –** multiple position pinhole for high spatial resolution, fluorescence and background rejection and application optimisation
- **Five-Position Grating Turrets –** for unrivalled spectral resolution from <0.1 cm^{-1} and coverage over 5 cm^{-1} - 30,000 cm^{-1}
- **Internal Standards and Auto-Calibration –** to ensure the highest quality data you can trust, at all times
- **Ramacle® Software –** One powerful software package for complete system control compatible with all techniques from data acquisition to data analysis

"THIS HIGH-END RESEARCH TOOL HAS BEEN BUILT WITH NO COMPROMISES; RESULTING IN A SYSTEM THAT STANDS ALONE."

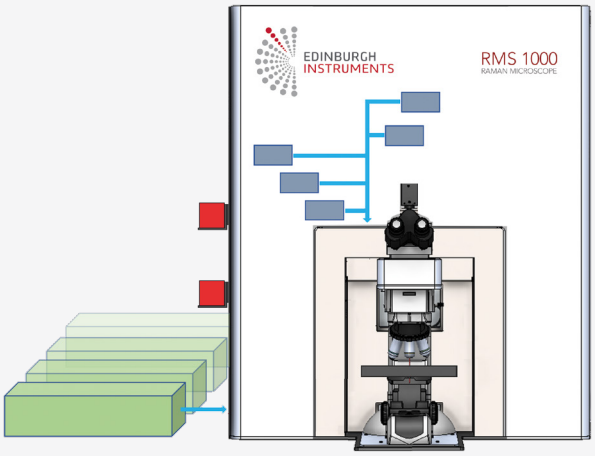
COSMETICS | SEMICONDUCTORS | ART & MUSEUM | FORENSICS | GEOLOGY

LASER BEAM PATH – LASER CHOICE

The open architecture design of the RMS1000 offers a versatile and customisable laser beam path and a maximum choice of lasers. Once configured, all hardware selections and measurement options are fully automated.

- Up to 5 fully integrated lasers of compact design
- Multiple external lasers of larger footprint
- Accurate laser power attenuation
- Laser line rejection filters with excellent performance, allowing for low wavenumber measurements
- Fully software-controlled operation, no manual switching of sources and optical components

Integrated Raman lasers
External lasers
Pulsed Lasers



RECOMMENDED LASER SOURCES

GENERAL PURPOSE
532 nm | 638 nm | 785 nm

SEMICONDUCTORS
325 nm | 473 nm | 532 nm

PHARMACEUTICALS
532 nm | 638 nm | 785 nm

NANOMATERIALS
532 nm | 638 nm | 785 nm

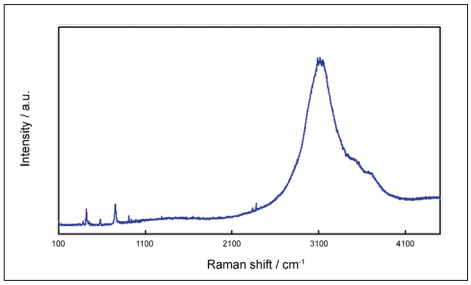
BIOSCIENCES
785 nm | 830 nm | 1064 nm

POLYMERS
532 nm | 638 nm | 785 nm

GEOLOGY
532 nm | 785 nm

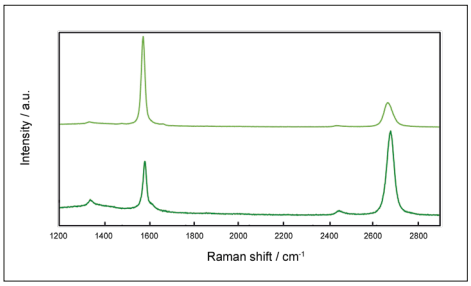
SEMICONDUCTORS: 325 nm

UV Raman analysis of GaN materials provides both Raman and photoluminescence data which can be used to detect defects in the material. This facilitates monitoring and improvement of manufacturing processes and device performance.



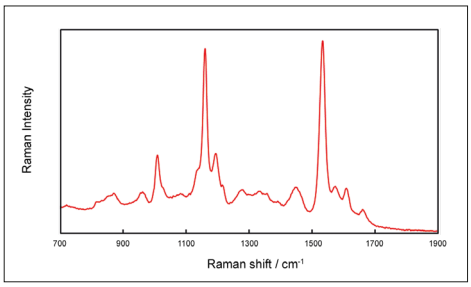
NANOMATERIALS: 532 nm

Confocal Raman is ideal for characterising the electronic structure of graphene. Graphene has 2 major bands (1580 cm^{-1} and 2680 cm^{-1}). The ratio of these peaks changes in dependence of the number of layers.



BIOSCIENCES: 785 nm

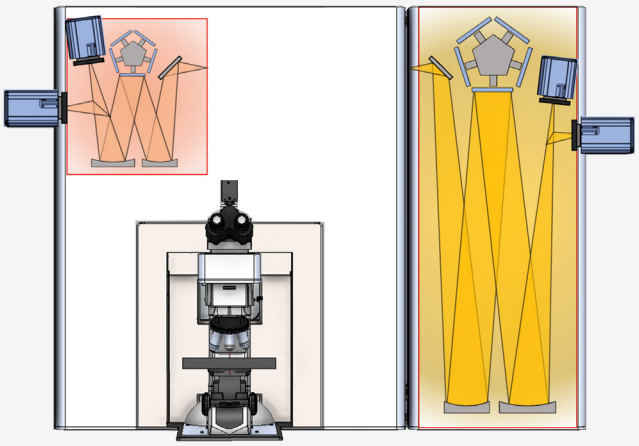
Raman spectrum taken from a grain of buttercup pollen, showing Raman peaks from carotenoid species as well as proteins and amino acids which can be used to identify species. 785 nm excitation was chosen to minimise fluorescence background.



