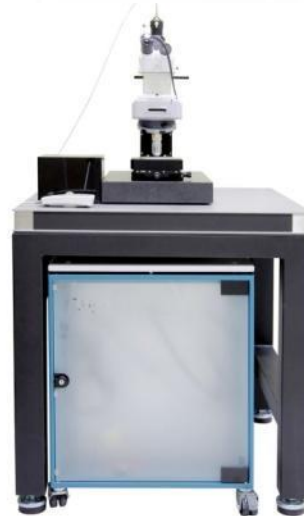


Confocal-Raman

Normal Operation Training Course



1. Syllabus

10:00~11:30, 3 April

Personal practice 3,4,10,11,17,18 April

Test 24 or 25 April

UNIST

ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

Qualification for Raman operation

1. Raman self-user training

- 1) Theory class (Raman manager Seonhye Son, 4175)
- 2) Operation class (Raman manager Seonhye Son, 4175)
 - 10:00-12:00 A.M : Manager explains about Raman
 - 13:30-16:30 P.M : Each person practices with manager

2. Practice Raman yourself

- Each person practice with manager 3 times.
- Please contact manager and make an appointment.

3. Attend the Raman test

- 20 min.test
- Explain about Raman and measurement methods.
- Sample measurement and laser power meter setting.

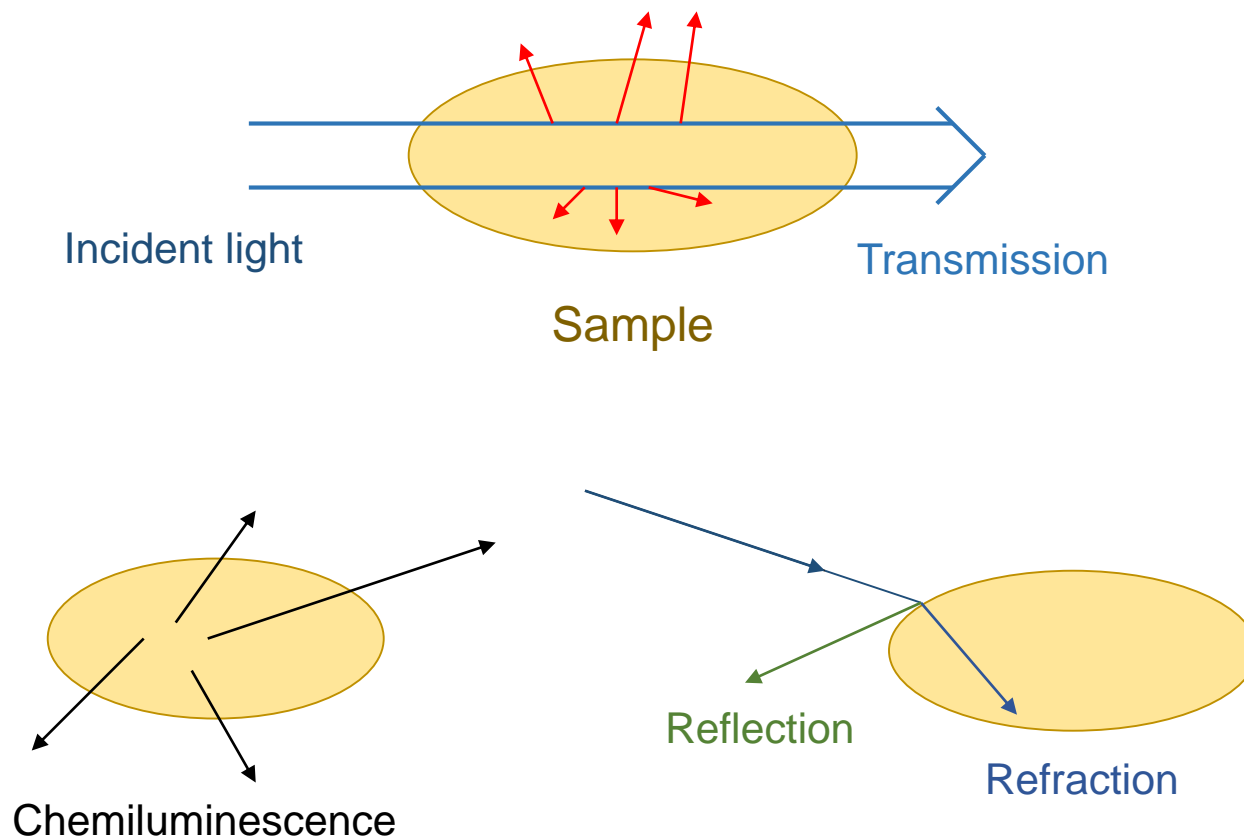
2. Basic Principles

UNIST

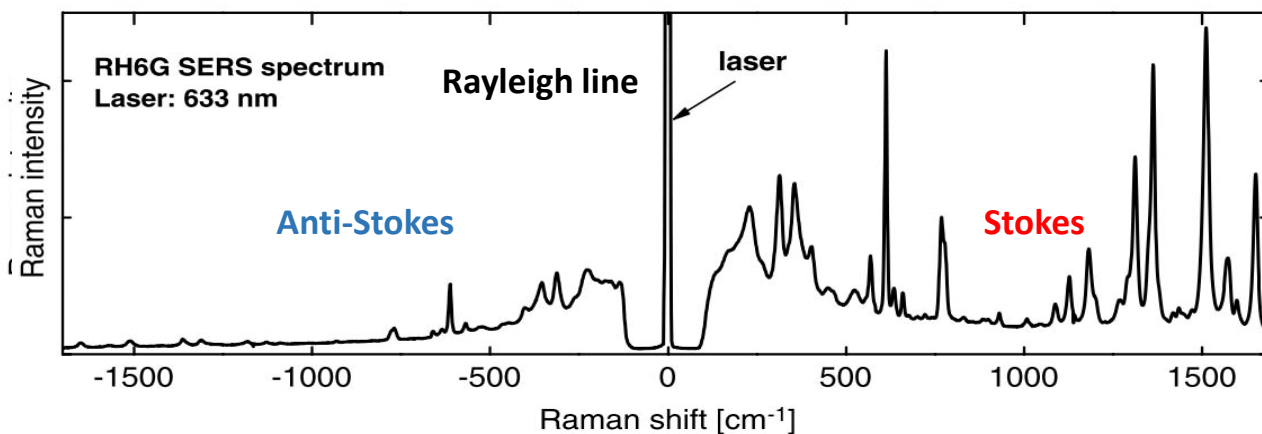
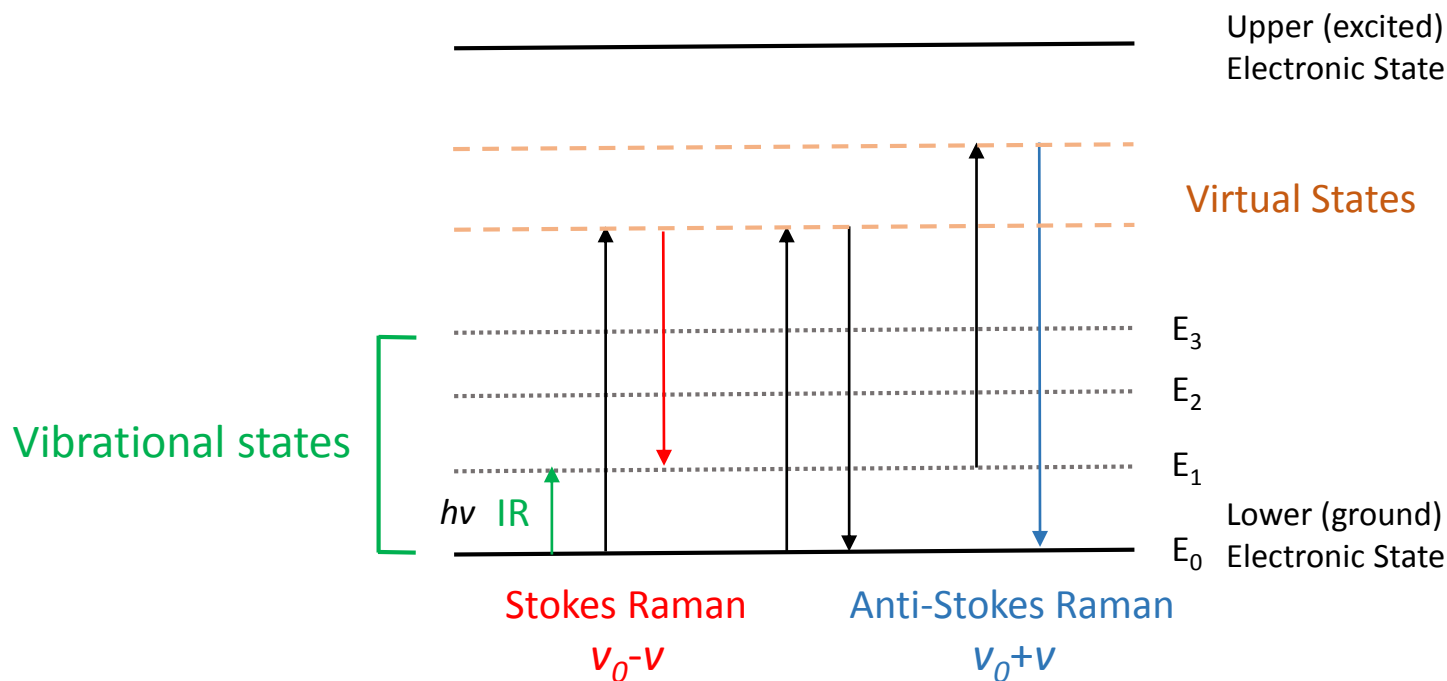
ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

Types of interaction between radiation and matter.

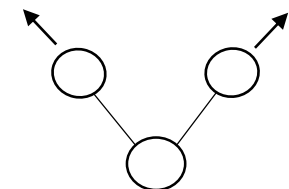
Scattering and Photoluminescence



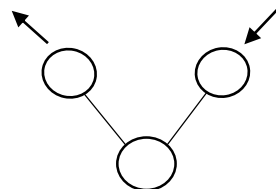
Raman spectroscopy



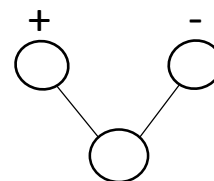
Molecular vibration



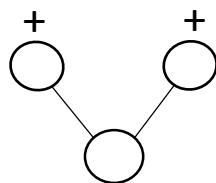
Symmetrical stretching



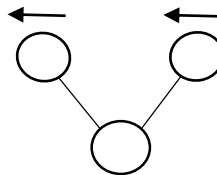
Asymmetrical stretching



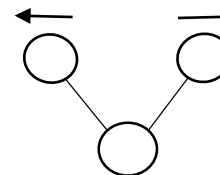
Twisting
(deformation out-of-plane)



Wagging
(deformation out-of-plane)

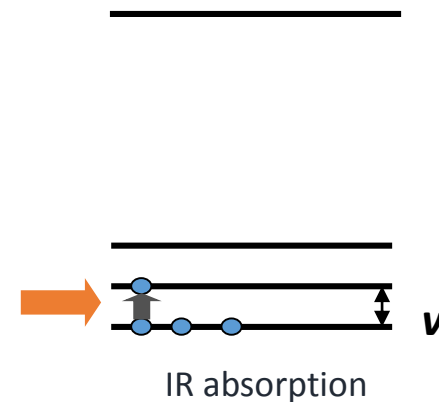
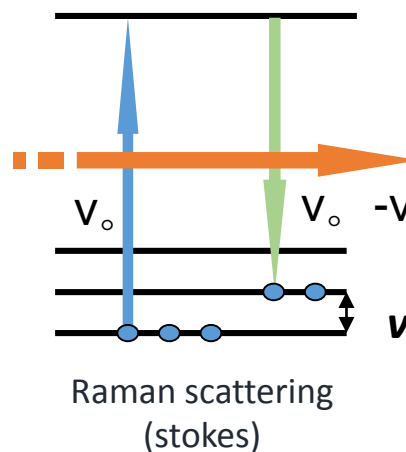


Rocking
(deformation in-plane)



Scissoring
(deformation in-plane)

Selection rules	Vibration
IR active Dipole moment	 Asymmetrical stretching
Raman active Polarizability	 Symmetrical stretching



IR	Raman
Absorption	Emission of scattered laser light
Senses dipole vibrations O-H, N-H, C=O	Senses polarizable vibrations C=C, Aromatic group
Sample preparation necessary, short optical pathlength required	Little or no sample preparation, measure through transparent packaging
Non-aqueous samples	Aqueous samples

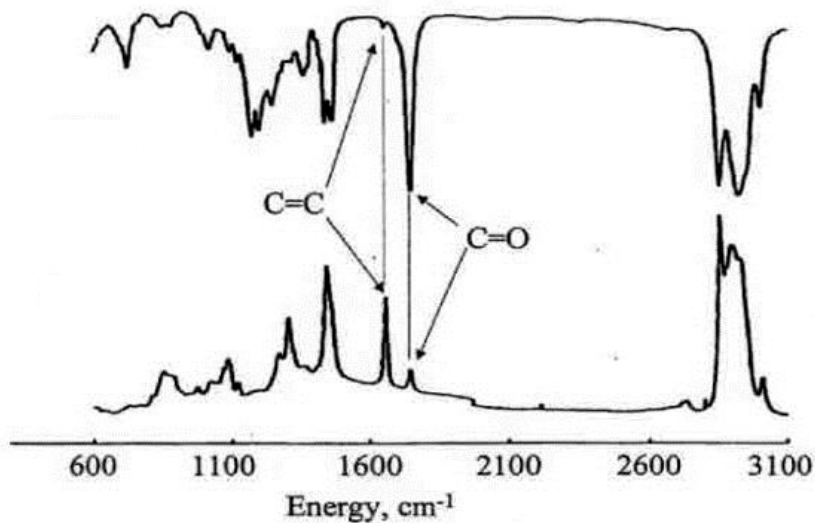
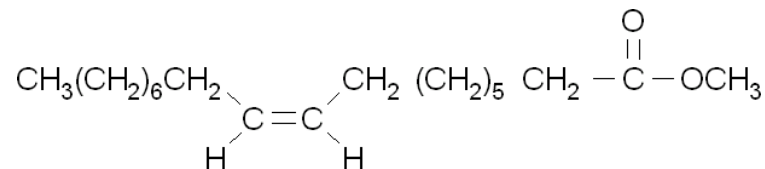


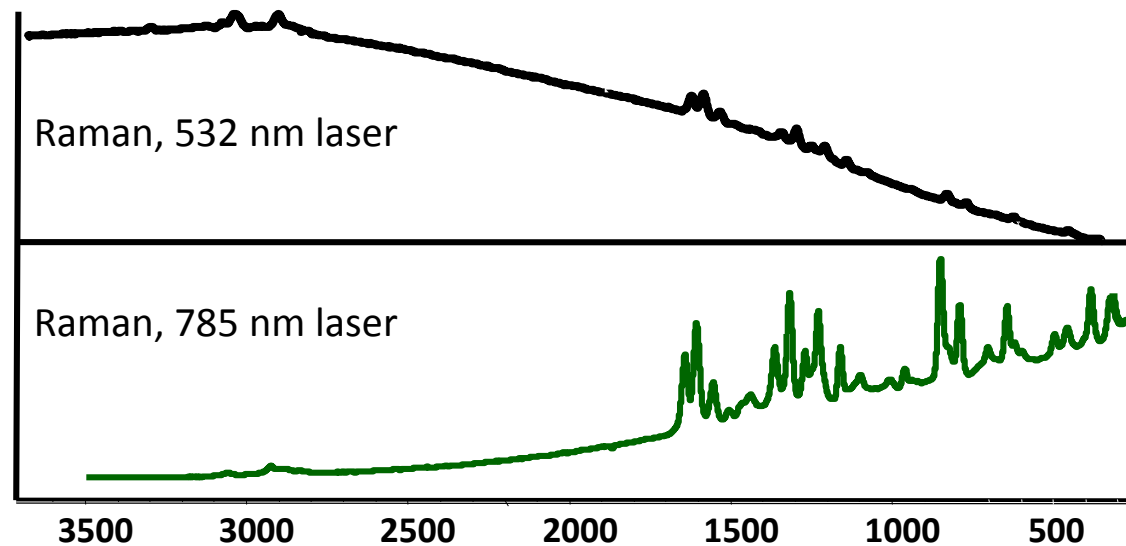
Fig. FT-IR(upper) transmission and Raman scattering(lower) of oleic acid methyl ester.



McCreery, R. L., *Raman Spectroscopy for Chemical Analysis*, 3rd ed., Wiley, New York: 2000

Fluorescence Avoidance

- In general spectrum is invariant with $\lambda_{\text{excitation}}$
- I_{Raman} proportional to $1/\lambda^4$
- NIR or UV wavelengths have been used to avoid background fluorescence interference.



