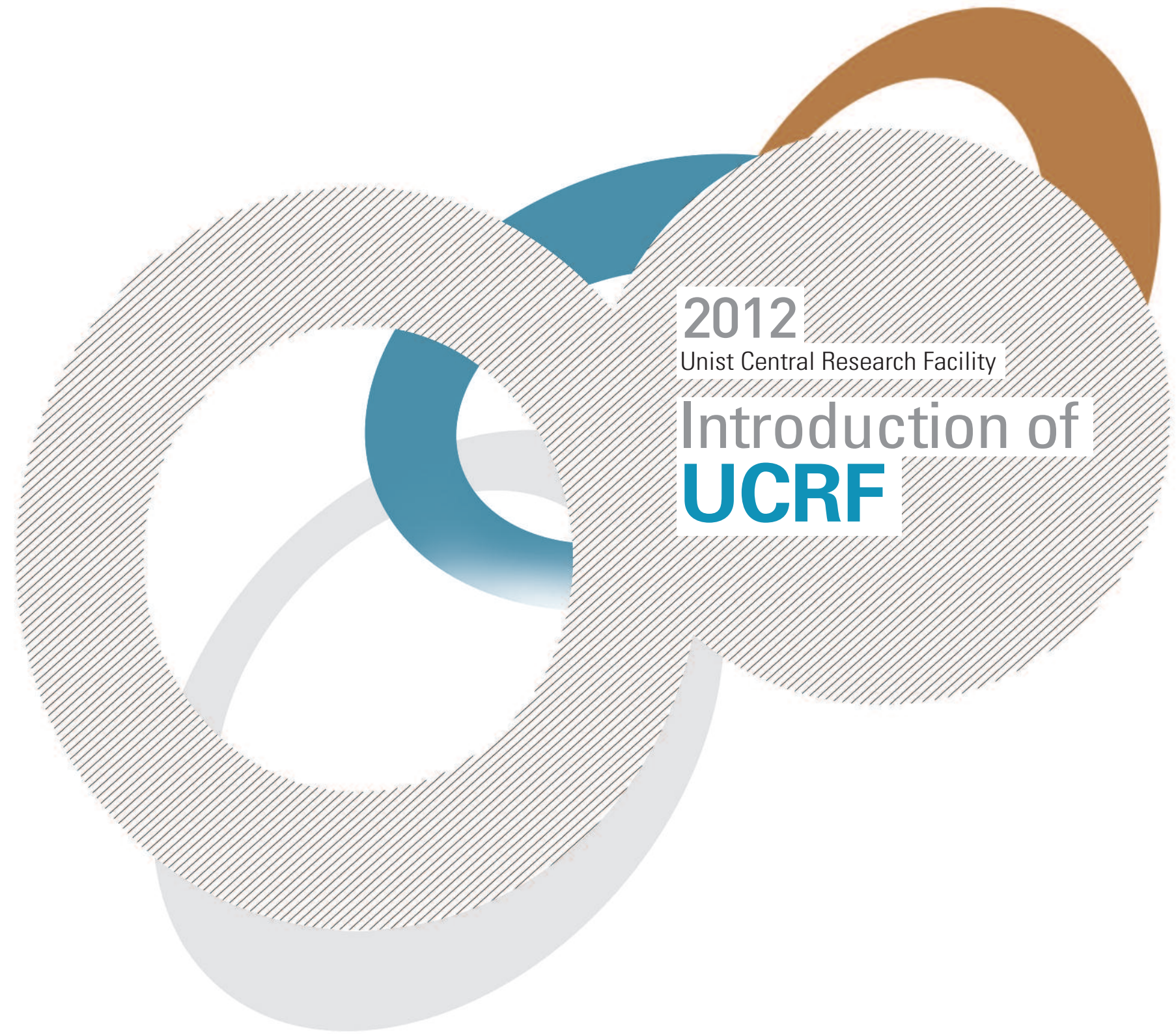




2012

Unist Central Research Facility

# Introduction of **UCRF**



UNIST-gil 50 (Banyeon-ri 100), Ulsan 689-798, Republic of Korea  
Tel. +82.52.217.4032~4043, 4046~4069 / Fax. +82.52.217.4039  
<http://www.unist.ac.kr>

# Contents

Message from the president  
Organization & Members

Introduction of Analysis Lab  
List of Instruments  
Electron Microscopy  
X-ray Analysis  
Spectroscopic Analysis  
Surface Analysis  
Mass Analysis  
Thermal Analysis

Introduction of Environmental Analysis Lab  
List of Instruments  
Environmental Analysis

Introduction of Nanofabrication Lab  
List of Instruments  
Photolithography  
Etching Process  
Thin Film Process  
Measurement  
Packing

Introduction of Machine Shop  
List of Instruments  
CNC Machine Tool  
General Purpose Machine Tool  
Measuring Instrument

Introduction of UOBC  
List of Instruments  
System Microscope  
General Microscope

Introduction of *in vivo* Research Center (IVRC)  
Introduction of Radioisotope Lab  
List of Instruments  
Radiation Measurement

Unist Campus Map  
How to get to UCRF

## Message from the President



I will be committed to develop UNIST  
as a world’s leading university  
in the 21<sup>st</sup> century.

UNIST has been founded with the aim of becoming not only one of Korea’s most prominent national universities but also one of leading global universities in education and research of science and technology.

UNIST is located in ulsan metropolitan city where korea’s leading industries including automobile, ship building and petroleum chemistry are clustered.

With this location, UNIST has the potential of emerging as a hub of industry-academic cooperation in high technology.

One of UNIST’s long term visions is being a leading global university by focusing on interdisciplinary studies of science and technology.

By recruiting highly qualified faculty, staff and students from all over the world, UNIST pledges to provide an optimal educational environment to our students.

Research activities will be focused on some interdisciplinary areas which can generate basic principles and on technological innovation.

And, coursework for graduate students will mainly consist of various research activities.

Construction of a first-class ubiquitous campus and other infrastructure was opened in 2009.

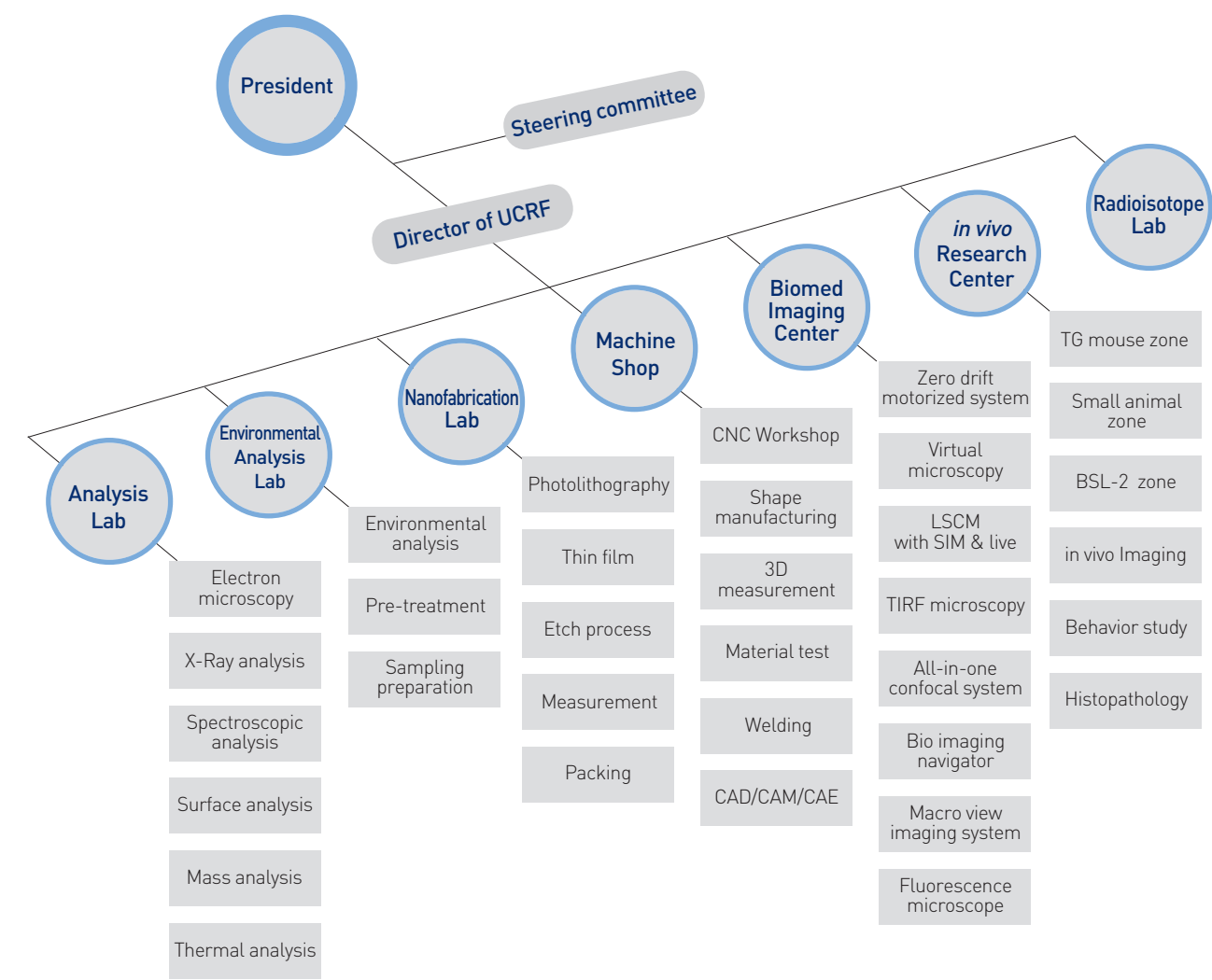
We plan to promote education and research activities.

UNIST is aimed at serving as a base for cultivating global leaders who can lead our society, industry and the academic world, and creating innovative theories and cutting-edge technologies that can make a great impact on our future society.

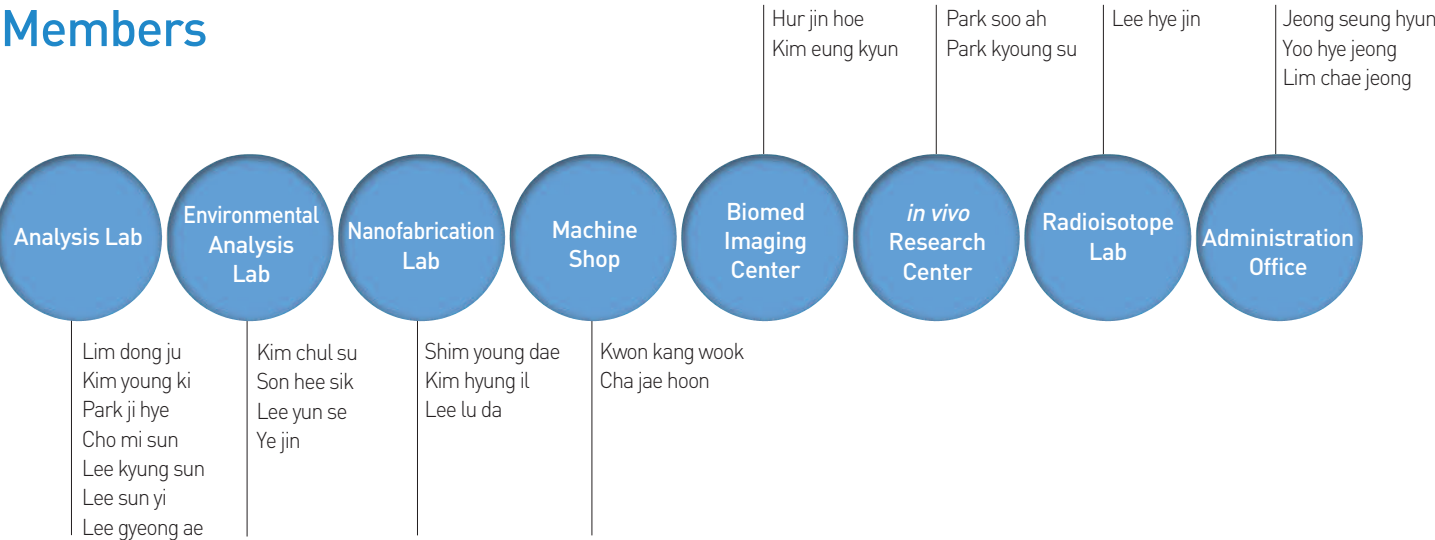
As a first president, I will be committed to develop UNIST as a world’s leading university in the 21<sup>st</sup> century.

President **Moo Je Cho**

Organization



Members



Introduction of Analysis Lab

The Analysis lab was established in 2009 for the purpose of enhancing the ability to do better research at UNIST through the sharing expensive equipment including advanced TEM, TOF-SIMS, FT-NMR etc. Analysis lab possesses more than 30 different types of state-of-the-art research equipment, including Electron Microscopy Analysis, X-ray Analysis, Spectroscopic Analysis, Surface Analysis, Mass Analysis and a room for Thermal Analysis, all of which are equivalent to approximately 44 million U.S. dollars.

