Training Material Number :

Author :

Date :



# **Confocal-Raman**

# Normal Operation Training Course





# 1. Syllabus





#### 1. Raman self-user training

- 1) Theory class (Raman manager Yeong Bi Kang, 4168)
- 2) Operation class (Raman manager Yeong Bi Kang, 4168)
  - Manager explains about Raman
  - 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

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

## **2. Basic Principles**



### The history of Raman spectroscopy



Chandrasekhara Venkata Raman

- November 7, 1888 ~ November 21, 1970
- In 1928, C. V. Raman discovers that small changed occur the frequency of a small portion of the light scattered by molecules
- Raman was awarded the Nobel Prize in Physics in 1930 for his discovery
- In the 1970's lasers made Raman much more practical.
   Near-IR lasers (1990's) allowed for avoidance of fluorescence in many samples. New continuous-wave(CW) and pulsed laser designs (2000's) have allowed for advances in Raman microscopy and other modes of Raman spectroscopy.

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Types of interaction between radiation and matter.

**Scattering and Photoluminescence** 





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rules

Dipole

moment

Raman active

**Polarizability** 



#### **Molecular vibration**

Symmetrical stretching



Raman scattering

(stokes)

**IR** absorption

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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

- Compounds for which Raman offers increased sensitivity
  - Weak IR absorbers -> strong Raman emitters
  - Symmetric bonds represented more (S-S, C-C, etc.)
  - Molecular backbone emphasized more
  - End groups de-emphasized
  - Spectral range offers more information on inorganics







- In general spectrum is invariant with  $\lambda_{excitation}$
- $I_{Rayleigh} = 10^6 X I_{Raman}$
- $I \propto \frac{I}{\gamma^4}$ ,  $I_{Raman}$  proportional to  $1/\lambda^4$  (5 times more effective for 400 nm than 600 nm)
- NIR or UV wavelengths have been used to avoid background fluorescence interference.



### **Raman applications**



#### Raman spectrum

#### Single spectrum



#### Image scan(mapping)



1310-1380 cm<sup>-1</sup>

1530-1630 cm<sup>-1</sup>

2605-2740 cm<sup>-1</sup>





### **Raman** applications



	Raman spectrum	Information
	Characteristic Raman frequencies	Composition of material
	Changes in frequency of Raman peak	Stress and strain state
Parallel	Polarization of Raman peak dicular	Crystal symmetry and orientation
	Width of Raman peak	Quality of crystal
Î	Intensity of Raman peak	Amount of material

### **Various Carbon**





#### Raman spectrum of graphene



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

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### **Raman applications**

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#### Spectral Imaging (Mapping)





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







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#### **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 :

N.A. =  $n \times \sin\theta$ 



- n = refraction rate of the medium between specimen and objective lenses. (air : n=1, oil : n=1.515)
- $\theta$  = angle which is made by the optical axis and refraction of the light farthest from the center of lens.

### **Raman applications**

**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.

 $\epsilon = 0.61 \text{ x} \frac{\lambda}{\text{N.A.}}$  (Reyleigh formula)

 $\lambda$  : 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.

 $\pm$  D.O.F. =  $\frac{\epsilon \times 250,000}{N.A. \times M} + \frac{\lambda}{2(N.A.)^2}$  (µm)

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

### **Raman applications**

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#### Resolving power



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

For example. Image scan :  $30x30 \ \mu m$  with Raman 532nm, 100x 0.9 objective

Magnification	N.A.	Λ [nm]	∆x [nm]
	0.5	532	649
50x		633	772
		785	957
50x	0.8	532	405
		633	482
		785	598
	0.9	532	360
100x		633	429
		785	532

Point/Line (Line/Image)=Geometry Width (Height)<br/>Resolution ( $\triangle x$ )=30,000 nm<br/>360 nm=83 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