Raman spectrum

Single spectrum

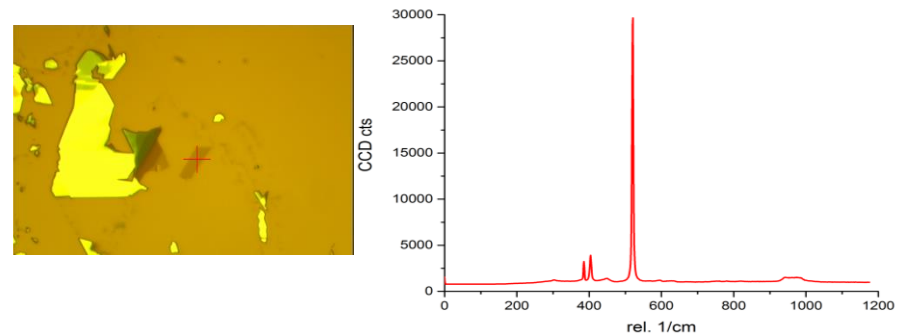
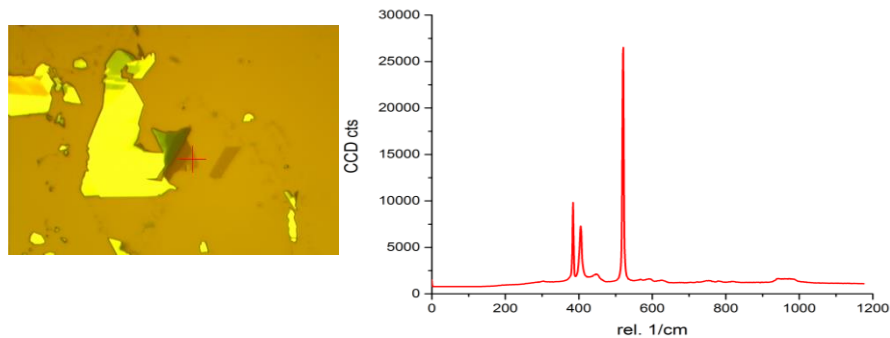
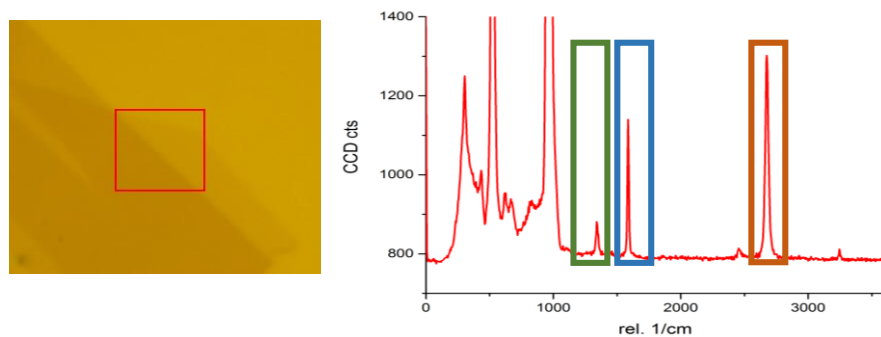
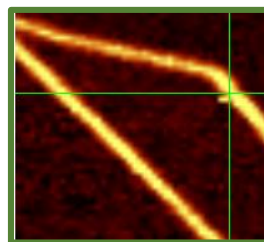


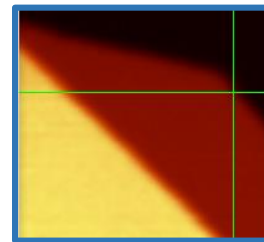
Image scan(mapping)



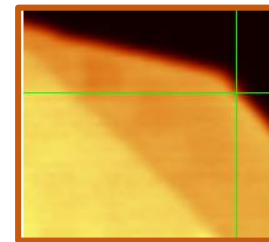
1310-1380 cm^{-1}



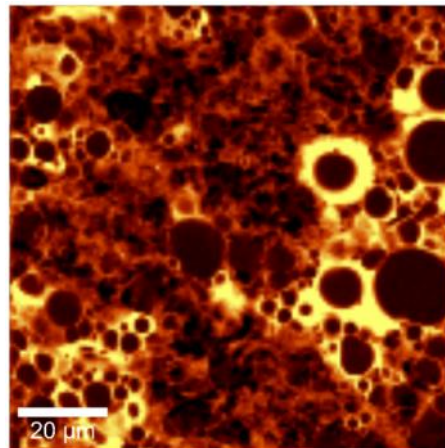
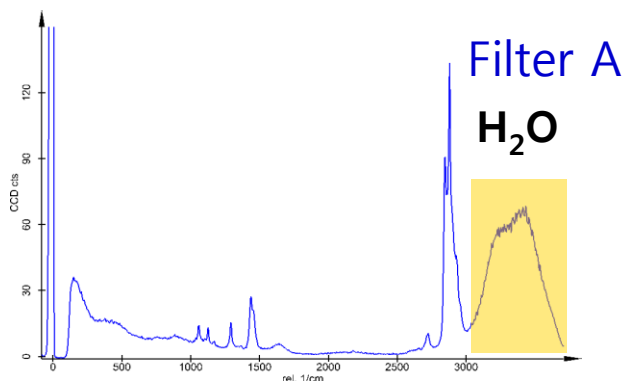
1530-1630 cm^{-1}



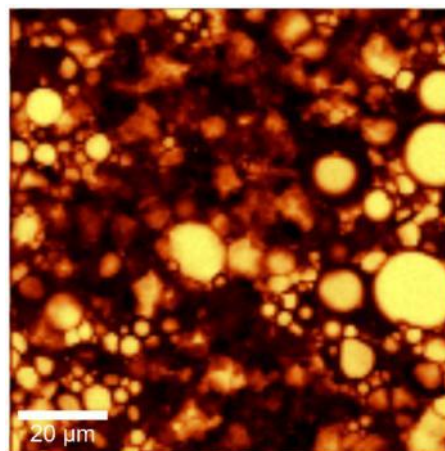
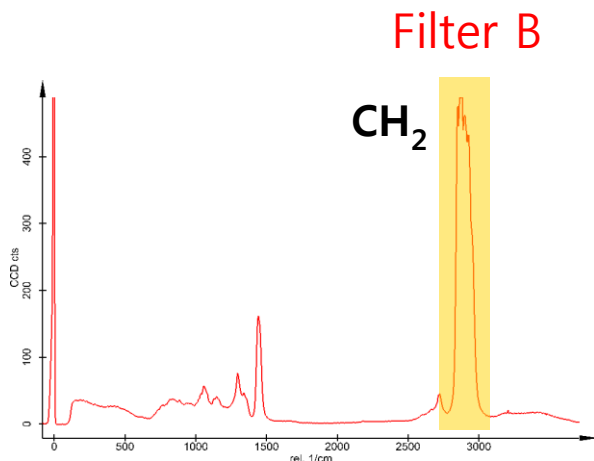
2605-2740 cm^{-1}



Spectral Imaging (Mapping)



Sample: Oil/Water Emulsion
Excitation: 532nm, 2 mW
Scan Range: 100 μm²
Resolution: 180 x 180 point
40ms/spectrum, 22 min



Optical Terminology

Working Distance(W.D.)

The distance between the front edge of the objective lens and the specimen surface (with the surface of the cover glass in case of the cover glass objective lens) when the Specimen is focused.

Numerical Aperture (N.A.)

The numerical aperture is a key factor to the performance of objective lens (resolving power, focal depth and brightness).

The N.A. is determined by the following formula :

$$\text{N.A.} = n \times \sin\theta$$

n = refraction rate of the medium between specimen and objective lenses.

(air : $n=1$, oil : $n=1.515$)

θ = angle which is made by the optical axis and refraction of the light farthest from the center of lens.

Optical Terminology

Resolving power

The resolving power of an objective lens is measured by **its ability to differentiate two lines or points in an object.**

The larger the N.A., the higher the resolving power.

$$\varepsilon = 0.61 \times \frac{\lambda}{\text{N.A.}} \quad (\text{Reyleigh formula})$$

λ : wavelength or radiation in use
N.A. : objective lens N.A.

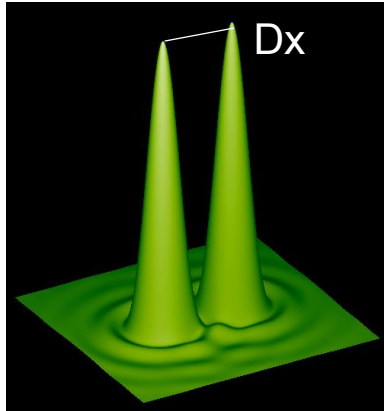
Focal depth of Microscope

The focal depth refers to the depth of the specimen layer which is in sharp focus at the same time, even if the distance between the objective lens and the specimen plane is changed when observing and shooting the specimen plane by microscope.

$$\pm \text{D.O.F.} = \frac{\omega \times 250,000}{\text{N.A.} \times M} + \frac{\lambda}{2(\text{N.A.})^2} \quad (\mu\text{m})$$

ω : resolving power
N.A. : objective lens N.A.

Resolving power



$$\Delta x = \frac{0.61 \times \lambda}{\text{N.A.}}$$

For example. Image scan : 30x30 μm
with Raman 532nm, 100x objective

Magnification	N.A.	λ [nm]	Δx [nm]
20x	0.4	532	811
		633	965
		785	1197
50x	0.8	532	405
		633	482
		785	598
100x	0.9	532	360
		633	429
		785	532

$$\text{Point/Line (Line/Image)} = \frac{\text{Geometry Width (Height)}}{\text{Resolution } (\Delta x)} = \frac{30,000 \text{ nm}}{360 \text{ nm}} = 83 \text{ Point}$$

Image scan (Point/Line & Line/Image) will be 83 point and it is enough good.

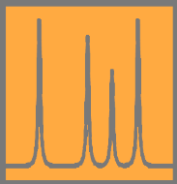
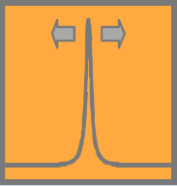
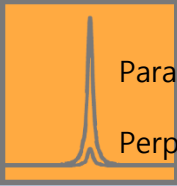
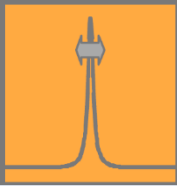
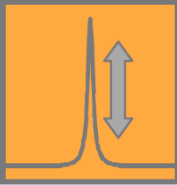
To improve image scan, Image scan can be multiple three times by 83 points.

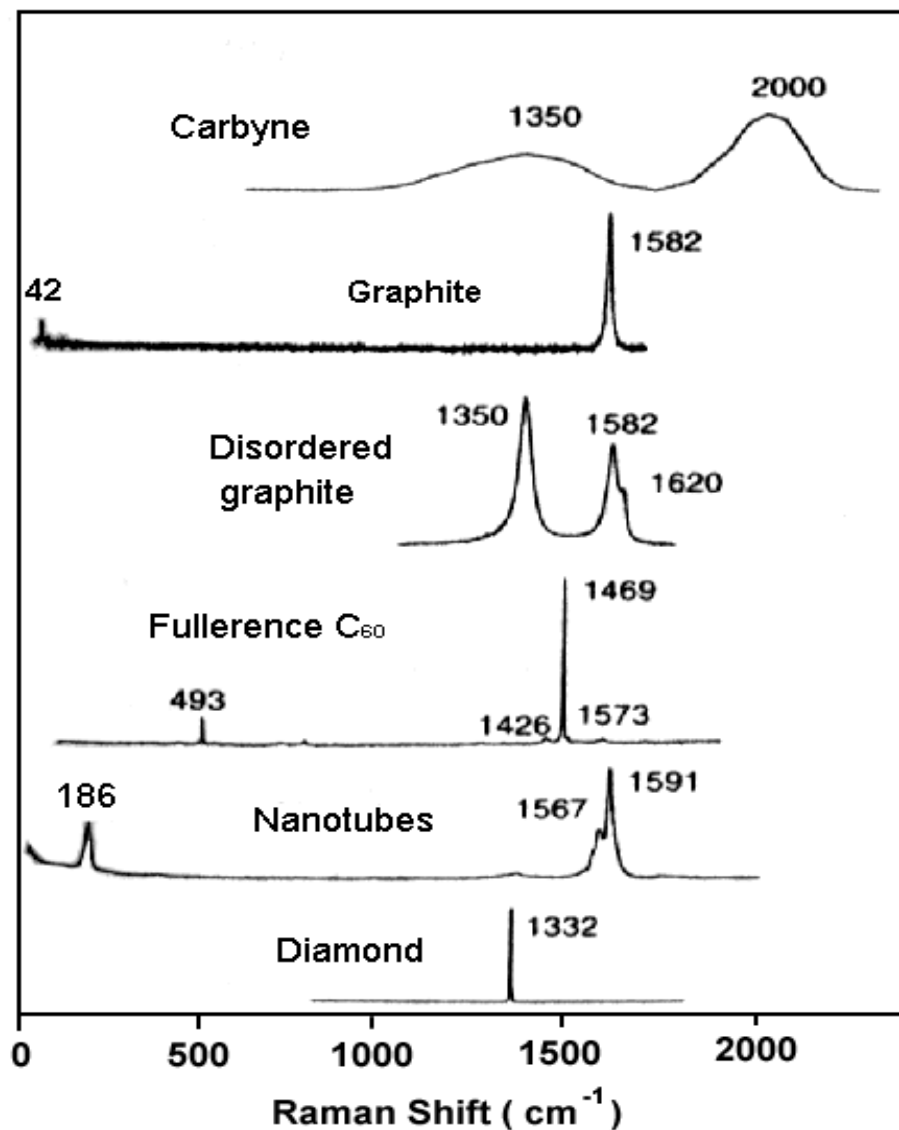
Why three times? That's a kind of statics.

The more you do image scan double, triple and four times, the more you get the better image.

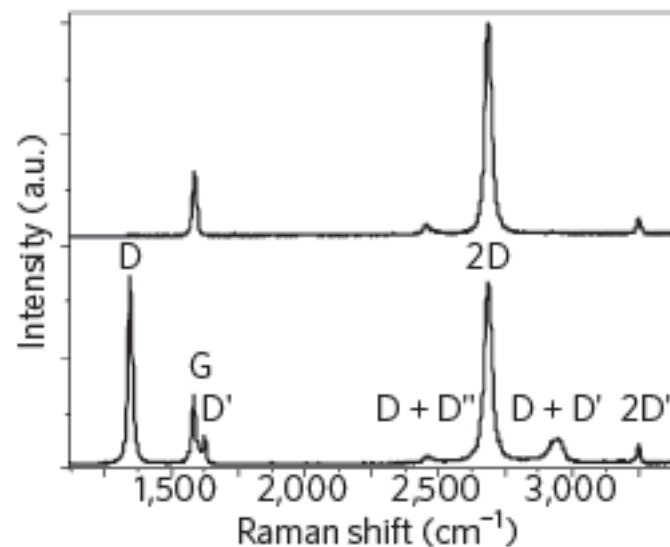
However, measurement time is increasing. Triple is enough.

- Optical Resolution: 200 nm/ laterally, 500 nm/ vertically
- Spectral Resolution: 0.02 wavenumbers

Raman spectrum	Information
 <p>Characteristic Raman frequencies</p>	Composition of material
 <p>Changes in frequency of Raman peak</p>	Stress and strain state
 <p>Polarization of Raman peak</p>	Crystal symmetry and orientation
 <p>Width of Raman peak</p>	Quality of crystal
 <p>Intensity of Raman peak</p>	Amount of material



Raman spectrum of graphene



Raman spectra of pristine (top) and defected (bottom) graphene. The main peaks are labelled.

NATURE NANOTECHNOLOGY | VOL 8 | APRIL 2013

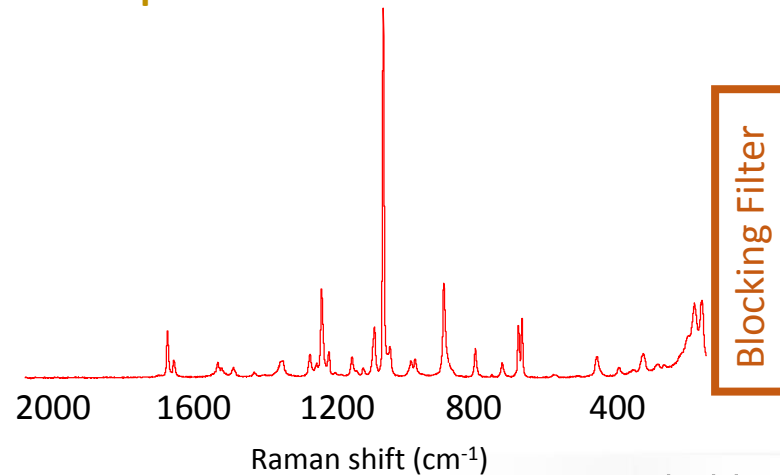
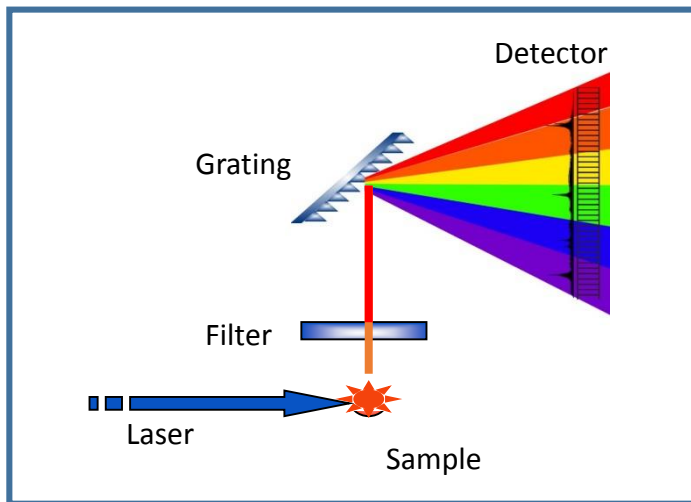
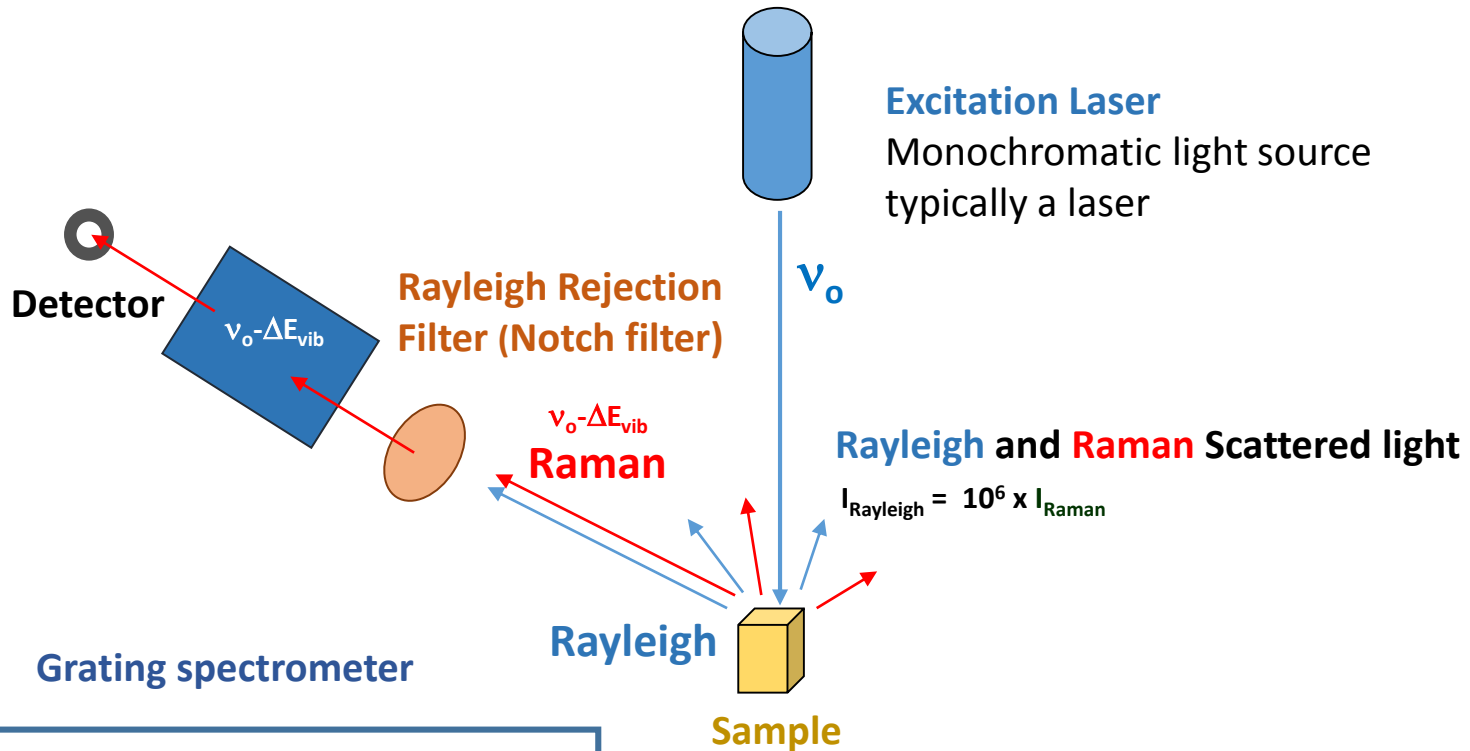


