50, UNIST-gil, Eonyang-eup, Ulju-gun, Ulsan, 689-798 Rep. of KOREA
Tel. +82.52.217.4032~4053, 4056~4069 / Fax. +82.52.217.4169
http://www.ucrf.unist.ac.kr

UNIST CENTRAL RESEARCH FACILITIES

ULSAN NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY

UNIST CENTRAL RESEARCH FACILITIES

CONTENTS

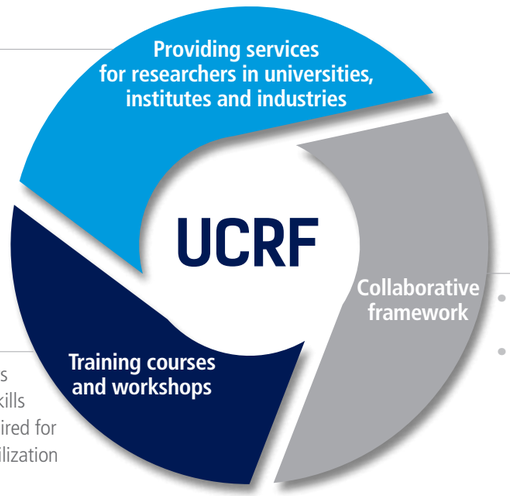
Research Facilities Enabling Exceptional Achievement!

About UCRF

UNIST Central Research Facilities (UCRF) was established in 2009 for the purpose of enhancing the research abilities of UNIST through the sharing of expensive equipment, the promoting of interdisciplinary studies and the establishing networks of professionals specialized in analysis and instrumentation. In addition to serving the faculty, students and staff who conduct cutting-edge research at UNIST, the UCRF also provides services to regional industries, institutes and universities. The UCRF is equipped with Analysis lab, Nano Fabrication Cleanroom, Maker Lab, Environmetal Analysis Center, Biomed Imaging Center, *In Vivo* Research Center, Radiation Safety Lab, Synchrotron Radiation Research Center. Furthermore, the UCRF offers the advanced training courses and seminars to help the users learn the skills and analytical methods required for the effective and efficient utilization of this equipment. From this day forward, we will do our best to serve researchers who need our facilities for characterization, analysis and micro/nano fabrication and to continuously procure expensive and state-of-the-art equipment.
Thank you.

Mission of UCRF

- Continuous procurement maintenance of expensive equipment
- Maintenance of state-of-the-art equipment



- Interdisciplinary studies of science and technology
- Industry-academic cooperation for development of advanced technologies

- Training courses for self-users
- Workshops to develop the skills and analytical methods required for the effective and efficient utilization of the equipment

Organization of UCRF

President

Director

Steering Comittee

UNIST Mechanical Analysis Lab (UMAL)
- Electron Microscopy
- X-ray Analysis
- Spectroscopic Analysis
- Surface Analysis
- Mass Analysis
- Thermal & Physical Analysis

UNIST Nano Fabrication Center (UNFC)
- Photolithography
- Thin Film
- Etch Process
- Measurement
- Packing

UNIST Maker Lab
- CNC Workshop
- Shape Manufacturing
- 3D Measurement
- Material Test
- Welding
- CAD/CAM/CAE

UNIST Environmental Analysis Center (UEAC)
- Environmental Analysis
- Organic/Inorganic Analysis
- Quantitative Analysis
- Pre-treatment
- Field Sampling

UNIST Optical Bio-Med Imaging Center(UOBC)
- Super Resolution Microscope
- Multiphoton & Enhanced Confocal Microscope
- Confocal Laser Scanning Microscope
- Selective Plane Illumination Microscope(SPIM)
- TIRF & Live Cell Microscope
- Histological System Microscope
- Macro System Microscope
- Analysis Software

***In Vivo* Research Center (IVRC)**
- Strain Preservation Zone
- Small Animal Zone
- Return Animal Zone
- BSL-2 Zone
- In Vivo Imaging
- Behavior Study
- Histopathology
- Autopsy

UNIST Radiation Safety Lab (URSL)
- Radioisotope lab.
- Radioactive waste

UNIST Synchrotron Radiation Research Center (USRRC)
- XAS
- SAXS / WAXD
- Crystallography

Method on Reservation and Analysis

Request of Analysis


To request analysis


Contact UCRF & discuss

Visit UCRF homepage for reservation


Staff measurement


Review the result with user and inform


Inform the cost to the requester in the following month

For Self-users


Self-user


Training & test for self-user

Visit UCRF homepage for reservation


Self-user measurement


Fill in logbook & examine equipment


Inform the cost to the user in the following month

UNIST Mechanical Analysis Lab (UMAL)

The UNIST Mechanical Analysis Lab (UMAL) 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. The lab possesses more than 50 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 25 million U. S. dollars.

List of Instruments

Lab	No.	Equipment	Model	Maker	Page
Electron Microscopy	1	Advanced Transmission Electron Microscope	Titan3 G2 60-300	FEI, USA	8
	2	High Resolution Transmission Electron Microscope	JEM-2100F	JEOL, Japan	9
		Field Emission-Transmission Electron Microscope	Tecnai G2 F20 X-Twin	FEI, USA	9
	3	Normal Transmission Electron Microscope	JEM-2100	JEOL, Japan	10
		Bio-Transmission Electron Microscope	JEM-1400	JEOL, Japan	10
	4	Dual-Beam Focused Ion Beam	Helios 450HP	FEI, USA	11
		Dual-Beam Focused Ion Beam	Quanta 3D FEG	FEI, USA	11
	5	Field Emission-Scanning Electron Microscope	SU8220	Hitachi, Japan	12
		Field Emission-Scanning Electron Microscope	S-4800	Hitachi, Japan	12
	6	Field Emission-Scanning Electron Microscope	Quanta 200	FEI, USA	13
		Field Emission-Scanning Electron Microscope	NovaNanoSem230	FEI, USA	13
TEM/SEM sample prep.	7	Ultramicrotome	CR-X	RMC, USA	14
		Ion Milling System	IM4000	Hitachi, Japan	14
		Nano Mill	Model 1040	Ficshione, USA	14
		Low Angle Ion Mill	Model 1050	Ficshione, USA	14
	8	Mechanical Polishing System	Metprep3/Multiprep	ALLIED, USA	15
		Mounting Press	Techpress 2	ALLIED, USA	15
		Low Speed Saw	TechCut 4	ALLIED, USA	15
		Dimple Grinder	Model 656	Gatan, USA	15
		Inverted Metallurgical Microscope	DMI3000 M	Leica, Germany	15
	9	Advanced Plasma System	Gatan-690	Gatan, USA	16
		PIPS	Gatan 691	Gatan, USA	16
		PECS	Gatan 682	Gatan, USA	16
		Plunge Freezer	VITROBOT	FEI, USA	16
X-ray Analysis	10	High Resolution Powder X-ray Diffractometer	SmartLab	Rigaku, Japan	17
		High Resolution Thin Film X-ray Diffractometer	D8 Discover	Bruker, Germany	17
	11	High Power X-ray Diffractometer	DMAX-2500	Rigaku, Japan	18
		Normal Powder X-ray Diffractometer	D8 Advance	Bruker, Germany	18
	12	Single Crystal X-ray Diffractometer	R-AXIS RAPID II	Rigaku, Japan	19
		Wavelength Dispersive X-ray Fluorescence Spectrometer	S8 Tiger	Bruker, Germany	19
Spectroscopic Analysis	13	600 MHz FT-NMR	VNMRS 600	Agilent, USA	20
		400 MHz FT-NMR	AVANCE III HD	Bruker, Germany	20
	14	UV-Vis-NIR	Cary 5000	Agilent, USA	21
		UV-Vis Microspectrometer	20/20 PV	CRAIC, USA	21
	15	Fluorometer	Cary Eclipse	Agilent, USA	22
		Spectrofluorometer	FP-8500	Jasco, Japan	22
		Fluorescence Spectrometer	FLS 920	Edinburgh, UK	22
	16	FT-IR	670-IR ; 620-IR Imaging Model	Agilent, USA	23
		Sub-micron size & Zeta Potential Measuring System	NanoZS	Malvern, UK	23
	17	Micro Confocal Raman	Alpha300R	WITec, Germany	24
		Combined AFM & Confocal Raman Microscope	Alpha300S	WITec, Germany	24
Surface Analysis	18	Time-of-Flight Secondary Ion Mass Spectrometer	TOF-SIMS 5	ION TOF, Germany	25
	19	X-ray Photoelectron Spectroscope	K-alpha	ThermoFisher, UK	26
		X-ray Photoelectron Spectroscope	Escalab 250Xi	ThermoFisher, UK	26
	20	Atomic Force Microscope	Dimension 3100	Veeco, USA	27
		Atomic Force Microscope	Multimode 8	Veeco, USA	27
	21	Physisorption Analyzer	ASAP 2020	Micromeritics, USA	28
		Physisorption Analyzer	ASAP 2420	Micromeritics, USA	28
Mass Analysis	22	DART-HRMS	AccuTOF4G+ DART	JEOL, Japan	29
		Matrix Assisted Laser Desorption Ionization Time-of-Flight Mass Spectrometer	Ultraflex III	Bruker, Germany	29
	23	Liquid Chromatography Mass Spectrometer	HCT Basic System	Bruker, Germany	30
		Gas Chromatography Mass Spectrometer	450-GC & 320 MS	Bruker, Germany	30
		GPC/MALS	Agilent 1200 series, miniDAWN	Agilent, USA, Wyatt, USA	30
	24	Element Analyzer I	Flash 2000	Thermo Scientific, Netherlands	31
		Element Analyzer II	TrueSpec Micro CHNS	LECO Corporation, USA	31
Thermal & Physical Analysis	25	Thermogravimetric Analyzer	Q500	TA Instrument, USA	32
		Differential Scanning Calorimeter	Q200	TA Instrument, USA	32
	26	Dynamic Mechanical Analyzer	Q800	TA Instrument, USA	33
		Simultaneous TGA/DSC	Q600	TA Instrument, USA	33
	27	Cryogenic Probe Station	CRX-4K	Lake Shore, USA	34
		Seebeck Coefficient & Electrical Conductivity	SBA 458 Nemesis	Netzsch, Germany	34
	28	Dilatometry	DIL 402C	Netzsch, Germany	35
		Rheometer	Haake MARS3	Thermo Electron(Karlsruhe) Gmbh, Germany	35

Office Phone Number : 4034, 4035
Office Email : analysis-lab@unist.ac.kr

Electron Microscopy

01 Advanced Transmission Electron Microscope

Model • Titan3 G2 60-300 *[Cs-Corrector: Image & Probe]* [FEI, USA]

Principle

TEM is used to analyze microstructures of materials with high spatial resolution. The high voltage electron beam generated from electron gun is illuminated on thin film specimen. The beam penetrating the specimen passes through an array of magnetic lenses and forms a high resolution electron image of the electron diffraction pattern.

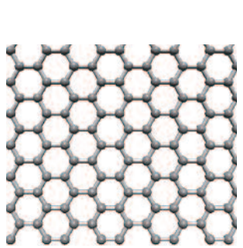
Room #B112

Specifications

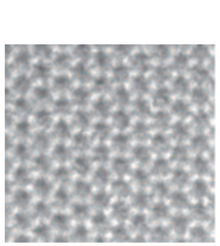
- Acceleration voltage : 60 ~ 300 kV
- Lattice resolution : 0.065 nm
- STEM resolution : 0.070 nm
- EDS resolution : 136 eV
- EELS resolution : 0.16 eV
- Probe stability : ≤ 1 nm/min
- Stage stability : ≤ 1 nm/min
- Contamination : ≤ 1 nm/min

Applications

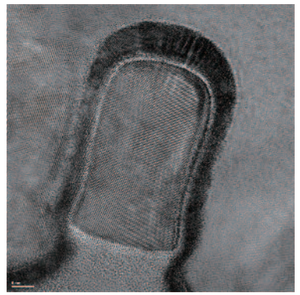
- Sub angstrom spatial resolution TEM
- Atomic resolution at low kV
- Imaging and spectroscopy of soft matters
- Dynamics of individual atoms
- High energy resolution EELS and EDS
- Energy-filtered imaging and diffraction

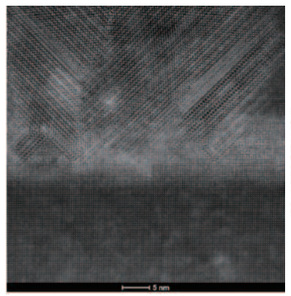


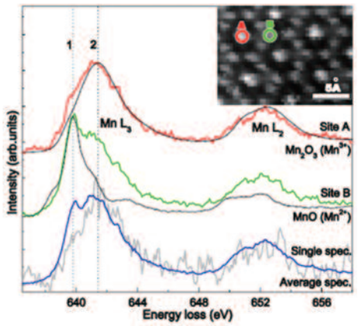
Atomic image



Single raw image
at 80 kV







[Optics of Cs-corrector for TEM]

02 [High Resolution | Field Emission] Transmission Electron Microscope

Model • JEM-2100F *[Cs-Corrector: Probe]* [JEOL, Japan] | Tecnai G2 F20 X-Twin [FEI, USA]

Principle

TEM is used to analyze micro-structures of materials with high spatial resolution. The high voltage electron beam generated from electron gun is illuminated on thin film specimen. The beam penetrating the specimen passes through an array of magnetic lenses and forms a high resolution electron image of the electron diffraction pattern.

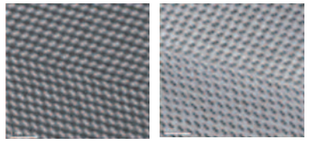
Room #B106

Specifications

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

Applications

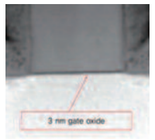
- Ultra high resolution electron image
- STEM image (BF, HAADF)
- Diffraction pattern
- Energy dispersive spectroscopy (EDS)
- Electron energy loss spectroscopy (EELS)



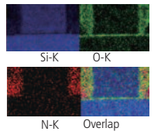
STEM HAADF Image

STEM BF Image

[Si (110) Twin Crystal]



STEM HAADF Image



[EDS Mapping of Gate]

Room #B109

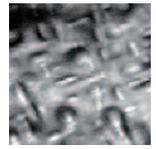
Specifications

- Acceleration voltage : 200 kV
- Lattice resolution : 0.144 nm
- Point resolution : 0.25 nm
- STEM resolution : 1.0 nm
- EDS resolution : 136 eV
- Specimen tilting : X = ± 30 °, Y = ± 30 °

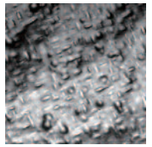
Applications

- High resolution electron image
- STEM image (BF, HAADF)
- Diffraction pattern
- Energy dispersive spectroscopy (EDS)

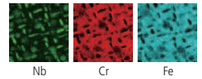
TEM image

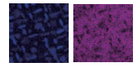


EDX-HADDF image



EDS analysis





03 [Normal | Bio] Transmission Electron Microscope

Model • JEM-2100 [JEOL, Japan] | JEM-1400 [JEOL, Japan]

Principle

TEM is used to analyze micro-structures of materials with high spatial resolution. The high voltage electron beam generated from electron gun is illuminated on thin film specimen. The beam penetrating the specimen passes through an array of magnetic lenses and forms a high resolution electron image of the electron diffraction pattern.

