

**RAMAN  
MICROSCOPE**

**MantaRay** 



# Why MantaRay?

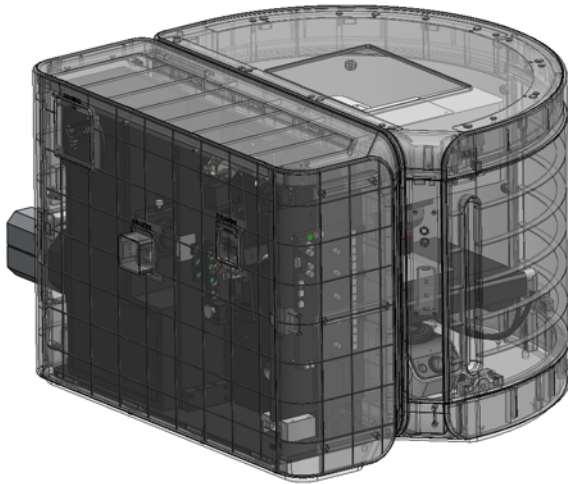
**MantaRay** minimizes accuracy distortion by aberration-compensated spectral design. The built-in calibration standard lamp and automatic calibration algorithm (patented) ensure the initial measurement settings are preserved.

High reproducibility of measurement results are secured by dual-head rotary encoders with less than 0.003 degrees of error, easily replaceable gratings, built-in silicon sample and guide beam.

The path of laser is optimized for the shortest distance which directly influences sustainability and reliability. For simpler management, maintenance, and increasing mechanical stability minimized design was applied.



# Measurement stability



A sample measuring microscope is enclosed in a case to ensure laser safety and prevent interference with ambient light. Laser is constantly monitored with an optical camera and the measuring position is managed with sub-micrometer accuracy by a specially designed electronic control unit.

The sample measurement and spectrometry detector are completely separated for simpler maintenance and scalability.

The design of MantaRay allows simple replacement of consumables (neon lamps, gratings, polarizers) and easy adjustment of the laser alignment.

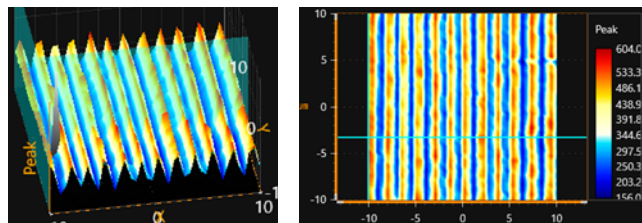
# High sensitivity, Spatial Resolution

## ▪ Sensitivity Data

The quarter spectral signal of silicon is a representative way to describe the sensitivity of a Raman spectroscopy system, and the signal above was measured with a standard-grade spectroscopic CCD instrument.



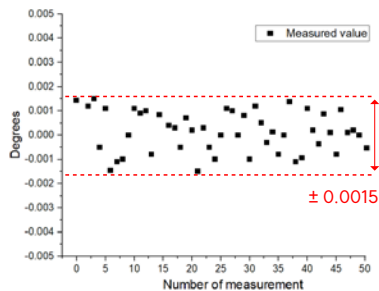
## ▪ Spatial resolution Data



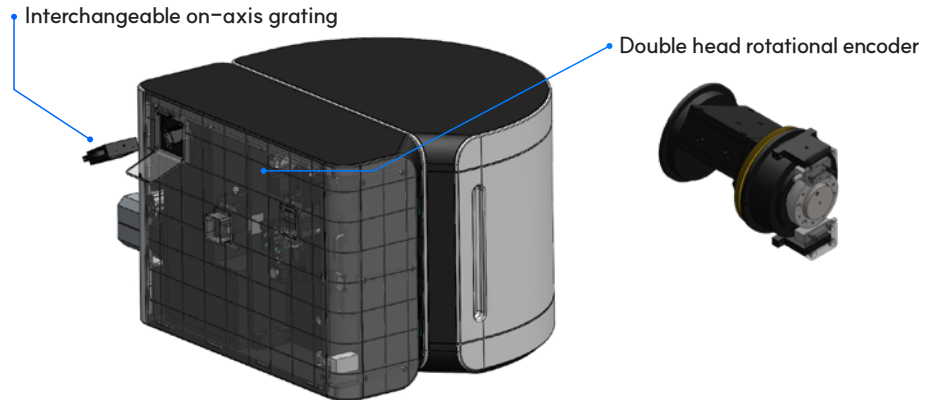
Mapping image of optical grating  
(600gr/mm) ( 40 x 40 pixel, 0.5 um step)

# Measurement Repeatability

WEVE Raman spectrometer is equipped with interchangeable gratings that can be easily replaced by the user. Precise control of the grating rotation angle is required to achieve accurate measurement and reproducibility. The internal guide beam and double head rotational encoder provide excellent measurement reproducibility and accuracy compared to conventional Raman spectrometers.



Encoder RMS error over 50 times =  $\pm 0.0015$  degrees. Rotation accuracy of the grating measured over 50 repeated measurements.