Members of Analysis Lab

| Name             | Responsible Equipment                                 | E-mail                | Phone        |
|------------------|-------------------------------------------------------|-----------------------|--------------|
| Lim dong ju      | SEM[3], AFM[3], XPS, VTSTM                            | djlim@unist.ac.kr     | 052-217-4032 |
| Kim young ki     | Normal TEM, Bio TEM, HR-STEM, Advanced TEM            | cclock95@unist.ac.kr  | 052-217-4033 |
| Park ji hye      | XRD[4], XRF, Raman[2], CLSM, Zeta, PS                 | sophia@unist.ac.kr    | 052-217-4035 |
| Cho mi sun       | FT-NMR, UV-Vis-NIR, FT-IR, Fluorometer, GPC/MALS      | shail019@unist.ac.kr  | 052-217-4034 |
| Lee kyung sun    | TOF-SIMS, MALDI-TOF-TOF, GC/MS/MS, LC/MS/MS           | kslee@unist.ac.kr     | 052-217-4036 |
| Lee sun yi       | DB-FIB, Microtome, Polishing, TEM/SEM sample prep.[3] | ssun295@unist.ac.kr   | 052-217-4023 |
| Lee gyeong ae    | EA, SDT, DSC, DMA, ICP-OES sample prep.               | allsunday@unist.ac.kr | 052-217-4163 |
| Yoo hye jeong    | Charge & administration work                          | yoohj900@unitst.ac.kr | 052-217-4038 |
| Jeong seung hyun | Purchasing & administration work                      | jsh33@unist.ac.kr     | 052-217-4160 |

List of Instruments

| Lab                    | Equipment                                          | Model                              | Maker                          | Page  |
|------------------------|----------------------------------------------------|------------------------------------|--------------------------------|-------|
| Electron Microscopy    | Advanced Transmission Electron Microscope          | Titan3 G2 60-300                   | FEI, USA                       | 06    |
|                        | High Resolution Transmission Electron Microscope   | JEM-2100F                          | JEOL, JAPAN                    | 06    |
|                        | Transmission Electron Microscope                   | JEM-2100/JEM-1400                  | JEOL, JAPAN                    | 07    |
| TEM/SEM sample prep    | Ultramicrotome                                     | CR-X                               | RMC,USA                        | 08    |
|                        | Polishing Machine                                  | TechCut4 with three type           | Allied, USA                    | 08    |
|                        | Grinding Machine                                   | Disc Punch with two type           | Gatan, USA                     | 09    |
|                        | Dual-Beam Focused Ion Beam                         | Quanta 3D FEG                      | FEI, USA                       | 09    |
| Electron Microscopy    | Field Emission-Scanning Electron Microscope        | Quanta 200/NanoSem 230             | FEI, USA                       | 10    |
| X-Ray Analysis         | Cold FE-SEM                                        | S-4800                             | Hitachi, Japan                 | 10    |
|                        | High Power X-Ray Diffractometer                    | D/MAZX 2500V/PC                    | Rigaku, Japan                  | 11    |
|                        | High Resolution X-Ray Diffractometer               | D8 Discover                        | Bruker, Germany                | 11    |
|                        | X-Ray Diffractometer                               | D8 Advance                         | Bruker, Germany                | 11    |
|                        | X-Ray Fluorescence Spectrometer                    | T8 Tiger                           | Bruker, Germany                | 12    |
|                        | Single Crystal X-Ray Diffractometer                | R-AXIS RAPID II                    | Rigaku, Japan                  | 12    |
| Spectroscopic Analysis | FT-NMR 600 MHz                                     | VNMRS 600                          | Agilent, USA                   | 13    |
|                        | Fluorometer                                        | Cary Eclipse                       | Agilent, USA                   | 13    |
|                        | UV-Vis-NIR                                         | Cary 5000                          | Agilent, USA                   | 14    |
|                        | FT-IR                                              | 670-IR / 620-IR Imaging            | Agilent, USA                   | 14    |
|                        | Sub-micron Size & Zeta Potential Measuring System  | Nano ZS                            | Malvern, UK                    | 15    |
| Surface Analysis       | X-ray Photoelectron Spectroscopy                   | K-alpha                            | Thermo Fisher, UK              | 15    |
|                        | Variable Temperature Scanning Tunneling Microscope | UHV VT 7000                        | RHK Technology, USA            | 16    |
|                        | Combined AFM & Confocal Raman Microscope           | Alpha300S                          | WITec, Germany                 | 16    |
|                        | Micro Confocal Raman Microscope                    | Alpha300R                          | WITec, Germany                 | 17    |
|                        | Atomic Force Microscope                            | Multimode V/Demension 3100         | Veeco, USA                     | 17,18 |
|                        | Electrochemical Atomic Force Microsoope            | Agilent 5500                       | Agilent, USA                   | 18    |
|                        | Confocal Laser Scanning Microscope                 | OLS3100                            | Olympus, Japan                 | 19    |
|                        | Cryogenic Free Probe Station                       | CRX-4K                             | Lake Shore, USA                | 19    |
|                        |                                                    |                                    |                                |       |
| Mass Spectrometry      | Time-of-Flight Secondary Ion Mass Spectrometry     | TOF SIMS 5                         | ION TOF, Germany               | 20    |
|                        | MALDI TOF/TOF                                      | Ultraflex III                      | Bruker, Germany                | 20    |
|                        | GC/MS/MS                                           | 450-GC & 320-MS                    | Bruker, Germany                | 21    |
|                        | LC/MS/MS                                           | HCT Basic System                   | Bruker, Germany                | 21    |
|                        | GPC/MALS                                           | Agilent 1200 series/miniDAWN TREOS | Agilent, Wyatt, USA            | 22    |
|                        | Element Analyzer                                   | Flash 2000                         | Thermo Scientific, Netherlands | 22    |
| Thermal Analysis       | Simultaneous TGA/DSC                               | Q600                               | TA Instruments, USA            | 23    |
|                        | Differential Scanning Calorimeter                  | Q200                               | TA Instruments, USA            | 23    |
|                        | Dynamic Mechanical Analyzer                        | Q800                               | TA Instruments, USA            | 23    |

## Advanced Transmission Electron Microscope

Model **Titan3 G2 60-300 (Image Corrector) (FEI, USA)**



### Specifications

- Acceleration voltage : 60-300 kV
- Lattice resolution : 0.06 nm
- BF-STEM resolution : 0.14 nm
- HAADF-STEM resolution : 0.12 nm
- Probe stability : 1 nm/min or less
- Stage stability : 1 nm/min or less
- EDS resolution : 128 eV
- EELS resolution : 0.16 eV
- Contamination : 1 nm/min or less

### Applications

- Sub angstrom spatial resolution TEM
- Atomic resolution at low kVs
- High sensitivity imaging
- Imaging and spectroscopy of soft matters
- Dynamics of individual atoms
- High energy resolution EELS and EDS
- Nano-area diffraction and CBED
- Energy-filtered imaging and diffraction

Manager : Kim young ki  
E-mail : cclock95@unist.ac.kr  
Phone : 052-217-4033

## Transmission Electron Microscope

Model **JEM-2100 (JEOL, JAPAN)**

### Specifications

- Acceleration voltage : 200 kV
- Lattice resolution : 0.23 nm
- Point resolution : 0.14 nm
- Specimen tilting :  $X = \pm 35^\circ$ ,  $Y = \pm 30^\circ$
- Image recording system : CCD
- EDS resolution : 132 eV

### Applications

- High resolution electron imaging
- Diffraction pattern
- Energy dispersive spectroscopy (EDS)

Manager : Kim young ki  
E-mail : cclock95@unist.ac.kr  
Phone : 052-217-4033



## High Resolution Transmission Electron Microscope

Model **JEM-2100F (Probe Corrector) (JEOL, JAPAN)**



### Specifications

- Acceleration voltage : 200 kV
- Lattice resolution : 0.102 nm
- BF-STEM resolution : 0.14 nm
- HAADF-STEM resolution : 0.096 nm
- Probe stability : 1 nm/min or less
- Stage stability : 1 nm/min or less
- EDS resolution : 128 eV
- EELS resolution : 0.8 eV
- Contamination : 1 nm/min or less

### Applications

- Ultra high resolution electron imaging
- STEM imaging (BF, HAADF)
- Energy dispersive spectroscopy (EDS)
- Electron energy loss spectroscopy (EELS)

Manager : Kim young ki  
E-mail : cclock95@unist.ac.kr  
Phone : 052-217-4033

## Transmission Electron Microscope

Model **JEM-1400 (JEOL, JAPAN)**

### Specifications

- Acceleration voltage : 120 kV
- Lattice resolution : 0.38 nm
- Point resolution : 0.20 nm
- Specimen tilting :  $X = \pm 25^\circ$ ,  $Y = \pm 70^\circ$
- Image recording system : CCD

### Applications

- High resolution electron imaging
- Diffraction pattern

Manager : Kim young ki  
E-mail : cclock95@unist.ac.kr  
Phone : 052-217-4033



## Ultramicrotome

Model CR-X (RMC, USA)



### Specifications

- Auto thin sectioning from 5 nm
- Auto thick sectioning to 15  $\mu\text{m}$
- Cutting speed range from 0.1  $\sim$  49.9 mm/sec
- Specimen auto feed 200  $\mu\text{m}$
- Variable return speed over entire cutting speed range

### Applications

- SEM, TEM sample prep

Manager : Lee sun yi  
E-mail : ssun295@unist.ac.kr  
Phone : 052-217-4023

## Grinding Machine

Model Disc Punch (Gatan, USA) Dimple Grinder (Gatan, USA) Precision Ion Polishing System (Gatan, USA)

### Specifications

- Ion guns : two penning ion guns
- Milling angle :  $-10^\circ \sim +10^\circ$
- Ion beam energy : 100 eV  $\sim$  6.0 keV
- Size : 300 x 200 x 125 mm (W x D x H)
- Shipping weight : 10 kg
- Power requirements : 100  $\sim$  240 VAC

### Applications

- SEM, TEM sample prep

Manager : Lee sun yi  
E-mail : ssun295@unist.ac.kr  
Phone : 052-217-4023



## Polishing Machine

Model TechCut4 (Allied, USA) TechPress2 (Allied, USA) MetPrep4 (Allied, USA) MultiPrep (Allied, USA)



### Specifications

- Variable platen speed : 40  $\sim$  600 RPM
- Variable platen jog speed : 40  $\sim$  600 RPM
- Variable cycle time : 0  $\sim$  60 min.

### Applications

- SEM, TEM sample prep

Manager : Lee sun yi  
E-mail : ssun295@unist.ac.kr  
Phone : 052-217-4023

## Dual-Beam Focused Ion Beam

Model Quanta 3D FEG (FEI, USA)

### Specifications

- Electron optics
  - Resolution
    - (1) HV : 1.2 nm @ 30 kV
    - (2) LV : 1.5 nm @ 30 kV
    - (3) ESEM : 1.5 nm @ 30 kV
  - Accelerating voltage : 200 V  $\sim$  30 kV
  - Probe current : up to 200 nA
  - Magnification : 30 x  $\sim$  1,280 kx
- Ion optics
  - Resolution : 7 nm @ 30 kV
  - Accelerating voltage : 2  $\sim$  30 kV
  - Probe current : 1 pA  $\sim$  65 nA
  - Magnification : 40 x  $\sim$  1,280 kx

### Applications

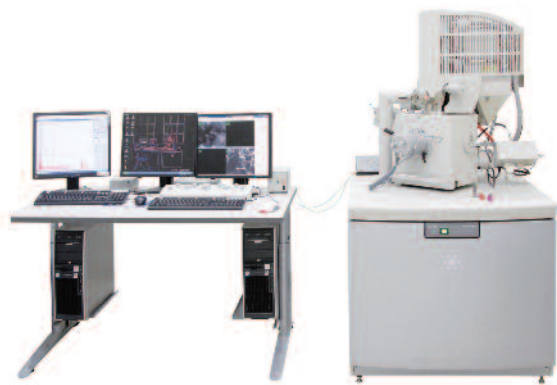
- Ultra high resolution electron, ion imaging
- TEM sample preparation
- Energy dispersive spectroscopy (EDS)

Manager : Lee sun yi  
E-mail : ssun295@unist.ac.kr  
Phone : 052-217-4023



## Field Emission-Scanning Electron Microscope

Model **Quanta 200 (FEI, USA)**



### Specifications

- Schottky type thermal FE gun
- Resolution
  - < 1.2 nm @ 30 kV high vacuum mode
  - < 1.5 nm @ 30 kV low vacuum mode
  - < 1.5 nm @ 30 kV ESEM mode
- Beam current : > 100 nA
- Chamber vacuum : Up to 40 mbar
- Attachment : EDS
- 1000 or 1500 °C heating stage

### Applications

- Mode : high vacuum / low vacuum / ESEM

## Field Emission-Scanning Electron Microscope

Model **NanoSem 230 (FEI, USA)**



### Specifications

- Schottky type thermal FE gun
- Conventional operation
  - < 1.0 nm @ 15 kV
  - < 1.6 nm @ 1 kV
- Probe current : 0.6 pA ~ 100 nA
- Attachment : EDS

### Applications

- Secondary electron image
- Backscattered electron image
- X-ray elemental mapping
- Characterization : nano, magnetic materials

## Cold FE-SEM

Model **S-4800 (Hitachi, Japan)**



### Specifications

- Resolution : 1.0 nm at 15 kV
- Magnification : LM 20 ~ 2,000x, HM 100 ~ 800,000x
- Accelerate voltage : 0.1 ~ 30 kV (0.1kV/step)
- Detector : SE, EDS
- Electrical image shift :  $\pm 12 \mu\text{m}$  (WD=8mm)
- Electron gun : cold cathode field emission electron source

### Applications

- Secondary electron image
- Energy dispersive spectroscopy (EDS)

Manager : Lim dong ju  
E-mail : djlim@unist.ac.kr  
Phone : 052-217-4032

## High Power X-Ray Diffractometer

Model **D/MAZX 2500V/PC (Rigaku, Japan)**

### Specifications

- X-ray generator : 18 kW
- Angular range : - 60 ~ 128 °
- Attachment
  - High temperature (RT ~ 1500 °C)
  - Battery cell for charging & discharging

### Applications

- WASX / SASX
- Material characterization
  - temperature variation
  - charging & discharging



## High Resolution X-Ray Diffractometer

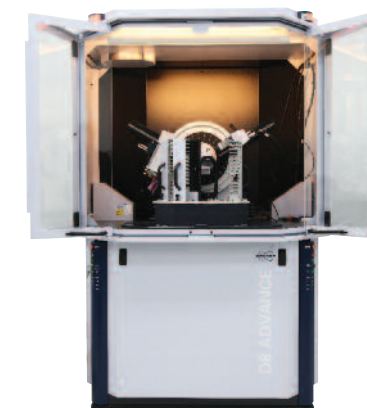
Model **D8 Discover (Bruker, Germany)**

### Specifications

- X-ray generator : 3 kW
- $\theta$  -  $2\theta$  based goniometer
- Angular range :
  - $\theta$  : 0 ~ 360 °
  - $2\theta$  : - 110 ~ 168 ° more

### Applications

- Thin film characterization
  - GID / HRXRD / XRR



## X-Ray Diffractometer

Model **D8 Advance (Bruker, Germany)**

### Specifications

- X-ray generator : 3 kW
- $\theta$  -  $2\theta$  based goniometer
- Angular range :
  - $\theta$  : 0 ~ 360 °
  - $2\theta$  : - 110 ~ 168 ° more

### Applications

- Material characterization
  - liquid samples
  - airproof samples

Manager : Park Ji hye  
E-mail : sophia@unist.ac.kr  
Phone : 052-217-4035



## X-Ray Fluorescence Spectrometer

Model T8 Tiger (Bruker, Germany)



### Specifications

- X-ray generator : 4kw
- X-ray tube : Rh-anode source
- Goniometer : decoupled theta and 2 theta
- Analyzing crystal : LIF(200)/ PET/ XS-55/ TIAP/ XS-B/ XS-C/ XS-Ge-C
- Sample preparation equipment
  - electric furnace / ball mill / pellet Press

### Applications

- Element analysis (WDS)
- Semi-quantitative analysis

Manager : Park ji hye  
E-mail : sophia@unist.ac.kr  
Phone : 052-217-4035

## Single Crystal X-Ray Diffractometer

Model R-AXIS RAPID II (Rigaku, Japan)



### Specifications

- X-ray generator : 3kw
- X-ray tube : Mo source
- Goniometer : decoupled theta and 2 theta
- Imaging plate detector : - 60 ~ 144 °

### Applications

- Structural analysis
  - small molecules crystallography
  - absolute structure determination (organic sample)

Manager : Park ji hye  
E-mail : sophia@unist.ac.kr  
Phone : 052-217-4035

## FT-NMR 600 MHz

Model VNMRS 600 (Agilent, USA)

### Specifications

- Premium shielded 600 MHz magnet
- 3 channel console
- Available probes
  - dual broad band auto X probe
  - automated triple resonance probe
  - nano TM probe
  - 5 mm double resonance MAS solid probe
- Possibility of advanced techniques
  - 1H, 13C, 19F, 31P, DEPT
  - COSY, HSQC, HMBC, NOESY, TOCSY etc.