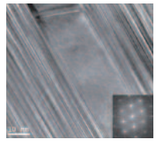
Room #B104

Specifications

- Acceleration voltage : 200 kV
- Lattice resolution : 0.23 nm
- Point resolution : 0.14 nm
- Specimen tilting : X = ± 35 °, Y = ± 30 °
- Image recording system : CCD
- EDS resolution : 132 eV

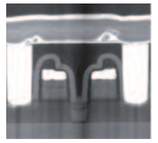
Applications

- High resolution electron image
- Diffraction pattern
- STEM image (BF, HAADF)
- Energy dispersive spectroscopy (EDS)

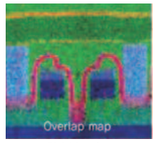


HR EM Image/DP
[SiC Nanowire]

STEM HAADF Image



STEM BF Image
[Semiconductor device]



EDS Mapping

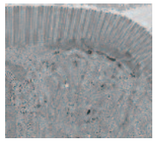
Room #B105

Specifications

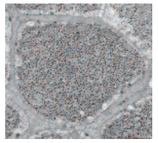
- Acceleration voltage : 120 kV
- Lattice resolution : 0.38 nm
- Point resolution : 0.20 nm
- Specimen tilting : X = ± 25 °, Y = ± 70 °
- Image recording system : CCD

Applications

- High resolution electron image
- Diffraction pattern



Small intestine of mouse



Mytillus edulis
Anterior Byssus Retractor Muscle

04 Dual-Beam Focused Ion Beam

Model • Helios 450HP [FEI, USA] | Quanta 3D FEG [FEI, USA]

Principle

Dual-beam FIB has a multitude of capabilities including high resolution electron imaging, ion imaging, nano device fabrication, and material deposition. Simultaneous patterning and imaging are possible to nm resolution for both imaging and machining. FIB with both ion and electron beams enables high precision cross-section processing and TEM/3DAP sample preparation.

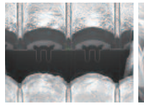
Room #B108

Specifications

- Electron optics - Resolution : 0.9 nm @ 15 kV, 1.4 nm @ 1 kV
  - Accelerating voltage : 1 ~ 30 kV
  - Probe current : ~ 200 nA
  - Magnification : 30 x ~ 1,280 kx
- Ion optics - Resolution : 5 nm @ 30 kV
  - Accelerating voltage : 500 V - 30 kV
- Multichem gas injection systems : C, Pt, W, H2O

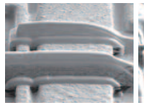
Applications

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

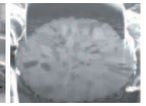


Cross section

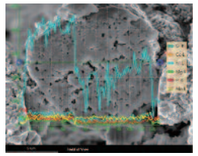
SE Image



Pt,C deposition



SI Image



EDS

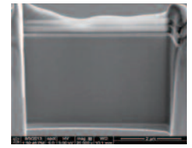
Room #B108

Specifications

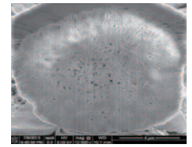
- Electron optics - Resolution : 1.2 nm @ 30 kV
  - Accelerating voltage : 1 ~ 30 kV
  - Probe current : ~ 200 nA
  - Magnification : 30 x ~ 1,280 kx
- Ion optics - Resolution : 7 nm @ 30 kV
  - Accelerating voltage : 2 ~ 30 kV
  - Probe current : 1 pA ~ 65 nA
  - Magnification : 40 x ~ 1,280 kx

Applications

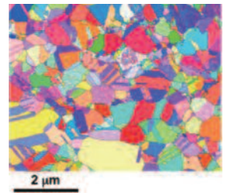
- Ultra high resolution electron, ion image
- TEM sample preparation
- Energy dispersive spectroscopy (EDS)
- EBSD image



TEM sample



Cross section



EBSD

05 Field Emission Scanning Electron Microscope

Model • SU8220 [Hitachi, Japan] | S-4800 [Hitachi, Japan]

Principle

SEM is a microscope that uses electrons instead of light to form an image. The SEM uses electromagnets rather than lenses, the researcher has much more control in the degree of magnification. Field-emission scanning electron microscope provides ultra high resolution image down to 1 nm resolution thanks to the inherent brightness of field–emission electron gun.

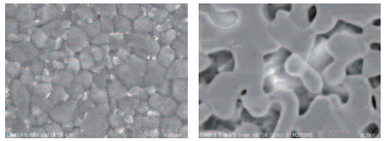
Room #B114

Specifications

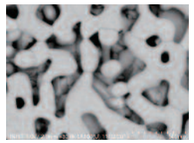
- Electron gun : Cold cathode field emission
- Resolution : 0.8 nm @ 15 kV, 1.1 nm @ 1 kV (Deceleration mode)
- Magnification : LM 20 ~ 2,000 x, HM 100 ~ 800,000 x
- Accelerate voltage : 0.1 ~ 30 kV (0.1 kV/step)
- Electrical image shift : ±12 μm (WD = 8 mm)

Applications

- Secondary electron image
- Backscattered electron image
- Energy dispersive X-ray analysis EDS
- X-ray elemental mapping
- Nano-particles characterization



SE image SE image



BSE image

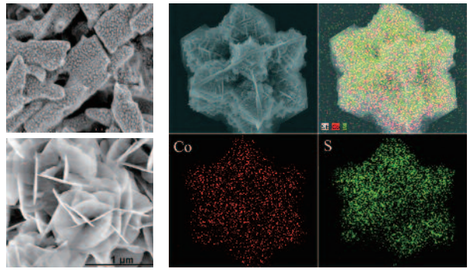
Room #B110

Specifications

- Electron gun : Cold cathode field emission
- Resolution : < 1.0 nm @ 15 kV
- Magnification : LM 20 ~ 2,000 x, HM 100 ~ 800,000 x
- Accelerate voltage : 0.1 ~ 30 kV (0.1 kV/step)
- Electrical image shift : ±12 μm (WD = 8 mm)

Applications

- Secondary electron image
- Backscattered electron image
- Energy dispersive X-ray analysis EDS
- X-ray elemental mapping
- Nano-particles characterization

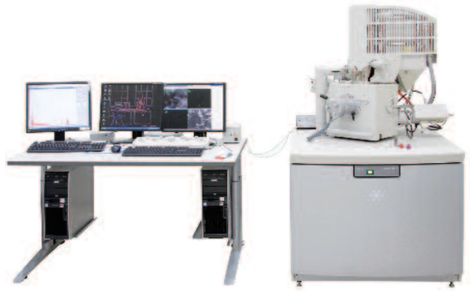


06 Field Emission Scanning Electorn Microscope

Model • Quanta200 [FEI, USA] | NovaNanosem230 [FEI, USA]

Principle

SEM is a microscope that uses electrons instead of light to form an image. The SEM uses electromagnets rather than lenses, the researcher has much more control in the degree of magnification. Field-emission scanning electron microscope provides high resolution image down to 1 nm resolution thanks to the inherent brightness of field–emission electron gun.



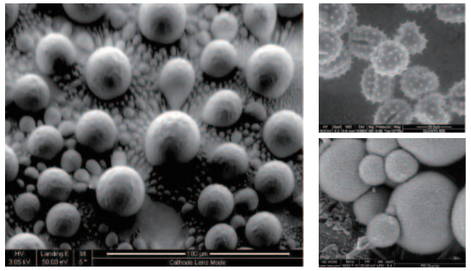
Room #B110

Specifications

- Electron gun : 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
- Heating stage : 1,500 ℃
- Cooling stage : -20 ℃

Applications

- High vacuum mode
- Low vacuum mode (10 ~ 130 Pa)
- ESEM mode (10 ~ 4,000 Pa)
- X-ray elemental mapping
- Backscattered electron image



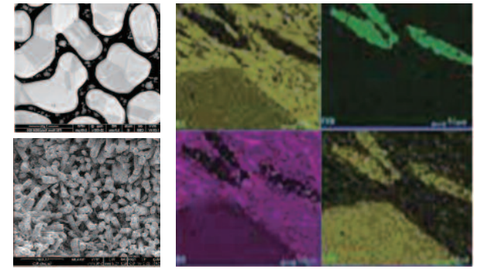
Room #B114

Specifications

- Electron gun : Schottky type thermal FE gun
- Resolution : < 1.0 nm @ 15 kV
  < 1.6 nm @ 1 kV
- Probe current : 0.6 pA ~ 100 nA
- Reduced charge & contamination operation

Applications

- Secondary electron image
- Backscattered electron image
- Energy dispersive X-ray analysis EDS
- X-ray elemental mapping
- Nano-particles characterization



TEM/SEM sample prep.

07 Ultramicrotome | Ion milling system

Model • CR-X [RMC, USA] | IM4000 [Hitachi, Japan]

Principle

Ultramicrotome is precision mechanical instrument designed to cut uniformly thin sections of materials for detailed microscopic examination.

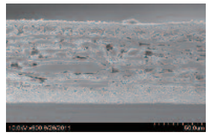
Room #B115

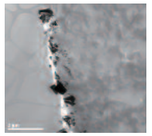
Specifications

- Sectioning thickness : 5 nm ~ 15 μm
- Cutting speed : 0.1 ~ 49.9 mm/sec
- Specimen auto feed : 200 μm

Applications

- Optical, SEM and TEM sample preparation





Principle

Ion milling system is used to prepare specimens for SEM imaging and analysis such as EDS and EBSD, and is capable of both cross-section and flat ion milling.

Room #B115

Specifications

- Type : cross-section milling
- Accelerating voltage : 0 ~ 6 kV
- Maximum sample size : 20(W) X 12(D) X 7(H) mm
- Swing angle : ± 15 °, ± 30 °, ± 40 °
- Milling rate : cross-section - 300 μm/hr (sample Si, 6 kV) or better
- Ar gas flow contro : high accuracy mass flow control

Applications

- High-quality sectioning (paper, polymers, powders)
- SEM sample preparation

Razor cutting

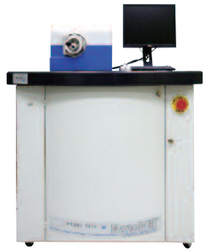
Ion Milling

Nano Mill | Low Angle Ion Mill

Model • Model 1040 [Ficshione, USA] | Model 1050 [Ficshione, USA]

Principle

Nano mill system's concentrated argon ion beam, typically in the energy range of 50 to 2000 eV, excels at targeted milling and specimen surface damage removal.



Room #B115

Specifications

- Beam energy : 50 ~ 2000 V
- Beam current density : 1 mA/cm²
- Beam diameter : 2 μm
- Milling angle : 0 ~ ± 10 °
- Stage temperature : -175 °C

Applications

- TEM specimen preparation

Principle

Low angle ion mill is a machine fabricating a semiconductor and inorganic materials in the diameter of the disk-shaped 3 mmφ thickness 50 ~ 80 μm and create a sample for TEM analysis to several tens of nanometers thin by making the disk medium.

Specifications

- Beam energy : 100 ~ 6000 V
- Beam current density : 10 mA/cm²
- Beam diameter : 2 μm
- Milling angle : 0 ~ ±10 °
- Specimen rotation angle : 360 °

Applications

- TEM specimen preparation

Room #B114

08 Mechanical Polishing System | Mounting Press | Low Speed Saw

Model • Metprep3/Multiprep [ALLIED, USA] | Techpress 2 [ALLIED, USA] | TechCut 4 [ALLIED, USA]

Principle

The mechanical polishing system enables precise semiautomatic sample preparation of a wide range of materials for microscopic (optical SEM, FIB, TEM, AFM etc.) evaluation.

Room #B111

Specifications

- Platen JOG speed : 40 ~ 600 rpm
- High-torque DC motor : 375 W
- Cycle time : 0 ~ 120 minutes

Applications

- Cross-sectioning
- Serial/3-D preparation
- Wedge polishing, EBSD polishing
- SIMS sample preparation

Principle

The mounting press is used to encapsulate samples for metallographic preparation.

Room #B111

Specifications

- Heating power : 1500 W
- Preheat/molding temp : 0 ~ 200 °C
- Molding pressure : ~5,500 psi(379 Bar)

Applications

- Variable sample mounting

Principle

The low speed saw is for cutting smaller, delicate samples that cannot tolerate increased heat caused by high speed sectioning.

Room #B111

Specifications

- Blade range : 75 ~ 150 mm
- Variable speed : 10 ~ 500 rpm
- Cutting capacity : 51 mm

Applications

- Variable sample sectioning

Dimple Grinder | Inverted Metallurgical Microscope

Model • Model 656 [Gatan, USA] | DMI3000 M [Leica, Germany]

Principle

Dimple grinder is used to create a dimple in the thinned sample for a thinner central area and mechanical stability.

Room #B111

Specifications

- Wheel speed : 100 ~ 600 rpm
- Conuter weight : 0 ~ 60 g
- Accuracy : 1 μm
- Stereo microscope : 40 x ~ 80 x
- Micro position accuracy : 10 μm

Applications

- TEM specimen preparation

Principle

Inverted Microscope can observe the microstructure of the polymer material, metal, organic material, inorganic material etc.

Room #B115

Specifications

- Source : Halogen lamp
- Magnification : 50 x ~ 1,000 x
- 3 plate mechanical stage

Applications

- Observation of the microstructure

09 Advanced Plasma System | PIPS

Model • Gatan 690 [Gatan, USA] | Gatan 691 [Gatan, USA]

Principle

Advanced plasma cleaning system removes the hydrocarbon contamination on TEM and SEM samples.

Room #B104

Specifications

- RF power supply : 50 W
- Operation pressure : 400 mTorr
- Gas selection : H_2/O_2, Ar/O_2, air

Applications

- TEM specimen preparation

Principle

PIPS ion mill is a precision ion polisher system designed to produce high quality, TEM specimens with large electron transparent area.

Room #B114

Specifications

- Beam energy : 1 ~ 6 keV
- Beam density : 10 mA/cm²
- Beam tilt : 0 ~ ± 10 °
- Beam diameter : about 350 μm
- Continuous rotation : 1 ~ 6 rpm
- Polishing sector speed : 6 rpm
- Each polishing sector : 60 °

Applications

- TEM specimen preparation

PECS | Plunge Freezer

Model • Gatan 682 [Gatan, USA] | VITROBOT [FEI, USA]

Principle

PECS is the ideal instrument for application requiring sample cleaning or etching followed by high-resolution sputter coating.

Specifications

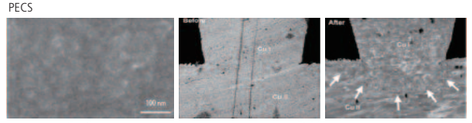
- Ion guns : one penning ion guns(Ar)
- Ion beam energy : 1.0 keV ~ 10.0 keV
- Etched area : about 7 mm ~ 10 mm
- Sample rotation : 10 ~ 60 rpm
- Target : Ti, C

Applications

- SEM sample coating and etching

Room #B114

PECS



Coating Etching

Principle

Plunge freezer performs the cryo-fixation process at constant physical and mechanical conditions like temperature, relative humidity, blotting conditions and freezing velocity.

