Raman Confocal Microscope

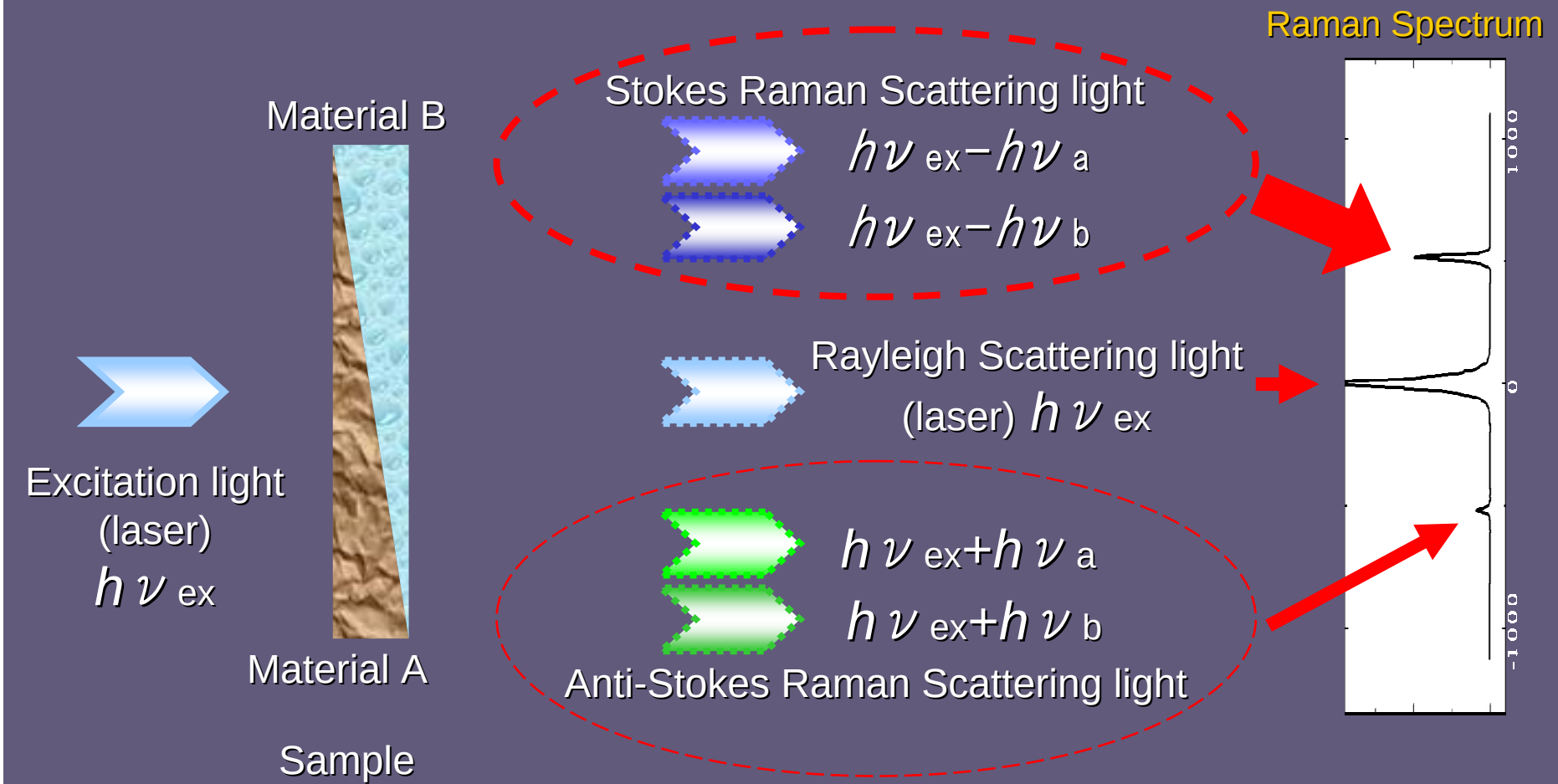
"Nanofinder® FLEX"

Nanofinder®FLEX

Overview of Raman Spectroscopy

Raman Spectroscopy

- Spectroscopy of vibration modes of molecules or crystals.
- Analytical method based on analysis of the spectra, scattered by sample.



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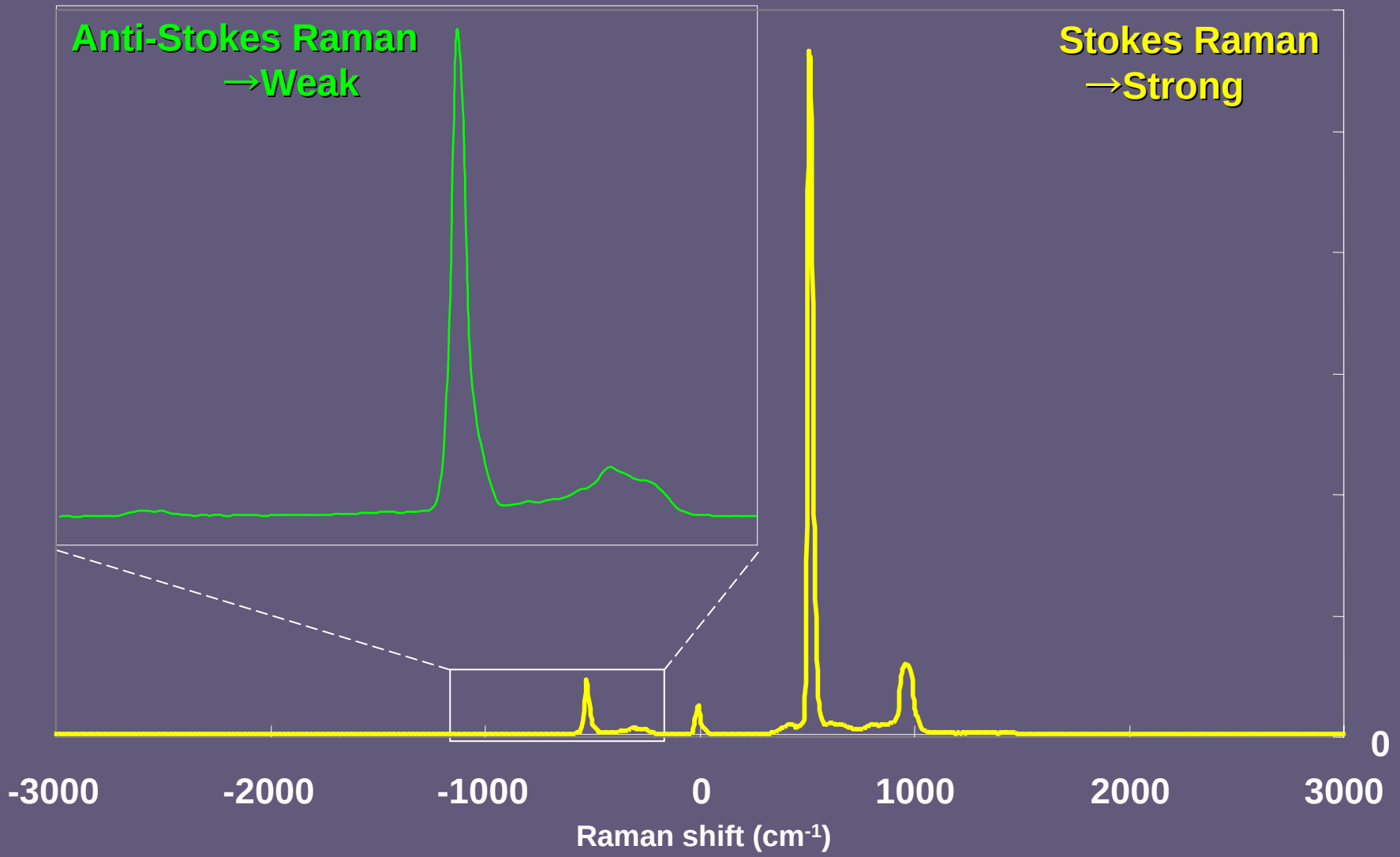
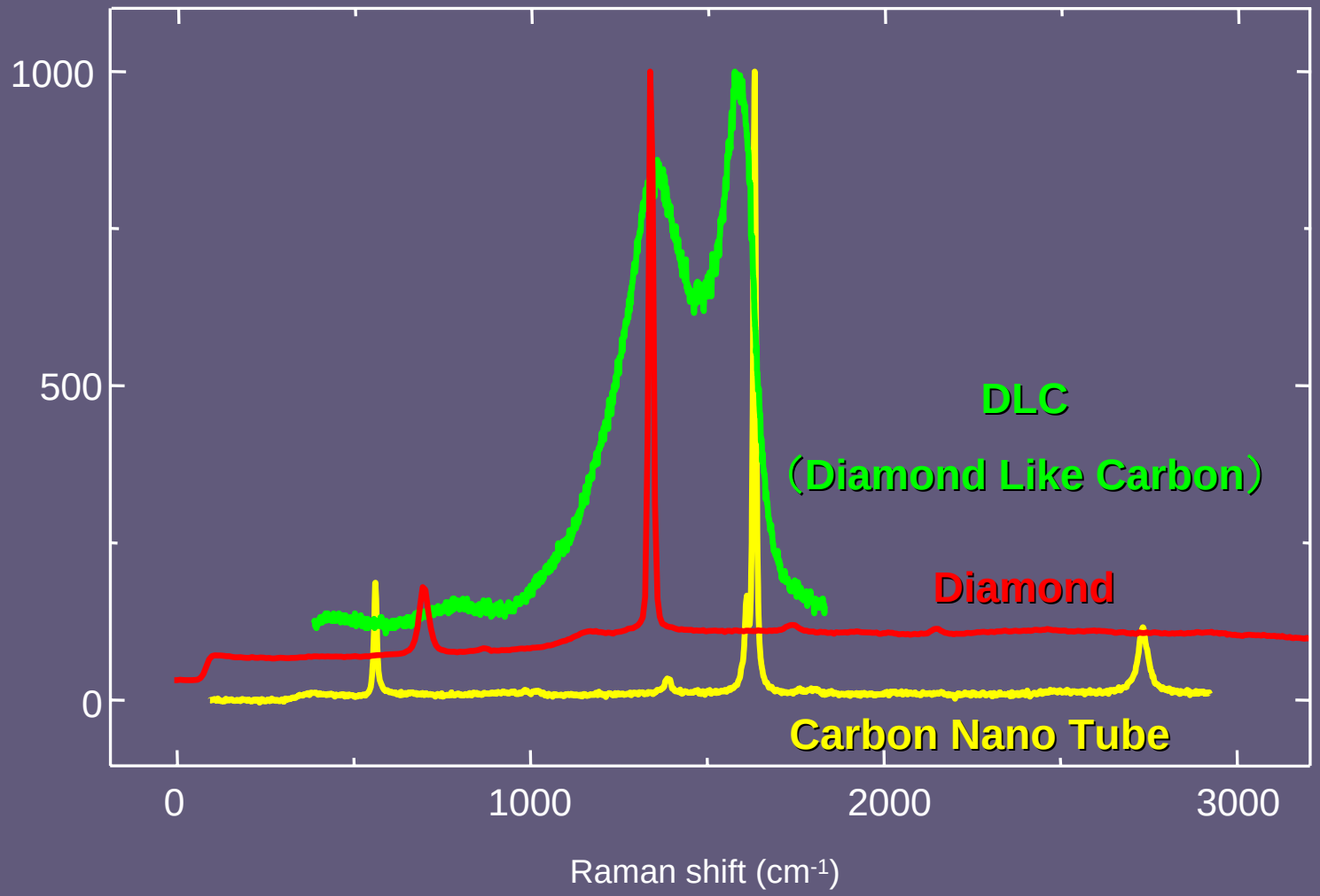
Sample:Silicon



Application example: Sample temperature estimation, using intensity ratio of these Raman peaks.