### Applications

- Structural elucidation of chemicals

Manager : Cho mi sun  
E-mail : shail019@unist.ac.kr  
Phone : 052-217-4034



## Fluorometer

Model Cary Eclipse (Agilent, USA)

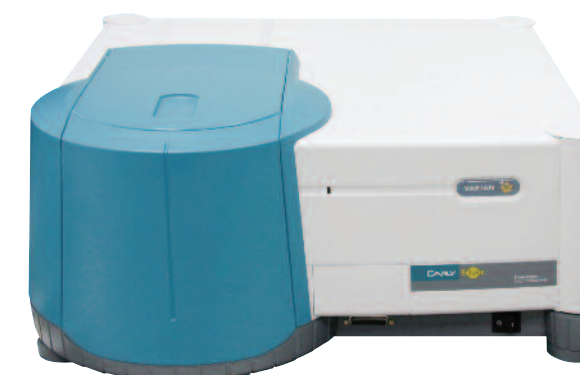
### Specifications

- Wavelength range
  - excitation : 200 ~ 900 nm
  - emission : 200 ~ 900 nm
- Wavelength accuracy : < 1.5 nm
- Limiting resolution : 1.5 nm
- Wavelength reproducibility : < 0.2 nm
- Source : Xe pulsed lamp
- Detector : photomultiplier tube

### Applications

- Measurement
  - emission, lifetime, concentration

Manager : Cho mi sun  
E-mail : shail019@unist.ac.kr  
Phone : 052-217-4034



## UV-Vis-NIR

Model **Cary 5000 (Agilent, USA)**



### Specifications

- Wavelength range : 175 ~ 3,300 nm
- Limiting resolution
  - UV-Vis < 0.048 nm
  - NIR < 0.2 nm
- Wavelength accuracy
  - UV-Vis :  $\pm 0.08$  nm @ 190 ~ 900 nm
  - NIR :  $\pm 0.04$  nm @ 760 ~ 3,000 nm
- Source
  - UV-Vis : deuterium lamp
  - NIR : tungsten halogen lamp
- Detector
  - UV-Vis : R928 PMT
  - NIR : cooled PbS

### Applications

- Measurement
  - absorbance, transmittance, reflectance ratio

Manager : Cho mi sun  
E-mail : shail019@unist.ac.kr  
Phone : 052-217-4034

## Sub-micron Size & Zeta Potential Measuring System

Model **Nano ZS (Malvern, UK)**

### Specifications

- Size measurement (below 1 $\mu$ m)
  - Principle : dynamic backscattering
  - min. sample volume range : 1.0 mL
  - min. sample concentration : 0.1 wt%
- Zeta potential measurement
  - Principle : laser doppler velocimetry
  - Range : - 150 mV ~ + 150 mV
- Attachment : MPT (multi purpose titration)

### Applications

- Size analysis of nano particles
- zeta potential analysis or nano particles

Manager : Park ji hye  
E-mail : sophia@unist.ac.kr  
Phone : 052-217-4035



## FT-IR

Model **670-IR / 620-IR Imaging (Agilent, USA)**



### Specifications

- Spectral range : 7,900 ~ 50  $\text{cm}^{-1}$
- Spectral resolution : 0.075  $\text{cm}^{-1}$
- Signal to noise ratio (5 sec)
  - 12,000 : 1 with 25 % source power
- Field of view : 5.5  $\mu\text{m}$  per 1 pixel
- 64 x 64 focal plane array detector
- ATR imaging : 1.4  $\mu\text{m}$  per 1 pixel

### Applications

- Molecular structure analysis
- Qualitative and quantitative analysis

Manager : Cho mi sun  
E-mail : shail019@unist.ac.kr  
Phone : 052-217-4034

## X-ray Photoelectron Spectroscopy

Model **K-alpha (Thermo Fisher, UK)**

### Specifications

- Double-focusing hemispherical analyzer
- Multi-element, high-transmission spectrometer input lens
- 128-channel detector for high quality
- Energy range : 200 eV ~ 3 keV
- High flux even at low beam energy
- 250 mm rowland circle monochromator

### Applications

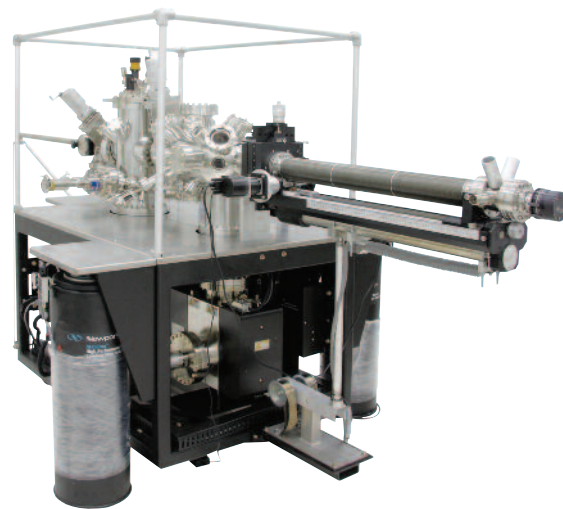
- Analysis of organic compounds
- Analysis of thin film
- Depth profile

Manager : Lim dong ju  
E-mail : djlim@unist.ac.kr  
Phone : 052-217-4032



## Variable Temperature Scanning Tunneling Microscope

Model UHV VT 7000 (RHK Technology, USA)



### Specifications

- Scan range (X,Y) : 5  $\mu\text{m}$
- Resolution (X,Y) : 0.5  $\text{\AA}$
- Resolution (Z) : 0.5  $\text{\AA}$
- Thermal drift (X,Y,Z) < 1  $\text{\AA}/\text{min}$
- Cooling temperature : 30 K or more
- Heating temperature : 1,000  $^{\circ}\text{C}$  or higher

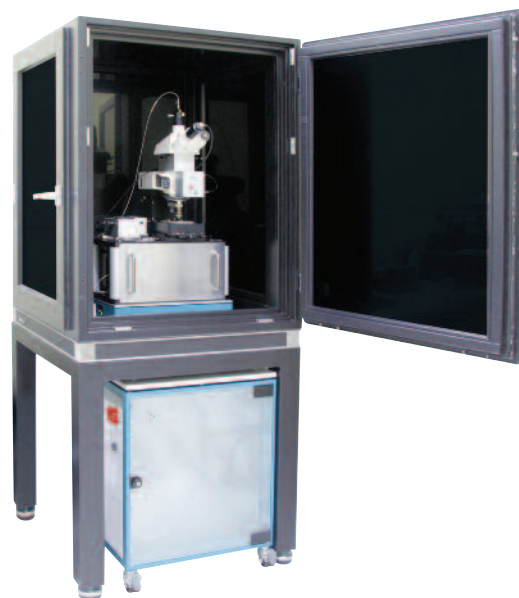
### Applications

- Observation of the surface with an atomic scale
- Observation of the atomic array of the surface or its variation to change in temperature
- Research of the band gap on the surface of conductive materials or semiconductors

Manager : Lim dong ju  
E-mail : dylim@unist.ac.kr  
Phone : 052-217-4032

## Combined AFM & Confocal Raman Microscope

Model Alpha300S (WITec, Germany)



### Specifications

- Scanning near-field optical microscope
- AFM mode
  - acoustic AC mode
  - contact mode
- Laser wavelength
  - 532nm/ 633nm/ 785nm
- Lens magnification : 100x, 20x

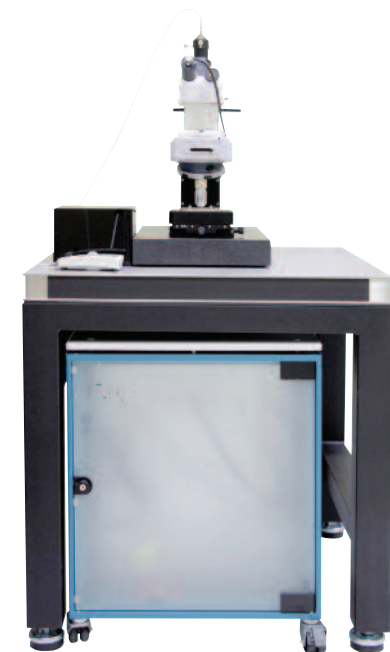
### Applications

- Measurement of surface topography (AFM mode)
- Measurement of Raman image & single spectrum (Raman mode)

Manager : Park ji hye  
E-mail : sophia@unist.ac.kr  
Phone : 052-217-4035

## Micro Confocal Raman Microscope

Model Alpha300R (WITec, Germany)



### Specifications

- Laser wavelength : 532nm
- Lens magnification : 50x, 10x
- Heating cryostat
- Freezing cryostat

### Applications

- Measurement of Raman mapping or spectrum with temperature variation

Manager : Park ji hye  
E-mail : sophia@unist.ac.kr  
Phone : 052-217-4035

## Atomic Force Microscope

Model Multimode V (Veeco, USA)



### Specifications

- Resolution
  - Noise level RMS : < 0.3  $\text{\AA}$  RMS
  - Vertical resolution : 0.1  $\text{\AA}$
  - Lateral resolution : 1  $\text{\AA}$

### Applications

- Surface morphology
- Conductive AFM
- Nano indenter

Manager : Lim dong ju  
E-mail : dylim@unist.ac.kr  
Phone : 052-217-4032

## Atomic Force Microscope

Model **Demension 3100 (Veeco, USA)**



### Specifications

- Resolution
  - noise level RMS :  $< 0.5 \text{ \AA}$  RMS
  - vertical resolution :  $0.1 \text{ \AA}$
  - lateral resolution :  $1 \text{ \AA}$

### Applications

- Surface morphology
- Conductive AFM
- Nano indenter

Manager : Lim dong ju  
E-mail : [djlim@unist.ac.kr](mailto:djlim@unist.ac.kr)  
Phone : 052-217-4032

## Confocal Laser Scanning Microscope

Model **OLS3100 (Olympus, Japan)**



### Specifications

- Laser wavelength : 310nm
- Microscope mode : confocal, non-confocal
- Lens : 5x, 10x, 20x, 50x, 100x
- Max. magnification : 14,430x

### Applications

- Line width, depth measurement
- Area, surface, volume measurement
- 2D, 3D roughness measurement
- Particle analysis

Manager : Park ji hye  
E-mail : [sophia@unist.ac.kr](mailto:sophia@unist.ac.kr)  
Phone : 052-217-4035

## Electrochemical Atomic Force Microscope

Model **Agilent 5500 (Agilent, USA)**



### Specifications

- 100  $\mu\text{m}$  x 100  $\mu\text{m}$  scanning range
- 0.05 % non-linearity
- 0.5 nm RMS X-Y position noise
- Compatible with all imaging modes, multipurpose scanners & liquid cells

### Applications

- Structural analysis
  - small molecules crystallography
  - absolute structure determination (organic sample)

Manager : Lim dong ju  
E-mail : [djlim@unist.ac.kr](mailto:djlim@unist.ac.kr)  
Phone : 052-217-4032

## Cryogenic Free Probe Station

Model **CRX-4K (Lake Shore, USA)**



### Specifications

- Temperature range : 1.5 ~ 475 K
- Four micro-manipulated probe arms
- 4-inch wafer probe capabilities
- Cryogen-free CCR (Closed Cycle Refrigerator)
- High vacuum to  $10^{-7}$  Torr

### Applications

- I-V measurement in temperature variation
- 4 probe resistivity measurement

Manager : Park ji hye  
E-mail : [sophia@unist.ac.kr](mailto:sophia@unist.ac.kr)  
Phone : 052-217-4035

## Time-of-Flight Secondary Ion Mass Spectrometry

Model TOF SIMS 5 (ION TOF, Germany)



### Specifications

- Mass resolution (@ 29 u) : > 10,000 (for Bi<sup>+</sup>)
- Sensitivity (@ 29 u) : > 3 x 10<sup>-8</sup> At/nC
- Mass range : > 9,000 amu
- Base pressure : < 5.0 x 10<sup>-10</sup> torr
- A self-adjusting charge compensation system
- Primary source : pulsed Bi cluster ion source
- O<sub>2</sub> and Cs dual sources for depth profiling

### Applications

- Analysis of molecular structure
- Analysis of trace elements
- Chemical mapping
- Depth profiling & 3D analysis

Manager : Lee kyung sun  
E-mail : kslee@unist.ac.kr  
Phone : 052-217-4036

## GC/MS/MS

Model 450-GC & 320-MS (Bruker, Germany)

### Specifications

- Ionization mode
  - electron ionization
  - positive/negative chemical ionization
- Mass range : 10 ~ 2,000 amu
- Mass axis stability : ± 0.1 unit over 24 hrs
- Resolution : 0.7 amu at 1,250 amu/sec  
0.6 amu at 500 amu/sec
- Mass type : tandem triple quadrupole
- Library : NIST library

### Applications

- Confirmation of organic compounds structure
- Confirmation of molecular weight
- Identification of impurities & byproducts

