

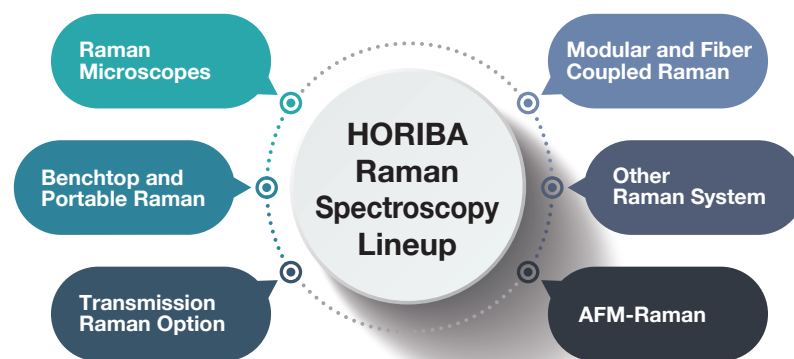
HORIBA Product Lineup of Raman Spectroscopy

HORIBA Scientific manufactures fully automated, easy to use instruments for Raman Spectroscopy.



HORIBA Scientific, the world leader in Raman spectroscopy, provides Raman spectroscopy solutions for analytical measurements, research Raman, UV Raman, QC/QA and industrial Raman applications.

These include Raman microscopes, hybrid Raman systems (such as Raman-AFM), modular Raman systems, transmission Raman analyzers, dedicated in situ process Raman spectrometers, and miniaturized Raman instruments for high volume OEM manufacture.



Raman Microscopes



XploRA PLUS
For research and analytical labs

XploRA series Raman Microscope

Fully automated and fully confocal Raman microscopes allow fast non-destructive chemical micro-analysis and Raman chemical imaging.



XploRA INV
For biological applications



XploRA One
For industrial and routine analysis



LabRAM HR Evolution
Ultimate Raman Spectroscopy

High spectral and spatial resolution analytical Raman microscope ideally suited to both micro and macro measurements, with advanced confocal imaging capabilities in 2D and 3D.



[Excitation] 532 or 785 nm (XploRA One)
532, 638, 785 nm, others on request (XploRA PLUS/INV)

[Confocal imaging]
1 μ m XY (XploRA One), 0.5 μ m XY (XploRA PLUS/INV)

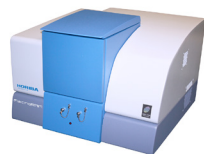
[Spectral range] UV-NIR (200 - 2,100 nm)
[Cutoff] >50 cm^{-1} (Standard), >5 cm^{-1} (Option)
[Detectors] Up to three detectors

Benchtop and Portable Raman

Benchtop and portable Raman systems designed for portability and high quality Raman measurements:

MacroRAM

Affordable Benchtop Raman Spectrometer



Transmission Raman

Provides a cost effective access to a technique ideally suited to bulk chemical analysis of opaque samples, including powders and tablets. Also available as an accessory for most of the HORIBA Raman microscope systems.

Transmission Raman



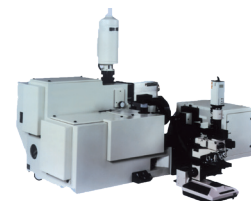
Modular and Fiber Coupled Raman

A range of spectrometers and detectors for integrating into your own Raman experiment, with performance to suit all requirements.

Modular Raman



Other Raman System



The Triple grating Raman spectrometer offers the ultimate in spectroscopic performance. For fundamental research and advanced application of chemical analysis using Raman spectroscopy.

T64000

Triple Raman System



Versatile with possibility to measure Raman, Photoluminescence and Cathodoluminescence. For identification of compounds molecular bindings, phases and polymorphism of its sample under vacuum, eventually at low temperature using a cold sample stage.

R-CLUE

SEM-Raman



Process Raman

High efficiency dedicated process Raman analyzer for rugged and robust Raman monitoring.

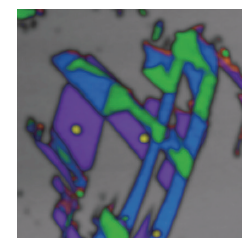
AFM-Raman

HORIBA Scientific and AIST-NT, manufacturer of advanced SPM systems designed specifically for integration with optical spectroscopy, provide an innovative solution that addresses the challenges of NanoRaman imaging.

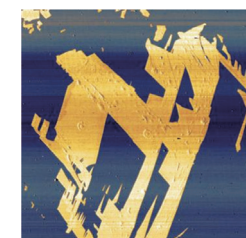


Co-localized Raman-AFM

Conventional Micro-Raman provides diffraction limited sub-micron spatial resolution. Co-localized measurement is all about overlapping a Raman map with an AFM map (topography, phase, capacitance, etc.).