Stokes Raman and Anti-Stokes Raman components

Samples : Carbon contained materials.



Raman Spectra

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Raman and IR Absorption Spectroscopy:

- Vibration spectroscopy

・Qualitative and Structural analysis materials in atmosphere, non destructive, non contact.

Raman vs. Infrared Absorption Spectroscopy

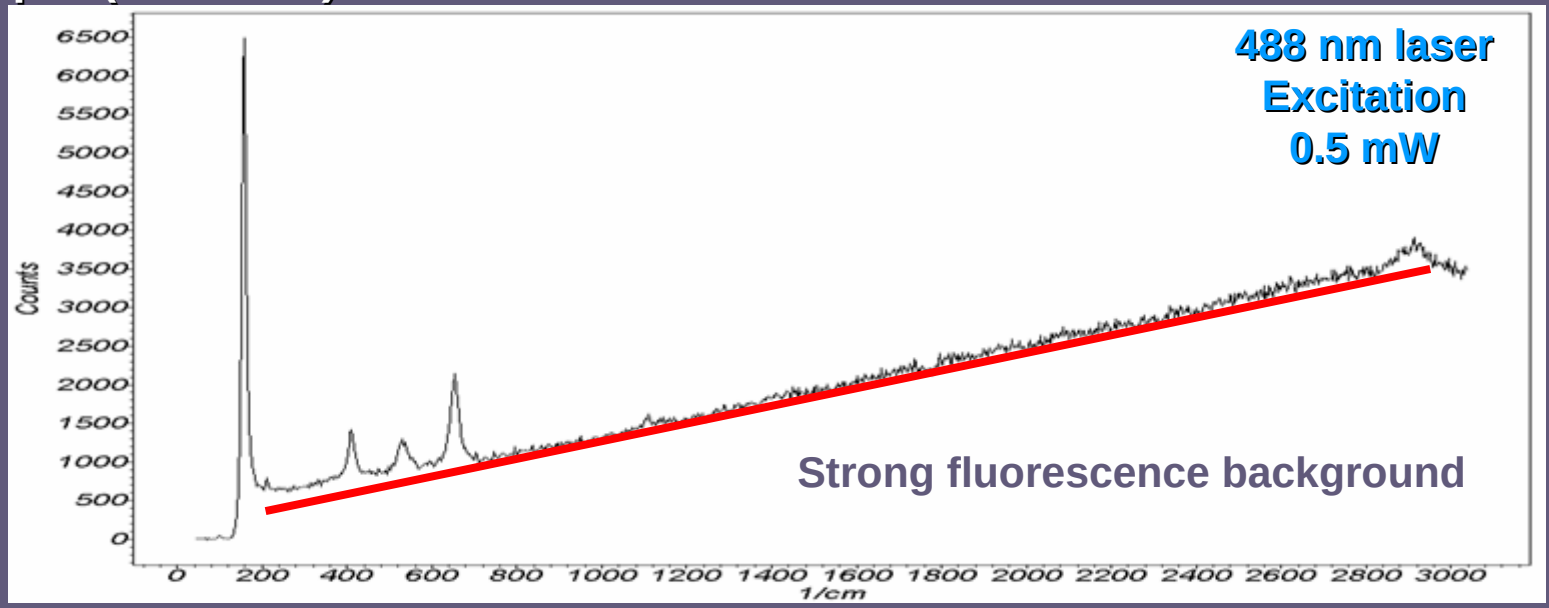
Good!

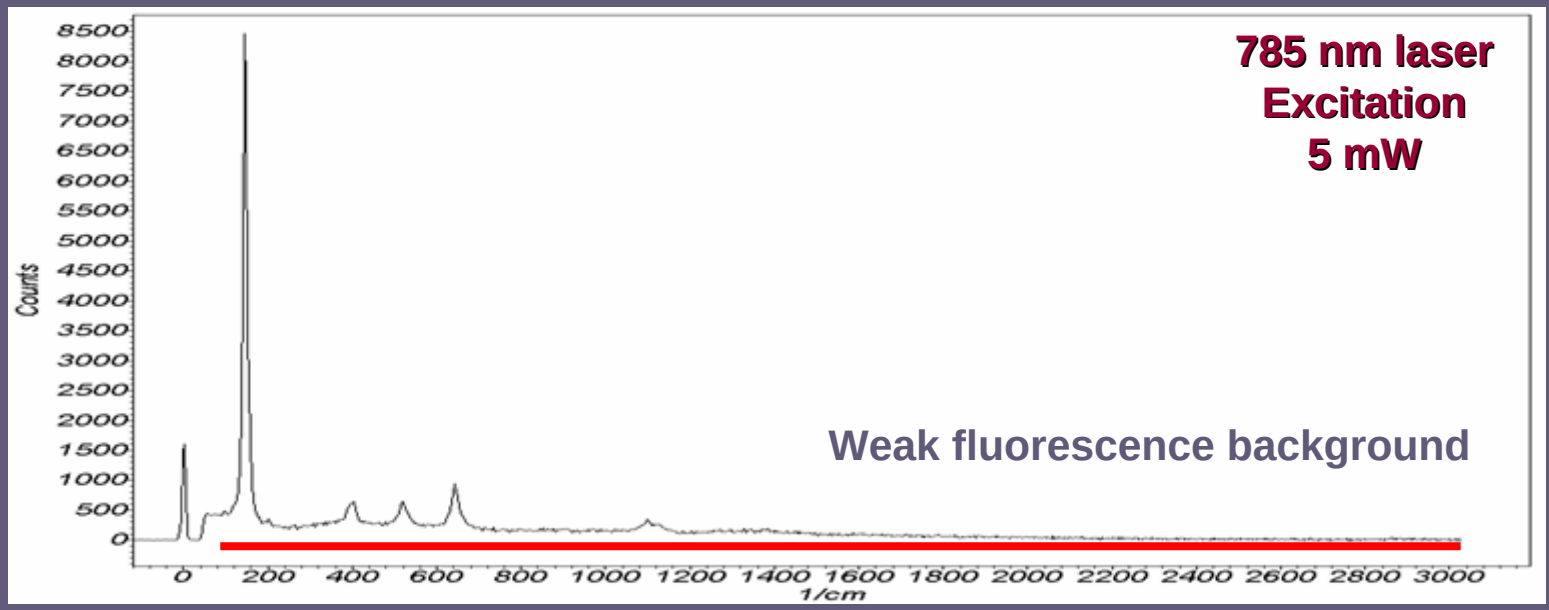
Sample in Aqueous Solution easily
Sample in Glass, Plastic and other containers
High resolution (under ϕ 0.5 μ m)
※ around 10 μ m by IR Absorption spectroscopy
Depth analysis with 1 μ m resolution possible
Available signal Enhancement technique

Bad…

Poor database
Fluorescence background from specific samples

Sample : Paper (cellulose)





Raman spectra excited by different wavelengths

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Features of *Nanofinder® FLEX*

Point 1

New concept model in Nanofinder series

-Compact
-Free layout
-Easy control
-Reasonable price

+

Point 2

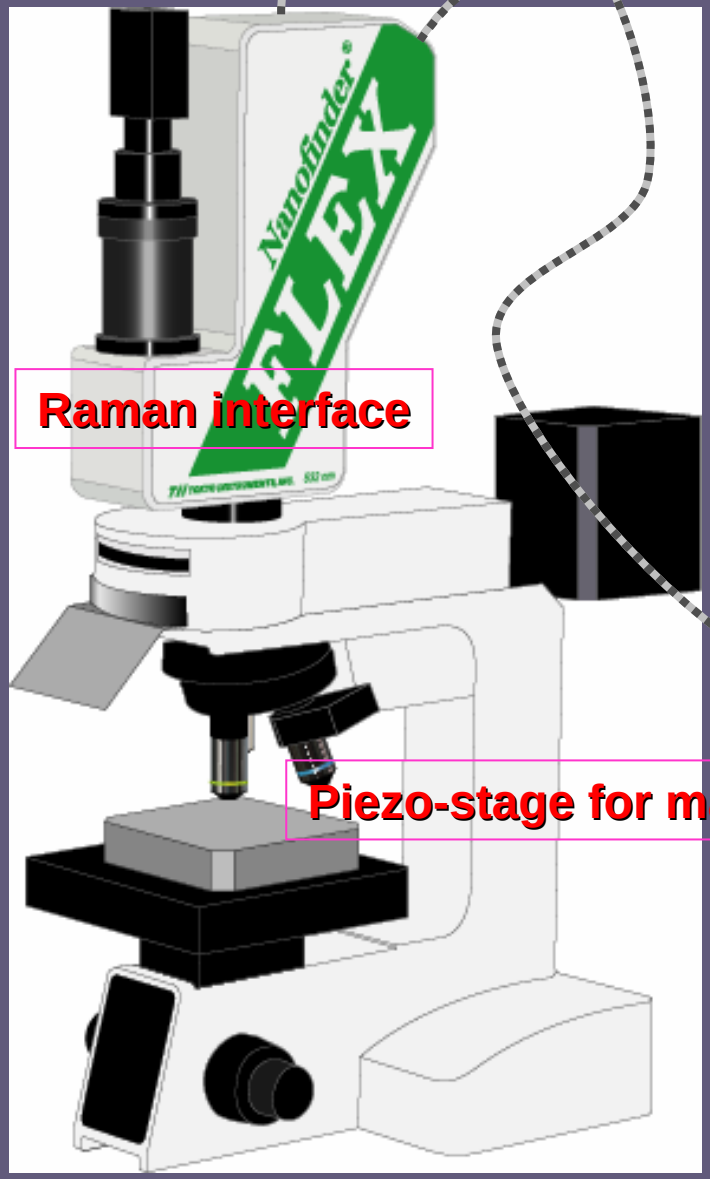
High Sensitivity

-Detectable 4th order of Silicon Raman Peak within 1 minute
-Possibility to get good quality Raman spectrum (and image) with low excitation laser power (no sample damage)