# Spectral Repeatability



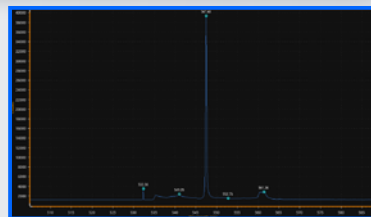
MantaRay synchronizes with an integrated guide beam to maintain the accuracy of grating rotation and ensures long-term measurement reproducibility regardless of gratings being replaced or added.

CCD pixel RMS error < 0.5 pixel  
Repeated measurement results for center (A) and left (B) right(C) of the CCD

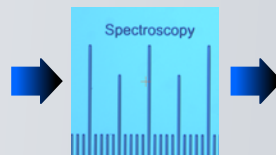
\* X : 520.73 / counts : 35840, X : 520.06 / counts : 39373,  
X : 520.06 / counts : 35387

## Built-in standard sample

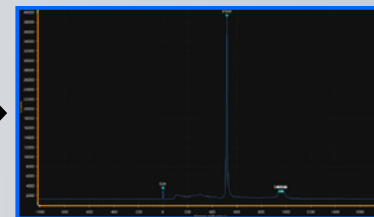
Easy grating replacement and measurement reproducibility with internal guide beam and built-in silicon sample



Silicon 1st (nm)



Rayleigh calibration by built in standard(automatic)

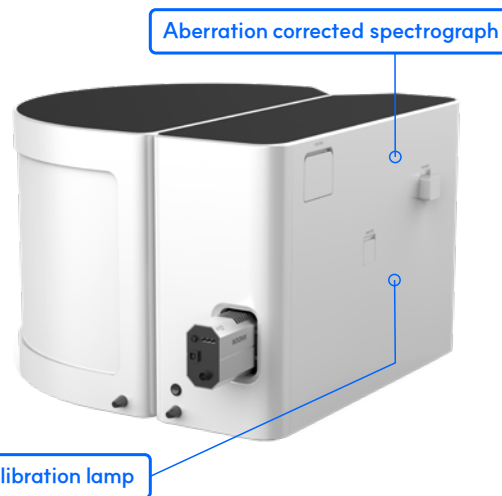


Silicon 1st (cm<sup>-1</sup>)

# Measurement Accuracy

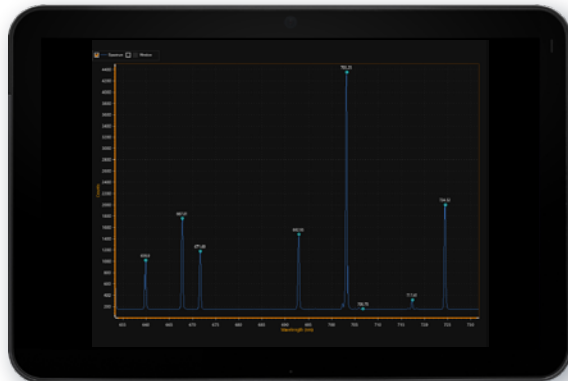
The aberration-corrected spectrometer and high-speed auto-calibration technology enable improved measurement efficiency and superior measurement accuracy by overcoming optical and mechanical limitations of conventional Raman spectrometers. Built-in Neon calibration lamp allows the system to keep the settings without additional calibrations using automatic proprietary calibration algorithm of WEVE.

- Spectral accuracy is the most important factor in spectroscopic measurement, especially in Raman measurements, where an error of just one pixel can prevent accurate analysis.
- Traditional techniques may require regular calibration by specially trained technicians to maintain accuracy.
- WEVE's **EverCal** technology provides an inherently higher calibration than traditional calibration methods. In addition, it uses a built-in neon gas lamp to automatically calibrate itself every day without user intervention, maintaining sub-pixel measurement accuracy across the entire area of the CCD



## Neon calibration lamp DATA

1200gr/mm Grating  
 0.08nm/pixel resolution  
 RMS error over 10 spectral lines = 0.0195nm



| 600gr    | 585.249 | 607.434 | 621.728 | 659.895 | 692.947 | 724.517 |
|----------|---------|---------|---------|---------|---------|---------|
| Maesured | 585.23  | 607.42  | 621.72  | 659.9   | 692.96  | 724.53  |
| Error    | -0.019  | -0.014  | -0.008  | 0.005   | 0.013   | 0.013   |
| 1200gr   | 659.895 | 667.828 | 671.704 | 692.947 | 703.241 | 724.517 |
| Maesured | 659.89  | 667.82  | 671.71  | 692.94  | 703.25  | 724.52  |
| Error    | -0.005  | -0.008  | 0.006   | -0.007  | 0.009   | 0.003   |
| 1800gr   | 603     | 614.306 | 621.728 | 633.443 | 638.299 | 640.225 |
| Maesured | 603     | 614.31  | 621.73  | 633.44  | 638.3   | 640.23  |
| Error    | 0       | 0.004   | 0.002   | -0.003  | 0.001   | 0.005   |

# Application

MantaRay can be used in various research fields such as environment, energy, materials engineering, biomedicine, sensor development, photocatalysis, solar cell development, plasmonic microparticle development, LED inspection, microplastics, carbon dioxide capture & utilization, etc.

