Newest modular 3D Imaging Raman Microspectroscopy System

Nanofinder®FLEX

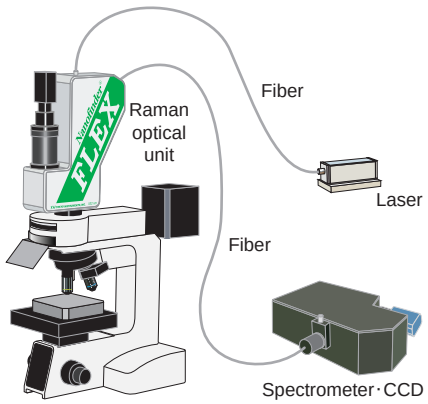
Simple operation and low cost with all the basic features of our top of the line *Nanofinder®30* system.

Structural images of transparent samples (plastic, film, organic EL) with Raman and fluorescence spectroscopy.

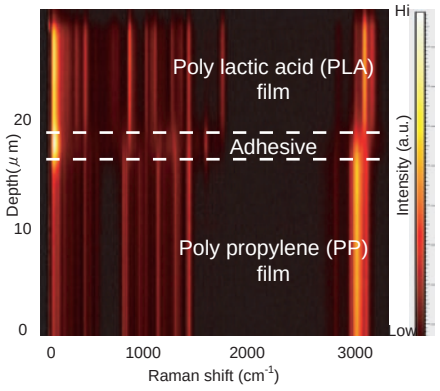
High Performance, Compact Size, Low cost

Features

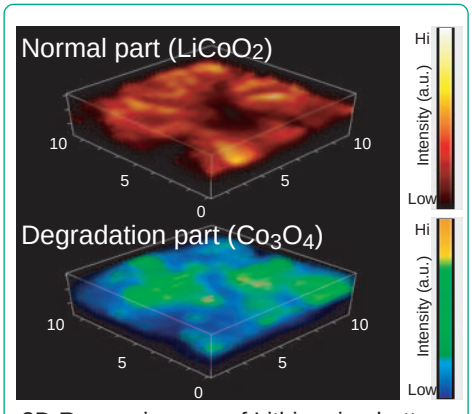
- Raman imaging with 300 nm spatial resolution.
- High sensitivity: 4th order Raman Si peak can be detected in less than 1 min. using a low intensity laser (4 mW)
- Confocal laser microscope designed for 3D Raman.
- Compact Raman optical system directly coupled to the microscope for high stability.
- No need adjustment because no moving parts.
- nm positional accuracy with piezo X-Y-Z stage.
- Modular optical system, spectrometer/CCD and laser.
- The simpler successor to the *Nanofinder®30* - using the same powerful software.
- 1.5 x improvement in spatial resolution using deconvolution software.



Compact and modular type



Depth profile of Plastic laminate film
(This analysis is difficult by confocal laser microscope)



3D Raman images of Lithium ion battery
(using specific peak for each material)

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TOKYO INSTRUMENTS, INC.

Nanofinder® FLEX

Spectroscopic analysis with high spatial resolution imaging

Finally, a high spatial resolution, high sensitivity, compact and low cost Raman microscopy system.

The Nanofinder FLEX is a flexible 3D Raman microscope that retains the basic features and performance of our high-end Nanofinder 30 system. Modular assemblies including a new compact Raman optical unit.

●The Raman optical unit is installed directly upon an upright microscope, creating a clean and compact installation taking no more bench space than a standard microscope.

●Other units are fiber optic coupled and can be placed in convenient locations for ease of operation and a space saving installation.

●Simple changeover of excitation laser and Raman optical system when required.

Nanofinder FLEX has high special resolution < 300 nm and high sensitivity without complex optical adjustments.

The system uses our highly acclaimed Nanofinder software with powerful imaging and data management capabilities.

New, lower cost Raman unit and piezo stage are now in within the reach of most laboratory budgets. For further savings and flexibility, the Nanofinder FLEX system can be used with many existing lasers, CCD Cameras, and spectrometers.