Point 3

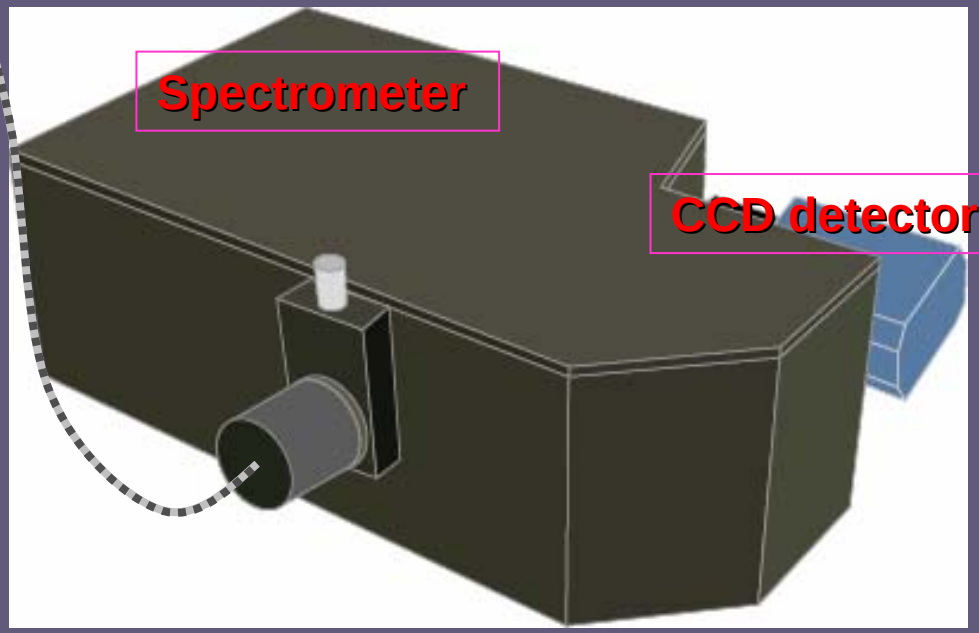
High 3D spatial resolution

-Raman image analysis with 300 nm spatial resolution
-Depth analysis by confocal technique



Raman interface

Piezo-stage for mapping



Spectrometer

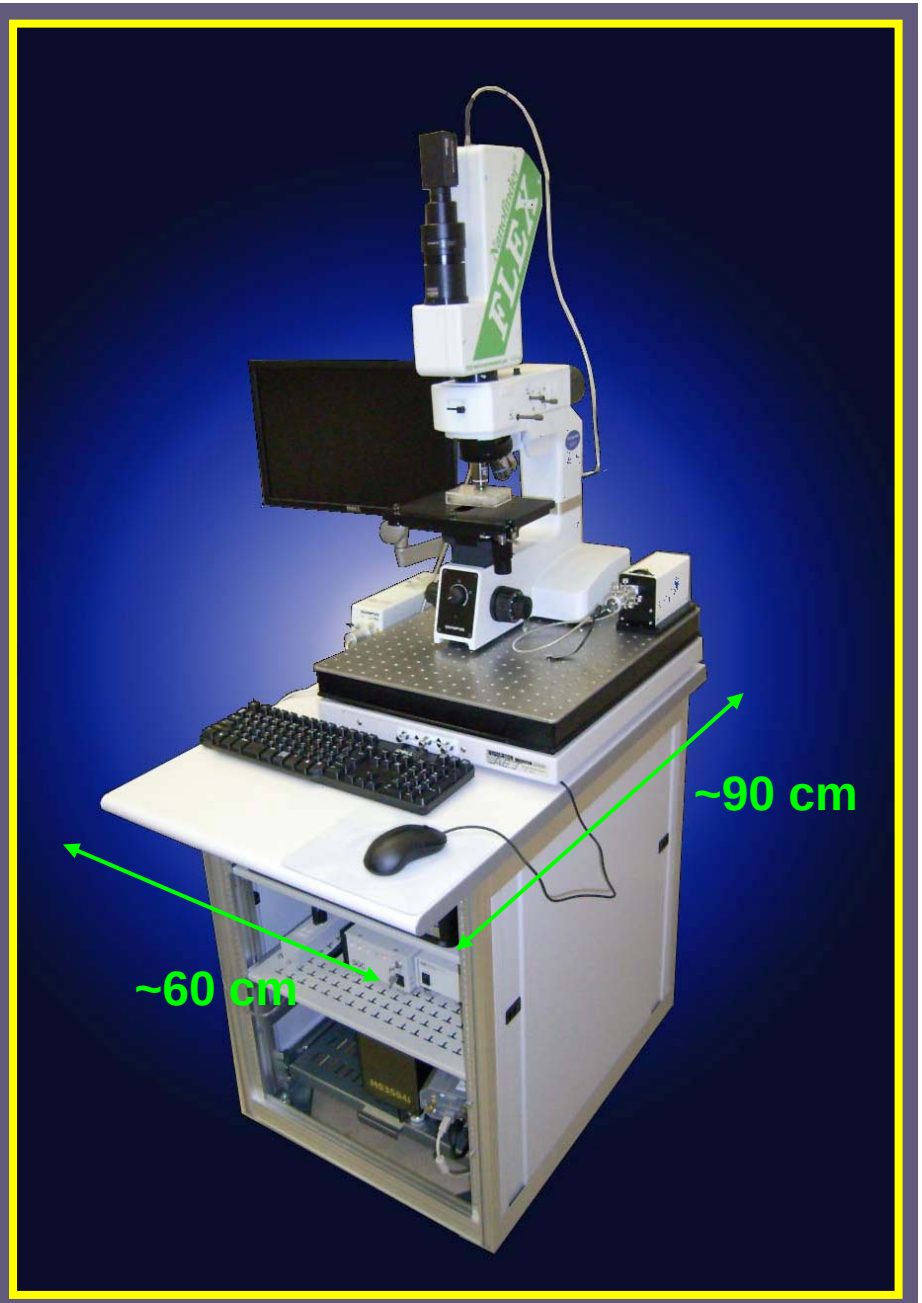
CCD detector

Laser

Layout of *Nanofinder® FLEX* system

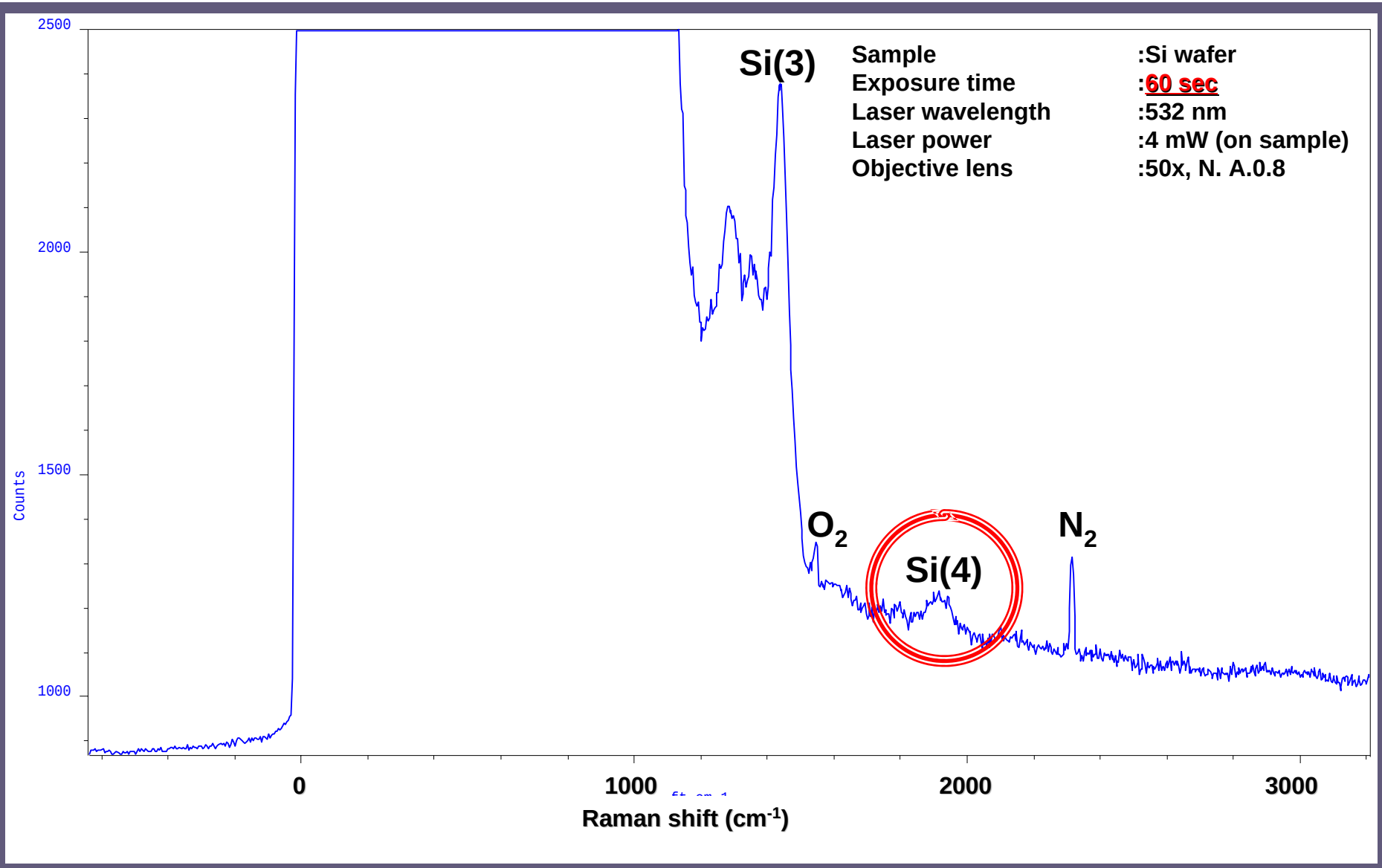
↑ Raman interface and spectrometer

Full system view→



That's all. No need any another device for Raman measurement. And possible to rearrange layout to fit available space.