Manager : Lee kyung sun  
E-mail : kslee@unist.ac.kr  
Phone : 052-217-4036



## MALDI TOF/TOF

Model Ultraflex III (Bruker, Germany)



### Specifications

- High mass resolution at every mass from 700 ~ 6,000 Da
- Resolution ≥ 1,100 & mass accuracy of ≤ 80 ppm in linear mode for protein
- Mass accuracy of ≤ 3 ppm for peptide mass range in reflectron mode
- Sensitivity in low attomole range with high S/N ratio in TOF/TOF mode

### Applications

- Analysis of bio-molecules
- Analysis of large organic molecules

Manager : Lee kyung sun  
E-mail : kslee@unist.ac.kr  
Phone : 052-217-4036

## LC/MS/MS

Model HCT Basic System (Bruker, Germany)

### Specifications

- Ion source : ESI, APCI
- Mass range : 50 ~ 3,000 (m/z)
- Resolution : 0.6 u
- Accuracy : 0.1 ~ 0.3 % absolute
- Scan speed : 26,000 amu/sec
- Mass accuracy : ± 0.15 u
- Electro sensitivity
  - MS : reserpine 5 pg S/N 10:1
  - MS/MS : reserpine 1 pg S/N 50:1

### Applications

- Analysis of organic composition
- Identification of molecular weight
- Analysis of DNA, RNA & proteins
- Analysis of environmental samples

Manager : Lee kyung sun  
E-mail : kslee@unist.ac.kr  
Phone : 052-217-4036



## GPC/MALS

Model **Agilent 1200 series (Agilent, USA)** miniDAWN TREOS (Wyatt, USA)



### Specifications

- GPC
  - flow precision : < 0.07% RSD
  - pressure : 0 ~ 400 bar
  - detector type : double-beam photometer
  - wavelength range : 190 ~ 600 nm
- MALS
  - light source : 60 mW GaAs linearly polarized laser
  - laser wavelength : 658 nm
  - molecular weight range :  $10^3 \sim 10^6$  g/mole
  - molecular size range : 10 ~ 50 nm

### Applications

- Analysis of synthetic polymer
- Analysis of biopolymer

Manager : Cho mi sun  
E-mail : shail019@unist.ac.kr  
Phone : 052-217-4034

## Element Analyzer

Model **Flash 2000 (Thermo Scientific, Netherlands)**



### Specifications

- Measuring elements : C, H, N, S & O
- Measuring range : 100 ppm ~ 100 %
- Sample size : 0.01 ~ 500 mg
- Accuracy : 0.1 ~ 0.3 % absolute
- Detector : TCD
- Furnace temperature : 1,100 °C
- Analysis time
  - C, H, N, S : 10 min
  - oxygen : 5 min

### Applications

- Qualitative analysis of organic & inorganics
- Qualitative analysis of environmental samples
- Qualitative analysis of geological samples
- Identification of empirical formula for organics

Manager : Lee gyeong ae  
E-mail : allsunday@unist.ac.kr  
Phone : 052-217-4163

## Simultaneous TGA/DSC

Model **Q600 (TA Instruments, USA)**

### Specifications

- Sample capacity : 200 mg
- Balance sensitivity : 0.1 µg
- Temperature range : ambient ~ 1500 °C
- Calorimetric accuracy/ precision :  $\pm 2$  %
- DTA sensitivity : 0.001 °C

### Applications

- Measurement of mass change
- Evaporation of water
- Thermal decomposition
- Thermal stability
- Compositional analysis



## Differential Scanning Calorimeter

Model **Q200 (TA Instruments, USA)**

### Specifications

- Temperature range : 725 °C
- Cooling accessories : - 180 ~ 725 °C
- Temperature accuracy :  $\pm 0.1$  °C
- Calorimetric reproducibility :  $\pm 0.1$  %
- Baseline curvature : 10 µW
- Sensitivity : 0.2 µW

### Applications

- Glass transition temperature
- Specific heat capacity
- Temperature of fusion
- Crystallinity, temperature of crystallization



## Dynamic Mechanical Analyzer

Model **Q800 (TA Instruments, USA)**

### Specifications

- Force : 0.00001 N ~ 18 N
- Force resolution : 0.00001 N
- Strain resolution : 1 nm
- Modulus range :  $10^3 \sim 3 \times 10^{12}$  Pa
- Modulus precision :  $\pm 1$  %
- Temperature range : - 150 ~ 600 °C
- Isothermal stability :  $\pm 0.1$  °C

### Applications

- Viscoelastic behavior
- Crystallization & melting

Manager : Lee gyeong ae  
E-mail : allsunday@unist.ac.kr  
Phone : 052-217-4163



# Introduction of Environmental Analysis Lab

Since 2010, the Environmental Analysis Lab has been providing support in the area of tracing of toxic substance measurements (Dioxins, PCBs, Heavy metals), through the application of cutting-edge environmental equipments including GC/HRMS and ICP-MS and various sample preparation apparatuses.

The Environmental Analysis Lab obtained an “Accreditation of Wastes Analysis” which was authorized by the Minister of Environment and an “Accreditation of POPs Sampling & Analysis” is currently being processed.

Based on the cutting-edge measurement experience, skillful sample preparation and analysis knowhow, all staff will strive to provide the best services in environment analysis by conducting various studies and through the outsourcing of contracts.

## Members of Environmental Analysis Lab

| Name        | Responsible Equipment             | E-mail                 | Phone        |
|-------------|-----------------------------------|------------------------|--------------|
| Kim chul su | HRGC/HRMS, GC/MSD                 | kimcs@unist.ac.kr      | 052-217-4067 |
| Son hee sik | ICP-MS, ICP-OES, GC/ECD           | redson7598@unist.ac.kr | 052-217-4068 |
| Lee yun se  | Sample collection & Pre-treatment | jedyknight@unist.ac.kr | 052-217-4021 |
| Ye jin      | Sample collection & Pre-treatment | yj731@unist.ac.kr      | 052-217-4020 |

## List of Instruments

| Lab                    | Equipment | Model                | Maker             | Page |
|------------------------|-----------|----------------------|-------------------|------|
| Environmental Analysis | HRGC/HRMS | Autospec Premier     | Waters, USA       | 25   |
|                        | ICP-MS    | ELAN DRC -II         | Perkin Elmer, USA | 25   |
|                        | GC/MSD    | 7890A GC / 5975C MSD | Agilent, USA      | 26   |
|                        | GC/ECD    | 7890A GC             | Agilent, USA      | 26   |
|                        | ICP-OES   | 720-ES               | VARIAN, USA       | 27   |

# HRGC/HRMS

Model Autospec Premier (Waters, USA)

## Specifications

- Sensitivity
  - $5 \times 10^{-7}$  C/ $\mu$ g for methyl stearate at m/z
  - 298.3, EI, 1,000 resolution and  $5 \times 10^{-8}$
  - C/ $\mu$ g for methyl stearate at m/z 298.3
  - EI, 10,000 resolution
  - Mass range : 2 ~ 1,200 Daltons or more
- Resolution : continuously variable above 60,000 (10 % valley) or more
- Scan rate : better than 3 scan/sec over the calibrated mass range 500 ~ 50 ~ 500 or equivalent
- Ion source : EI plug in ion volume
- Mass analyzer ion optics : EBE Tri-sector geometry

## Applications

- Analysis of persistent organic pollutants
- Sports doping test

Manager : Kim chul su  
E-mail : kimcs@unist.ac.kr  
Phone : 052-217-4067



# ICP-MS

Model ELAN DRC-II (Perkin Elmer, USA)

## Specifications

- Dual turbo-molecular pumps with ceramic bearings
- Vacuum levels:  $1 \times 10^{-6}$  Torr
- 27.12 ~ 40 MHz RF generator
- Dynamic reaction cell
- Thermal stabilization of the quadrupole power supply (QPS) at >2.5 MHz mass spectrometer

## Applications

- Qualitative analysis of various atoms
- Analysis of heavy metals in environmental samples
- Measurement of isotope ratio

Manager : Son hee sik  
E-mail : redson7598@unist.ac.kr  
Phone : 052-217-4068



## GC/MSD

Model **7890A GC / 5975C MSD (Agilent, USA)**



### Specifications

- Ionization mode
  - electron ionization
  - positive / negative chemical ionization
- Mass range : 1.6 ~ 1,050 amu
- Mass scan speed : max. 12,500 amu/sec
- Detector: triple-axis HED-electron multiplier
- Vacuum pumping system : 262 L/sec
- Library : wiley 8th with NIST 2008 MS library

### Applications

- Analysis of organic compound structure
- Identification of molecular weight
- Identification of impurities and byproduct

Manager : Kim chul su  
E-mail : kimcs@unist.ac.kr  
Phone : 052-217-4067

## ICP-OES

Model **720-ES (VARIAN, USA)**

### Specifications

- Wavelength range : 167 ~ 785 nm
- Simultaneous analysis
- 40 MHz free running RF generator
- CCD detector with image map tech.
- Cooled cone interface mechanism
- Plasma viewing : axially viewed system

### Applications

- Structural elucidation of chemicals
- Analysis of trace elements in environmental samples

Manager : Son hee sik  
E-mail : redson7598@unist.ac.kr  
Phone : 052-217-4068



## GC/ECD

Model **7890A GC (Agilent, USA)**



### Specifications

- Column oven
  - 4 ~ 450 °C with typical oven cool-down
- Micro-electron capture detector
  - max. temperature range : 400 °C
  - radioactive source : 15 mCi, Ni-63 foil
  - min. detectable : < 0.006 pg/sec lindane
  - accuracy : 3 mL/min
  - repeatability : 0.35 %

### Applications

- Analysis of polychlorinated biphenyls
- Analysis of halogen compounds

Manager : Son hee sik  
E-mail : redson7598@unist.ac.kr  
Phone : 052-217-4068

## Introduction of Nanofabrication Lab

The Nanofabrication Lab was established in 2009 for the purpose of providing the faculty and researchers with top-class facilities and technical skills. Another aim was to support various categories of studies, education and educational-industrial cooperation related to nanofabrication.

The Nanofabrication center is located in the basement of the building for natural science. The center possesses 24 different kinds of state of the semiconductor processing equipment and precision measurement instruments including E-beam lithography.

The goal of the nanofabrication center is to provides the best nanofabrication process service to regional universities, institutions and companies as well as UNIST.

### Members of Nano Fabrication Lab

| Name           | Responsible Equipment                   | E-mail                | Phone        |
|----------------|-----------------------------------------|-----------------------|--------------|
| Shim young dae | Photolithography, Etching process       | syd0620@unist.ac.kr   | 052-217-4064 |
| Kim hyung il   | Thin-film deposition, Measurement equip | hikim78@unist.ac.kr   | 052-217-4065 |
| Lee lu da      | e-beam lithography                      | luda30159@unist.ac.kr | 052-217-4022 |

### List of Instruments

| Lab               | Equipment                                   | Model           | Maker                  | Page |
|-------------------|---------------------------------------------|-----------------|------------------------|------|
| Photolithography  | Mask Aligner                                | MA6/BA6         | Suss Microtec, Germany | 29   |
|                   | E-beam Lithography                          | NB3             | NBL, UK                | 29   |
|                   | Nano Imprinter                              | ANT-6H          | Elan&KIMM              | 30   |
|                   | Spin Coater & Hot plate                     | JSP6D           | JD Tech, Korea         | 30   |
| Etching Process   | Deep Si Plasma Etching System               | Tegal 200       | Tegal, USA             | 31   |
|                   | Dielectric RIE                              | LABSTAR-D       | TTL, Korea             | 31   |
|                   | Metal RIE                                   | LABSTAR-M       | TTL, Korea             | 32   |
|                   | PR Asher                                    | V15-G           | KAMI, Germany          | 32   |
|                   | Wet Station                                 | Wet Station     | Donghun Tech. Korea    | 33   |
| Thin film Process | Furnace System (Oxide & POCl <sub>3</sub> ) | KHD-306         | KSM, Korea             | 33   |
|                   | MOCVD                                       | Marvel 260S     | Synnex, Korea          | 34   |
|                   | PE CVD                                      | PEH-600         | Sorona, Korea          | 34   |
|                   | UHV CVD                                     | UHV-CVD         | Wooshin Cryovac, Korea | 35   |
|                   | RF Sputter                                  | SRN-120D        | Sorona, Korea          | 35   |
|                   | DC Sputter                                  | SRN-120M        | Sorona, Korea          | 36   |
|                   | E-Beam Evaporator(Temescal)                 | FC-2000         | Temescal, USA          | 36   |
|                   | E-Beam Evaporator(Woosung)                  | WC-4000         | Woosung Hivac, Korea   | 37   |
|                   | SAM (Self Assembly Mono-layer) Coater       | AVC-150M        | Sorona, Korea          | 37   |
|                   | Parylene Coater                             | Parylene Coater | Alpha plus, Korea      | 38   |
| Measurement       | Measurement Microscope                      | Axio Scope A1   | Carl Zeiss, Germany    | 38   |
|                   | Surface Profiler                            | P-6             | KLA_Tencor, USA        | 39   |
|                   | Thin-film Thickness Measurement             | ST4000-DLX      | KMAC, Korea            | 39   |
|                   | 4-Point Probe System                        | CMT-SR2000N     | AIT, Korea             | 40   |
| Packaging         | Substrate Bonder                            | SB6L            | SUSS MicroTec, USA     | 40   |
|                   | Dicing Saw                                  | AR06DM          | Aaron, Korea           | 41   |

## Mask Aligner

Model **MA6/BA6 (Suss Microtec, Germany)**

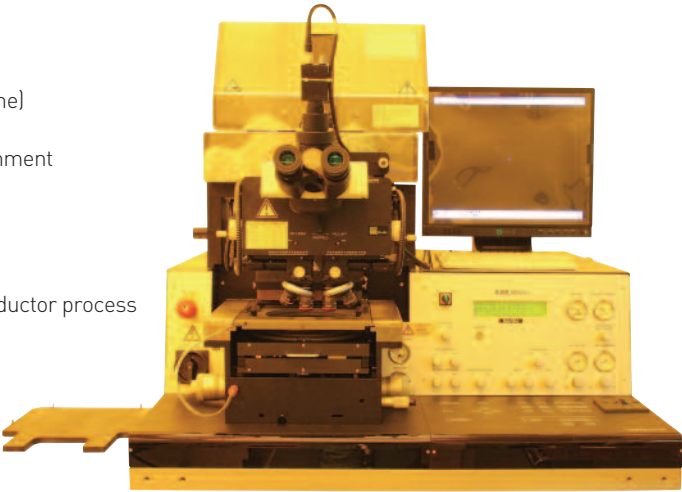
### Specifications

- UV lamp : Hg 350 W
- UV 400 : 350 ~ 450 nm (I-, H-, G-line)
- Gap adjustment accuracy : 1 μm
- Methods : top or bottom side alignment
- Alignment accuracy :
  - 0.5 μm with TSA, 1 μm with BSA

