



# **Nano fabrication lab Safety training**

**UNIST UCRF**

# **1. Cleanroom Definition**

## **2. Facility resources**

## **3. Equipment**

## **4. Lab policies**

## **5. Wet station**

## **6. Emergency measures**

## **7. Equipment reservation**

# Cleanroom definition

## 1. What is Cleanroom?

- Special room to manage to lower indoor dusts and airborne particles from prescribed cleanliness class and also to control temperature, pressure, humidity and distribution and velocity of air flow within a certain range.
- To gain and maintain cleanliness for the purpose of prevention of environment pollution .
- Cleanliness is the most important in the cleanroom and recently high cleanliness is required in all industries due to the development of industrial technology.

## 2. Types of Cleanroom

Cleanroom is divided into I.C.R(Industrial Clean Room) and B.C.R(Biological Clean Room) depending on the purpose of the room.

### 1) Industrial Clean Room(ICR) Applications

- Semiconductor, LCD/PDP manufacturing processes, Computer assembly process
- Optical lens, Film manufacture, Watches, Cameras, Microscopes, Laser device
- Bearing product manufacturing process, Precision

### 2) Medical Applications of clean room(bio)

- Hospital operating room: sterile hospital room, sterile operating room that require removal of bacteria in the air
- Animals Experiment Laboratory(GLP Good Laboratory Practice): animal experiments or vivo experiments field
- Pharmaceuticals production facilities(G.M.P Good Manufacturing Practice)

# Cleanroom definition

## 3. Cleanness Class

### 1) Units of Class

Units of Class are based on the number of dust of 0.5 micron ( $\mu\text{m}$ ) in 1 cubic feet(  $\text{ft}^3$  )

Note: 1 cubic feet (  $\text{ft}^3$  ) = horizontal 30.43 cm \* vertical 30.43 cm \* height 30.43 cm

Unit	Number of Dust		Standard
	number/ $\text{m}^3$	number/ $\text{ft}^3$	
CLASS 1	Under 35.3	Under 1	0.5micron ( $\mu\text{m}$ )
CLASS 10	Under 353	Under 10	
CLASS 100	Under 3,530	Under 100	
CLASS 1,000	Under 35,300	Under 1,000	

### 2) Functions of HEPA Filter and ULPA FILTER

- ① HEPA filters control to 99.97% of 0.3 ( $\mu\text{m}$ ) dust
- ② ULPA filters control to 99.9997% of 0.3 ( $\mu\text{m}$ ) dust

### 3) Pressurization : Cleanroom manage the pressure to prevent outside air from entering the clean-room



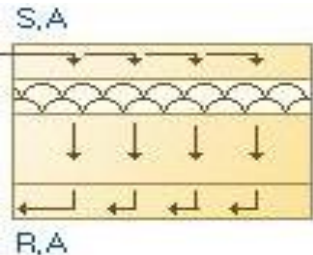
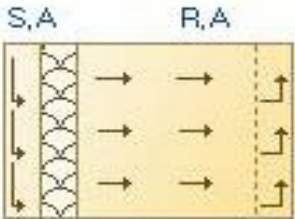
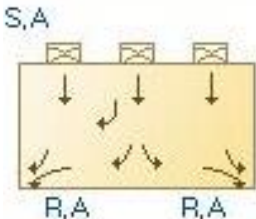
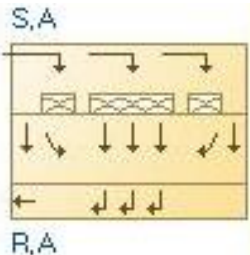
<Negative>



<Positive>

# Cleanroom definition

## 4. Clean room Air conditioning

	Vertical laminar airflow	Horizontal laminar airflow	Turbulent airflow	Mixed airflow	note
Class	1~100	100	1,000~100,000	1,000~100,000	
Cost	high	medium	low	medium	
Layout change	easy	difficult	easy	easy	
Method					



< Yellow room >



< White room >

# ★ Cleanroom definition

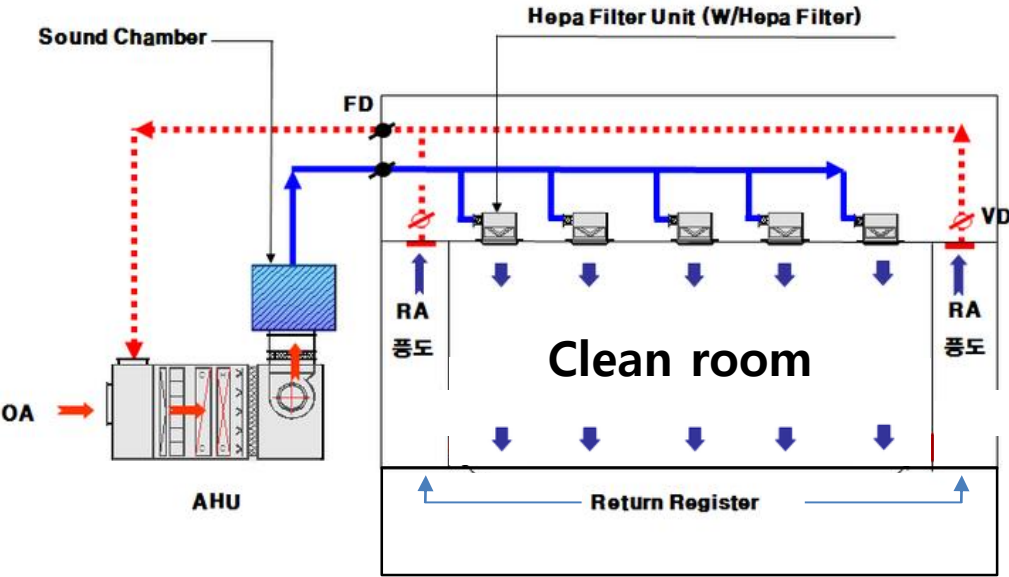
## 5. Conditions and management to maintain cleanliness

- 1) Cleanroom cleaning : Conduct once a week with students, administrators and researchers.
- 2) Air conditioner filter replacement cycle.

Division	O.A filter	Pre filter	Medium filter	HEPA filter
Replacement cycle	Frequent	3 months	3 or 6 months	2 years

### 3) Temperature and humidity management

Division	Period	Temperature	Humidity	Note
Cleanroom	Year round	22℃	55%	24 hours



< UCRF Nanofabrication HVAC Flow Diagram >

- 1. Cleanroom Definition**
- 2. Facility resources**
- 3. Equipment**
- 4. Lab policies**
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- 6. Emergency measures**
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# Facility resources

## 1. Management system

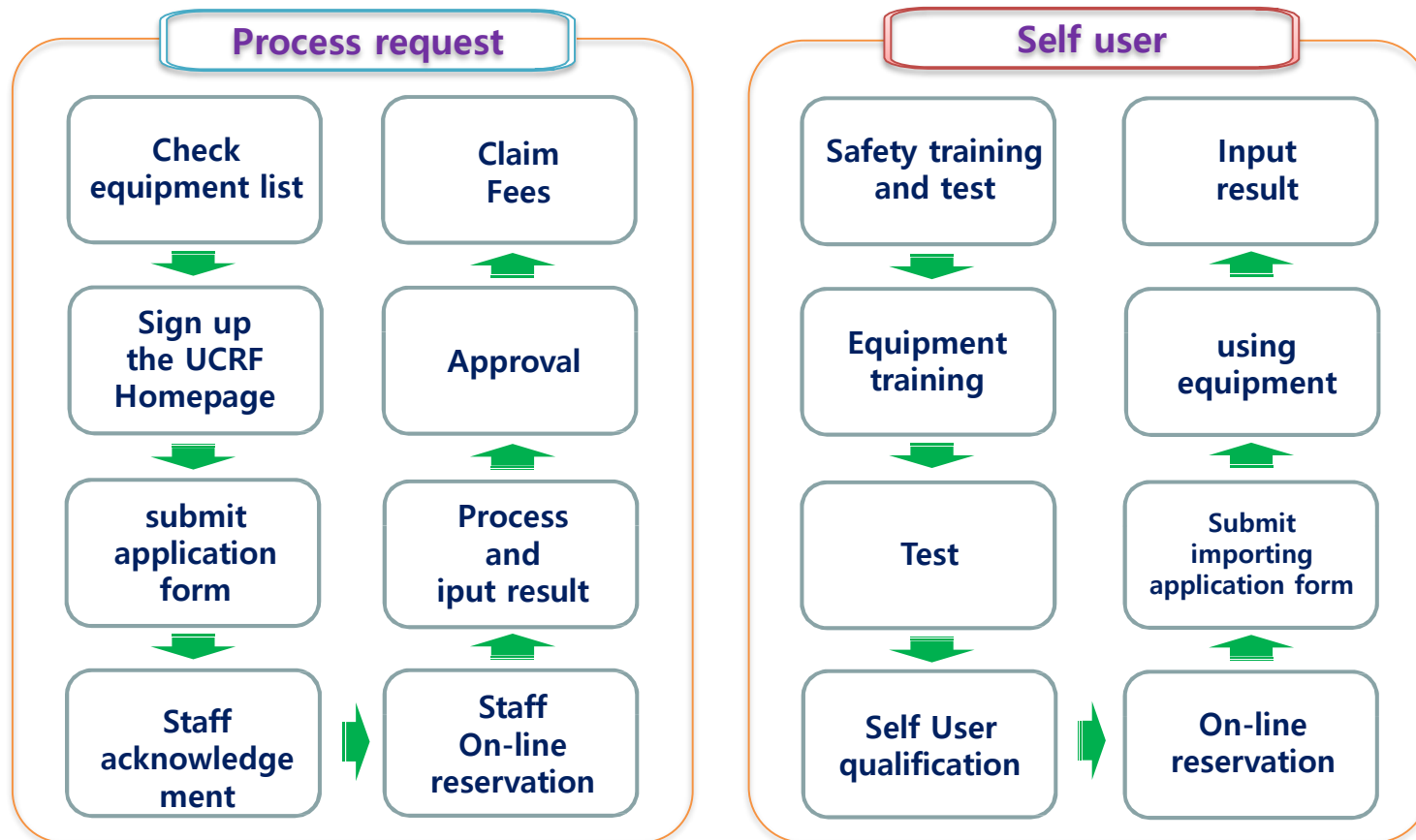
- 1) Lab hours
- Available during working hours only(Monday through Friday, 9am – 6pm)
  - During off-hours and weekends is subject to the “long term entrance” rule.
- 2) Common rules (reference the Lab polices)
- Access application and Equipment reservation
  - Must report process and equipment problems
- 3) Staff support

구분		담당자	연락처	비고
Cleanroom entrance and equipment training		Goh-myeong Bae	4189	
Equipment	Process, Imprint, Bonder	Minjae Kim	4064	
	E-Beam evaporator, Sputter, UHV-CVD, Sam coater, Parylene Coater Utilities	Hyungil Kim	4065	
	E-Beam/Photo lithography, Ellipsometer, E-beam evaporator(woosung), Wire bonder, E-beam evaporator, Contact angle, RTP, Surface/optical profiler, probe station	Goh-myeong Bae	4189	
	PE CVD, LP CVD, Furnace, ALD, Dicing Saw	Juhee Seok	4190	
	Wet & Dry Etch process, 4-point probe, Normal SEM	Kang-O Kim	4182	
Cleanroom Tour		Minjae Kim / Hyungil Kim	4064/4065	
Administrative Q&A or Etc.		Minjae Kim	4064	



# ★ Facility resources

## 4) Equipment/Process procedure - <http://ucrf.unist.ac.kr> (sign up & training application)



ref.

- 👉 Submit Process request form in the UCRF Homepage
- 👉 Cleanroom entrance – 1day / 1/3/6 months \_ Entrance application form submit
- 👉 Brining in New materials – Chemical importing application form /MSDS and attach tag(appendix #1)
- 👉 Holiday cleanroom safety checklist – After professor's signature on it and re-submit us.