Specifications

- Working temperature : 4 ~ 60 °C
- Maintain relative humidity : 100 %

Applications

- Biological TEM specimen preparation

Room #B105

X-ray Analysis

10 High Resolution Powder X-ray Diffractometer | High Resolution Thin Film X-ray Diffractometer

Model • SmartLab [Rigaku, Japan] | D8 Discover [Bruker, Germany]

Principle

X-ray diffraction is based on constructive interference of monochromatic X-rays and a crystalline sample. The X-rays are generated by a cathode ray tube, filtered to produce monochromatic radiation, collimated to concentrate, and directed toward the sample. The interaction of the incident rays with the sample produces constructive interference when conditions satisfy Bragg's Law ($n\lambda=2d \sin\theta$). This law relates the wavelength of electromagnetic radiation to the diffraction angle and the lattice spacing in a crystalline sample. These diffracted X-rays are then detected, processed and counted. By scanning the sample through a range of 2θ angles, all possible diffraction directions of the lattice should be attained due to the random orientation of the powdered material. Conversion of the diffraction peaks to d-spacings allows identification of the mineral because each mineral has a set of unique d-spacings. Typically, this is achieved by comparison of d-spacings with standard reference patterns.

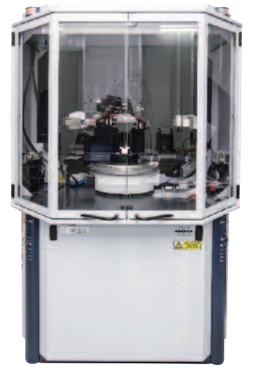
Room #B101-2

Specifications

- X-ray source : Kalpha1 only Cu-rotating anode x-ray
- X-ray generator power : 9 kW (40 KV, 450 mA)
- Goniometer (angular range) : 10 ° ~ 130 °
- Attachment
  1) Capillary rotation attachment
  2) Auto sample changer

Applications

- Phase Analysis
- Qualitative, quantitative analysis
- Analysis for cell parameter, degree of crystallinity and crystallite size
- Refinement analysis for poly-crystal powders



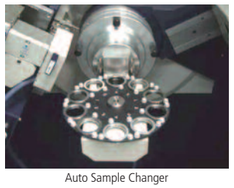
Room #B101-2

Specifications

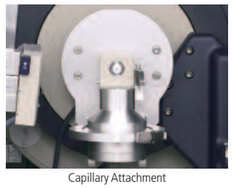
- X-ray source : Cu x-ray tube
- X-ray generator : 3 kW (40 KV, 40 mA)
- Incident Beam Optics for High Resolution :
  4-bounce Monochromator for Cu Radiation, Asymmetric Ge 220
- Diffracted Beam Attachment for High Resolution :
  3-bounce Germanium channel cut monochromator
- Goniometer (angular range) : 10 ° ~ 130 °

Applications

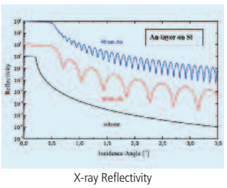
- Phase analysis of the films
- Grazing incidence investigations (GID)
- Determination of the thickness, roughness, and density of the film (XRR)
- Determination of lattice mismatch between film & substrate (Rocking curve)



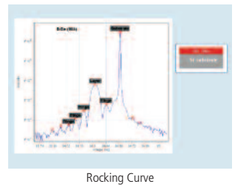
Auto Sample Changer



Capillary Attachment



X-ray Reflectivity



Rocking Curve

11 High Power X-ray Diffractometer | Normal Powder X-ray Diffractometer

Model • D/MAX 2500V/PC [Rigaku, Japan] | D8 Advance [Bruker, Germany]

Principle

X-ray diffraction is based on constructive interference of monochromatic X-rays and a crystalline sample. The X-rays are generated by a cathode ray tube, filtered to produce monochromatic radiation, collimated to concentrate, and directed toward the sample. The interaction of the incident rays with the sample produces constructive interference when conditions satisfy Bragg's Law ($n\lambda=2d \sin\theta$). This law relates the wavelength of electromagnetic radiation to the diffraction angle and the lattice spacing in a crystalline sample. These diffracted X-rays are then detected, processed and counted. By scanning the sample through a range of 2θ angles, all possible diffraction directions of the lattice should be attained due to the random orientation of the powdered material. Conversion of the diffraction peaks to d-spacings allows identification of the mineral because each mineral has a set of unique d-spacings. Typically, this is achieved by comparison of d-spacings with standard reference patterns.

Room #B101-2

Specifications

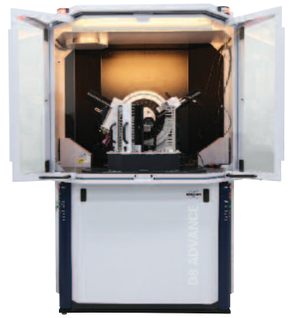
- X-ray source : Cu-rotating anode
- X-ray generator : 18 kW (60 kV, 300 mA)
- Two goniometer angular range : 0.5 ° ~ 130 °
- Attachment
  - high temperature (RT ~ 1,500 °C)
  - Auto sample

Applications

- Phase Analysis of poly-crystal powder
- Characterization of materials with temperature variation

SAXS

WAXS



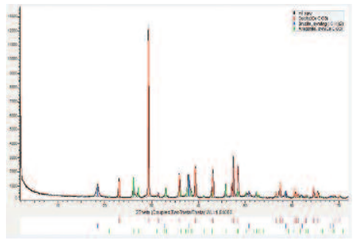
Room #B101-2

Specifications

- X-ray source : Cu-closed x-ray tube
- X-ray generator : 3 kW (40 KV, 40 mA)
- θ-θ based goniometer
- Angular range (2θ) : 10 ° ~ 130 °
- Attachment
  - Auto sample changer

Applications

- Material characterization (Phase analysis)



Phase ID from peak position

12 Single Crystal X-ray Diffractometer | Wavelength Dispersive X-ray Fluorescence Spectrometer

Model • R-AXIS RAPID II [Rigaku, Japan] | S8 Tiger [Bruker, Germany]

Principle

Single-crystal diffractometers use either 3- or 4-circle goniometers. These circles refer to the four angles (2θ, X, φ, and Ω) that define the relationship between the crystal lattice, the incident ray and detector. Samples are mounted on thin glass fibers which are attached to brass pins and mounted onto goniometer heads. Adjustment of the X, Y and Z orthogonal directions allows centering of the crystal within the X-ray beam.
X-rays leave the collimator and are directed at the crystal. Rays are either transmitted through the crystal, reflected off the surface, or diffracted by the crystal lattice. A beam stop is located directly opposite the collimator to block transmitted rays and prevent burn-out of the detector. Reflected rays are not picked up by the detector due to the angles involved. Diffracted rays at the correct orientation for the configuration are then collected by the detector.

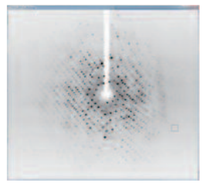
Room #B101-2

Specifications

- X-ray tube : Mo source
- X-ray generator : 3 kW (max : 60 kV, 60 mA)
- Goniometer : decoupled θ and 2θ
- Imaging Plate (IP) detector : + 5 ~ + 35 °C

Applications

- New mineral identification, crystal solution and refinement
- Determination of unit cell, bond-lengths, bond-angles and site-ordering
- Characterization of cation-anion coordination
- Variations in crystal lattice with chemistry



Diffraction pattern

Principle

X-ray fluorescence is the emission of characteristic secondary X-rays from a material that has been excited by bombarding with high-energy X-rays. XRF is able to analyze quality and quantity of various elements of solid materials such as geological specimens, slugs, soils, and ceramics.

Room #B101-2

Specifications

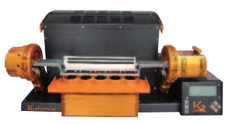
- X-ray generator : 4 kW (max. : 60 kV, 170 mA)
- X-ray tube : Rh-anode source
- Goniometer : decoupled θ and 2
- Analysis elements : 4 Be ~ 92 U
- Concentration : 100 ppm ~ 100 %
- Sample preparation equipment
  - Ball mill (8000D)
  - pressor (X-Press)
  - Bead machine (k2)
  - Freezer mill (6770)

Applications

- Element or oxide analysis
- Semi-quantitative analysis

Ball mill

Pressor



Bead machine

Freezer mill

Spectroscopic Analysis

13 600 MHz FT-NMR | 400 MHz FT-NMR

Model • VNMRS 600 [Agilent, USA] | AVANCE III HD [Bruker, Germany]

Principle

NMR(Nuclear Magnetic Resonance) spectroscopy uses radio-wave interacted with nuclear spin. Nuclear spin is degenerate when sample placed on normal condition. If sample closed to magnet(B_0), Nuclear spin`s energy state will be splitted according to rotation direction. Radio-wave could change energy state level of nuclear spin. NMR provide chemical shift, integration, diffusion coefficient(T1, T2 relaxation time). It determine the structure of most organic and some inorganic molecules.

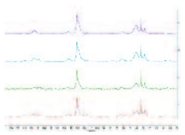
Room #B119

Specifications

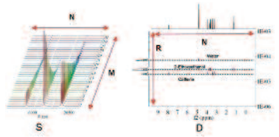
- 14.09 T magnet
- 3 channel console
  Ch1 : ^{1}H, ^{19}F
  Ch2 : ^{15}N ~ ^{31}P
  Ch3 : Decoupling
- Available probes
  - Dual broad band auto X probe (Solution NMR probe)
  - Automated triple resonance probe (Solution NMR probe)
  - 1.6 mm HXY fast MAS triple resonance probe (Solid-state NMR probe)
  - 5 mm double resonance MAS solid probe (Solid-state NMR probe)
  - Nano TM probe (HR-MAS probe in Bruker)

Applications

- Structural elucidation of chemicals
- Structural determination of biomolecules (DNA, RNA, proteins, peptides, etc.)
- Solution NMR: 1D, 2D(COSY, NOESY, ROESY, HSQC, HMBC, etc.), DOSY
- Solid-satete NMR: 1D(One-pulse, CP-MAS, CP-MAS-TOSS)
- Dual broad band auto X probe
  - Detectable nuclei : ^{1}H, ^{7}Li, ^{9}Be, ^{11}B, ^{13}C, ^{15}N, ^{17}O, ^{19}F, ^{23}Na, ^{27}Al, ^{29}Si, ^{31}P, ^{35}Cl, ^{119}Sn, etc.



^{13}C CP-MAS of butadiene rubber



DOSY(Diffusion Ordered SpectroscopY)

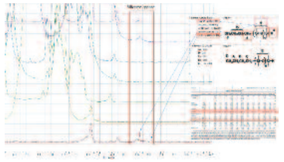
Room #B119

Specifications

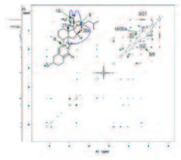
- 9.4 T magnet
- 2 channel console
  - Channel 1 : high band with ^{1}H, ^{19}F observe
  - Channel 2 : broadband observe (^{31}P ~ ^{15}N)
- Channel 1 = 100 Watt / Channel 2 = 500 Watt
- Auto Tune & Match
- 5 mm BBO NMR Probe
- 24 Auto-sampler
- Topspin 3.5 pl7 (Windows 7)
- Temperature : 25 ~ 80 °C

Applications

- Structural elucidation of chemicals
- Structural determination of biomolecules (DNA, RNA, proteins, peptides, etc.)
- Solution NMR : 1D, 2D(COSY, NOESY, ROESY, HSQC, HMBC, etc.), DOSY
- 5 mm BBO probe
  - Detectable nuclei : ^{1}H, ^{7}Li, ^{13}C, ^{15}N, ^{19}F, ^{31}P, etc.



^{1}H NMR of silicone oil in fiber



ROESY spectrum of vitamin-d3

14 UV-Vis-NIR | UV-Vis Microspectrometer

Model • Cary 5000 [Agilent, USA] | 20/20 PV [CRAIC, USA]

Principle

UV-Vis-NIR spectroscopy is used for optical absorbance, transmittance, and reflectance measurement in the wavelength range 175 ~ 3,300 nm (UV-Vis spectrum interacts with electron transition, NIR spectrum interacts with molecular vibration). For example, When a sample of an unknown compound is exposed to light, certain functional groups within the molecule absorb light of different wavelength. It is used for qualitative and quantitative analysis of materials.

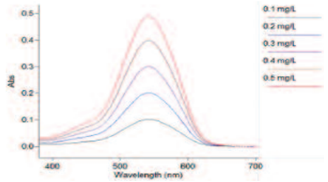
Room #B111

Specifications

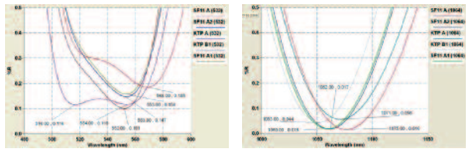
- Wavelength range : 175 ~ 3,300 nm
- Limiting resolution : UV-Vis < 0.048 nm
  NIR < 0.2 nm
- Monochromator : double out-of-plane littrow
- Source - UV : D2 lamp
  - Vis-NIR : tungsten halogen lamp
- Detector - UV-Vis : PMT
  - NIR : PbS
- Accessory : VW SRA, DRA, VASRA

Applications

- Measurement of absorbance and transmittance
- Measurement of reflectance
- Calculation of energy-band gap, haze



Absorbance spectra of chromium solution



Absolute specular reflectance spectra of low-R samples

Principle

UV-Vis-NIR microspectrometer measures transmission(absorption) and reflectance spectrum for micron size areas of sample. And while microspectrum is being acquired, the sample is viewed with high-resolution digital image.

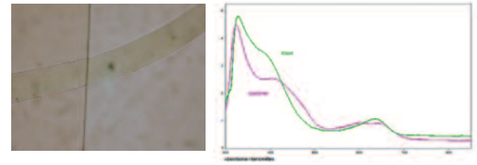
Room #B111

Specifications

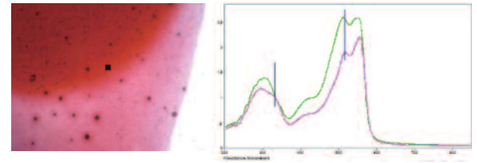
- Spectral rage : 200 ~ 1050 nm
- Spectrum bandwidth : 0.32 nm
- Source : XBO75(Xe lamp), HAL 100(Halogen lamp)
- Full range single scan time : 8 msec
- Image resolution : more than 1 Mpixel
- Mode : absorbance, transmittance, reflectance

Applications

- Microscale characterization
- Micro-contaminant identification
- Identifying protein, DNA, RNA crystals



Spectrum comparison of two green wool fibers



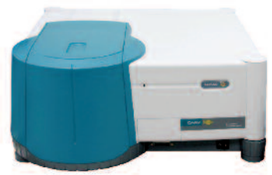
Microspectrometer and image of red pigment

15 Fluorometer | Spectrofluorometer | Fluorescence Spectrometer

Model • Cary Eclipse [Agilent, USA] | FP-8500 [Jasco, Japan] | FLS920 [Edinburgh, UK]

Principle

Fluorescence occurs that a photon is emitted the electron when the molecule returns to the electronic ground state from the excited state. It is capable of measuring excitation and emission spectra in UV-Vis range.