RAMAN SCATTER PATH – SPECTROGRAPH CHOICE

The RMS1000 features a versatile and configurable Raman scatter path with all hardware options fully computer-controlled. Two spectrograph versions are available for standard research and the most demanding applications.

- Standard and/or long focal length spectrograph with multitude of camera and grating options
- Integrated variable pinhole turret
- Auto beam alignment
- Integrated and external viewing camera for widefield observations



STANDARD SPECTROGRAPH

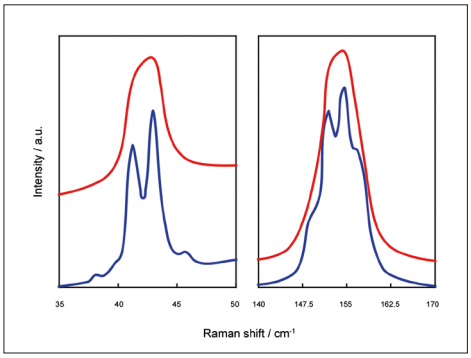
- Compact, integrated
- Suitable for most Raman applications
- 5-position grating turret
- Up to 2 detectors

LONG FOCAL LENGTH SPECTROGRAPH

- For the most demanding Raman applications requiring extra high resolution and additional stray light rejection
- Particularly useful in combination with UV excitation
- 5-position grating turret
- Up to 2 detectors

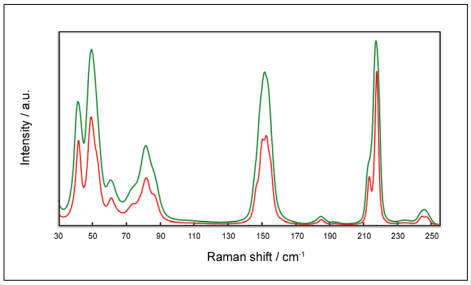
SPECTROGRAPH CHOICE

Spectral resolution with standard (red) and long focal length (blue) spectrographs for histidine (left) and sulphur (right). The background reduction and the increased spectral resolution for the measurement with the long focal length spectrograph are evident providing industry-leading spectral resolution from <0.1 cm^{-1}.



PRECISION SLITS

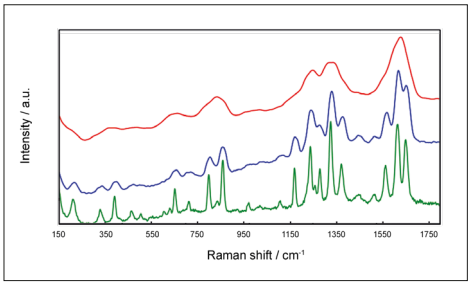
Both spectrograph options are fitted with a high precision slit that is quasi-continuously adjustable. The spectra demonstrate the capability of controlling the resolution by the slits. The example of Raman scans of sulphur with 100 µm slit (green) and 20 µm slit (red), clearly show the better resolved band structures with the smaller slit width.



FIVE POSITION GRATING TURRET

Raman spectra of paracetamol, taken with 300 g/mm (red), 600 g/mm (blue) and 1800 g/mm (green) gratings. A wide selection of gratings to match the excitation laser is available for use with both spectrographs.

The wide selection of gratings, together with the option for extended scan, allows for user optimisation over the entire spectral range.

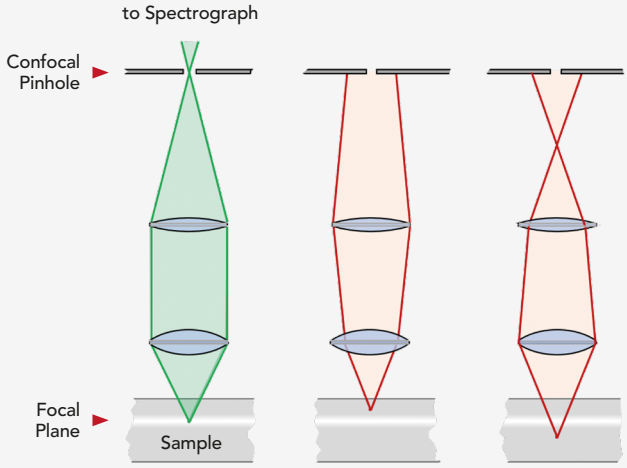


CONFOCAL RAMAN MICROSCOPY

Due to its true confocal design, the RMS1000 offers excellent 2D mapping, depth profiling, and 3D mapping capabilities and provides close to diffraction-limited spatial resolution.

- True confocal design with a software-controlled confocal pinhole turret
- More than 10 confocal pinhole sizes under 100 µm
- Rejection of unwanted background
- Ultimate control for superior Raman mapping contrast and spatial resolution
- Optical sectioning and depth profiling of the sample by rejecting out-of-focus light

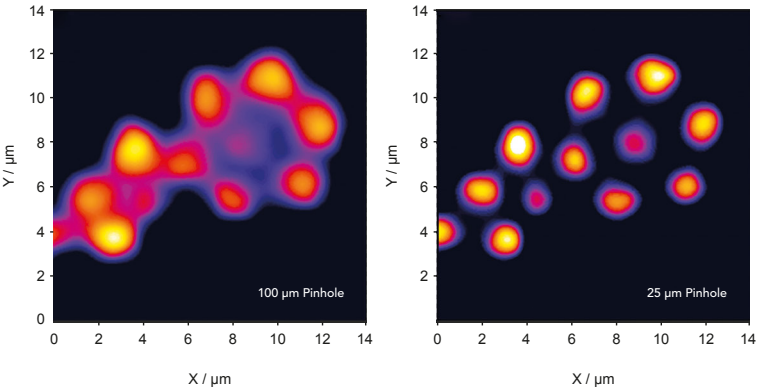
detected radiation rejected radiation



IMPROVEMENT OF SPATIAL RESOLUTION

The confocal pinhole design significantly enhances the contrast of 2D Raman maps due to better spatial selection and better discrimination from unwanted signal surrounding the focus point.