# Facility resources

## 2. Fees-I

구분	장비 (Model)	분석 항목	단위	이용료		비고
				내부 (70%)	외부 (100%)	
나노 소자 공정실	E-beam lithography (NB3)	공정	2hr	210,000	300,000	· Pattern 의뢰자 제공
		추가요금	0.5hr	56,000	80,000	
		· 기본 ER/PR 및 Chemical 제공 (AR-P 6200.09, AR-P 671.04, AR-N 7520.18, AR 600-546, AR 300-71, AR 300-46) · Data consulting, Job file making, e-beam resist coating, baking 및 develop 무료				
	Photo lithography (MA6#1, #2)	공정	0.5hr	21,000	30,000	· 개인 재료(PR) 사용시, 30분당 1,800원 할인
			· 기본 PR 및 Chemical 제공 (GXR601, XT40, DPRJ-1549, AZ5214, AZ4330, AZ9260, nLOF2035, MIF300) · Spin Coater, Wet Station, Oven, Hot plate 무료			
	Photo lithography (MDA400S)	공정	0.5hr	17,500	25,000	· 개인 재료(PR) 사용시, 30분당 1,800원 할인
			· 기본 PR 및 Chemical 제공 (GXR601, XT40, DPRJ-1549, AZ5214, AZ4330, AZ9260, nLOF2035, MIF300) · Spin Coater, Wet Station, Oven, Hot plate 무료			
	Nano Imprinter (ANT-6H)	공정	1회 기준 ≤ 3hr	42,000	60,000	
	Nano Imprinter (ANT-6H)	공정	1회 기준 ≤ 3hr	42,000	60,000	
	Wet Station (Wet Station)	공정	1회 (1hr)	21,000	30,000	
			장기 입실자 무료			
	Deep Si Etcher (Tegal 200)	공정	1회 ≤ 100μm	105,000	150,000	· 100μm 이상 진행시 별도 협의
		추가요금	100μm	35,000	50,000	
	Dielectric RIE (Labstar)	공정	1회 기준	42,000	60,000	· 30분 이상 진행시 별도 협의
	Metal RIE (Labstar)	공정	1회 기준	42,000	60,000	· 30분 이상 진행시 별도 협의
	Dielectric ICP-RIE (FABstar)	공정	1회 기준	63,000	90,000	· 30분 이상 진행시 별도 협의
	Metal ICP-RIE (FABstar)	공정	1회 기준	63,000	90,000	· 30분 이상 진행시 별도 협의
	PR Asher (V15-G)	공정	1회 기준 ≤ 30min	14,000	20,000	· 30분 이상 진행시 별도 협의
	SAM coater (AVC-150M)	공정	1회	42,000	60,000	· Contact angle 측정 무료
	PR Asher (V15-G)	공정	1회 기준 ≤ 30min	14,000	20,000	· 30분 이상 진행시 별도 협의
	Furnace (KJF-306)	공정	1회 기준 Batch(25장)	210,000	300,000	· 습식 산화막 :1μm 기 준 · 건식 산화막 :0.3μm 기준

# Facility resources

## 2. Fees-II

구분	장비 (Model)		분석 항목	단위	이용료		비고
					내부 (70%)	외부 (100%)	
Sputter	DC Sputter (SRN-120)		공정	1회(≤ 500nm)	42,000	60,000	. 특수 타겟 협의 (사용자 준비) . 추가요금 기준 - 온도: 100°C/30,000원 - layer추가 30,000원
			추가요금	≤ 100nm	7,000	10,000	
		RF Sputter (SRN-120)	공정	1회(≤ 30min)	63,000	90,000	
			추가요금	≤ 30min	63,000	90,000	
	HSC Sputter (SRN130)	DC	공정	1회(≤ 500nm)	42,000	60,000	
			추가 요금	≤ 100nm	7,000	10,000	
		RF	공정	1회(≤ 30min)	63,000	90,000	
			추가 요금	≤ 30min	63,000	90,000	
	PE CVD#1.#2 (PEH-600)		공정	1회	63,000	90,000	. 추가요금 ≤SiO <sub>2</sub> 1μm ≤Si <sub>3</sub> N <sub>4</sub> 0.5μm
	PE CVD#3 (FABStar-PECVD)		공정	1회	63,000	90,000	. 추가요금 ≤SiC 0.5μm ≤Si <sub>3</sub> N <sub>4</sub> 0.5μm
LP CVD (KVL206)		공정	1회 기준 Batch(25장)	210,000	300,000	. 추가요금 ≤D-Poly 0.2μm ≤Si <sub>3</sub> N <sub>4</sub> 0.5μm	
E-beam Evaporator (WC-4000)		공정	1회 기준 ≤ 300nm	63,000 (Single layer)	90,000 (Single layer)	. 6인치 1장 기준 재료비 실비 정산 (Au, Ag, Pd, Pt 등) . 특수 metal 및 crucible 사용자 준비	
		추가 요금	layer추가 100°C	31,500 21,000	45,000 30,000		
Auto Parylene Coating system (NRPC-500)		공정	1회 기준	70,000	100,000		
Atomic layer deposition (Lucida D100)		공정	1회	75,000	150,000	. 추가요금 100Å 이상 추가 증착시 50Å당 40,000원	
				. 100Å 이상 시 별도 협의			
Atomic layer deposition (Atomic premium CNT)		공정	1회	75,000	150,000	. 추가요금 100Å 이상 추가 증착시 50Å당 40,000원	
				. 100Å 이상 시 별도 협의			
UHV CVD (UC-1)		공정	1회	105,000	150,000		
E-beam evaporator (Temescal EC-2000)		공정	1회 기준 ≤ 300nm	63,000 (Single layer)	90,000 (Single layer)	. 6인치(5장), 4인치(13) 재료비 실비 정산 (Au, Ag, Pd, Pt 등) . 특수 metal 및 crucible 사용자 준비	
		추가요금	layer추가 100°C	31,500 21,000	45,000 30,000		
Measurement Microscope (Axio Scope A1)		측정	1회 기준 ≤ 30min	7,000	10,000	. 장기 원실자 무료	
Surface Profiler (P-6)		측정	1회 기준 ≤ 10min	4,200	6,000	. 장기 원실자 무료	
Thickness Measurement (ST4000-DLX)		측정	1회 기준 ≤ 10min	4,200	6,000	. 장기 원실자 무료	
Surface & Height 3D profiler		측정	1회 기준 ≤ 10min	4,200	6,000	. 장기 원실자 무료	
4-Point Probe System (CMT-SR2000N)		측정	1회 기준 ≤ 10min	4,200	6,000	. 장기 원실자 무료	

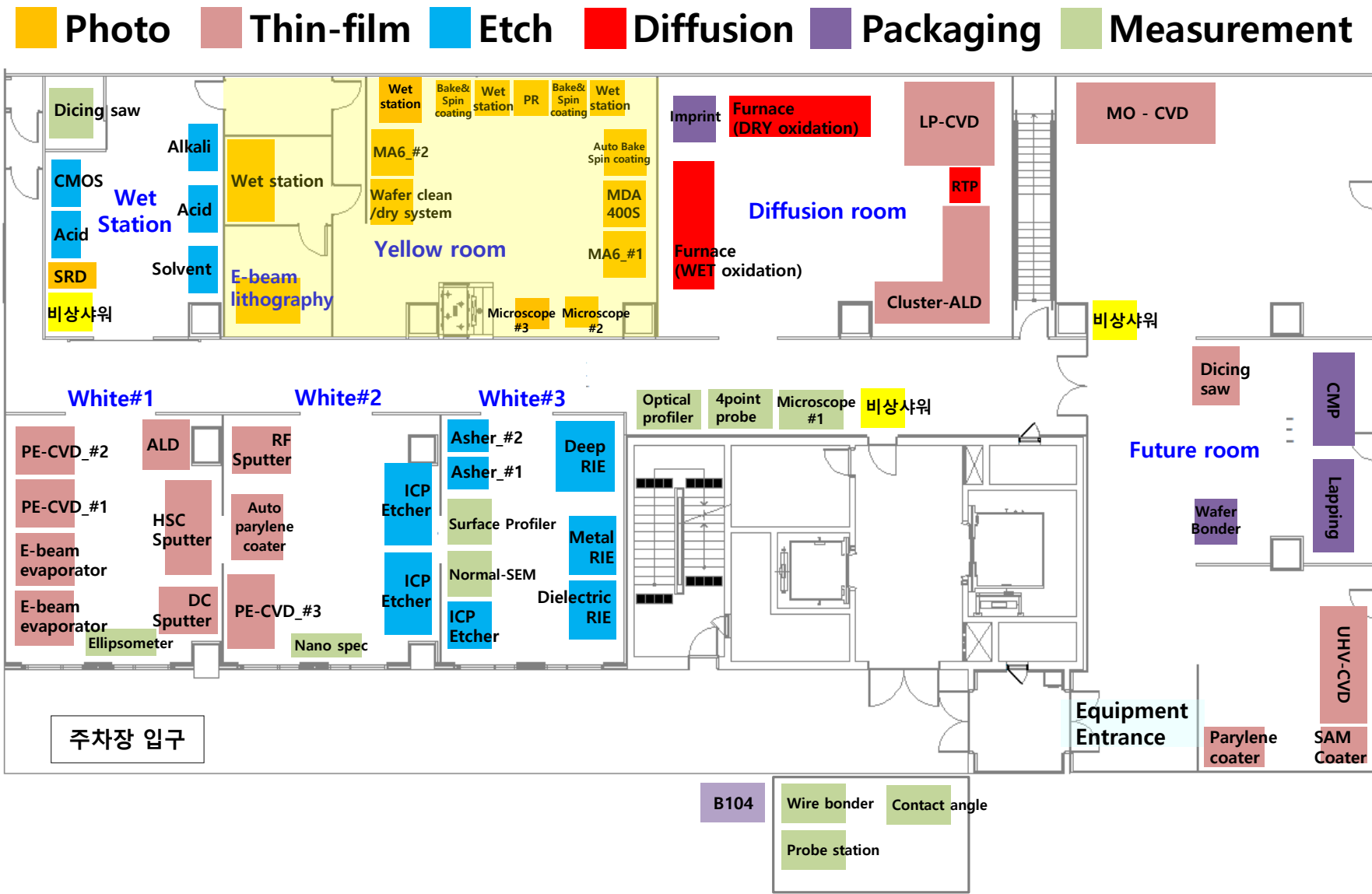
# Facility resources

## 2. Fees-III

구 분	장비 (Model)	분석 항목	단위	이용료		비고
				내부 (70%)	외부 (100%)	
	Contact angle measurement (CAM-100)	측정	1회 기준 ≤ 10min	4,200	6,000	. 장기 입실자 무료
	Ellipsometer (AR06DM)	측정	1회 기준 ≤ 10min	4,200	6,000	. 추가요금: 신규 물질 . reference data . 장기 입실자 무료
			추가요금	-	10,000	
	Substrate Bonder (SB-6L)	후공정	1회	56,000	80,000	
	Dicing Saw#1 (AR06DM)	후공정	장 (A공정)	21,000	30,000	. A공정: Non-pattern . B공정: Pattern . 추가요금: Dicing line 30개 초과 . Glass, Quartz, Si 외 기판 협의
			장 (B공정)	28,000	40,000	
			추가요금 (> 30line)	7,000	10,000	
	Dicing Saw#1 (AR06DM)	후공정	장 (A공정)	21,000	30,000	. A공정: Non-pattern . B공정: Pattern . 추가요금: Dicing line 30개 초과 . Glass, Quartz, Si 외 기판 협의
			장 (B공정)	28,000	40,000	
			추가요금 (> 30line)	7,000	10,000	
	Dicing Saw#2 (NDS-1012)	후공정	장 (A공정)	21,000	30,000	. A공정: Non-pattern . B공정: Pattern . 추가요금: Dicing line 30개 초과 . Glass, Quartz, Si 외 기판 협의
			장 (B공정)	28,000	40,000	
			추가요금 (> 30line)	7,000	10,000	
	Normal SEM	미세 구조물 프로필 분석	시간	28,000	40,000	. 추가 요금: Sputter 사용
	CMP&Lapping system	공정	30분	35,000	50,000	
			기 본료(wf)	70,000	100,000	. 8" wafer
		CMP	> 1μm	70,000	100,000	
			기 본료(wf)	42,000	60,000	. 6" wafer
			> 200μm	14,000	20,000	
	입실료	기간별 입실료	7,000/day 108,000/1M 215,000/3M 380,000/6M			

# ★ 시설 이용

## 3. 나노소자공정실(UNFC) 장비 및 시설 배치 현황





# ★ 시설 이용

## 4. Bay



**Smock Room**



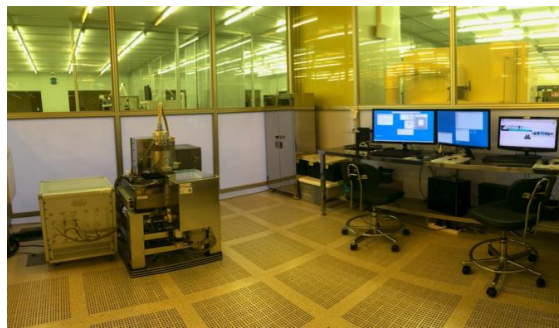
**Corridor**



**Wet Station**



**Yellow room**



**E-beam litho. room**



**White room#1**



**White room#2**



**White room#3**

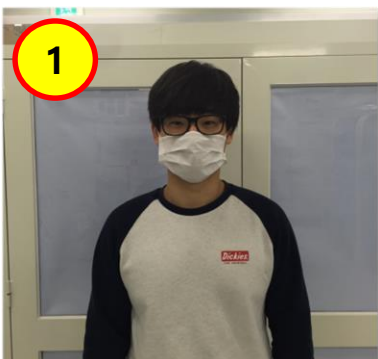


**Diffusion room**

# ★ Facility resources

## 5. Gowning smock procedure

- 1) smock wear order : wearing mask – wearing gloves  
– wearing clean garment – wearing clean shoes
- 2) smock undressing order : undressing clean shoes – undressing  
clean garment – undressing clean glove – undressing mask



### ❖ Wearing mask

- ① Aluminum parts up wearing
- ② Checking whether you press the bridge of the nose.
- ③ Use mask unfolded exactly.



### ❖ Wearing cleanroom glove

- ① Wearing clean glove first
- ② Wearing vinyl glove nest
- ③ Make clean gloves to go to the end of neck of clean garment sleeves



### ❖ Wearing clean hat

- ① Wear it not to eyebrows visible and put the ends of the mask into the clean cap and moderately tighten the neck strap.
- ② Check the status of the bonding sites not to body inside visible.
- ③ Put the bottom of the cap into the clean garment.



### ❖ Wearing clean garment

- ① Wear private clean garment. If you do not have, wear the blue public clean garment.
- ② Check zipper bad and wrist elastic state.
- ③ Wear own proper size of clean garment.



### ❖ Wearing clean shoes

- ① Wear to the knees.
- ② Check the cleanliness and the tightness of the rubber band.
- ③ Wear own proper size of clean shoes.
- ④ Check zipper status.