## Sensing

- Biosensor (SERS)
- Plasmonic biosensor(nano architecture based)
- Polymer– nanomaterial compound
- Micro plastic

## Battery & energy

- Organic electrode
- Metal oxide
- Carbon material(graphite)
- Electrolytes (solid, aqueous)
- Polymers / ceramics, metal–alloys
- Solar cell/Photoelectrochemical cell
- Energy storage – carbon capture & utilization

## Display

- Graphene, 2D nanomaterial, epi thin film– Micro LED & Nano LED
- Quantum dot / OLED, QLED, PeLED

## Catalysis

- Electrocatalysis /metal compound NPs : Chlor–Alkali industry)
- petroleum refinery)
- Battery
- Plastic recycling
- Photocatalyst – Fuel cell

## Semiconductor

- SemiconductorSemiconductor Devices (Low–Dimensional, Compound Semiconductors)
- MoS<sub>2</sub>, WS<sub>2</sub>, MoTe<sub>2</sub>, WTe<sub>2</sub>, MoSe<sub>2</sub> / III–V compounds

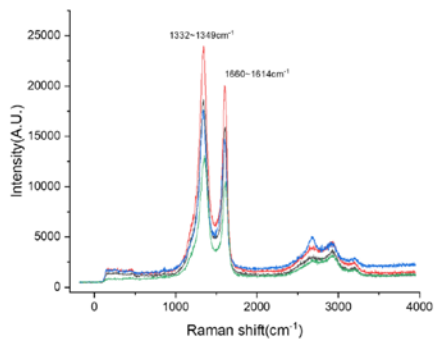
## Carbon materials

- Graphene & graphite film – Transparent electrodes/Batteries/Catalysts/Semiconductor devices, Transistors

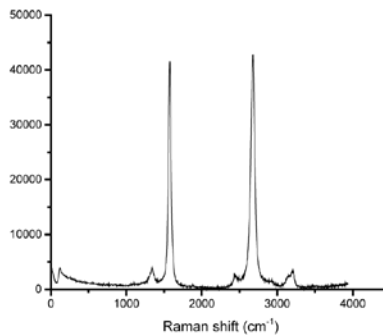
## ▪ Application spectrum

### Carbon material

Activated charcoal

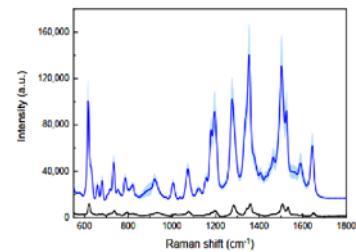


CNT fiber



### SERS effect

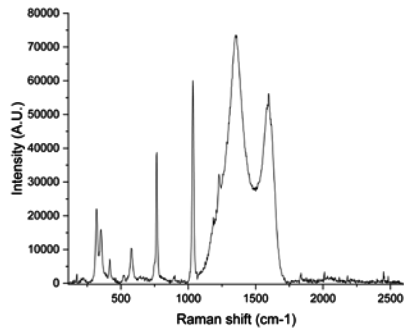
Rh B on si based(black) vs AuNP / Si(blue)



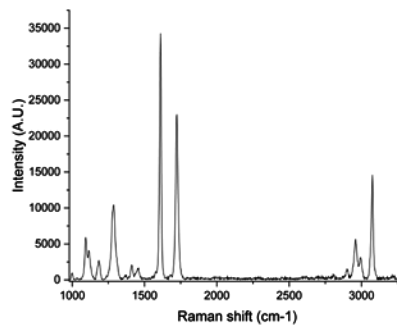
## ▪ Application spectrum

### Battery, Plastic

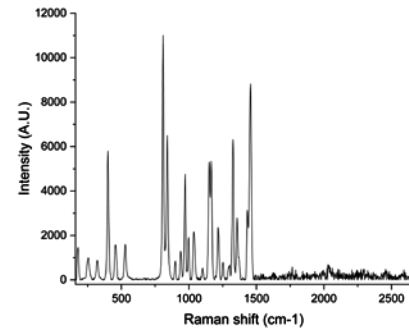
In-situ raman monitoring of Metal ion battery



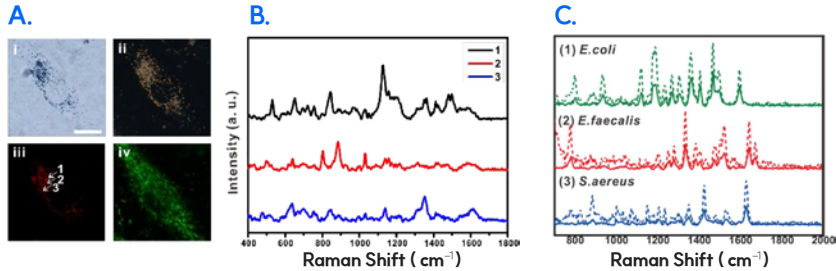
PET (Poly Ethylene Terephthalate)