Outline of *Nanofinder® FLEX* system



4th order of Si Raman peak

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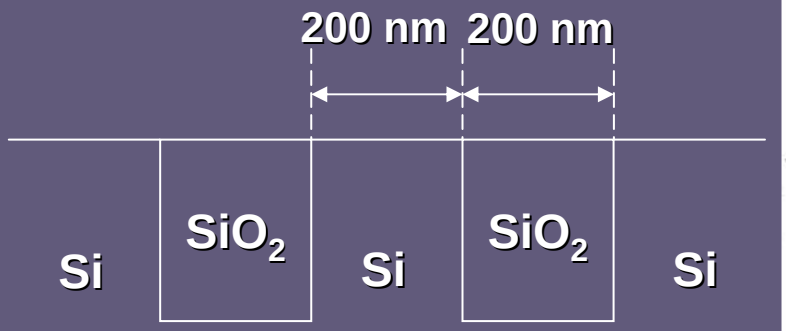
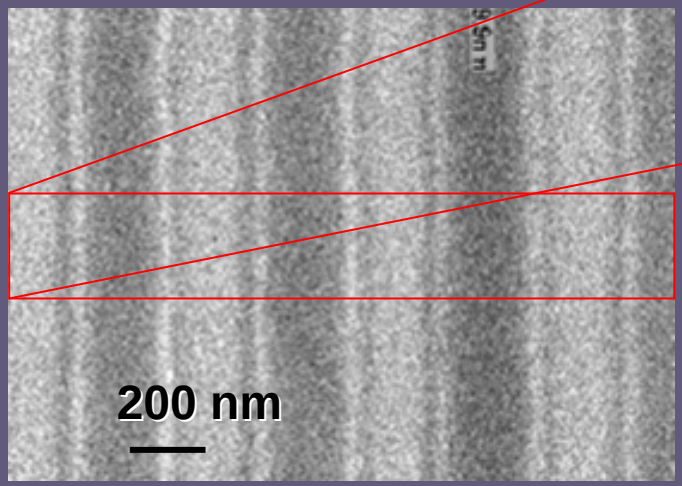
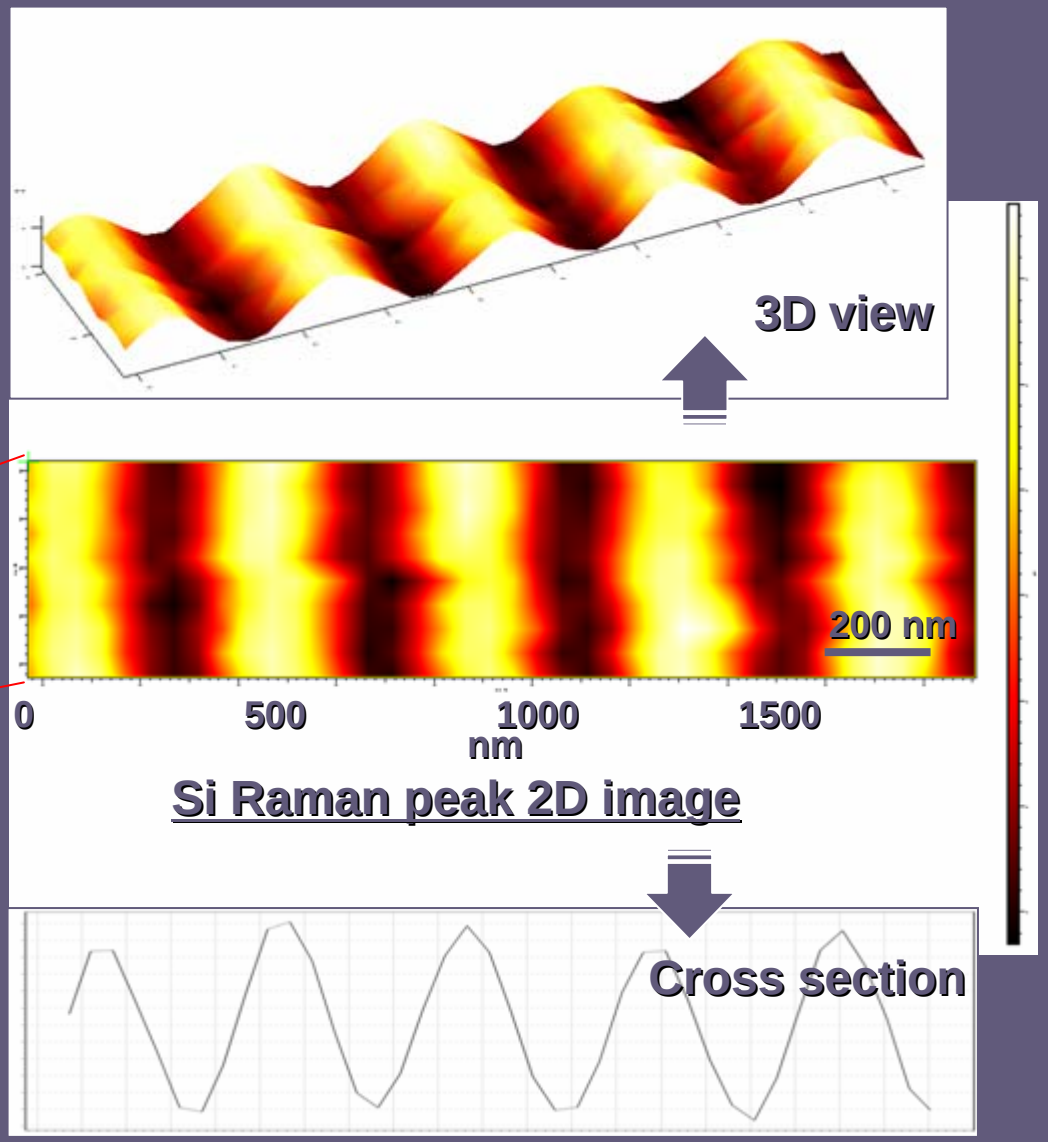


Sample structure



SEM image



Resolution	:40 x 10 point, 50 x 50 nm step,	Measuring time	:~2 min
Mapping speed	:0.2 sec/point,	Laser	:532 nm, 9 mW (on sample)
Objective lens	:100x, N.A. 1.4 oil		

High resolution (200 nm Line & Space)

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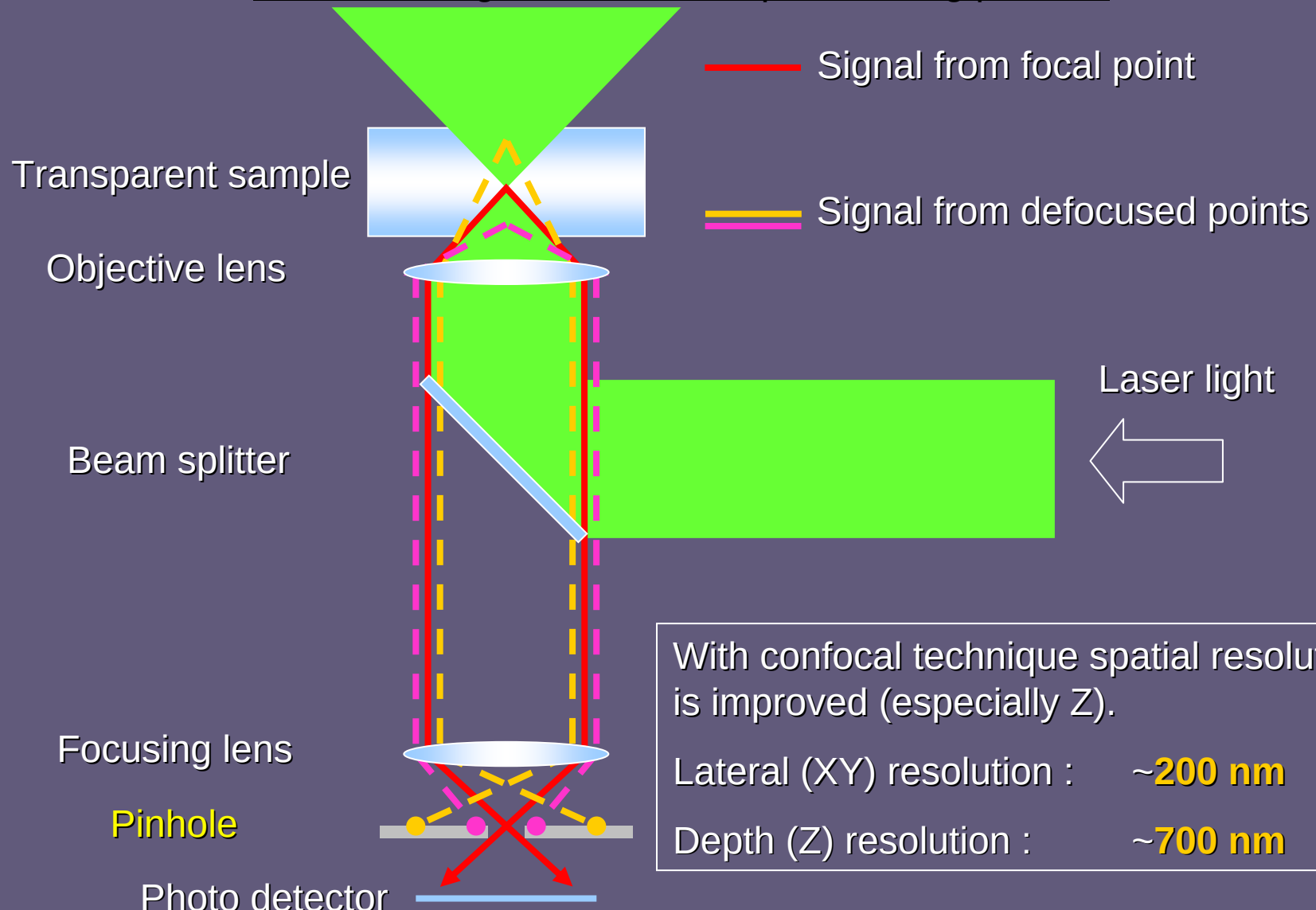
Confocal system collects signal from small volume around focal point and blocks signals from other points using pinhole.



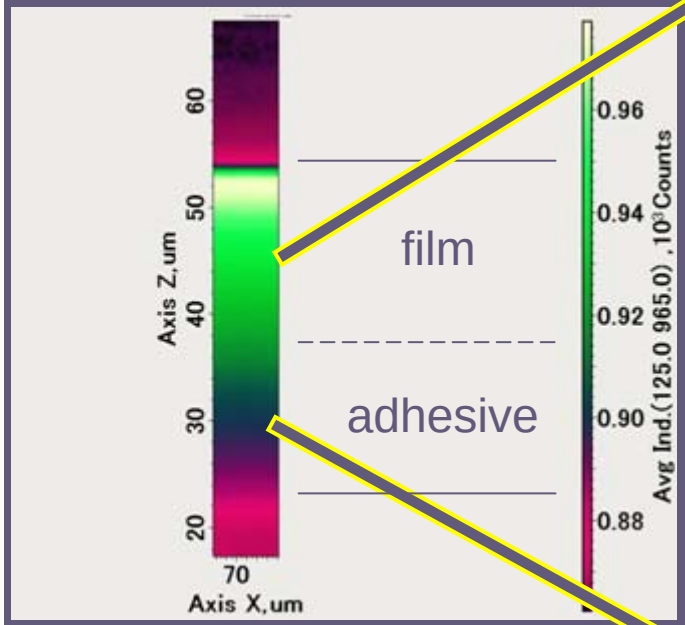
With confocal technique spatial resolution is improved (especially Z).