### **3. Hardware**



### **Conceptual Raman Spectrometer**





### **Raman spectrometer**

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



Image Mode

Raman Mode

### **Raman spectrometer**



장비명	Confocal-Raman	AFM-Raman	Rama
			× No Ma Sc
위치	102- B107	102- B107	у <b>Те</b>
사용	의뢰/자율사용 가능	의뢰/자율사용 가능	: '
모델명	Alpha300R	Alpha300S	② <b>Mi</b> : 2
시료	Powder, liquid, film	Powder, liquid, film	3 Fla
Measurement mode	Single scan, Image scan	Single scan, Image scan, SNOM	
Laser source (nm)	532	532, 633, 785	Temp
Objective (N.A., WD mm)	50x (0.8, 0.54), 50x (0.5, 10.6), 10x (0.25, 7.0)	100x (0.9, 1.0), 50x (0.5, 10.6), 20x (0.4, 3.8)	range
Temperature controller	사용	가능	Temp stabili
			Llold

#### Raman scan table



% No sample holder

 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
 Min. sample size
 : 2 mm in x- and y-direction

③ Flat & Smooth Surface

#### **Temperature controller**

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

### 4. Raman operation



### **Mode setting**





Image Mode

Laser Mode



Raman Mode

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



#### 1. Laser on → warm up (10 min)





#### 2. WITec Control Pro. START $\rightarrow$ wait cooling down (10 min)



#### 2-1. Program setting



3. Put down a Si substrate(reference) on a slide glass (Turn the lens sideways and place the sample)



- Illumination: 100
- Spectrograph1
- Grating: 600 g or 1800 g
- Spectral center: 2040 or 600

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- Video control: lens choice
- Image mode

	Beam	Notch	Push
	Splitter	Filter	Rod
Image Mode	BF	IN	IN

- X50 lens setting
- Lens stage distance check
- Lens position center check

### Spectrograph\_Grating

#### 600g/mm

The resolution of X axis is about 3~4 cm<sup>-1</sup>. You can see the whole range of Raman spectrum when the 'Spectral Center' is 2040 cm<sup>-1</sup>.



#### 1800g/mm

The resolution of X axis is about 1 cm<sup>-1</sup>. You can see the spectrum that the range is about 1000 cm<sup>-1</sup>. Please input the 'Spectral Center' value differently for your sample peak.

When you input 500~600 cm<sup>-1</sup> at 'Spectral Center', you can see the Si peak during calibration.



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

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#### 4. Image Mode $\rightarrow$ Control $\rightarrow$ Illumination = 100, Speed 100 $\rightarrow$ down



5. Illumination = 50, Speed 50  $\rightarrow$  down $\rightarrow$  Illumination = 30, Speed 30  $\rightarrow$  down $\rightarrow$  Illumination = 10, Speed 10  $\rightarrow$  down $\rightarrow$  Speed 5  $\rightarrow$  slowly down (take a focus)

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		Diffuse layer					

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# 6. Video Control → Calibrate Video Image click → Rotation < ± 0.1</li> 6-1. Scan Table → X,Y,Z=0



#### 7. Laser Mode $\rightarrow$ Laser shutter on $\rightarrow$ Slit decrease $\rightarrow$ Laser position = red circle (Video Control $\rightarrow$ Set Video Origin click $\rightarrow$ Laser position click) $\rightarrow$ Slit max $\rightarrow$ Shutter off



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8. Raman Mode $\rightarrow$		Beam Splitter	Notch Filter	Push Rod
$\rightarrow$ Slit increase -> Maximize peak intensity	Raman Mode	DF	IN	OUT





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



10. Real Time Spectrum  $\rightarrow$  Move a cursor to the highest point (520 cm<sup>-1</sup> peak)  $\rightarrow$ Z Value  $\geq$  7,000 CCD cts (If, Z Value < 7,000 CCD cts  $\rightarrow$  Z axis Speed 0.5  $\rightarrow$  down or up, Maximize



peak intensity)



11. Graphic Tool  $\rightarrow$  Zoom click  $\rightarrow$  Zoom in 520 cm<sup>-1</sup> peak  $\rightarrow$ Center point of 520 cm<sup>-1</sup> peak = 520.0 ~520.5 cm<sup>-1</sup>(Position  $\rightarrow$  Spectral Position) $\rightarrow$ Control  $\rightarrow$  Spectrograph  $\rightarrow$  Laser Wavelength change



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#### 12. Oscilloscope Stop

#### 13. Control → Single Spectrum → Acc. Single Spectrum click(Integration Time = 0.05 s, 1 scan) 14. Data labeling(2025XXXX\_Si\_Cal.)