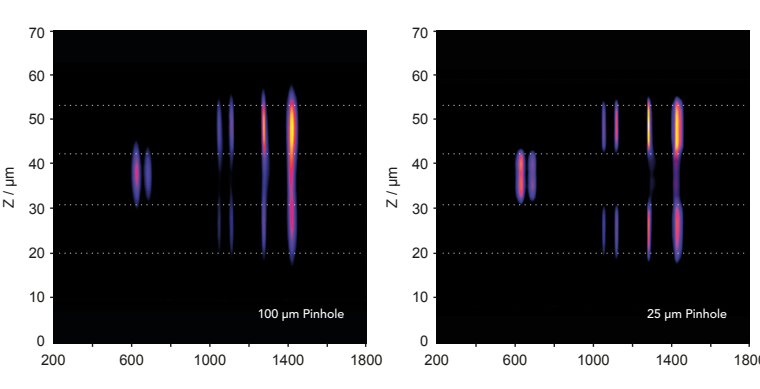
The example shows a 2D Raman map of a cluster of 3 µm sized polystyrene beads on a silicon substrate. The comparison between 100 µm and 25 µm confocal pinholes shows the improved image quality that truly confocal detection can achieve.



DEPTH PROFILING

A confocal pinhole design is an essential requirement if the 'Z-dimension' of the sample is to be investigated. With true confocality, volumes within the sample can be 'viewed' by the detector.

This measurement, taken on a PET-PVC-PET multilayer polymer sample, shows how the Raman spectrum changes when the focus is moved through the depth of the sample with fixed X and Y positions. The reduction of the pinhole size clearly demonstrates the enhancement of contrast in the 'Z' dimension.



RAMAN MAPPING

The RMS1000 comes with Raman Mapping that has been central to the design from concept to completion. Raman Mapping truly adds a different dimension to this high-end Raman Microscope.

Mapping the Raman spectra within a sample space provides previously unavailable information about the chemical and physical differences across a sample. This can confirm the identity and presence of specific components, and reveals their location and distribution within the sample.

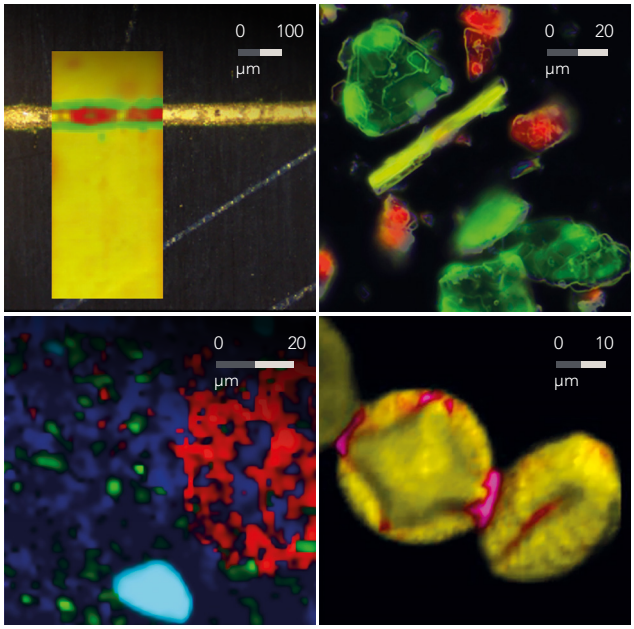
Using a motorised X, Y, Z scanning stage 2D and 3D maps are easily measured. For both, there are the additional software upgrade of FastMAP® which can greatly reduce acquisition times and SurfMAP®, which is a feature that allows the user to measure uneven surfaces with confidence.

Material sciences
Investigate how structure, stress and strain vary across a sample

Biology and life sciences
Image tissues, whole cells or their components without the need for dyes and stains; or locate Raman and SERS tags

Pharmaceuticals
Identify ingredients and analyse their distribution in drug development and drug production