PP (Poly Propylene)

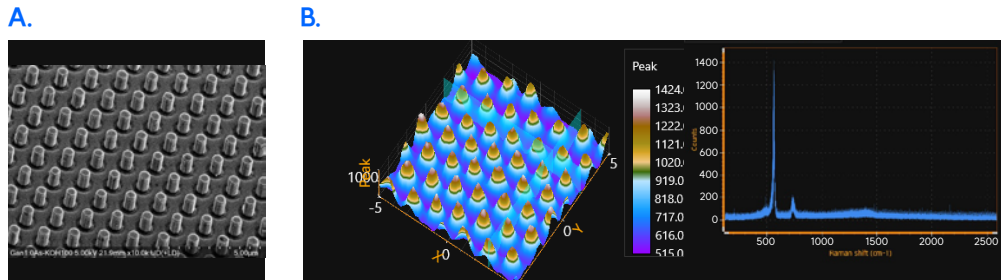


## Skin, Cell and tissue



- A.** Bright, Dark field, Raman mapping and fluorescence images
- B.** Raman spectra from inside cells
- C.** Raman spectra of Bacteria DNA

## Display and LED



- A.** SEM image of Nano LED(GaN)
- B.** Raman mapping image(L) and Spectrum(R) of Nano LED(GaN)

# System Configuration

## 01 Spectrometer

**Wavelength range** : Optical aberration and distortion free from UV to NIR bands are available.

**Number of gratings** : Implementation of various gratings in UV and NIR bands is possible due built in automatic correction functionality.

## 02 Input light

**Laser wavelength options** : 532, 633, 785(standard), 325, 405, 488nm (On request) (Built in, External, Up to 3)

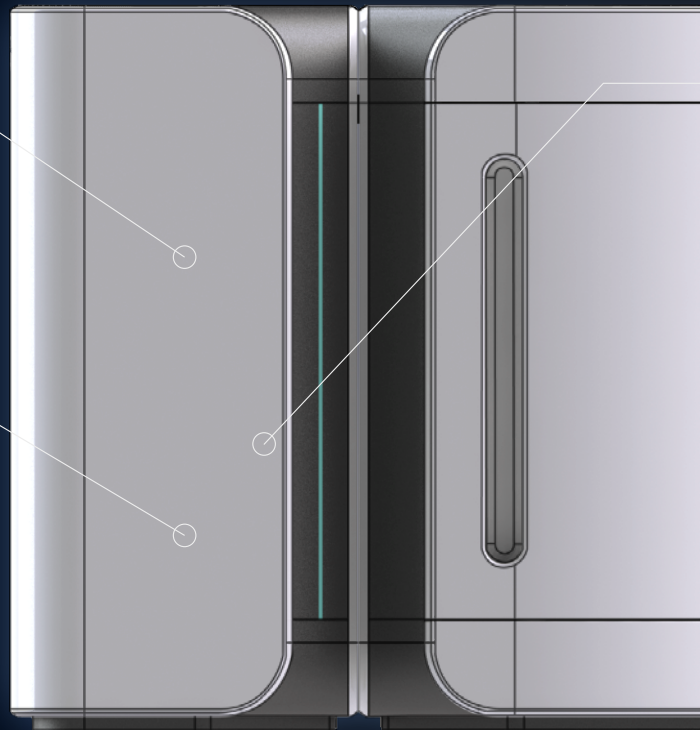
### Accuracy

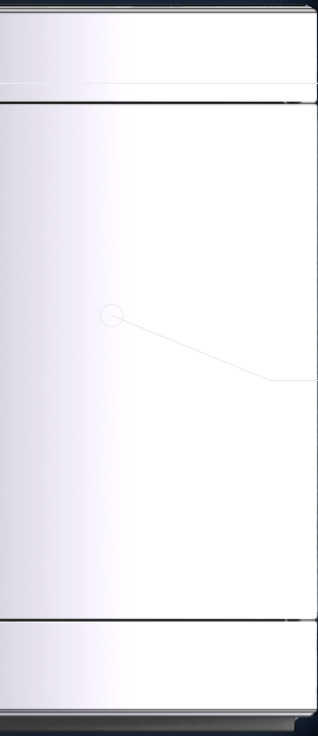
Built-in standard neon lamp and constant automatic calibration thorough position control system, provide the highest level of accuracy and reproducibility to the aberration-corrected spectrometer. ( $\sim 0.04\text{nm}$ )

### Stability

Design is optimized for minimal repositioning of optical components which significantly improves the reliability and lifetime of the equipment.