- 1. Cleanroom Definition**
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## 1. Yellow zone - Lithography

장비 (모델, 회사)	사양 및 특징	주요 parameter
<b>E-Beam Lithography</b> (NB3, NBL) 	<ul style="list-style-type: none"> <li>Theoretical beam size : 2.1nm @ 100 keV, 7nA</li> <li>Line width : &lt; 5nm</li> <li>Deflection : vector scan, 55MHz</li> <li>Address grid resolution : 1nm, 1mm main field</li> <li>Beam voltage : 30~100keV (normally 80KeV)</li> <li>Writing area : 195mm×195mm(8inch)</li> </ul>	<ul style="list-style-type: none"> <li>Beam current                             <ul style="list-style-type: none"> <li>- 0.7, 1.0, 3.5nA</li> </ul> </li> <li>PR에 따른 Dose                             <ul style="list-style-type: none"> <li>- 671.04 : 8~12</li> <li>- 6200.09 : 1.5~2.5</li> </ul> </li> <li>Align mark : 7x10um rectangle</li> <li>Main/Sub field trim</li> <li>dxr CAD File</li> </ul>
<b>Mask aligner #1</b> (MA6, SUSS MicroTec) 	<ul style="list-style-type: none"> <li>High efficiency &amp; accurate UV exposure system</li> <li>UV lamp : Hg 350 W</li> <li>UV 400 : 350~450 nm (I-, H-, G-line)</li> <li>Gap adjustment accuracy : 1μm</li> <li>Alignment accuracy : 1μm</li> </ul>	<ul style="list-style-type: none"> <li>Exposure time</li> <li>Contact mode</li> <li>Bake &amp; Develop time</li> </ul>
<b>Mask aligner #2</b> (MDA-400S, MIDAS) 	<ul style="list-style-type: none"> <li>#1                             <ul style="list-style-type: none"> <li>- Methods : top &amp; back side alignment</li> <li>- Exposure type : vacuum, low vac., proximity, hard, soft, flood-exposure mode</li> </ul> </li> <li>#2                             <ul style="list-style-type: none"> <li>- Methods : top side alignment only</li> <li>- Microscope magnification : 90x~500x</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>AZ계열 PR 기본 제공                             <ul style="list-style-type: none"> <li>- AZ5214E, nLoF, 4330, 9260</li> </ul> </li> </ul>

## 1. Yellow zone - Lithography





장비 (모델, 회사)	사양 및 특징	주요 parameter
<p><b>Nanoimprint lithography</b> (ANT-6H, Elan&amp;KIMM)</p> 	<ul style="list-style-type: none"> <li>• Curing type : UV, thermal, UV &amp; thermal</li> <li>• Imprint area : ~ 6 inch</li> <li>• Stamp : Quartz, Si, Ni, PDMS, PMMA, etc.</li> <li>• Imprint Pressure : ≤ 2 bar (UV), ≤ 60 bar (Thermal)</li> <li>• UV System : ~ 50 mw/cm<sup>2</sup> , 2 kW</li> <li>• Temperature : RT ~ 250 °C</li> </ul>	<ul style="list-style-type: none"> <li>• 압력 및 온도</li> <li>• 압력이 가해지는 속도</li> <li>• Step별 압력/온도/속도 설정</li> </ul>
<p><b>Spin coater &amp; Bake system</b> (SSP200, SVS)</p> 	<ul style="list-style-type: none"> <li>• Spin coater                             <ul style="list-style-type: none"> <li>- Speed range : Max. 6,000rpm</li> <li>- Speed accuracy : Setting RPM ± 1rpm</li> <li>- Back side rinse(Back side rinse) : 2-Nozzle position(Acetone)</li> <li>- Coater bowl exhaust : 2-hole exhaust</li> </ul> </li> <li>• Hot-plate                             <ul style="list-style-type: none"> <li>- Plate flatness : ±10um</li> <li>- Temperature control range : ~200°C</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• EBR 및 BR</li> <li>• Hot plate pin up/down을 통한 정확한 시간 통제</li> </ul>
<p><b>Spin coater</b> (JSP6D, JD Tech) (3000DT, MIDAS)</p> 	<ul style="list-style-type: none"> <li>• Wafer suitability loading size</li> <li>• Chamber size : 300 mm diameter</li> <li>• Sample size : piece ~ 6 inch</li> <li>• Speed range : Max. 5,000 rpm</li> <li>• Vacuum input : - 450mmHg ~ - 750mmHg</li> </ul>	-

## 2. White zone - Etching



장비 (모델, 회사)	사양 및 특징	주요parameter
<b>Deep RIE</b> (TEGAL 200, TEGAL) 	<ul style="list-style-type: none"> <li>• Loading ~ 6inch</li> <li>• Source generator : 5500 W</li> <li>• Dual bias generator : LF 300W(pulse), RF 300W</li> <li>• E-chuck He cooling system(center/edge)</li> <li>• SF<sub>6</sub> / C<sub>4</sub>F<sub>8</sub> / O<sub>2</sub> / Ar</li> <li>• Bosch process</li> </ul>	<ul style="list-style-type: none"> <li>• RF Power</li> <li>• Gas 양 및 ratio</li> <li>• Step time(dep vs etching)</li> <li>• Chuck temp</li> <li>• Pressure</li> <li>• Etching time</li> </ul>
<b>Dielectric ICP-RIE</b> (Fabstar, TTL) 	<ul style="list-style-type: none"> <li>• Load lock / process chamber transfer</li> <li>• Loading : 6inch wafer</li> <li>• ICP source power : 2,000 W (1,000W 내외 사용)</li> <li>• Chuck bias power : 500 W (200W 내외 사용)</li> <li>• Back He cooling (chiller :상시 RT, 10 ~ 60°C)</li> <li>• Gas <ul style="list-style-type: none"> <li>- Metal ICP : SF<sub>6</sub>, CF<sub>4</sub>, Cl<sub>2</sub>, BCl<sub>3</sub>, Ar, O<sub>2</sub>, N<sub>2</sub></li> <li>- Dielectric ICP : SF<sub>6</sub>, CF<sub>4</sub>, CHF<sub>3</sub>, Cl<sub>2</sub>, BCl<sub>3</sub>, Ar, O<sub>2</sub>, N<sub>2</sub></li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• RF Power</li> <li>• Gas 양 및 ratio</li> <li>• Chuck temp</li> <li>• Pressure</li> <li>• Etching time</li> </ul>
<b>Metal ICP-RIE</b> (Fabstar, TTL) 		
<b>Metal ICP-RIE#2</b> (ICP380, Oxford) 	<ul style="list-style-type: none"> <li>• Load lock / process chamber transfer</li> <li>• Loading : 6inch wafer</li> <li>• ICP source power : 2,000 W (1,000W 내외 사용)</li> <li>• Chuck bias power : 300 W (200W 내외 사용)</li> <li>• Back He cooling (Heating RT~ 200°C)</li> <li>• Gas : Cl<sub>2</sub>, HBr, Ar, O<sub>2</sub></li> </ul>	<ul style="list-style-type: none"> <li>• RF Power</li> <li>• Gas 양 및 ratio</li> <li>• Chuck temp</li> <li>• Pressure</li> <li>• Etching time</li> </ul>

# ★ 보유 장비





## 2. White zone - Etching

장비 (모델,회사)	사양 및 특징	주요parameter
<b>Metal RIE</b> (Lab star-M, TTL) 	<ul style="list-style-type: none"> <li>• 200 mm electrode with water cooled by chiller</li> <li>• Loading : piece, 4,6 inch</li> <li>• RF generator &amp; auto match network : 500 W, 13.56 MHz solid state</li> <li>• Chuck temp : 15°C</li> </ul>	<ul style="list-style-type: none"> <li>• RF Power</li> <li>• Gas 양 및 ratio</li> <li>• Chuck temp</li> <li>• Pressure</li> <li>• Etching time</li> </ul>
<b>Dielectric RIE</b> (Lab star-R, TTL) 	<ul style="list-style-type: none"> <li>• Metal RIE <ul style="list-style-type: none"> <li>- MFC BCl<sub>3</sub>, Cl<sub>2</sub>, SF<sub>6</sub>, Ar, O<sub>2</sub></li> </ul> </li> <li>• Dielectric RIE <ul style="list-style-type: none"> <li>- MFC CF<sub>4</sub>, CHF<sub>3</sub>, Ar, O<sub>2</sub></li> </ul> </li> </ul>	
<b>Wet station</b> (Donghun tech) 	<ul style="list-style-type: none"> <li>• Chemical supply : manual</li> <li>• Chemical temp. : ~ 120 °C</li> <li>• Solvent bath : 4대 Acid bath: 3대 Alkali : 1대</li> </ul>	<ul style="list-style-type: none"> <li>• RCA, SPM Cl'n</li> <li>• BOE, KOH Etching</li> <li>• PR develop &amp; removing</li> <li>• Lift off</li> </ul>
<b>PR Asher (#2)</b> (V15-G, KAMI) 	<ul style="list-style-type: none"> <li>• Ch# size : 250 x 250 x 250 mm</li> <li>• Microwave power generator : 2.45 GHz, 600W</li> <li>• O<sub>2</sub> , Ar , CF<sub>4</sub> gas control unit : ≥ 200 ml/min</li> </ul>	<ul style="list-style-type: none"> <li>• RF Power(Pulse 기능)</li> <li>• Gas Flow</li> <li>• Ashing time</li> </ul>




## 3. White zone - Thin-film

장비 (모델, 회사)	사양 및 특징	주요 parameter
<b>E-Beam evaporator #1</b> (FC-2000, Temescal) 	<ul style="list-style-type: none"> <li>Thickness uniformity : less than <math>\pm 5\%</math> (6inch)</li> <li>#1 Temescal               <ul style="list-style-type: none"> <li>15cc, 6 pockets (Au, Al, Ag, Cr, Ti, Ni, Pt, Pd)</li> <li>Power supply : 6 kW (10kV fix), normal 100mA</li> <li>Substrate heat 300 °C &amp; Rotation</li> <li>Loading : 6inch 5매, 4inch 13매</li> </ul> </li> <li>#2 Woosung               <ul style="list-style-type: none"> <li>7cc, 6 pocket (Au, Al, Ag, Cr, Ti, Ni, Pt, Pd, <b>Cu</b>)</li> <li>Power supply : 10 kW (8.5kV beam center값) normal 100~200mA</li> <li>Substrate heat 300 °C &amp; Rotation</li> </ul> </li> <li>차이점 - Loading 6 vs 1 (6inch 기준)               <ul style="list-style-type: none"> <li>source 소모량 3 vs 1(100nm 기준)</li> <li>#2 Cu 사용 가능</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>e-beam current</li> <li>substrate heat &amp; rotation</li> <li>sweep</li> </ul>
<b>E-Beam evaporator #2</b> (WC-4000, Woosung) 	<ul style="list-style-type: none"> <li>#2 Woosung               <ul style="list-style-type: none"> <li>7cc, 6 pocket (Au, Al, Ag, Cr, Ti, Ni, Pt, Pd, <b>Cu</b>)</li> <li>Power supply : 10 kW (8.5kV beam center값) normal 100~200mA</li> <li>Substrate heat 300 °C &amp; Rotation</li> </ul> </li> <li>차이점 - Loading 6 vs 1 (6inch 기준)               <ul style="list-style-type: none"> <li>source 소모량 3 vs 1(100nm 기준)</li> <li>#2 Cu 사용 가능</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Cr, Ti seed(최종 두께 10% 이내)</li> <li>Au, Al, Ag전극용으로 주로 사용</li> </ul>
<b>DC Sputter</b> (SRN 120-M, SORONA) 	<ul style="list-style-type: none"> <li>Substrate size : piece ~ 6 inch (HSC : 10 slot/cassette)</li> <li>Substrate rotation speed : 0 ~ 60 rpm</li> <li>RF pre-cleaning : 300 W / Ar plasma</li> <li>Number of target : 4 different targets</li> <li>Thickness uniformity : less than <math>\pm 5\%</math></li> </ul>	
<b>RF Sputter</b> (SRN-120, SORONA) 	<ul style="list-style-type: none"> <li>DC Sputter               <ul style="list-style-type: none"> <li>Target : Cr, Al, Ag, W, Mo, Co,</li> <li>Substrate heating : 300 °C</li> <li>Power source : 3 kW DC power (실제 1kW 미만 사용)</li> </ul> </li> <li>RF Sputter               <ul style="list-style-type: none"> <li>Target : ITO, ZnO, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub></li> <li>Substrate heating : 500 °C</li> <li>Power source : 13.56 MHz, 1kW RF power (실제 600W 미만)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Power</li> <li>Gas : Ar, O<sub>2</sub>, N<sub>2</sub> (plasma 생성)</li> <li>Temp (normally R.T)               <ul style="list-style-type: none"> <li>roughness개선</li> </ul> </li> </ul>
<b>HSC Sputtering system</b> (SRN-130, SORONA) 	<ul style="list-style-type: none"> <li>HSC Sputter               <ul style="list-style-type: none"> <li>Target size : 10 inch</li> <li>Cathode#1(Al, Cr, Zn/ZnO, Pulsed DC 15 kW)</li> <li>Cathode#2(Ti/TiN, High step coverage, DC 15 kW &amp; 600 W RF power)</li> <li>Cathode#3(SiO<sub>2</sub>) : RF 2kW</li> </ul> </li> </ul>	