3. Hardware

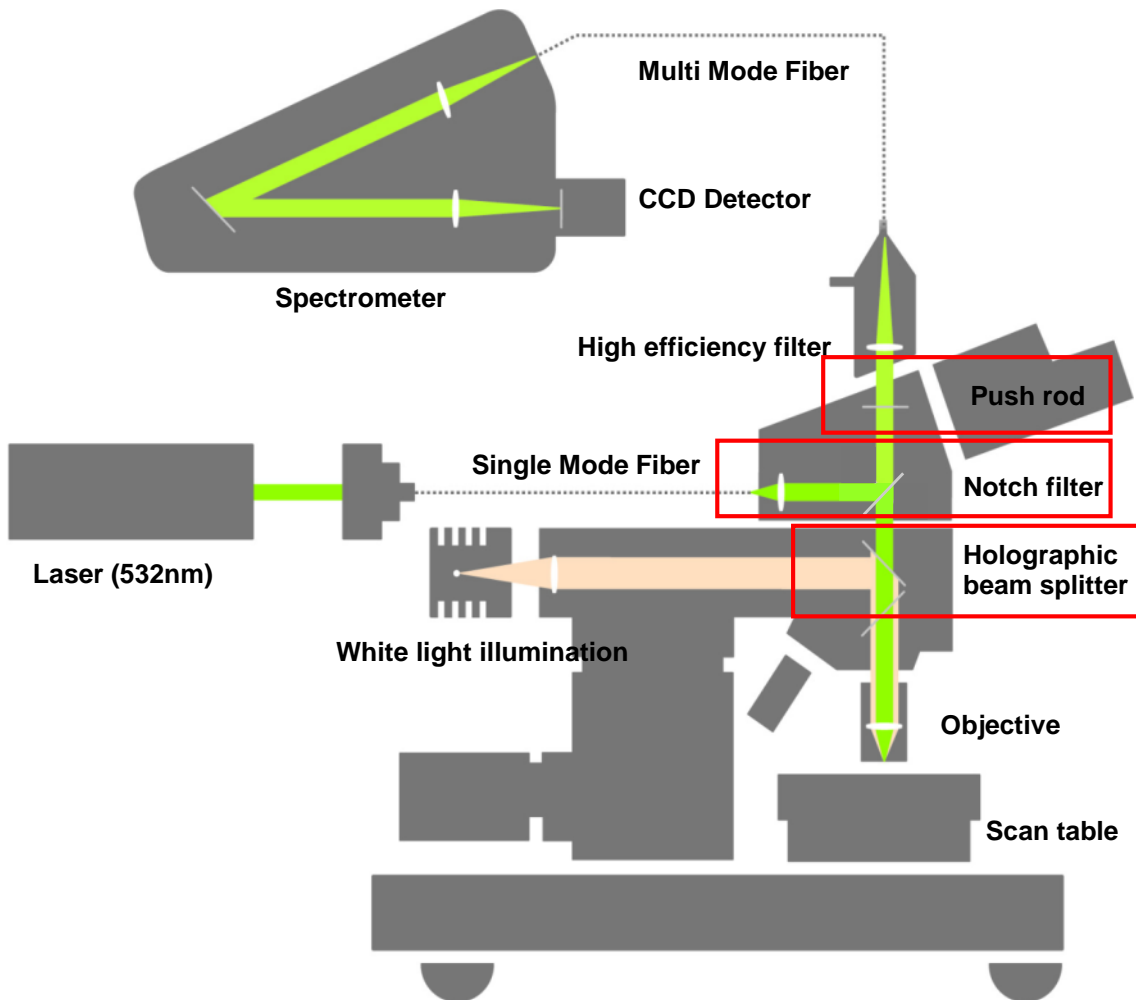
UNIST

ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

Conceptual Raman Spectrometer



Raman spectrometer



	Beam Splitter	Notch Filter	Push Rod
Image Mode	BF	IN	IN
Laser Mode	DF	OUT	IN
Raman Mode	DF	IN	OUT

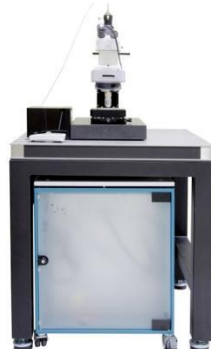


Image Mode

Laser Mode

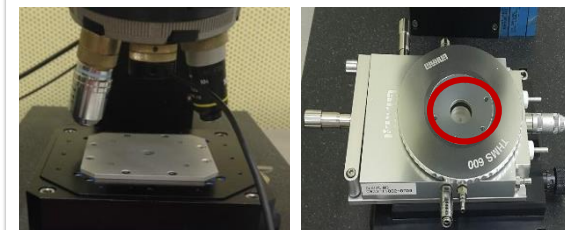
Raman Mode

장비명	Confocal-Raman	AFM-Raman
-----	----------------	-----------



위치	102- B107	102- B107
사용	의뢰/자율사용 가능	의뢰/자율사용 가능
모델명	Alpha300R	Alpha300S
시료	Powder, liquid, film	Powder, liquid, film
Measurement mode	Single scan, Image scan	Single scan, Image scan, SNOM
Laser source (nm)	532	532, 633, 785
Objective (N.A., WD mm)	50x (0.8, 0.54), 10x (0.25, 7.0)	100x (0.9,1.0), 50x (0.5, 10.6), 20x (0.4, 3.8)
Temperature controller	사용 가능	

Raman scan table



※ No sample holder

① Max. sample size

Scan table: 120 mm in x- and y-direction, 25 mm in height
Temperature control scan table: 10 mm in x- and y-direction, 4 mm in height

② Min. sample size

: 2 mm in x- and y-direction

③ Flat & Smooth Surface

Temperature controller

Temperature range	-185 ~ 300°C (~600 °C with cooling system)
Temperature stability	<0.1°C
Hold time at 77K	About 3 hrs

4. Raman operation

UNIST

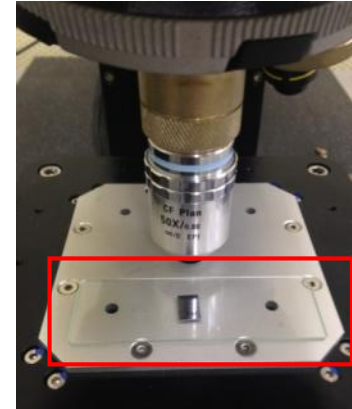
ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

Si calibration

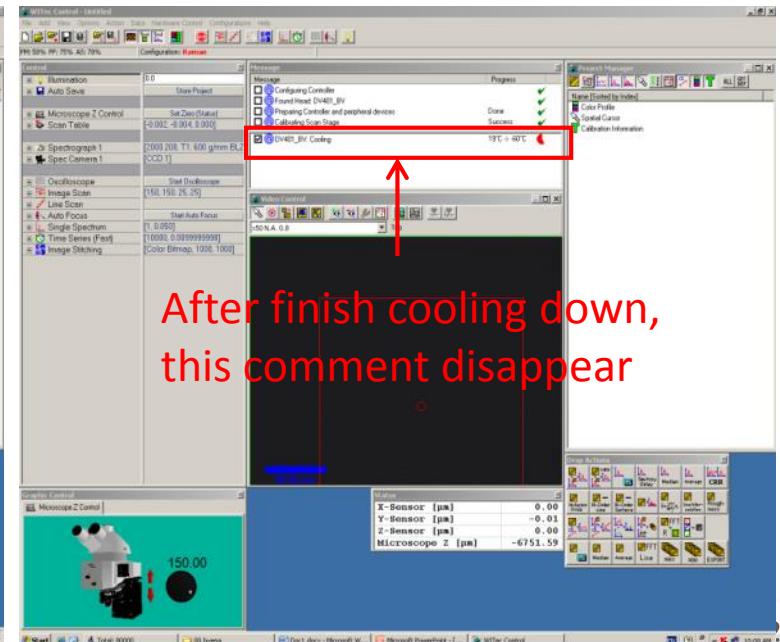
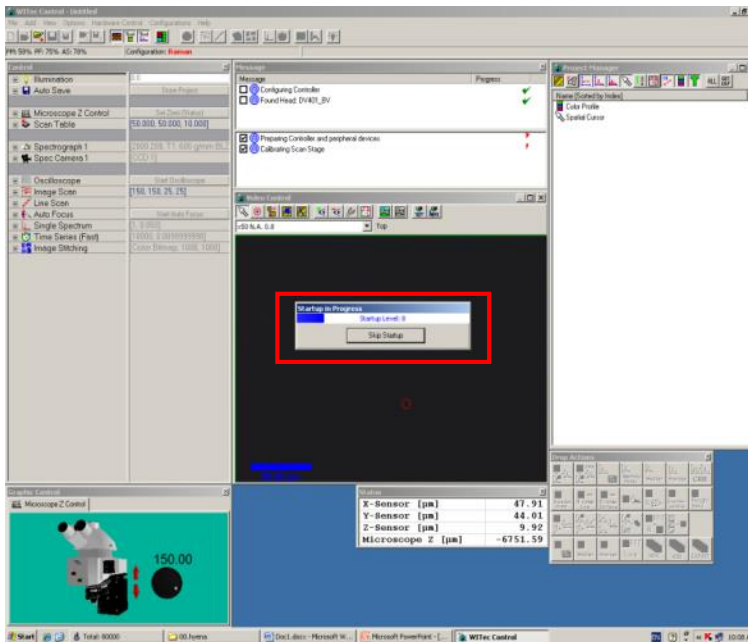
1. Laser on → warm up (10 min)



3. Put down a Si substrate(reference) on a slide glass



2. WITec Control Pro. START → wait cooling down (10 min)



4. Image Mode → Control → Illumination = 100, Speed 100 → down

WITec Control - Untitled

File Add View Options Action Data Hardware Control Configurations Help

PM: 58% PF: 74% AS: 77% Configuration: **Raman**

Left Sidebar (Control Options):

- ☒ Illumination: 100.0
- ☒ Auto Save: Store Project
- ☒ Microscope Z Control: Set Zero (Status)
- ☒ Scan Table: [-0.002, -0.004, 0.000]
- ☒ Spectrograph 1: [2000.208, T1: 600 g/mm BLZ]
- ☒ Spec Camera 1: [CCD 1]
- ☒ Oscilloscope: Start Oscilloscope
- ☒ Image Scan: [150, 150, 25, 25]
- ☒ Line Scan
- ☒ Auto Focus: Start Auto Focus
- ☒ Single Spectrum: [1, 0.050]
- ☒ Time Series (Fast): [10000, 0.00999999998]
- ☒ Image Stitching: [Color Bitmap, 1000, 1000]

Message:

- ☐ Found Head: DV401_BV
- ☐ Preparing Controller and peripheral devices
- ☐ Calibrating Scan Stage
- ☐ DV401_BV

Progress: Done, Success, Stabilized at -60°C

Video Control:

x50 N.A. 0.8 Top

30.00 μm

Project Manager:

Name [Sorted by Index]

- Color Profile
- Spatial Cursor
- Calibration Information

Drop Actions:

- MAX, Savitzky, Median, Average, CRR
- Inclusion Area, N-Order Line, N-Order Surface, R=10, R=10, Line Interpolation, Roughness
- Line, FFT, R, FFT, Line, MAX, AOD, EXPORT

Status:

X-Sensor [μm]	0.00
Y-Sensor [μm]	-0.01
Z-Sensor [μm]	0.00
Microscope Z [μm]	-6711.48

Graphic Control:

Microscope Z Control

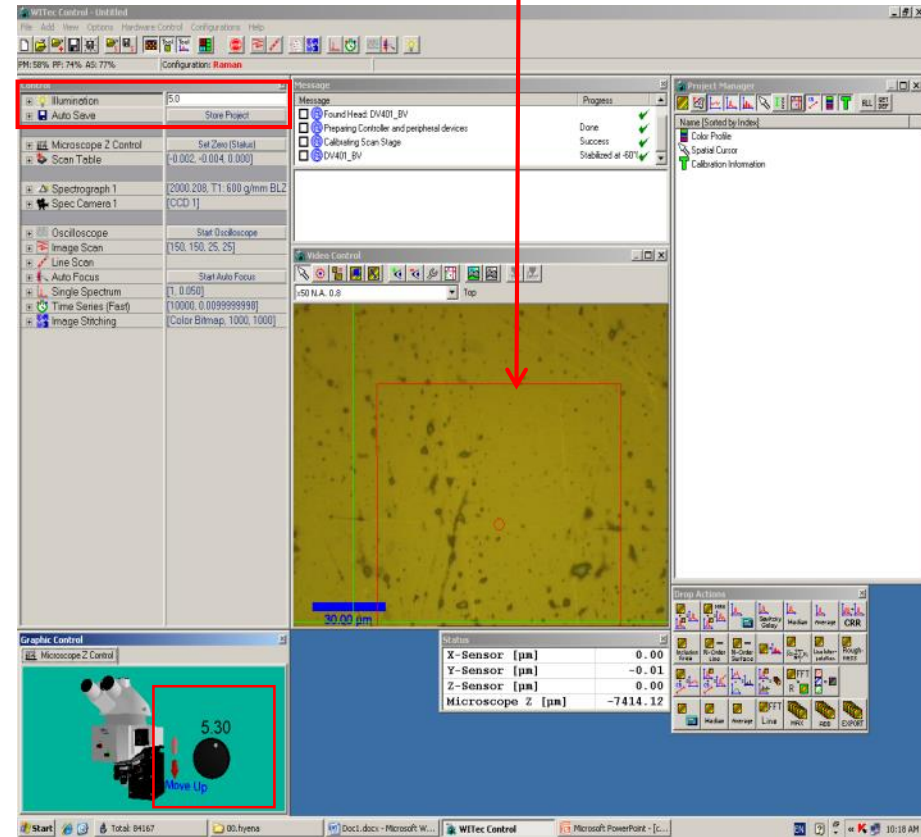
101.24

Bottom Status Bar:

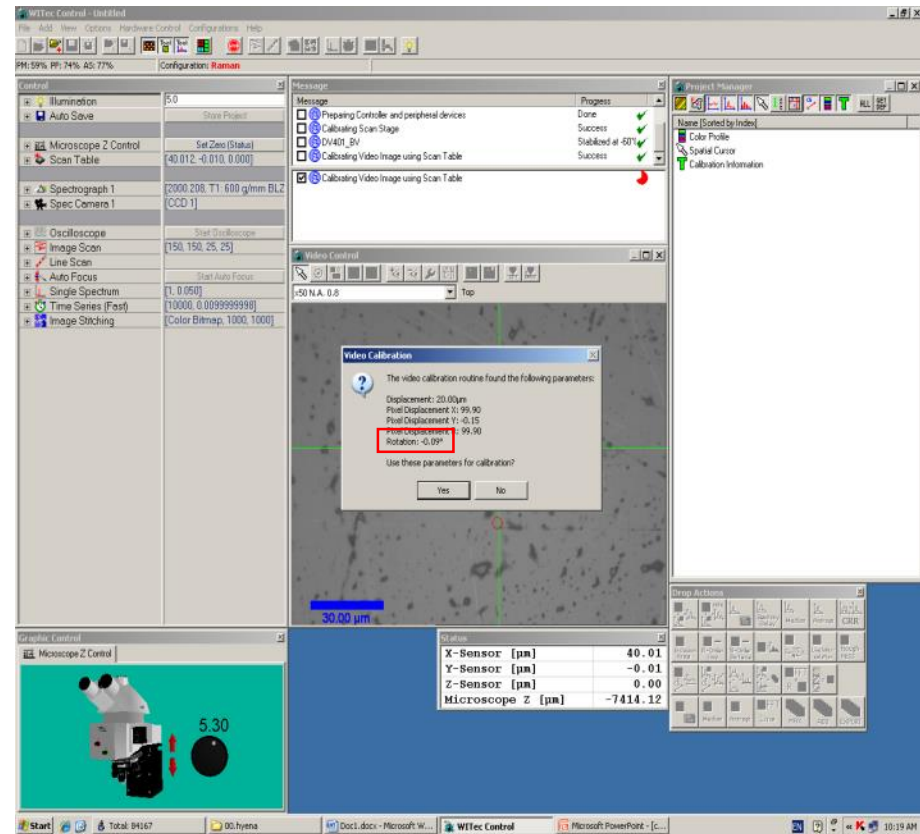
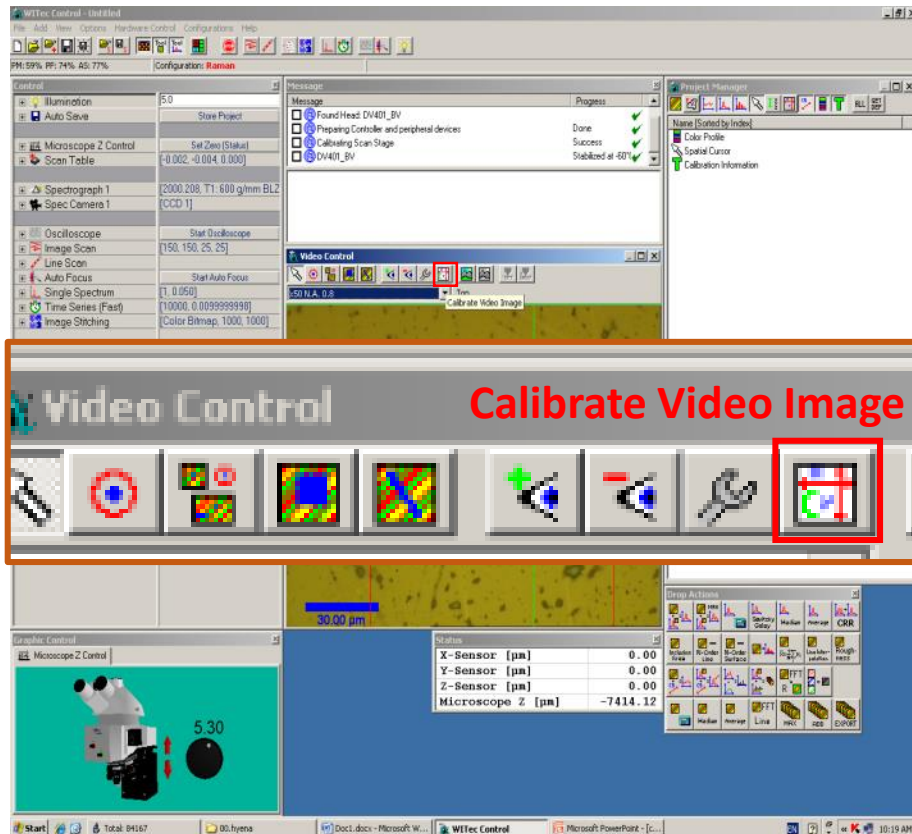
Start Total: 84167 00.hyena Doc1.docx - Microsoft W... WITec Control Microsoft PowerPoint - [c... 10:15 AM