# FEATURES & SPECIFICATIONS





03

## Main body

**Low wavenumber cut-off** :  $<50 \text{ cm}^{-1}$  :  
depending on laser wavelength

**High wavenumber cut-off** :  $5,000 \text{ cm}^{-1}$

04

## Detector

**Detector size** : 1024 X 256 pixels  
(standard) : other options available

**Detector operating temperature** :  
 $-100 \text{ }^{\circ}\text{C}$  (max)

05

## Optical Microscope

**Axial resolution** :  $<1\mu\text{m}$   
**Lateral resolution** :  $<2\mu\text{m}$

06

## Controls

**Latest Windows OS** : SWs  
(operating, off-line analysis,  
database & identification)



## Convenience

The system is able to diagnose its performance using embedded standard silicon . Detachable design and simplified part exchange allows quick and convenient parts exchange and calibration if needed.



## Scalability

Depending on the application field, image options such as Bright & Dark field, DIC can be added. Various measurement conditions are supported as well (temperature, electricity, pressure, polarization, chemical reactions, Hyper spectral, etc.).

# Detailed Specification

| Category            |                                | Description                                                                                                                                                           |
|---------------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General Performance | Raman Shift Range              | From 50cm <sup>-1</sup> @ Low wave cut-off filter to 4500cm <sup>-1</sup> or higher) 80cm <sup>-1</sup> @ > 50% edge steepness                                        |
|                     | Spectral Resolution            | Average [0.07 nm / CCD pixel @ 1200gr/mm, 650 nm] [~ 1cm <sup>-1</sup> @ 2400gr/mm] [0.2cm <sup>-1</sup> / pixel @ HRS(high resolving) mode]                          |
|                     | Spectral Accuracy              | <0.04nm @2400gr                                                                                                                                                       |
|                     | Designed Spectral Range for PL | 185 ~ 2,400nm ( or higher )                                                                                                                                           |
|                     | Detecting Coverage             | One single continuous acquisition from 50cm <sup>-1</sup> ~ 4000cm <sup>-1</sup> ( or more ) with high resolution ( <1cm <sup>-1</sup> ) without step and stitch work |
|                     | Spatial Resolution             | Around 1 um ( lateral ) / 2 um ( axial ) or better laser spot diameter : smaller than 600 nm @ 532nm, optimized design for 100x objective lens                        |
|                     | Auto Calibration               | Grating, lamp, laser path alignment & wavelength calibration                                                                                                          |
| Input Light         | Wavelength                     | 532, 633, 785 (Standard) 325, 405, 488 (On request) nm Up to 3 lasers ( Built-in, External )                                                                          |
|                     | Output Power ( @aperture )     | 25mW ~ 170 mW                                                                                                                                                         |
|                     | Mode                           | Single longitudinal                                                                                                                                                   |
|                     | Power Stability                | 1~3%                                                                                                                                                                  |
|                     | Spectral Line Width            | 0.001 ~ 0.00001 nm                                                                                                                                                    |



| Category     |                            | Description                                                                                                  |
|--------------|----------------------------|--------------------------------------------------------------------------------------------------------------|
| Spectrograph | Aberration                 | Aberration corrected spectrograph ( minimum astigmatism over 700 nm at 2400gr/mm grating)                    |
|              | Focal length               | 250nm                                                                                                        |
|              | Grating                    | 1200gr/nm as a standard ( on-axis interchangeable unlimited grating turret replacement )                     |
|              | Measurable                 | 200nm to 1050nm by CCD detector                                                                              |
|              | Scan to scan repeatability | better than 0.1cm <sup>-1</sup>                                                                              |
| Detector     | Cooling                    | TE cooled down to - 70°C ( with chiler ) / -100°C ( Water ) -55°C ( Air cooling ) suitable for both Raman PL |
|              | Pixel format               | 1024x256 pixel, sother higher available on request                                                           |
|              | Chip size                  | 26.6x6.6mm ( 26x26microns )                                                                                  |
|              | Spectral range             | 200nm ( or less ) to 1050nm ( or more )                                                                      |
|              | Dark noise                 | 0.0014 e-/pix/sec at min. temperature.                                                                       |
|              | QE                         | >55% ( MAX )                                                                                                 |
|              | Interface                  | USB interface, 220-230VAC single phase                                                                       |
| Application  | Laser illumination         | Raman, PL, Up-conversion                                                                                     |
|              | Microscope image           | White light image, Dark-field, DIC                                                                           |

# Options, Accessories

## Optional

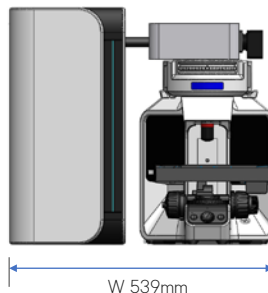
MantaRay  
**Standard** Weight 100 kg



### Material science

- metal oxide, carbon materials, polymer
- In-situ monitoring (catalysts, electrode material)
- Plastics, Metal Nps
- Mineral carbonation(CCU)
- Functional materials