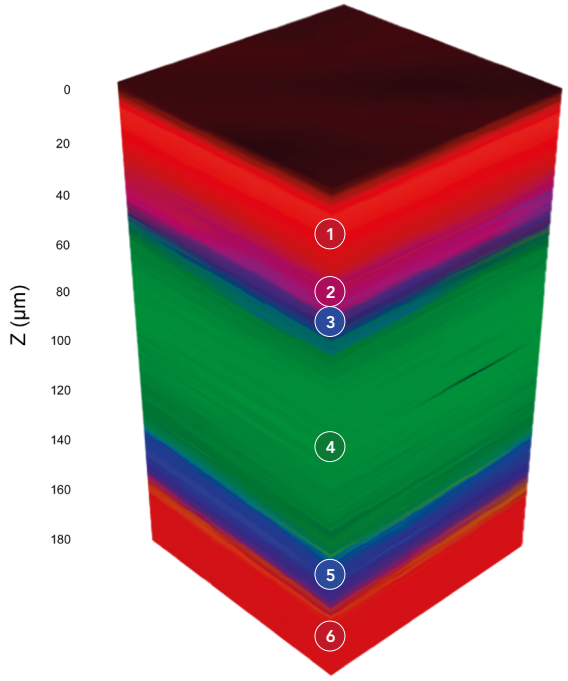
2D RAMAN MAPPING

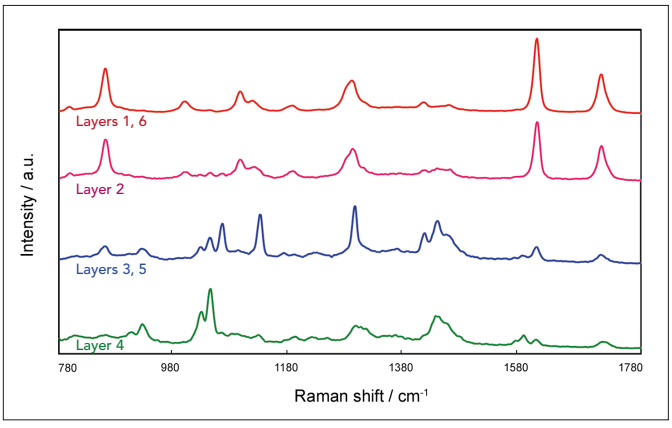


2D Raman maps of a silicon solar cell (top left) and a mixture of amino acid crystals (top right), both shown overlaid with their respective darkfield microscope images. 2D Raman maps of toothpaste (bottom left) and pollen grains (bottom right).

Effective Raman mapping sets special requirements for hardware and software. The fastest and most sensitive array detectors, EMCCDs, should be considered, together with a fast scan stage and proven and tested software that can acquire and process vast data sets with high accuracy and in the shortest possible time.

3D RAMAN MAPPING





3D confocal Raman map of a transdermal patch. Spectra were collected at 10 µm steps in X and Y axes and 1 µm steps in Z axis resulting in a stack of 188 2D Raman maps. The volume render shows the separate layers of the patch; the representative spectra reveal the identities of poly(ethylene terephthalate) (red), PET/polyisobutylene (pink), polyethylene (blue) and the active ingredient (green).

FLEXIBILITY IN MICROSCOPY

PUSHING THE BOUNDARIES IN RAMAN

The RMS1000 is available with either an upright or an inverted confocal microscope for Raman research in material and biological sciences.

The microscopes can be configured with reflective and/or transmitted light illumination and have options for all modern visualisation and contrast enhancement techniques. There is space for fluorescence illuminators, scan stages and advanced sample holders, such as temperature stages and pressure cells.