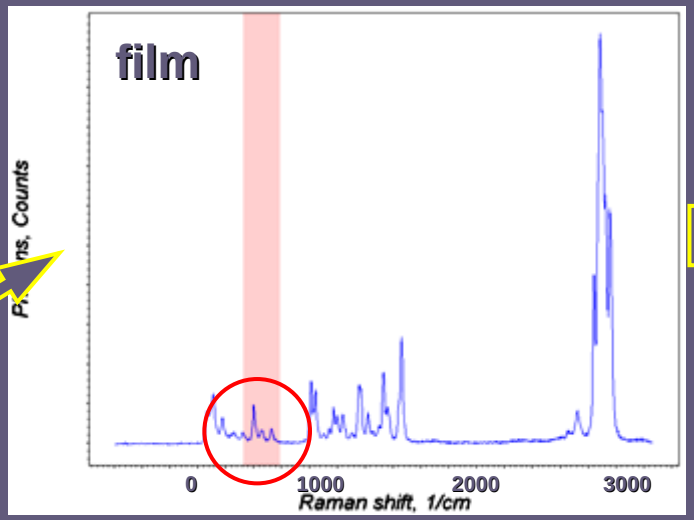
Lateral (XY) resolution : ~**200 nm**

Depth (Z) resolution : ~**700 nm**

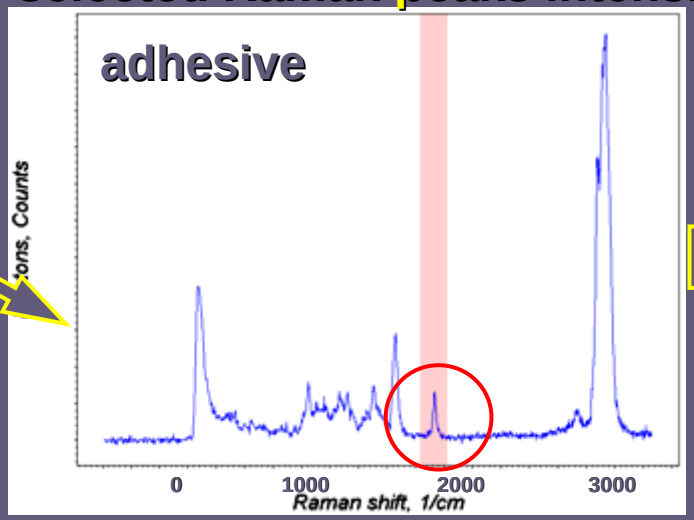
Confocal technique

Sample : Scotch tape

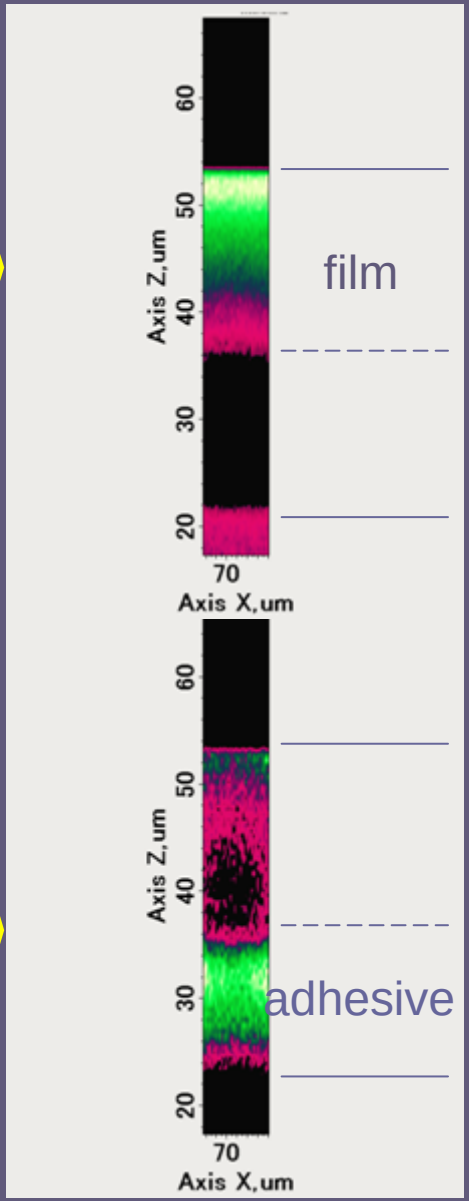




Cross-section images with selected Raman peaks intensity



Cross-section image using total Raman signal intensity (all peaks summarized)



Resolution	:32 x 100 point, 500 x 500 nm step	Measuring time	:50 min
Mapping speed	:0.5 sec/point,	Laser	:532 nm, 6 mW (on sample)

How to make Raman image

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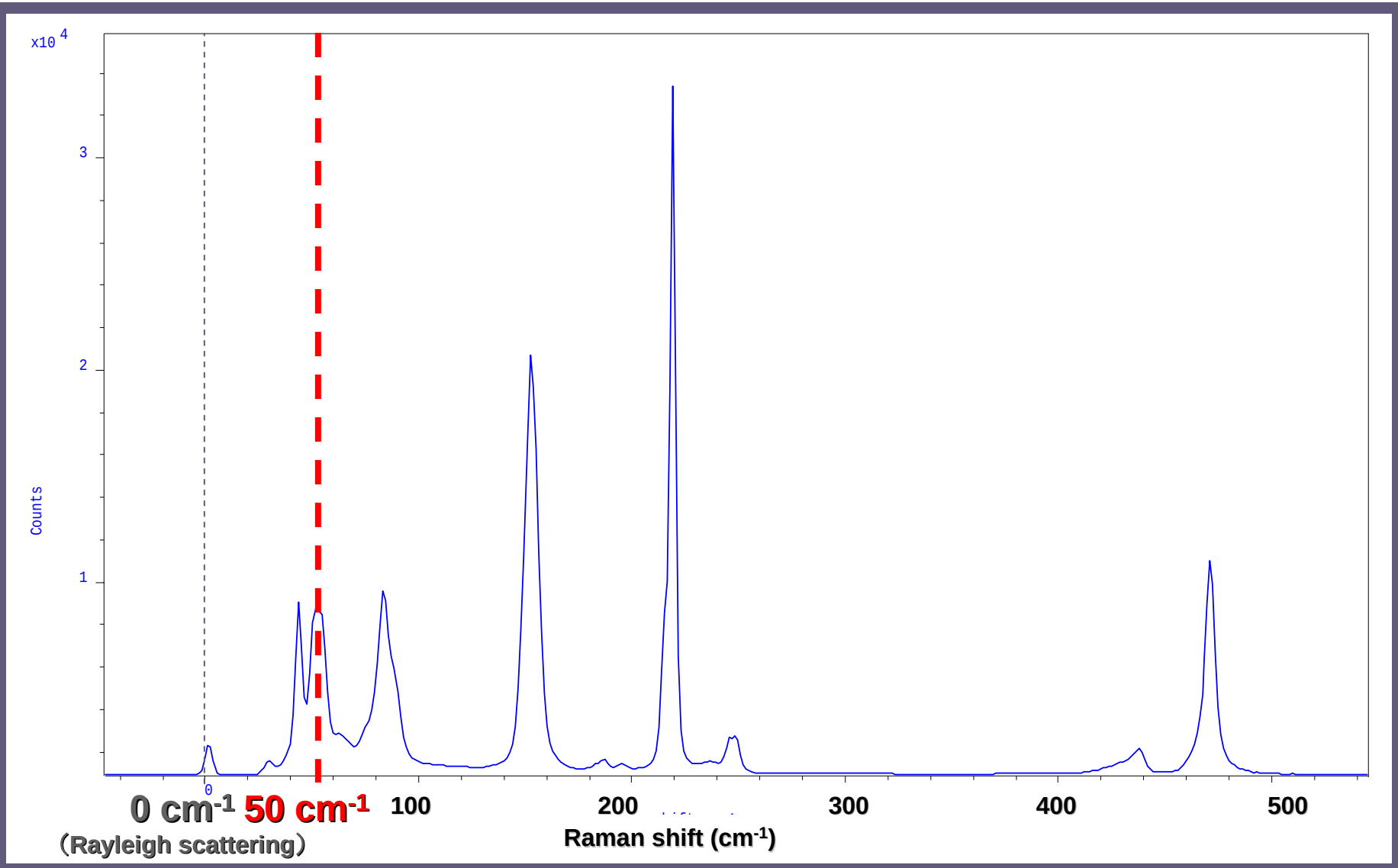
Measurement data



Sample	:sulfur	Exposure time	:0.1 sec
Laser wavelength	:532 nm	Laser power	:20 mW (on sample)
Objective lens	:x50, N.A. 0.8	Grating	:1800 G/mm