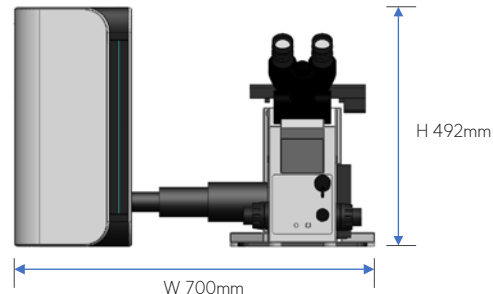
MantaRay  
**Fusion** Weight 90 kg



### Open space

- Electrocatalysis
- Display
- Fiber recycling (nano fiber )
- Engineering alloy design
- Cryostat & electrochemistry cell

MantaRay  
**Inverted** Weight 90 kg

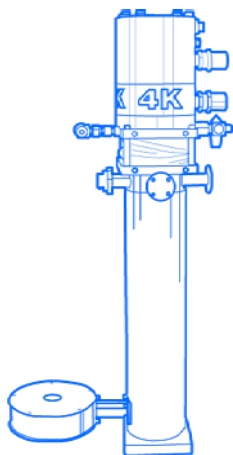


### Bio application

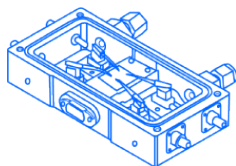
- Bio-sensor, bio-imaging ( bio marker )
- Live cell monitoring ( incubator )
- SERS

## Utilize a variety of Accessories

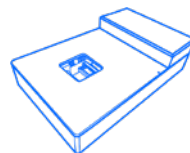
Depending on the measurement conditions and research direction, different versions of the spectroscopy system and accessories are available.



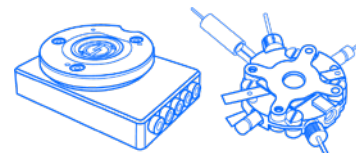
■ Cryostat (low vibration)  
down to 4K



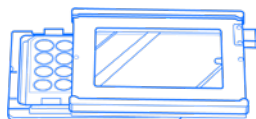
■ Micro Probe-station\*



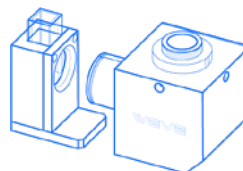
■ Tensile test stage



■ Electrochemical test cell



■ Incubator

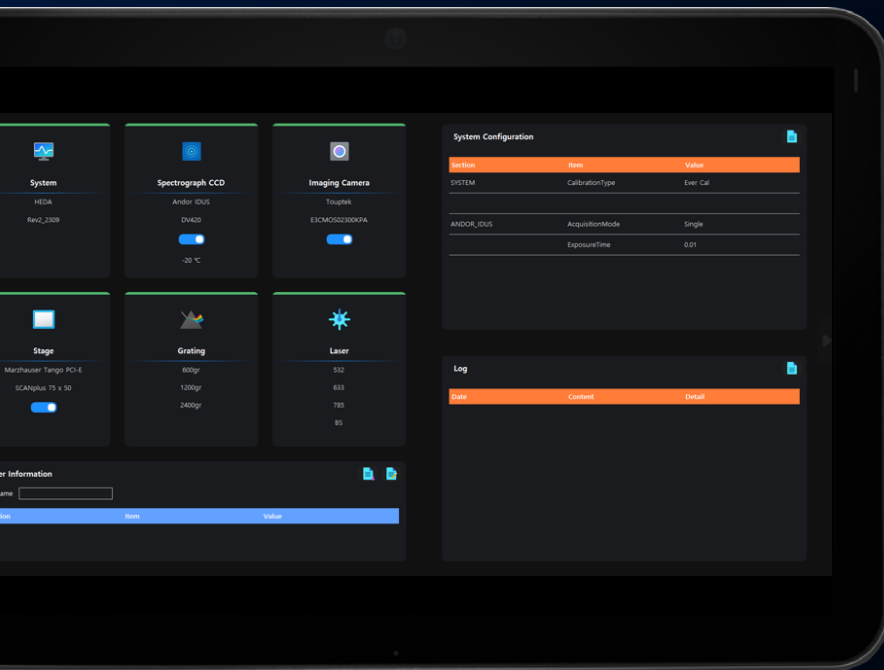


■ Objectives for Liquid  
Samples

### \* Micro probe-station

For Electroluminescence,  
Photocurrent and Temperature  
dependent experiment

# Control Software : *Rays-ON*



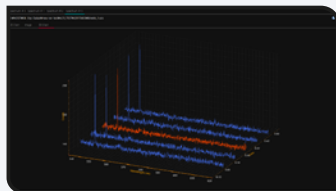
## MAIN UI

- Know the connection status of each device
- Control on-off connections
- Individual user log-in
- Fast and easy maintenance
- Open & save log & config file
- Quick guide attached

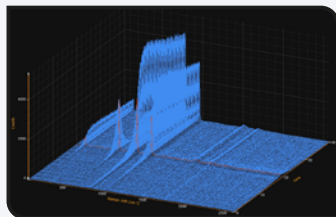
## Various data display methods

### ■ 2D spectrum display in time and depth

In-situ monitoring , changes in composition and structure of samples



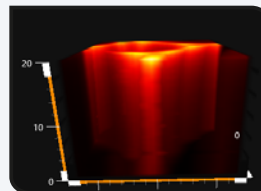
The study of reaction mechanisms by observing changes in external conditions (physical, chemical, electrical) or changes in spectra over time.