2 Upright microscope
Standard spectrograph

1 Inverted microscope
Standard spectrograph

FLEXIBILITY IN RESOLUTION

FOR ADVANCED RAMAN RESEARCH

3 Inverted microscope

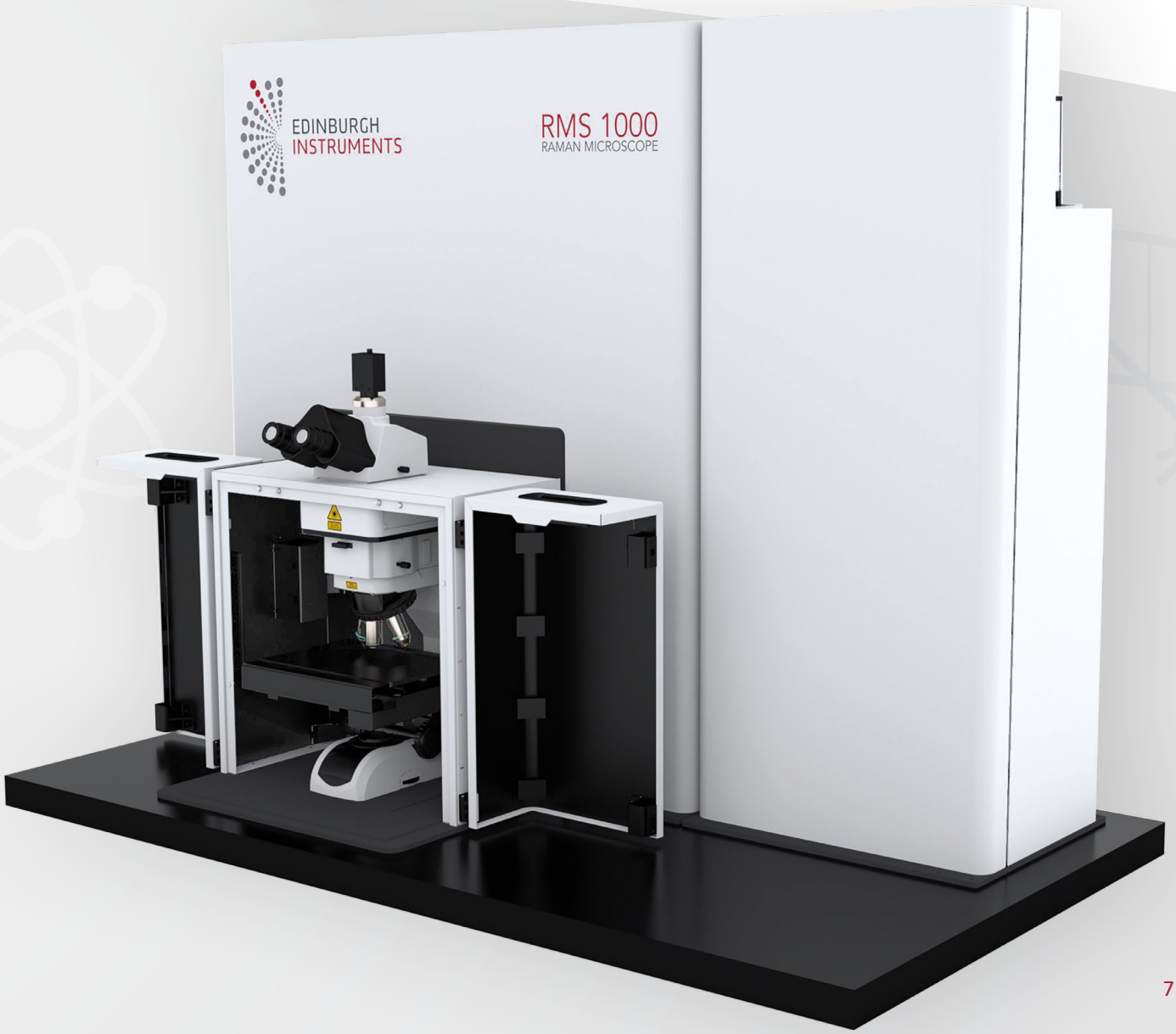
Long focal length spectrograph

For applications that require ultimate spectral resolution or ultraviolet wavelength excitation, the RMS1000 can integrate a second long focal length spectrograph.

Both the standard and long focal length spectrographs can contain 5 gratings on an interchangeable grating mount for ultimate flexibility over spectral resolution and spectral range.

4 Upright microscope

Long focal length spectrograph, laser safety enclosure

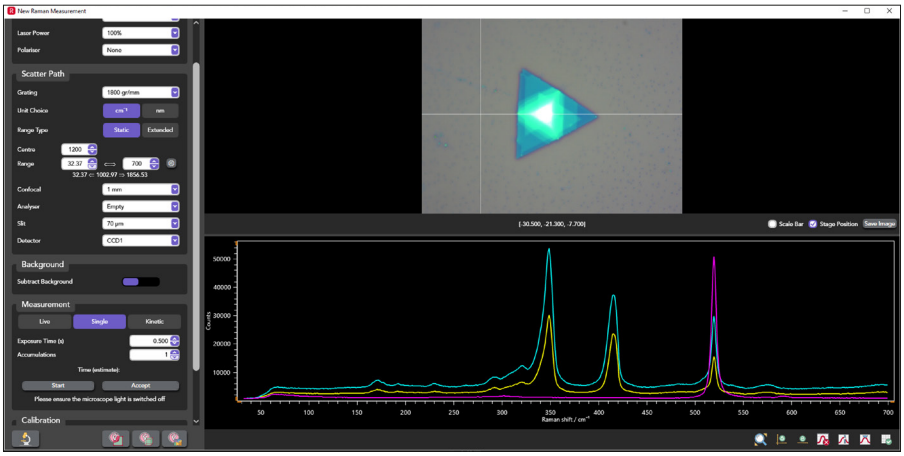


RAMACLE®

Ramacle is an exceptional software package written for complete instrument control and data handling on the RMS1000 system. It focuses on all modern Raman spectroscopy applications while at the same time, provides a user-friendly interface with 'ready to publish' outputs.

INTUITIVE INTERFACE

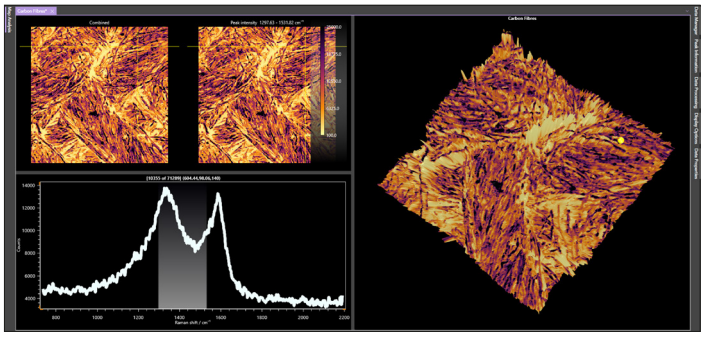
The software provides control of the RMS1000, visualisation, data acquisitions, analysis, and presentation. The instrument status and signal are displayed and continually updated during measurements to provide a live view.



MAPPING UPGRADE

After upgrading to a motorised stage new features become available in Ramacle. 2D mapping and 3D mapping allow the user to see distribution of components, as well as revealing areas under high stress or strain, and defects. If using short exposures times FastMAP® is also available to reduce total acquisition times.

SurfMAP® is a tool which allows accurate mapping of uneven surfaces giving the user assurance that their measurements are in focus.



Raman SurfMAP® of carbon fibres

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 (Raman and Photoluminescence)
- 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

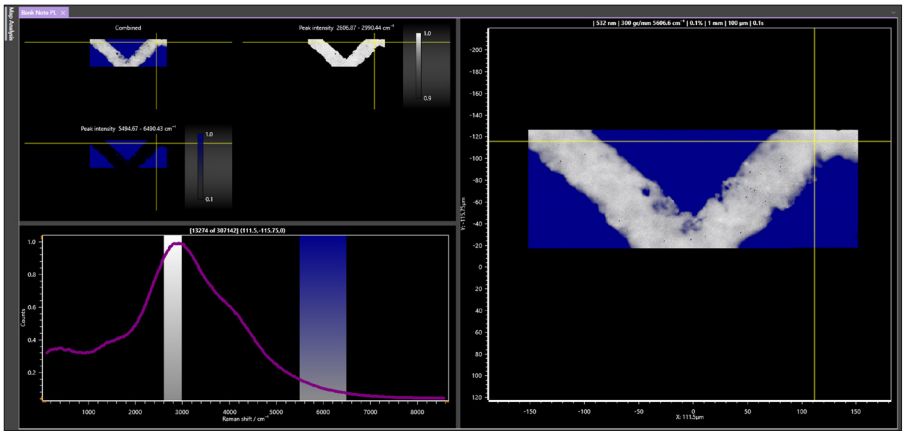
ONE POWERFUL SOFTWARE PACKAGE

The upgradeability of the RMS1000 is not limited to hardware. Upgrades to the software are done together with instrument enhancements allowing your RMS1000 to continuously advance alongside your research.