## 3. White zone - Thin-film




장비 (모델, 회사)	사양 및 특징	주요 parameter
<b>PE-CVD #1,2</b> (PEH-600, SORONA) 	<ul style="list-style-type: none"> <li>Loading size : piece ~ 6 inch</li> <li>Substrate Temperature : ~ 400 °C</li> <li>Power Supply : 600 W, 13.56 MHz RF Generator</li> <li>Thickness uniformity : less than <math>\pm 5 \%</math></li> <li>Nitride/Oxide 증착 : 100 Å ~ 2 um</li> <li>#1                             <ul style="list-style-type: none"> <li>- SiO<sub>2</sub>, Si<sub>3</sub>N<sub>4</sub> deposition</li> <li>- Process gas : SiH<sub>4</sub>, N<sub>2</sub>O, NH<sub>3</sub>, N<sub>2</sub>, CF<sub>4</sub>/O<sub>2</sub></li> </ul> </li> <li>#2                             <ul style="list-style-type: none"> <li>- Si<sub>3</sub>N<sub>4</sub>, SiC deposition</li> <li>- Process gas : SiH<sub>4</sub>, NH<sub>3</sub>, CH<sub>4</sub>, N<sub>2</sub>, SF<sub>6</sub>/O<sub>2</sub>, He</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>RF power</li> <li>Pressure</li> <li>온도</li> <li>Gas량 및 ratio</li> </ul>
<b>PE-CVD #3</b> (Fabstar-PECVD, TTL) 		
<b>LP-CVD</b> (KVL206, KSM) 	<ul style="list-style-type: none"> <li>Wafer size : ~ 6 inch silicon wafer</li> <li>Vertical furnace type(25매 단위 진행)</li> <li>Thickness uniformity : less than <math>\pm 3 \%</math></li> <li>Doped-Poly                             <ul style="list-style-type: none"> <li>- process gas : SiH<sub>4</sub> : PH<sub>3</sub> = 1000 : 80</li> <li>- temp : 530 °C , -dep rate : 35Å/min</li> </ul> </li> <li>Nitride                             <ul style="list-style-type: none"> <li>- process gas : DCS : NH<sub>3</sub> 30 : 100</li> <li>- temp : 785 °C, -dep rate : 25Å/min</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Gas, 온도, pressure &amp; process time</li> <li>doped poly 면 저항 30Ω/sq</li> </ul>
<b>UHV-CVD</b> (UHV-CVD, Wooshin) 	<ul style="list-style-type: none"> <li>vacuum range : 5 x 10<sup>-10</sup> mT</li> <li>Heater stage : 1500 °C, 2inch target</li> <li>Gas supply : H<sub>2</sub>, N<sub>2</sub></li> <li>3 grid LEED, electronics, retraction, fan shutter</li> </ul>	<ul style="list-style-type: none"> <li>진공, 온도</li> </ul>

3. White zone - Thin-film

장비 (모델, 회사)	사양 및 특징	주요 parameter
<b>Thermal ALD</b> (Lucida D100, NCD) 	<ul style="list-style-type: none"> <li>Substrate size : ~ 8 inch</li> <li>Uniformity : less than <math>\pm 2 \%</math></li> <li><math>\text{HfO}_2</math>, <math>\text{TiO}_2</math>, <math>\text{Al}_2\text{O}_3</math>, <math>\text{ZnO}</math></li> <li>Thermal ALD                             <ul style="list-style-type: none"> <li>temperature : <math>\sim 350^\circ\text{C}</math></li> <li>Precursor sources : 3 (heated 2 sources and <math>\text{H}_2\text{O}</math> source)</li> </ul> </li> <li>Cluster ALD                             <ul style="list-style-type: none"> <li>temperature : <math>\sim 450^\circ\text{C}</math></li> <li>Dual process mode : thermal and plasma</li> <li>Dual ch# : metal / non-metal 구분</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Chamber 온도</li> <li>Source 온도</li> <li>Source open time</li> <li>Cycle</li> </ul>
<b>Cluster ALD</b> (Atomic premium, CN1) 		
<b>Auto Parylene Coater</b> (NRPC-500, Nuritech) 	<ul style="list-style-type: none"> <li>Dimer type : c, n (type별 자료 확인)</li> <li>Substrate size : 200 mm X 3ea</li> <li>Process temperature                             <ul style="list-style-type: none"> <li>Evaporation(vapor heater): Max <math>250^\circ\text{C}</math></li> <li>Pyrolizer(furnace heater): Max <math>1000^\circ\text{C}</math></li> </ul> </li> <li>Chiller(cooler): Max <math>-90^\circ\text{C}</math></li> </ul>	<ul style="list-style-type: none"> <li>Dimer 용량 (1um/3.2g, 5um/20g)</li> </ul>
<b>SAM Coater</b> (AVC-150M, SORONA) 	<ul style="list-style-type: none"> <li>Contact angle : <math>5^\circ \sim 110^\circ</math> (water)</li> <li>Wafer sample size : <math>\leq 300</math> mm</li> <li>Precursor usage : 0.1 cc/batch (-&gt; 소수)</li> <li>RF Plasma Surface treatment (-&gt; 친수)</li> </ul>	<ul style="list-style-type: none"> <li>FOTS 용량</li> <li>Syringe motor 제어</li> </ul>




## 3. White zone - Diffusion





장비 (모델, 회사)	사양 및 특징	주요 parameter
<b>Furnace (Wet Oxidation)</b> (KHD-306, KSM) 	<ul style="list-style-type: none"> <li>Wet Oxidation process</li> <li>Heater spec (2 zone) : 400~ 1100 °C</li> <li>Wafer size : piece ~ 6 inch, 25매 단위 진행</li> <li>Thickness uniformity : less than <math>\pm 3 \%</math></li> <li>dielectric film annealing chamber</li> </ul>	<ul style="list-style-type: none"> <li>온도</li> <li>Gas : H<sub>2</sub>, O<sub>2</sub>, N<sub>2</sub></li> <li>Process time</li> </ul>
<b>Furnace (Dry Oxidation)</b> (KHD-306, KSM) 	<ul style="list-style-type: none"> <li>Dry Oxidation process</li> <li>Heater spec (3 zone) : 400(ITO) ~ 1100 °C</li> <li>Wafer size : piece ~ 6 inch, 25매 단위 진행</li> <li>Thickness uniformity : less than <math>\pm 3 \%</math></li> <li>Metal film annealing chamber</li> </ul>	<ul style="list-style-type: none"> <li>온도</li> <li>Gas : O<sub>2</sub>, N<sub>2</sub></li> <li>Process time</li> </ul>
<b>Rapid Thermal Processing</b> (Allwin21) 	<ul style="list-style-type: none"> <li>Wafer Size : 4~6" wafer &amp; pieces</li> <li>Tray : Metal, Non-Metal로 구분하여 사용</li> <li>Duration time : 0~60s(고온), 300s(저온)/step</li> <li>Temperature : Max. 1000 °C</li> <li>Ramp up rate : 10~120 °C/s</li> <li>Temp Control : Thermocouple &amp; Pyrometer 택 1</li> </ul>	<ul style="list-style-type: none"> <li>온도</li> <li>Gas : N<sub>2</sub>, O<sub>2</sub> (Max. 10 SLM)</li> <li>Process time</li> </ul>



## 4. White zone - Inspection

장비 (모델, 회사)	사양 및 특징	비 고
<b>Normal SEM</b> (S-3400N, Hitachi) 	<ul style="list-style-type: none"> <li>Resolution : 3.0 nm at 30 kV, 10 nm at 3 kV (SE mode)</li> <li>Magnification : x 5 to x 300,000 (continuous)</li> <li>Accelerate voltage : 0.3 to 30 kV (0.1 kV/step)</li> <li>Traverse : X axis 0 ~ 100 mm, Y axis 0 ~ 50 mm</li> </ul>	
<b>Inspection microscope#1,#3</b> (DM4000M, Leica) 	<ul style="list-style-type: none"> <li>Magnification(Objective lens) : 2.5x, 5x, 10x, 20x, 50x, 100x, Magnification(Ocular) : 10x</li> <li>6-position nosepiece(M32), 4-position turret for filter cubes</li> <li>Contrast methods RL : BF, DF, Pol, ICR, Fluo</li> <li>CCD : 1/2 inch, 211 mil-pixel CCD image sensor</li> <li>Frame rate : 7.5 F/S &amp; 30 F/S (Optional)</li> <li>Electronic shutter : auto/manual/off, 1/15~ 1/5000</li> </ul>	
<b>Inspection microscope#2</b> (Axio scope A1, CarlZeiss) 		
<b>Ellipsometer</b> (Elli-SE-UaM8, Elipso Technology ) 	<ul style="list-style-type: none"> <li>Wavelength range : 240 nm ~ 1000 nm (CCD Type)</li> <li>Beam spot size : <math>\geq 1.5</math> mm</li> <li>Measuring constants Film thickness, n, k vs <math>\lambda</math></li> <li>Thickness range : sub A ~ 10 <math>\mu</math></li> <li>Number of layers Up to 10</li> </ul>	

4. White zone - Inspection

장비 (모델, 회사)	사양 및 특징	비 고
<b>Thin film measurement</b> (ST4000-DLX, K-MAC) 	<ul style="list-style-type: none"> <li>• Detector : used wavelength range is 400 ~ 800 nm</li> <li>• Stage size : 300 mm x 300 mm (12 inch wafer)</li> <li>• Lens : m5x, m10x, m50x</li> <li>• Reflection probe : choose wavelength (300~800nm)</li> <li>• Thickness measurement range : 100 Å ~ 50 μm</li> </ul>	
<b>Surface Profiler</b> (P-6, KLA Tencor) 	<ul style="list-style-type: none"> <li>• Single 2D &amp; 3D scanning profiler</li> <li>• 150mm diameter sample stage</li> <li>• Automatic step detection and multiple cursor</li> <li>• Stylus force : adjustable between 1 ~ 15 mg</li> <li>• L-stylus : 2 um radius 60 degree</li> </ul>	
<b>4-Point probe</b> (CMT-SR2000N, AIT) 	<ul style="list-style-type: none"> <li>• Measurement range : Ω, Ω/sq, Ω/cm</li> <li>• Current source : 10 nA ~ 100 mA</li> <li>• Voltage : 0 ~ 2,000 mV</li> <li>• Substrate size(mm) : ~200(wafer) 140×140(square)</li> <li>• Data analysis : data map, contour &amp; 3D mapping</li> </ul>	
<b>Contact angle</b> (Phoenix 300, SEO) 	<ul style="list-style-type: none"> <li>• Static / dynamic contact angles</li> <li>• Advancing and receding contact angle by captive method</li> <li>• Sequence image captures by time basis &amp; dynamic movies</li> <li>• Sessile drop/ pendent drop, surface tension</li> </ul>	

## 4. White zone – Inspection & Package

장비 (모델, 회사)	사양 및 특징	비 고
<b>Cryogenic probe station</b> (CRX-4K, Lakeshore) 	<ul style="list-style-type: none"> <li>• Measurement of I-V in temperature variation</li> <li>• Temperature : 6 K ~ 340 K</li> <li>• Wafer size : piece ~ 2 inch</li> <li>• Capacitance : 1pF ~ 100nF (Frequency: 1kHz to 10Mhz)</li> <li>• Voltage bias: <math>\pm 30V</math> (Resolution: 1.0mV)</li> <li>• Detector : KEITHLEY (4200-SCS)</li> </ul>	
<b>WLI</b> (Microxam 800, KLA) 	<ul style="list-style-type: none"> <li>• VSI, PSI 3D scan mode (2D Profiling)</li> <li>• Step Repeatability : 1 nm or 0.10%</li> <li>• Vertical Resolution : 0.2 nm</li> <li>• 150mm diameter sample stage</li> <li>• Light Source : White and Green LEDs</li> <li>• Lens : 10x-50x (714 x 546 ~ 143 X 109 Field of View, <math>\mu m</math>)</li> <li>• X-Y-Z stage Stitching</li> </ul>	
<b>CMP</b> (ORBIS, LOGITECH) 	<ul style="list-style-type: none"> <li>• Head : Twin head system</li> <li>• Carrier Size : 4~8 inch (Speed : 10~100 rpm)</li> <li>• Plate Size : 600 mm (Speed : 100 rpm)</li> <li>• Down Load (Back Pressure) : 0~50 psi (0~9 psi)</li> <li>• Slurry Flow rete : 20~500 ml/min</li> <li>• EPD : Co-efficient system</li> <li>• Slurry : Silica</li> </ul>	
<b>Lapping</b> (LP70, LOGITECH) 	<ul style="list-style-type: none"> <li>• Plate Speed : 5~100 rpm</li> <li>• Jig Speed : 5~100 rpm</li> <li>• Cylinder : 2L x 2ea</li> <li>• Abrasive flow rate : 1~100 ml/min</li> <li>• Auto Plate Flatness (<math>\pm 0.1 \mu m</math>), Thickness control (<math>\pm 1 \mu m</math>)</li> </ul>	

## 4. White zone – Package

장비 (모델, 회사)	사양 및 특징	비 고
<b>Substrate sawing machine</b> (AR06DM, Aaron) 	<ul style="list-style-type: none"> <li>• Substrate size : ~ 6 inch</li> <li>• Cutting materials : silicon, glass, quartz &amp; GaAs</li> <li>• X-axis (chuck table horizontal movement)</li> <li>• Work-piece width setting range : 0.01 ~ 160 mm</li> <li>• Cut speed : 0.05 ~10 mm/s or more</li> </ul>	
<b>Dicing saw</b> (NDS1012, Neontech) 	<ul style="list-style-type: none"> <li>• Substrate size : ~ 8 inch</li> <li>• Blade Diameter : 2" Blade</li> <li>• Cutting materials : silicon</li> <li>• X-axis (chuck table horizontal movement)</li> <li>• Work-piece width setting range : 0.01 ~ 160 mm</li> <li>• Cut speed : 0.1 ~400 mm/s</li> </ul>	
<b>Substrate bonder</b> (SB-6L, SUSS MicroTec) 	<ul style="list-style-type: none"> <li>• Wafer size : 6" semi standard wafer</li> <li>• Pressure regulation accuracy : <math>\pm 2\%</math></li> <li>• Maximum temperature : 500 °C (uniformity <math>\pm 3\%</math>)</li> <li>• Maximum bond force : 8 kN</li> <li>• Bond voltage and current (Anodic optional)</li> <li>• Maximum voltage : 2,000 V <math>\pm</math> polarity</li> <li>• Maximum current : 60 mA</li> </ul>	
<b>Wire bonder</b> (HB02, TPT) 	<ul style="list-style-type: none"> <li>• Ultrasonic system 63 kHz transducer, PLL Control</li> <li>• Ultrasonic power 0 - 1 watt Low / 0 -2 watt High</li> <li>• Bond time 20 - 999 msec.</li> <li>• Bond force 15 - 130 grams</li> <li>• Temperature controller up to 250°C +/- 1°C</li> </ul>	

- 1. Cleanroom Definition**
- 2. Facility resources**
- 3. Equipment**
- 4. Lab policies**
- 5. Wet station**
- 6. Emergency measures**
- 7. Equipment reservation**

# Lab policies

## 1. Penalty imposed

[Attached Table 1].

