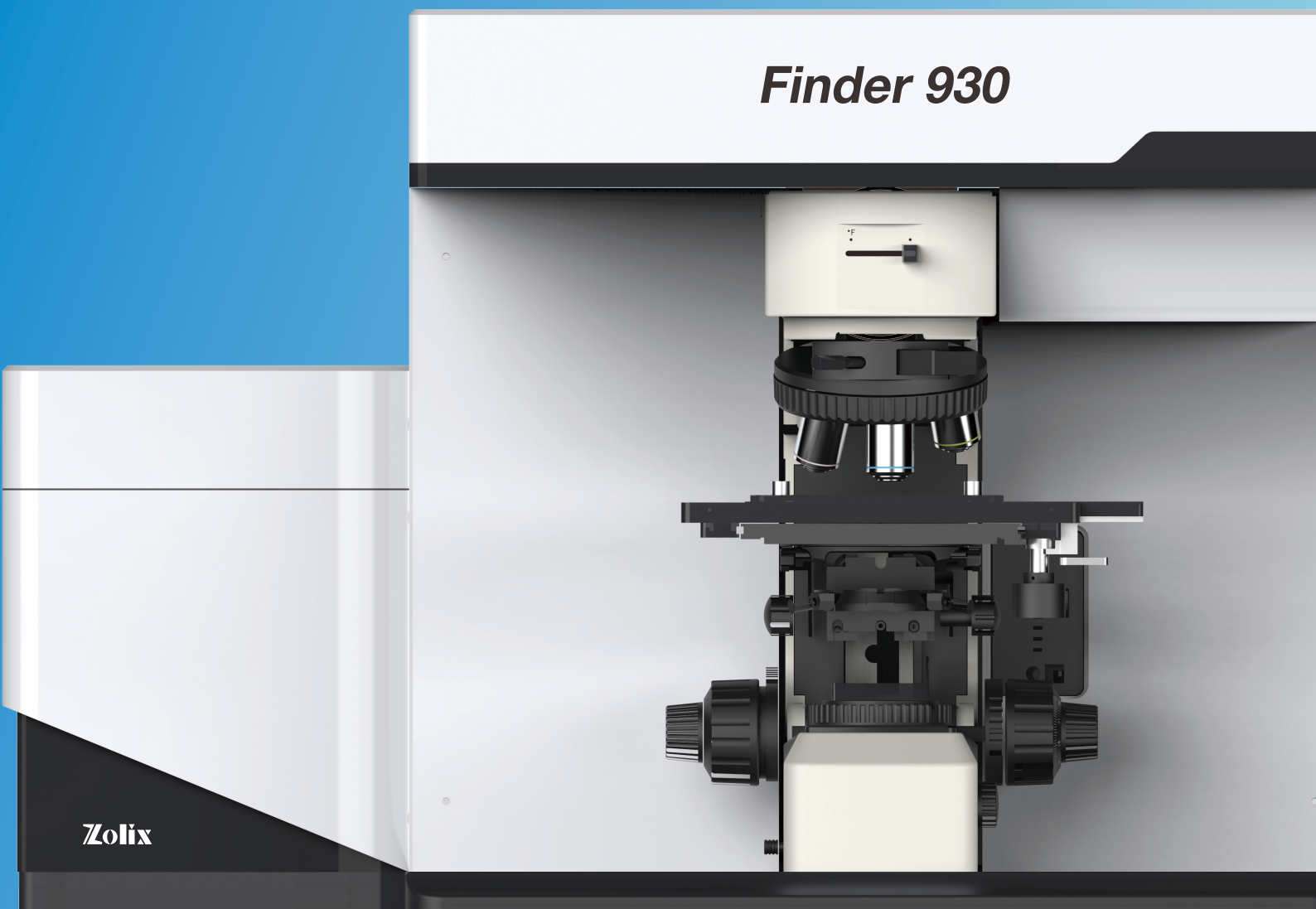
Zolix

Finder 930 series

Fully Automatic Raman Spectroscopy Analysis System

Zolix Instruments Co., Ltd.

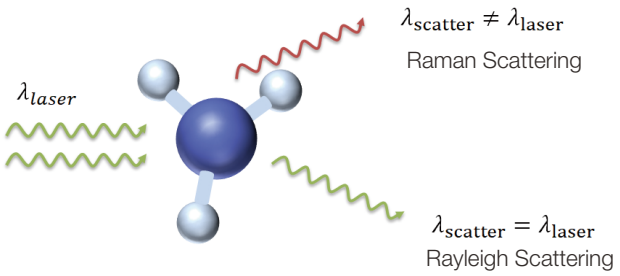


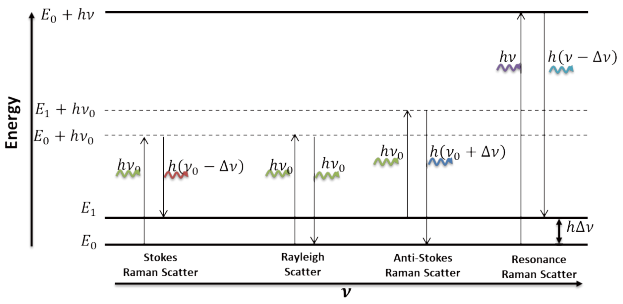
Raman Spectroscopy

Principle

Raman Spectroscopy is a scattering technique which analyzes the scattered light of different wavelength than the incident light to obtain the molecule structure of the analyte. When a incident laser light illuminate the sample, light collide material molecules and scatter. Most of the scattered light features the same wavelength with the incident light, only a very small amount scattered light(typically 0.0000001%) at different wavelengths with incident light, which is inelastic scatter called Raman scatter. The scattered light frequency less than incident light is called Stokes scattering, the scattered light frequency bigger than incident light is called Anti-Stokes scattering, they are symmetrically distributed on both sides of the Rayleigh scattering.

The frequency difference Δv between the incident light and scattered light is called the Raman shift. Raman shift has no relationship with the incident light frequency, determined by the energy level structure of the material molecule, and different chemical bonds correspond one-to-one with the Raman shift, so the Raman spectrum is also considered to be the “fingerprint” of the material.



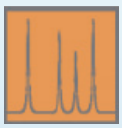
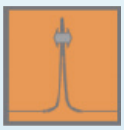
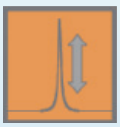


Advantage of the Raman spectrum

- Molecule “Fingerprint”, identify the molecule structure and characteristic of the analyte
- Non-destructive testing without sample marking
- Simple sample preparation and measurement of samples containing water
- Small amount of sample, detection spot less than 1 micron
- High spatial resolution
- High temperature and high pressure testing

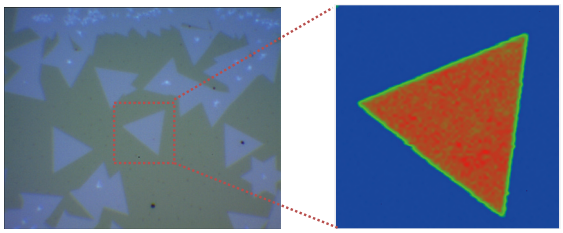
Raman Spectroscopy Analytical Method

The intensity, frequency shift, line width, number of characteristic peak, and depolarization of Raman spectra are closely related to the vibrational energy state, rotational energy state, and symmetry of the molecule.