PHOTOLUMINESCENCE MEASUREMENTS

Spectral

Ramacle measures spectral PL responses using the CCD camera enabling single point and mapping data to be collected. Measurements are made by selecting a low groove density grating to cover the entire emission range. The software can be operated in both wavenumber and wavelength scale making working in Raman and PL effortless.

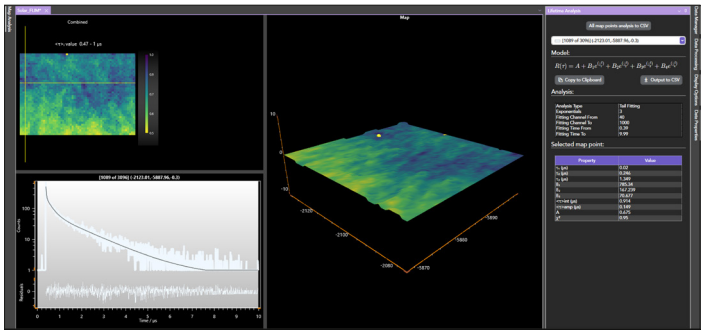


PL FastMAP® of Scottish bank note

Time-Resolved – FLIM & PLIM

Ramacle easily handles the transition from spectral to lifetime measurements. The software auto-switches the laser alignment path to ensure the pulsed laser reaches the sample and signal is automatically directed onto a PMT detector. SurfMAP®, 2D, and 3D mapping are available for both spectral and lifetime measurements.

Ramacle carries out analysis producing an image of the average lifetime or other lifetime parameters. The software can operate in TCSPC* or MCS* mode to suit the lifetime profiles of any sample.



FLIM SurfMAP® of a solar cell

FEATURES INCLUDED WITH UPGRADES

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

*TCSPC – Time-Correlated Single Photon Counting; MCS – Multi-Channel Scaling

RAMAN AND BEYOND

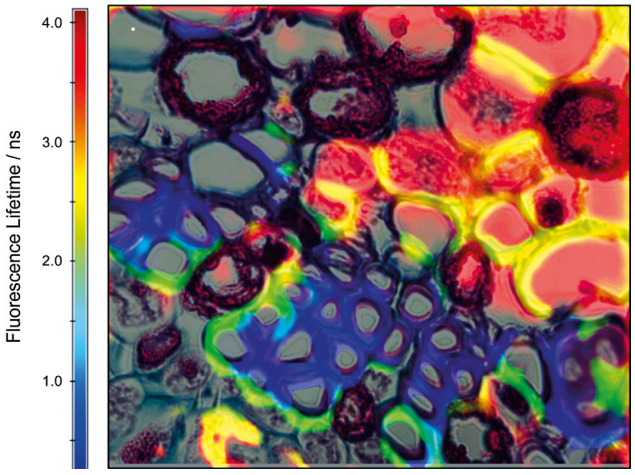
The RMS1000 has been designed with ultimate flexibility in mind. Keeping open architecture at the forefront the user can go beyond Raman microscopy, thanks to its ability to house multiple external lasers and detectors to suit every application.

TIME-RESOLVED PHOTOLUMINESCENCE

Fluorescence Lifetime Imaging (FLIM)

Fluorescence lifetime images can be set up and analysed using Ramacle. Edinburgh Instruments pulsed lasers are easily coupled into the RMS1000 and by using Ramacle software the lifetime measurement conditions can be set, and the light path is automatically directed to a PMT detector.

After processing the fluorescence decays Ramacle produces an image of the average lifetime, or other lifetime parameters.



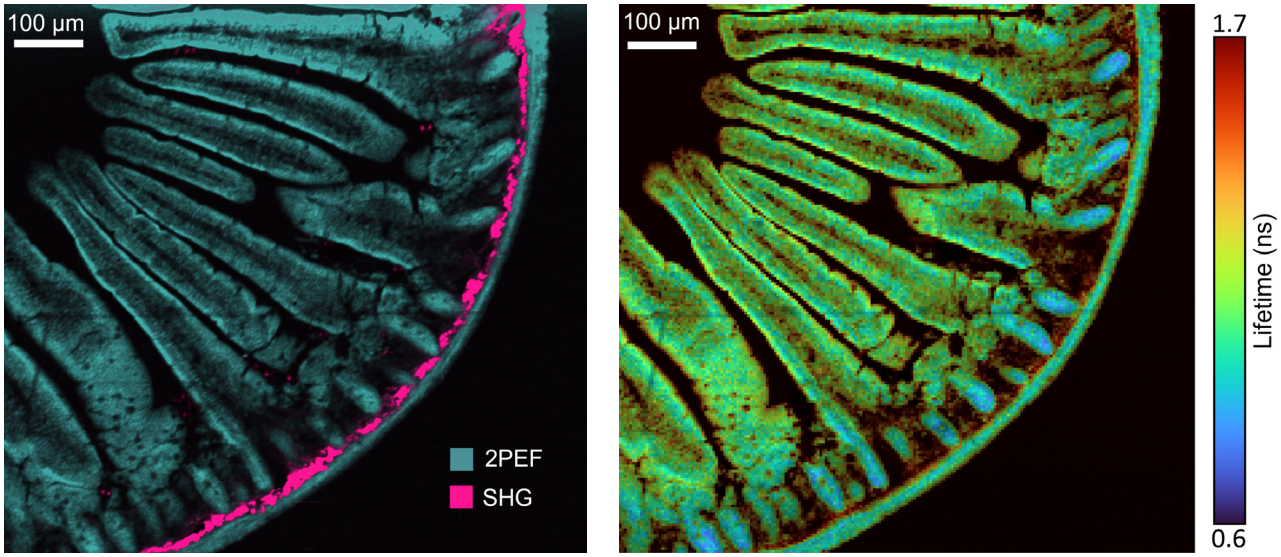
FLIM map from a stained pine tree section, superimposed in the brightfield image.