### Laser powermeter calibration



#### Laser Power Meter (power setting)- in Raman Mode





- 1. Remove a laser powermeter cover
- 2. Connect a connector -> put on the laser powermeter connection point
- 3. Lase powermeter power on
- 4. Set the "zero" point
- 5. Laser shutter on
- 6. Set the measurement power by rotating slit
- 7. Laser powermeter power off
# Sample measurement\_Single spectrum

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



- 5. WITec Control Pro. CLOSE→ wait heating (10min)
- 6. Laser off

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### **Data processing**







#### 1. Si calibration

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

# **3. Open Image scan1) 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).

WITEC Control - Untitled			_ [5] ×
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Control	E	Points per Line	100
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<ul> <li></li></ul>	Set Zero (Status) [-0.003, -0.007, -0.001]	Layers per Scan	1
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Layers per Scan	- <sup>1</sup>	Height [µm]	25
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# 3. Open Image scan2) 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.





#### 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

M	5_6_ML_1004_Sp	ec.Data 1				
_	_		Export			•
12000	-		Mouse Mo	de		
Ccts			Scale and Z	oom		•
208-	-		Mode	Ø	Mouse Move	M
4000	-	Misc Vis Options	Misc Visua Options / C	•	Mouse Zoom in (select regio	on)
			Graphs	1	Mouse Marker	
		Iλ	M5_6_ML_	~	Mouse Follow 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

#### Image scan\_BG Ave.

**Spectral Position** 





Sum Filter\_BG Ave.





BG Ave. 16

BG Ave. 8

BG Ave. 4

1=0

### Image scan\_Filter manager

- **Sum Filter** SUM filter create a new image data object with the dimension X, Y and integrated intensity Which can then be displayed as an image. Sum=  $\sum_{i=n_1}^{n_2} I_i$ 
  - 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.



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### Image scan\_Filter manager

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Sum filter

Width filter



- 1. Si calibration
- 2. Prepare temperature controller stage
- 1) Open the top of sample stage



#### 2) Prepare sample position





- 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
- Connect power connection
   Connect the LNP with controller
   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.

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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 N<sub>2</sub> gas across Window and eliminate external condensation

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Do not fasten catches until the

bubbling noise from boiling off

Nitrogen subsides.

\*\*

- 6. Prepare Liquid Nitrogen
- 1) Open the top of dewar
- 2) Fill dewar approximately 3cm from top
- 3) Close the top



7. Connect the liquid nitrogen line with the stage







LNP supply liquid nitrogen to the stage TMS94 is temperature controller

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





8. Set the TMS94 temperature controller
1) Change the temperature (°C)
Limit – Press the number- Enter



#### 2) Change the existing rate (°C/min) **Rate** – Press the number - **Enter**





- 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



# **5.** Cautions



### Cautions

ļ



#### 1. Don't touch this part



- 2. Hold this part, NOT lens
- 3. Lens up, whenever you change a sample

2



#### 4. Laser off





- 5. Laser Power Meter
- The head is very sensitive





### Cautions

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#### 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**

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#### If the rotation value is not within the range(-0.1<rotation value<0.1),

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. Video Calibration  $\times$ 2. Please input '0' at the Position(X), (Y). The video calibration routine found the following parameters: ? 3. Click calibrate video image and check the rotation value again. Displacement: 20.00µm Pixel Displacement X: 100.02 Pixel Displacement Y: -0.03 🗌 🔞 Calibrating Sca Pixel Displacement R: 100.02 Calibrating Vide Rotation: -0.02° H BA Microscope Z Control 1 🗖 🔞 Calibrating Vide Scan Table 0.000, 0.000, -0.001 Use these parameters for calibration? Listen Position Never 🗹 🔞 DV401\_BV: He Position (X) [µm] 0.000 Position (Y) [um] Yes No Position (Z. Microscope 0.000 Set Zero (Position) Set Zero (Position) 🖉 Video Contro - | D | X | Focus Speed [µm/s] 3. 30 8 5 8 **1** 0 0 S F. 18. L Focus Up Focus Up Focus Down Focus Down 10x 0.25 1999.996. T1: 600 g/mm BLZ E A Spectrograph 1 Ŧ 😘 Spec Camera 1 Oscilloscope Start Oscilloscope [150, 150, 25, 25] 🗉 🞏 Image Scan 1-1) Line Scan Start Auto Focus Auto Focus 1.0.0501 Single Spectrum 🐯 Time Series (Fast) 10000, 0.00999999981 🗉 🚼 Image Stitching [Color Bitmap, 1000, 1000] Sample stage part 30.00 µm

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 um(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.