Characteristic Raman shift, fingerprint peak	Changes in Raman peak position	Polarization characteristics of Raman peak positions	Raman peak broadening	The intensity of the Raman peak
				
Material composition, Material identification	Material is under tension or pressure	Crystal symmetry and orientation	Crystal quality and crystal defects	Amount or layers of material
Such as the identification of GaAs and InP	Such as stress on silicon wafers in semiconductor manufacturing	Such as the orientation of diamond prepared by CVD	Such as whether the GaN substrate has defects and dislocations	Such as the intensities changes of the 2D peaks of monolayer and multilayer graphene

Sample Mapping Result

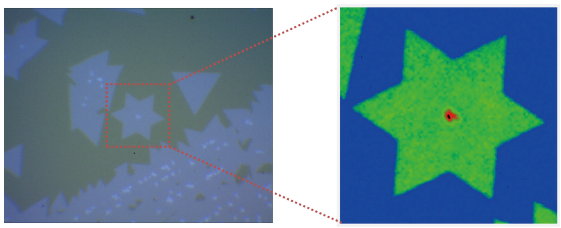
Sample: triangular MoS_2 nanosheets



Measurement condition:

- Excitation light source: 532nm;
- Step size: 0.2μm;
- Microscope objective: 100X darkfield objective;

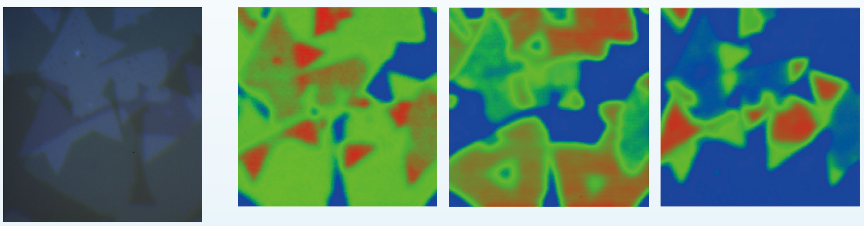
Sample: hexagonal MoS2 nanosheets



Measurement condition:

- Excitation light source: 532nm,
- Step size: 0.2μm,
- Microscope objective: 100X darkfield objective

Correlation imaging

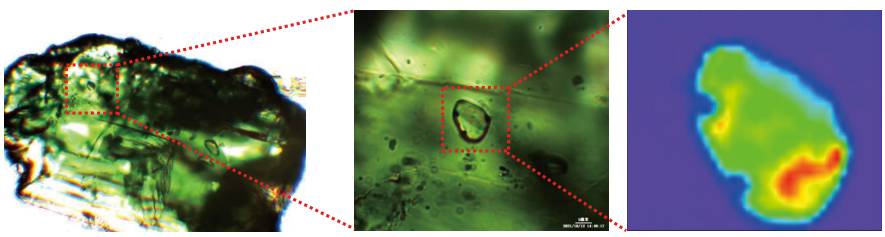


Peak1 Peak2 Peak3

Measurement condition

- Sample: Heterojunction samples
- Excitation light source: 532 nm
- Step size: 0.2μm
- Test area: 32 × 32 μm
- Microscope objective: 100X darkfield objective

Sample: Rock Inclusions



Measurement condition

- Excitation light source: 532 nm
- Microscope objective: 50X darkfield long focal length objective
- Step size: 0.5μm
- Scan area: 18 × 18 μm
- Integrating time: 1s

Product Overview

Since entering the field of Raman spectroscopy in 2003, Zolix has continued to accumulate technical strength, and continuously updated Raman products. The products have been widely used in materials, geology, biology, chemistry, medicine, food, investigate and other fields. After long-term discussions with customers in different industries, we have launched a new generation of Raman system: Finder 930, which aims to create a high-end laser confocal Raman spectrometer with high performance, high stability and high cost performance. Based on the successful experience of previous generations of products, Finder 930 has been fully upgraded in hardware and software:

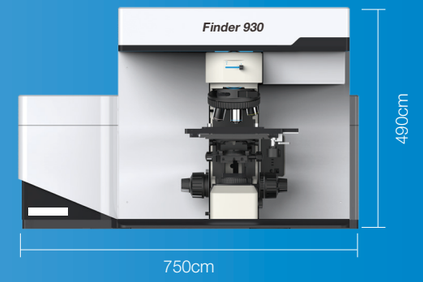
- Using a new generation of image calibration spectrometer, the imaging quality is better, and the wavelength repeatability and accuracy are higher, making your experiment data more reliable.
- The high-precision automatic electric control system intelligently controls laser switching, laser power, confocal pinhole size, and automatic optical path correction not only makes the equipment more intelligent and easier to operate, but also greatly improve the stability, plug and play, and maintenance free.
- The new system software features fluorescence Mapping, Raman Mapping, fluorescence lifetime imaging, hyperspectral data processing, easy to use, making your data analysis more convenient and fast.
- The newly launched Finder 930 is a general analytical instrument with high performance, high reliability and high intelligence, and is a good helper for scientific research.

1 Micro-Excitation Configuration:
Multi-lasers with switched by software (three lasers can be installed internal of the system, one laser can be installed external and reserve laser interface);