MULTIPHOTON IMAGING

Two-Photon Excited Fluorescence | Second Harmonic Generation

Two-photon excited fluorescence (2PEF) and second harmonic generation (SHG) are complementary multiphoton imaging techniques for studying biological samples.

The RMS1000's ability to couple external lasers allows a femtosecond laser to be coupled into the microscope for multiphoton imaging.



Sample: Mouse intestine stained with Alexa Fluor® 568

Left: simultaneous measuring of spectral 2PEF and SHG from Alexa Fluor® 568 dye and fibrillar collagen respectively. Measurement using femtosecond laser and CCD camera.

Right: 2PEF lifetime image measured using femtosecond laser and hybrid PMT detector

MULTIMODAL CONFOCAL MICROSCOPY

Bespoke systems for cutting edge research drives the RMS1000's multimodal design. Benefiting from numerous upgrade options one system can carry out several techniques for complete sample characterisation.

COMPLIMENTARY IMAGING

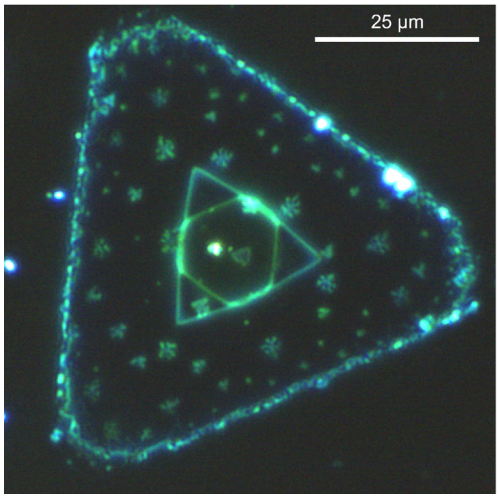
Darkfield Microscopy | Raman | Photoluminescence | Second Harmonic Generation

Ramacle was designed to ensure simple set up for correlative mapping. The software retains set mapping positions and step sizes so maps can easily be repeated with different techniques.

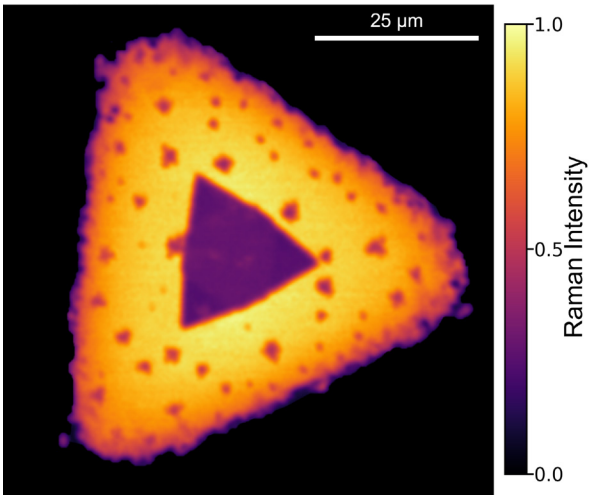
2D materials are often studied with different measurement techniques, the RMS1000 can easily be configured to carry out all imaging techniques on the same sample area providing a full suite of complimentary information.

Example shown is a WSe_2 crystal. The darkfield (DF) image reveals areas of different heights, likely due to different WSe_2 layer numbers. This can be confirmed by Raman mapping by measuring the intensity of prominent bands.

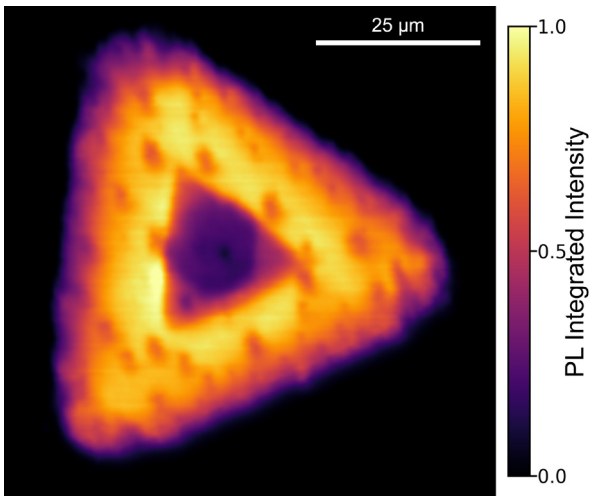
Raman, photoluminescence (PL), and second harmonic generation (SHG) images can be used correlatively to identify layer number, and highlight areas of stress, strain, dopants, and defects.