### Applications

- Submicron patterning for semiconductor process
- MEMS/nano device fabrication

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064



## E-beam Lithography

Model **NB3 (NBL, UK)**

### Specifications

- Theoretical beam size : 2.1 nm @100 KeV, 7 nA
- Line width : > 5 nm
- Deflection : vector scan, 55 MHz
- Beam voltage : 30 ~ 100 keV
- Writing area : 195 × 195 mm
- Substrate size : 5 ~ 200 mm

### Applications

- nm level device fabrication
- Mask manufacture
- Generating fine patterns

Manager : Lee lu da  
E-mail : luda30159@unist.ac.kr  
Phone : 052-217-4022



## Nano Imprinter

Model ANT-6H (Elan&KIMM)



### Specifications

- Curing type : UV, thermal, UV & thermal
- Hole wafer size : 4 ~ 6 inch
- Min. stamp size: 1 inch
- Stamp : quartz, Si, Ni, PDMS, PMMA, etc.
- Imprinting pressure : ~ 2 bar (UV) < 0.1 kg (2 bar)  
50 bar (thermal) < 1 kg (50 bar)
- XZ stage/unit : x-axis LM 450 mm,  
z-axis sliding unit 150 mm
- UV system : > 50 mW/cm<sup>2</sup>
- Temperature : RT ~ 250 °C

### Applications

- Nanostructure device imprint fabrication
- Functional device (chemical nanosensor)

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064

## Deep Si Plasma Etching System

Model Tegal 200 (Tegal, USA)



### Specifications

- Substrate size : 100 ~ 200 mm (4 to 8")
- Source : 5.5 kW RF – Bosch process
- Etch rate : > 12 μm/min
- Selectivity over photoresist mask : > 100 : 1
- Etch profile : 90 ± 1°
- Initial mask undercut : < 1.5 mm/edge
- Sidewall roughness (scallops)  
< 700 nm peak-to-through

### Applications

- Deep etching process of Si / SiO<sub>2</sub> / Si<sub>3</sub>N<sub>4</sub>

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064

## Spin Coater & Hot plate

Model JSP6D (JD Tech, Korea)



### Specifications

- Wafer suitability loading size
  - sample size : piece ~ 6 inch
  - chamber size : 300 mm dia.
- Rotation speed : 7,000 rpm / 10,000 rpm
  - max. : 5,000 rpm
- Vacuum input : - 450 ~ -750 mmHg

### Applications

- Adhesion treatment on substrates
- Photoresist coating

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064

## Dielectric RIE

Model LABSTAR-D (TTL, Korea)



### Specifications

- SiO<sub>2</sub> etch
  - etch rate : > 35 nm/min
  - uniformity : ± 5 % across 200 mm dia.
  - selectivity : (SiO<sub>2</sub> : resist = 3 ~ 5 : 1)
- Si<sub>3</sub>N<sub>4</sub> etch
  - etch rate : > 50 nm /min
  - uniformity : ± 5 % across 200 mm dia.
  - selectivity : (Si<sub>3</sub>N<sub>4</sub> : resist = 1.5 ~ 3 : 1)

### Applications

- Dry etching of Si / SiO<sub>2</sub> / Si<sub>3</sub>N<sub>4</sub>

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064

## Metal RIE

Model LABSTAR-M (TTL, Korea)



### Specifications

- Reactor (process chamber) module
  - capacity of sample holding : 4 & 6 inch
- RF generator & auto match network
  - 600 W, 13.56 MHz solid state RF generator
- Pt etch process : etch rate (10 nm /min or higher)
  - selectivity to PR mask : better than 1.5 : 1
- Au etch process : etch rate (25 nm/min or higher)
  - selectivity to PR mask : better than 2 : 1

### Applications

- Dry etching process of metal layer

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064

## Wet Station

Model Wet Station (Donghun Tech. Korea)

### Specifications

- Chemical supply : manual
- Chemical temp. : 50 ~ 120 °C
- PR wet station (2 SET)
  - ultrasonic bath, develop bath, Q.D.R. bath
- Acid wet station
  - SC-1,2 / SPM / BOE / DHF / H<sub>3</sub>PO<sub>4</sub> / Q.D.R Bath
- Solvent / Etching / MEMS / CMOS wet station

### Applications

- Photoresist developing and surface cleaning
- Wet etching (Si wafer/ SiO<sub>2</sub> layer etc.)

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064



## PR Asher

Model V15-G (KAMI, Germany)



### Specifications

- Reactor with 200 mm water cooled chuck
- Microwave power generator :
  - 2.45 GHz from 100 up to max. 600 W
- O<sub>2</sub>, Ar gas control unit (MFC) : ≥ 200 ml/min
- Process storage capability : 10 main process with 16 sub-process, rotation table 19"

### Applications

- Polymer elimination and thickness control
- Photoresist residue elimination

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064

## Furnace System (Oxide & POCl<sub>3</sub>)

Model KHD-306 (KSM, Korea)

### Specifications

- Heater spec (3 zone) : 600 ~ 1200 °C (process temp. 800 ~ 1,150 °C)
- Wet oxidation thickness uniformity
  - within wafer : 3 % , within run : 3 %
- Dry oxidation thickness uniformity
  - within wafer : 3 % , within run : 3 %
- POCl<sub>3</sub> doping resistivity uniformity
  - within wafer : 5 % , within run : 5 %

### Applications

- Oxidation layer deposit & metal layer annealing
- Impurity doping for solar cell

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065



## MOCVD

Model **Marvel 260S (Sysnex, Korea)**



### Specifications

- 6 x 2" reactor system
- RF generator max. power 30 kW
- SiC coated graphite susceptors (2 EA)
- Hydrogen and nitrogen gas manifold for selection each of the Mo source
- One set MKS Differential controller with pressure sensor, control valves
- MO line : TMAI, TMIn, TMGa1, TEG, Cp2Mg

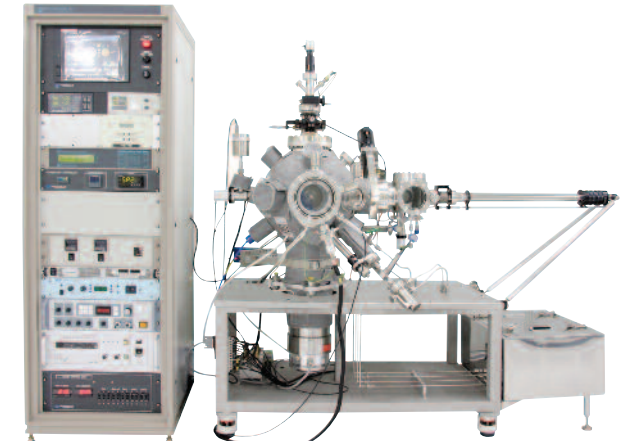
### Applications

- Passivation layer( $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ ) of semiconductor

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## UHV CVD

Model **UHV-CVD (Wooshin Cryovac, Korea)**



### Specifications

- Main chamber :  $< \varnothing 500 \text{ mm}$  (vac. range :  $10^{-10}$ )
- Heater stage :  $1,500^\circ\text{C}$  temp. 2 inch target
- Gas supply :  $\text{SiH}_4$ ,  $\text{GeH}_4$ ,  $\text{C}_2\text{H}_4$ ,  $\text{H}_2$ ,  $\text{N}_2$
- LEED package : 3-grid LEED
  - max. beam current :  $> 30 \mu\text{A}$  for LaB6 filament
  - transfer width :  $> 250 \text{ \AA}$  @  $E=100\text{eV}$
  - fixed focus range :  $20 \sim 500 \text{ eV}$
  - viewing angle :  $102^\circ$

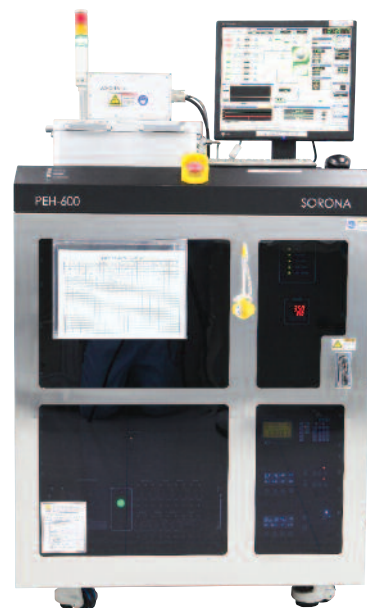
### Applications

- Thin film deposition for MEMS/nano device

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## PE CVD

Model **PEH-600 (Sorona, Korea)**



### Specifications

- Wafer size :  $4 \sim 6"$
- Max. substrate temperature :  $400^\circ\text{C}$
- Power supply : 600 W, 13.56 MHz RF generator
- Process gas :  $\text{N}_2\text{O}$ ,  $\text{SiH}_4$ ,  $\text{NH}_3$ ,  $\text{CF}_4$
- With in wafer uniformity :  $\pm 3\%$
- Wafer to wafer uniformity :  $\pm 3\%$
- Robotic arm for wafer handling

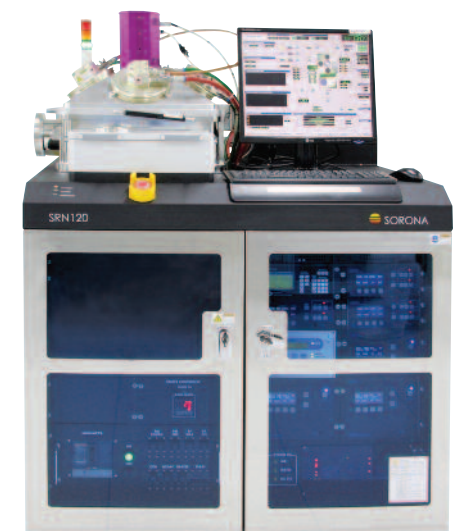
### Applications

- Passivation layer( $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ ) of semiconductor

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## RF Sputter

Model **SRN-120D (Sorona, Korea)**



### Specifications

- Substrate size:  $4 \sim 6 \text{ inch}$
- RF pre-cleaning : 300 W, automatic RF matching
- Substrate heating :  $500^\circ\text{C} \pm 3\%$
- Target : ITO, ZnO,  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$
- Available multi-layer processing
- Power source : 13.56 MHz RF power processing
- Film uniformity : less than  $\pm 5\%$  using oxide material

### Applications

- Thin film deposition of passivation layer

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## DC Sputter

Model **SRN-120M (Sorona, Korea)**



### Specifications

- Substrate size: 4 ~ 6 inch wafer
- RF pre-cleaning : 300 W, automatic RF matching
- Substrate heating : 500 °C  $\pm$  3 %
- Target : Ti/Ta/Cr/Cu/Ni/Al/Mo metal deposition
- Available multi-layer processing
- Power source : 3 kw DC power processing
- Film uniformity : less than  $\pm$  5 %

### Applications

- Thin film deposition

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## E-Beam Evaporator(Woosung)

Model **WC-4000 (Woosung Hivac, Korea)**



### Specifications

- E-beam source assembly
  - 6 cc, 6 pocket (Au, Cr, Ni, Ti, Al, Cu, Pt, Pd)
  - power supply 6 kW, 208 V
  - low profile sensor package 2.75 "
- Thickness control
  - multi film thickness control 2 channel
  - frequency resolution : 0.5 Hz @ 6.0 MHz

### Applications

- Metal deposition of micro scale device

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## E-Beam Evaporator(Temescal)

Model **FC-2000 (Temescal, USA)**



### Specifications

- E-beam source assembly
  - 15cc, 6 pocket (Au, Cr, Ni, Ti, Al, Pt, Pd)
  - power supply : 6 kW, 208 V (CV-6SLX)
  - source control module (Temescal)
  - programble sweep controller (Inficon)
- Thickness control
  - frequency resolution : 0.5 Hz @ 6 MHz
  - multi-layer depositions : 2ch crystal rate control
- SUBSTRATE HOLDER(TP-8-20) for Loft off Process
  - 5 wafers for 6 inch wafer per batch

### Applications

- Metal layer deposition

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## SAM (Self Assembly Mono-layer) Coater

Model **AVC-150M (Sorona, Korea)**



### Specifications

- Superior monolayer properties
  - contact angle : 5 ~ 110 ° (water)<sub>2</sub>
  - work of adhesion : 3 ~ 100  $\mu$ J/m<sup>2</sup>
  - RMS roughness : < 0.2 nm
  - uniformity :  $\pm$  3 %
  - repeatability :  $\pm$  3 % (wfr-wfr),  $\pm$  3% (run-run)
- System specifications
  - wafer sample size :  $\leq$  300 mm
  - base pressure : < 30 mTorr
  - surface treatment : RF plasma (100 ~ 300 W)

### Applications

- Nano patterning of bio devices
- Nano patterning of polymer memory device

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## Parylene Coater

Model **Parylene Coater (Alpha plus, Korea)**



### Specifications

- Dimer type : C
- Deposition rate : over 1 ~ 2  $\mu\text{m/hr}$
- Substrate size : max. dia. 200 mm
- Process temperature
  - furnace (R/T ~ 1,000  $^{\circ}\text{C} \pm 3^{\circ}\text{C}$ )
  - vaporizer (R/T ~ 300  $^{\circ}\text{C} \pm 3^{\circ}\text{C}$ )
- Thickness variation : within  $\pm 10\%$  (Center to Edge)

### Applications

- Polymer deposition for MEMS / nano device
- Dimer coating for bio device

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## Surface Profiler

Model **P-6 (KLA\_Tencor, USA)**

### Specifications

- Features & configuration
  - single 2D & 3D scanning profiler
  - manual or auto theta sample stage
- Specification
  - scan length : 150 mm
  - scan speed : 2  $\mu\text{m} \sim 25\text{ mm/sec}$
  - vertical range / resolution : 13  $\mu\text{m} / 0.1\text{ \AA}$
  - stylus force : adjustable between 1 ~ 15 mg
  - l-stylus : 2  $\mu\text{m}$  radius 60  $^{\circ}$