Raman spectrum in near excitation range

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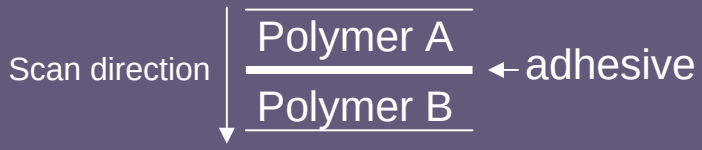
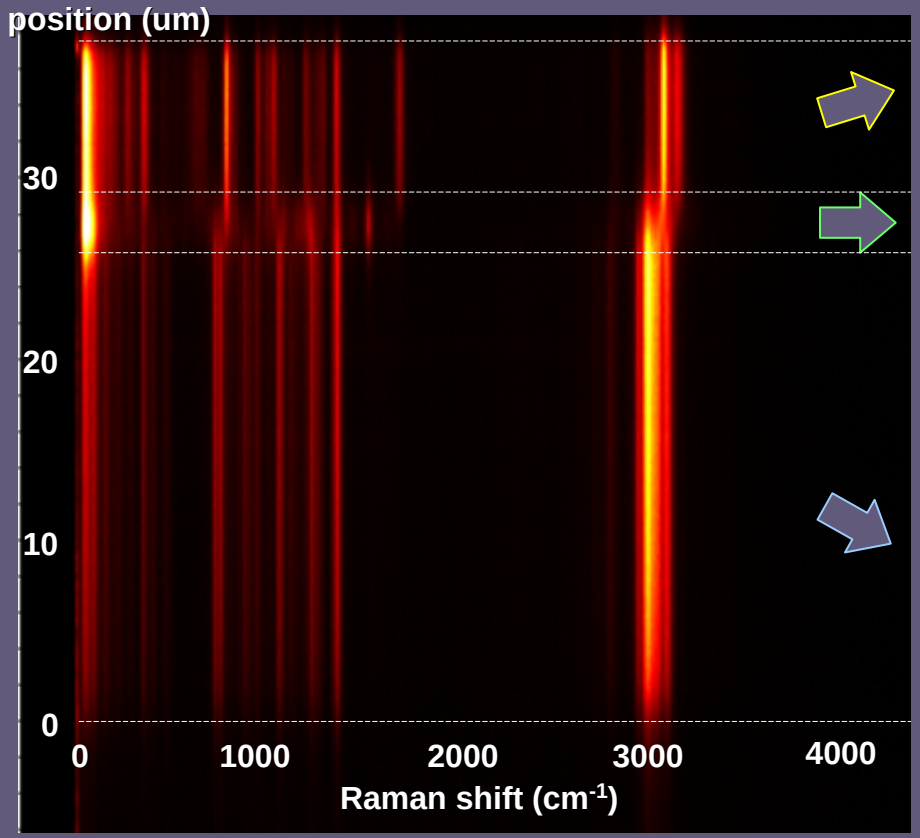
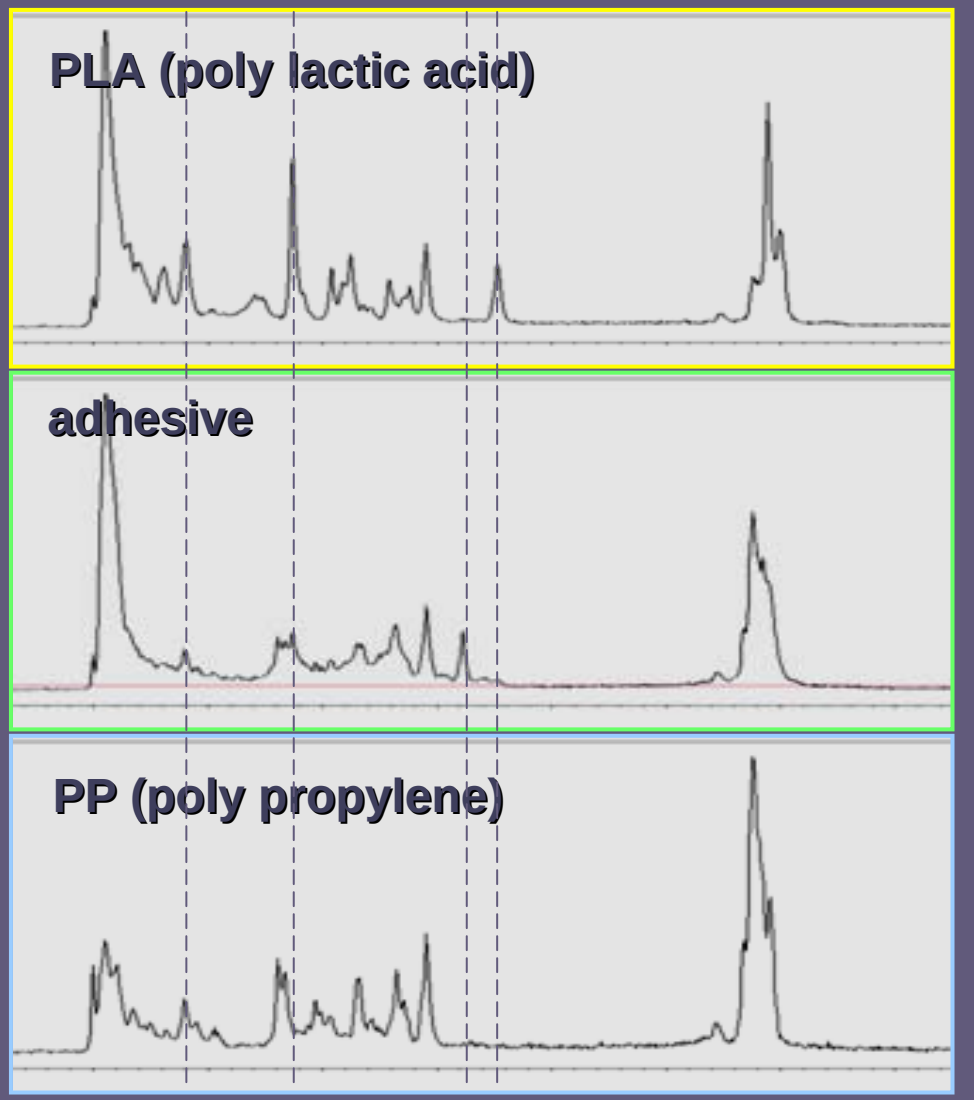
Sample : laminate film



Depth profile of Raman spectrum



Raman spectrum



Depth analysis using confocal technique

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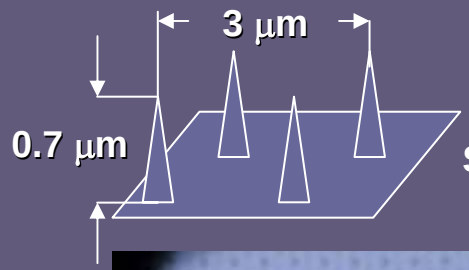
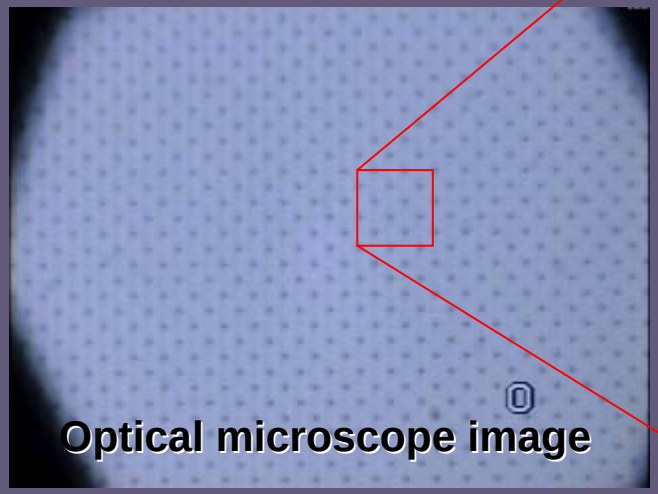
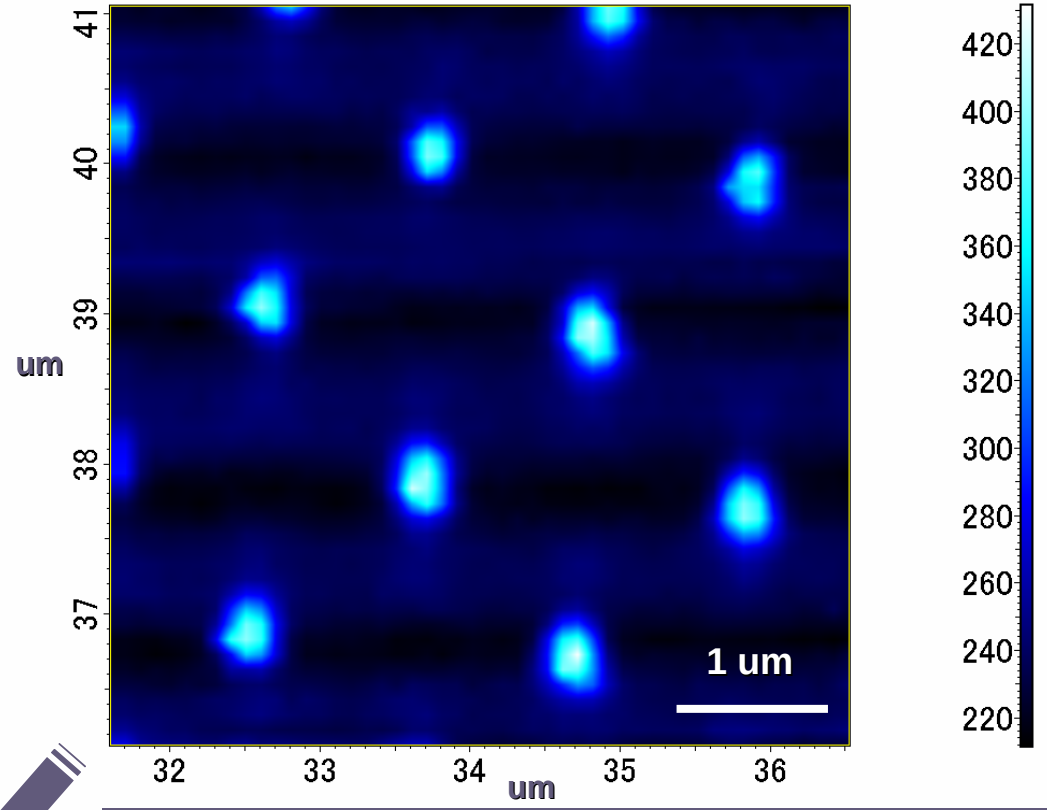
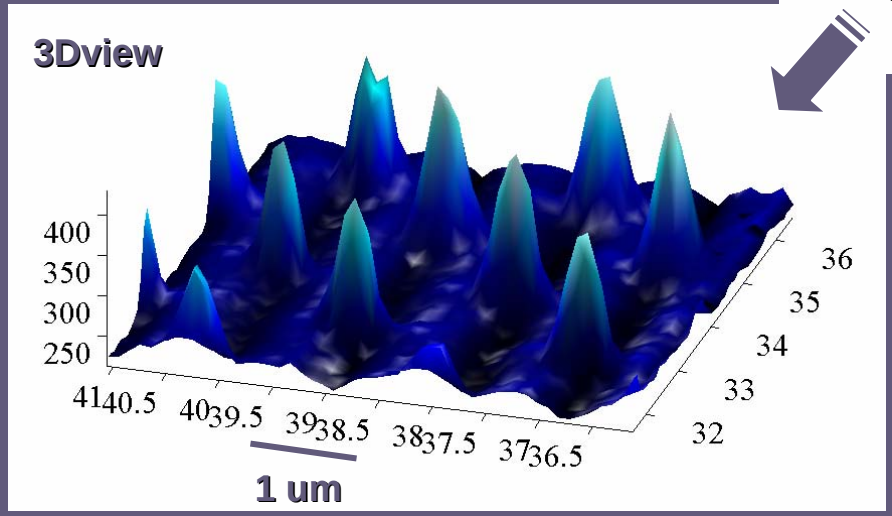