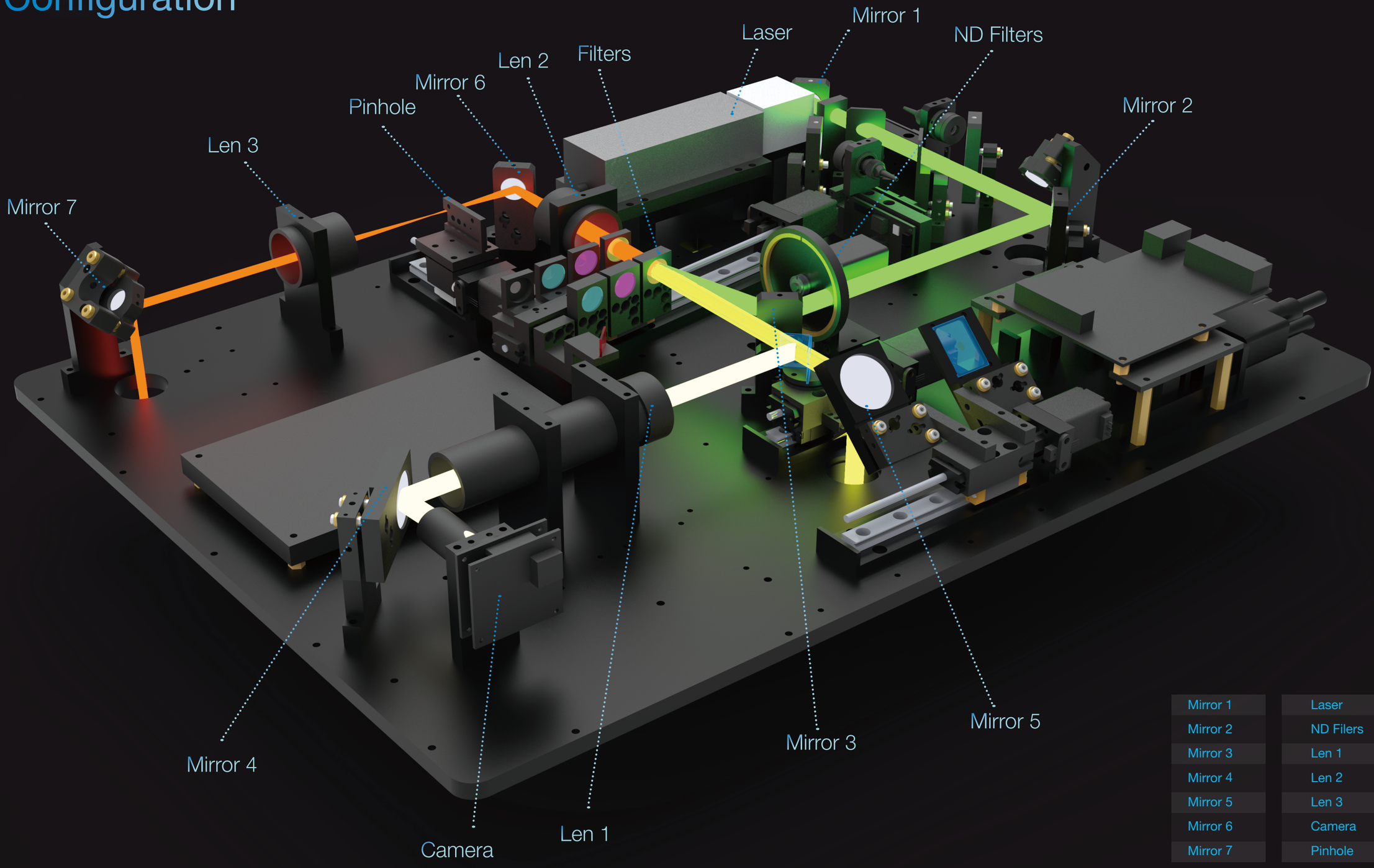
2 Raman Microscope:
Upright microscope (Standard epi-illumination bright and dark field illumination, other illumination methods can be upgraded);

3 Motorized Sample Stage:
75x50mm travel and 1um position accuracy;

4 Spectrograph:
Focal length 320mm imaging spectrometer with F/4.2, stray light $1x10^{-5}$.



Configuration

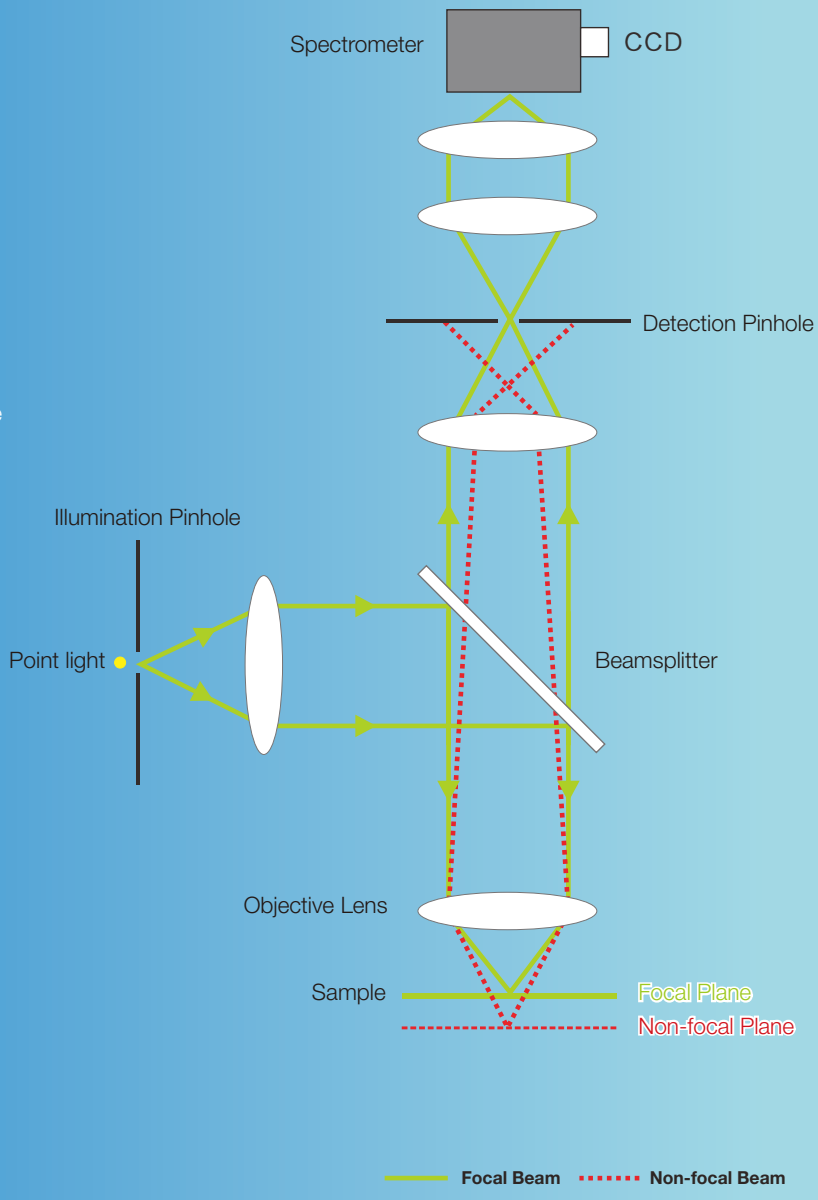


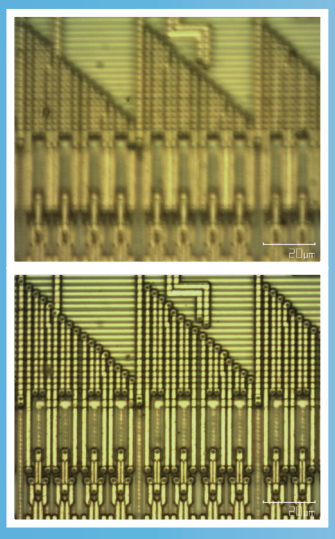
Mirror 1	Laser
Mirror 2	ND Filers
Mirror 3	Len 1
Mirror 4	Len 2
Mirror 5	Len 3
Mirror 6	Camera
Mirror 7	Pinhole