### Applications

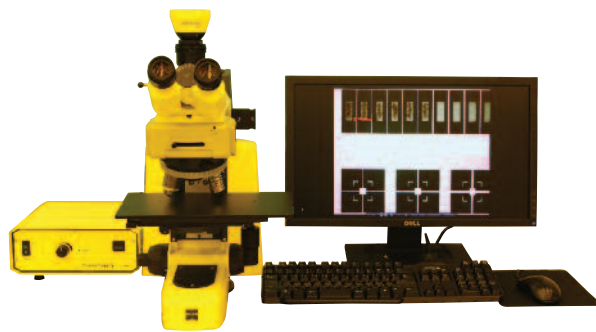
- Measurement of metal film thickness
- Measurement of device step & height

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064



## Measurement Microscope

Model **Axio Scope A1 (Carl Zeiss, Germany)**



### Specifications

- Image CCD
  - image sensor : 1/2.5 " CMOS format, color
- Scan method
  - viewing posture made to measure : the ergonomic viewing tubes 30  $^{\circ} / 23$
  - field of view 23 mm with the 30  $^{\circ}$  viewing angle
  - integration time : 0.1 ~ 3 sec

### Applications

- Measurement of MEMS/nano device shape

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064

## Thin-film Thickness Measurement

Model **ST4000-DLX (KMAC, Korea)**

### Specifications

- Wavelength range : 400 ~ 800 nm
- Stage size : 300 x 300 mm (12 " wafer)
- Spot size : 40, 20, 4  $\mu\text{m}$
- Reflection probe wavelength range : 300 ~ 800 nm
- Thickness measurement range : 100  $\text{\AA} \sim 50\text{ }\mu\text{m}$
- Theoretical resolution : 1 nm

### Applications

- Measurement of thin film ( $\text{SiO}_2$ ,  $\text{Si}_3\text{N}_4$ ) thickness
- Measurement of polymer layer thickness

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065



## 4-Point Probe System

Model CMT-SR2000N (AIT, Korea)



### Specifications

- Measurement range : 1 mohm/sq  $\sim$  2 Mohm/sq
- Measurement accuracy :  $\pm 0.5\%$  (Standard resistor)
- Measure pattern : ASTM, SEMI, Customer design.
- Measurement range : ohm, ohm/sq, ohm/cm
- Current Source : 10 nA  $\sim$  100 mA
- Voltage : 0  $\sim$  2,000 mV
- Substrate size :
  - 200 mm (wafer), 140 X 140 mm (square)

### Applications

- Measurement of sheet resistance of thin film

Manager : Kim hyung il  
E-mail : hikim78@unist.ac.kr  
Phone : 052-217-4065

## Dicing Saw

Model AR06DM (Aaron, Korea)

### Specifications

- Substrate size : 2  $\sim$  6"
- Cutting materials : silicon, glass and sapphire
- Work-piece width setting range : 0.01  $\sim$  160 mm
- Cutting range: 160 mm or more,
- Cut speed : 0.05  $\sim$  300 mm/s or more

### Applications

- Wafer dicing for chip scale semiconductor
- Si/glass wafer dicing for fabrication process

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064



## Substrate Bonder

Model SB6L (SUSS MicroTec, USA)



### Specifications

- Wafer size: 6" SEMI standard wafer
- Pressure regulation accuracy :  $\pm 2\%$
- Max. temperature & uniformity : 500  $^{\circ}\text{C} \pm 3\%$
- Max. bond force & voltage : 8 kN / 2,000 V
- Max. current : 60 mA

### Applications

- Anodic bonding for wafer to wafer
- Thermo-compression bonding
- Eutectic bonding using metal layer

Manager : Shim young dae  
E-mail : syd0620@unist.ac.kr  
Phone : 052-217-4064

Introduction of Machine Shop

The Machine Shop was founded with the purpose of supplying the UNIST researchers with precise apparatus or all sorts of specimens required.

The Machine Shop was build in 2009 and uses cutting-edge manufacturing tools including 3 & 5-axis machining center, milling, lathe, CNC surface grinding, electro discharging machine, band saw and Arc welding machine in order to provide accurate processing service.

The Machine Shop also possesses tools for precise measurement including three dimensional measurement, a coordinate measuring machine, a powerful microscope and a laser interferometer. It also offers precise tensile test samples, machine parts, various apparatus as a product and special welding service.

Members of Machine Shop

| Name           | Responsible Equipment                     | E-mail              | Phone        |
|----------------|-------------------------------------------|---------------------|--------------|
| Kwon kang wook | 3&5-axis M/C, Lathe, 3D-measurement       | kku1050@unist.ac.kr | 052-217-4066 |
| Cha jae hoon   | CNC Lathe, Milling, Electro Discharge M/C | cjh614@unist.ac.kr  | 052-217-4069 |

List of Instruments

| Lab                          | Equipment                     | Model      | Maker             | Page |
|------------------------------|-------------------------------|------------|-------------------|------|
| CNC Machine Tool             | CNC 5-Axis Machining Center   | C40U       | Hermle, Germany   | 43   |
|                              | CNC 3-Axis Machining Center   | B300V      | Hermle, Germany   | 43   |
|                              | CNC Lathe                     | TSL-6      | S&T, Korea        | 44   |
|                              | CNC Surface Grinding          | DGS-630CNC | Dae San, Korea    | 44   |
| General purpose Machine Tool | Lathe                         | TIPL-410   | S&T, Korea        | 45   |
|                              | Vertical Milling Machine      | STM-2VM    | Stonic, Korea     | 45   |
|                              | Metal Cutting Band Saw        | KDBS-200   | KyongDong, Korea  | 46   |
|                              | Electro Discharge Machine     | ZNC200M    | Kooje, Korea      | 46   |
| Measuring Instrument         | Coordinate Measuring Machine  | PGS        | Dukin, Korea      | 47   |
|                              | Three-Dimensional Measurement | NV-3000    | Nanosystem, Korea | 47   |
|                              | Semi Auto Formtracer System   | 525-421K-1 | Mitutoyo, Japan   | 48   |
|                              | Multi-Component Dynamometer   | 2825A      | Kistler, UK       | 48   |
|                              | laser Interferometer          | XL-80      | Renishaw, U.K     | 49   |
|                              | Powerful Microscope           | MF-1010B   | Mitutoyo, Japan   | 49   |

CNC 5-Axis Machining Center

Model C40U (Hermle, Germany)

- Specifications**
- Table
    - size : over than  $\varnothing$  800 mm
    - swivel range : + 25 ° ~ -110 °
    - max. load capacity : over than 1,200 kg
    - speed - swiveling axis A : over than 25 rpm
    - speed - rotary axis C : over than 30 rpm
  - Work area
    - traverse X-Y-Z : over than 850 x 700 x 500 mm
    - linear rapid traverse X-Y-Z : over than 45 m/min
  - Main spindle speed : over than 18,000 rpm
  - Automatic tool changer
    - magazine pockets : over than 38 pockets
    - max. tool length : over than 300 mm
    - max. tool diameter : over than  $\varnothing$  90 mm

- Applications**
- Geometric image processing
  - Round cam, propeller, ship screw, under cut, tire mold

Manager : Kwon kang wook  
E-mail : kku1050@unist.ac.kr  
Phone : 052-217-4066



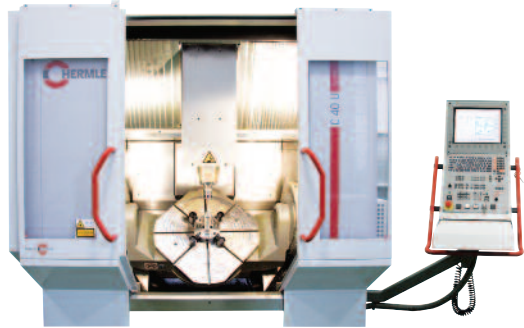
CNC 3-Axis Machining Center

Model B300V (Hermle, Germany)

- Specifications**
- Table
    - size : over than 1,000 x 560 mm
    - max. load capacity : over than 700 kg
  - Work area
    - traverse X-Y-Z : over than 700 x 550 x 500 mm
    - linear rapid traverse X-Y-Z : over than 30 m/min
  - Main spindle speed : over than 15,000 rpm
  - Automatic tool changer
    - magazine pockets : over than 24 pockets
    - max. tool length : over than 300 mm
    - max. tool diameter : over than  $\varnothing$  80 mm

- Applications**
- Geometric image processing
  - Precision machining flat
  - 3D image processing

Manager : Kwon kang wook  
E-mail : kku1050@unist.ac.kr  
Phone : 052-217-4066



# CNC Lathe

Model TSL-6 (S&T, Korea)



- Specifications**
- Capacity
    - max. bar working dia :  $\Phi$  42 mm
    - spindle speed : 50 ~ 5,000 rpm
  - Travel
    - X-axis travel : 170 mm
    - Z-axis travel : 480 mm
  - Rapid traverse
    - X-axis rapid traverse : 20 m/min
    - Z-axis rapid traverse : 24 m/min
  - Spindle motor: 7.5 / 11 kW
  - Floor space (LxWxH) : 2,400 x 1,400 x 1,800 mm
  - CNC controller : FANUC
- Applications**
- Mass production
  - Round machining
  - Geometric image processing

Manager : Cha jae hoon  
E-mail : cjh614@unist.ac.kr  
Phone : 052-217-4069

# Lathe

Model TIPL-410 (S&T, Korea)



- Specifications**
- Capacity
    - swing over bed :  $\Phi$  410 mm
    - swing over carriage :  $\Phi$  220 mm
    - distance between centers : 1,060 mm
  - Spindle
    - spindle nose : KS B4022-A-6
    - spindle taper : MT NO.6
    - spindle speed : 60 ~ 1,500 rpm
  - Feed
    - longitudinal feed : 0.039 ~ 0.541 mm/rev
    - cross feed : 0.019 ~ 0.271 mm/rev
    - metric thread : 0.5 ~ 7 mm/p
- Applications**
- Taper machining
  - Screw machining
  - Nulling
  - Groove machining
  - Machining diameter

Manager : Kwon kang wook  
E-mail : kku1050@unist.ac.kr  
Phone : 052-217-4066

# CNC Surface Grinding

Model DGS-630CNC (Dae San, Korea)



- Specifications**
- Capacity
    - working surface of table : 650 x 300 mm
    - max. travel : 750 x 340 mm
    - distance from table surface to wheel center : 550 mm
    - electro-magnetic chuck : 600 x 300 x 110 mm
    - graduation of hand wheel : 0.001, 0.01, 0.1 mm
  - Grinding wheel
    - speed : over than 1,800 rpm
    - diameter x width x bore :  $\Phi$  305 x 38 x 127 mm
  - Motor grinding wheel spindle : 3.75 kW/4p
- Applications**
- Precision machining flat
  - Precision grooving

Manager : Kwon kang wook  
E-mail : kku1050@unist.ac.kr  
Phone : 052-217-4066

# Vertical Milling Machine

Model STM-2VM (Stonic, Korea)



- Specifications**
- Table
    - max. travel (longitudinal) : 820 mm
    - max. travel (cross) : 300 mm
    - max. travel (vertical) : 450 mm
    - table load (max.) : 250 kg
  - Spindle
    - taper of spindle bore : 50 NT
    - number of spindle speeds : 9 step
    - taper of spindle speeds : 90 ~ 1,400 rpm
    - head tilting angle :  $\pm$  45°
  - Motor
    - main spindle motor : 3.7 [5 HP]
    - long & cross feed motor : 1.5 [2 HP]
    - vertical rapid motor : 1.1 [1.5 HP]
- Applications**
- Drilling machining
  - Spiral groove machining
  - Groove machining
  - Flat machining
  - Angle machining

Manager : Cha jae hoon  
E-mail : cjh614@unist.ac.kr  
Phone : 052-217-4069

## Metal Cutting Band Saw

Model KDBS-200 (KyongDong, Korea)



### Specifications

- Capacity
  - round bar :  $\Phi$  220 mm
  - rectangle : 220 x 400 mm
  - type : vise turning
  - round bar :  $\Phi$  160 mm
  - rectangle : 165 x 225 mm
- Saw blade
  - length : 3,035 mm
  - width : 25 mm
  - thickness : 0.9 mm
  - blade speed : 25, 40, 51, 71 m/min
- Electric drive motor : 1 kW

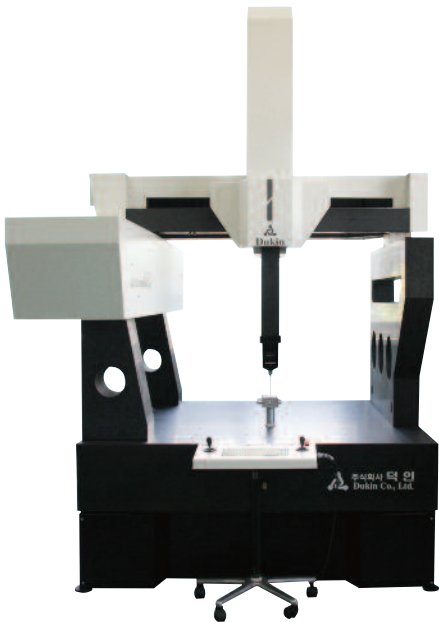
### Applications

- Cutting cylinder
- Taper cutting
- Cutting non-ferrous metals

Manager : Cha jae hoon  
E-mail : cjh614@unist.ac.kr  
Phone : 052-217-4069

## Coordinate Measuring Machine

Model PGS (Dukin, Korea)



### Specifications

- Measuring range (XYZ) : 700 x 1,000 x 660 mm
- Resolution : 0.39  $\mu$ m
- Max. permissible error per ISO 10360 - 2( $\mu$ m, L : mm) : E : 1.5 + L / 330 P : 1.5
- Max. velocity : 520 mm/s
- Air requirements : 5.35 kg/cm, NL/min

### Applications

- Automotive parts test
- Measurement test
- Mold parts test
- Plastic injection part test

Manager : Kwon kang wook  
E-mail : kku1050@unist.ac.kr  
Phone : 052-217-4066

## Electro Discharge Machine

Model ZNC200M (Kooje, Korea)