### Penalty Points System in UNFC(Cleanroom).

#### 1. Criteria for penalty points.

- ① A user shall be fined the penalty points in the event that any inappropriate behavior falls under the following. Each penalty item may be counted multiple times. (The expiration of penalty points is 1 year from the date of imposition.)

Case description		Penalty points
Class A Violation	A person causes the leakage of a harmful substance such as toxic gases or toxic substances.	10
	A person causes fires and accidents.	10
	The act of intentionally damaging the equipment.	10
	Not notifying the equipment manager when the amount of waste tank storage is more than 1/2.	10
	Not wearing safety equipment (goggles, gas mask, apron, protective gloves, face mask, etc.) when using the wet station or working related to waste tank treatment.	10
	Incorrect classification of waste liquid.	10
	Arbitrarily changing the chemical bath designated for each type (acid, organic, alkali).	10
	Operating electricity, gas, firefighting, and other utilities without prior consultation with the equipment manager.	10
	Other acts that may damage the safety of others.	10
	Equipment is used without reserving it, or equipment is used in excess of the reservation time without permission.	5
Class B Violation	A person accesses UNFC using someone else's pass.	5
	Use of equipment by making a reservation(login) in someone else's identity.	5
	Excessive use of equipment without prior consultation.	5
	A person uses or steals the personal items (consumables, equipment, and materials for processes) of another person without prior consent.	5
	Use of chemicals not approved by the equipment manager in the cleanroom (including non-submission of application form for importing chemical).	5
	A person causes accidents or neglects it after using a chemical substance.	5
	A person leaves a seat without leaving a note containing information such as chemical information in use, expected use time, affiliation, name, and contact information during the wet station experiment.	5

	Other acts that may endanger safety, damage equipment, or violate UNFC rules.	5
Class C Violation	The act of not inputting the usage record or inputting false records after the use of the equipment.	3
	Violation of how to wear dust-proof clothing and acts that affect cleanliness (make-up, etc.).	3
	A person uses items that are not permitted in the cleanroom.	3
	A person uses hot plates and chemicals other than the specified hood.	3
	A person neglects replaced equipment parts, used process consumables, specimens, etc. for a long time.	3
	A person helps another person who has not completed safety training to access UNFC without the consent of the equipment manager.	3
	A person leaves chemical substances in an unspecified place.	3
	A person violates the rules by bringing the prohibited goods or equipment (except for experimental purposes such as laptops and iPads) in.	3
	A person runs, leans on equipment, or sits on the floor in the cleanroom.	3
	An action may be judged to require sanctions by damaging the laboratory safety of the cleanroom and another person's equipment use.	3

#### 2. Actions taken after subjecting penalty points.

- ① If the cumulative penalty points exceed a certain criterion, the action corresponding with the table below will be taken.
- ② When a user violates the rule, an official letter from UCRF is sent to the department or institution(in case of the user outside) of the violator. The content will be posted on the cleanroom bulletin board.

Type	Penalty points	Action
Total penalty points awarded to the individual.	10 points or more	The user is prohibited from using the equipment for 1 month.
	20 points or more	The user is prohibited from using the equipment for 3 months. (Access to UNFC of the user is blocked for 1 month in case of damage to the environment of UNFC).
	30 points or more	The user is prohibited from accessing UNFC for 3 months.
Total penalty points awarded to students affiliated with the same laboratory.	40 points or more	The members of the laboratory are prohibited from using the equipment for 1 month.
	50 points or more	The members of the laboratory are prohibited from accessing UNFC for 1 month.

## 2. Common rules

### Common rules

- ☞ Enter the cleanroom only after safety training finished (If you do not qualify, contact your administrator).
- ☞ Regular weekday operating hours are 09:00 to 18:00.
- ☞ When using the cleanroom after the regular operating hours, two or more people should use cleanroom together.
- ☞ Clean Room entrant should comply with the following.
  - Only use dust-free paper and a ballpoint pen (prohibition on use pencil or water-based pen)
  - Must remove the pollutants of take-in items.

Items not related to the purpose of the process are restricted. (need administrator approval if you want to carry in)

  - Leaning on the equipment, running (except emergency), and sitting on the table and floor are prohibited.
  - Eating, chewing and wearing make up are prohibited.
- ☞ Aware emergency evacuation and fire extinguisher location.
- ☞ Be sure to wear the proper protective gear before the experiments.
- ☞ Check over the equipment/chemical before/after use. If there is any problem, report to administrator quickly.
- ☞ If you leave the room inevitably during experiment, take safety measures and post the experimental details to communicate with others.
- ☞ Last person who leaves the room should power off the electrical appliances and tidy up.

## 3. Facility & Equipment

### Facility & Equipment

- ☞ Do not put a flammable / combustible materials around the machine.
- ☞ Unavailable equipment should be locked and you have to mark a fault.
- ☞ Be well-informed how to use and cautions when to use machines.
- ☞ During the experiment, wear a suitable protective gear.

Especially during the work of fugitive dust or debris, MUST wear a safety glasses and face shield.

- ☞ Be sure to stop the operation and lock the machine before you clean, inspect, or repair the machines.
- ☞ When you shut down the operation of the machine, shut off the operating switch and the power switch.
- ☞ To prevent leakage, check the coolant, supply/drainage valve and piping that are connected to the equipment or machine frequently.



## 4. Electronics

### Electronics

- ✎ Do not expose all of the contact portion of the electrical equipment such as wiring, wet money or thing prohibited the contact of electrical equipment.
- ✎ When unplugging, do not pull on the wires, hold and pull the plug.
- ✎ Use suitable electrical facilities cord or wiring devices of equipment to meet the capacity and specifications.
- ✎ Avoid using multi-outlet if possible, and use the code lines as short as possible. .
- ✎ Used handles of tools and equipment used to repair electrical equipment that is made of a nonconductor.
- ✎ When a fuse is blown, should not replace with a larger-capacity fuse than that of original one.
- ✎ Electrical facilities such as outlets or switches are installed far away from water, chemicals, and oil.
- ✎ When you repair the electrical equipment, stop the operation, power off the machine, and mark the "Repair in progress".
- ✎ Route the electrical cored or extension cord not through the aisle, hallway, and above the door.
- ✎ Since it is possible to be injured or get a shock because of bare wires and tool damage, pay attention when you make the electrical wiring.
- ✎ Heaters not used are kept off the switch by removing the plug.

## 5. Chemicals

### Chemicals

- ☞ Must wear safety protective gear when handling chemicals.
- ☞ When purchasing or handling of chemicals, must aware of the nature and risks of the material through the Material Safety Data Sheet, MSDS.
- ☞ Depending on the properties of chemicals, similar or low reactive chemicals kept together with each other during storage.
- ☞ When accident due to chemicals happens, wash the affected area for at least 20 minutes in running water, and it must be reported to the administrator.
- ☞ When you store drugs on the shelf, large-capacity drugs should be on the bottom of the shelf and take the physical action to prevent the drug conduction.
- ☞ Safe passage of the laboratory is kept clean at all times.
- ☞ Do not leave or store chemicals on the laboratory floor surface.
- ☞ Never touch or sniff directly in the mouth hazardous substances such as reagents.
- ☞ Above the bench, just put reagents required, and keep only the minimum amount needed as possible.
- ☞ When using chemicals to obtain a separate container, must indicate a name clearly.

## 6. Fume Hood

### Fume Hood

- ☞ Use a fume hood when taking harmful chemicals, dusts, gases, or volatile substances.
- ☞ Fume hood doors are open with minimal (less than 1/3) during the experiment.
- ☞ Check the pressure using a differential pressure gauge and goods easy to be scattered such as toilet paper.
- ☞ Do not put the head and body into the hood.
- ☞ Always clean and manage internal and glass doors of the hood.
- ☞ Prohibit storage of combustible materials except the chemicals required for the experiment
- ☞ If you use electricity in fume hood, electric outlet plug should be installed on the outside of the fume hood.
- ☞ When handling chemicals, always wear proper safety protective equipment (gloves, masks, goggles, protective clothing, etc.)
- ☞ Check the cooling water connected to the fume hood, water supply/drainage, gas valve and pipes frequently.

## 7. Waste disposal

### Waste disposal

- ☞ Smoking and firearms are strictly prohibited in the chemical waste handling and storage places.
- ☞ When collect wastes, collect separately and display by the waste acid, waste alkali, waste organic solvent, waste oil, etc.
- ☞ Waste containers should take measures such as closing the double cap to prevent leakage or odor of the waste.
- ☞ Before the liquid waste treatment, fully investigate the nature of the waste and then neutralize and pretreat such as injection of small amount of drugs added, etc.
- ☞ Be careful to avoid waste container being damaged due to conduction and degradation.
- ☞ General waste and hazardous waste are discarded separately.
- ☞ Collected chemical waste containers should be stored in a well-ventilated storage area where can avoid direct sunlight. Do not neglect it in the places such as hallways, stairs, etc.

## 8. Gas

### Gas

- ✎ Mark the type of gases on the gas cylinders and gas lines.
- ✎ Cylinders should be fixed on the wall or test benches by a chain or a belt to avoid conduction.
- ✎ During the transportation and storage of the containers, must put the cap on them.
- ✎ During the transportation of the containers, must transport them after chaining to the cart.
- ✎ Do not handle the flammable gases near chemicals or at the places where the spark-plug which generates fire and sparks exists.
- ✎ Frequently test the leakage of the flammable, toxic, valve threads of corrosive gases, safety devices, connection parts, etc.
- ✎ If you do not use the cylinder in long-term, must block the valve and emit all of the pressure in gas pipeline.
- ✎ Always wear a protective gear during operations such as pressure regulators, connecting or disconnecting the lines.
- ✎ Take an action immediately to get the gas supply company to retrieve the faulty containers and empty bottle.

9. Gas list

Inert

Toxic, Flammable

Oxidizing

Corrosive

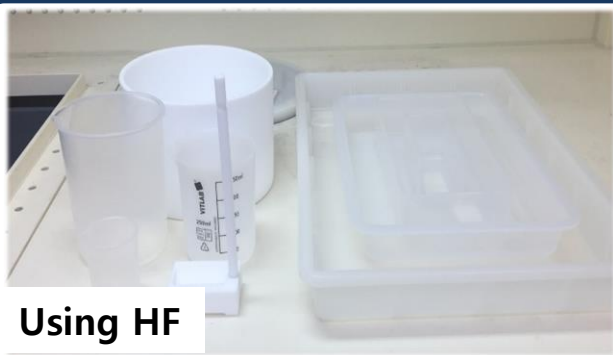
Process	Equipment	PN <sub>2</sub>	GN <sub>2</sub>	He	Ar	O <sub>2</sub>	CF <sub>4</sub>	CHF <sub>3</sub>	SF <sub>6</sub>	C <sub>2</sub> H <sub>4</sub>	SiH <sub>4</sub> 5%	SiH <sub>4</sub> 100%	H <sub>2</sub>	NH <sub>3</sub>	BCL <sub>3</sub>	CL <sub>2</sub>	C <sub>4</sub> F <sub>8</sub>	GeH <sub>4</sub>	N <sub>2</sub> O	CH <sub>4</sub>	DCS	PH <sub>3</sub>	HBr	비고
Photo	Mask aligner	O																						
	Nano Imprinter		O																					
	Spin coater		O																					
	PR Wet station		O																					
Etch	Dielectric RIE	O	O		O	O	O	O																
	Metal RIE	O	O		O	O			O						O	O								
	Deep RIE	O	O	O	O	O	O		O								O							
	PR Strip		O		O	O	O																	
	Dielectric ICP-RIE	O	O		O	O	O	O	O						O	O								
	Metal ICP-RIE	O	O		O	O	O		O						O	O								O
	Metal ICP-RIE#2		O		O	O										O								O
	Wet station		O																					
Thin film	Furnace (Oxide)	O				O							O											
	Furnace (POCl3)	O				O																		
	PE CVD (SiO <sub>2</sub> , Si <sub>3</sub> N <sub>4</sub> )	O	O			O	O				O			O					O					
	UHV-CVD	O			O					O	O		O						O					
	RF Sputter	O	O		O	O																		
	DC Sputter	O	O		O	O																		
	Evaporator	O			O																			
	SAM Coater	O			O	O																		
	LP CVD (D-Poly, Si <sub>3</sub> N <sub>4</sub> )	O	O									O		O							O	O		
	PE CVD (SiC, Si <sub>3</sub> N <sub>4</sub> )	O	O	O		O			O		O	O		O						O				

- 1. Cleanroom Definition**
- 2. Facility resources**
- 3. Equipment**
- 4. Lab policies**
- 5. Wet station**
- 6. Emergency measures**
- 7. Equipment reservation**