System Characteristic

High Confocal Performance

When a point light source (usually a laser) is focused on the sample through the objective lens, the image formed by this point is detected by the detector through the detection pinhole. At this time, the illumination pinhole and the detection pinhole are conjugate with respect to the focal plane of the objective lens. , which is confocal. In confocal microscopy, only the scattered light signal of the illuminated sample will be accepted, which ensures lateral spatial resolution; while the signal of the sample located in the illuminated area of the light source but not on the focal plane will be defocused due to defocusing. The probed pinhole (spatial filter) is strongly attenuated, which also ensures longitudinal spatial resolution. Therefore, when we move the sample up and down along the direction of incidence of the laser, we can focus the laser on different layers of the sample to achieve section analysis of the sample. Another advantage of confocals is that they have better background suppression for transparent, translucent samples, or samples with strong fluorescence and blackbody radiation backgrounds.





(A)

(B)

In widefield imaging (A), out-of-focus light can significantly reduce image resolution and contrast; however, in confocal imaging systems (B), pinholes are used to remove defocused light, resulting in higher contrast and resolution Image.

High system stability

The confocal Raman system has high requirements on the stability of the light spot, and the drift of the light spot will seriously affect the performance of the system. Therefore, ensuring the stability of the system is the primary issue.

1.The effect of temperature and humidity on stability

The temperature and humidity will deform the optical mount and cause the spot to drift, the longer the optical path, the greater the drift. In order to solve this problem, Finder 930 adopts the built-in laser, which minimizes the optical path, and at the same time uses the aviation aluminum optical mount that is minimally deformed by temperature and humidity.

2.The effect of optical path switching on stability

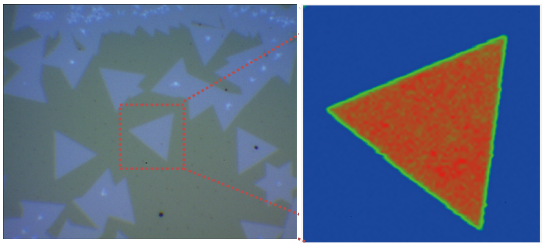
For a multi-channel laser system, there are high requirements for positioning accuracy and repeatability, normally a motorized stage is used to switch the laser light path. Finder 930 cleverly combines multiple lasers through dichroic mirrors without motorized stage. When replacing lasers, only the lasers need to be switched on and off, avoiding the effect of the motorized stage on the optical path of the system.

Excellent Spectrum Imaging Capabilities

Raman Mapping can intuitively reflect the molecular properties of substances with high spatial resolution and fast imaging speed.

1.Spatial Resolution:

Lateral （XY）and Longitudinal（Z）; Lateral resolution can be affected by objective NA, laser wavelength, pinhole size and laser beam quality; Longitudinal resolution is the confocal performance we are talking about. In addition to the above factors, it also has a great relationship with the optimal design of the system.This Raman System Finder930: Lateral resolution will be 0.5um and Longitudinal resolution 1.79um when 532nm laser with 100X, 0.9NA objective;



2.Mapping Imaging Speed

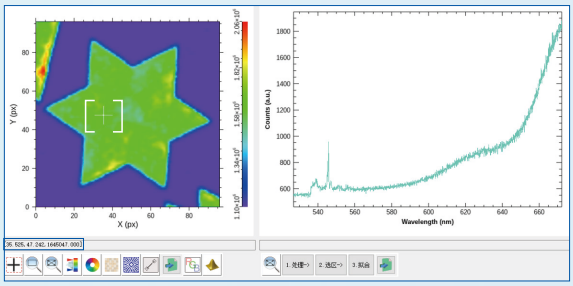
Mapping imaging speed is very important parameter which mainly depends on system sensitivity, motorized accuracy and software processing. The sensitivity will be higher enough, the acquisition time of single spectrum will be shorter, and the mapping speed can be improved; High precision motorized stage will prevent image distortion; The software mapping logic will improve mapping speed with the synchronization function and software real-time processing such as noise suppression and background subtraction can extract Raman spectra from weak signals and complex signals for real-time display.

Software Analysis

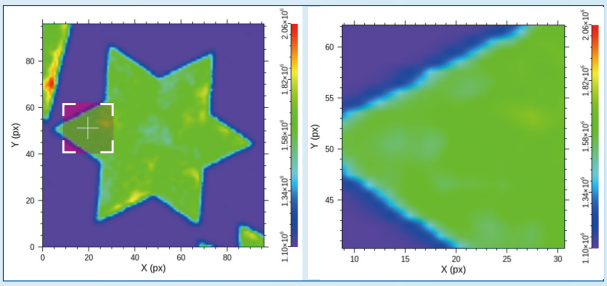
With powerful data analysis software, the Mapping data can be pre-processed such as de-baseline and smoothing, and then can be imaged through the integration, average, and maximum values of signal intensity according to requirements; in addition, single-peak and multi-peak Perform data fitting. For the output image, beautification processing such as color table matching can be performed.

Browsing Data

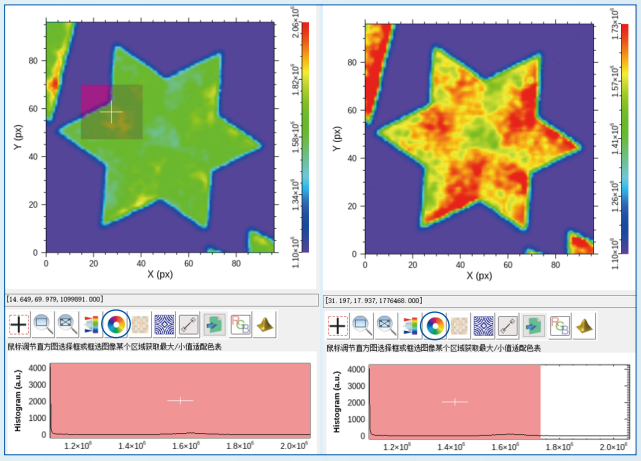
Browsing data and View single-point data information, display spectral curves at different positions; zoom in on local images;