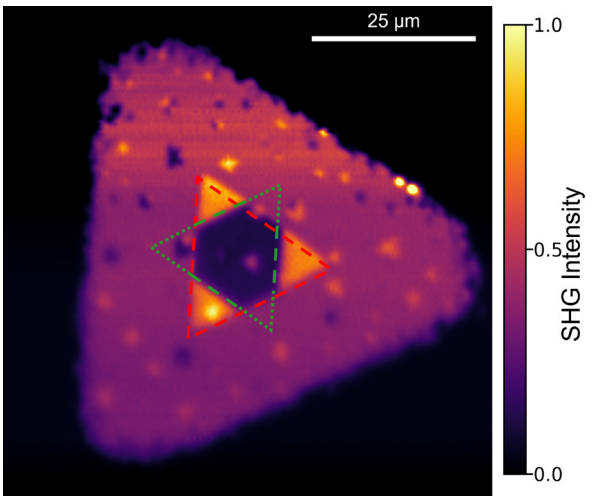
Reflected Darkfield



E^1_{2g} & A_{1g} Raman Band Intensity



PL Integrated Intensity

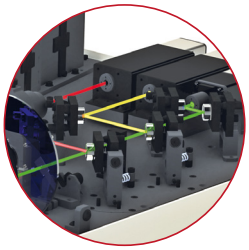


SHG Intensity

UPGRADE OPTIONS

LASERS

The RMS1000 is built with flexibility in mind. A choice of excitation lasers (internal or external to the system) and associated laser rejection filters (both edge and notch) are available. Additionally picosecond pulsed diode lasers (EPL, HPL series) can be added if fluorescence lifetime measurements are required.



SPECTROGRAPHS

The RMS1000 can be fitted with both standard and long focal length spectrographs. This allows the system to be configured for ultimate spectral resolution, maximum optical throughput, low wavelength and ultraviolet spectral ranges, or for highly sensitive measurements.

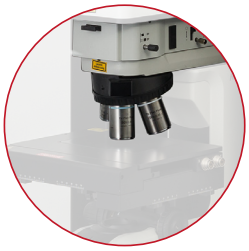
DETECTORS

A choice of CCD, EMCCD, and InGaAs detectors for Raman and photoluminescence measurements. For fluorescence lifetime measurements PMT detectors can be integrated. In total, a system can accommodate 4 detectors.

MICROSCOPE ACCESSORIES

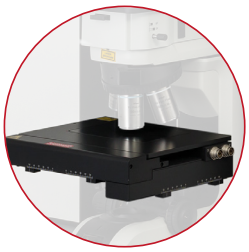
The RMS1000 uses either an upright or inverted microscope platform which is compatible with all standard microscopy applications.

Brightfield, darkfield, polarised light, differential interference contrast (DIC) and fluorescence accessories are all available. A large choice of high-quality objectives, high-performance visualisation cameras, collimators and illuminators can be added to the microscope at any time.



SAMPLE STAGES

Manual or motorised stages are available. The motorised stage allows automated XYZ Raman and fluorescence maps to be obtained and generated through Ramacle. Autofocus and heating/cooling of samples is also available.



ACCESSORIES AND LASER SAFETY

Other accessories such as a polarisation kit, cuvette holder, and a Class I laser safety enclosure are also available to further expand the capabilities, flexibility and safety of your RMS1000 system. Coupling to other fluorescence spectrometers is also possible.

SPECIFICATIONS – RMS1000

LASERS		Up to 5 integrated narrow-band lasers: 532 nm, 638 nm, 785 nm typically used
		Additional lasers from UV to NIR are available. External lasers can be integrated
		Laser selection is fully computer-controlled
		Associated laser rejection filters included, fully computer-controlled
SPECTROGRAPHS	Wavelength Range	200 nm - 2,200 nm
	Gratings	5-position grating turrets
	Slits	Continuously adjustable, fully computer-controlled
SPECTRAL RESOLUTION		From <0.1 cm^{-1} (depending on grating, laser and CCD selection)
SPATIAL RESOLUTION	XY (lateral), Z (axial)	0.25 µm, <1 µm (depending on laser and microscope objective)
SPECTRAL RANGE		5 cm^{-1} * - 30,000 cm^{-1} (*with low wavenumber attachment)
CONFOCAL IMAGING		Adjustable confocal pinhole, fully computer-controlled
DETECTORS	CCD Detector	High sensitivity ultra low noise spectroscopy CCDs
		Front illuminated CCD (TE-cooled) for standard use and optimisation in the NIR
		Back illuminated CCD (TE-cooled) for enhanced sensitivity and spectral range
	Optional Second Detector	EMCCD detector, 1600 x 200 pixels, TE-cooled -100°C (fast response time)
		InGaAs array, 1024 pixel, TE-cooled -90°C, up to 2,200 nm
		PMT detectors for lifetime measurements
SOFTWARE	Ramacle®	Comprehensive all-in-one, intuitive software package
	Optional	Chemometric, spectral library packages
FLUORESCENCE	Spectral	With low resolution grating and integrated CCD
	Lifetime	With pulsed lasers, TCSPC or MCS electronics, fast photon counting detectors
		Spectral and lifetime fluorescence mapping is also available
LASER SAFETY	Without Laser Enclosure	Class 3B (depending on external laser source)
	With Laser Enclosure	Class 1
DIMENSIONS	W x D x H	From 975 mm x 610 mm x 1170 mm
	Weight	From 114 kg

EDINBURGH INSTRUMENTS

2 Bain Square,
Kirkton Campus,
Livingston, EH54 7DQ
United Kingdom

Tel: +44 (0)1506 425 300
Fax: +44 (0)1506 425 320

sales@edinst.com

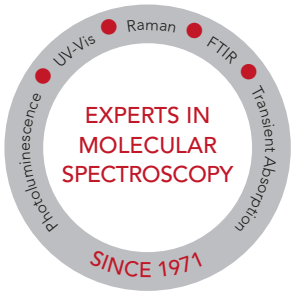
U.S. OFFICE CONTACT:

Tel: +1 800 323 6115

ussales@edinst.com

Customer support is available worldwide

MANUFACTURED WITH PRIDE IN THE UNITED KINGDOM



edinst.com

Registered in England and Wales No: 962331 VAT No:GB 271 7379 37

STG31 / 10.2023