### Specifications

- Work tank dimensions : 820 x 520 x 380 mm
- Work table dimensions : 550 x 280 mm
- Dielectric oil tank capacity : 240 L
- Max. weight of electrode : 80 kg
- Approximate weight : 750 kg
- Machine space : 1,700 x 800 x 2,350 mm

### Applications

- Small holes
- Arc welding
- Electrostatic precipitator
- Fluorescent lamp
- Neon signs

Manager : Cha jae hoon  
E-mail : cjh614@unist.ac.kr  
Phone : 052-217-4069

## Three-Dimensional Measurement

Model NV-3000 (Nanosystem, Korea)



### Specifications

- Interferometric objective : 5 lens available
- Scan range : 0 ~ 180  $\mu$ m (option 270  $\mu$ m, 5 mm)
- Vertical resolution : WSI < 0.5  $\mu$ m/PSI < 0.1  $\mu$ m
- Lateral resolution : 0.2 ~ 4  $\mu$ m
- Tip/tilt :  $\pm$  6° (probe tip/tilt)
- Workpiece stage :
  - NV-P2020 / 200 x 200 mm (motorized)
  - NV-P4050 / 400 x 500 mm (motorized)

### Applications

- 3D analysis of surface
- Semiconductor parts test
- Roughness average measurement

Manager : Kwon kang wook  
E-mail : kku1050@unist.ac.kr  
Phone : 052-217-4066

## Semi Auto Formtracer System

Model 525-421K-1 (Mitutoyo, Japan)



- Specifications**
- X-Axis measuring range : 100 mm
  - Measuring force of detector : 0.75 mN
  - Vertical travel : 300 mm power column
  - Granite base size ( WxD ) : 610 x 450 mm

- Applications**
- Surface roughness measurement
  - Profile measurement
  - Height measurement
  - Cylindricity measurement

Manager : Kwon kang wook  
E-mail : kku1050@unist.ac.kr  
Phone : 052-217-4066

## laser Interferometer

Model XL-80 (Renishaw, U.K)

- Specifications**
- Accuracy :  $\pm 0.5$  ppm
  - Linear resolution : 1 nm
  - Max. travel velocity : 4 m/s
  - Between each automatically updated environmental compensation: 7 secs
  - Dynamic capture rate : 50 kHz
  - Linear range as standard : 80 m

- Applications**
- Measurement of pitch error
  - Measurement of straightness
  - Measurement of angle
  - Measurement of rotary index

Manager : Cha jae hoon  
E-mail : cjh614@unist.ac.kr  
Phone : 052-217-4069



## Multi-Component Dynamometer

Model 2825A (Kistler, UK)



- Specifications**
- Measuring range
    - Fx, Fy, Fz : - 250 ~ 250 N
    - Mx, Mz : - 11 ~ 11 N
  - Overload (Fx, Fy, Fz) : - 300 ~ 300 N
  - Threshold : < 0.002 N
  - Sensitivity
    - Fx, Fz : - 26 pc/N
    - Fy : - 13 pc/N
  - Linearity, all ranges : <  $\pm 0.4$  % FSO
  - Hysteresis, all ranges : <  $\pm 0.5$  FSO
  - Crosstalk : <  $\pm 2$  %
  - Degree of protection EN60529 : IP 67

- Applications**
- Measurement of cutting resistance
  - Measurement of machinability
  - Measurement of tool lifespan
  - Interpretation of cutting force

Manager : Cha jae hoon  
E-mail : cjh614@unist.ac.kr  
Phone : 052-217-4069

## Powerful Microscope

Model MF-1010B (Mitutoyo, Japan)

- Specifications**
- Measuring range : X- 100 mm, Y- 100 mm
  - Z-axis height of the max. mass : 150 mm
  - Effective class size : 180 mm x 180 mm
  - Max. weight : 10 kg
  - Digital counter resolution
    - 0.001 / 0.0005 / 0.0001 mm

- Applications**
- Measurement of surface roughness
  - Measurement of pitch screw
  - Measurement of tool
  - Measurement of gauge

Manager : Kwon kang wook  
E-mail : kku1050@unist.ac.kr  
Phone : 052-217-4066



Introduction of UNIST OLYMPUS Biomed Imaging Center (UOBC)

The UNIST-OLYMPUS Biomed Imaging Center (UOBC) was established in 2010 with the aim to enhance research capabilities and achieve global competitiveness using state of the art equipment.

UOBC is located on the 7th floor of Engineering building 1. UOBC provides state of the art technologies in the areas of optical equipment and advanced imaging tools including systemic microscopes, general microscopes and imaging analysis system.

UOBC will build up the systemic bio image and information database pursuing the qualitative growth through the development of real time image analysis and appliance skills with cells.

Members of UOBC

| Name          | Responsible Equipment                                              | E-mail               | Phone        |
|---------------|--------------------------------------------------------------------|----------------------|--------------|
| Hur jin hoe   | MX10, IX71, FSX100, IX81-ZDC(6F), LSM700(6F), MetaMorph, Autoquant | jhhur@unist.ac.kr    | 052-217-4161 |
| Kim eung kyun | FV1000, FV10i, Cell^R, Cell^TIRF, dotSlide, Cellsens               | kyunfeel@unist.ac.kr | 052-217-4162 |

List of Instruments

| Lab                | Equipment                                         | Model              | Maker          | Page |
|--------------------|---------------------------------------------------|--------------------|----------------|------|
| System Microscope  | LSCM with SIM and Live                            | FV1000SPD          | Olympus, Japan | 51   |
|                    | All-In-One Confocal Microscope                    | FV10i              | Olympus, Japan | 51   |
|                    | Zero Drift Motorized Microscope                   | IX81-ZDC or Cell^R | Olympus, Japan | 52   |
|                    | Total Internal Reflection Fluorescence Microscope | Cell^TIRF          | Olympus, Japan | 52   |
| General Microscope | Fluorescence Inverted Microscope                  | IX71               | Olympus, Japan | 53   |
|                    | Bio Imaging Navigator                             | FSX100             | Olympus, Japan | 53   |
|                    | Macro-view Imaging System                         | MX10               | Olympus, Japan | 54   |
|                    | Virtual Microscope                                | dotSlide           | Olympus, Japan | 54   |

LSCM with SIM and Live

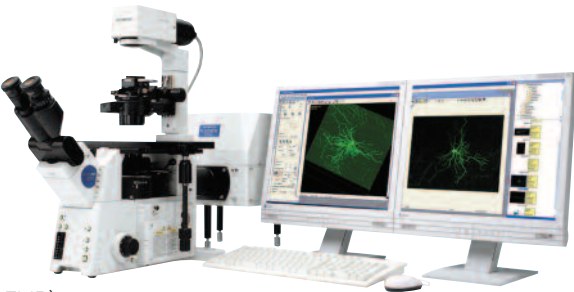
Model FV1000SPD (Olympus, Japan)

Specifications

- Olympus motorized inverted microscope IX81
- Spectral detector : 1 ~ 100nm band-pass (emission)
- Objectives: 10x, 20x, 40x, 60x(oil), 100x(oil)
- Observation : BF, DIC, Fluorescence, Confocal
- SIM Scanner:  
Synchronizing laser light stimulation & confocal imaging
- Laser: 405, 440, 473, 559, 635 nm

Applications

- FRET efficiency
- Live cell imaging (1ch DIC)
- Confocal imaging (4ch fluorescences)
- Analysis of kinetics (FCS, FCCS, RICS and FRAP / FLIP)
- Photoactivation and photoconversion (Kaede, Dronpa and PA-GFP)



Manager : Kim eung kyun  
E-mail : kyunfeel@unist.ac.kr  
Phone : 052-217-4162

All-In-One Confocal Microscope

Model FV10i (Olympus, Japan)

Specifications

- Objectives: 10x, 60x (zoom : 1x ~ 10x)
- Detector module fluorescence: 2 channels
- Phase contrast : 1 channel
- Laser light source :  
- 405 nm (22 mW), 473 nm (15 mW),  
559 nm (18 mW), 635 nm (12 mW)
- CO<sub>2</sub> Incubator

Applications

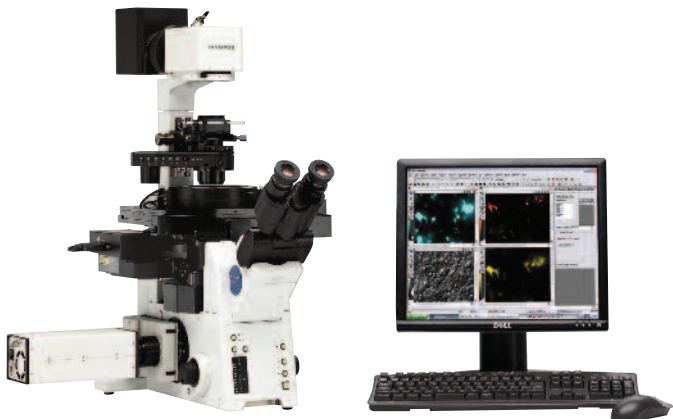
- Live cell imaging (1ch phase contrast)
- Confocal imaging (2ch fluorescences)
- 3-dimensional image
- Multi time-lapse image
- Stitching image



Manager : Kim eung kyun  
E-mail : kyunfeel@unist.ac.kr  
Phone : 052-217-4162

## Zero Drift Motorized Microscope

Model IX81-ZDC or Cell^R (Olympus, Japan)



Specifications

- Olympus motorized inverted microscope IX81
- Objectives: 10x, 20x, 40x, 60x[oil], 20x, 40x(LW)
- Transmitted light source: 100 W halogen
- Fluorescence light source: 150 W Xe
- Observation: BF, DIC, fluorescence

| Filter | Ex [nm]   | DM [nm] | Em [nm]   |
|--------|-----------|---------|-----------|
| Fura   | 340 ~ 380 | 409     | 420 ~ 460 |
| DAPI   | 360 ~ 370 | 400     | 420 ~ 460 |
| GFP    | 460 ~ 480 | 485     | 495 ~ 540 |
| RFP    | 535 ~ 555 | 565     | 570 ~ 625 |

Applications

- Short or long time lapse - live cell imaging
- Fluorescence imaging (DAPI, GFP, RFP)
- Calcium ratio analysis - Fura-2, Fluo-3 or 5

Manager : Kim eung kyun  
E-mail : kyunfeel@unist.ac.kr  
Phone : 052-217-4162

## Fluorescence Inverted Microscope

Model IX71 (Olympus, Japan)



Specifications

- Objectives : 4x, 10x(PHC), 20x(PH1), 40x(PH2)
- Fluorescence light source: 100W Hg Apo
- Observation: BF, fluorescence, phase contrast

| Filter | Ex [nm]   | DM [nm] | Em [nm] |
|--------|-----------|---------|---------|
| DAPI   | 330 ~ 385 | 400     | 420     |
| GFP    | 400 ~ 480 | 500     | 515     |
| RFP    | 510 ~ 550 | 570     | 590     |

Applications

- FRET efficiency
- Live cell imaging (phase contrast)
- Fluorescence imaging (blue, green, red)

Manager : Hur jin hoe  
E-mail : jhhur@unist.ac.kr  
Phone : 052-217-4161

## Total Internal Reflection Fluorescence Microscope

Model Cell^TIRF (Olympus, Japan)



Specifications

- Olympus motorized Inverted Microscope IX81
- Objectives: 10x, 20x, 40x, 60x[oil], 100x[oil]
- Transmitted light source: 100W halogen
- Fluorescence light source: 150W Xe
- Observation : BF, DIC, fluorescence, TIRF
- Laser : 405, 491, 561 nm

Applications

- Short or long time lapse
  - live cell imaging for TIRF
- Single molecule observation
- Exocytosis, endocytosis

Manager : Kim eung kyun  
E-mail : kyunfeel@unist.ac.kr  
Phone : 052-217-4162

## Bio Imaging Navigator

Model FSX100 (Olympus, Japan)



Specifications

- Objectives: 10x, 40x (zoom: 4.2x ~ 80x)
- Fluorescence light source: 100W metal halide
- Observation: BF, phase contrast, fluorescence

| Filter | Ex [nm]   | DM [nm] | Em [nm]   |
|--------|-----------|---------|-----------|
| DAPI   | 360 ~ 370 | 400     | 420 ~ 460 |
| GFP    | 400 ~ 495 | 505     | 510 ~ 550 |
| RFP    | 535 ~ 550 | 570     | 575       |

Applications

- Multiple-fluorescence image
- Live cell imaging
- Stitch imaging
- Phase contrast imaging

Manager : Hur jin hoe  
E-mail : jhhur@unist.ac.kr  
Phone : 052-217-4161

## Macro-view Imaging System

Model    **MX10 (Olympus, Japan)**



**Specifications**

- Magnification: 0.63 ~ 6.3x (2x : 1.26 ~ 12.6x)
- Zoom ratio: 1:10
- Total magnification: 0.63 ~ 126x
- Working distance: 20 mm
- Fluorescence light source: 120 W metal halide

**Applications**

- Observation of fluorescence from thick sample (zebra fish, egg and c-elegance)
- Stereo-view imaging

Manager : Hur jin hoe  
E-mail : jhhur@unist.ac.kr  
Phone : 052-217-4161

## Introduction of *in vivo* Research Center (IVRC)

IVRC(area of 3,300㎡) is scheduled for completion in august 2012. IVRC is composed of 5 zones and 4 laboratories:5 zones are TG mouse zone, Small animal zone, BSL-2(Biosafety Level-2) zone, Return animal zone, Cleaning zone and 4 laboratories are Imaging analysis lab.-1, Imaging analysis lab.-2, Behavior analysis lab., Histopathology analysis lab.

IVRC supports animal research such as the establishment of a model for animal disease, the development of transgenic mice, the construction of a embryo bank system and *in vivo* efficacy validation using bio-fusion technology.

**Members of IVRC**

| Name           | Responsible Equipment     | E-mail             | Phone        |
|----------------|---------------------------|--------------------|--------------|
| Park soo ah    | IVRC equipment management | sapark@unist.ac.kr | 052-217-2611 |
| Park kyoung su | IVRC equipment management | pks75@unist.ac.kr  | 052-217-2612 |

## Virtual Microscope

Model    **dotSlide (Olympus, Japan)**



**Specifications**

- Olympus upright microscope Bx51
- Objectives: 2x, 10x, 20x, 40x
- Transmitted light source: 100 W halogen

**Applications**

- Virtual high quality image
- H&E / IHC slide image analysis

Manager : Kim eung kyun  
E-mail : kyunfeel@unist.ac.kr  
Phone : 052-217-4162

## Introduction of Radioisotope Lab

The Radioisotope Lab has been providing support to the management of safe and efficient radioactive substances by supervising radioactive isotopes and radioactive generators used in UNIST.