Sample shape







2D Raman image

Resolution	: 50 x 50 point 100 x 100 nm step
Measuring time	:15 min
Mapping speed	:0.3 sec/point
Laser	:532 nm, 5 mW (on sample)

2D Raman image from test sample for AFM

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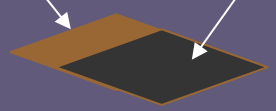
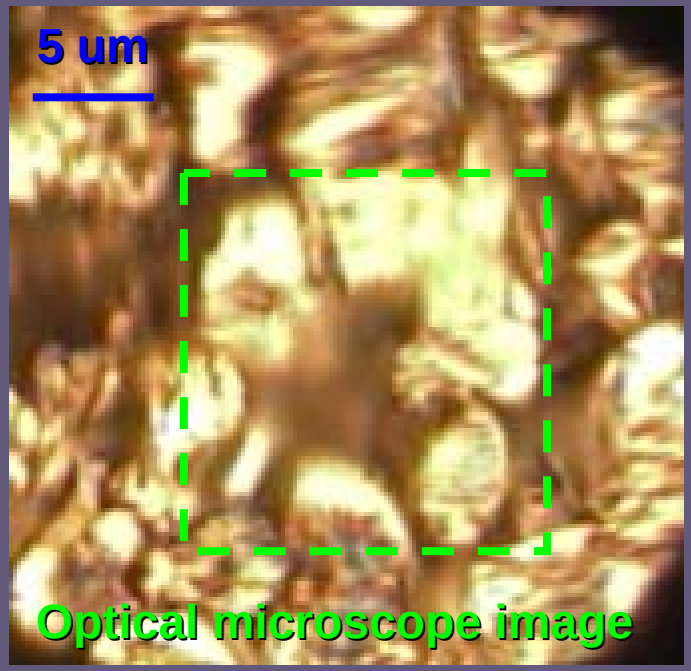
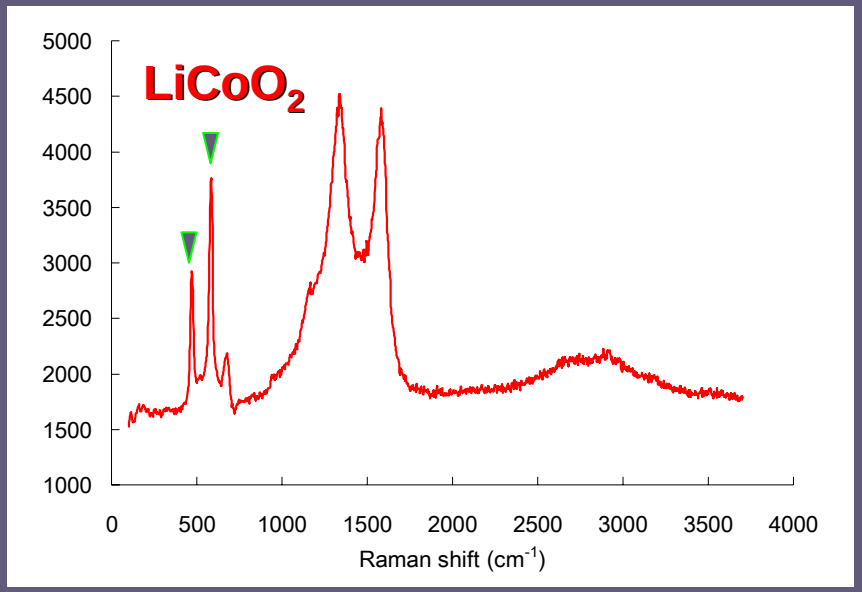
Cupper foil

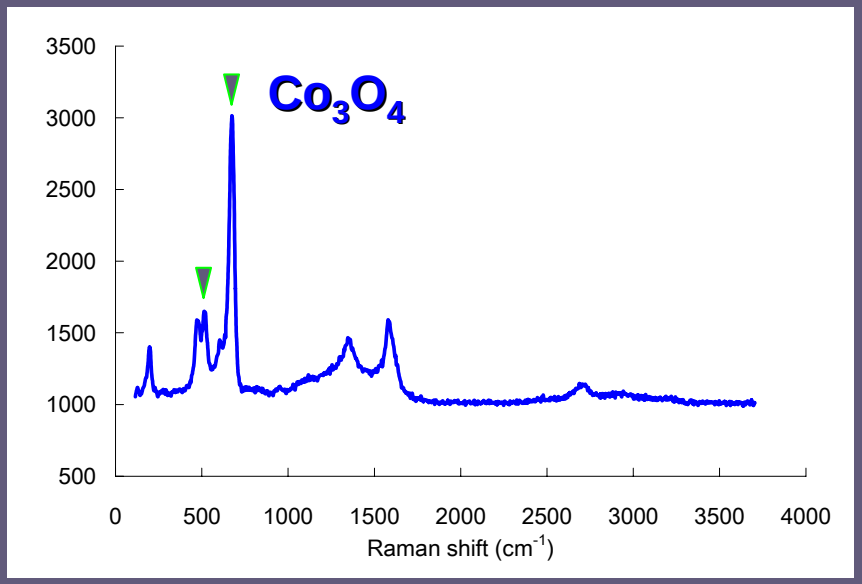
Carbon particles
+
$LiCoO_2$



Positive electrode in Lithium ion battery







Different Raman spectrum in same Sample

Normal Li ion battery: only $LiCoO_2$ can be detected.

Degraded Li ion battery: also Co_3O_4 can be detected.

Raman analysis of Lithium ion battery

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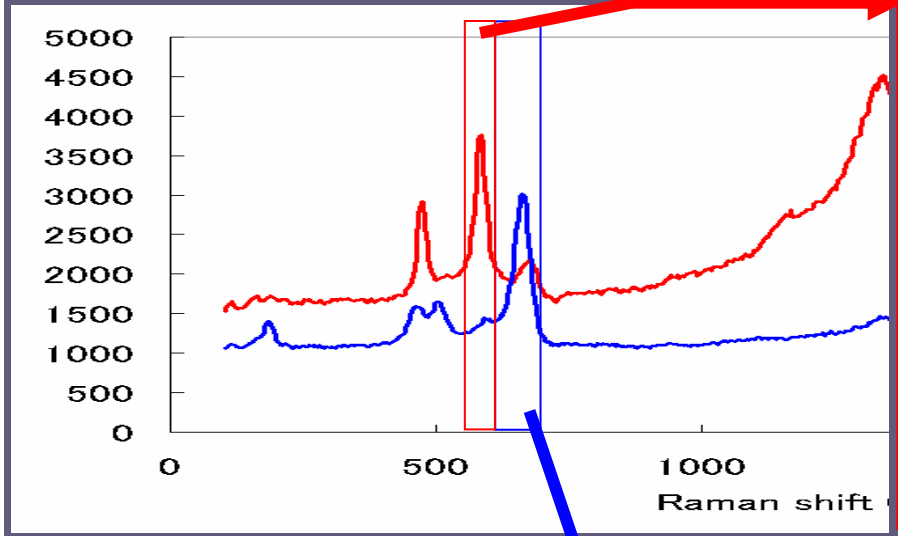
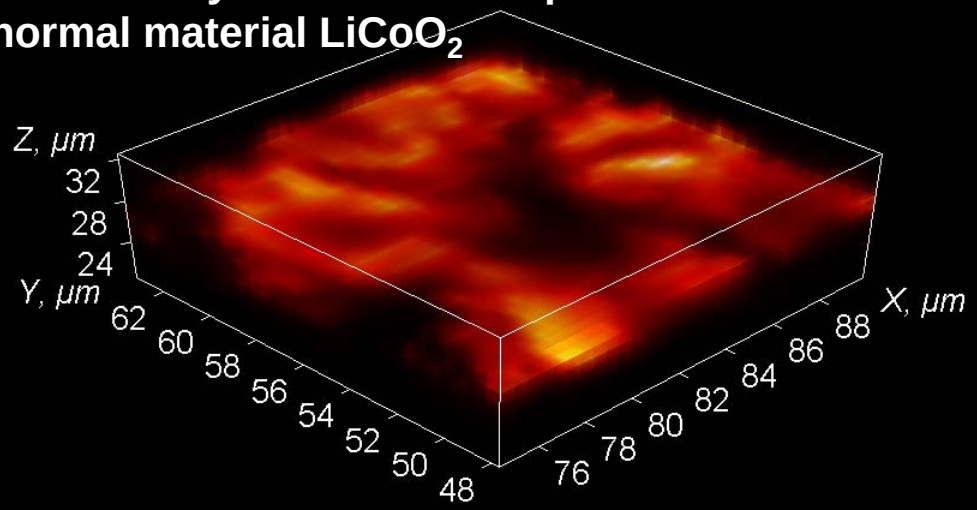
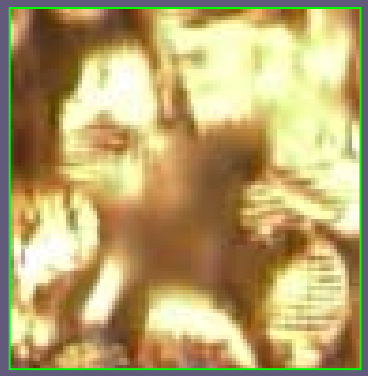
Raman Spectrum at different points

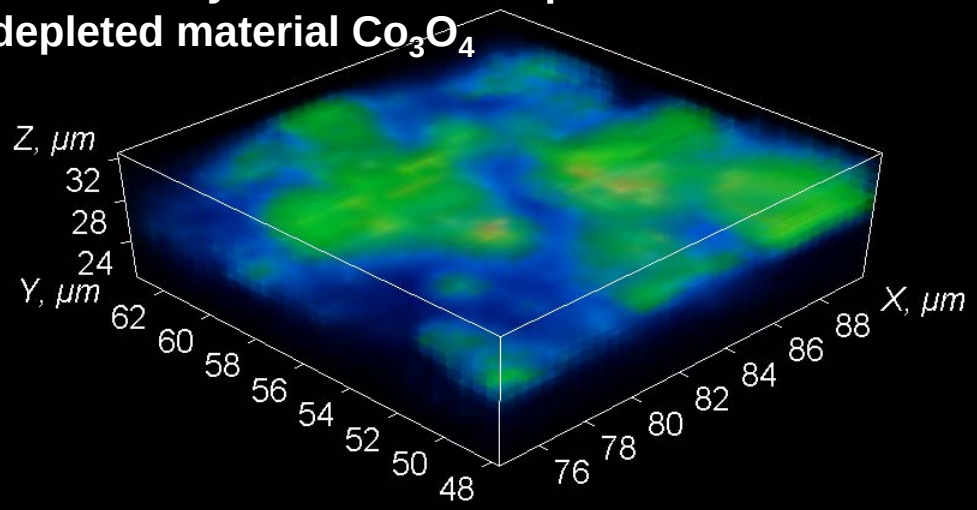


3D Intensity Distribution at peak ~600 cm^{-1} from normal material $LiCoO_2$





3D Intensity Distribution at peak ~700 cm^{-1} from depleted material Co_3O_4



This sample has rough surface due to carbon particles presence. 3D imaging is possible to apply for such samples.