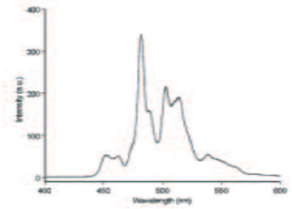
Room #B111

Specifications

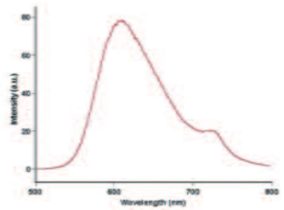
- Light source : Xe lamp (75 kW)
- Wavelength range : 200 ~ 900 nm
- Wavelength accuracy : < 1.5 nm
- Limiting resolution : 1.5 nm
- Detector : PMT (photomultiplier tube)
- Temperature : 25 ~ 100 °C

Applications

- Qualitative and quantitative analysis of fluorescence for organic and inorganic compounds
- Study of kinetic
- Temperature control measurement
- Multi-cell measurement



Fluorescence emission spectra of Ovalene in PMMA



Chemiluminescence of Tris (2,2' - bipyridyl) Ruthenium(II) complex

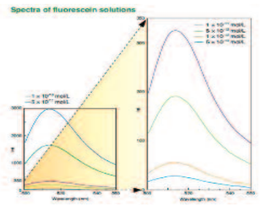
Room #B111

Specifications

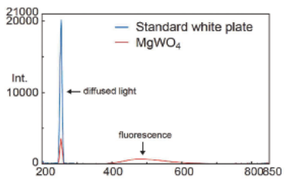
- Light source : Xe lamp (150 W)
- Wavelength range : 200 - 850 nm
- Wavelength accuracy : < 1.0 nm
- Limiting resolution : 1.0 nm
- Detector : PMT
- Integrating sphere
- Quantum yield scan range : 350 ~ 850 nm
  - Liquid cell : 1 ~ 3 mm
  - Film size : 2 x 2 cm

Applications

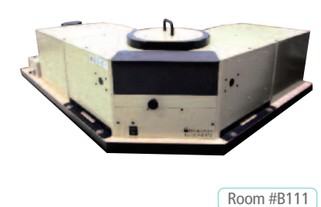
- Quantum yield (external & internal)
- Qualitative and quantitative analysis of fluorescence for organic and inorganic compounds
- Study of kinetic
- Measurement of quantum yield



Highest S/N performance spectra of fluorescein solution



Quantum yield calculation (80.8 %) of $MgWO_4$



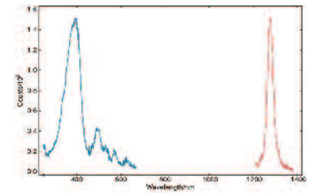
Room #B111

Specifications

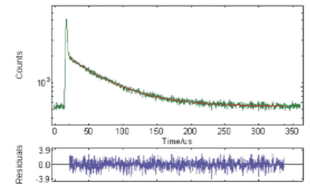
- Light source
  - Xe lamp (450 W)
  - Microsecond flash lamp (MCS)
  - Nanosecond flash lamp
- Wavelength range
  - High speed PMT : 200 - 850 nm
  - NIR PMT : 300 - 1400 nm
- Wavelength accuracy : < 0.2 nm
- Limiting resolution : 0.05 nm
- Detector : PMT

Applications

- Lifetime
- Qualitative and quantitative analysis of fluorescence for organic and inorganic compounds
- Study of kinetic



Emission spectrum of hematoporphyrin in ethanol, λ_{ex} = 380 nm, λ_{em} = 1270 nm



Time Resolved Singlet Oxygen Measurements
μF900 H rate 100 Hz, NIR-PMT, Fit Result : t = 58.5 μs

16 FT-IR | Sub-micron size & Zeta Potential Measuring System

Model • 670-IR ; 620-IR Imaging Model [Agilent, USA] | NanoZS [Malvern, UK]

Principle

FT-IR stands for Fourier transform infrared, the preferred method of infrared spectroscopy. When IR radiation is passed through a sample, some radiation is absorbed by the sample and some passes through (is transmitted). Spectra patterns of the fourier transform results help identify or quantify the sample, since molecules exhibit specific IR fingerprints.

Room #B111

Specifications

- Spectral range : 4000 ~ 50 cm^{-1}
- Spectral resolution : 0.075 cm^{-1}
- Detector
  - MCT (10000 ~ 450 cm^{-1})
  - DLaTGS (10000 ~ 150 cm^{-1})
  - Far-IR DLaTGS (600 ~ 50 cm^{-1})
- Signal to noise ratio (5 sec) : 12,000 : 1 with 25 % source power
- ATR imaging : 1.4 μm per 1 pixel

Applications

- Qualitative analysis of samples
- Quantitative analysis of samples
- Defect analysis
- Analysis of molecular structure

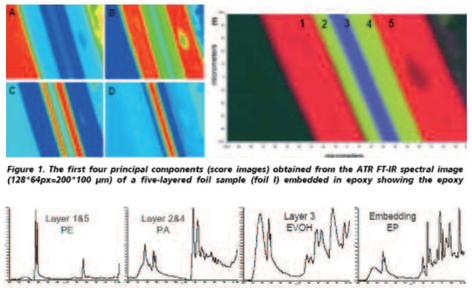


Figure 1. The first four principal components (score images) obtained from the ATR FT-IR spectral image (128*64px=200*100 μm) of a five-layered foil sample (foil I) embedded in epoxy showing the epoxy

ATR FT-IR spectra and spectral image of a five-layered foil sample

Principle

Particles, emulsions, and molecules in suspension undergo Brownian motion. If the particles or molecules are illuminated with a laser, the intensity of the scattered light fluctuates at a rate that is dependent upon the size of the particles as smaller particles are kicked further by the solvent molecules and move more rapidly. Analysis of these intensity fluctuations yields the velocity of the Brownian motion and hence the particle size using the Stokes-Einstein relationship.

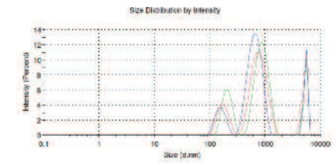
Room #B111

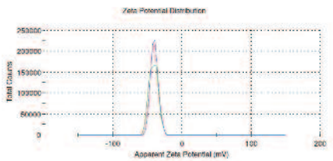
Specifications

- Particle measurement
  - Volume range of 12 μL ~ 1.0 mL
  - Sample concentration : > 40 % by weight
- Zeta potential measurement
  - Principle : laser doppler velocimetry
  - Range : - 150 mV ~ + 150 mV
- Attachment : Multi Purpose Titorator (MPT)

Applications

- Size measurement
- Zeta-potential measurement



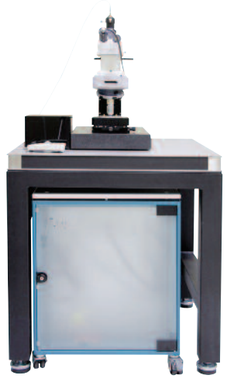


17 Micro Confocal Raman | Combined AFM & Confocal Raman Microscope

Model • Alpha300R [WITec, Germany] | Alpha300S [WITec, Germany]

Principle

Raman information present to characterization of the molecular structure by scattered radiation of different wavelengths. The energy change (either lost or gained) of Raman depends on the symmetry of the molecule. It is possible to obtain confocal Raman microscopy combined AFM.



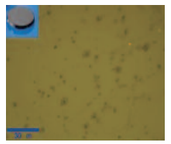
Room #B107

Specifications

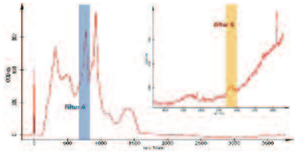
- Laser wavelength : 532 nm
- Lens magnification : 50 x (N.A. 0.8, W.D. 0.54), 10 x (N.A. 0.25, W.D. 7.0)
- Single spectrum, line scan, image mapping
- Heating cryostat temperature range : ~ 600 °C
- Freezing cryostat temperature range : 77 ~ 300 K
- Powder, liquid, film sample

Applications

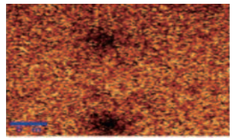
- Measurement of raman image & single spectrum with temperature variation

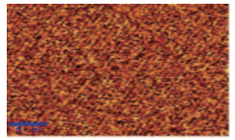


Confocal Image



Single Spectrum





Scan Image

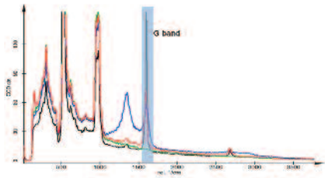
Room #B107

Specifications

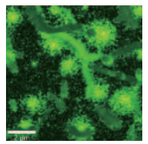
- AFM mode (Acoustic AC and contact mode)
- Laser wavelength : 532 nm/ 633 nm/ 785 nm
- Lens magnification : 100 x (N.A. 0.9, W.D. 1.0), 50 x (N.A. 0.5, W.D. 10.6), 20 x (N.A. 0.04, W.D. 3.8)
- Single spectrum, line scan, image mapping, TERS, SNOM
- Temperature controller (-185 ~ 300 °C)
- Powder, liquid, film sample

Applications

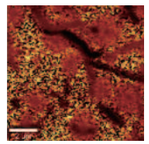
- Measurement of surface topography (AFM mode)
- Measurement of raman image & single spectrum (Raman mode)



Confocal Raman AFM imaging of SWCNT



Width analysis of G band



Center of mass of G band

Surface Analysis

18 Time-of-Flight Secondary Ion Mass Spectrometer

Model • TOF-SIMS 5 [ION TOF, Germany]

Principle

Secondary ion mass spectrometry (SIMS) is a technique to analyze the composition of solid surfaces and thin films by sputtering the surface of the specimen with a focused primary ion beam and collecting and analyzing ejected secondary ions. Time-of-flight (TOF) is a method of mass spectrometry in which ions are accelerated by an electric field of known strength. The velocity of the ion depends on the mass-to-charge ratio. The time that it subsequently takes for the particle to reach a detector at a known distance is measured. This time will depend on the mass-to-charge ratio of the particle (heavier particles reach lower speeds).

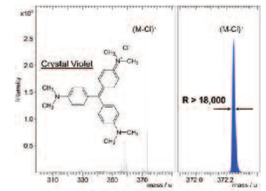
Room #B118

Specifications

- Mass resolution (@ 29 amu) : >10,000 (for Bi+)
- Sensitivity (@ 29 amu) : >3 x 10^{-8} Al+/nC
- Mass range : > 9,000 amu
- Base pressure : < 5.0 x 10^{-10}
- A self-adjusting charge compensation system
- Primary source : pulsed Bi cluster ion source
- O_2 and Cs dual sources for depth profiling

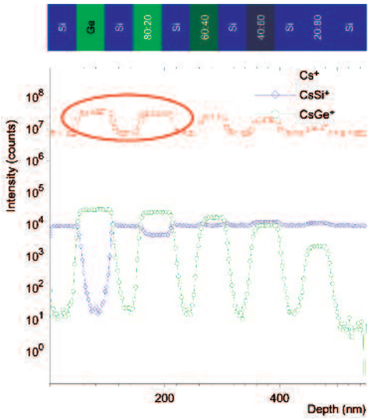
Applications

- Analysis of molecular structure
- Analysis of trace elements (including H, He)
- Chemical mapping (SIMS imaging)
- Depth profiling and 3D analysis



Positive Surface Spectrum of Crystal Violet on a Silicon Wafer

Chemically Treated Woven Fibres



Depth Profiling of Multilayer

19 X-ray Photoelectron Spectroscope

Model • K-alpha [ThermoFisher, UK] | Escalab 250 Xi [ThermoFisher, UK]

Principle

X-ray photoelectron spectroscopy (XPS) is a quantitative spectroscopic technique that measures the elemental composition, empirical formula, chemical state and electronic state of the elements that exist within a material. XPS spectra are obtained by irradiating a material with a beam of aluminum or magnesium X-rays while simultaneously measuring the kinetic energy (KE) and number of electrons that escape from the top 1 to 10 nm of the material being analyzed.

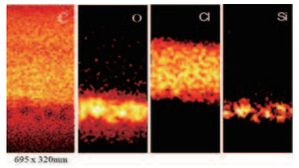
Room #B116

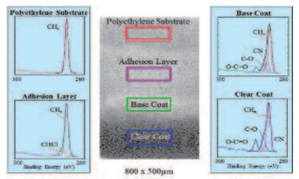
Specifications

- Source
  - Monochromated Al Ká[1] for XPS
  - Ultraviolet He for UPS
- Spot size
  - XPS : 30 ~ 900 μm
  - UPS : 2 mm
- Binding energy
  - XPS : 0 ~ 1,496 eV (^{3}Li to ^{92}U)
  - UPS : 0 ~ 21.2 eV
- Resolution
  - Energy resolution (FWHM) : < 0.77 eV for Ag at 650 μm x-ray spot
  - Hemispherical energy analyzer resolution : 0.45 eV
  - XPS imaging resolution : 3 μm
- Charge compensation
- Ultra high vacuum : 1 x 10^{-10} torr

Applications

- Surface spectroscopy
- Depth profiling
- Surface imaging (mapping)
- Work function





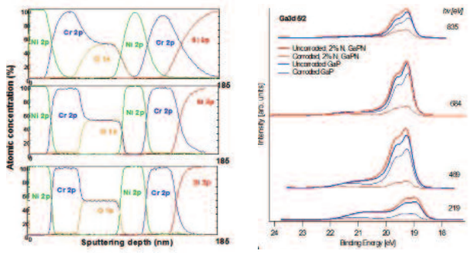
Room #B117

Specifications

- Source : Monochromated Al Ká[1]
- Spot size : 50 ~ 400 μm
- Binding energy : 0 ~ 1,496 eV (^{3}Li to ^{92}U)
- Energy range : 200 eV ~ 3 keV
- Energy resolution (FWHM) : 0.97 eV for Ag at 400 μm x-ray spot

Applications

- Surface spectroscopy
- Depth profiling
- Surface imaging (mapping)

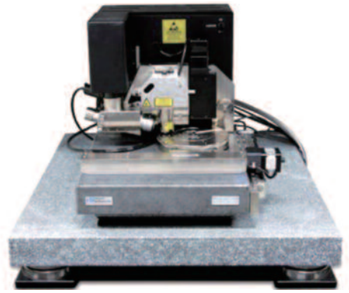


20 Atomic Force Microscope

Model • Dimension 3100 [Veeco, USA] | Multimode 8 [Veeco, USA]

Principle

AFM or SPM is a branch of microscopy that forms images of surfaces using a physical probe that scans over the specimen. An image of the surface is obtained by mechanically moving the probe in a raster scan of the specimen. An image of the surface is obtained by mechanically moving the probe in a raster scan of the specimen line by line and recording the probe-surface interaction as a function of position.