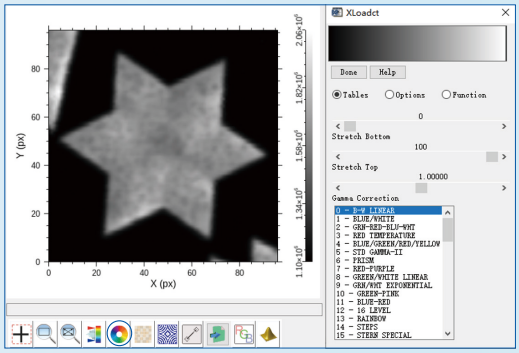
Drag the mouse to enlarge the image



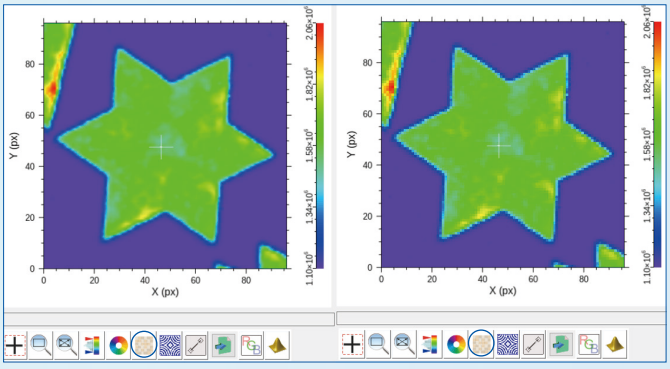
Support changing image color contrast



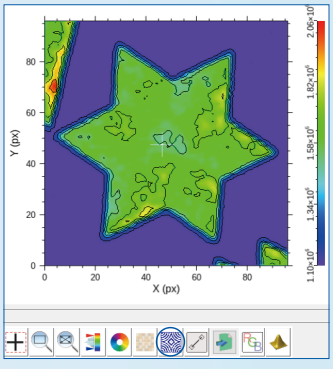
Color Table



Difference Display



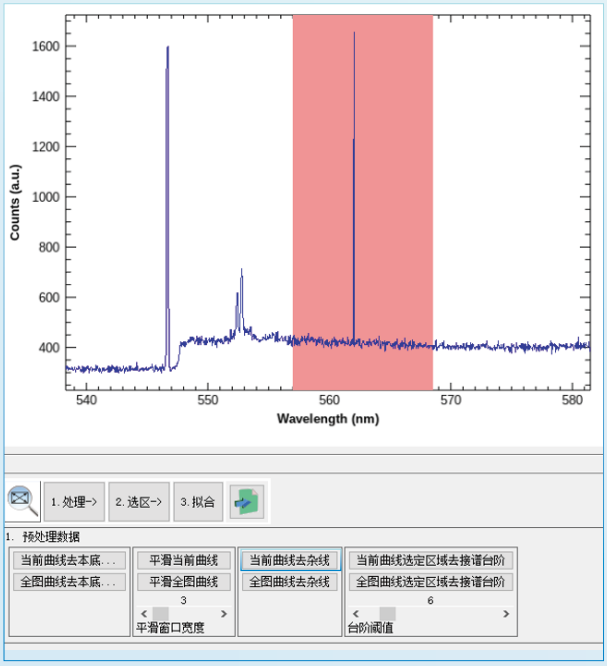
Contour display

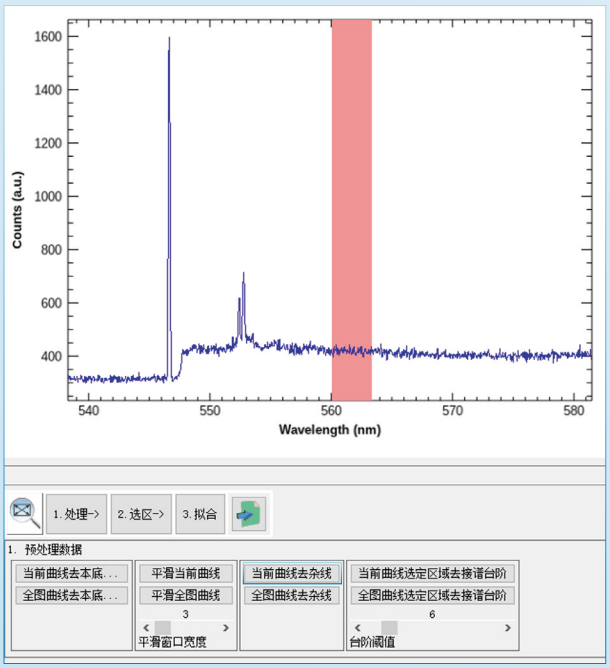


Mapping data processing

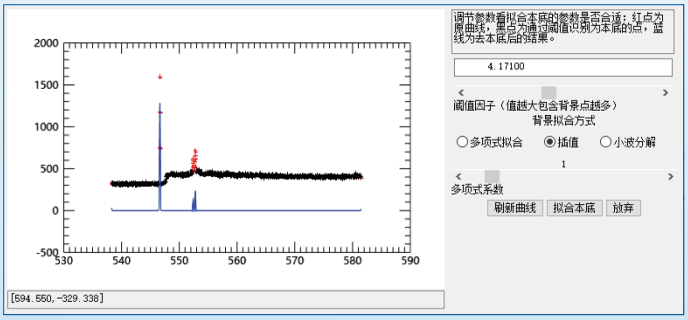
Single point (full image) data can be preprocessed, including removing "cosmic rays", spectral bases, smoothing spectral curves, etc.;

Remove "Cosmic Rays"