**Members of Radioisotope Lab**

| Name        | Responsible Equipment   | E-mail            | Phone        |
|-------------|-------------------------|-------------------|--------------|
| Lee hye jin | Radioisotope management | hjlee@unist.ac.kr | 052-217-2504 |

**List of Instruments**

| Lab                   | Equipment                         | Model             | Maker            | Page |
|-----------------------|-----------------------------------|-------------------|------------------|------|
| Radiation Measurement | Liquid Scintillation Beta Counter | Tri-Carb 2910TR   | PerkinElmer, USA | 56   |
|                       | Automatic Gamma Counter           | 2470 WIZARD2      | PerkinElmer, USA | 56   |
|                       | IP Biomolecular Imager            | Typhoon™ FLA 7000 | GE, USA          | 57   |
|                       | Biomolecules Purification System  | ÄKTAFLC™          | GE, USA          | 57   |

## Liquid Scintillation Beta Counter

Model Tri-Carb 2910TR (PerkinElmer, USA)



### Specifications

- Energy range : 0 ~ 2,000 keV
- Efficiency & (E2/B)
  - $^3\text{H}$  60 %, 180
  - $^{14}\text{C}$  5 %, 380
- Background
  - $^3\text{H}$  17.3 CPM
  - $^{14}\text{C}$  24.3 CPM

### Applications

- General purpose biomedical research using radiotracer
- Swipe or wipe assays
- Environmental monitoring
- Nuclear power effluent/contamination monitoring

Manager : Lee hye jin  
E-mail : hjlee@unist.ac.kr  
Phone : 052-217-2504

## IP Biomolecular Imager

Model Typhoon™ FLA 7000 (GE, USA)

### Specifications

- Detection modes
  - fluorescence, chemifluorescence, filmless autoradiography, digitization
- Excitation wavelengths
  - 473 nm (blue LD laser), 532 nm (green SHG laser), 635 nm (red LD laser), 650 nm (red LD laser)
- Radioisotopes :  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{32}\text{P}$ ,  $^{33}\text{P}$ , and  $^{35}\text{S}$

### Applications

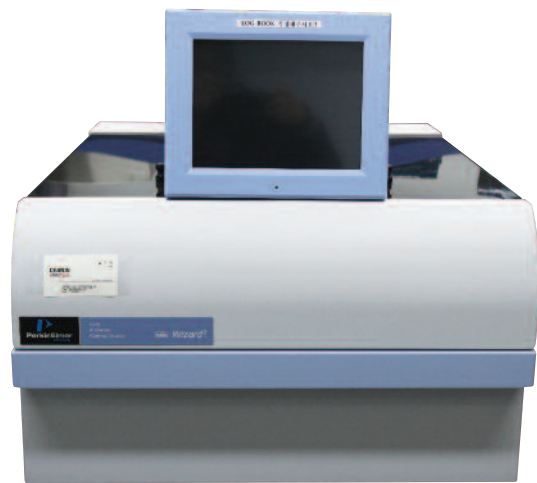
- Quantitative westerns
- Visible fluorescence
- Phosphorimaging
- cell documentation

Manager : Lee hye jin  
E-mail : hjlee@unist.ac.kr  
Phone : 052-217-2504



## Automatic Gamma Counter

Model 2470 WIZARD2 (PerkinElmer, USA)



### Specifications

- Radio library : 45 type
- Energy range : 15 ~ 1,000 keV
- Max. count rate : 6 million DPM for  $^{125}\text{I}$

### Applications

- RIA using  $^{125}\text{I}$
- Chromium release with  $^{51}\text{Cr}$ - (cell cytotoxicity)
- Receptor binding with  $^{51}\text{Cr}$
- Vitamin B12 deficiency with  $^{57}\text{Co}$  and  $^{58}\text{Co}$  (dicopac test)
- Monitoring of blood samples in Positron Emission Tomography
- Haemoglobin testing with  $^{59}\text{Fe}$
- Environmental samples with  $^{137}\text{Cs}$

Manager : Lee hye jin  
E-mail : hjlee@unist.ac.kr  
Phone : 052-217-2504

## Biomolecules Purification System

Model ÄKTA FPLC™ (GE, USA)

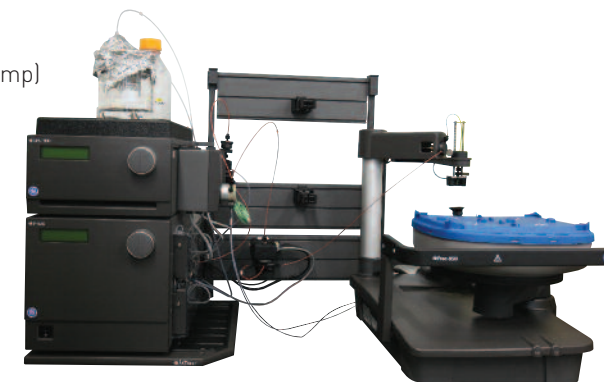
### Specifications

- Flow-rate range 0.05 ~ 20 ml/min
- Pressure range 0 ~ 5 MPa (50 bar, 725 psi)
- Wavelength
  - 254, 280, 313, 405, 436, 546 nm (with Hg lamp)
  - 214 nm (with Zn lamp)
- Conductivity range 1  $\mu\text{S}/\text{cm}$  ~ 999.9 mS/cm (RPC – IEX – HIC gradients)
- pH range : 0 ~ 14

### Applications

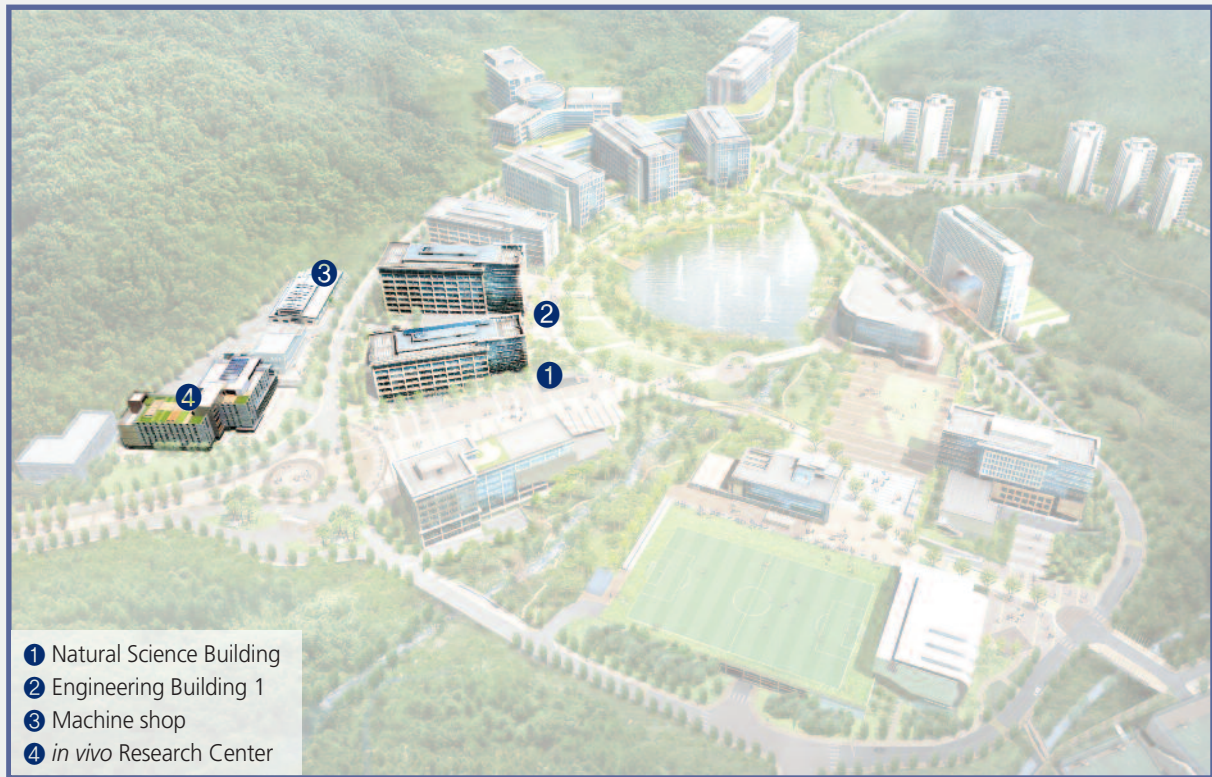
- Automatic protein and enzyme purification
- Nucleic acids and peptide purification

Manager : Lee hye jin  
E-mail : hjlee@unist.ac.kr  
Phone : 052-217-2504



58

## UNIST Campus Map



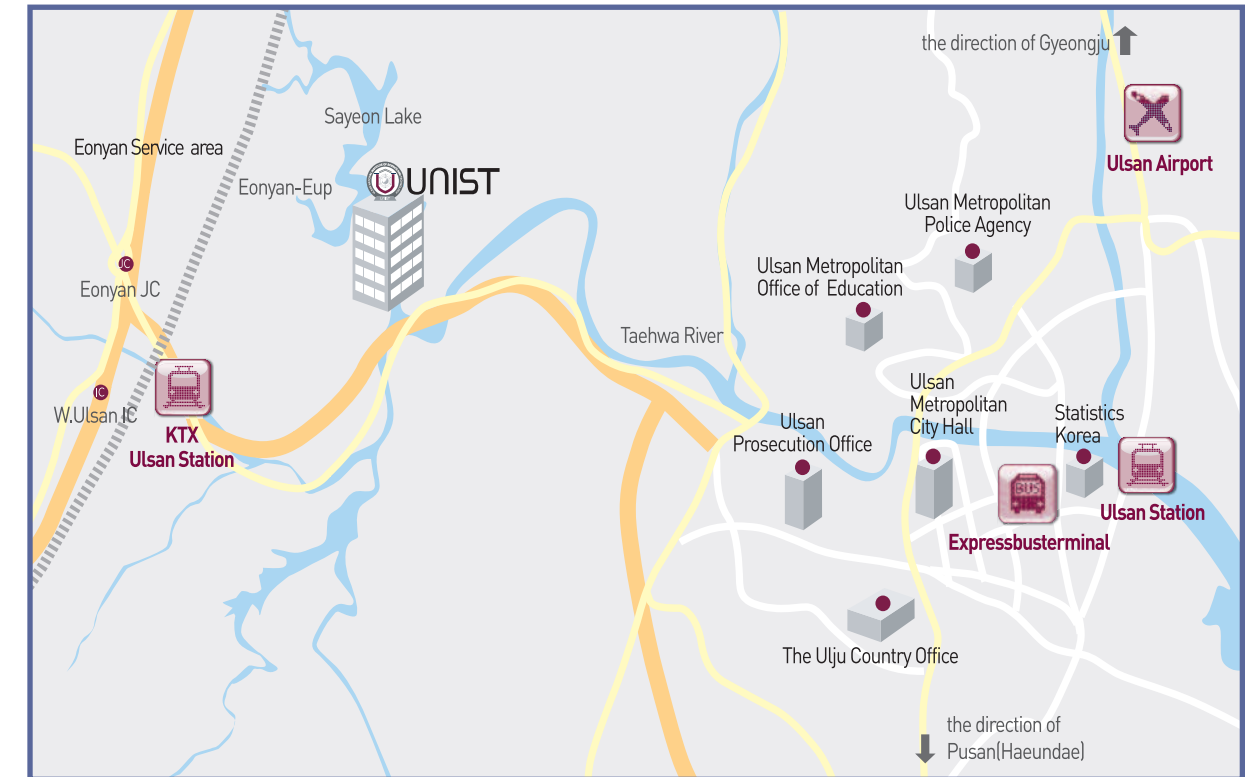
### UCRF Office Location

- Analysis Lab Office : Natural Science Building, Room B122, B123
- Environmental Analysis Lab Office : Natural Science Building, Room B122
- Nanofabrication Lab Office : Natural Science Building, Room 201-11 (2F)
- Machine Shop Office : Machine Shop Building, Room 103 (1F)
- Biomed Imaging Center Office : Engineering Building 1, Room 705-7 (7F)
- *in vivo* Research Center Office : Natural Science Building, Room 201-11 (2F, Temporary)
- Radioisotope Lab office : Natural Science Building, Room 201-11

### Mail address

- **Office Location as stated above** + 100 Banyeon-ri, Eonyang-eup, Ulju-gun, Ulsan Metropolitan City, Republic of Korea, 689-798

## How to get to UNIST



### By car

- From Seoul, Daejeon, Daegu  
Gyeongbu Expressway toward Busan ▶ West Ulsan IC ▶ Highway No. 24 toward Ulsan ▶ UNIST
- From Busan  
Gyeongbu Expressway toward Seoul ▶ West Ulsan IC ▶ Highway No. 24 toward Ulsan ▶ UNIST

### By airplane

- Taxi or Bus Service From Ulsan Airport to UNIST
  - (Ulsan Airport - 402, 422 ▶ get off at Sam Ho Bridge - 133, 233, 807 ▶ UNIST)
  - (Ulsan Airport - 432, 452 ▶ get off at Shinbok Rotary - 733 ▶ UNIST)

### By train

- Taxi or Bus Service From Ulsan Station(KTX) to UNIST
  - No. 807 (Ulsan Station(KTX) ▶ UNIST) Note: 807 continues to Ulsan.
  - No. 327, 337 ( Ulsan Station(KTX) ▶ get off at the UNIST Entrance ▶ 1km(Walk about 15 mins) ▶ UNIST)
- Taxi or Bus Service From Taehwagang Station (General Train) to UNIST
  - No. 133, 733, 807 (Taehwagang Station ▶ UNIST) Note : 807 continues to Eon Yang
  - No. 327, 337 ( Taehwagang Station ▶ get off at the UNIST Entrance ▶ 1km(Walk about 15 mins) ▶ UNIST)

### By express bus

- Taxi or Bus Service From Ulsan Express Bus Terminal to UNIST
  - No. 133, 733, 807 (Ulsan Express Bus Terminal ▶ UNIST) Note: 807 continues to Eon Yang
  - No. 327, 337 ( Ulsan Express Bus Terminal ▶ get off at the UNIST Entrance ▶ 1km(Walk about 15 mins) ▶ UNIST)