Red Arrow: down

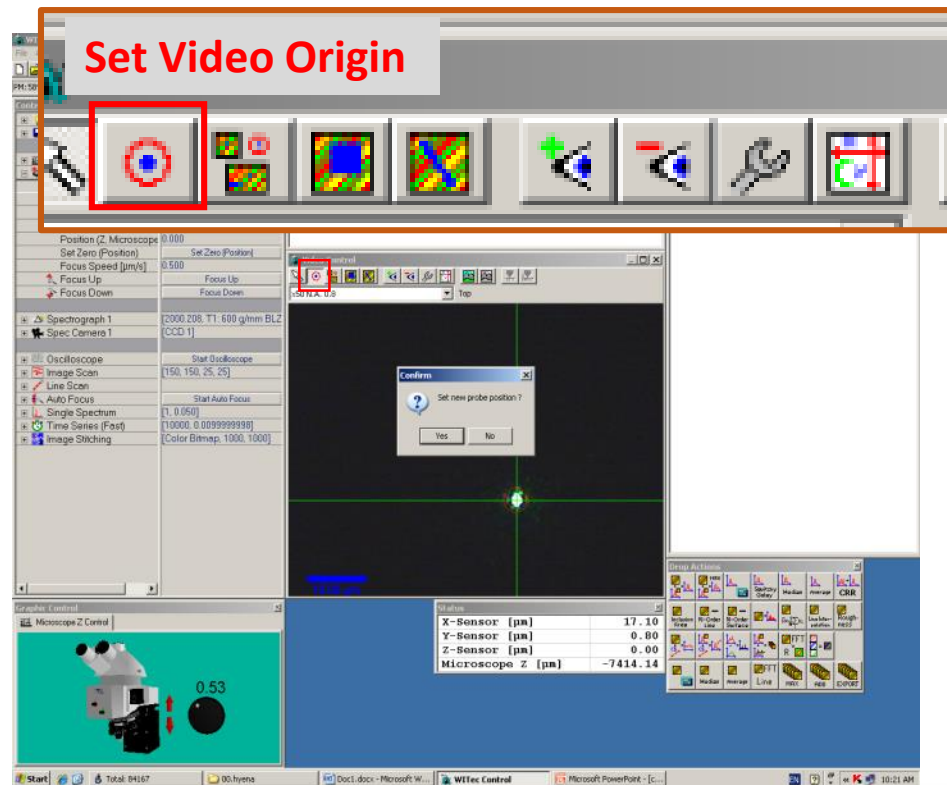
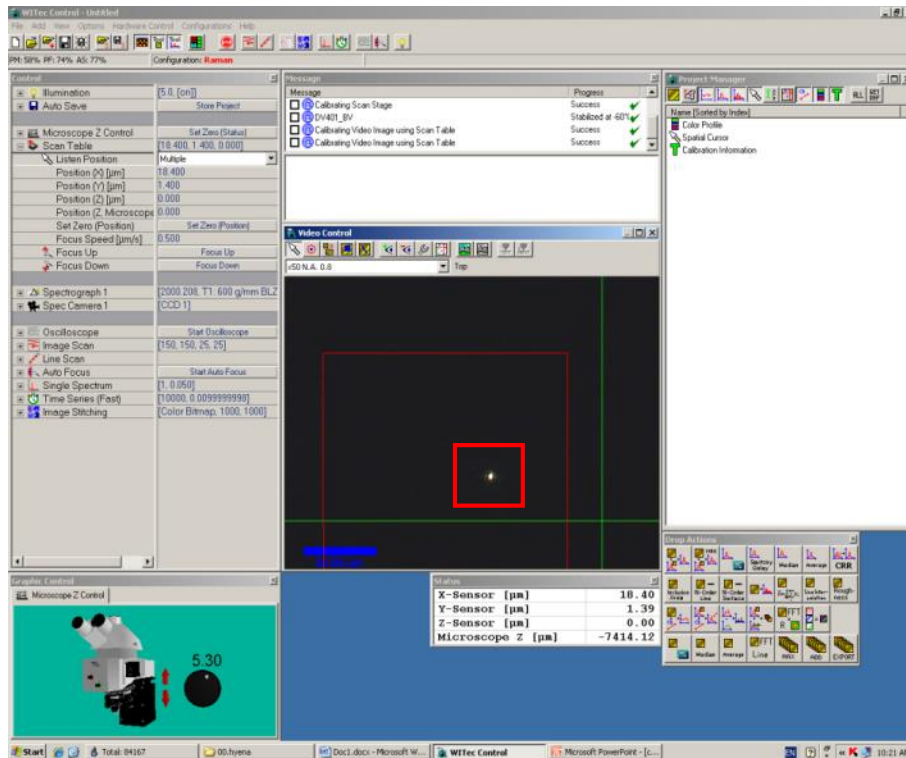
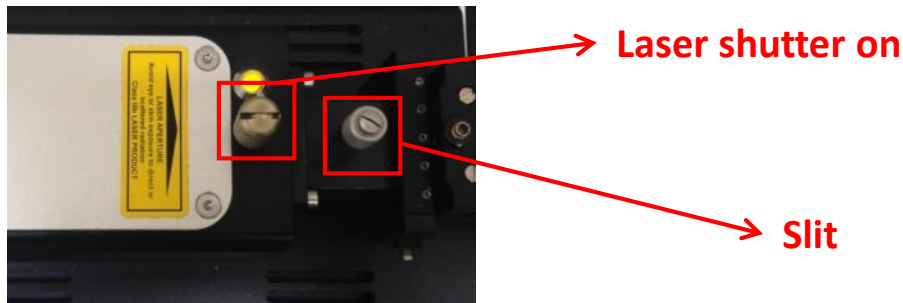
Diffuse layer



6. Video Control → Calibrate Video Image click → Rotation < ± 1



7. Laser Mode → Laser shutter on → Slit decrease → Laser position = red circle
(Video Control → Set Video Origin click → Laser position click)



8. Raman Mode → Control → Oscilloscope Start (Integration Time = 0.05 s) → Slit increase

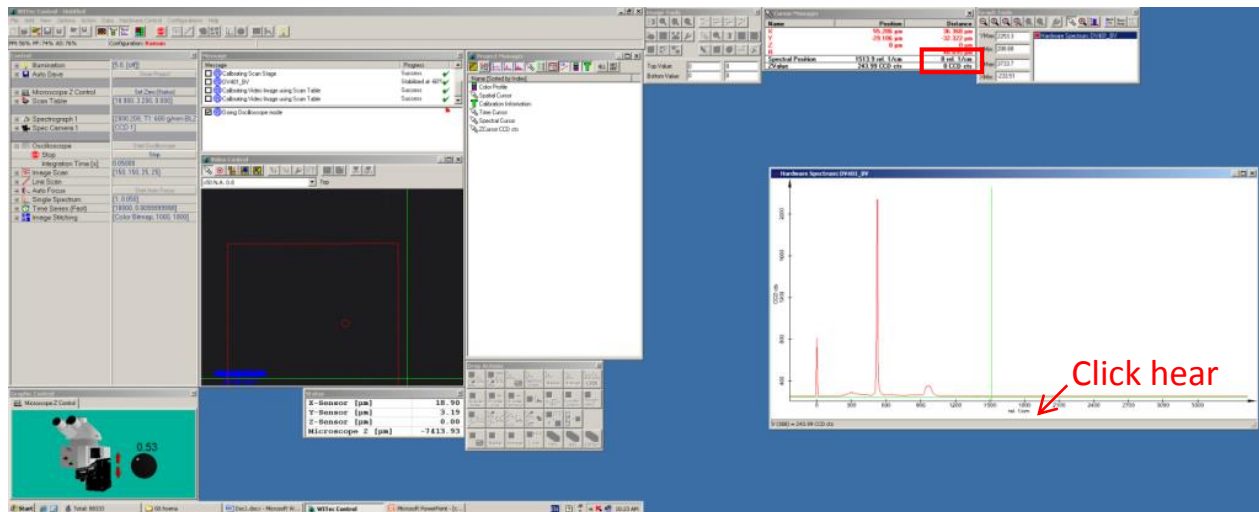
The screenshot displays the WITec Control software interface. The main window is divided into several panels:

- Control Panel:** Shows various system controls including Illumination (5.0, off), Auto Save, Microscope Z Control (Set Zero (Status)), Scan Table (18.900, 3.200, 0.000), Spectrograph 1 (2000.208, T1: 600 g/mm BL2, CCD 1), Spec Camera 1, and Oscilloscope (Start Oscilloscope). The Oscilloscope section is highlighted with a red box.
- Message Panel:** Displays a list of messages with checkboxes and progress indicators. The messages include:
 - Calibrating Scan Stage: Success
 - Stabilized at 60°: Success
 - Calibrating Video Image using Scan Table: Success
 - Calibrating Video Image using Scan Table: Success
 - Doing Oscilloscope mode: Success
- Project Manager:** Shows a list of projects with checkboxes and progress indicators. The projects include:
 - Color Profile
 - Spatial Cursor
 - Calibration Information
 - Time Cursor
 - Spectral Cursor
 - 2D Cursor CCD cts
- Video Control Panel:** Shows a video feed of the sample with a red box indicating the area of interest. The box is labeled "30.00 μm".
- Graphs Panel:** Displays a graph titled "Hardware Spectrum DV401_BV". The graph shows a red line representing the spectrum, with a green vertical line indicating the position of the slit. The x-axis is labeled "rel. Wavenumber" and the y-axis is labeled "Counts".
- Microscope Z Control Panel:** Shows a 3D model of the microscope and a status table with the following data:

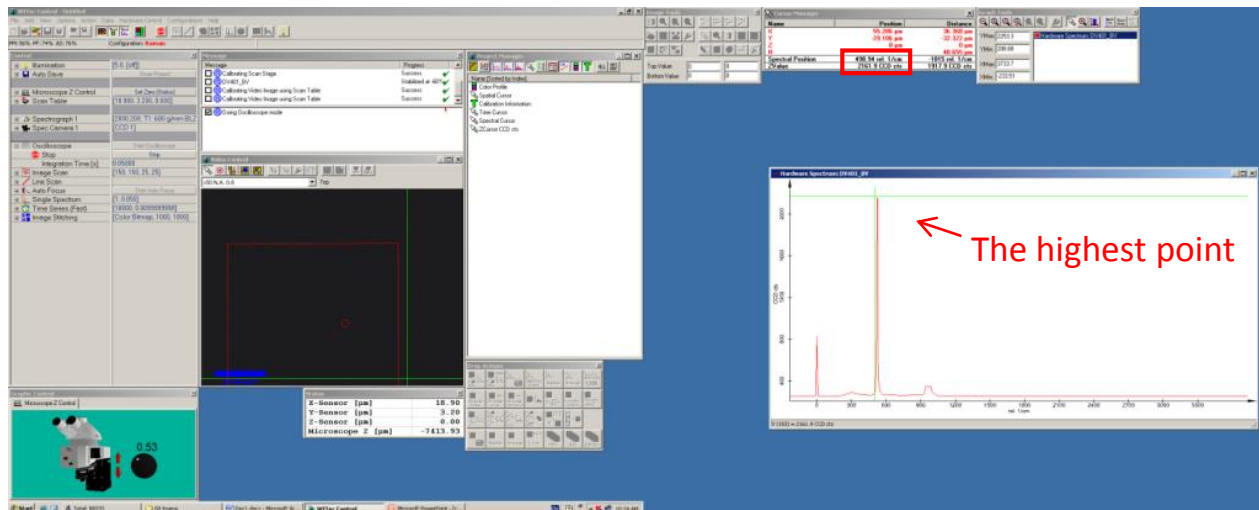
Status	X-Sensor [μm]	Y-Sensor [μm]	Z-Sensor [μm]	Microscope Z [μm]
	18.90	3.20	0.00	-7414.14

The bottom status bar shows the total counts as 88333 and the time as 10:22 AM.

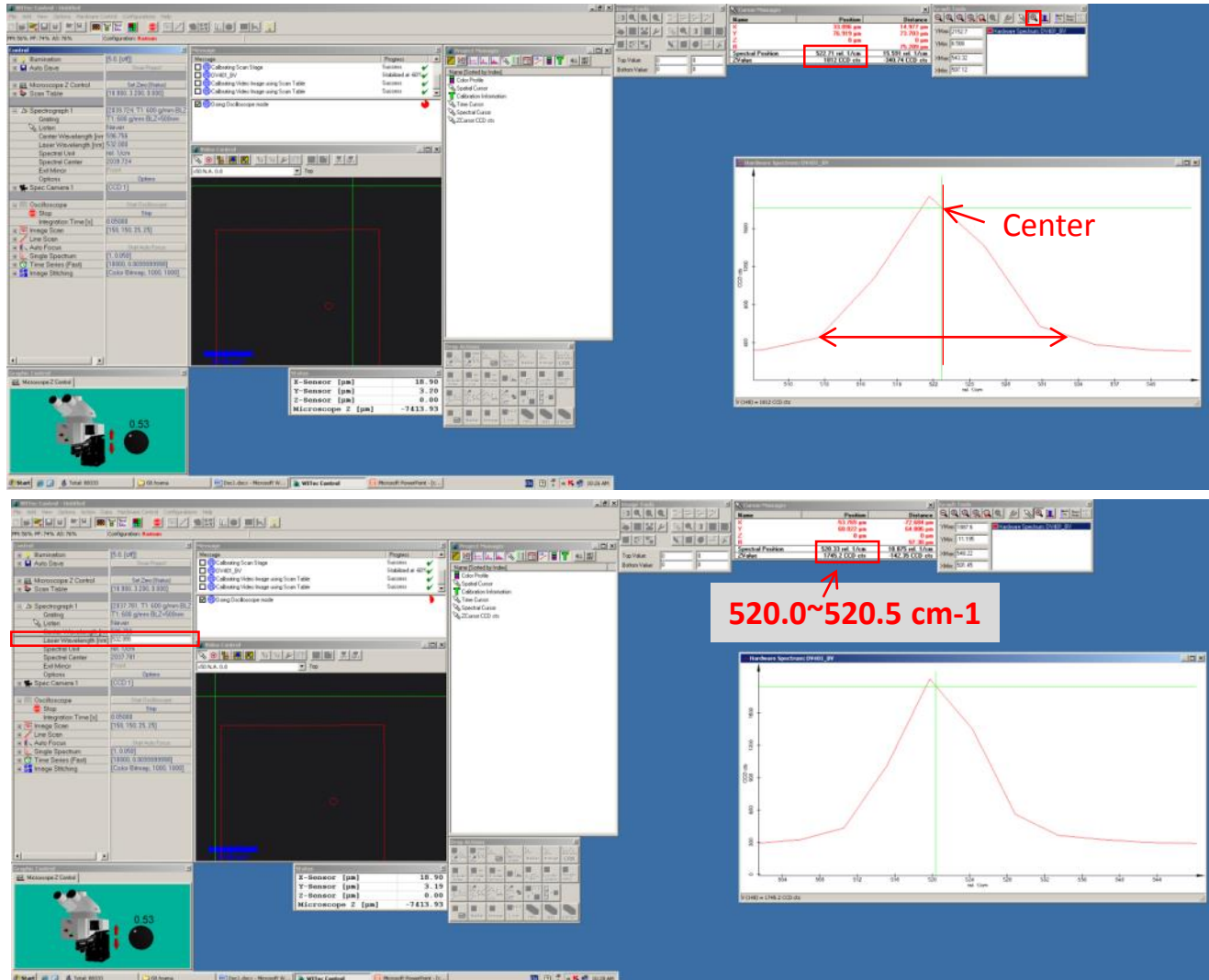
9. Real Time Spectrum → Lowest point click → Cursor Manager →
Distance: Spectral Position = 0, Z Value = 0



10. Real Time Spectrum → Move a cursor to the highest point (520 cm⁻¹ peak) →
Distance: Z Value ≥ 15000 CCD cts (If, Distance: Z Value < 15000 CCD cts → Speed 0.5 → down or up)



11. Graphic Tool → Zoom click → Zoom in 520 cm⁻¹ peak →
Center point of 520 cm⁻¹ peak = 520.0 ~ 520.5 cm⁻¹ (Position → Spectral Position) →
Control → Spectrograph → Laser Wavelength change



12. Oscilloscope Stop

13. Control → Single Spectrum → Acc. Single Spectrum click(Integration Time = 0.05 S)

The screenshot displays the WITec Control software interface. The 'Control' panel on the left shows the 'Oscilloscope' section with a 'Stop' button highlighted. Below it, the 'Single Spectrum' and 'Acc. Single Spectrum' buttons are also highlighted. The 'Integration Time [s]' is set to 0.050. The 'Status' window at the bottom right shows the following sensor positions:

Sensor	Position [μm]
X-Sensor	18.90
Y-Sensor	3.20
Z-Sensor	0.00
Microscope Z	-7413.93

The 'Graphs' window on the right shows two spectral plots. The top plot, 'cal_532nm_600G_20131217_001_Spec.Data 1', shows a sharp peak at approximately 400 nm. The bottom plot, 'Hardware Spectrum DV401_BV', shows a similar peak at approximately 400 nm. The 'Cursor Manager' window at the top right displays the following data:

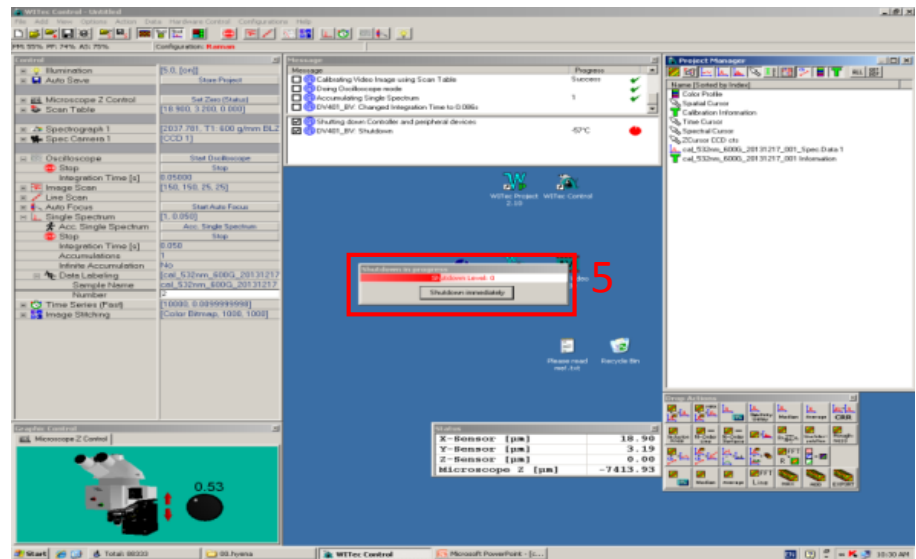
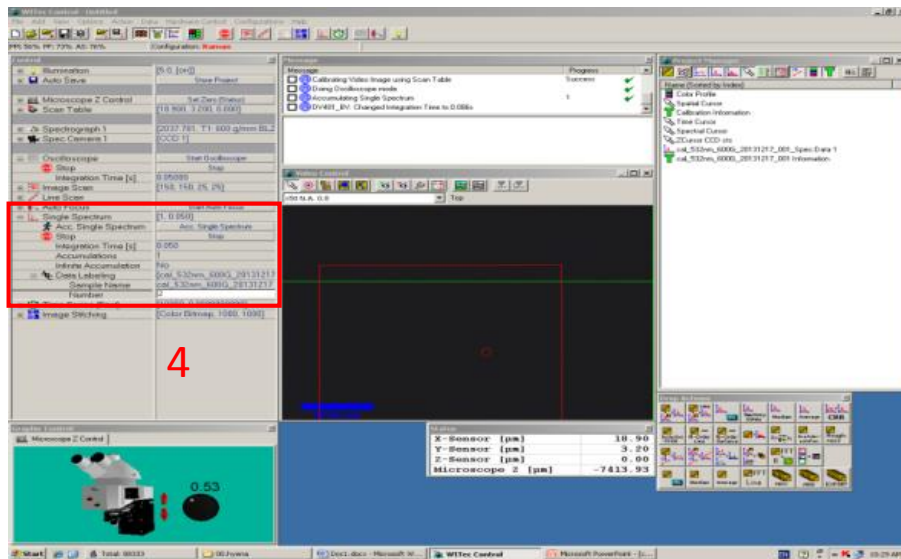
Name	Position	Distance
X	88.004 μm	69.005 μm
Y	41.022 μm	37.806 μm
Z	0 μm	0 μm
R		78.753 μm

The 'Spectral Position' window at the bottom right shows the following data:

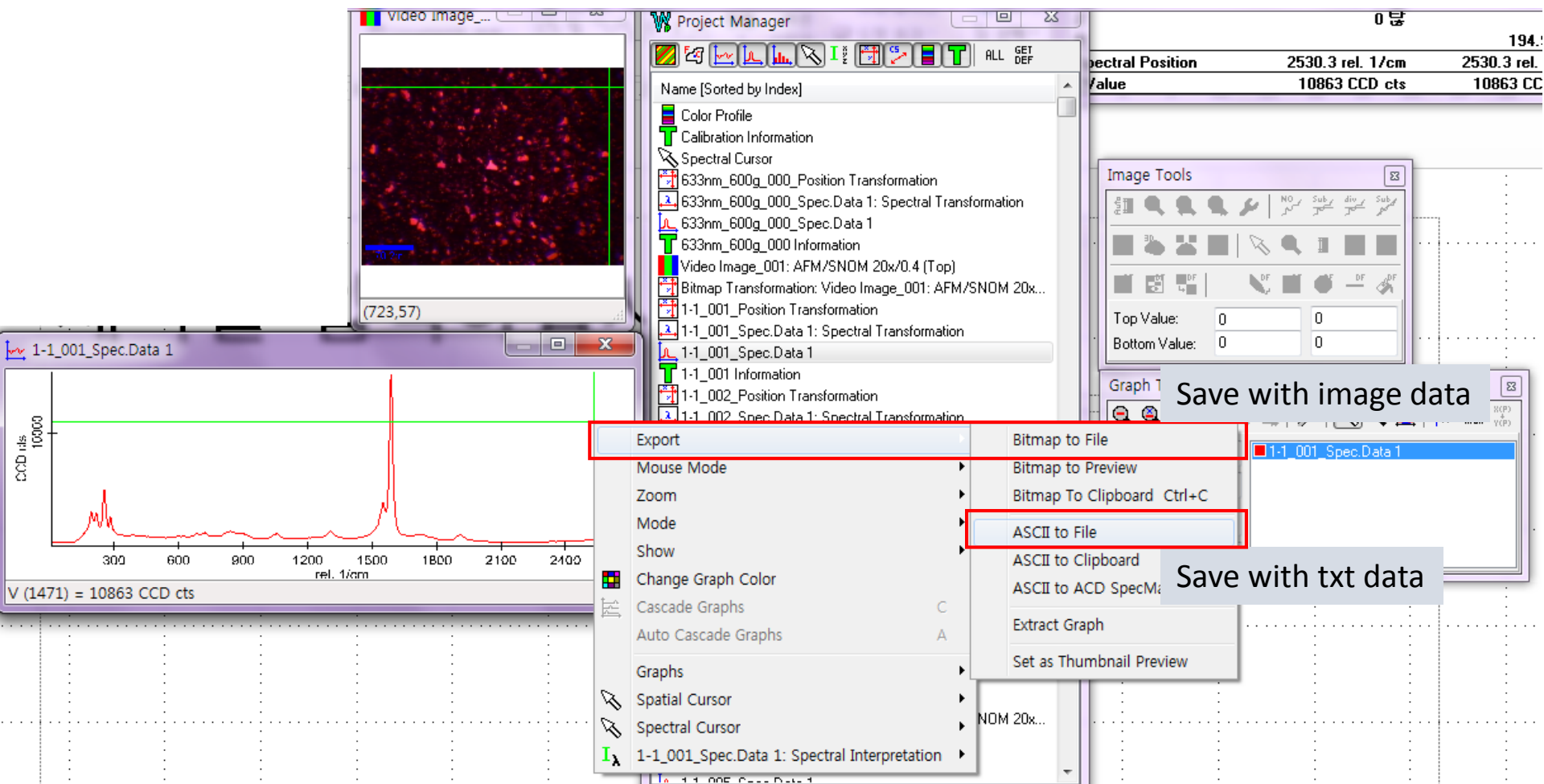
Spectral Position	-386.59 rel. 1/cm	-888.04 rel. 1/cm
ZValue	1784.5 CCD cts	-103.05 CCD cts

Sample measurement_Single spectrum

1. After calibration, Image Mode → Put down your sample on a slide glass
2. Take a focus (calibration 4,5 repeat)
3. Raman Mode → Oscilloscope Start → Increase main peak (Speed 0.5 → down or up)
4. Control → Single Spectrum → Parameter change → Acc. Single Spectrum click



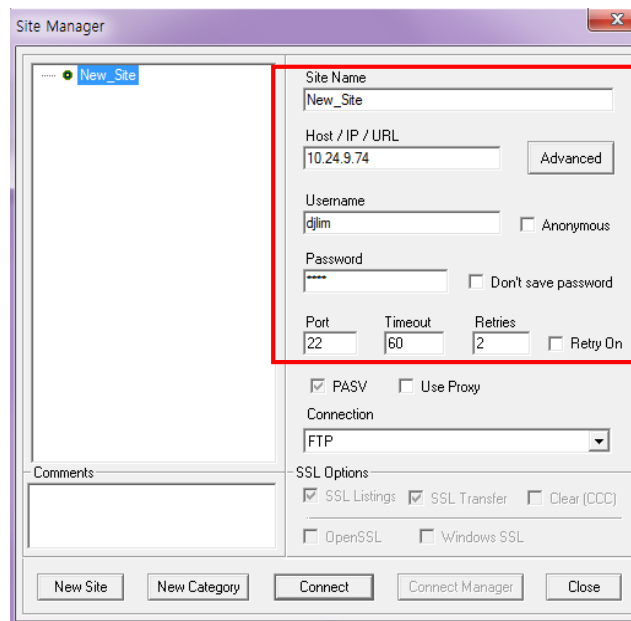
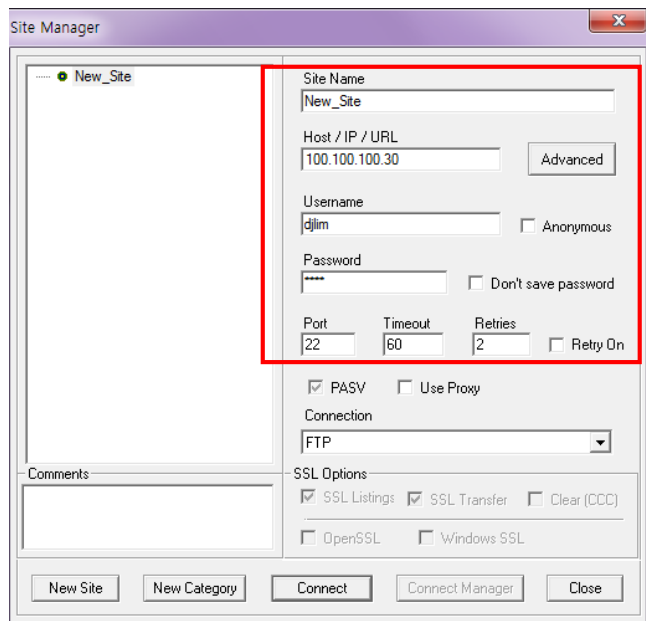
5. Open video image data or spectrum data → Click on the right mouse button → Export



6. WITec Control Pro. CLOSE→ wait heating (10min)

7. Laser off

8. Data translation



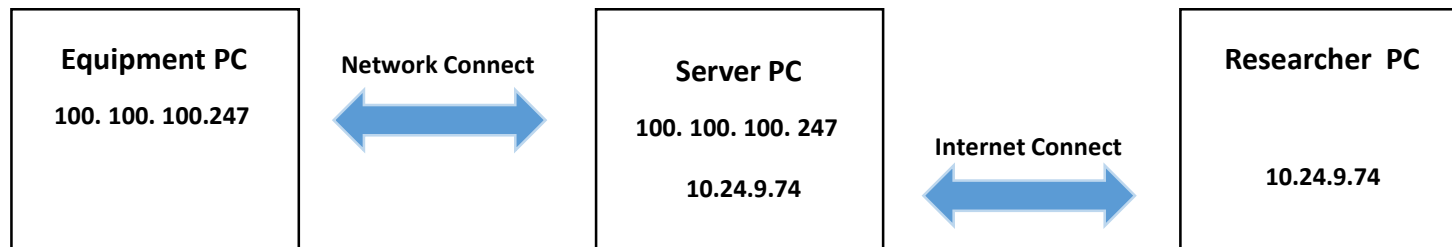
Host IP :
100.100.100.247 (in UCRF)
10.24.9.74 (from outside)

Username : djlim

PW : 0254

Port : 22

Sample measurement



Core FTP LE - 10.24.9.42:22

File View Sites Manage Help

250 CWD command successful. "/" is current folder.
PwD
257 "/" is current directory.
PASV
227 Entering Passive Mode (10,24,9,42,146,187).
LIST
Connect socket #1020 to 10.24.9.42, port 37563...
150 Opening data connection for f
226 File sent ok
Transferred 4,523 bytes in 0.008 s

UCRF PC or My PC

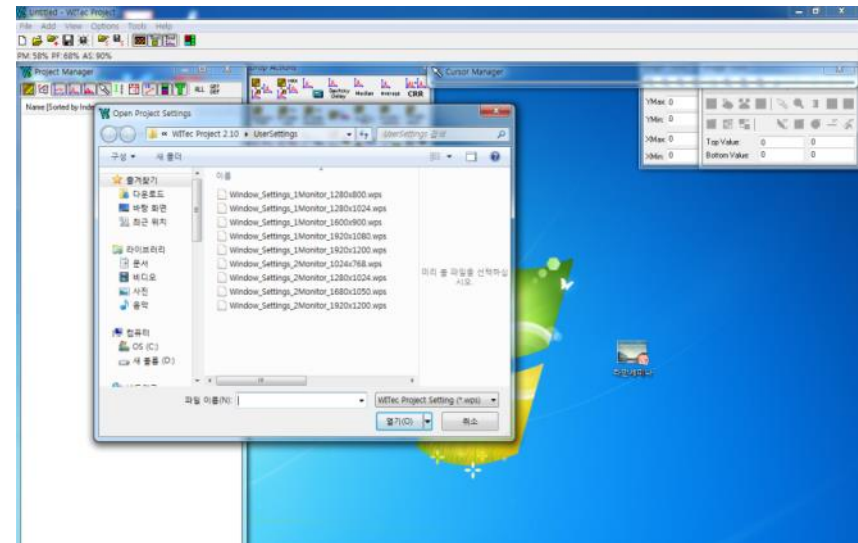
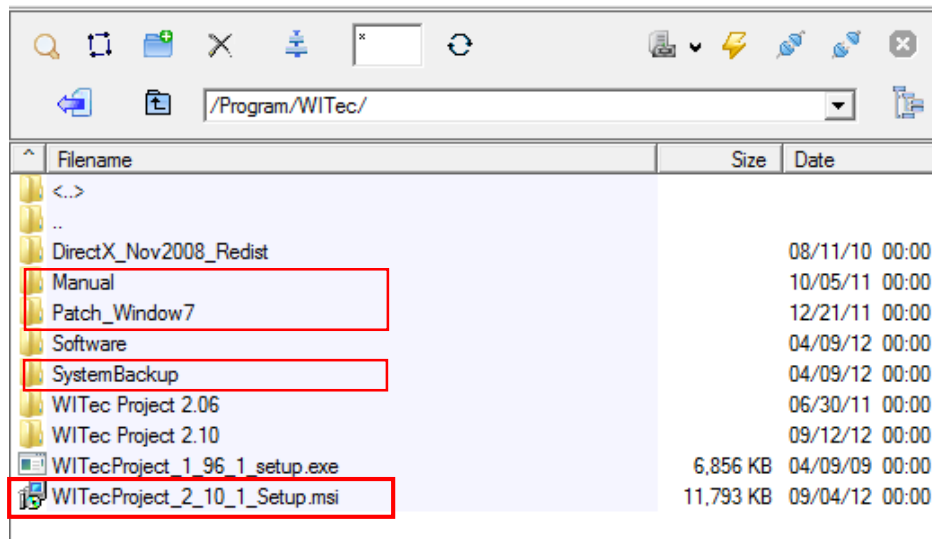
Filename	Size	Date
..		09/13/13 09:07
Fax		08/13/13 11:28
Malvern Instruments		09/19/12 10:43
SAP		10/03/13 17:24
Scanned Documents		08/13/13 11:28
경남은행		08/07/13 15:49
Self 교육.xlsx	14 KB	09/26/12 17:59
XRF_data_보정.xls	112 KB	12/27/12 13:22
거래내역조회_2009_출력.pdf	45 KB	08/07/13 16:13
동위원소실가동률계산_박지혜.xlsx	32 KB	04/26/13 18:00

Server PC

Filename	Size	Date
<..>		
..		
Company		10/04/13 11:...
Labs		10/06/13 20:...
Program		09/02/13 12:...
toengineer		01/30/13 10:...
touser		10/04/13 15:...
UCRF		10/02/13 17:...
UCRF 로그복관리		10/01/13 14:...
AFM 스캐너수리 요구내역.xlsx	0	04/27/13 15:...

Raman Analysis Program

- Core FTP > Program > WITec project download
- Download :
 - 1) WITecProject 2_10_1 setup
 - 2) System Backup
 - 3) Window7 Patch



Sample measurement_Image scan

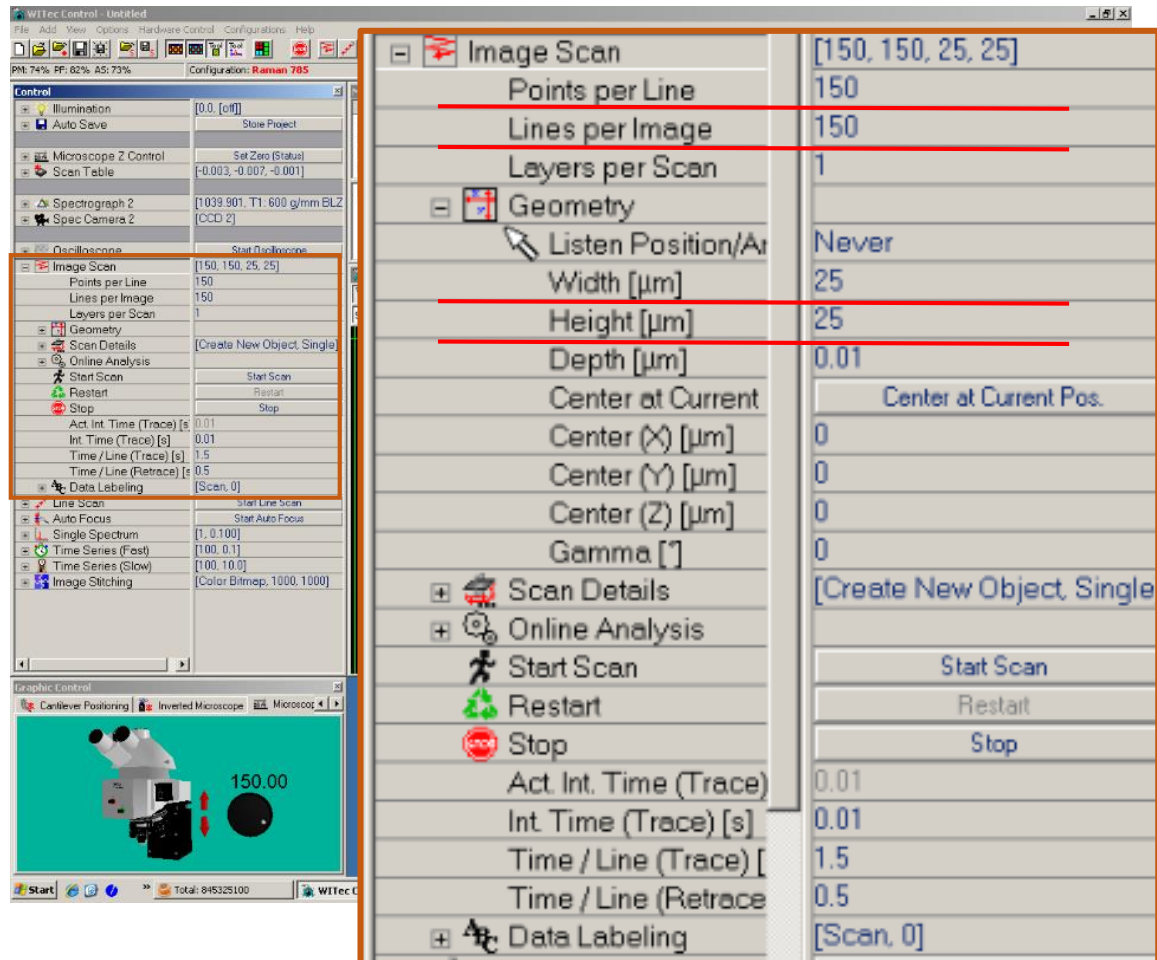
1. Si calibration

2. Check the Raman peak on your sample with single spectrum measurement

3. Open Image scan

1) Geometry

- Insert **Width and Height** value.
The max. value is **50um**.
- Insert **Points per Line** and **Line per image** after consider resolution.
(PPT page 14).



Sample measurement_Image scan

3. Open Image scan

2) Center of the image scan

- Center at Current Pos.

When you want to make the position measured single spectrum to the center of Image scan, please click **Center at current Pos.**

- Center (X), (Y)

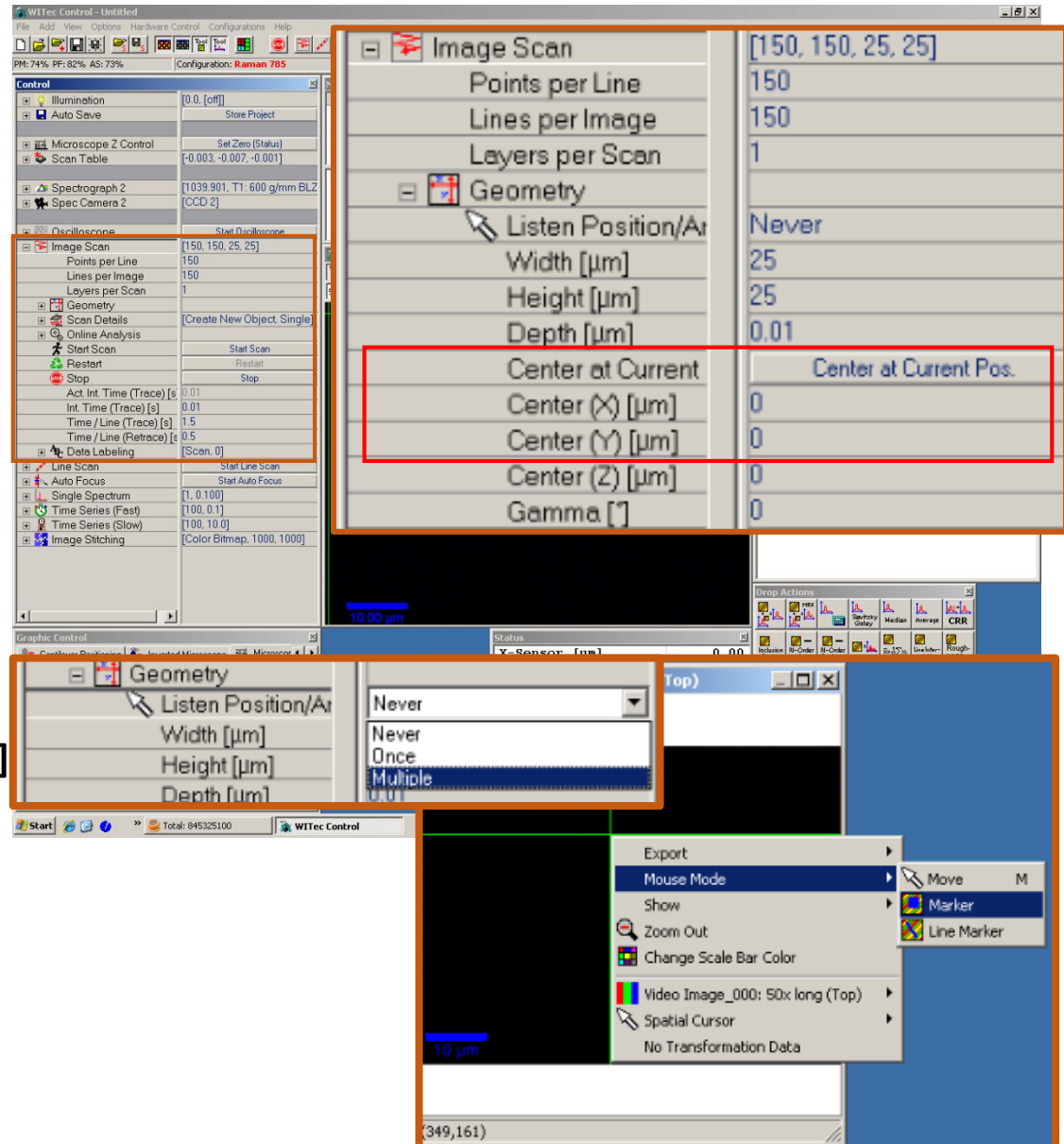
When you want to make the center with X,Y value, please insert specific value at **Center(X) and (Y)** part.