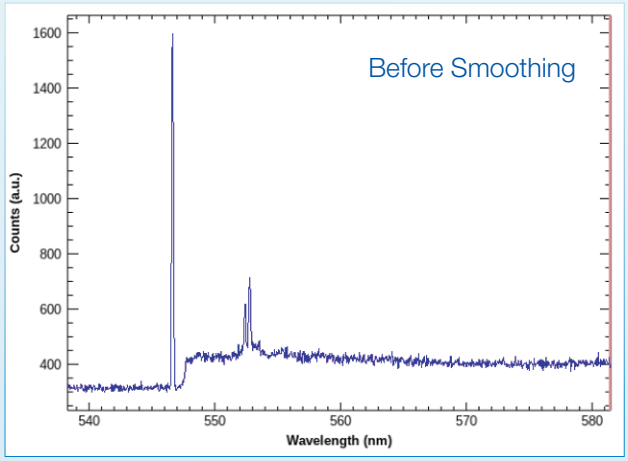


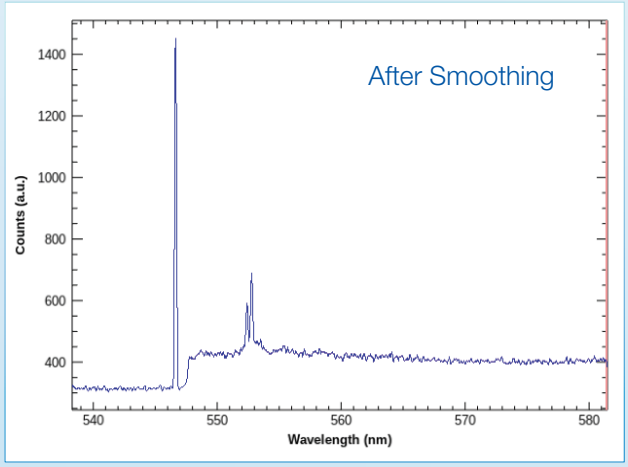


Remove Background Noise



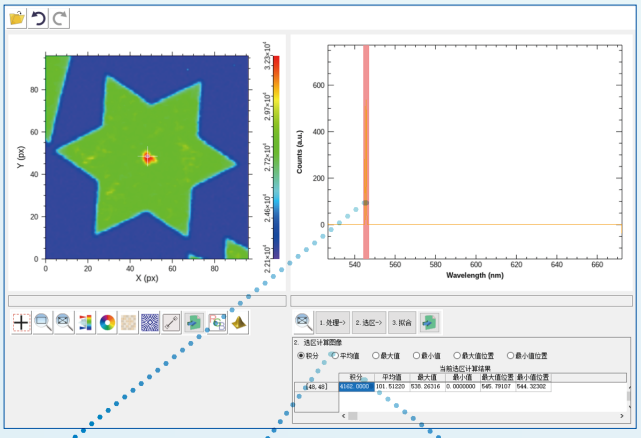
Spectrum Smoothing





Spectral data fitted image display

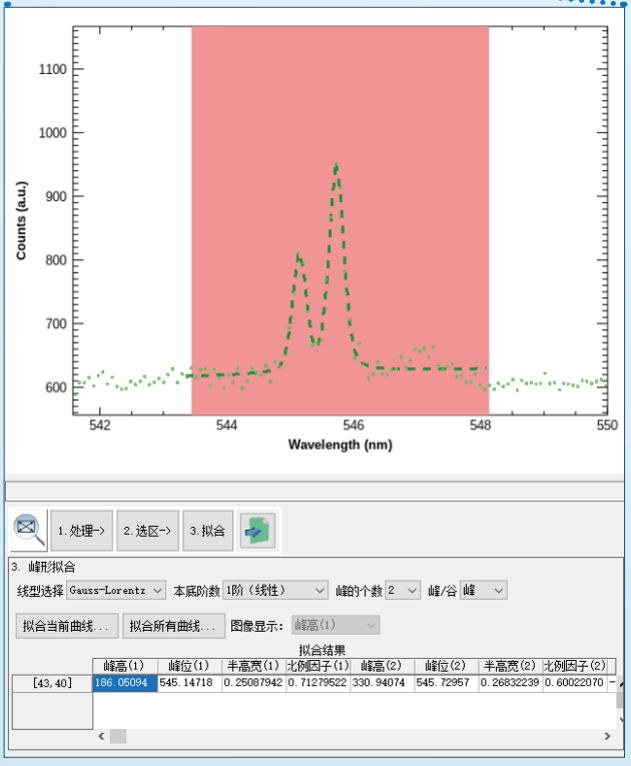
After the preprocessing is completed, the spectrum of each point can be processed by the methods of integral value, average value, maximum value, minimum value, maximum value position, and minimum value position to obtain an image.



The frame is used to select a segment of the spectrum

Choose different ways to form the left image

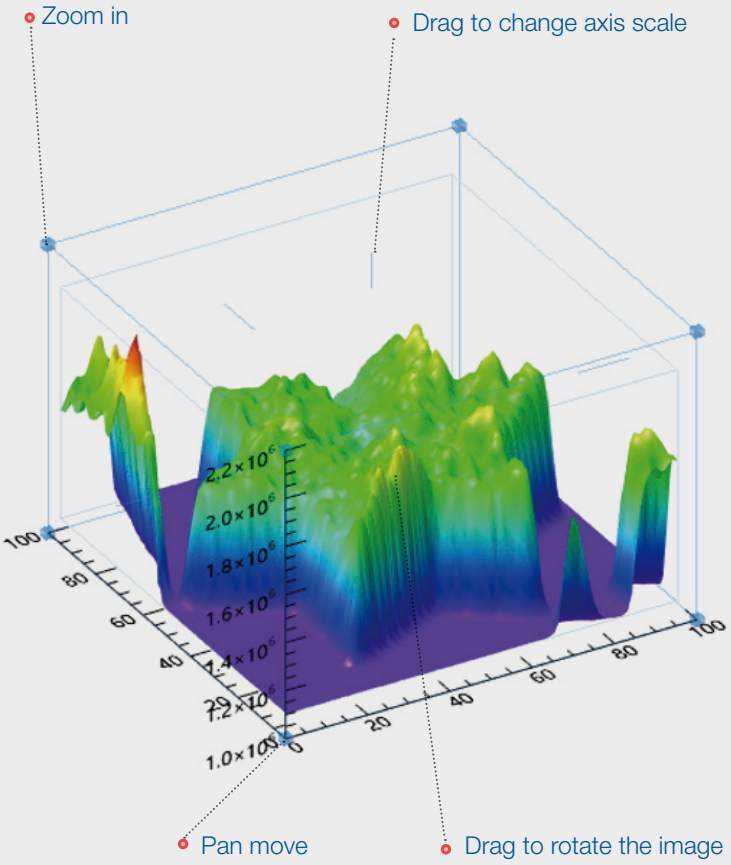
The table display the information of the selected spectrum



The single-point spectral data can be fitted in different ways to obtain peak position, half-height width and peak height information, and can be used for image display.

3D image display

3D image can be rotated, translated etc.



Accessories

Objective lens

Options

SLMPLN20X: Long working distance objective lens, NA 0.25, working distance 25mm, thread RMS;

SLMPLN50X: Long working distance objective lens, NA 0.35, working distance 18mm, thread RMS;

SLMPLN100X: Long working distance objective lens, NA 0.6, working distance 7.6mm, thread RMS;

LMU-15X-NUV: UV objective lens, spectral range 325-500nm, NA 0.3, working distance 8.6mm, thread RMS;

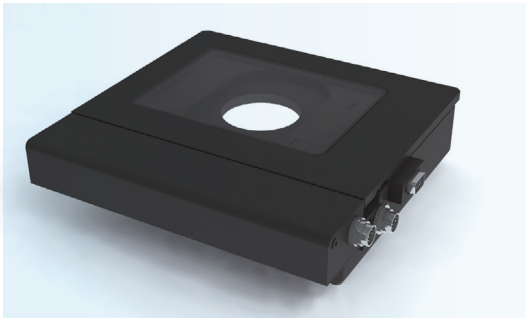
LMU-40X-NUV: UV objective lens, spectral range 325-500nm, NA 0.47, working distance 0.8mm, thread RMS;