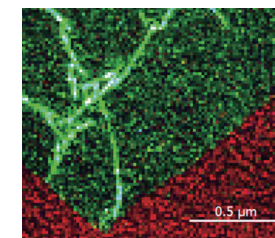
Composite Raman image of a graphene flake



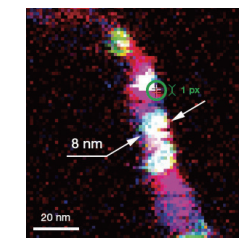
AFM Capacitance image of the same graphene flake

TERS: Tip Enhanced Raman Spectroscopy

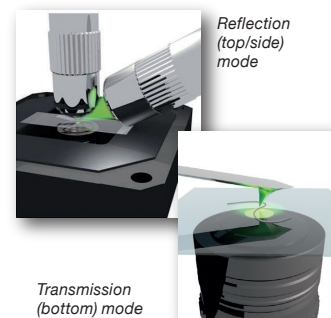
TERS brings you the chemical specificity of Raman spectroscopy with imaging at spatial resolution typically down to 10 nm. This technique can be demonstrated on various samples ranging from 1D, 2D nanomaterials, organic molecules and polymers, to life sciences samples.



D-band TERS map of a graphene oxide flake

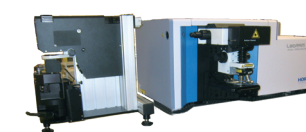


TERS mapping of a single carbon nanotube showing an optical spatial resolution down to 8 nm confirmed from the section analysis of the intensity of the TERS bands.



XploRA Nano

LabRAM HR Evolution and XploRA PLUS/INV integrated with Scanning Probe Microscopes (SPM) can provide nano imaging spectroscopy of Raman and SPM simultaneously. Compact, fully automated and easy-to-use Nano Raman systems for high speed TERS imaging at nano scale.



LabRAM HR Evolution Nano



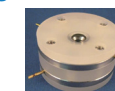
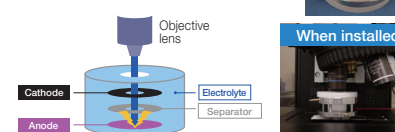
CombiScope XploRA

CombiScope XploRA is a fully integrated compact AFM-Raman system dedicated to transparent samples (Life sciences).

Options and Software

Cell for In-situ Analysis

It is possible to analyze the anode surface of the lithium battery in a closed state while charging.



When installed

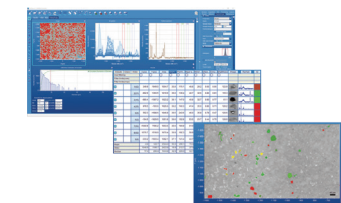
Multipass Cell Holder

The Sample-Ref accessory allows easy correction of data that have been influenced by environment changes (such as room temperature drifts). It is very useful for fine wavenumber shift measurement (semiconductor stress/strain, graphene, etc.).



ParticleFinder

ParticleFinder offers a user friendly tool for automated location, characterization and Raman analysis of particles. Hundreds or thousands of particles can be quickly located on a video image, analyzed for size and shape descriptors, and then chemically characterized using Raman spectroscopy.

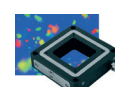


Specialized Stages

- Cooling/heating stages up to 1500° C or down to 4 K
- Catalytic cells for corrosive or conductive carrier gases
- Electrochemical cells
- Diamond anvil and pressure cells
- High-precision piezo-driven stages
- Humidity / incubator stages



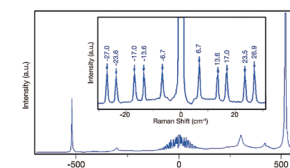
Cooling / heating stage



High-precision piezo-driven stage

Ultra Low Frequency (ULF)

The ULF module allows low frequency measurements down to 10 cm^{-1} . Low- and high-frequency spectral features can be acquired simultaneously with high throughput enabling easy access to ULF low frequency imaging and analysis.





HORIBA Scientific's LabSpec 6 software delivers a unique environment for complete instrument control and data processing. It combines simplicity with powerful analytical functionality, and opens up the full range of experiment protocols, ranging from the basic spectrum acquisition to hyperspectral confocal imaging with a complete suite of applications:

LabSpec 6 Options & Applications



All data, whether a single spectrum or a hyperspectral map comprising hundreds of thousands of spectra, can be processed with standard spectroscopic functions.