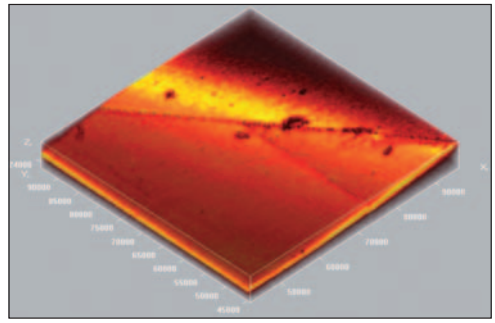
Raman optical unit
Spectrometer, CCD

Raman optical unit
attached on microscope

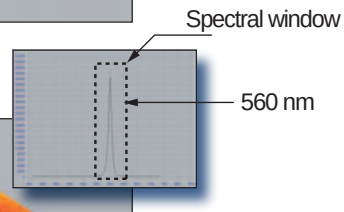
Control-rack
(Embedding PC, spectrometer, CCD)

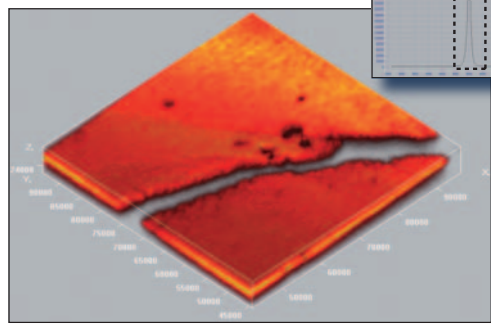
Easy materials identifying with Raman

ZnTe defect measurement



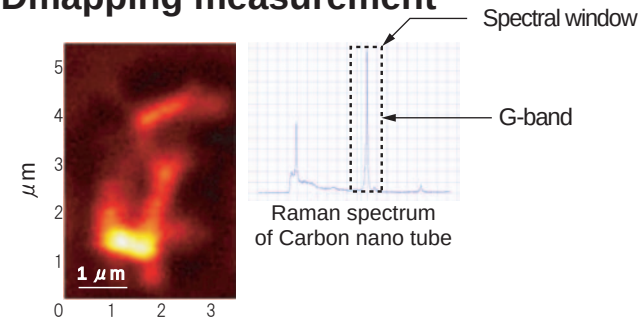
Topographic measurement
with confocal microscope mode





Spectroscopic imaging of ZnTe with photoluminescence mode
3D mapping using the 560 nm Raman peak

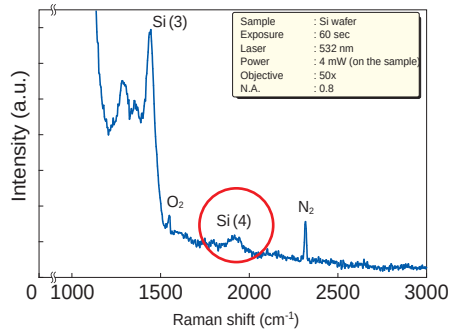
2Dmapping measurement



Raman spectrum
of Carbon nano tube

2D Raman image of CNT (at G-band ～1593 cm^{-1})

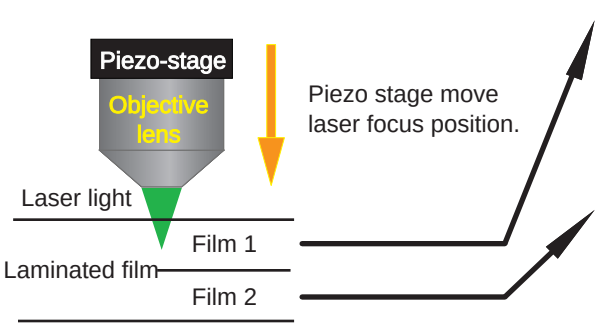
Measurement with high sensitivity



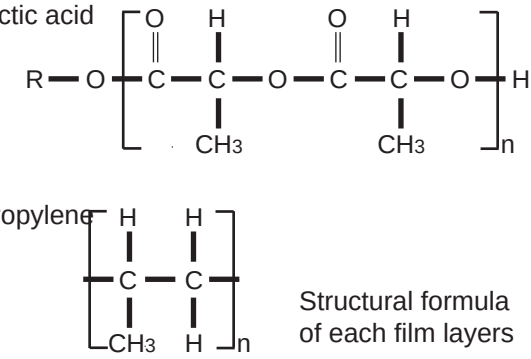
Detection of 4th order Si Raman spectrum
as demonstration of height sensitivity