LMPLN10XIR: Infrared objective lens, spectral range 700-1300 nm, NA 0.3, working distance 18mm, thread RMS;

LCPLN50XIR: Infrared objective lens, spectral range 700-1300 nm, NA 0.65, working distance 4.5mm, thread RMS;

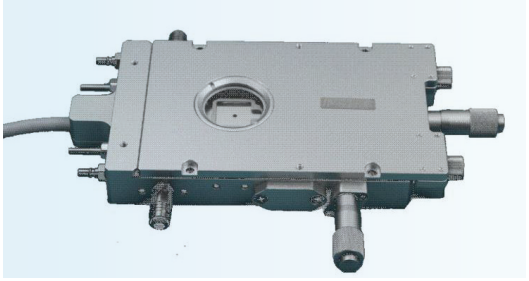
LCPLN100XIR: Infrared objective lens, spectral range 700-1300 nm, NA 0.85, working distance 1.2mm, thread RMS;

Motorized Stage



- Motorized stage, travel range 70 × 50 mm, handle control;
- 1μm positioning accuracy, minimum step 50 nm;
- 2D Raman/PL Mapping
- Weight capacity 1kg

Cryostat



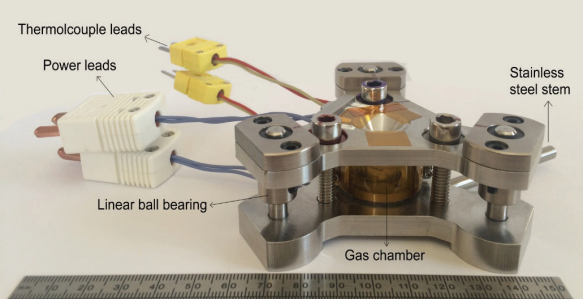
- Temperature range: -190℃ ~ 600℃ ;
- Temperature resolution: 0.01℃ ;
- Temperature stability: ±0.05℃ (> 25℃)±0.1℃ (< 25℃);
- Maximum heating speed: + 150℃ /min;
- Maximum cooling speed: - 50℃ /min;
- Minimum objective lens distance: 5 mm;

Electrochemical accessories

Features:

- Raman, IR compatible
- Gas available
- Windows are optional
- Minimum focal length 1 mm

High pressure



- Temperature range: Room temperature to 1000℃
- Temperature accuracy: +/- 0.1℃
- Heating speed: 0.1 to 150℃ /min
- Pressure range: Atmospheric pressure to 3GPa;
- Low temperature range: -100℃

In situ stretching device

It is a test device that stretching sample for infrared, ultraviolet and fluorescence research.

- Stretch adjustment range: 0.1-20 mm;
- Tension adjustment range: 1-100N, accuracy is about ±0.3% of full scale;
- Other tension ranges available.

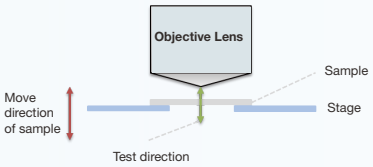
On-site verification

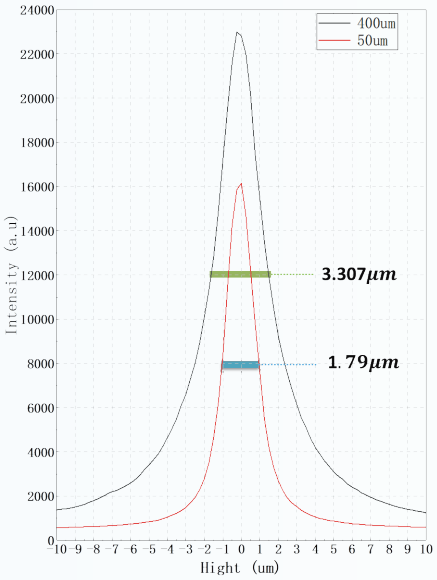
1 Spatial resolution

Longitudinal Resolution

Test configuration:

- Sample: Silicon Wafer
- Step size: 0.25μm
- Integral time: 0.3s
- Laser: 532nm
- Grating: 600g/mm@500nm
- Objective: 100X dark-field objective
- Slit: 100μm
- Pinhole: 50μm&400μm
- Resolution: 1.79um @ pinhole 50um;

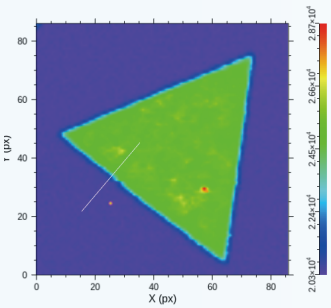


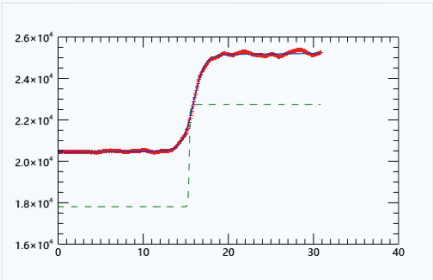


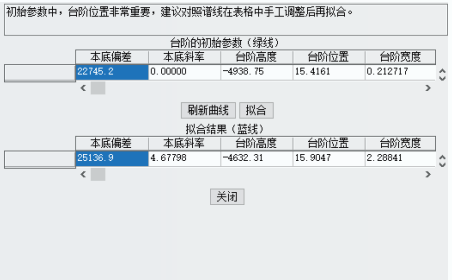
Lateral Resolution

Test configuration:

- Sample: Monolayer Molybdenum Disulfide
- Step size: 0.2μm
- Integral time: 0.5s
- Laser: 532nm
- Grating: 600g/mm@500nm
- Objective: 100X dark-field objective
- Slit: 100μm
- Pinhole: 50μm
- Resolution: A straight line is taken along the vertical direction at the edge of the Mapping image, and the lateral resolution of the instrument can be obtained by fitting this curve. After fitting the experimental data, the lateral resolution is ~458 nm.