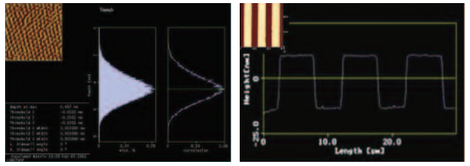
Room #B113

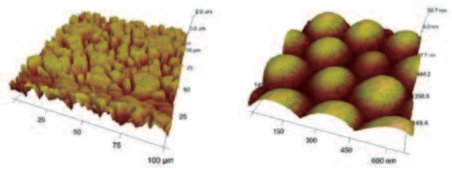
Specifications

- Resolution
  - Vertical resolution : 0.1 Å
  - Lateral resolution : 1 Å
  - Noise level RMS : < 0.5 Å RMS
- Max sample size
  - Diameter : < 20.3 cm (8”)
  - Thickness : < 1.3 cm (0.5”)
- Scan size : < 100 μm

Applications

- Contact mode
  - Lateral force microscopy (friction)
- Tapping mode
  - Phase imaging (friction)
  - Electric force microscopy
  - Magnetic force microscopy





Room #B113

Specifications

- Resolution
  - Vertical resolution : 0.1 Å
  - Lateral resolution : 1 Å
  - Noise level RMS : < 0.3 Å RMS
- Max sample size
  - Diameter : < 1.5 cm (0.6”)
  - Thickness : < 1.3 cm (0.5”)
- Scan size : < 100 μm

Applications

- Contact mode
  - Lateral force microscopy (friction)
  - Force modulation (modulus)
  - Conductive AFM (conductivity)
  - Scanasyst mode (auto-morphology)
- Tapping mode
  - Phase imaging
  - Electric, Magnetic force microscopy
  - Surface potential imaging

Mass Analysis

21 Physisorption Analyzer

Model • ASAP 2020 [Micromeritics, USA] | ASAP 2420 [Micromeritics, USA]

Principle

physisorption is used to measure surface area and pore size. As more gas molecules are introduced into the system, the adsorbate molecules tend to form a thin layer that covers the entire adsorbent surface. Based on the well-known Brunauer, Emmett and Teller (B.E.T.) theory.

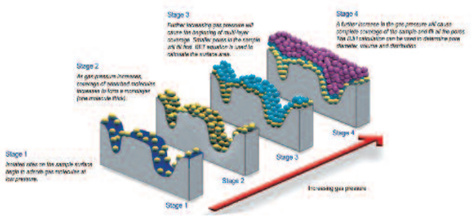
Room #B111

Specifications

- Pore Size Range : 3.0 ~ 5000 Å
- Analysis System
  - Pressure Range : 0 ~ 950 mmHg
  - Resolution : 0.001 mmHg
  - Accuracy : ± 0.1 % Full scale
- Degas system
  - Temperature Range : 25 ~ 450 °C
  - Backfill gas : He, N_2
  - Pressure Range : 0 ~ 950 mmHg
- Gas : N_2

Applications

- BET, langmuir surface area
- BJH, t-plot, MP, αs-Plot, D-A, H-K, DFT Plus
- Rate of adsorption
- Heat of adsorption
- Meso/micro-pores pore size distribution, volume



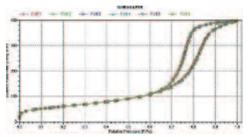
Room #B111

Specifications

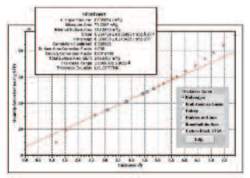
- Analysis System
  - Pressure Range : 0 ~ 950 mmHg
  - Resolution : 0.001 mmHg
  - Accuracy : ± 0.1 % Full scale
- Degas System
  - Pressure Range : 0 ~ 950 mmHg
  - Resolution : 0.001 mmHg
  - Accuracy : ± 0.1 % Full scale
  - Temperature Range : 25 ~ 450 °C
  - Backfill gas : He, N_2
- Gas : Nitrogen

Applications

- BET, langmuir surface.
- BJH, t-Plot, MP, αs-plot, D-A, H-K, DFT Plus (Micro/Mesopore)
- Pore size distribution, volume



Overlaid results from six samples of high surface area silica alumina



Both mesoporous and microporous sample

22 DART-Mass Spectrometer | MALDI-TOF(Matrix Assisted Laser Desorption Ionization Time-of-Flight Mass Spectrometer)

Model • AccuTOF4G+DART [JEOL, Japan] | Ultraflex III [Bruker, Germany]

Principle

DART stands for Direct Analysis in Real Time. It is a new ionization for rapid, non-contact surface sampling of compounds. Operating at ambient pressure with the sample at ground potential, the source enables near instantaneous determination of sample composition by using mass spectrometry. Electronic or vibronic excited-state species generated in the source interact with reagent molecules and polar or non-polar analyte present near the inlet of the mass spectrometer.

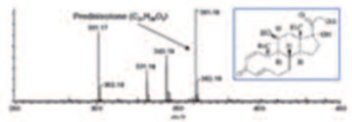
Room #B103-1

Specifications

- Ion source
  - ESI (Electrospray Ionization)
  - DART (Direct Analysis in Real Time)
- Analysis range : 6 ~ 10,000 amu (DART : 6 ~ 1,000 amu)
- Mass accuracy of ≤ 3 ppm

Applications

- Identification of purity of compound
- Analysis of molecular weight of compound
- Analysis of DNA, RNA, proteins
- Analysis of environmental samples (water, waste, soil)



Direct analysis of solid sample

Principle

Matrix-assisted laser desorption/ionization (MALDI) is a soft ionization technique used in mass spectrometry, allowing the analysis of biomolecules and large organic molecules which tend to be fragile and fragment when ionized by more conventional ionization methods. TOF/TOF is a tandem mass spectrometry method where two time-of-flight mass spectrometers are used consecutively. The first TOF-MS is used to separate the precursor ions, and the second TOF-MS analyzes the product ions. An ion gate for selecting the precursor ion, an ion fragmentation region (e. g. a collision cell) and an ion accelerator may be provided between the first and second TOF-MS.

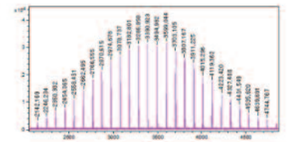
Room #B111

Specifications

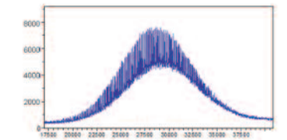
- Resolution ≥ 1,100 (in linear mode for protein)
- Mass accuracy of ≤ 80 ppm (in linear mode for protein)
- Mass accuracy of ≤ 3 ppm (in reflectron mode for peptide)
- Sensitivity in low attomole range with high S/N ratio in TOF/TOF mode

Applications

- Analysis of biomolecules (protein, peptide, sugar, etc)
- Analysis of large organic molecules (synthetic polymer, dendrimer, etc)



Polystyrene / Dithranol ionized with Ag^+



PMMA / DCTB ionized with Na^+

23 Liquid Chromatography Mass Spectrometer | Gas Chromatography Mass Spectrometer | GPC/MALS

Model • HCT Basic System [Bruker, Germany] | 450-GC & 320 MS [Bruker, Germany] | Agilent 1200 Series, miniDAWN [Agilent, USA/ Wyatt, USA]

Principle

LC/MS/MS is a powerful and widely used tool in qualitative and quantitative residue and contaminant analysis. The mixture is separated with HPLC preferably using a reversed-phase column. The analytes can be ionized with a suitable ion source by various methods, followed by partial fragmentation. After acceleration, they are deflected by a magnetic field which resolves them according to their mass.

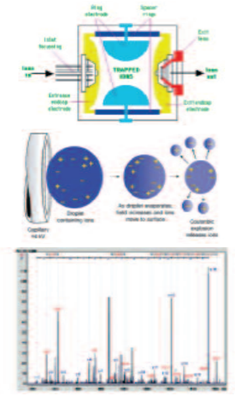
Room #B111

Specifications

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

Applications

- Analysis of organic composition
- Identification of molecular weight
- Analysis of DNA, RNA, proteins
- Analysis of environmental samples (water, waste, soil)



Principle

GC/MS/MS makes an effective combination for chemical analysis. Mixture of volatile substances is separated by gas chromatography. Via a transfer line the fractions of each peak are transferred into the ion source where the ionization takes place. After acceleration, the ions pass through a magnetic field which causes deviation of their linear flight curve according to their respective mass. After this magnetic field the detector counts the ions.

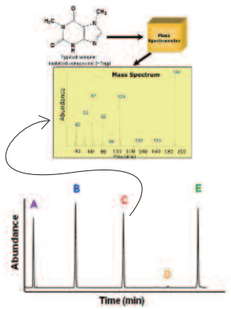
Room #B111

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 and by-products



Principle

Gel permeation chromatography (GPC) is a termused for when the separation technique size exclusion chromatography (SEC). GPC is often used to determined the relative molecular weight of polymer. Multiangle light scattering (MALS) is a technique for determining, independently, the absolute molar mass and the average size of particles in solution, by detecting how they scatter light.

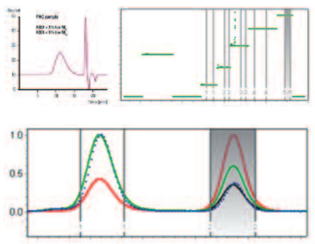
Room #B111

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
  - laser life time : >10,000 hours
  - detectors : 3 angles
- Molecular weight range : 103 ~ 106 g/mole
- Molecular size range : 10 ~ 50 nm

Applications

- Analysis of synthetic polymer
- Analysis of biopolymer



24 Element Analyzer I | Element Analyzer II

Model • Flash 2000 [Thermo Scientific, Netherlands] | TrueSpec Micro CHNS [Leco Corporation, USA]

Principle

Element analyzer determinates the percentage eights of carbon, hydrogen, nitrogen, sulfur and oxygen of a sample. This information is important to help determine the structure of an unknown compound, as well as to help prove the structure and purity of a synthesized compound. It is based on the dynamic flash combustion of the sample followed by reduction, trapping, complete GC Separation and detection of the products by thermal conductivity detector.

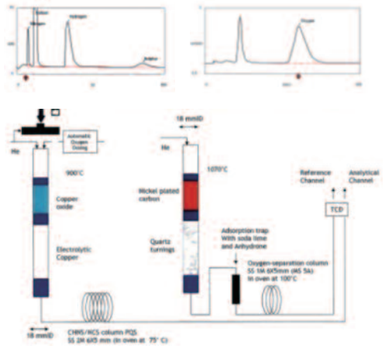
Room #B111

Specifications

- Measuring elements : C, H, N, S, O
- Measuring range : 0.01% ~ 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 and inorganic compounds
- Qualitative analysis of environmental samples
- Qualitative analysis of geological samples
- Identification of empirical formula for organic compounds



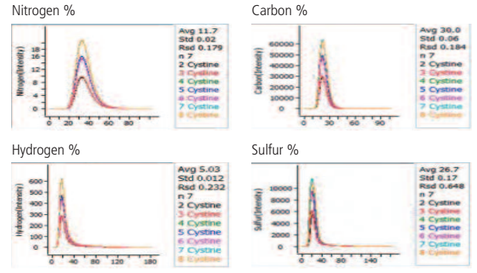
Room #B111

Specifications

- Measuring elements : C, H, N, S
- Measuring range : 0.01 % ~ 100 %
- Sample size : 0.01 ~ 2 mg
- Accuracy : 0.1 ~ 0.3% absolute
- Detector : TCD, IR cell
- Furnace temperature : 1,100 °C
- Analysis time
  - C, H, N, S : 5 min

Applications

- Qualitative analysis of organic and inorganiccompounds
- Qualitative analysis of environmental samples
- Qualitative analysis of geological samples
- Identification of empirical formula for organic compounds



Thermal & Physical Analysis

25 Thermogravimetric Analyzer | Differential Scanning Calorimeter

Model • Q500 [TA Instrument, USA] | Q200 [TA Instrument, USA]

Principle

Thermogravimetric Analysis (TGA) measures weight changes in a material as a function of temperature (or time) under a controlled atmosphere.
Its principal uses include measurement of a material's thermal stability and composition.

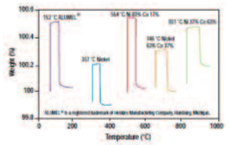
Room #B111

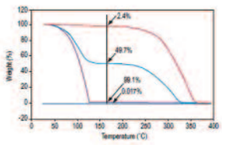
Specifications

- Maximum sample weight : 1 g
- Weight precision : ± 0.01 %
- Sensitivity : 0.1 micron
- Baseline dynamic drift : < 50 micron
- Temperature range : 25 ~ 900 °C
- Isothermal temp accuracy : ± 1 °C
- Isothermal heating rate : ± 0.1 °C
- Controlled heating rate : 0.01 ~ 100 °C/min
- Furnace cooling (forced air/N2) : 1000 ~ 50 °C < 12 min

Applications

- Compositional analysis
- Volatiles analysis
- Effect of additives
- Verification of thermal events
- Quantification of filler content
- Moisture content
- Thermal stability





Principle

Differential scanning calorimetry (DSC) is a thermo analytical technique in which the difference in the amount of heat required to increase the temperature of a sample. Enthalpy of samples is measured as a function of temperature or time.

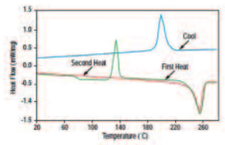
Room #B111

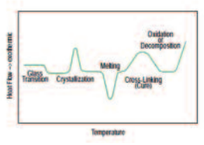
Specifications

- Temperature range : -80 ~ 400 °C
- Cooling accessories : - 80 ~ 0 °C
- Temperature accuracy : ± 0.1 °C
- Calorimetric reproducibility : ± 0.1 %
- Baseline curvature : 10 μW
- Sensitivity : 0.2 μW

Applications

- Glass transition temperature
- Crystallization time & temperature
- Percent crystallinity
- Heates of fusion and reaction
- Specific heat
- Rate of cure
- Degree of cure
- Reaction kinetics



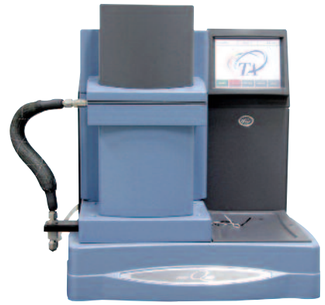


26 Dynamic Mechanical Analyzer | Simultaneous TGA/DSC

Model • Q800 [TA Instrument, USA] | Q600 [TA Instrument, USA]

Principle

Dynamic mechanical analysis measures the mechanical modulus of the material as a function of temperature, time, and frequency by giving the external force which vibrates to the specimen as stress of sinusoidal wave.