# ★ Wet Station

## 1. Chemical classification

	acid	alkali	solvent
<b>Definition</b>	To clean up material in an aqueous solution that the hydrogen ions ( $H^+$ )	Material by ionizing in an aqueous solution that fisheries ions ( $OH^-$ )	It refers to any object that is used to dissolve other materials
<b>Character</b>	<ul style="list-style-type: none"> <li>- Sour South</li> <li>- Varying the blue litmus paper red,</li> <li>- Neutralizing with base to produce the salt</li> <li>- Reacts with Fe, Zn and metal Sikkim generate hydrogen (corrosive)</li> </ul>	<ul style="list-style-type: none"> <li>- Bitterness M</li> <li>- Varying the bluish red litmus paper</li> <li>- Produce a neutralizing acid and salts</li> <li>- Greasy texture</li> </ul>	<ul style="list-style-type: none"> <li>- Most flammable strength</li> <li>- If the long-term vapor inhalation headache, dizziness occur, and strong volatility,</li> </ul>
<b>Purpose</b>	- Acids and bases are used in processes such as wafer cleaning and etching, cleaning quartz products, PR removal		-Organic solvents are used in wafer fabrication processes, equip, cleaning removing photoresist & photosensitive
<b>Chemical</b>	- HCl, $H_2SO_4$ , $HNO_3$ , HF, BOE, $H_2O_2$	- KOH, $NH_4OH$	- Acetone, IPA, Methanol, PR
<b>Use container</b>	<ul style="list-style-type: none"> <li>- Quartz, Glass, Teflon</li> <li>- HF, BOE : Only Teflon</li> </ul>	- Quartz, Glass	- Glass





# Wet Station

## 2. Wet Bench

### 1. Protective gear

- ① Apron
- ② Glove
- ③ Eye protector
- ④ Respiratory protector

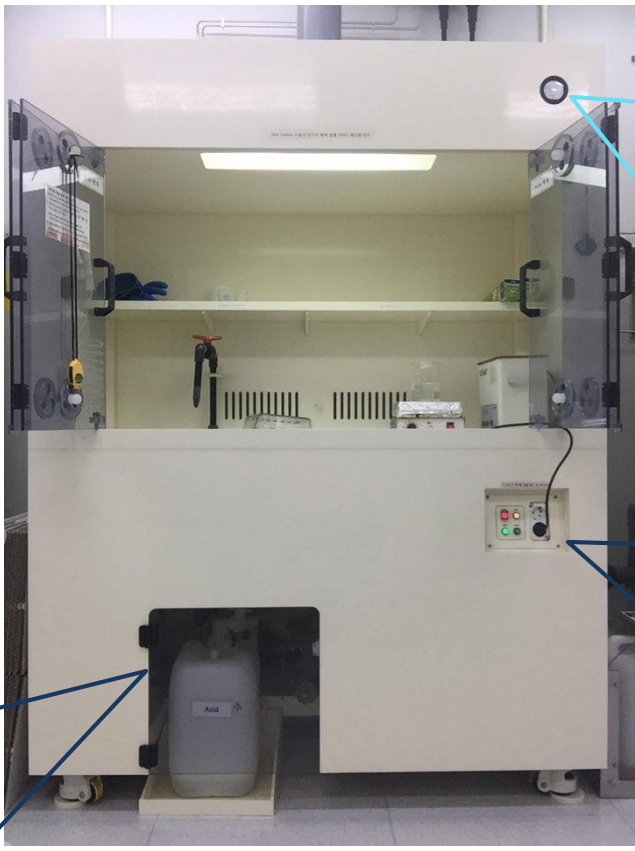
### 2. Pressure gauge

: make sure the hood is working well



### 3. Bottle level

: let manager know level is over half



### 4. Button



# Wet station

## 3. Do not mix each other

구분	Acids Inorganic 무기 산	Acids Oxidizing 산화성 산	Acids Organics 유기 산	Alkalis (Bases) 알칼리	Oxidizers 산화제	Poisons Inorganic 무기독성	Poisons Organics 유기독성	Water- reactives 물반응성	Organic Solvents 유기용제
Acids Inorganic 무기 산			X	X		X	X	X	X
Acids Oxidizing 산화성 산			X	X		X	X	X	X
Acids Organics 유기 산	X	X		X	X	X	X	X	
Alkalis (Bases) 알칼리	X	X	X				X	X	X
Oxidizers 산화제			X				X	X	X
Poisons Inorganic 무기독성	X	X	X				X	X	X
Poisons Organics 유기독성	X	X	X	X	X	X			
Water- reactives 물반응성	X	X	X	X	X	X			
Organic Solvents 유기용제	X	X		X	X	X			

4. How to take-off safety gloves

안전장갑의 선정과 관리  
안전장갑 착용 방법

### 올바른 장갑 벗는 순서

한 손으로 다른 한 손의 각 손가락에 끼워진 장갑을 당김

손가락 부분이 적당히 빠지면 손을 바꾸어 다른 손의 손가락에 끼워진 장갑도 당김

양손의 손가락 부분이 어느 정도 빠지면, 한 손으로 다른 한 손 장갑의 입구 부분을 잡음

입구 부분이 잡힌 손을 먼저 절반 정도 빼줌

손을 바꾸어 다른 한 손도 절반 정도 빼줌

순차적으로 손을 완전히 뺌



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순차적으로 손을 완전히 뺌





# Wet Station

## 6. Wet station room safety rules -I

-	Safety rules	-
1	Those who use all the chemicals (organic solvents, acids / bases) and toxic gases should receive safety training from safety representative and should be fully aware and understand safety precautions.	
2	Be aware of the location of the First Aid Tool (emergency exits, fire extinguishers, oxygen masks, eyewash, etc.).	
3	All chemicals should be used within well-ventilated hood (Wet station), and do not wear contact lenses in the place to use chemicals.	
4	Put tools and supplies assigned place after use.	
5	You should separately store and dispose of organic solvent, alkali and acid.	
6	You should not mix acid and organic solvent because it can be cause explosive and severe accidents.	
7	All chemical containers should be able to distinguish by attaching the cover (for example, "acid", "alkali", "organic chemicals")	
8	Be carefully use, pour chemical in bath, and keep the closure of chemical container clean.	
9	Check the safety protector before you use it to handle chemical.	
10	Do not touch the unknown liquid. You can check the pH of chemical by test paper. Then inform staff about situation.	

# Wet Station

## 7. Wet station room safety rules -II

-	Safety rules	-
11	Do not use unapproved chemicals before consultation with Managers in the clean room.	
12	Use chemicals in assigned bath as properties of chemical. (acid, alkali, organic solvent)	
13	If you use heater, do not heat up beyond the proper temperature, you should not leave the place until the end of the process.	
14	You can store individual laboratory instruments in assigned locker, after using the Wet- station, you should keep wet station clean for next users.	
15	Open the new chemical after running used chemical out.	
16	Put an empty chemical bottle in storage as properties of chemical.	
17	You can dispose waste chemical in assigned container (20l Bottle) after level check of 20l Bottle, and if it more than 1/2 level. Inform to the administrator.	

- 1. Cleanroom Definition**
- 2. Facility resources**
- 3. Equipment**
- 4. Lab policies**
- 5. Wet station**
- 6. Emergency measures**
- 7. Equipment reservation**

# ★ How to Respond in Emergencies

## 1. Medical Emergency Response

Contents	Respond	-
If you get any chemicals on the skin	<ul style="list-style-type: none"><li>① Undress chemicals contaminated clothing.</li><li>② Wash affected part for at least 15 minutes under running water. : The first 20 minutes washing is very important because that washing step neutralize and dilute water and chemicals. (Continue to wash in flowing water for a long time is better.)</li><li>③ Seek medical attention.</li></ul>	
In the case that you get the chemicals in the eye	<ul style="list-style-type: none"><li>① Wash eyes for more than 15 minutes from the eyewash. Holding the eyelids and turning pupil to enter the water evenly to eyes</li><li>② Seek medical attention as soon as possible.</li><li>※ Install washing device near the workbench dealing with chemicals or ventilation device so that you can wash the eye quickly.</li></ul>	
If swallowed chemicals	<ul style="list-style-type: none"><li>① Follow first aid measures indicated to display bottles of chemicals.</li><li>② If first aid measures are not listed, drink sufficiently large amounts of water to dilute acid or alkaline in the body. If safety accident occurs, do not panic, stay calm, and take a first aid quickly and appropriately. (contact 119 rescue team directly)</li><li>③ Never put finger to mouth to spit chemicals by vomiting by force. (to prevent secondary damage of esophagus and airway )</li></ul>	



# ★ How to Respond in Emergencies

Laboratory No.	Natural science building (108) B101	
Laboratory Name	Nanofabrication lap	
Safety Manager	Hyungil Kim Minjae Kim	4065 4064

External Main Telephone

Fire Station	119
Police Station	112
Joun samjung Hospital	052)220-7500



Fire, Explosion, Gas  
and Chemical Leak etc.