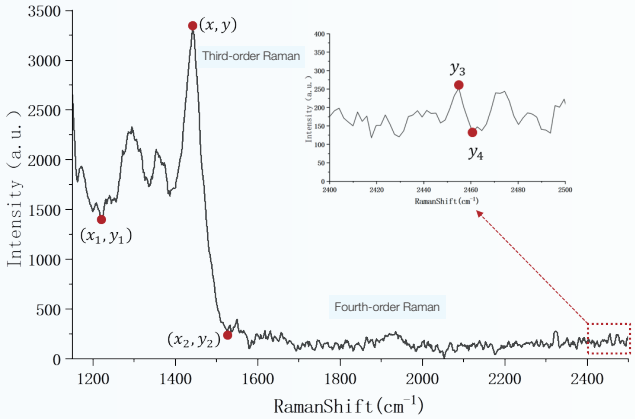




2 S/N (Signal of Noise)

Test configuration:

- Sample: Silicon wafer
- Integral time: 300s, Accumulate points once
- Laser: 532nm
- Grating: 600g/mm@500nm
- Objective: 100X dark-field objective
- Slit: 100μm
- Spectrum range: 1100-2500cm^{-1}
- Test result: Test silicon third order and four-order raman at pinhole 50um, the S/N of third order raman is 35:1;



3 Spectral Resolution

Test configuration:

Light source: Neon @585.25nm

Grating: 1800g/mm@500nm

Objective: 100X dark-field objective

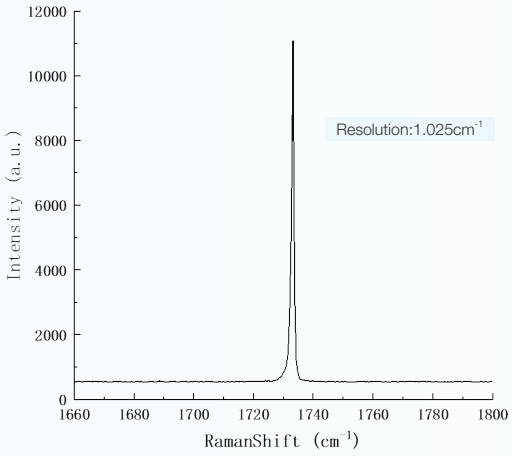
Slit: 10μm

Pinhole: 50μm

Spectrograph focal length: 320mm

Test result: 1.025cm^{-1}

Spectrum resolution（FWHM）：≤ 1.5cm^{-1}，Typical；2cm^{-1} guarantee



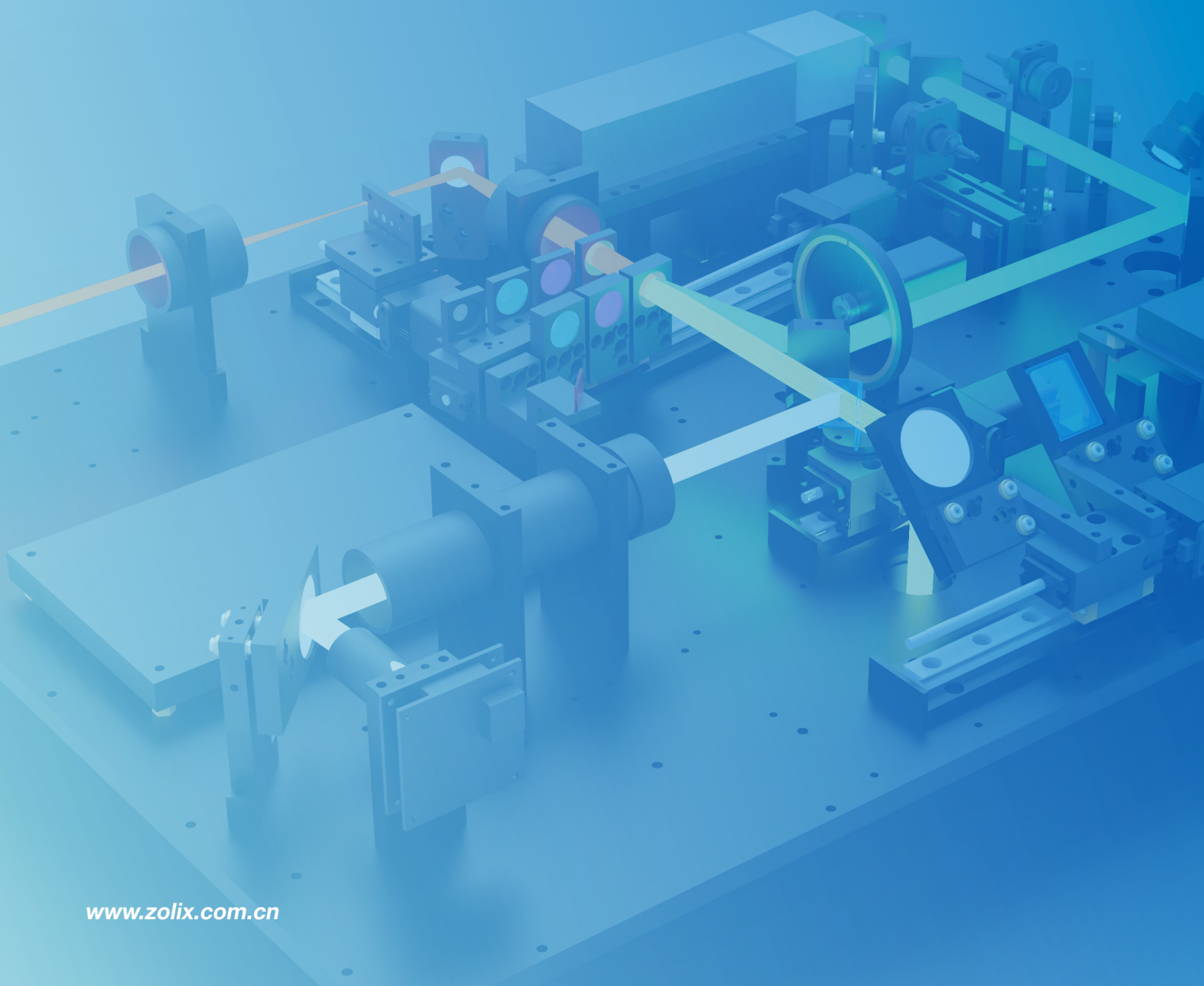
System Technical Information

Laser wavelength(nm)	Standard 532nm，optional 638nm、785nm
Laser power(mW)	>60（532nm）,>25（638nm）,>50（785nm）
Raman shift(cm^{-1})	80-9000@532nm, 80-6000@638nm, 80-3200@785nm
Microscopy	Upright
Sample holder	Standard: manual with travel 102*105mm
	Optional: motorized with travel 75*50mm
Objective	10x，50x(telephoto)，100x，(all are semi-apochromatic)
Epi-illumination	halogen lamp
Spectrograph	320 mm focal length，Czerny-Turner
CCD	2000x256 pixel, QE>90%，VIS to NIR
Grating	1800g/500nm blazed
	600g/500nm blazed
	150g/500nm blazed
Spectral resolution	< $1.5cm^{-1}$
S/N	> 30:1
Spatial (pinhole 50μm，532nm laser)	Longitudinal resolution: < 2μm
	Lateral resolution: < 500nm

Zolix

Zolix Instruments Co.,Ltd.

Address: No.68B LDUV, Tongzhou District, Beijing, China 101102
Tel: +86 10 56370168
Fax: +86 10 56370118
Email : info@zolix.com.cn



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