- Select the region of the image scan

[**Geometry - Listen Position_Mutiple**]

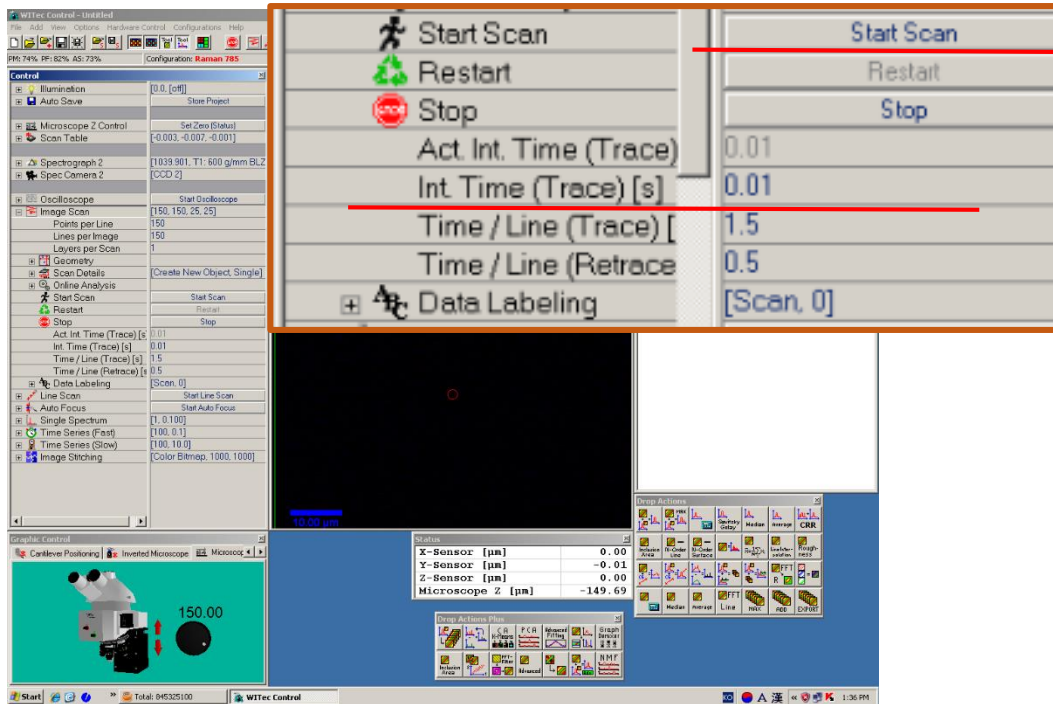
Open the -**Optical image** - Click the right button of mouse - Select the [**Mouse mode - Marker**]

Drag the area where you want to scan with mouse.

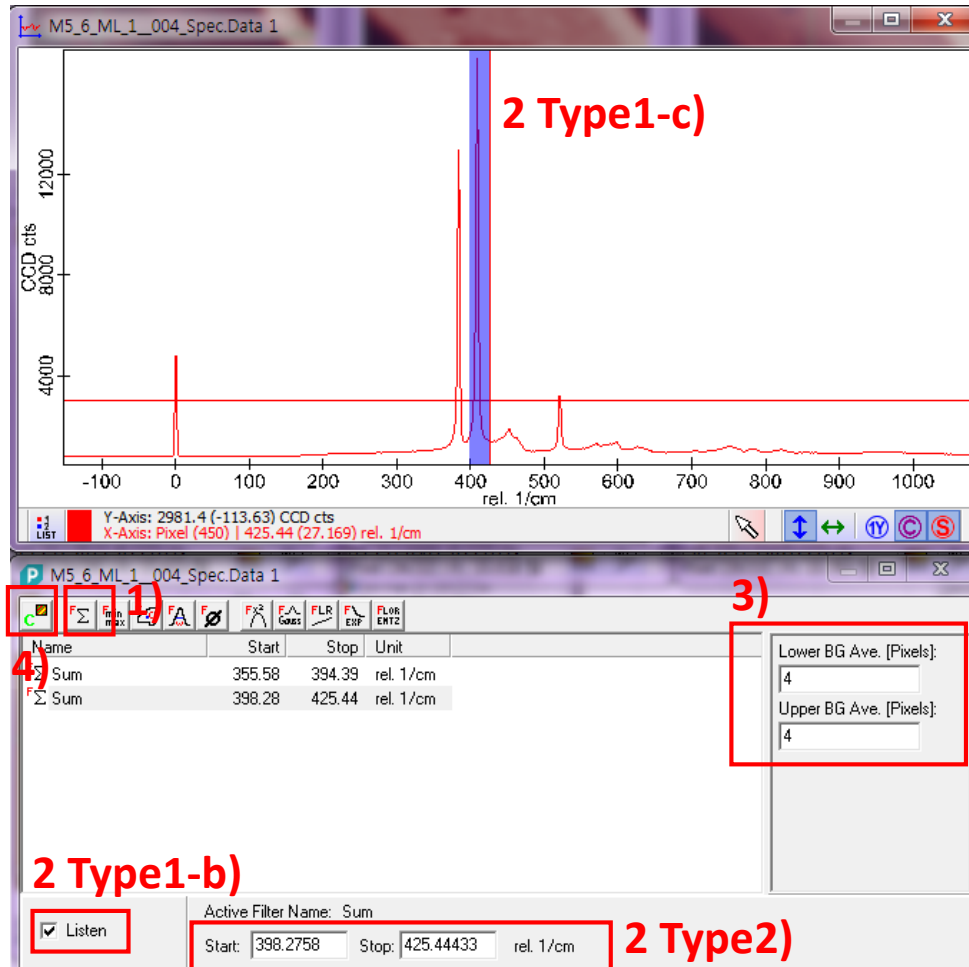


Sample measurement_Image scan

3. Open Image scan
- 3) Set the Int. Time
- 4) Start Scan



4. Filter the spectrum peak with Filter manager

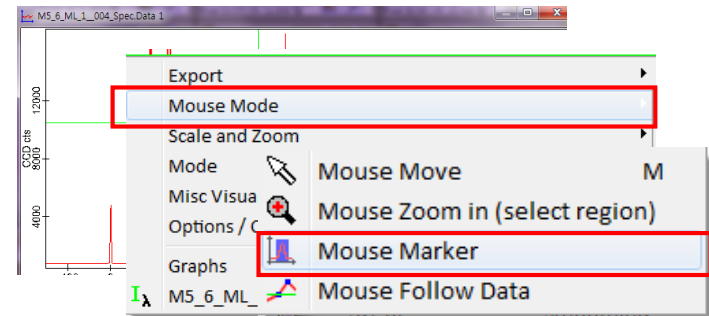


1) Click add sum filter.

2) Select area

Type 1

a) Click right button of mouse at **spec data**



b) Check **Listen** at filter manager

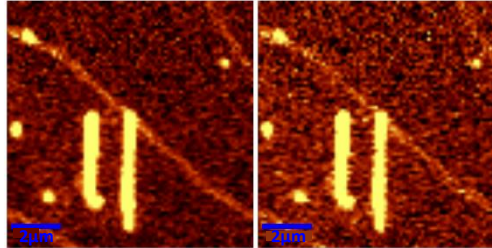
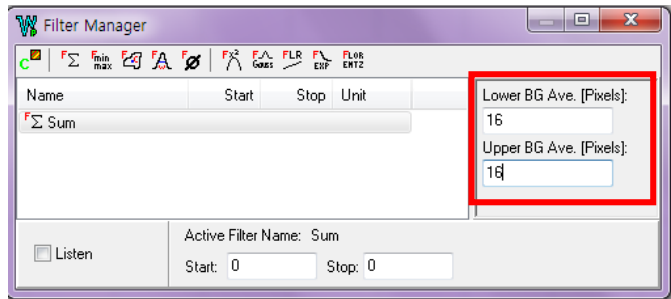
c) Drag the region of peak at the **spec data** window which you want to make mapping Image

Type2

Insert **Start and Stop wavenumber** at filter manager.

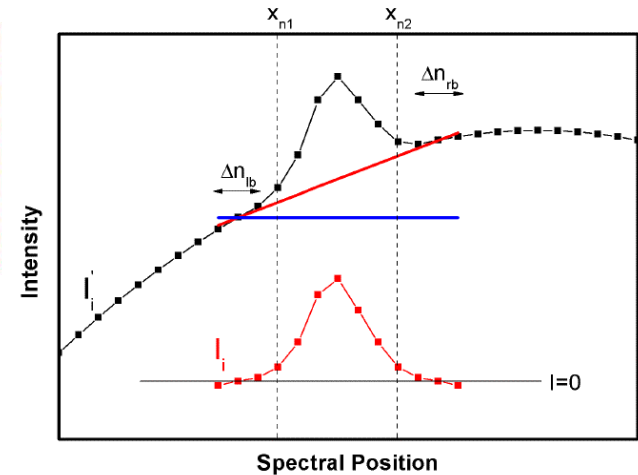
3) Change the BG Ave.[Pixel]

4) Click calculate

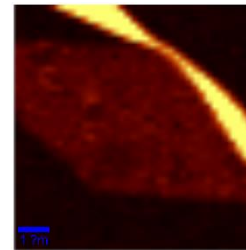
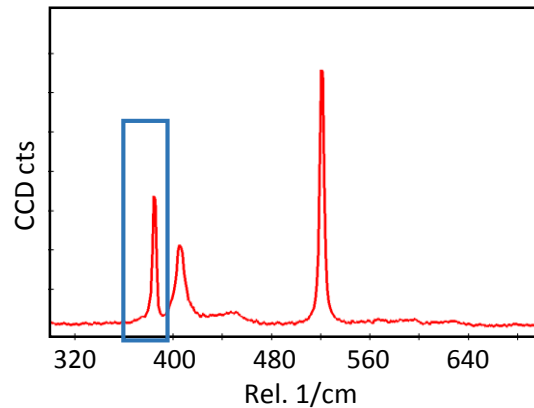
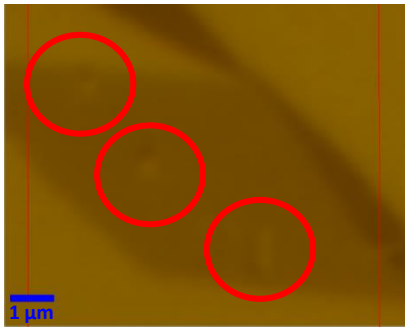


BG Ave. 16

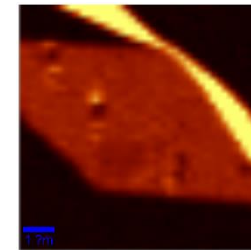
BG Ave. 4



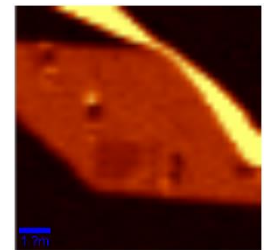
■ Sum Filter_BG Ave.



BG Ave. 16



BG Ave. 8



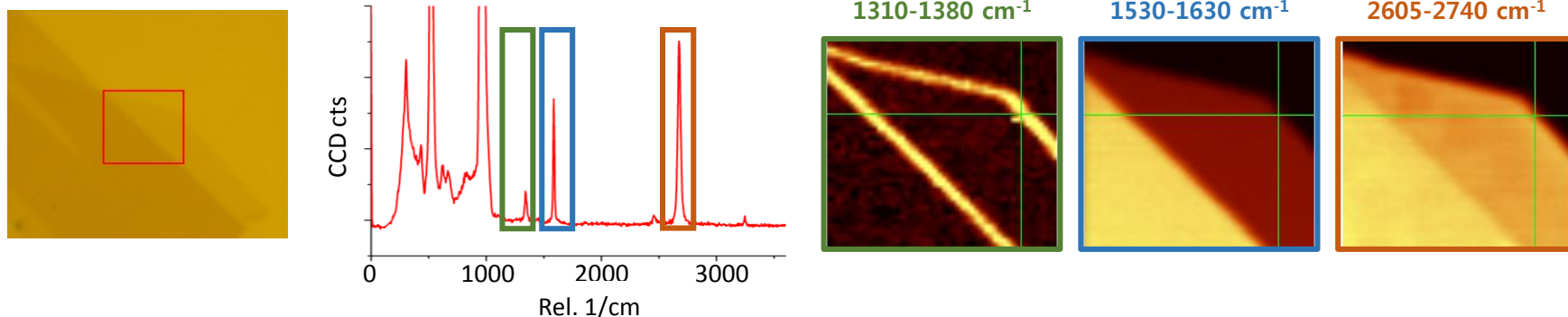
BG Ave. 4

Sum Filter

$$\text{Sum} = \sum_{i=n_1}^{n_2} I_i$$

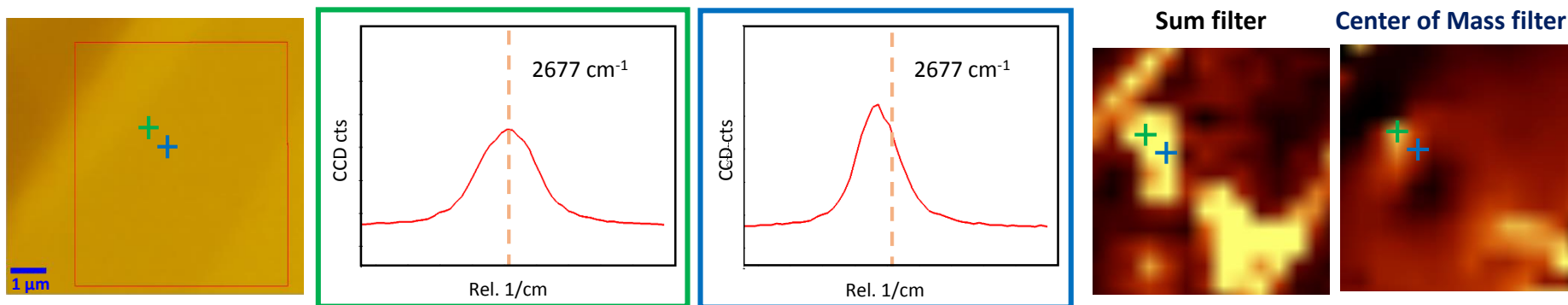
SUM filter create a new image data object with the dimension X, Y and integrated intensity Which can then be displayed as an image.

The output unit is the same as the z-interpretation of the spectrum(CCD counts).

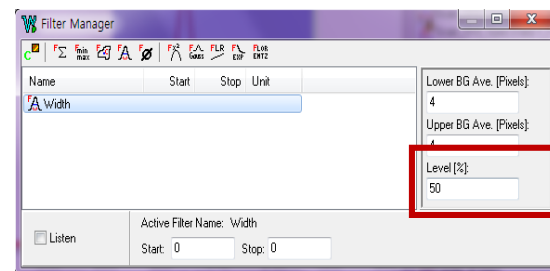
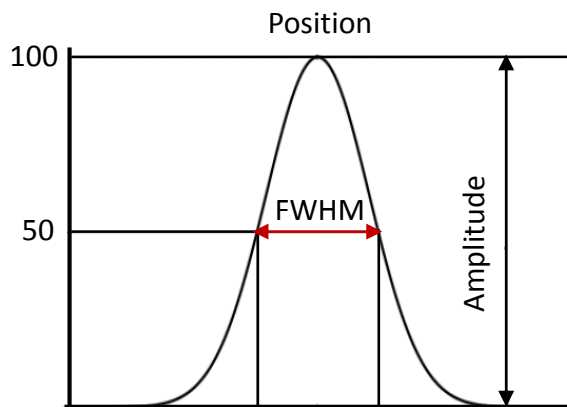
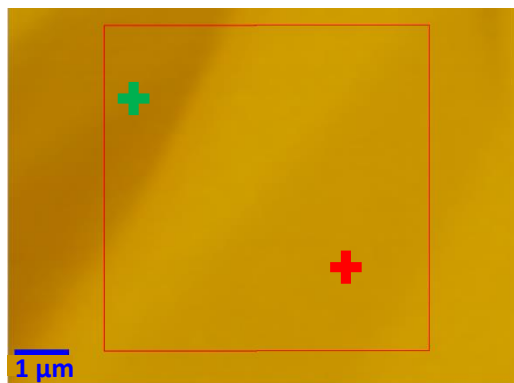


Center of Mass Filter

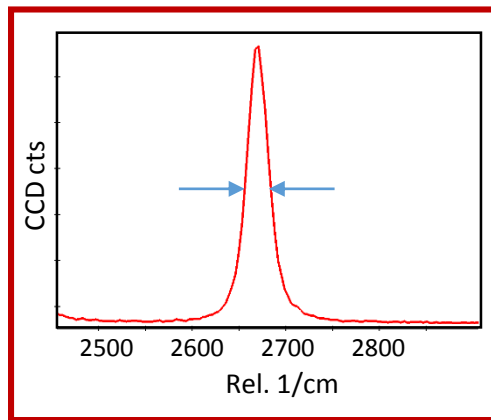
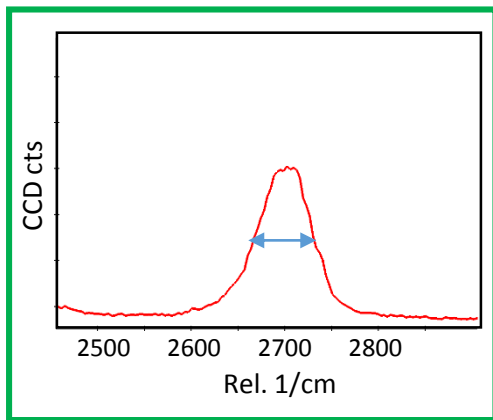
The center-of-mass filter calculates the intensity-weighted spectral position.