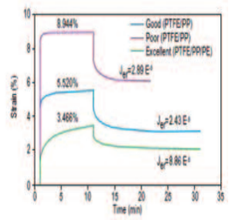
Room #B111

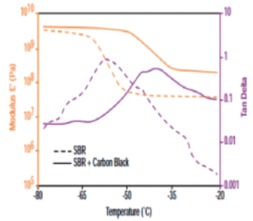
Specifications

- Force : 0.00001 N ~ 18 N
- Force resolution : 0.00001 N
- Strain resolution : 1 nm
- Modulus precision : ± 1 %
- Frequency range : 0.01 ~ 200 Hz
- Temperature range : - 150 ~ 600 °C
- Modulus precision : ± 1 %

Applications

- Viscoelastic behavior
- Relaxation behavior
- Glass transition
- Mechanical modulus
- Crystallization and melting
- Material faults





Effect of Carbon Black in Elastomers

Principle

Simultaneous DSC/TGA generally refers to the simultaneous application of Thermogravimetry (TGA) and Differential Scanning Calorimetry (DSC) to one and the same sample in a single instrument.

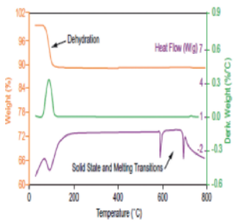
Room #B111

Specifications

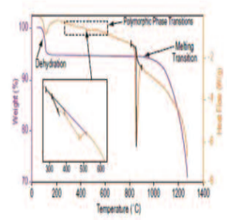
- Sample capacity : 200 mg
- Balance sensitivity : 0.1 μg
- Temperature range : 25 ~ 1,100 °C
- Calorimetric accuracy/precision : ± 2 %
- DTA sensitivity : 0.001 °C

Applications

- Measurement of mass change
- Evaporation of water
- Thermal decomposition
- Thermal stability
- Compositional analysis
  - volatiles, polymers, glass fibers, carbon black, and fillers



DSC-TGA : Sodium tungstate



27 Cryogenic Probe Station | Seebeck Coefficient and Electrical Conductivity

Model • CRX-4K [Lake Shore, USA] | SBA 458 [Netzsch, Germany]

Principle

A probe station is used to physically acquire signals from the internal nodes of a semiconductor device. If the device is being electrically stimulated, the signal is acquired by the mechanical probe and is displayed on an oscilloscope.

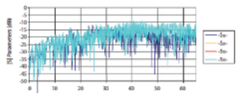
Room #B117

Specifications

- Temperature : 1.5 K ~ 475 K
- High vacuum to 10^{-7} torr
- 4 micro-manipulated probe arms
- 4" wafer probe capabilities
- Cryogen-free CCR (closed cycle refrigerator)
- Detector : KEITHLEY (4200-SCS)

Applications

- Electric characterization of semiconductor device using probes
  - DC I-V, C-V and pulse I-V measurement
- Measurement in temperature variation from 1.5 K to 475 K
- Measurement in high vacuum condition



Frequency (GHz)

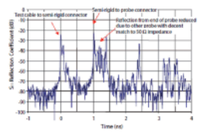
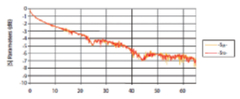


FIGURE 19 : TDR measurement with both port 1 and port 2 probe tips seated on a through test point



Frequency (GHz)
FIGURE 17 : Frequency Response at 4.3 K

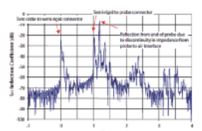


FIGURE 20 : TDR measurement with port 1 probe tip lifted off of the substrate; note the large reflection at ~1.2ns, which corresponds to the end of the tip

Principle

Thermoelectric materials with high working temperatures and optimized efficiency are under development for the generation of electrical energy from heat which has been released to the environment. Thereby, precise knowledge of the thermal properties is of paramount importance in order to develop beneficial thermoelectrics with high electrical conductivities, large Seebeck coefficients, and low thermal conductivities.

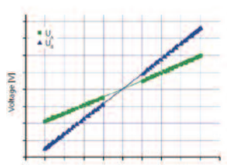
Room # B111

Specifications

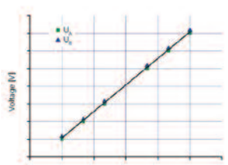
- Temperature Range : RT-1100 °C
- Temperature setting range : Unlimited number of temperature steps
- Sample dimensions
  - □ : 10 X 10 mm
  - Ø : 12.7 ~ 25.4 mm
  - Length X Width : 12.7 ~25.4 mm X 2.0 ~25.4 mm
  - Thickness : 100 nm ~3 mm
- Sample geometry : Square, round, rectangular, strips
- Seebeck coefficient range : 10 – 2000 μV/K
- Electrical conductivity range : 0.05 – 150000 S/cm
- Vacuum-tightness : 10-2 mbar

Applications

- Seebeck Coefficient
- Electrical Conductivity
- Thermal conductivity / Thermal diffusivity
- Density
- Specific heat capacity



Seebeck Coefficient



Electrical Conductivity

28 Dilatometry | Rheometer

Model • DIL 402C [Netzsch, Germany] | Haake MARS3 [Thermo Electron(Karlsruhe) Gmbh, Germany]

Principle

A dilatometer is a precision instrument for the measurement of dimensional changes in material as a function of temperature. Dilatometry can be used to test a wide range of material including traditional and advanced ceramics, glasses, metals, and polymers. It provides measurements of a wide variety of properties including linear thermal expansion, coefficient of thermal expansion, sintering temperature, shrinkage steps, phase transitions, density change, softening point and decomposition temperature, anisotropic behavior, and glass transition temperature.

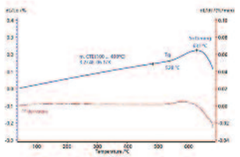
Room #B111

Specifications

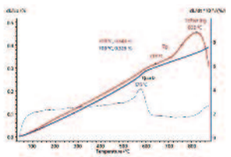
- Furnaces
  - Fused sillica : 25 ~ 1150 °C
- Heating rate : 0.001 ~ 50 K/min
- Sample dimensions
  - sample length max : 52 mm
  - Ø 12 mm standard
  - Ø 8 mm in dual sample holder system
- Temperature accuracy : 1 K
- Temperature precision : 0.1 K
- Thermal stability : ± 0.02 K
- Measuring range : ± 5000 μm

Applications

- Linear thermal expansion
- Coefficient of thermal expansion (CTE)
- Volumetric expansion
- Softening point
- Glass transition temperature
- Phase transitions
- Density change



Thermal expansion



Thermal expansion
(Comparing 2 sample)

Principle

A Rheometer is a laboratory device used to measure the way in which a liquid, suspension or slurry flows in response to applied forces. It is used for those fluids which cannot be defined by a single value of viscosity and therefore require more parameters to be set and measured.

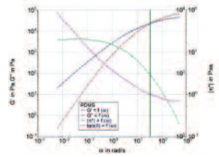
Room #B111

Specifications

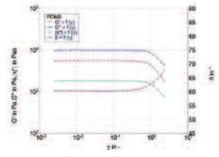
- Speed :
  - CR : 0.001 ~ 1500 min^{-1}
  - CS : 10-7 ~ 1500 min^{-1}
- Angular resolution : 0.012 micro rad
- Temp. range : - 150 ~ 600 °C (Optional)
- Frequency : 10^{-5} ~ 100 Hz
- MultiWave : 0.01 ~ 20 Hz
- Bearing : air bearing with micro stress control
- Normal force : 0.01 ~ ± 50 N

Applications

- G' (storage modulus)
- G" (loss modulus)
- tan delta
- η(Viscosity), Eta
- Thixotropic-loop



Frequency dependency of the viscoelastic standard material's rheological properties



Strain Dependency of
the rheological properties

UNIST Nano Fabrication Center (UNFC)

UNIST Nano Fabrication Center (UNFC) was established to support various nano-fabrication related research areas such as Semiconductor, MEMS, Bio, LED, Solar Cell, Lab-on-a-chip and Packaging. Nano technology is an emerging technology that enables manipulation of materials and fabrication of structures at nm scale, which will take a crucial role in determining the fundamentals and quality of human life in future.

List of Instruments

Lab	No.	Equipment	Model	Maker	Page
Lithography	1	E-beam lithography	NB3	NBL, UK	37
	2	Mask aligner	MA6	SUSS MicroTec, Germany	38
		Mask contact aligner	MDA-400S	MIDAS, Korea	38
	3	Nanoimprint lithography system	ANT-6H	Elan & KIMM, Korea	39
	4	Spin coator & Bake system	SSP200	SVS, Korea	39
Etching	5	Deep RIE	TEGAL 200	TEGAL, France	40
		Metal ICP etcher	ICP380	Oxford Instruments, UK	40
	6	Dielectric/Metal ICP RIE	FABStar	TTL, Korea	41
		Dielectric/Metal RIE	LABstar	TTL, Korea	41
	7	PR asher	V15-G	KAMI, Germany	42
	8	Wet station	Wet station	Changshin tech, Korea	42
Thinfilm	9	Thermal atomic layer deposition	Lucida D100	NCD, Korea	43
		Cluster atomic layer deposition	Atomic premiun	CN1, Korea	43
	10	Parylene coater	Parylene Coater	Alpha plus, Korea	44
		SAM (Self Assembly Mono-layer) coater	AVC-150M	SORONA, Korea	44
	11	UHV-CVD (Ultra High Vacuum Chemical Vapor Deposition)	UHV-CVD	Wooshin, Korea	45
		LP-CVD (Low Pressure Chemical Vapor Deposition)	KVL206	KSM, Korea	45
	12	PE-CVD (Plasma Enhanced Chemical Vapor Deposition)	PEH-600	SORONA, Korea	46
		SiC PE-CVD	FABStar-PECVD	TTL, Korea	46
	13	E-Beam evaporator (Temescal)	FC-2000	Temescal, USA	47
		E-Beam evaporator (Woosung)	WC-4000	WOOSUNG, Korea	47
	14	DC Sputtering system	SRN-120M	SORONA, Korea	48
		RF Sputtering system	SRN-120	SORONA, Korea	48
	15	Furnace system(Dry & Wet)	KHD-306	KSM, Korea	49
Measure-ment	16	Normal scanning electron microscope	S-3400N	Hitachi, Japan	50
	17	Digital inspection microscopy system	DM4000M	Leica, Germany	50
		Measurement microscope	Axio scope A1	CarlZeiss, Germany	50
	18	Ellipsometer	Elli-SE-UaM8	Elipso Technology, Korea	51
		Thin film measurement	ST4000-DLX	K-MAC, Korea	51
	19	Surface profiler	P-6	KLA Tencor, USA	52
		Full auto 4-Point probe system	CMT-R2000N	AIT, Korea	52
	20	Substrate sawing machine	AR06DM	Aaron, Korea	53
	21	Substrate bonder	SB-6L	SUSS MicroTec, USA	53

Office Phone Number : 4064, 4065
Office Email : u-nfc@unist.ac.kr

Lithography

01 E-Beam lithography

Model • NB3 [NBL, UK]

Principle

E-beam lithography is the practice of scanning a focused beam of electrons to draw custom shapes on a surface covered with an electron-sensitive film called a resist. The electron beam changes the solubility of the resist, enabling selective removal of either the exposed or non-exposed regions of the resist by immersing it in a solvent.

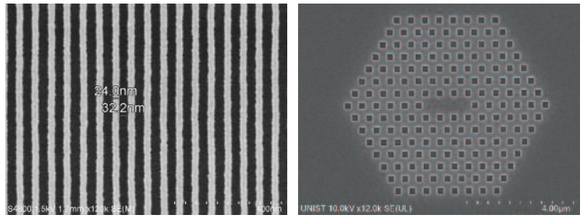
108 Room #B101

Specifications

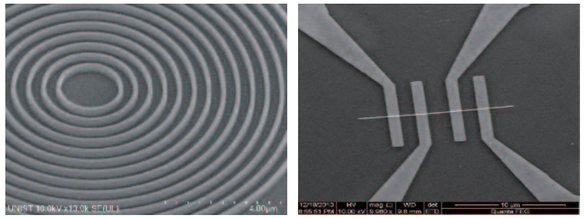
- Theoretical beam size : 2.1 nm @ 100 keV, 7 nA
- Line width : < 5 nm
- Deflection : vector scan, 55 MHz
- Address grid resolution : 1 nm, 1 mm main field
- Beam voltage : 30 ~ 100 keV (normally 80 KeV)
- Writing area : 150 mm × 150 mm (6 inch)

Applications

- Nano level device fabrication
- Generating fine patterns
- Contacts for Nanowires/rods



Positive electron resist pattern



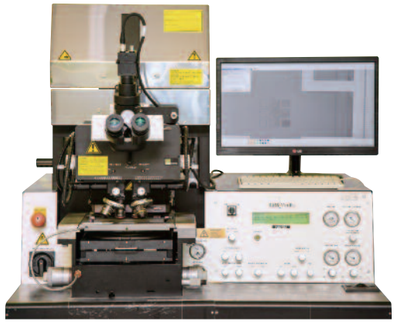
Negative electron resist pattern

02 Mask aligner | Mask contact aligner

Model • MA6 [SUSS MicroTec, Germany] | MDA-400S [MIDAS, Korea]

Principle

[MA6 | MDA-400S] performs alignment and exposures by UV lamp on the wafer and substrates coated by Photo-resist through mask with alignment keys



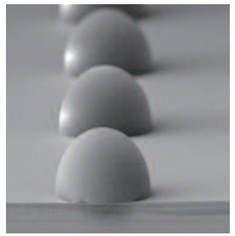
108 Room #B101

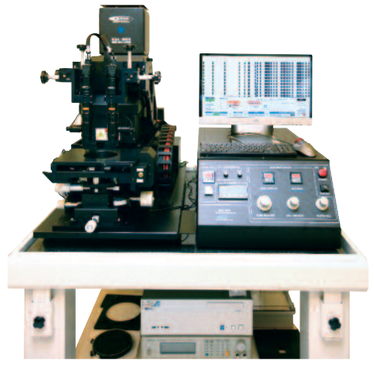
Specifications

- High efficiency & high accurate UV exposure system
- UV lamp : Hg 350 W / Hg 1000 W
- UV 400 : 350 ~ 450 nm (I-, H-, G-line)
- Gap adjustment accuracy : 1 μm
- Methods : top & back side alignment
- Alignment accuracy : 1 μm
- Exposure type : vacuum, low vac., proximity, hard, soft, flood-exposure mode
- Semi automatic system

Applications

- Micro scale patterning for semiconductor process
- MEMS / Nano device fabrication





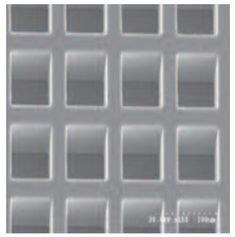
108 Room #B101

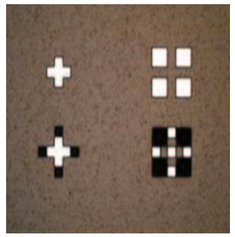
Specifications

- High efficiency & high accurate UV exposure system
- UV lamp : Hg 350 W
- UV 400 : 350 ~ 450 nm (I-, H-, G-line)
- Gap adjustment accuracy : 1μm
- Methods : top side alignment only
- Alignment accuracy : 1μm
- Microscope magnification : 90 x ~ 500 x
- Fully manual type system

Applications

- Micro scale patterning for semiconductor process
- MEMS / Nano device fabrication





03 Nanoimprint lithography system

Model • ANT-6H [Elan & KIMM, Korea]

Principle

Nano-Imprint fundamental principle is to transfer the master patterns defined in the stamp to deformable materials such as Photo-resist spun on substrate by mechanical press.