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#### 연구지원본부장비교육자료 59

Penalt	ty poin <sup>.</sup>	ts for	users o	f equi	<b>ipment</b>



• 벌점 부과 기준

No.	별점 부과 내용	벌점				
[장비 사용 자격 ]						
1	해당 장비에 대하여 직접 사용이 허가 되지 않은 사용자가 기기를 사용	5				
2	장비 예약하지 않고 장비 사용	3				
3	장비 예약자 본인이 아닌 자가 장비를 사용	3				
	[장비 사용 예약 ]					
4	허용시간 이외의 시간에 장비 예약 및 사용	1				
5	장비 예약시간을 초과하여, 예약시간 종료 전에 초과시간에 대한 예약없이 장비 사용	1				
6	장비 예약 취소 사실 통보 없이 해당 시간에 장비 사용하지 않은 경우	3				
7	「연구지원본부 운영지침」제7조의 내용을 기준으로, 장비 예약 취소 기한이 지나서 예약을 취소한 경우	1				
8	예약 후 장비담당자에게 통보하지 않고 기기 사용	1				
9	장비 사용 중 허용되지 않은 기능 조작	3				
10	장비 사용 중 장비의 이상이나 고장 발견 후 담당자에게 즉시 고지하지 않은 경우	3				
11	사용자 부주의로 기기 손상 및 고장	5				
12	사용자 부주의로 장비 부속품 분실 또는 파손	5				
13	장비 사용 후 장비사용일지를 작성하지 않거나 허위 작성 또는 일부만 작성	1				
14	담당자가 장비 또는 시설의 정상적인 작동과 안전을 유지하는 데에 반드시 파악해야할 시료의 정보를 제공하지 않아 장비 손상 및 고장을 초래	3				
15	야간 또는 장비 담당자의 정규 근무시간이 아닌 때에 장비 사용 후 소등. 출입문단속. 주변 정리 등을 확인하지 않고 퇴실	3				
16	유독 물질 및 가스의 누출 또는 화재 발생의 위험을 초래	5				
17	타인의 개인물품(분석 및 공정 소모품 및 기자재)을 사전 동의 없이 사용하거나 훔치는 행위	5				

# Penalty points for users of equipment



60

#### • Penalty points criteria

No.	Behaviors subject to penalty points	Penalty pts.					
	[Eligibility to use equipment]						
1	Unauthorized use of equipment without permission	5					
2	Use of equipment without a reservation	3					
3	Someone other than the equipment lessee used the equipment	3					
	[Reservations for using equipment]						
4	Reserved and used equipment outside of permitted hours	1					
5	Use of equipment beyond the time reserved without making another reservation beforehand for extra time	1					
6	Failed to use the equipment durng the reserved time and did not cancel reservation in advance	3					
7	Cancelling reservations for equipment after the cancellation deadline, under Article 7, Guideline for the Operation of the UNIST Central Research Facilities (UCRF)	1					
8	Use of any equipment without giving a prior notice to the equipment manager, after making a reservation	1					
	[Careless behaviors]						
9	Using functions on the equipment that are not permitted	3					
10	Failure to promptly notify the manager of any errors or failures detected during use	3					
11	Negligence that resulted in damages or failure to the equipment	5					
12	Negligence that resulted in loss or damage to an equipment component or part	5					
13	Failure to record in the equipment usage log after using any equipment, or misrepresentation or partial representation of the facts	1					
14	Failure to provide specimen information required by the equipment manager to ensure normal operations and safety of equipment or facilities, thus resulting in damage or failure to the equipment	3					
15	Leaving the laboratory without putting the laboratory back in order, without turning off the lights, or without properly locking the entrance door, after using equipment at nighttime or during the equipment manager's off-hours	3					
16	Causing leakage of toxic substances, gases, or causing risk of fire	5					
17	Using or stealing someone's personal items (e.g. supplies, equipment or materials for analysis and process) without prior consent	5					
	연구지원본	부장비교육자료					