Depth analysis for laminated film by confocal Raman mapping

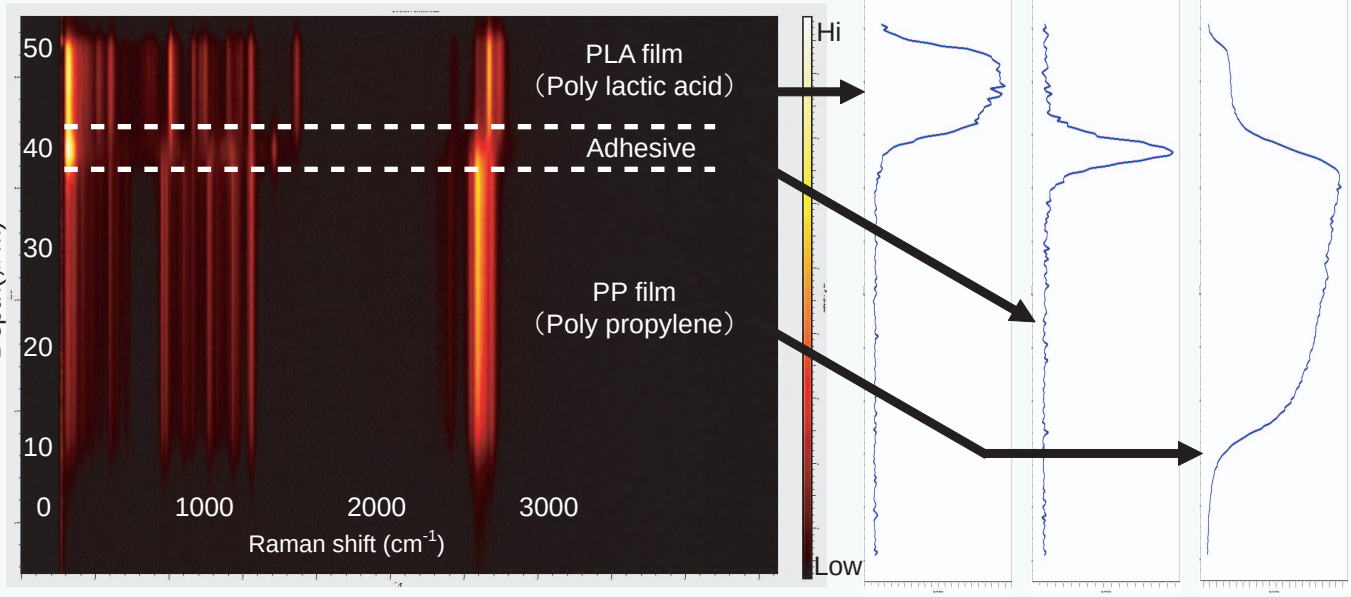
We made a Raman mapping at a laminated area in depth direction. In confocal system, Spectral depth profile can be measured by moving focus position in Laminated film.



Outline of measurement

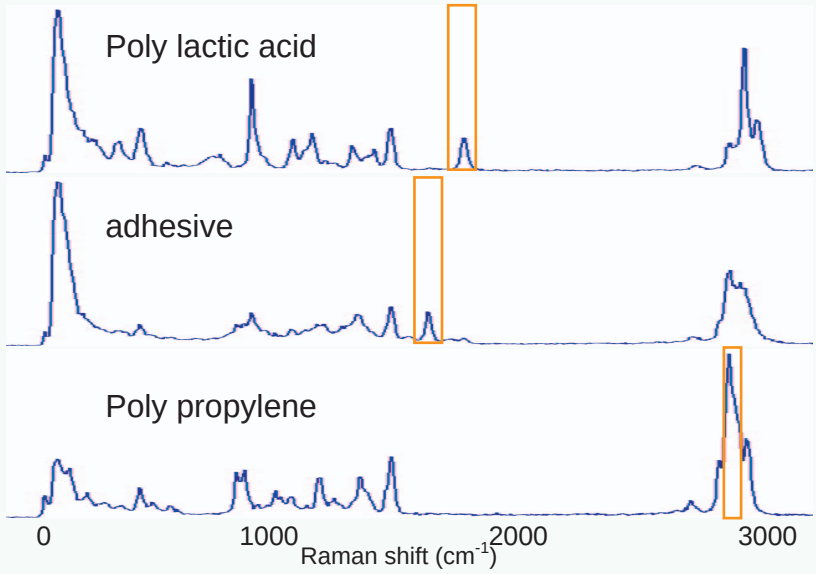


Structural formula of each film layers



Spectral depth profile image

Intensity profile for each materials (Specific peak)