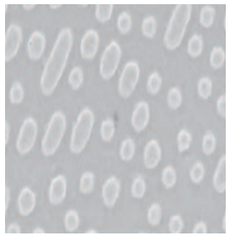
108 Room #B101

Specifications

- Curing type : UV, thermal, UV & thermal
- Imprint area : ~ 6 inch
- Stamp : Quartz, Si, Ni, PDMS, PMMA, etc.
- UV System : ~ 50 mw/cm2, 2 Kw
- Temperature : RT ~ 250 °C

Applications

- Nanostructure device imprint fabrication
- Functional device chemical & bio sensor



04 Spin coater & Bake system

Model • SSP200 [SVS, Korea]

Principle

The device which deposits the uniformly thick & thin Photo-resists by high speed.

108 Room #B101

Specifications

Spin coater

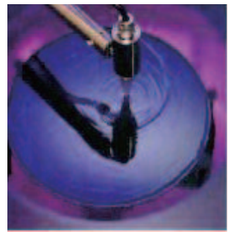
- Chamber size : 200 mm diameter
- Sample size : 2 ~ 6 inch
- Rotation speed : Max. 6,000 rpm
- Vacuum input : - 450 mmHg ~ - 750 mmHg

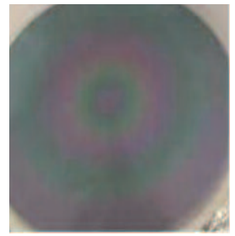
Hot plate

- Temperature ~200 °C
- Sample size : piece ~ 6 inch

Applications

- Adhesion treatment on substrates
- Photo resist coating





Etching

05 Deep RIE | Metal ICP Etcher

Model • TEGAL 200 [TEGAL, France] | ICP380 [Oxford Instruments, United Kingdom]

Principle

In current, micro-electro-mechanical systems (MEMS) fabrication, deep reactive ion etching (DRIE) is one of the most characteristic widely utilized techniques.

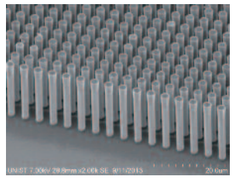
Room 108 #B101

Specifications

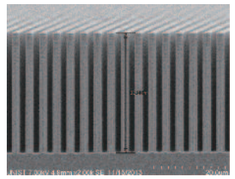
- Loadlock / Process chamber transfer
- Source generator : 5,500 W
- Dual Chuck generator : 300 W
- E-chuck, helium cooling system
- Gas : SF_6, C_4F_8, O_2, Ar

Applications

- Deep silicon etching (Bosch process)
- Etching process of Si / SiO_2 / Si_3N_4



Deep Si etch (column)



Deep Si etch (line)

Principle

In metal etch process, ICP etcher is essential equipment for fabrication precise nanoscale structure. Metal ICP etcher have powerful performance from high RF generators.

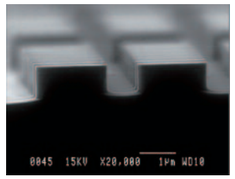
108 Room #B101

Specifications

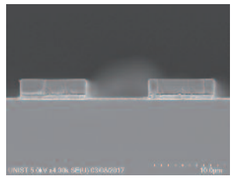
- Loadlock, process chamber transfer
- Loading : 6inch wafer
- ICP source power : 3,000 W
- Chuck bias power : 300 W
- Back He cooling (chiller 0 ~ 60 °C)
- Gases : HBr, Cl_2, Ar, O_2
- Uniformity : less than ± 5% within 6inch wafer

Applications

- Dry etching of metal (Al, Cr, Ti, Au and Pt)



Dry etch of InP



Dry etch of Al

06 Dielectric/Metal ICP RIE | Dielectric/Metal RIE

Model • FABstar [TTL, Korea] | LABstar [TTL, Korea]

Principle

It is designed for Reactive Ion Etching (RIE) process from Inductively Coupled Plasma (ICP) source. It can make high density plasma to powerfully etch patterns on dielectric and metal film.

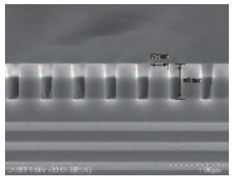
108 Room #B101

Specifications

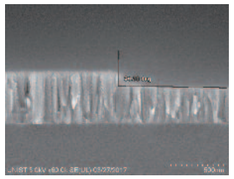
- Load lock, process chamber transfer
- Loading : 6inch wafer
- ICP source power : Max. 3,000 W
- Chuck bias power : Max. 600 W
- Back He cooling (chiller 10 ~ 60 °C)
- Gas
  - Dielectric : SF_6, CF_4, CHF_3, Cl_2, BCl_3, Ar, O_2, N_2
  - Metal : SF_6, CF_4, HBr, Cl_2, BCl_3, Ar, O_2, N_2
- Uniformity : less than ± 5 % within 6inch wafer

Applications

- Dry etching of dielectric (Si, SiO_2, Si_3N_4, HfO_2)
- Dry etching of metal (Al, Cr, W, Ti, Au, Pt)



SiO_2 etch



Cr etch

Principle

RIE (Reactive ion etching) is one of dry etching for fabrication of fine patterns by generating plasma. RIE is etching system for etching dielectric and metal patterns.

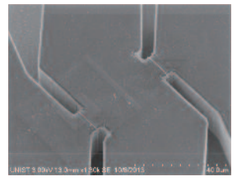
108 Room #B101

Specifications

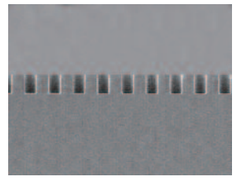
- Loadloack, process chamber transfer
- Loading : 4~6 inch wafer (200 mm electrode)
- RF power : Max. 600 W (13.56 MHz)
- RF generator with automatic match unit for bias power
- Gas
  - Dielectric : CF_4, CHF_3, Ar, O_2
  - Metal : BCl_3, Cl_2, Ar, O_2, SF_6
- Uniformity : less than ± 5 % within 6inch wafer

Applications

- Dielectric dry etching (Si, SiO_2, Si_3N_4)
- Metal dry etching (Al, Cr, Ti, W)



SiO_2 etch



Si etch

Thinfilm

07 PR asher

Model • V15-G [KAMI, Germany]

Principle

This equipment removes selectively coated photoresist for the semi conductor process using gas plasma.

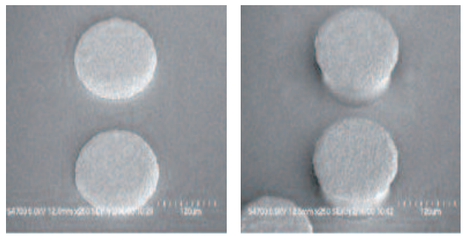
Room 108 #B101

Specifications

- 250 x 250 x 250 mm, aluminum chamber
- Microwave power generator : 2.45 GHz, max. 600 W
- Gas : O_2, Ar, CF_4
- Process storage capability of 10 main process with 16 sub-process

Applications

- Elimination of polymer
- Elimination of photoresist residue
- Control thickness of polymer layer



Control thickness of PR

08 Wet station

Model • Wet station [Changshin tech, Korea]

Principle

Wet process is necessary for photoresist development, wet cleaning, wet etching process in semiconductor samples. This wet station give users safe wet process.

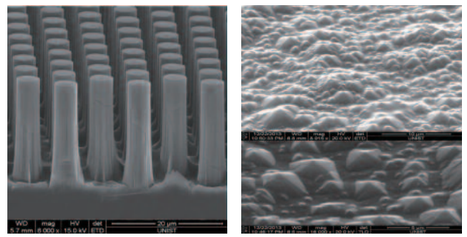
108 Room #B101

Specifications

- 3 type (solvent, acid, alkali) wet station
- Chemical supply : manual
- RCA cleaning, BOE, SPM, H_3PO_4, QDR batch bath, ultrasonic bath.
- Batch bath temp. : 50 ~ 120 °C
- DI water, N_2 gun, shelf in 1 wet station

Applications

- Photoresist developing
- Surface cleaning (solvent, SPM, RCA cleaning)
- Wet etching



Si wet etch

09 Thermal atomic layer deposition | Cluster atomic layer deposition

Model • Lucida D100 [NCD, Korea] | Atomic premium [CN1, Korea]

Principle

ALD is a thin film deposition technique that is based on the sequential use of a gas phase chemical process. The majority of ALD reactions use two chemicals, typically called precursors. These precursors react with the surface of a material one at a time in a sequential, self-limiting, manner. Through the repeated exposure to separate precursors, a thin film is slowly deposited.

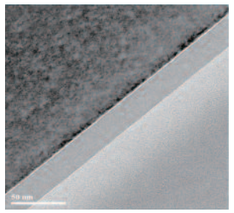
108 Room #B101

Specifications

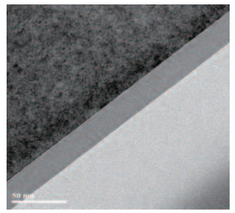
- Substrate size : Piece ~ 8 inch silicon wafer
- Substrate temperature
  - 100 °C ~ 350 °C (± 0.2 °C) in wafer
- Deposition uniformity : less than ± 2 % within wafer
- Precursor sources : TEMAHF, TTiP, TMA, DEZ

Applications

- High-k thin film
- Dielectric thin film



Al_2O_3



HfO_2

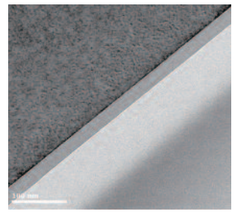
108 Room #B101

Specifications

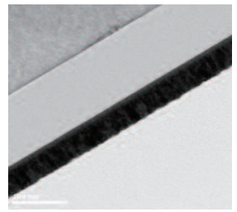
- Substrate size : 4 ~ 8 inch silicon wafer
- Process temperature : 30 °C ~ 450 °C
- Deposition uniformity : less than ± 2 % within wafer
- Dual process mode : thermal and plasma
- Shower head type multi-chamber cluster tool

Applications

- Dielectric thin films : Al_2O_3, HfO_2, etc
- Nitride & metal thin films : TaN, etc



Al_2O_3



TaN

10 Parylene Coater | SAM(Self Assembly Mono-layer) Coater

Model • Parylene Coater [Alpha plus, Korea] | AVC-150M [SORONA, Korea]

Principle

The Dimer is inserted into the vaporizer in the powder form and evap orated between 120 - 175 °C Furnace chamber heated to approximately 650 - 690 degrees through the monomer which is converted to the substrate. After the process, the temperature is recovered to room tem perature, creating a Poly-para-Xylylene film coating.

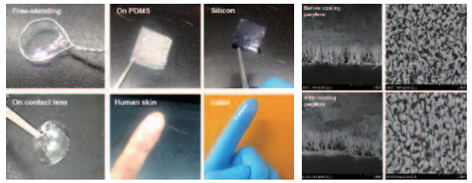
108 Room #B101

Specifications

- Dimer type : c
- Substrate size : max. dia. 200 mm
- Process temperature
  - furnace (R/T to 690 ± 3 °C)
  - Vaporizer (R/T to 175 ± 3 °C)
- Thickness variation : less than ± 10 % within wafer

Applications

- MEMS / NANO Device
- SAW filters
- UV embossing / Nano imprint lithography
- Telecommunication devices



Parylene coater

Principle

This machine can grow polymer mono-layer with very solid bonding force by forming O-H layer by natural oxygen on sample and supplied polymer source from vaporizer.

108 Room #B101

Specifications

- Contact angle : 5 ° ~ 110 ° (water)
- Work of adhesion : 3 ~ 100 uJ/m2
- Precursor usage : < 0.1 cc/batch (depends on application)
- Surface treatment : RF Plasma (100 ~ 300 W)
- Reactor cleaning by O_2 plasma

Applications

- Nano patterning of bio devices & display panel
- Polymer memory device by imprinting

Contact angle measurement

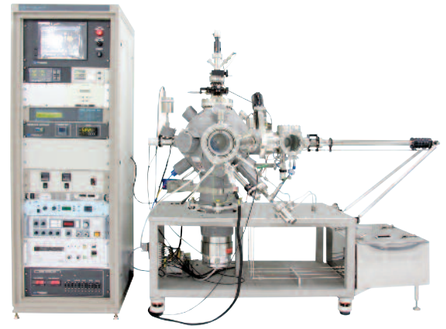
Before After

11 Ultra High Vacuum Chemical Vapor Deposition | Low Pressure Chemical Vapor Deposition

Model • UHV-CVD [Wooshin cryovac, Korea] | KVL206 [KSM, Korea]

Principle

UHV CVD system is the device which creates new qualified wafer based on chemical reaction between gas and sample by spraying a gas to keep base pressure at 1x10-10 torr.



108 Room #B101

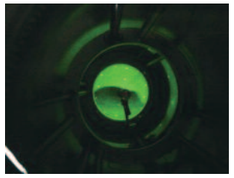
Specifications

- Main chamber : 500 mm (vacuum range : 5 x 10^{-10})
- Load lock chamber : 200 mm
- Magnetic transfer probe : 800 mm stroke include linear guide & sample transfer line
- Heater stage : 1,500 °C temp.
- Substrate size : 2" target
- Gas supply : MFC 4 sets (SiH_4, C_2H_4, H_2 , N_2)

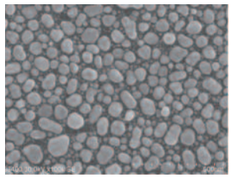
Applications

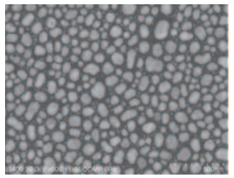
- High quality thin film deposition for MEMS / nano device

Silicon annealing



LEED analysis





Metal annealing

Principle

LPCVD refers to a thermal process used to deposit thin films from gasphase precursors at subatmospheric pressures. LPCVD is used to deposit a wide range of possible film compositions with good conformal step coverage.

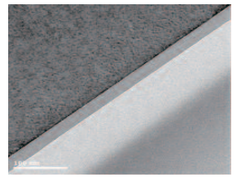
108 Room #B101

Specifications

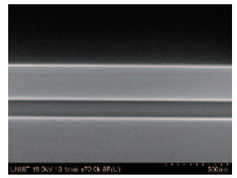
- Wafer size : Piece ~ 6 inch silicon wafer
- Vertical furnace type (6" 25ea)
- Thickness uniformity : less than ± 3 %
- Doped-Poly
  - process gas : SiH_4 : PH_3 =1000 : 80
  - temp : 530 °C, dep rate : 35 Å/min
  - Rs uniformity : less than ± 5 %
- Nitride
  - process gas : DCS : NH_3 = 30 : 100
  - temp : 785 °C, dep rate : 25 Å/min

Applications

- Nitride, Poly-Si layer deposition
- Impurity doping for solar cell
- Research of semiconductor, MEMS pocess



Nitride



Poly Si

12 Plasma Enhanced Chemical Vapor Deposition | Silicon Carbide Plasma Enhanced Chemical Vapor Deposition

Model • PEH-600 [SORONA, Korea] | FABStar-PECVD [TTL, Korea]

Principle

PECVD System is a multipurpose tool capable of deposition silicon oxide, silicon nitride using electron energy (plasma) as the activation method to enable deposition at a low temperature and at a reasonable rate.