• Follow-up Actions after Imposing Penalty Points

구분	벌점	조치내용				
	[장비사용자 개인 ]					
개인에게 부과된 벌점 합산	≥ 5 points	장비 담당자가 사용자 및 지도교수에게 이메일로 통보(벌점 8점 이상일 시 장 비 사용이 3개월간 금지됨을 공지)하고 해당 사용자의 벌점 내역을 기기실에 게시				
	≥ 8 points	장비 담당자가 사용자 및 지도교수에게 사용자의 해당 장비 사용이 3개월간 금지되고 재교육 후 사용이 가능함을 이메일로 통보하고 지도교수에게 공문 발송, 해당 사용자의 벌점 내역을 기기실에 게시				
		(사용자 소속 연구실)				
동일 연구실에서 동일 장비에 대하 여 연구실 소속 학 생들에게 부과된 벌점 합산	≥ 12 points	장비 담당자가 지도교수와 해당 사용자에게 벌점 15점 이상일 시 해당 연구실의 해당 장비 사용이 3개월간 금지됨을 이메일로 통보				
	≥ 15 points	장비 담당자가 지도교수에게 해당 연구실의 해당 장비 사용이 3개월간 금지됨을 이메일로 통보, 지도교수에게 공문 발송, 해당 사용자의 벌점 내역을 기기실에 게시				
동일 연구실에서 연구지원본부 전 체 장비에 대하여 연구실 소속 학생 들에게 부과된 벌 점 합산	≥ 20 points	연구지원본부에서 지도교수와 소속 학생에게 벌점 25점 이상일 시 해당 연구실의 연구지원본부 전체 장비 사용이 1개월간 금지됨을 이메일로 통보				
	≥ 25 points	연구지원본부에서 지도교수와 소속 학생에게 해당 연구실의 연구지원본부 전체 장비 사용이 1개월간 금지됨을 이메일로 통보, 지도교수에게 공문 발송, 해당 벌점 내역을 연구지원본부 게시판에 게시				



• Follow-up Actions after Imposing Penalty Points

Classification	Penalty pts.	Follow-up actions
		(Individual users of equipment)
Sum up penalty poin ts imposed to indivi duals	≥ 5 points	Equipment manager will notify user(s) and their supervising professor by email of their penalty points total, and shall post the details of their penalty points on the bulletin board of the equip ment room. Users with penalty points 8 points or higher may not use the relevant equipment f or 3 months.
	≥ 8 points	Equipment manager will notify user(s) and their supervising professor by email that the user(s) may not use the relevant equipment for 3 months until they complete the re-orientation cours e; will also forward an official notice to their supervising professor; and will post details of their penalty points on the bulletin board of the equipment room.
		(User's laboratory)
Sum up penalty poin ts imposed on the st	≥ 12 points	Equipment manager will notify the user(s) and their supervising professor by email that user(s) with penalty points 15 points or higher may not use the relevant equipment in the laboratory f or 3 months.
udents in the labora tory for the same eq uipment in the same laboratory	≥ 15 points	Equipment manager will email the supervising professor to inform that the user(s) may not use the relevant equipment in the laboratory for 3 months; will also forward an official notice to th eir supervising professor; and will post the details of their penalty points on the bulletin board of the equipment room.
Sum up penalty poin ts imposed on the st udents in the labora tory for all UCRF equ ipment in the same l aboratory	≥ 20 points	UCRF will notify students and their supervising professor by email that the user(s) with 25 pena Ity points or higher may not use any UCRF equipment in the laboratory for 1 month.
	≥ 25 points	UCRF will notify students and their supervising professor by email that user(s) may not use any UCRF equipment in the laboratory for 1 month; will also forward official notice to their supervis ing professor; and will post details of their penalty points on the bulletin board of UCRF.

# **6. Information**



### Information

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 근접		항 광학현미경 및 공초점 라만 현대	기경 시스템	
영문명	Combined SNOM & Confocal Raman Microscope System			

#### □ 연구시설·장비의 운영 인력

성명	소속부서명	연락처 (사무실)	이메일
강영비	연구지원본부	052-217-4168	ybkang@unist.ac.kr

#### □ Witec Application Specialist

성명	소속부서명	직급	연락처	이메일
성광익	㈜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

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#### **Create Account**

#### www.ucrf.unist.ac.kr



- 1. Click [Sign up].
- 2. Click [UNIST Member].
- 3. Input [Portal id/pw]\_Click [Confirm].