Comprehensive analysis routines are available, including integrated multivariate analysis with the application **Multivariate**. Spectrum identification is possible using the advanced capabilities of Bio-Rad's **KnowItAll** informatics suite* with the application **SpectDatabase**.

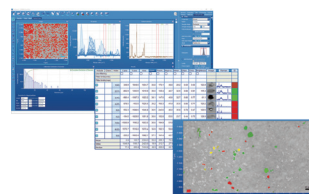
LabSpec 6 offers advanced automation, recordable methods for custom automation and full Visual Basic® Scripting (VBS) and ActiveX® for in-software programming and remote control.

Connect Device* is a new functionality offering the possibility to connect temperature control stages, and photocurrent mapping units. LabSpec 6 **ProtectionPlus*** application offers a fully configurable security and data integrity module compliant with the requirements of FDA 21CFR Part 11.

In addition, LabSpec 6 comes with advanced **MultiWell*** module for high throughput screening and **ParticleFinder*** module for automated particle location and location, statistical analysis, and Raman analysis, making it the ideal spectroscopy software for runaway operation.

* Option

New ParticleFinder application for automated particle location and analysis

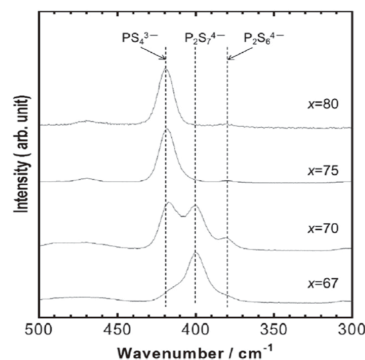


* KnowItAll is a trademark of Bio-Rad Laboratories, Inc.

* Visual Basic and Active X are trademarks or registered trademarks of Microsoft Corporation in the United States and other countries.

Application 1: Battery analysis

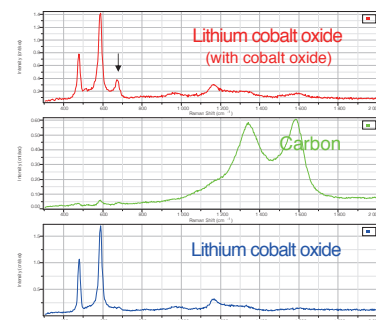
Analysis of solid electrolytes for fully solid sodium secondary batteries



With Raman spectroscopy of $\text{Na}_2\text{S}-\text{P}_2\text{S}_5$ glass solid electrolyte, it can be observed that the Na_2S content increases and the structural unit of the electrolyte changes from $\text{P}_2\text{S}_7^{4-}$ to PS_4^{3-} .

*Source: Professor Akitoshi Hayashi, Osaka Prefecture University Journal of Power Sources 269 (2014) 260-265

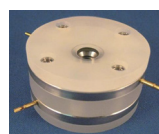
Raman image of cathode of lithium ion battery



After a discharge and recharge cycle, a lithium ion battery was discharged, disassembled and cleaned, and Raman mapping measurement was performed on the surface. The three spectra shown above were found in the mapping area. With Raman spectroscopy, it can be observed that repeated discharging and recharging causes the lithium cobalt oxide to become cobalt oxide.

It is possible to determine differences between the molecular structures and crystalline of organic and inorganic compounds and analyze the crystal structure and molecular structure of battery materials by a non-destructive, non-contact method while observing the materials through an optical microscope.

● Cell for *in-situ* analysis
It is possible to analyze the anode surface of the lithium battery in a closed state while charging.



High Spectral Resolution Analytical Raman Microscope

LabRAM HR Evolution

In-Situ analysis of discharging and recharging of lithium ion batteries

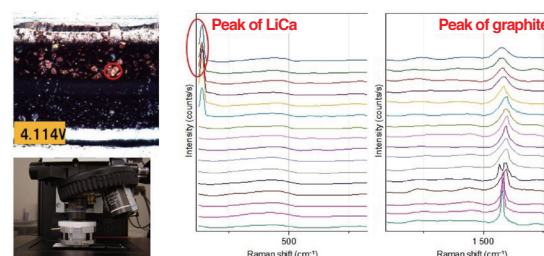
-Composite measurement of color confocal system and Raman fiber system-

This instrument is an example of a composite system developed by HORIBA, Ltd. and Lasertec Corporation.

Color confocal system



Raman analysis of anode of lithium ion battery

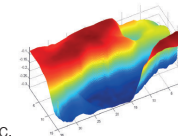


- Confocal microscope imaging is used to obtain a high-resolution observation image and information such as surface roughness.
- This is combined with Raman spectroscopy equipment to measure in the field of view that is being observed.