Raman spectra for each materials

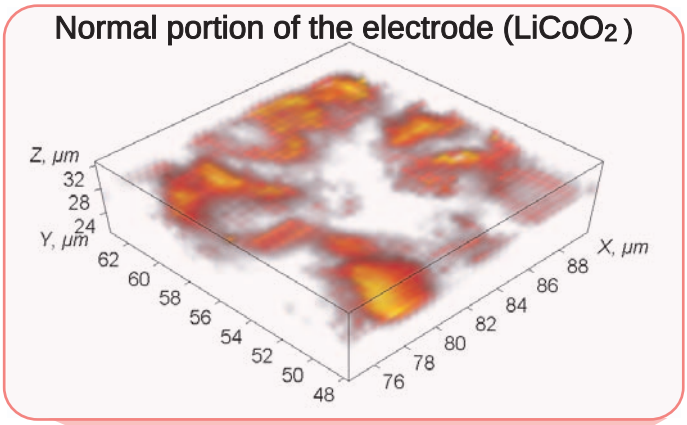
In spectral depth profile image, horizontal axis is Raman shift、vertical axis is depth in laminated film. Various spectra were measured along depth direction.

Raman spectra for each materials are shown below profile image. Right hand profiles in the profile image are intensity depth profiles for specific peak (orange color square). These 3 layers can be divided by this measurement.

3D Raman image analysis on positive electrode suface of Li-Ion battery

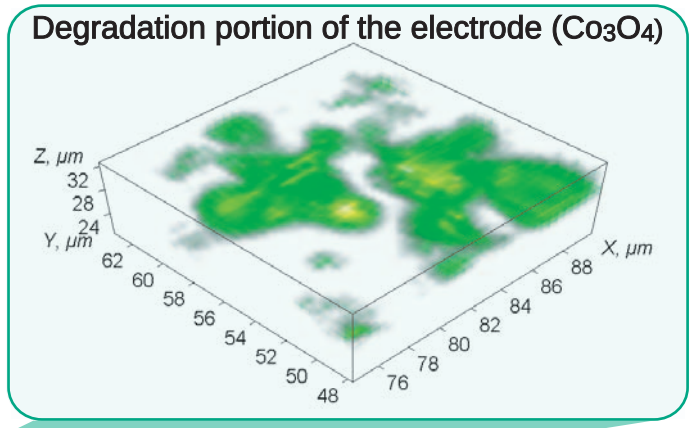
3D Raman mapping on a positive electrode of a degradation Li-Ion battery were conducted. Distributions of normal electrode material ($LiCoO_2$) and degradation material (Co_3O_4) from it can be obsereved as raman images .

Normal portion of the electrode ($LiCoO_2$)

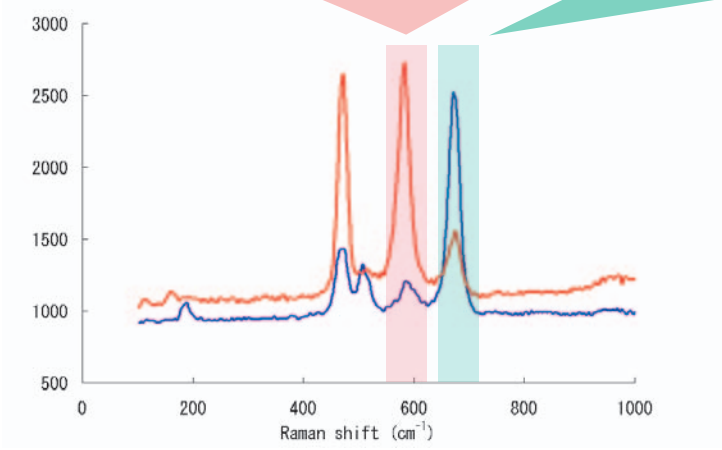


Raman intensity image of $LiCoO_2$ peak (600 cm^{-1})