Please check your information.

4. Input professor name in [Principal investigation]

\_Click [Professor search]\_Click professor name.

5. Click [Create Account].

UNIST member		Industry member	External member					
ID/E-mail		m*k*m @ unis	st.ac.kr					
Password	**	*	Confirm					
Name		홍길동						
Department		연구지원본부						
Student ID No. / Professor ID No. / Staff ID No.		20*39						
Contact	Extension	4064						
	Cell phone	010	** **					
Principal Investigator		김교수	Professor Search					
	Select		÷					

### **Request for Self-user**



#### www.ucrf.unist.ac.kr

		ROOM	Participatior	Space Q	
		<b>^</b>	>MY PAGE > Status of an	alysis request	
My Page		St	atus of analys	is request	
Request for Self-user	~		Equipment	Status	Application date
Status of analysis reques	st 🗸	<u> </u>			
Status of settlements	~		Reque	st for Se	lf-user
Status of education application	~	4-1	Materials Charact	erization Lab	~
Status of tour applicatio	n 🗸	4-2	Spectroscopic An	alysis	~

After pass the test,

- 1. Login UCRF website.
- 2. Click [My Page].
- 3. Click [Request for Self user].
- 4. Select the equipment.
  - 1) Select [Materials Characterization Lab].
  - 2) Select [Spectroscopic Analysis].
  - 3) Select [Confocal Raman].
  - 4) Click [Apply].



ULIIZL						Adminis	stration Roo	om Seonhye Son   Switch	Position   Settings   Site map	Log out		Q KOR	ENG
Home   Human Resourc	e   Financial	Procurement	Asset Budge	t Research Equip	oment   Fu	nd   Intellectu	ual Proper	rty   Application fo	r use of lecture 🕴 Bulletin	board Settings	Impr	ovement Re	quest
Equipment Reservation													
Detailed Navigation	📈 Equipment reserv	ation											🔞 help
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Envorito 🏟	1st classification:		2nd classification:	<b>•</b>	Equipment nam	ne:	•						
	Equipment booking list												
	Application Reser	vation cancel	Input result										
	Select Status	Sortation	Equipment name	Chief of research	Researvation date	Reservation time	Fee 1st	t classification	2nd classification name	Application date	Free_Test	Free_Longterm	Memo
	Reservation	Admin	Contocal Raman	김영기	2015.08.17	13:00~16:30	0.00 UN	MAL - 기기분석실	Surface Analysis	2015.08.04 18:44			
	Reservation	Admin	AFM-Raman	김영기	2015.08.17	13:00~16:30	0.00 UN	MAL - 기기분석실	Surface Analysis	2015.08.10 16:27			Q
	Reservation	Admin	Confocal Raman	김영기	2015.08.17	09:00~11:30	<u>0.00</u> UN	MAL - 기기분석실	Surface Analysis	2015.08.04 18:44			0
	Reservation	Admin	AFM-Raman	김영기	2015.08.17	09:00~11:30	<u>0.00</u> UN	MAL - 기기분석실	Surface Analysis	2015.08.10 16:27			Q
	Reservation	Admin	FT-IR	김영기	2015.08.13	15:00~18:00	<u>0.00</u> UN	MAL - 기기분석실	Spectorscopic Analys	2015.08.07 10:53			
	Reservation	Admin	FT-IR	김영기	2015.08.13	13:30~15:00	0.00 UN	MAL - 기기분석실	Spectorscopic Analys	2015.08.07 10:52			
	Reservation	Admin	<u>FT-IR</u>	김영기	2015.08.13	09:00~12:00	0.00 UN	MAL - 기기분석실	Spectorscopic Analys	2015.08.07 08:57			
	Reservation	Admin	Confocal Raman	김영기	2015.08.12	15:30~17:00	0.00 UN	MAL - 기기분석실	Surface Analysis	2015.08.07 17:15			
	Reservation	Admin	<u>FT-IR</u>	김영기	2015.08.12	10:30~11:00	0.00 UN	MAL - 기기분석실	Spectorscopic Analys	2015.08.07 14:57			
	Reservation	Admin	Confocal Raman	김영기	2015.08.12	09:00~10:30	0.00 UN	MAL - 기기분석실	Surface Analysis	2015.08.06 13:21			
	Reservation	Admin	<u>FT-IR</u>	김영기	2015.08.11	14:30~18:00	0.00 UN	MAL - 기기분석실	Spectorscopic Analys	2015.08.07 08:57			
	Reservation	Admin	Confocal Raman	김영기	2015.08.11	13:30~14:30	0.00 UN	MAL - 기기분석실	Surface Analysis	2015.08.05 11:42			
	Reservation	Admin	Confocal Raman	김영기	2015.08.11	09:00~10:00	0.00 UN	MAL - 기기분석실	Surface Analysis	2015.08.10 13:04			
	Reservation	Admin	FT-IR	김영기	2015.08.11	09:00~12:00	0.00 UN	MAL - 기기분석실	Spectorscopic Analys	2015.08.07 10:56			
	Reservation	Admin	FT-IR	김영기	2015.07.29	09:30~10:30	0.00 UN	MAL - 기기분석실	Spectorscopic Analys	2015.07.28 13:26			
	Reservation	Admin	<u>FT-IR</u>	김영기	2015.07.17	16:00~17:00	0.00 UN	MAL - 기기분석실	Spectorscopic Analys	2015.07.17 18:00			