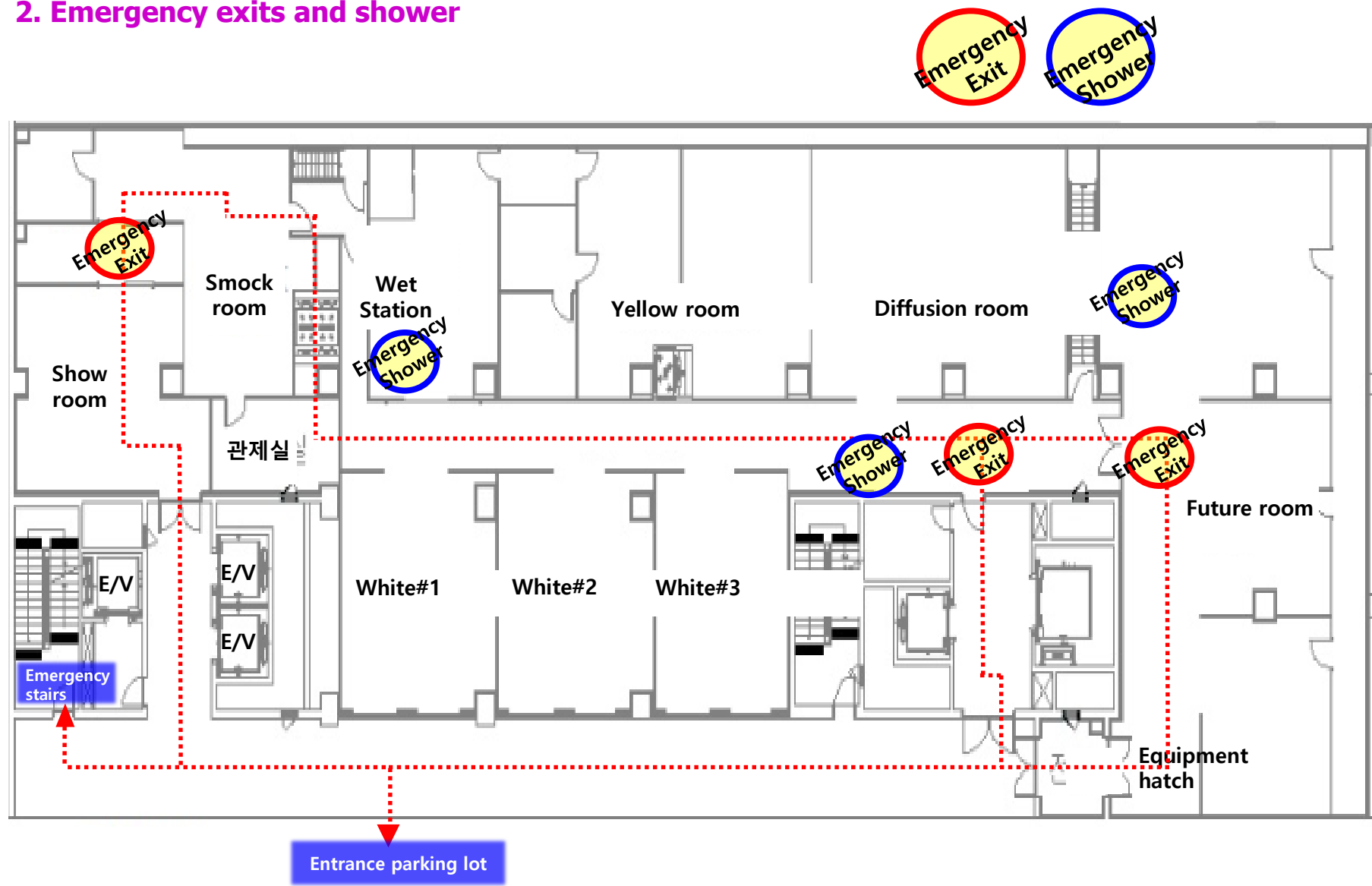
Emergency Call

---

052) 217-  
0119

# How to Respond in Emergencies

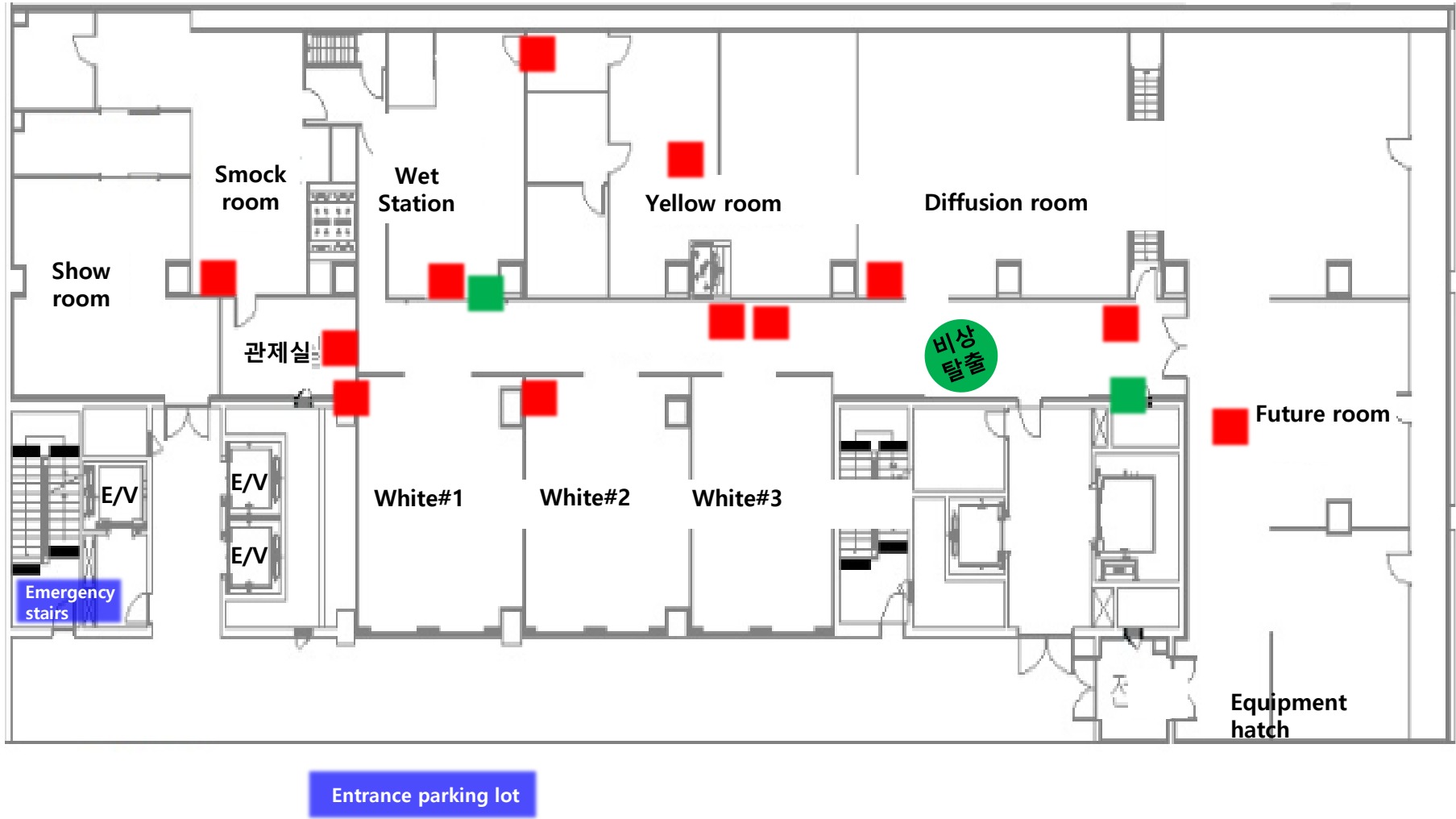
## 2. Emergency exits and shower



# How to Respond in Emergencies

## 3. Fire extinguisher and Hydrant

■ Fire extinguisher ■ Fire Hydrant



# ★ How to Respond in Emergencies

## 4. Fire extinguisher operating method and characteristic



1. Move to fire spot



2. Remove safety pin



3. Stand with the wind



4. Aim nozzle to fire and grab lever.

### 1) Response procedure

- ① Move to fire spot
- ② Remove safety pin
- ③ Stand with the wind
- ④ Aim nozzle to fire and grab lever.

### 2) Extinguisher character inside CR

- CO2 fire extinguisher

- ① Get rid of oxygen around the fire place
- ② Advantage that there is no debris
- ③ A large amount of oxygen is required

# ★ How to Respond in Emergencies

## 7. Protective device



**Emergency Box(1)**

Air mask  
Portable lamp  
Protective suit  
Dust mask



**Emergency Box(2)**

Protective suit  
Mask for fire evacuation  
Portable lamp



**Protective box**

Protective suit  
Fireproof gloves  
fireproof blanket  
Eye protector  
earplug



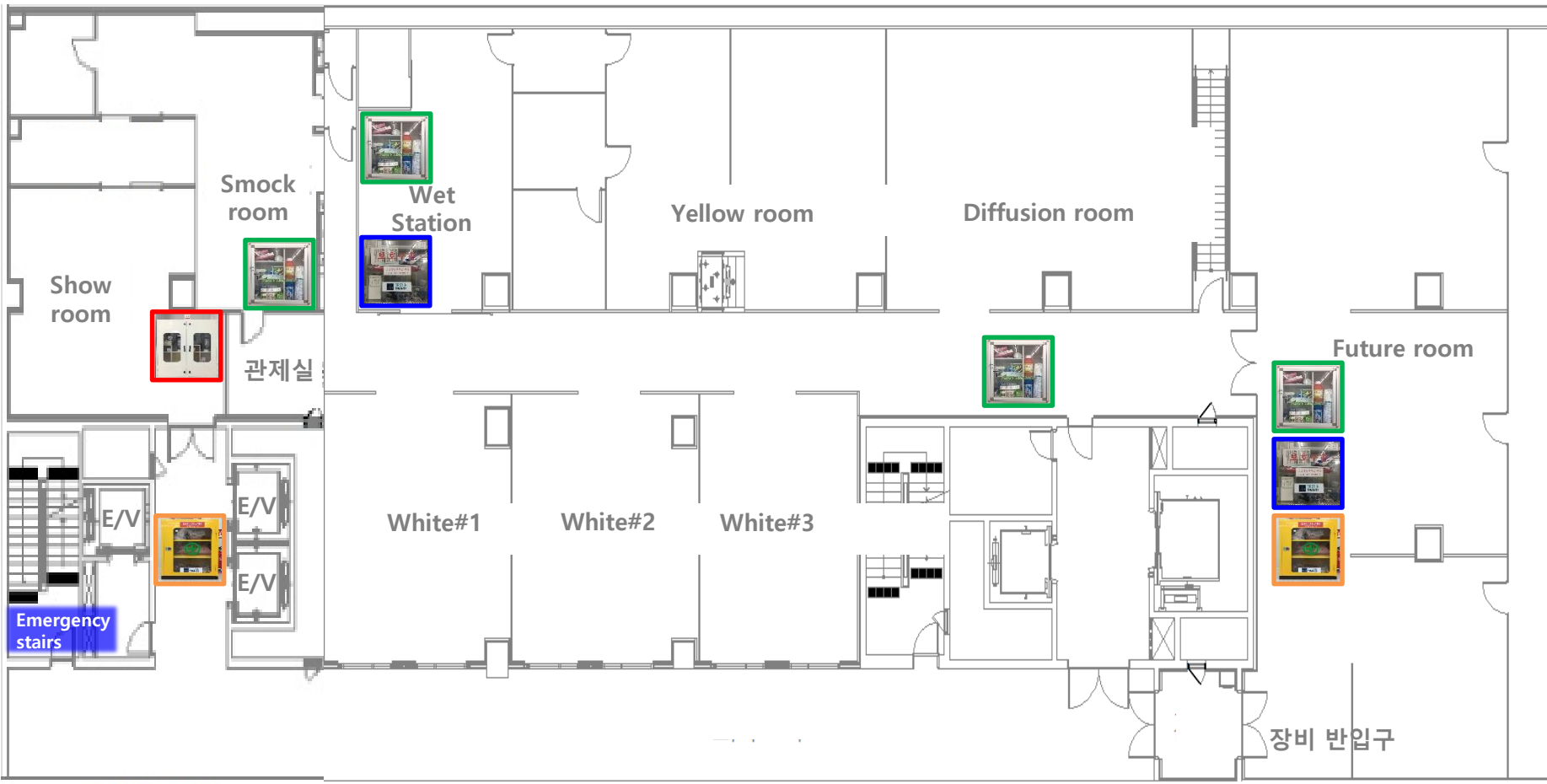
**First aid kit**

HF cream  
disinfectant, a Band-Aid  
Wrist guards  
Portable oxygen, etc.

# ★ How to Respond in Emergencies

## 8. Place of Protective device

-  Emergency Box(1)
-  Emergency Box(2)
-  Protective box
-  First aid kit



Entrance parking lot

- 1. Cleanroom Definition**
- 2. Facility resources**
- 3. Equipment**
- 4. Lab policies**
- 5. Wet station**
- 6. Emergency measures**
- 7. Equipment reservation**

# ★ Equipment reservation

## 1. Sign up and apply for self user (ucrf.unist.ac.kr)

The screenshot shows the UNIST UCRF sign-up form. It has a header with the UNIST and UCRF logos and a close button (X). Below the header are three tabs: 'UNIST member' (highlighted with a red box and a yellow circle with the number 1), 'Industry member', and 'External member'. The form fields are as follows:

- ID/E-mail: 'm\*k\*m' followed by '@unist.ac.kr'.
- Password: '\*\*\*\*\*' followed by a 'Confirm' button (highlighted with a red box and a yellow circle with the number 2).
- Name: 'Kil dong'.
- Department: 'UCRF'.
- Student ID No. / Professor ID No. / Staff ID No.: '20\*39'.
- Contact: Extension '4064'.
- Cell phone: '010' followed by two '\*\*\*\*' placeholders.
- Principal Investigator: 'Prof. Kim' followed by a 'Professor Search' button (highlighted with a red box and a yellow circle with the number 3).
- Below the Principal Investigator field is a 'Select' dropdown menu.
- At the bottom is a 'Create Account' button (highlighted with a red box and a yellow circle with the number 4).

The screenshot shows a 'Request for Self-user' pop-up window. It has a close button (X) in the top right corner. Below the title are three dropdown menus:

- 'Nano Fabrication Center' with a downward arrow.
- 'Etching' with a downward arrow.
- 'Deep Si Etcher' with a downward arrow.

At the bottom is an 'Apply' button (highlighted with a red box and a yellow circle with the number 1).

My page -> click request for self-user in left bottom corner  
-> pop up above manu, select machine and click Apply  
After approval  
can reserve in the UCRF homepage and Portal Equipment research

Click sign up-> select UNIST Member -> input Portal id/pw & click confirm  
-> personal info displayed automatically -> input prof.'s name & click search  
-> find your prof. and click -> click Create Account



# Equipment reservation

## 2. Access permission application

UNIST Central Research Facilities

About UCRFEquipment StatusData RoomParticipation Space

Equipment Search

Please enter the name of equipment.

Laboratory

Notice

Education & Seminar

Tour Application

Access Permissions Application

Equipment Reservation/Analysis Request

Status of Analysis Request

Download of document related to payment

Status of Education Application

600 MHz FT-NMR

Calendar

UNIST Central Research Facilities

UCRF Equipment Catalog

Details

Notice Archive

Thermal Analysis Notice

2016.01.22

Normal TEM will be repaired

2016.01.20

Normal XRD is working with manual mode only.

2016.01.18

No entry normal TEM room on 1/15

2016.01.14

BET 분석장비) 명칭 변경 (Renamed the BET ...

2016.01.12

Procedure

This is the procedure to use the equipment of UCRF. Please ensure the procedure is different by each laboratory.

Discount Criteria

This is the criteria of discount for the use of equipment. Please refer to the specified criteria of discount.

go to UCRF homepage

### Access Permissions Application

Participation Space > Access Permissions Application

### UNFC Entrance Application

UNFC Entrance Application

Advisor	<input type="text"/>		
Department	<input type="text" value="연구지원본부행정실"/>		
Applicant	<input type="text" value="김민재"/>		
Contact	Office	<input type="text" value="Select"/>	- <input type="text"/> - <input type="text"/>
	Cell phone	<input type="text" value="010"/>	- <input type="text" value="4848"/> - <input type="text" value="2951"/>
Position	<input type="text" value="직원"/>		
E-mail	<input type="text" value="mjkim"/>	@ <input type="text" value="unist.ac.kr"/>	<input type="text" value="Select"/>
Date (Period)	<input type="radio"/> 1 day (5,000won) <input type="radio"/> 1 month (90,000won) <input type="radio"/> 3 month (180,000won) <input type="radio"/> 6 month (320,000won)		<div>Begin <input type="text"/></div>

daily and 1/3/6months possible  
make sure the begin date

fill in the form and click apply

# Equipment reservation

## 3. Reservation-I

Portal -> Research equipment -> Reservation/input result -> Apply

UNIST

Administration Room MINJAE KIM | Switch Position | Settings | Site map | Log out

Home | Human Resource | Financial | Procurement | Asset | Budget | **Research Equipment** | Fund | Intellectual Property | Application for use of lecture

Approval for Equipment Fee | **Equipment Reservation**

Detailed Navigation

Equipment Reservation

Equipment Reservation List

Equipment Status

Favorite

Equipment reservation

Search condition

Inquiry

Reservation date: 2015.08.01 ~ 2016.02.17

Reservation

Input result

Completed

All

1st classification:

2nd classification:

Equipment name:

Equipment booking list

Application

Reservation cancel

Input result

Select	Status	Sortation	Equipment name	Chief of research	Reservation date	Reservation time	Fee	1st classification	2nd classification name	Application date	Free_Test	Free_Longterm	Memo
<input type="checkbox"/>	Reservation	Self	PR Asher		2016.02.02	16:00~17:00	0.00	UNFC - 나노소자공정실	Etching	2016.02.02 16:11	<input type="checkbox"/>	<input type="checkbox"/>	

\* You can check Self/request history and input memo

# Equipment reservation

## 3. Reservation-II

“application” click(previous screen), below menu will pop up -> 1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup> category equipment select -> time select -> “application” click

장비예약

Application Expand<->unexpand

Select equipment

Member ID: mjkim@unistackr 20139 / Kil dong

Subscriber: 20139 Kil dong

1st classification: UNFC - 나노소자공정실 2nd classification: Etching 3rd classification: PR Asher

Project informaion

Chief 100**	Chief Kim	Detail project number	detailed item	Executable amount	Useable amount
				0	0

Reservation control information

Reservation time unit	Daily maximum reservation time	Reservation open timing	Cancelable timing	Fee
10 시간	3.0 시간	14 일전	1 시간전	1.0 OP 20,000 원

유의사항02

실적입력시 진행횟수를 정확히 입력하세요(Input result should NOT be time or sample amount but be operation number)

유의사항01

After using the machine, Power "OFF"

Time/Date	02/02(T)	02/03(W)	02/04(T)	02/05(F)	02/06(S)	02/07(S)	02/08(M)	02/09(T)	02/10(W)	02/11(T)	02/12(F)	02/13(S)	02/14(S)	02/15(M)	02/16(T)
00:00~01:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
01:00~02:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
02:00~03:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
03:00~04:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
04:00~05:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
05:00~06:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
06:00~07:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
07:00~08:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
08:00~09:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
09:00~10:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10:00~11:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11:00~12:00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Equipment list only you have self user qualification will be displayed.