Application categories

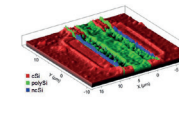
Carbon Materials

- Carbon nanotube
- Diameter, chirality, doping, etc.
- Graphene
- Layers, defects, etc.
- Others
- sp^2 and sp^3 structure
- DLC coating properties
- Diamond quality and provenance



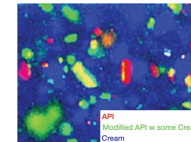
Semiconductors

- Stress/strain analysis
- Doping/Defect
- Contaminations
- Superlattice structure
- Crystal form analysis
- Photoluminescence (PL)
- Micro-analysis



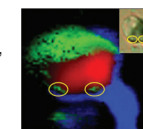
Pharmaceuticals - Cosmetics

- Chemical identification content uniformity
- API quantification
- High-throughput screening
- Polymorphs, crystal-form transformation and thermal stability analysis
- Drug counterfeiting and additive detection
- Drug-cell interaction
- Real-time reaction monitoring and terminal product detection



Life Sciences

- Bio-macromolecule (lipids, proteins, carbohydrates, DNA, etc.)
- Bacteria location, identification and classification
- Cell analysis (cell imaging)
- Drug distribution in cells/tissues
- Diseases & early diagnosis, oncology
- Label-free in-vivo and in-vitro analysis
- Nanotoxicology



Geology

- Minerals/crystal forms
- Fluid inclusion
- Phase transformation
- In-situ high/low temperature reaction
- Thermal oxidation of organic materials
- Fluorescence micro-analysis

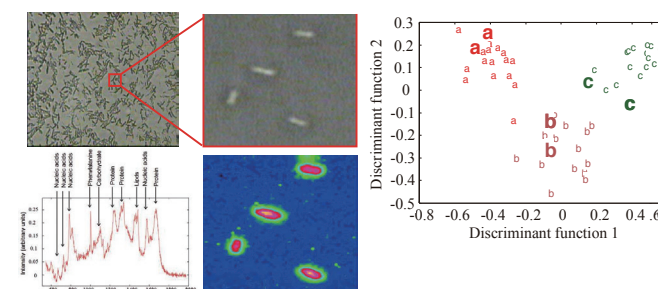


Jewelry - Museum - Forensics

- Gemstones/jade
- Metalware corrosion
- Cellulose/Textiles/Fibers
- Handwriting authentication
- Explosives/bullet remnants
- Printing inks/pigments
- Drugs



Application 2: Bacteria identification



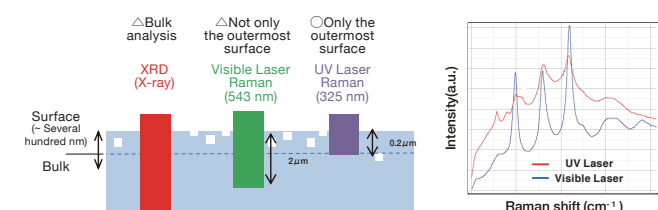
- Raman imaging gives a distribution and chemical information.
- Raman data analyzed by multivariate analysis shows us a good discrimination of the bacteria species.

The bacteria species could be identified by the combination of Raman and multivariate analysis.

XploRA INV



Application 4: Crystalline evaluation of outermost surface of photocatalytic material



Comparison of penetration length of X-ray and laser

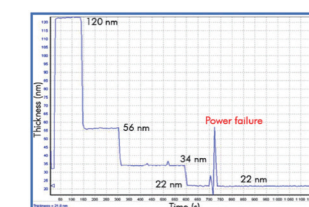
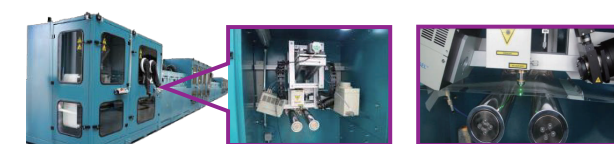
Visible and ultraviolet laser Raman spectra measured at the same location

The differences in crystalline can be detected by using ultraviolet laser microscope Raman spectroscopy for the difference in crystalline of the sample's outermost surface, which could not be conventionally distinguished by XRD or visible laser microscopy Raman spectroscopy.



XploRA PLUS

Application 5: In-line analysis of film thickness and composition in Roll to Roll production process



Sensor unit of Ellipsometer

Al₂O₃ film on PET Substrate

In the Roll to Roll film production process, the film is pulled at the other side during coating and wound on the opposite side. At this time, the variation in coating film thickness and composition change affects the yield. By installing sensors of Raman and ellipsometer in the Roll to Roll production equipment, the variation in coating film thickness and composition change can be monitored in line, during the production process.