### Reservation

13:30~14:00

14:00~14:30

14:30~15:00

15:00~15:30

15:30~16:00 16:00~16:30

16:30~17:00

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	Reservati	on	Self	AFN	1-Raman		김영	경기		2015.0	07.24	14:00~15:00	<u>0.</u>	.00	UMAL - 기기분석실		Surface Analysis	2015.07.17 11:08			
	Reservati	on	Self	Cor	focal Rama	in	김영	경기		2015.0	07.24	14:00~15:00	<u>0.</u>	.00	UMAL - 기기분석실	l	Surface Analysis	2015.07.17 11:07			
	Reservati	on	Self	FT-I	IR		김영	경기		2015.0	07.23	13:30~17:00	<u>0.</u>	.00	UMAL - 기기분석실	l	Spectorscopic Analys	2015.07.17 11:05			
	Reservati	on	Self	Cor	nfocal Rama	in	김영	경기		2015.0	)7.22	13:00~14:00	0.	.00	UMAL - 기기분석실	1	Surface Analysis	2015.07.20 11:20			
	Reservati	on	Self	Fluc	prometer		김영	격기		2015.0	07.20	14:00~14:30	0.	.00	UMAL - 기기분석실	1	Spectorscopic Analys	2015.07.17 11:03			
	Reservati	0.0	Self	Eluc	rometer		210	371		2015.0	17.20	13:30~14:00		00	니MAL - 기기분성실		Spectorscopic Analys	2015 07 16 16:55			
	Reconsti		Colf		ID ID		210	3171		2015.0	717	16:00-17:00	<u>.</u>		비사이 기기분석신	•	Spectorscopic Analys	2015.07.17 18:00			
	Reservati	on	Sell	<u>F1-</u>	<u>IK</u>		83	321		2015.0	//.1/	10.00~17.00	<u>u.</u>	.00	UMAL - 기기문식설	2	Spectorscopic Analys	2015.07.17 16.00			0
	3 1	장비역약 Application Select equipr Client ID: 1st classificatio	<mark>shson35@unistacl</mark>	기<->펼치기 cr	30678	/ 손선혜 nd classificatior	C Surface Analy	sis	v	Subscriber: 3rd classificatio	30678 n: Confocal Raman	순선혜 h <b>▼</b>	]				1. Select the cla	ssification ar	nd equ	ipment	t
0		project informalon     Chief of research Chief of research Detail project number     20032 2/871					•	d	etailed item	Executable a	amount 0		0		2. Select the tim	e you want o	n whit	e box.	ζ.		
		Reservation control information           Reservation time unit         daily maximum reservation time           30 분         30 시간           80 분         30 시간           80 분         30 시간				Reservation 5 일전	open timing		Cancelable timing 2 시간전		Fee 0.5 H	Hour 12,500 원		Red box : oth	ers reservatio	on					
	2	Time/date 09:00~09:30 09:30~10:00	07/20(M)	07/21(T) ✓	07/22(W)	07/23(T)	07/24(F)	07/25(S)	07/26(S)	07/27(M)	07/28(T) 0	77/29(W) 07/30(T)	07/31(F)	08/0	01(5) 08/02(5) 0	08,	3. Click [Applica	tion].			
		10:00~10:30 10:30~11:00 11:00~11:30	N N N N N N N N N N N N N N N N N N N	N N N																	
		11:30~12:00	×	×																	
		12:30~13:00																			
		13:00~13:30			~																