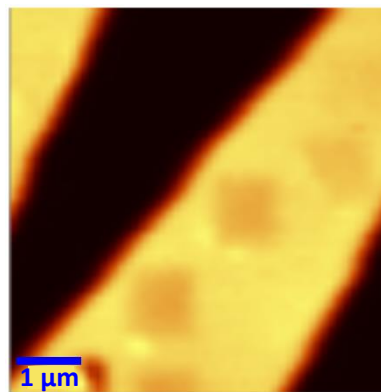
Width Filter



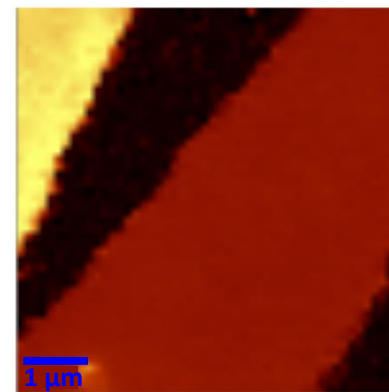
Level (%) 1~99



Sum filter



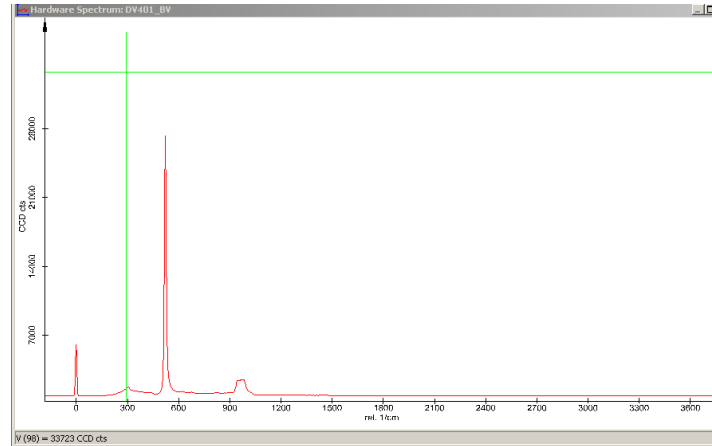
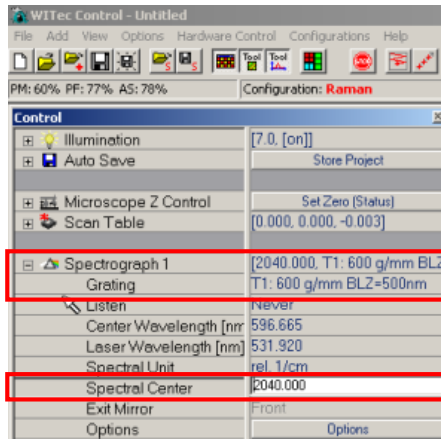
Width filter



Spectrograph_Grating

600g/mm

The resolution of X axis is about $3\sim 4\text{ cm}^{-1}$. You can see the whole range of Raman spectrum when the 'Spectral Center' is 2040 cm^{-1} .

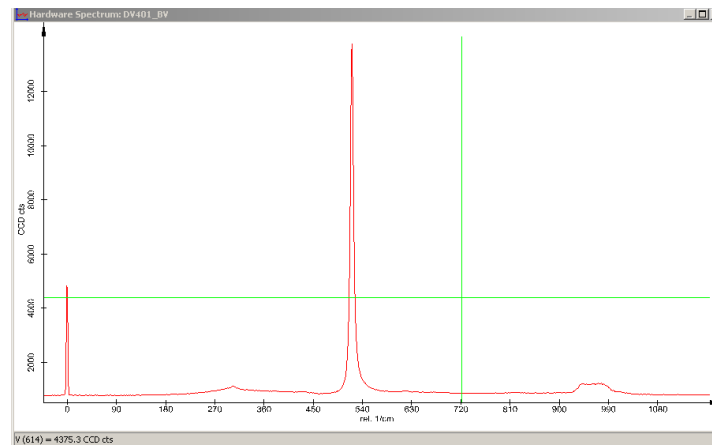
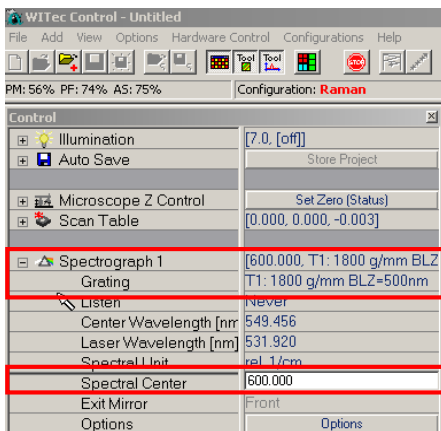


1800g/mm

The resolution of X axis is about 1 cm^{-1} . You can see the spectrum that the range is about 1000 cm^{-1} .

Please input the 'Spectral Center' value differently for your sample peak.

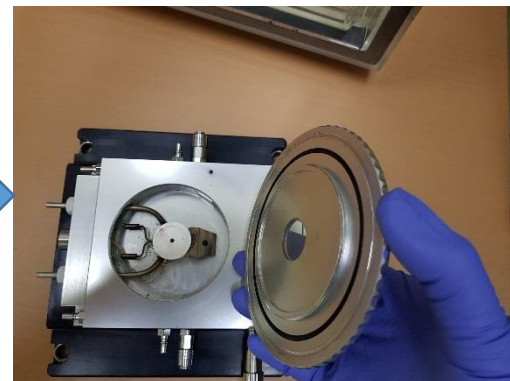
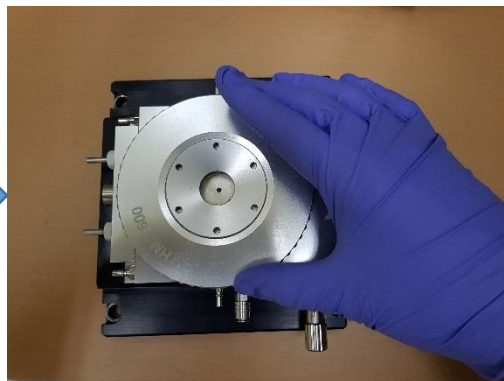
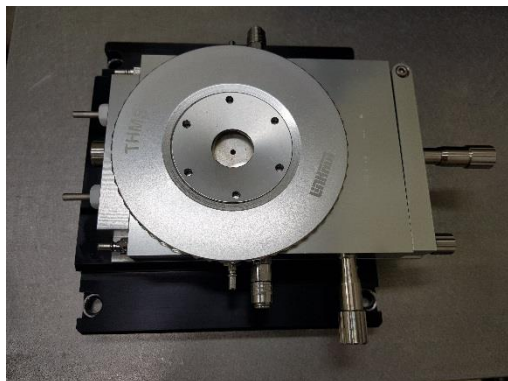
When you input $500\sim 600\text{ cm}^{-1}$ at 'Spectral Center', you can see the Si peak during calibration.



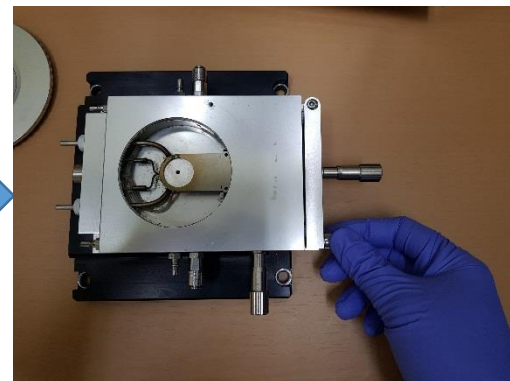
Check 'Spectral Center' when you change the grating condition.

Temperature control measurement

1. Si calibration
 - 1) Open the top of sample stage

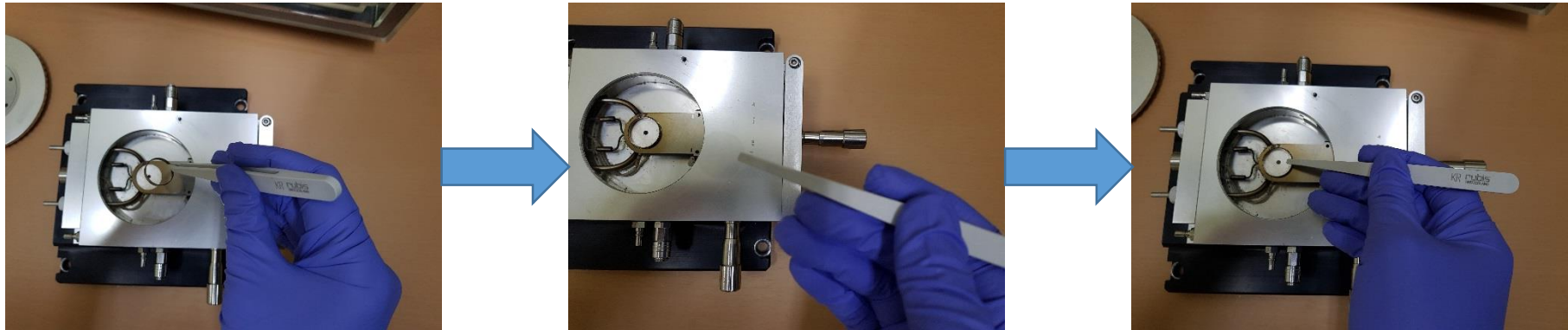


- 2) Prepare sample position

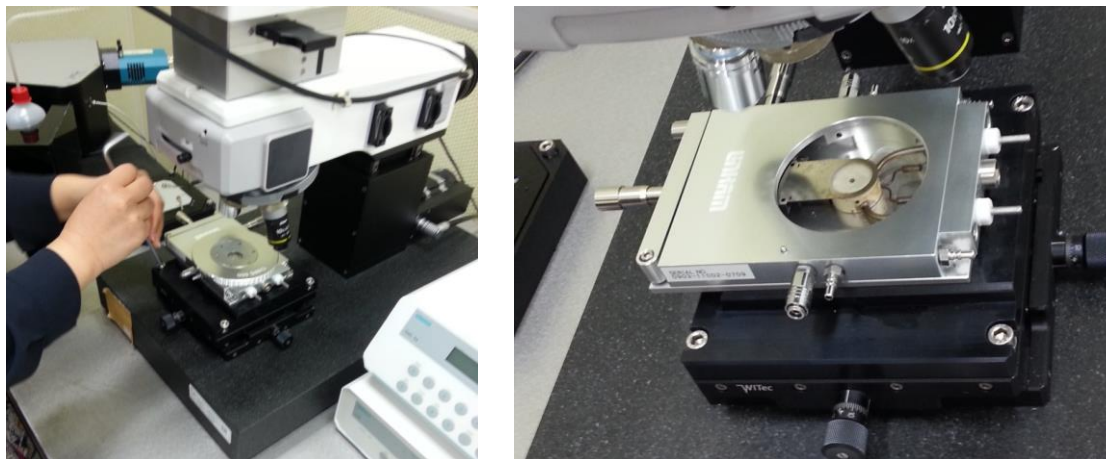


Temperature control measurement

- Place the stainless steel ring
- Cover the glass slip into the stainless steel ring



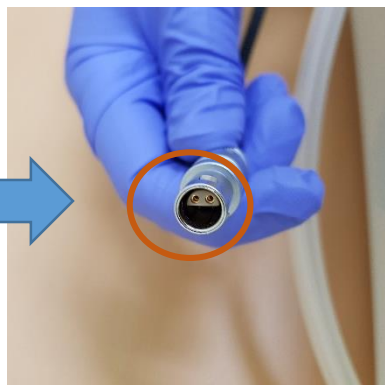
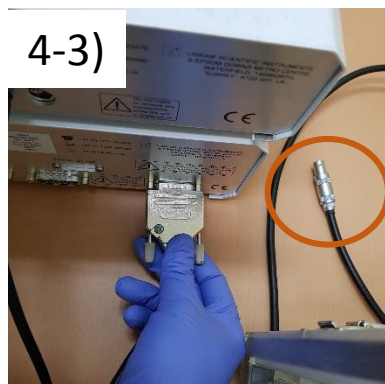
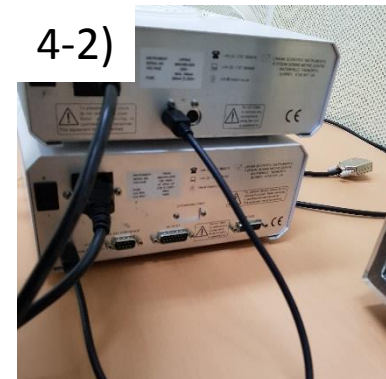
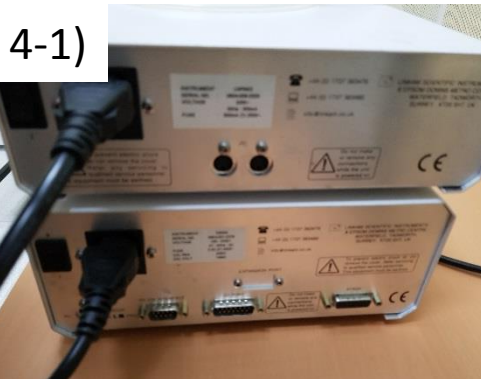
3. Exchange the sample stage for temperature controller stage



4. Load the sample on the stage and close the cover

5. Prepare LNP and Temperature controller

- 1) Connect power connection
- 2) Connect the LNP with controller
- 3) Connect the stage with controller



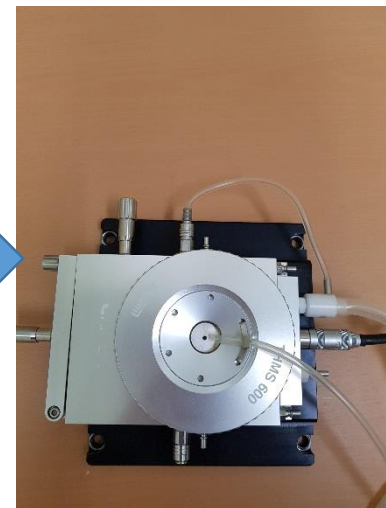
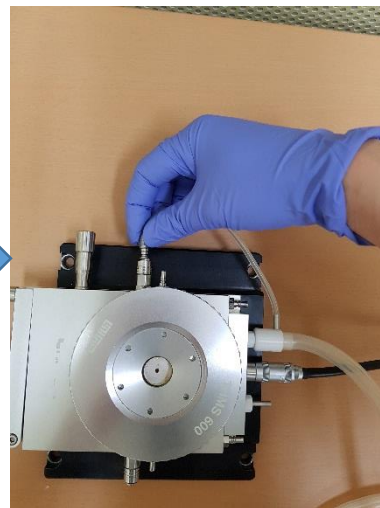
The stage lead carries data to the temperature controller and supplies power to the stage.

The stage lead is specific to THMS600 stage.

The connector contains a chip with information required for temperature control, rates and limits.

5. Prepare LNP and Temperature controller

4) Connect the LNP line



Insert purging tube
into the gas valve to
Purging air from
stage and avoid
Condensation
forming on sample.

Place window tube
onto lid to blow N2
gas across
Window and
eliminate external
condensation

6. Prepare Liquid Nitrogen

- 1) Open the top of dewar
- 2) Fill dewar approximately 3cm from top
- 3) Close the top

❖ Do not fasten catches until the bubbling noise from boiling off Nitrogen subsides.



7. Connect the liquid nitrogen line with the stage



Temperature control measurement



LNP supply liquid nitrogen to the stage
TMS94 is temperature controller

7. Switch on the SNP and TMS94
TMS94 – Press **Start** button



Temperature control measurement

8. Set the TMS94 temperature controller

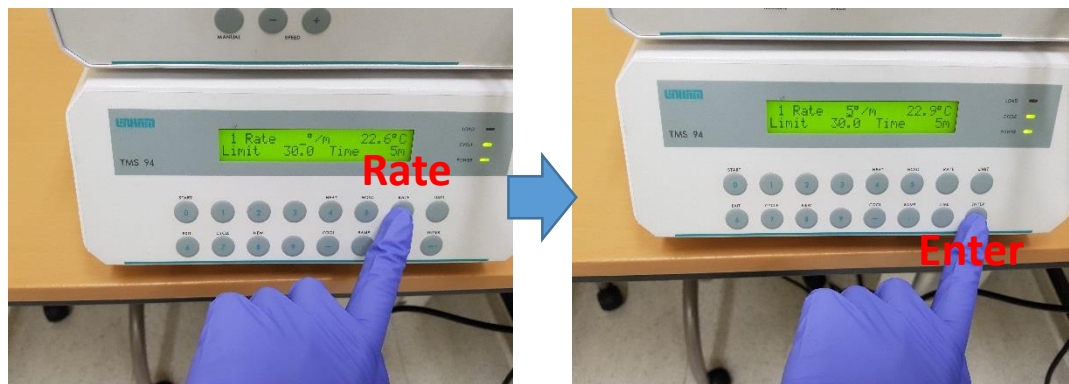
1) Change the temperature ($^{\circ}\text{C}$)

Limit – Press the number- **Enter**



2) Change the existing rate ($^{\circ}\text{C}/\text{min}$)

Rate – Press the number - **Enter**

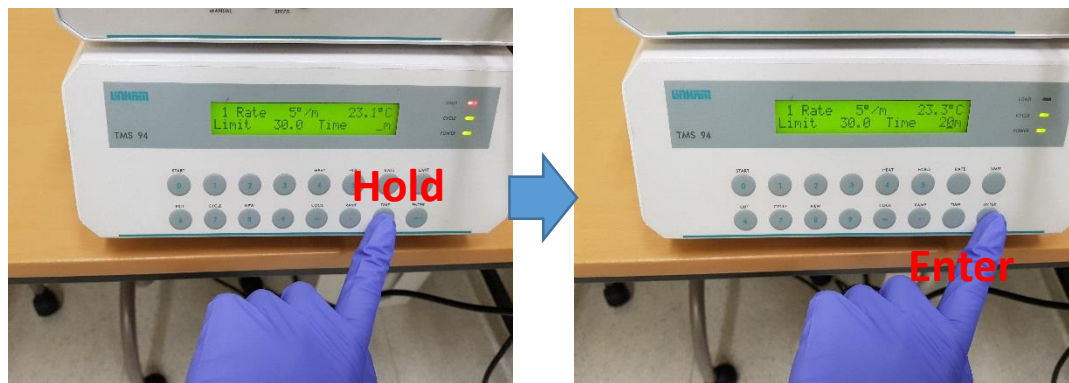


Temperature control measurement

8. Set the TMS94 temperature controller

3) Change the hold time (min.)