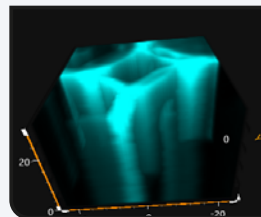
Characterize a sample by observing its spectrum as a function of depth

### ■ 3D mapping Stack & rendering view

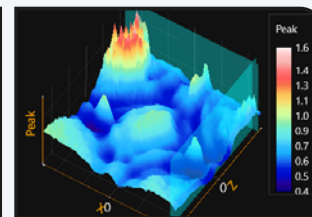
Display the 2D spectrum image of the sample by display by depth (based on wavelength, intensity, half-width, integration)



2D Stack view image



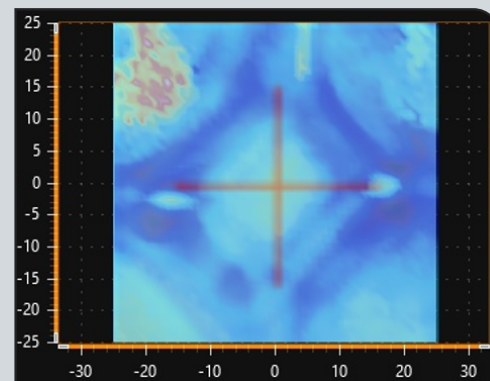
3D Rendering image



2D spectrum image by peak int

## Various data display methods

### ■ Overlap



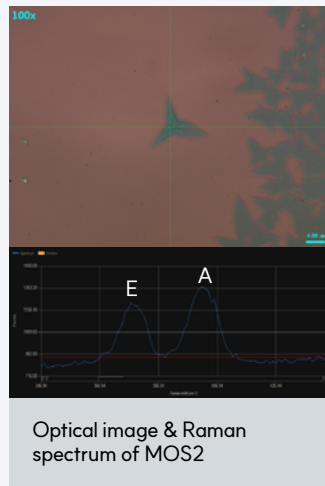
Spectrum and optical image with the same wavelength and measurement area displayed at once. Display a spectrum image and an optical image with the same measurement area simultaneously.

It is possible to overlap or separate Spectrums on a single screen, displaying as individual colors with different measurement information.

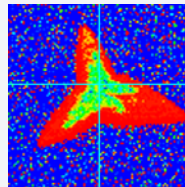
## Data processing and analysis

### ROI

2D representation of specific peaks with information such as half-width, intensity, wavelength, etc.

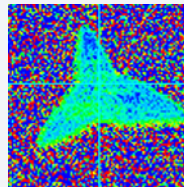


E.peak

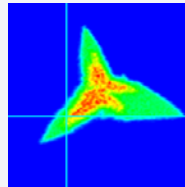


Raman shift

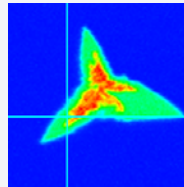
A.peak



Raman shift

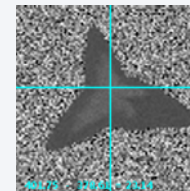


Raman Intensity

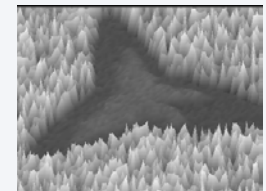


Raman Intensity

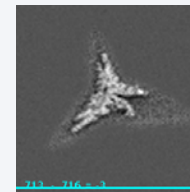
Wavelength, intensity, half-width, integration in 3D.



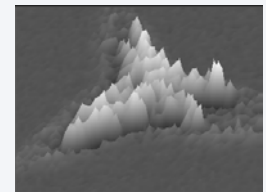
E - A peak Raman shift Mapping image



3D displayed



E - A peak Raman intensity Mapping image

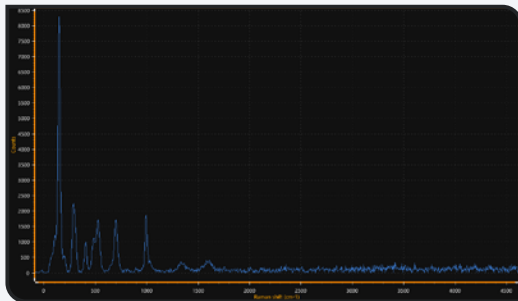


3D displayed

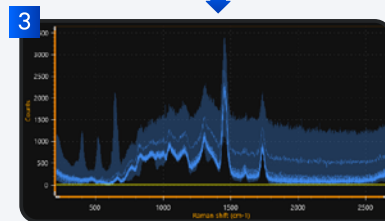
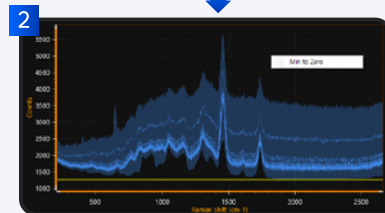
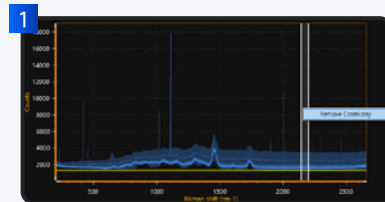
**Arithmetic operation:** Representation of calculated values such as ratio, sum, etc. of wavelength, intensity, half-width information of two or more peaks