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#### **Reservation cancel**



#### **Equipment reservation**

Search	Search condition										
Q Inc Researva 1st class	Q Inquiry Researvation date: 2015.01.01										
Equipr	Reserva	ation ca	ancel								
р	plication Reservat	tion cancel 📝 In	put result								
Select	Status	Sortation	Equipment name	Chief of research	Researvation date	Reservation time	Fee	1st classification	2nd classification name		
	Reservation	Self	Confocal Raman	김영기	2015.07.24	14:00~15:00	<u>0.00</u>	UMAL - 기기분석실	Surface Analysis		
	Reservation	Self	Confocal Raman	김영기	2015.07.22	13:00~14:00	<u>0.00</u>	UMAL - 기기분석실	Surface Analysis		

- 1. Select the reservation.
- 2. Click the [Reservation cancel].

### **Input result**

#### After measurement, you have to input result instead of filling in log sheet

🛛 Eq	Equipment reservation												
Search	condition												5
Q Inq Researva 1st class	vation date:       2015.01.01       ID       ~       2015.08.04       ID         ssification:       UMAL - 717분석실       ✓       2nd classification:       Surface Analysis       ✓         Equipment name:       Confocal Raman       ✓												
Equipm	nent booking li	nput	result										E
Ар	plication Reservat	tion cancel 📝 In	put result										
select	Status	Sortation	Equipment name	Chief of research	Researvation date	Reservation time	Fee	1st classification	2nd classification name	Application date	Free_Test	Free_Longterm	Memo
•	Reservation	Self	Confocal Raman	김영기	2015.07.24	14:00~15:00	<u>0.00</u>	UMAL - 기기분석실	Surface Analysis	2015.07.17 11:07			
	Reservation	Self	Confocal Raman	김영기	2015.07.22	13:00~14:00	<u>0.00</u>	UMAL - 기기분석실	Surface Analysis	2015.07.20 11:20			0

- 1. Select the reservation.
- 2. Click the [Input result].
- 3. Check the information and click [Save]

	oment rec	사용실적입력										) 🗆	×
).	ndition	Save Close											
1	7	Reservation information											
lesearvati	on date: 2015	Reservation number: 2015001217 Reserv Application date: 2015.07.17	ation date: 2015.07.24	Clier	nt authoritization:	lf	:	shson35@	unist.ac.kr		손선혜		
st classifi	cation: UMA	Reserv	ation time: 14.00-13.00	Rate	50	,	Equipment name	Coniocal P	aman				_
quipme	nt booking	Project informaion											
Appl	ication 🕞 F	Chief of research Chief of research	Detail project numbe	r		detailed item	Exec	utable amo	unt	-		_	
Select	Status	20032 김영기			•		•		0	0		0	
<b>V</b>	Reservation	Fee											1
	Reservation	Cost	Unit quanti	y Unit	unit amount	discount applying	Option applying	Amount	Fee	Rate	Amount		
		기본공정료	0	5 н	12,500			1.0	25,000	50		12,500	
		합계							25,000			12,500	
													1
		Process condition											
		equipment status (problem and repair)											
													1

# 7. Emergency


## Emergency

ULÉSAN NU SCIENT





## 8. Related Equipment



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.

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보유기관	기초과학연구원 (IBS in UNIST)
연구책임자	Rodney S. Ruoff
제작사/모델명	Witec / Alpha 300M+
장비 정보	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. 자외선-가시광선 영역 공초점 라만이미징시스템는 레이저와 전자구조간 의 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.