Degradation portion of the electrode (Co_3O_4)

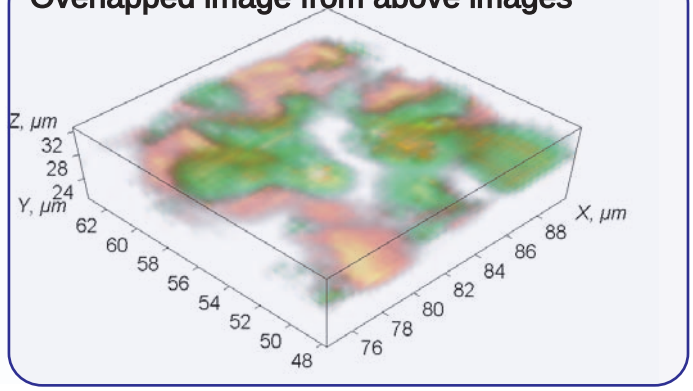


Raman intensity image of Co_3O_4 peak (700 cm^{-1})



Typical Raman spectrum

Overlapped image from above images



3D Mapping conditions

Excitation laser wavelength：532 nm
Excitation laser power：5 mW
Exposure time：1 sec/point
Total mapping time：5 hours
Mapping points：32x32x10
Objective lents：100x N.A. 0.9

As a material for an positive electrode of Li-Ion battery, $LiCoO_2$ is mainly used. The electrode material, however, degrades after repeating discharge and charge and then some porsions of it turn into Co_3O_4, which can't contribute to charge. Material distributions on the surface can be observed with distinct peak intensity images, because different spectra are taken from these materials respectively.

As shown in the upper images, there is a competely different pattern between normal $LiCoO_2$ portion and degradation Co_3O_4 portion.

Specifications

Nanofinder® FLEX
3D Raman microscope system

System configuration

-Upright microscope
  Objective lens (x100, x50) /Monitoring CCD
-Raman optical unit (1 wavelength)
-Imaging spectrometer
-Cooled CCD
-Piezo stage (X-Y-Z)
-Excitation laser (532 nm)
-System controller, software / LCD monitor

Overall specifications

-Spatial resolution
  XY: < 300 nm (100x, N.A. 0.95)
  Z: < 900 nm (100x, N.A. 0.95)
-Wavenumber range: 50 cm^{-1} ～4000 cm^{-1}
  (532 nm)
-Wavenumber resolution: 2 cm^{-1}
  (f=35 cm imaging spectrometer)

Each unit specifications

-Raman optical unit
  Resettable filter unit
  Fiber connecting (incident and output)
  FC connector coupling

-Imaging spectrometer MS3504i
  Focal length: 35 cm, F: 3.8
  Reciprocal linear dispersion: 2.37 nm/mm
  @1200G/mm
  Wavelength resolution: 0.06 nm/pixel @ 550 nm,
  1200G/mm
  Wavenumber resolution: 2 cm^{-1}/pixel @ 550 nm,
  1200G/mm
  4 gratings available (selectable)

-Cooled CCD detector
  Elements: 1024 x 127
  Element size: 26 x 26 μm
  Cooling temperature:-100 ℃ (water),
  -80 ℃ (air)

-Piezo stage
  X-Y-Z axis stroke: 100 μm (Closed loop)
  Resolution: 5 nm
  Repetition accuracy: ±5 nm

-Excitation laser
  1. LD pumped solid state laser
    Wavelength: 532 nm
    Power : 50 mW
  2. LD laser
    Wavelength: 785 nm
    Power : 70 mW
  Other lasers available

-Controller
  Software: Software for Nanofinder
  Main function:
  Control of spectrometer/piezo stage
  Measurement of Raman spectra and images
  Correlation of a spectral background
  2D/3D data display
  Image restructure from 2D/3D data
  OS: Windows(r) XP Professional

-Size
  Microscope and Raman optical unit
  W300 x D400 x H770 mm
  Desk with 19 inch mount (option)
  W600 x D850 x H700 mm
  (Including as follows: spectrometer/CCD,
  laser, piezo/system controller)

-Power supply 100VAC-12A

-Options
  Compatibility with AFM for simultaneous
  AFM/Raman measurement