Hold – Press the number- **Enter**



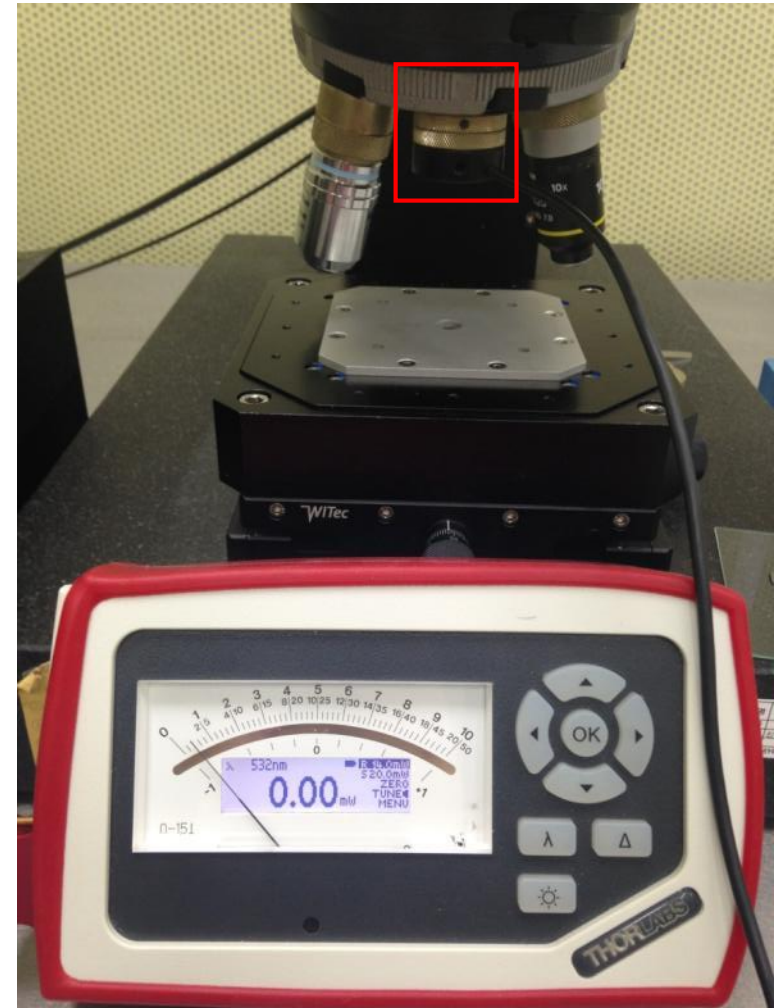
4) Exit the program

Set the temperature 25 °C and wait the stabilization.

Press **Exit** - **Enter**



Laser Power Meter (power setting)- in Raman Mode



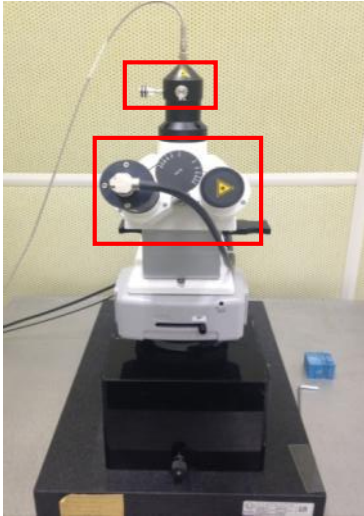
5. Cautions

UNIST

ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

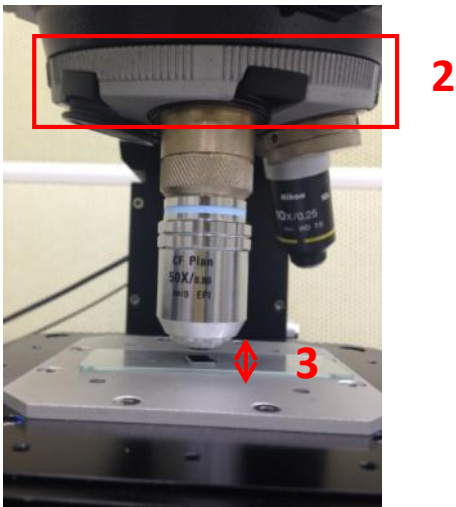
Cautions

1. Don't touch this part

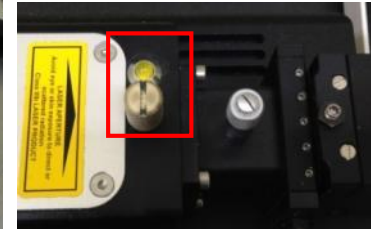


2. Hold this part, NOT lens

3. Lens up, whenever you change a sample



4. Laser off



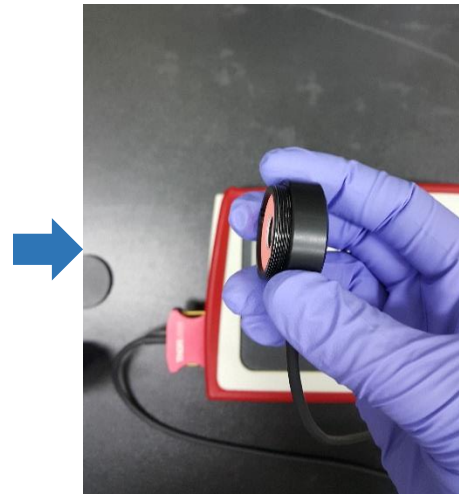
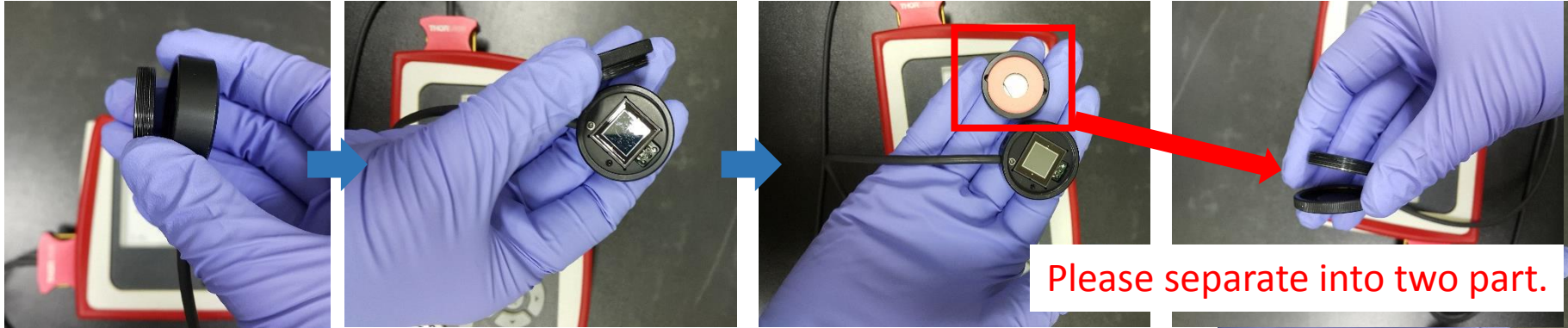
5. Laser Power Meter

- The head is very sensitive



6. Laser power meter

When you have trouble using the laser power meter as shown in the image below,



< Caution >

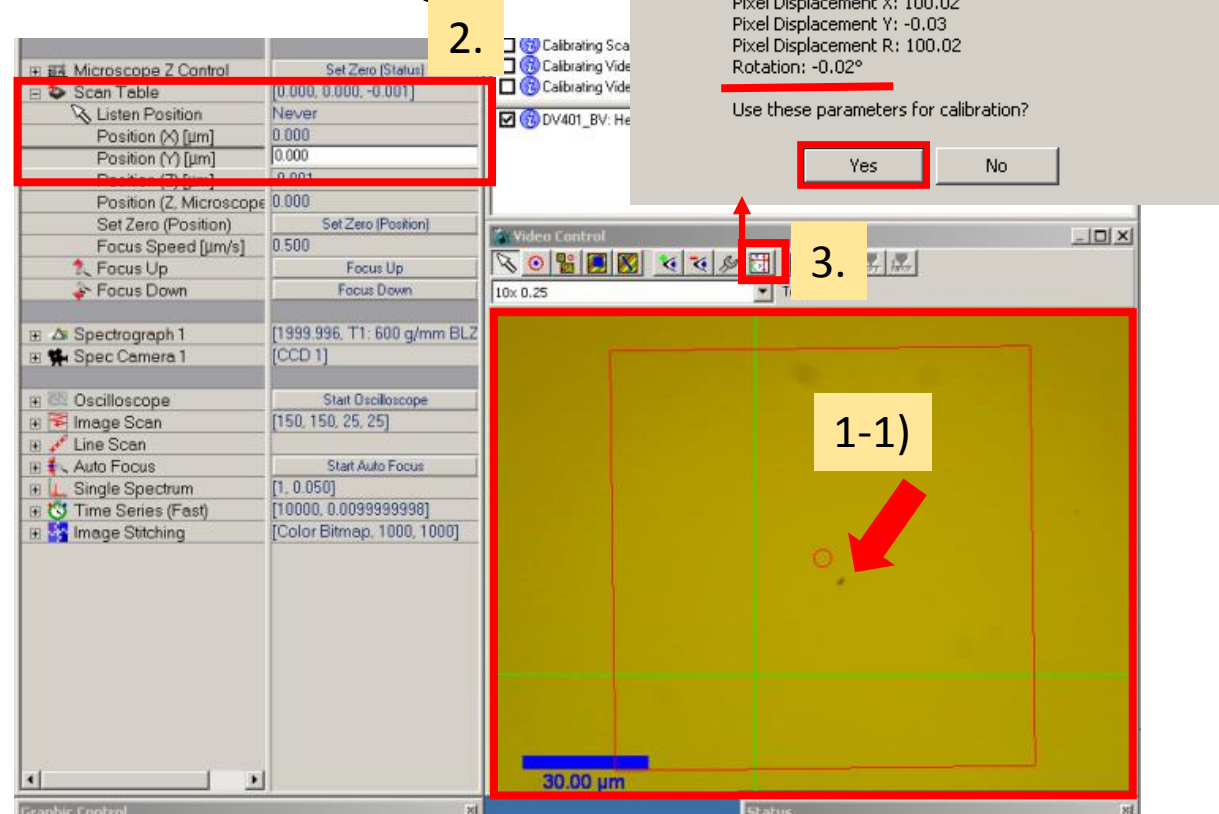
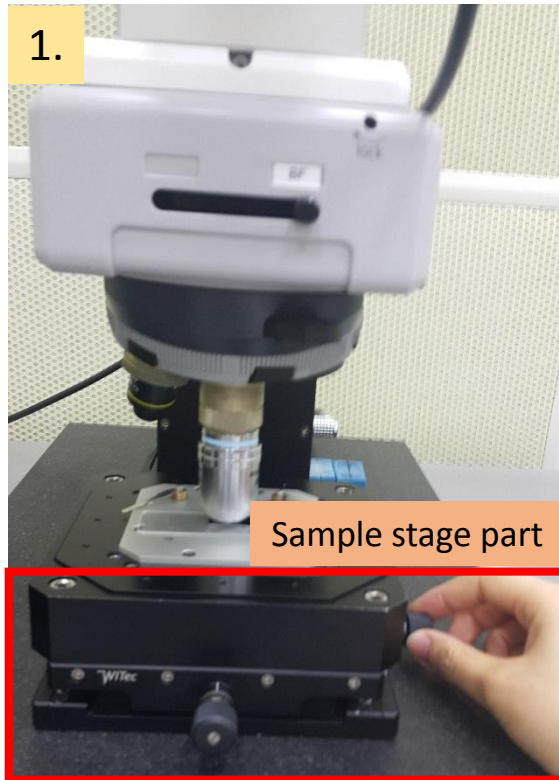
Please put on gloves and be careful not to touch the sensor part.

Please reassemble the sensor part.

Calibrate video image

If the rotation value is not within the range(-1<rotation value<1),

1. Please find the another position on the sample surface with sample stage part and focus again.
 - 1) You have to find the position where a perceptible change in image.
2. Please input '0' at the Position(X), (Y).
3. Click calibrate video image and check the rotation value again.



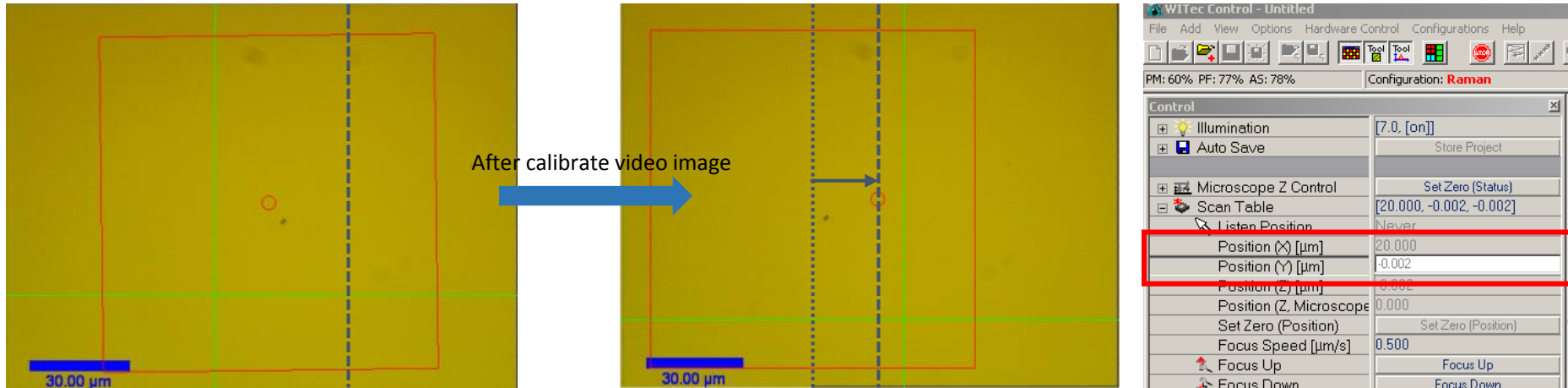
If the rotation value is not within the range after this process and show similar wrong value repeatedly, please contact manager.

Calibrate video image

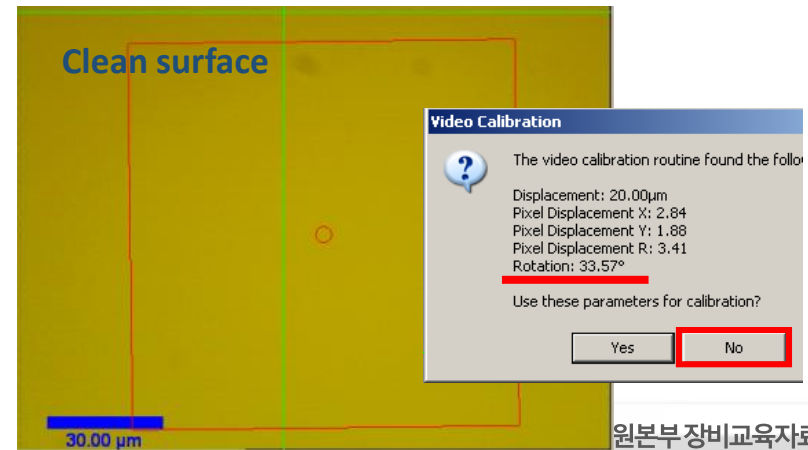
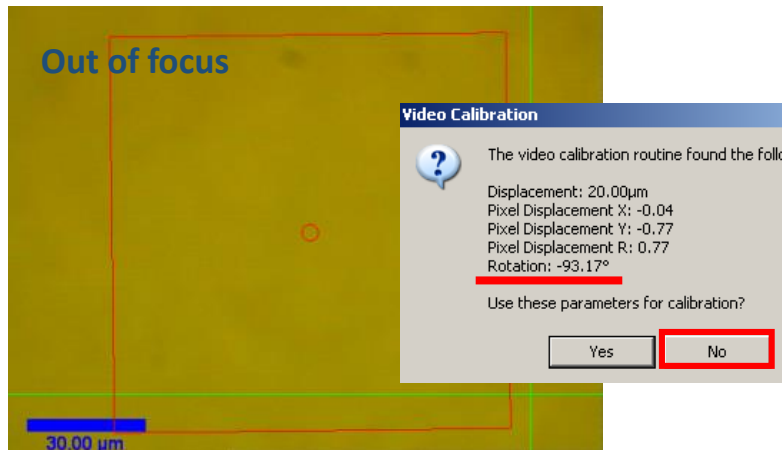
When you click calibrate video image, the Position(X) of measurement point(red circle part) move to +20 μm (with 50x lens).

The program can detect the change of image detecting the movement of measurement point.

We need detectable surface image to calibrate video image successfully.



You will fail 'calibrate video image' when the surface image is out of focus and very clean surface because program cannot detect the change of image.



6. Information

UNIST

ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

□ 국가연구시설장비 정보 등록증

고정자산관리번호	14004475	연구시설, 장비 구분	주장비
취득 방법	구매	모델명	Alpha300S
제작사	Witec	제작 국가	독일
취득금액 (원)	697,575,270 원	취득일자	2009-06-10
활용 범위	공동활용서비스 가능	장비용도	분석
장비 등록 번호	NFEC-2012-09-171092	등록 일자	
한글명	주사 근접장 광학현미경 및 공초점 라만 현미경 시스템		
영문명	Combined SNOM & Confocal Raman Microscope System		

□ 연구시설·장비의 운영 인력

성명	소속부서명	연락처 (사무실)	이메일
손선혜	연구지원본부	052-217-4175	shson35@unist.ac.kr

□ Witec Application Specialist

성명	소속부서명	직급	연락처	이메일
성광익	(주)나노인스텍	이사	02-486-7930	sung@nanoinstech.co.kr

Reservation control information

		Raman
UNIST	Client(70%)	17,500/hr
	Self-user(50%)	12,500/hr

Reservation time unit	Daily maximum reservation time	Cancelable timing
30 min.	3.0 hr	2.0 hr

7. Emergency

UNIST

ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

Emergency

연구실 번호
(Laboratory No.)

자연과학관
B107호

연구실명
(Laboratory Name)

AFM-Raman

연구실 책임자
(Laboratory Supervisor)

신태주

내선(4178)

연구실 안전담당자
(Safety Manager)

손선혜

내선(4175) 010-3176-1793

★ Please do not hesitate to contact **“Safety Manager”**, if you have any queries or urgent business.

(문의 사항 또는 급한 용무가 있을 시, “연구실 안전담당자”에게 연락 요망)

원외 주요 연락처

External Main Telephone

소방서 Fire Station 119

경찰서 Police Station 112

좋은삼성병원 052)22
Hospital 0-7500



화재, 폭발, 가스 · 화학약품 누출 등 응급상황 발생시

Fire, Explosion, Gas and Chemical Leak etc.

응급상황 발생시
Emergency Call

052) 217-
0119

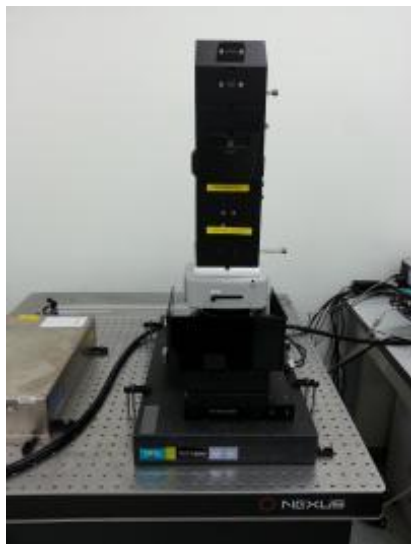
8. Related Equipment

UNIST

ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

자외선-가시광선 영역 공초점 라만이미징시스템 (UV-Vis Confocal Raman Imaging System)

Microscope, Laser, Raman Laser Coupler, Controller 로 구성된 본 장비는 라만 효과를 이용하여 시료에 대한 결함 분석, 극미량의 분자 구조 분석 등 시료 표면의 구조를 관찰할 수 있다.



보유기관	기초과학연구원 (IBS in UNIST)
연구책임자	Rodney S. Ruoff
제작사/모델명	Witec / Alpha 300M+
장비 정보	<p>micro-Raman with mapping functionality, with highest sensitivity for 266nm, 488nm and 532 nm excitation wavelength, High Throughput Configuration using 2 Spectrometer and 2 CCD Cameras.</p> <p>자외선-가시광선 영역 공초점 라만이미징시스템은 레이저와 전자구조간의 공명으로 인해 라만 분광법을 이용하여 소재의 진동모드나 포논모드를 측정할 수 있다. 일반적인 488 nm, 532 nm 의 레이저 외에 추가로 266 nm를 갖춘 라만 분광 장비이다.</p>