## Fitting ( Polynomial , Mean difference & manual) and smoothing

### ■ Background removal



### ■ Cosmic ray, background removal in mapping spectrum chart



1 Remove Cosmicray

2 Min to Zero

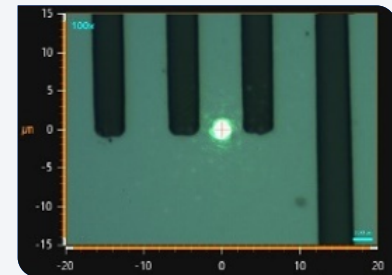
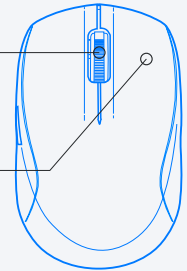
With the above process, you can easily remove the cosmic ray and background from the mapping spectrum chart.

## Usability and user-friendly controls

- Mouse control : Adjust sample position (mouse click), focus the optical image (wheel scroll)
- Position save : Save sample measurement location information
- Objective lens position correction : Compensating for position error due to microscope optical lens magnification
- Multi point scanning : Specify measurement positions to save automatic measurements of signals and optical images
- Guide beam ( for easy adjustment of the optical image of the sample's surface)

**Mouse Wheel scroll**  
: focus the optical image

**Mouse Right click**  
: Adjust sample position



**Example guide beam image**

## Dedicated viewer

### ■ Dedicated viewer " WeVu "

Data measured with WEVE's MantaRay and StingRay can be further analyzed using the dedicated viewer WeVu.

### 1.Back subtraction

- Polynomial fitting
- Mean difference Eq
- User defined

### 2.Selectable Data format

- Microscopic image
- Spectra signal
- Mapping image

### 3.Data display window

- Bright field/Darkfield image
- Single/Multi spectrum
- Color display
- Creative 2D color mapping image

### 4.Signal processing

- Average
- Mean
- Smoothing

### 5.Peak finder

- Set peak count number
- Control interval value

### 6.ROI analysis

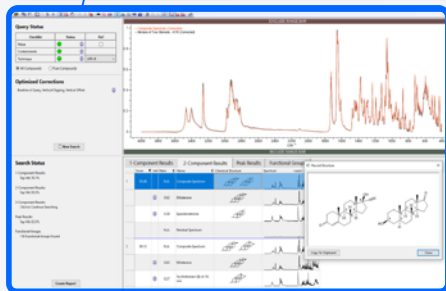
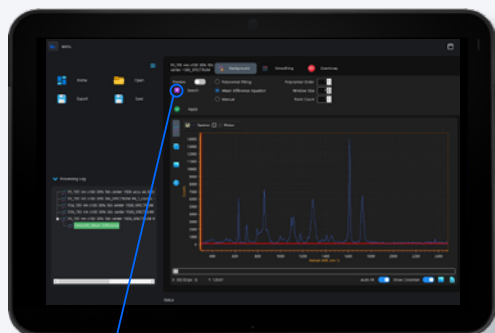
- Max intensity
- Center wavelength (wave number)
- FWHM
- Integration



## KnowItAll Suite : Analytical Tools & Raman Database

" WeVu " + WILEY

WEVE's WeVu dedicated viewer is fully integrated with Wiley KnowItAll analytical tools, offering advanced analysis capabilities and access to a continuously updated Raman database.



### Analytical tools

- Basic Spectrum Analysis
- Advanced Spectrum Search & Mixture Analysis
- Database Building / Management
- Structure Drawing & Reporting (Chem Window)
- Spectrum Processing
- Comprehensive KnowItAll Raman Spectral Library
- Quantitative Analysis Option

### Raman data base / 26K+ Spectra

- Raman Consumer Goods
- Raman Controlled & Prescription Drugs
- Raman Flavors & Fragrances
- Raman Inorganics, Materials, Minerals
- Raman Nutraceuticals, Organometallics
- Raman Pigments & Dyes
- Raman Polymers, Forensi
- Raman Polymers & Monomers
- Raman Semiconductor materials

★The KnowItAll Analytical Edition software and Raman database are optionally offered as a bundled package, available through an annual subscription. The WeVu viewer is provided free of charge.

# MantaRay<sup>®</sup>

## Brochure

Specifications and equipment are subject to change  
without notice or liability on the part of the manufacturer.

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## Closer view of the brighter future

The images used in this brochure are based on MantaRay rendered images. In addition, the images of the software UI, etc. were created with the actual operating screen of Rays-ON, our in-house developed software. The actual images may differ slightly from the contents of the brochure.



Webpage shortcuts, ENG



Webpage shortcuts, KR