# Equipment reservation

## 4. Input result

**Equipment reservation** help

**Search condition**

Reservation date: 2015.08.01 ~ 2016.02.17 ☐ Reservation ☐ Input result ☐ Completed ☐ All

1st classification:  2nd classification:  Equipment name:

**Equipment booking list**

**1 check row which you want, and click input result**

Select	Status	Sortation	Equipment name	Chief of research	Reservation date	Reservation time	Fee	1st classification	2nd classification name	Application date	Free_Test	Free_Longterm	Memo
<input checked="" type="checkbox"/>	Reservation	Self	PR_Asher		2016.02.02	16:00~17:00	0.00	UNFC - 나노소재공정실	Etching	2016.02.02 16:11	<input type="checkbox"/>	<input type="checkbox"/>	

**장비사용신청** Save **4**

**Reservation information**

Reservation number: 2016004867 Reservation date: 2016.02.02 Client authorization: Self mjkim@unistackr Kil dong

Application date: 2016.02.02 Reservation time: 16:00~17:00 Rate: 50 Equipment name: PR\_Asher

**Project information**

Chief of research	Chi	Kim	Detail project number	detailed item	Executable amount	Useable amount
					0	0

**Fee** **2 input result**

Cost	Unit quantity	Unit	unit amount	discount applying	Option applying	Amount	Fee	Rate	Amount
기본공정료	1.0	OP	20,000	<input checked="" type="checkbox"/>		10	20,000	50	10,000
합계							20,000		10,000

**Process condition** **3 process condition**

Power(W)	Pressure(mT)	Process Time(sec)
CF4(sccm)	O2(sccm)	Ar(sccm)
Remark		



# Appendix #1

## Application for chemical import

### 화학약품 반입신청서 (나노소자공정실)

반입일자	(날짜)			
반출일자(예정)	(날짜)			
신청인	소속	이름	이메일	지도교수
화학약품	순번	1	2	3
	화학약품명			
	분류 (산/염기/유기)			
	수량			
	용량			
	유효기간			
참고사항	1. MSDS에 근거하여 상기 자료를 작성하고, 제조사의 MSDS 반드시 제출 2. 분류 - 산, 염기, 유기 (폐기 - 불산, 황산, 기타산, 염기, PR 등) 3. 화학약품 유효기간 확인 필요 4. 화학약품 통에 아래의 정보(화학약품명, 신청인) 태그 부착하여 관리 5. 보관기간 (1년 - 감광제/유기, 6월-산, 알칼리)  본인은 울산과학기술원 연구지원본부 나노소자공정실의 안전 관리 규정을 준수합니다. 또한 위 내용에 대한 내용이 정확함을 확인하고 잘못된 정보, 폐액 분류 규정을 지키지 않아서 발생하는 사고에 대하여 연대 책임 질 것에 동의합니다.  신 청 인: (서명) 지도교수: (서명)			

Chemical	Ex. Acetone
Import (Date)	Ex. 21. 01. 01
Export (Date)	Ex. 22. 12. 31
Property	Solvent
Department	UNIST UCRF
Name	Kang O Kim
Contact No.	010-****-**** (#4182)

Chemical	
Import (Date)	
Export (Date)	
Property	
Department	
Name	
Contact No.	

Ex)

Chemical	Acetone
Date import	
Date export	
Chemical Property	Solvent, Acid, Alkali
Department	UCRF
Name	X X X
Contact No.	010-****-****(#4165)

Max PR 1 year,  
other chemical 6months can stock.

Chemical	
Date import	
Date export	
Chemical Property	
Department	
Name	
Contact No.	

# Appendix #2

## Holiday safety checklist for the UNFC

### 연구지원본부 나노소자공정실(클린룸) 휴일 점검 일지

관문(호실)	설명설명	점검 일자	연구활동종사자		
			소속(학부)	점검자	책임자
자연과학관(B101)	나노소자공정실	2021. . . . .		(인)	(인)

\* ☐ 새로운 연 내용한 작업후 담당자에게 제출해줍니다. ( ☐ 이 내용은 휴일전 담당자 점검 전행 ) 참고 : 풍향(O), 역향(X) 수역(X)

항 목		비 고	확 인	특 이 사 항
열반연전	실내실외 장력장온 및 장온 상태	확인전		
	연구실내 균열, 음식물 반입 및 섭취 여부	확인전		
	배상 연락망 및 배상시 행동요령 배지 상태	확인전		
	실내 폐기물 관리상태	확인전		
	위험표지 및 안전, 경고 표지 부착 여부	확인전		
소방연전	화재발 소확기 적정 배치 및 숙지 여부	확인전		
	화재경보기의 설치 및 설치장소 숙지 여부	확인전		
	불꽃 내는 난방기구/실내기기 관리 상태	확인전		
Smock room	양압 필터 동작 상태	통작전		
	자동문 동작 상태	통작전		
	Air shower 동작 상태	통작전		
White room	장대 alarm 및 이상 여부	통작전		
	누수 및 Gas detector alarm 여부	확인전		
Photo room	Air shower 동작 상태	통작전		
	장대 alarm 및 이상 여부	확인전		
Wet room (하공연전)	물밀폐전 보전자료(MSDS)의 배치 여부	확인전		
	약품물 저장용기 및 보관 장소 적정 여부	확인전		
	약품 위생성 분류에 따라 분류 보관 여부	확인전		
	표준, 배기 등 환경기준 관리 및 작동 상태	통작전		
	배액통 레벨 상태(W2.물산)	확인전		
	배액통 레벨 상태(W3.알칼리)	확인전		
	배액통 레벨 상태(W4.물산)	확인전		
	배액통 레벨 상태(W4.물산)	확인전		
	배액통 레벨 상태(W5.물산)	확인전		
	개인 보호 장비 보유 및 사용 상태	확인전		
전 계연전	전기기기의 절연, 피복손상 및 접지 적정여부	확인전		
	코드, 배선기구의 용량 및 규격 적합 여부	확인전		
	전원기 주변 가연성물질 등의 배치 여부	확인전		
	누전차단기의 설치 및 작동 상태	통작전		
계량기구	고온/고압 실험장비 사용시 안전장치 설치상태	통작전		
	레이저 등의 광학기구 작동상태	통작전		
세척실	Gas, water, oil leak 여부	확인전		
	Burn scrubber 동작 상태	통작전		
	Power drain 동작 상태	통작전		
	Pump류 소음(일람) 및 oil leak유무	확인전		
	폐수 펌프 이상 유무	확인전		
	폐수 처리 장치 동작 상태	통작전		
가스연전 (Gas room)	가스채널의 밀폐 여부(의상시 채널넷 #기체)	통작전		
	산소 농도 측정기 동작 상태(정상범위 20.9%)	13-03.5		
	Burn scrubber 동작 상태 및 누수 여부	통작전		
	가스용기 고정 및 관리(밸브 및 배관) 상태	확인전		
	매사용 고압가스용기 보호캡 설치여부	확인전		
	고압가스 용기 충전기한 적정여부	확인전		

\* 이상 발생시 점검 일자 및 이상 내용을 득서함에 붙여 기재할 것







# Appendix #3

## Rules for using UNFC

### Rules for using UNIST Nano Fabrication Center (UNFC).

(UNFC, June 4, 2021).

#### Article 1. Access

- ① The UNFC is open 24 hours a day. Only research workers who have completed safety training and passed the assessment can enter the UNFC.
- ② A person can apply for 1 day or 1 to 6 months access on the UCRF website and can enter (exit) using his or her pass after approval by the person in charge. The entrance fee is charged according to the access period, and it is non-refundable.
- ③ Each user must enter (exit) individually using the pass card with their own identity. It is prohibited to enter using another person's pass or to enter together without permission.
- ④ A person who uses the UNFC at night (PM18-AM09 on the next day) or on holidays must enter after establishing personal safety and protection rules (accompanying 2 or more people, preparing for an emergency contact, etc.) for lab accidents.
- ⑤ A person who violates Article 1 section 1-4 stated above regarding to accessing UNFC shall be obligated to compensate for all safety and property damage caused by the violation.

#### Article 2. Use of Space

- ① Only a person who has experience at UNFC for more than 6 months can use the equipment at night, on weekends, and on holidays.
- ② A UMCL user on weekends or holidays must fill out the UNFC holiday safety sheet (Attachment 2) provided in each laboratory room, and submit it to equipment manager, with the signature of the professor (or supervisor) within 3 days from the date of use.
- ③ A UNFC user must understand and follow the general safety rules for the cleanroom.

- 1) In the cleanroom, entering with make-up and smoking is prohibited. The room must be kept quiet, and tidy up at all times.
- 2) A user of the cleanroom must comply with the following.
  - A. To maintain the "clean class", only authorized items (non-dusting paper, coated paper, etc.) should be used. (Prohibited from pencil, water-based pen, etc.)
  - B. Only items (parts, equipment, etc.) approved by the equipment manager can be brought in after cleaning.
  - C. Prohibited from sitting on a workbench, leaning on equipment, running, or sitting on the floor.
- 3) Before starting the analysis and process, you should familiarize yourself with the safety rules for each equipment.
- 4) A user must wear appropriate safety protection before the experiment.
- 5) A user must check that there is no problem before using equipment, chemicals, etc., and if there is a problem, a user should promptly report to the equipment manager.
- 6) A user must thoroughly fill out the "Performance Records" after using the equipment.
- 7) UNFC holiday safety sheet must be submitted to the cleanroom person in charge after obtaining the approval of the principal investigator of the user.
- 8) A user must take safety measures by posting the contents of the experiment to deliver accurate information to others if he inevitably leaves his seat during the experiment.
- 9) A final user must leave the cleanroom after tidying up the area and checking up for any problem in the cleanroom.
- ④ A user must wear the blue dust-proof clothes (not allowed personal items) provided in the smock room, follow the order of wearing. A user must not wear or soil another person's clothes and tidy up when undressing.
- ⑤ A user should clean up the area after finishing the experiment and must promptly notify the equipment manager if there is a problem with the equipment or environment. Violation of the notification obligation may result in restrictions on the use of the equipment.





# Appendix #3

## Rules for using UNFC

### Article 3. Use of Equipment.

- ① A person who wishes to use the equipment of UNFC must reserve and use the equipment after completing the training of the equipment manager, assessment test, and acquiring self-user qualification. (Analysis or process request is irrelevant to equipment training and qualification test.).
- ③ A user who completes regular or occasional training (including practice) by the equipment manager can receive practical training from the senior student of his or her laboratory to improve proficiency before the assessment test. The qualification of the senior must be at least 1 year of experience (more than 5 times in the previous 3 months) in using the equipment. The laboratory (in the case of an outsider, affiliated institution) is responsible for all safety and property issues arising from the practical training conducted by the senior student..
- ③ If there is no record of equipment used in the last 90 days, the qualification for self-use ends. A person who wants to reacquire the self-user qualification must receive equipment training and pass the assessment test conducted by the equipment manager..
- ④ Equipment reservations or requests can be made on the UNIST Portal System and the website of UCRF (<http://ucrf.unist.ac.kr>), and the reservation time should not be unnecessarily occupied for a long time, so it does not affect the opportunity for others..
- ⑤ Bringing chemicals and other items for personal use should be consulted with the equipment manager. After submitting an application form for importing chemical and material safety data sheets (MSDS), they can be brought in with the approval of the equipment manager. (refer to attachment 1).
- ⑥ A user must notify the equipment manager of any special matters before and after using the equipment..

### Article 4. Cancellation after equipment reservation.

- ① A self-user can cancel equipment reservation by himself up to 2 hours before equipment reservation time. However, E-Beam lithography can

be canceled up to 24 hours before. (※ Cancellation is not possible after the cancellation deadline has passed.) ..

- ② In the case of a process request, a user who does not appear at the reservation time without prior notice to the equipment manager will be charged a processing fee for the reserved time after the process reservation. ..

### Article 5. Laboratory safety and user management.

- ① A person who harms the safety of the laboratory or violates the rules of using UNFC and damages the equipment use of another person can be subject to penalties according to [Attached Table 1] and be taken appropriate action..
- ② If the violation of the rules is deliberately determined, the sanctions may be strengthened. If a user voluntarily declares after violating the rules, the sanctions may be eased. ..
- ③ If it is judged that the sanctions are difficult to be properly implemented due to the status of the violator (graduation or resignation), the user may be blocked from accessing UNFC..
- ④ A person who damages the property and facilities of UNFC by violating the rules shall be held liable to compensate for the damage. ..
- ⑤ If a violator does not follow the sanctions, the advisor of the violator will be held jointly responsible. (In the case of an outsider, the supervisor in charge of the affiliated institution) ..



# Thank you