3D Raman imaging (1)

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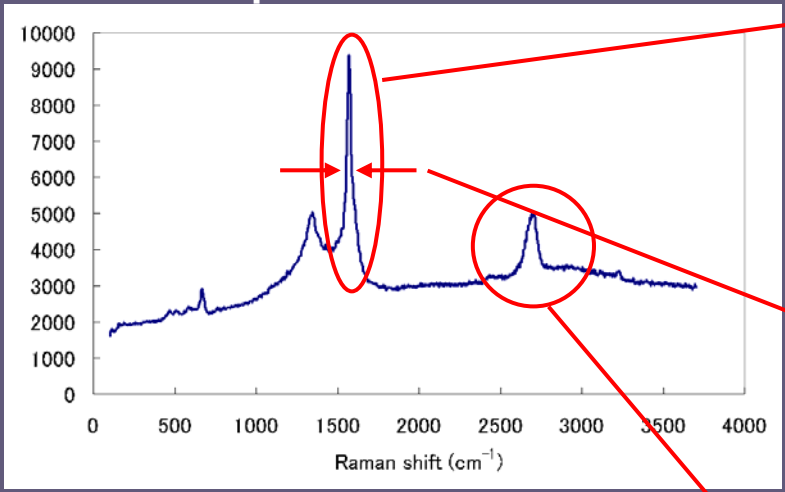
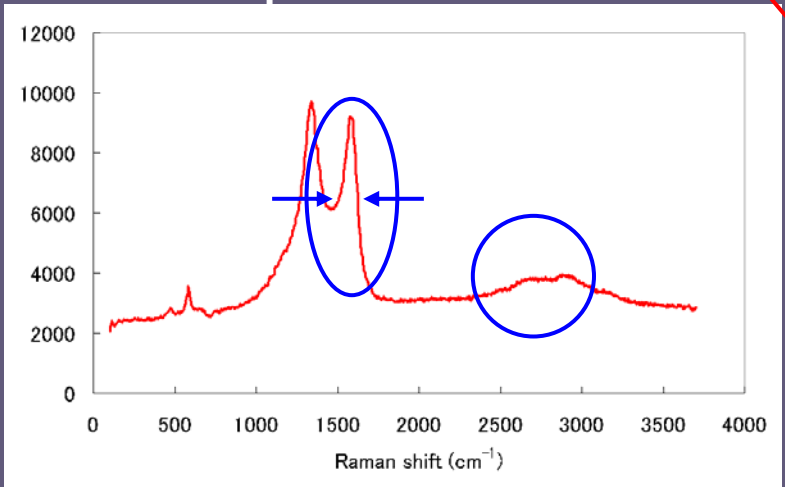
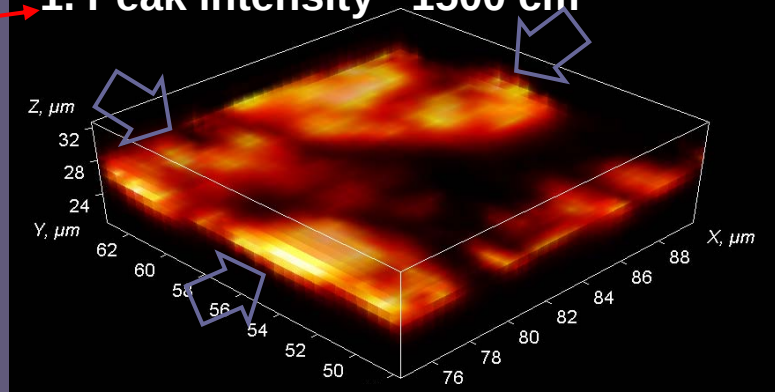
Spectrum 1



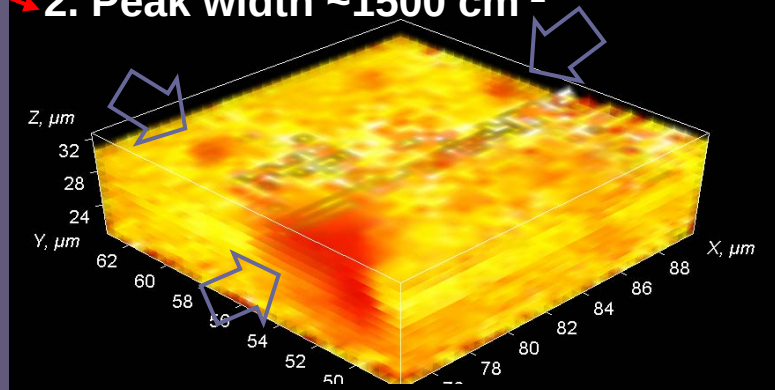
Spectrum 2



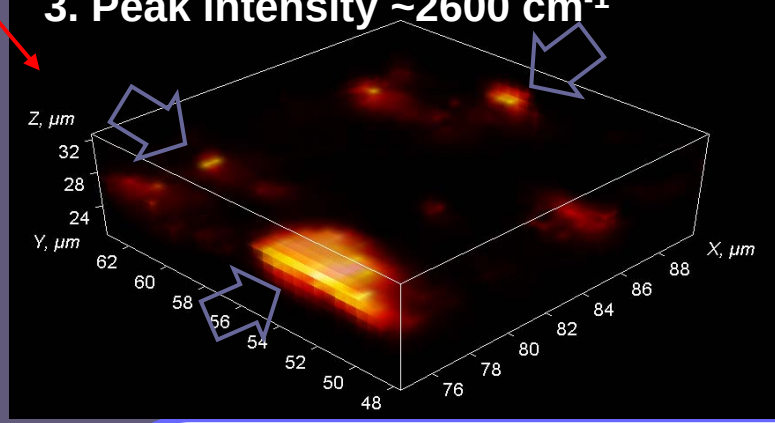
1. Peak intensity ~1500 cm^{-1}



2. Peak width ~1500 cm^{-1}



3. Peak intensity ~2600 cm^{-1}



Distribution of Image 2 (peak width ~ 1500 cm^{-1}) and Image 3 (peak intensity ~ 2600 cm^{-1}) are very similar.

3D Raman imaging (2)

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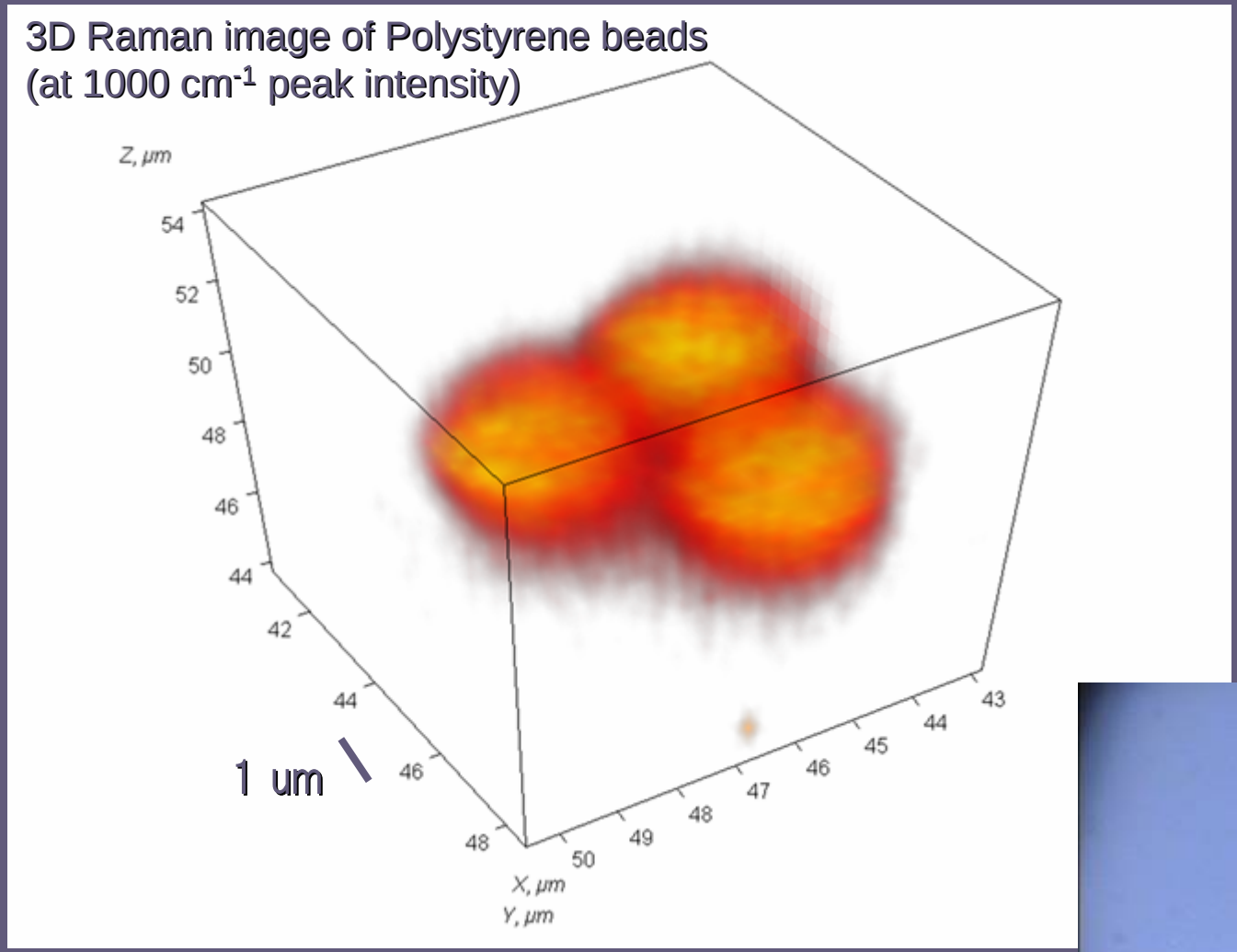
3D Raman image of Polystyrene beads
(at 1000 cm^{-1} peak intensity)



Resolution	: 32 x 32 x 15 points, 250 x 250 x750 nm step
Measuring time	: 90 min
Mapping speed	: 0.3 sec/point
Laser	: 532 nm, 1 mW (on sample)

3D Raman image of polystyrene beads

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