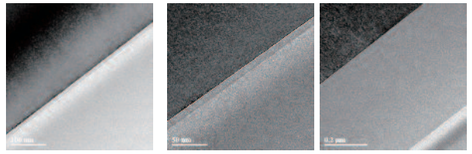
108 Room #B101

Specifications

- Loading size : piece ~ 6 inch
- Substrate Temperature : ~ 400 °C
- Power Supply : 600 W, 13.56 MHz RF Generator
- Thickness uniformity : less than ± 5 %
- Process guarantee : 100 Å ~ 2 um
- SiO_2, Si_3N_4 deposition
- Process gas : SiH_4, N_2O, NH_3, N_2, CF_4, O_2

Applications

- Passivation layer of semiconductor
- Inter metal dielectric of semiconductor
- Inter layer dielectric of semiconductor



Si_3N_4 SiO_2

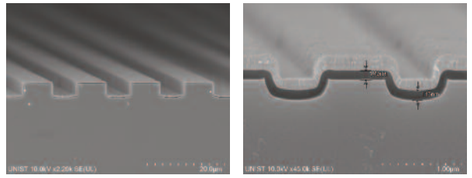
108 Room #B101

Specifications

- Loading size : piece ~ 6 inch
- Substrate Temperature : ~ 400 °C
- Power Supply : 600 W, 13.56 MHz RF Generator
- Thickness uniformity : less than ± 5 %
- Process guarantee : 100 Å ~ 1 um
- Si_3N_4, SiC deposition
- Process gas : SiH_4, NH_3, CH_4, N_2, SF_6, O_2, He

Applications

- High rate and high quality silicon carbide deposition with stress control
- Passivation layer
- Inter metal dielectric of semiconductor
- Inter layer dielectric of semiconductor



SiC Si_3N_4

13 E-Beam evaporator system

Model • FC-2000 [Temescal, USA] | WC-4000 [WOOSUNG HI-VAC, Korea]

Principle

Electron beam source is shown by the power supply to the hot filament electron beam from the magnetic field induced by magnet.

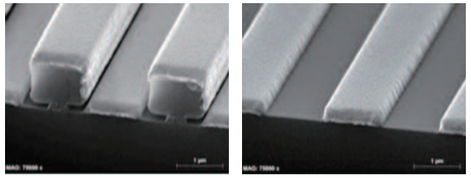
108 Room #B101

Specifications

- E-beam source assembly by Temescal
- 15 cc, 6 pocket (Au, Cr, Ni, Ti, Al, Pt, Pd, Ag)
- Power supply : 6 kw (CV-6SLX)
- Source control module (Temescal)
- Substrate heat : 300 °C (4 kW)
- Programmable sweep controller (Inficon)
- Uniformity : less than ± 5 % within wafer
  less than ± 5 % wafer to wafer

Applications

- Conventional materials coating
- Lift off process
- Metal electrode deposition on surfaces



전극형성

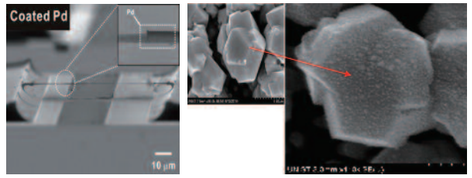
108 Room #B101

Specifications

- E-beam source assembly by TELEMARK
- 7 cc, 6 pocket (Au, Cr, Cu, Ni, Ti, Al, Pt, Pd)
- Power supply : 6 kW (SJ Power)
- Substrate Rotation Speed : 0 ~ 80 rpm
- Programmable sweep controller (Sycon)
- Uniformity : less than ± 5 % within wafer

Applications

- Conventional materials coating
- Lift off process
- Metal electrode deposition on surfaces



Metal Island 형성

14 DC sputtering system | RF sputtering system

Model • SRN-120M [SORONA, Korea] | SRN-120 [SORONA, Korea]

Principle

DC Sputtering system is a multi-purpose tool generating plasma inside chamber by supplying 3 kw DC power to cathode and capable of thin film deposition of metal materials on wafer by sputtering a metal target by DC negative voltage.

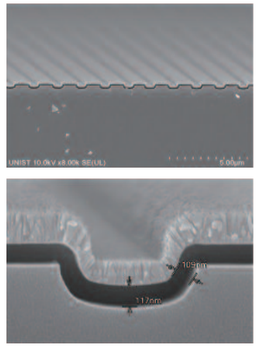
108 Room #B101

Specifications

- Substrate size : Piece ~ 6 inch
- Substrate rotation speed : 0 ~ 60 rpm
- RF pre-cleaning : 300 W, automatic processing
- Substrate heating : 300 °C ± 3 % (wafer temp)
- Number of target : max. 4 different targets
- Power source : 3 kW DC power processing
- Uniformity : less than ± 5 % within wafer

Applications

- Thin film for semiconductor
- Fabrication of contacts interconnects



Principle

RF Sputtering system is a multi-purpose tool generating plasma inside chamber supplying 13.56 Mhz RF power to cathode and capable of thin film deposition of insulator on wafer by sputtering an insulator target by self bias voltage.

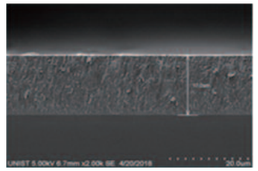
108 Room #B101

Specifications

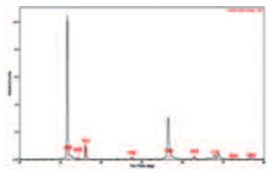
- Substrate size : Piece ~ 6 inch
- Substrate rotation speed : 0 ~ 60 rpm
- RF pre-cleaning : 300 W, automatic processing
- Substrate heating : 500 °C ± 3 % (wafer temp)
- Target : ITO, ZnO, SiO_2, Al_2O_3, TiO_2
- Power source : 13.56 Mhz RF power
- Uniformity : less than ± 5 % within wafer

Applications

- Thin film for semiconductor
- Insulation layer deposition



ZnO



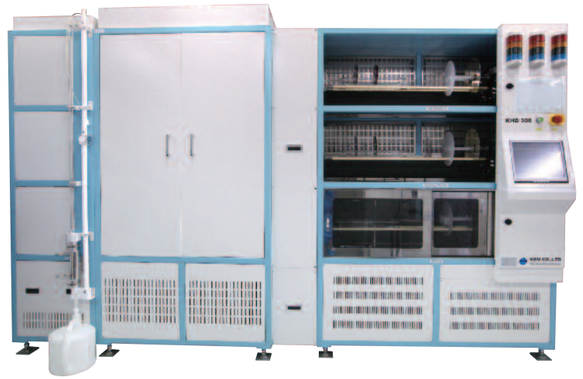
XRD Data

15 Furnace system(Dry & Wet)

Model • KHD-306 [KSM, Korea]

Principle

Silicon dioxide (SiO_2) is a main insulating material used in micro technology and the most common technique in a furnace. This is because silicon can form a coating which is easy to oxidize and has excellent insulating properties. There are two methods of oxidation. (Dry and wet) The surface of the silicon wafer is thermally oxidized in a simple oxygen atmosphere or a mixed gas atmosphere of oxygen and water vapor. The oxidizing agent is adsorbed on the silicon surface, and the oxidizing agent enters the interface of the oxide-silicon wafer through the diffusion to form an oxide film.



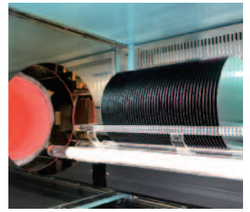
Specifications

- Dry & Wet Oxidation process
- Heater spec (6 zone) : 400(ITO) ~ 1100 °C
- Wafer size : piece ~ 6 inch silicon wafer (4", 6" 25ea)
- Thickness uniformity : less than ± 3 %
- Metal & dielectric film annealing chamber

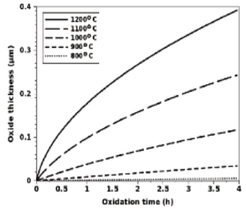
Applications

- Oxidation layer growth on silicon wafer
- Metal & dielectric layer annealing process

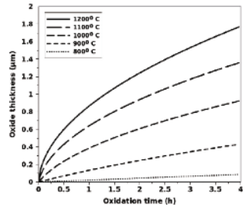
108 Room #B101



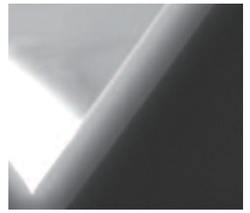
Batch loading

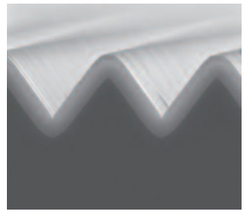


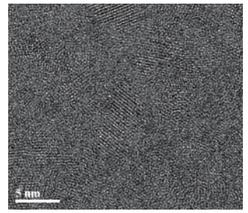
Dry oxidation



Wet oxidation







Oxidation

Annealing

Measurement

16 Normal scanning electron microscope

Model • S-3400N [Hitachi, Japan]

Principle

SEM is a microscope that uses electrons instead of light to form an image. The scanning electron microscope has many advantages over traditional microscopes.

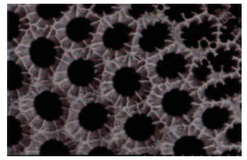
108 Room #B101

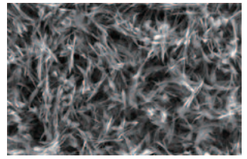
Specifications

- Electron gun : precentered cartridge filament
- Resolution : 3.0 nm at 30 kV, 10 nm at 3 kV (SE mode)
- Magnification : x 5 to x 300,000 (continuous)
- Accelerate voltage : 0.3 to 30 kV (0.1 kV/step)
- Detector : SE + BSE
- Electrical image shift : ± 50 μm (WD = 10 mm)
- Traverse : X axis 0 ~ 100 mm, Y axis 0 ~ 50 mm

Applications

- Secondary electron image
- Backscattered electron image





17 Digital inspection microscopy system | Measurement microscope

Model • DM4000M [Leica, Germany] | Axio scope A1 [CarlZeiss, Germany]

Principle

Versatile functionality and analysis is only of use if high-quality original images can be obtained. The Digital Microscope has succeeded in producing sharper, super high resolution observation images by applying sophisticated technologies to every process from lighting to image generation.

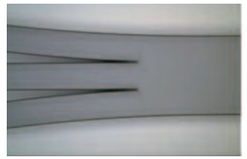
108 Room #B101

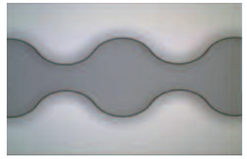
Specifications

- 6-position nosepiece (M32)
- 4-position turret for filter cubes
- Contrast methods RL : BF, DF, Pol, ICR, Fluo
- Optional contrast methods TL : BF
- Large samples up to 150 * 150 mm
- Rotatable through 360 degree sample stage
- Ultra-bright LED Illumination with high-power LED
- Magnification (Objective lens) : 2.5x, 5x, 10x, 20x, 50x, 100x
- Magnification (Ocular) : 10x

Applications

- Electric/Electronics device inspection
- Image capture & measurement





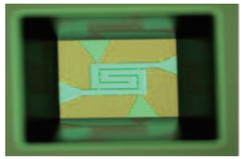
108 Room #B101

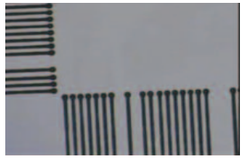
Specifications

- Image CCD : 1/2 inch, 211 mil-pixel CCD image sensor
- Frame rate : 7.5 F/S & 30 F/S (Optional)
- Electronic shutter : auto/manu/off, 1/15 ~ 1/5000
- Supercharge shutter : 0.2 sec. to 17 sec. can be set in increments
- Magnification (Objective lens) : 2.5x, 5x, 10x, 20x, 50x, 100x
- Magnification (Ocular) : 10x

Applications

- Electric/Electronics device inspection
- Image capture & measurement





18 Ellipsometer | Thin film measurement

Model • Elli-SE-UaM8 [Elipso Technology, Korea] | ST4000-DLX [K-MAC, Korea]

Principle

Spectroscopic Ellipsometer(SE), the industry standard technology that enables one to accurately measure thickness and optical constants of thin film, simultaneously, is used for characterization of a variety of materials including AR coatings, OLED, and low(high)-materials.

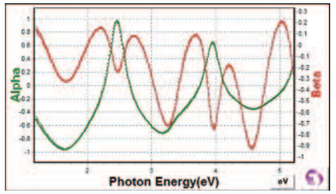
108 Room #B101

Specifications

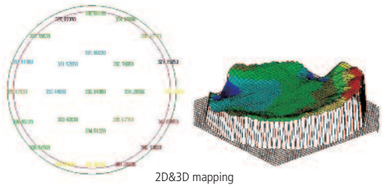
- Wavelength range : 240 nm ~ 1,000 nm
- Stage size : 200 mm X 200 mm (8inch)
- Beam spot size : ≥ 1.5 mm
- Measuring constants : Film thickness, n, k vs λ, Reflectivity
- Thickness range : sub Å ~ 10 μm (depends on film type)
- 2D, 3D Auto Mapping : 8 Inch Mapping Stage, Automatic Stage Control

Applications

- Semiconductor : Poly-Si, GaAs, GaN
- Dielectric material : SiO_2, Si_3N_4, ITO, TiO_2, Al_2O_3, HfO_2
- Polymer : PET, PP, PR



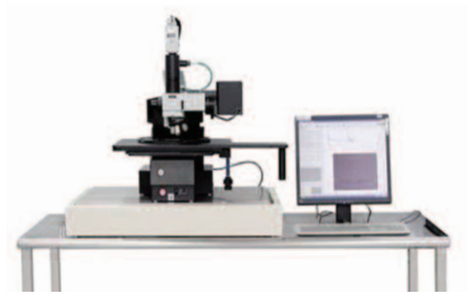
Fitting graph with SiO_2



2D&3D mapping

Principle

Some portion of the light that is incident on the thin film surface is reflected from the upper surface of the sample, other portion is reflected from the interfaces between the thin film and the substrate.



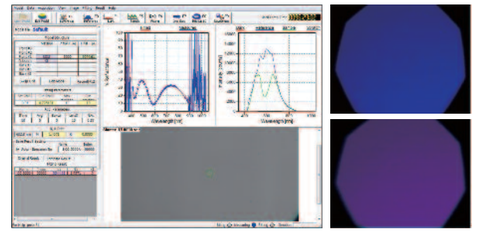
108 Room #B101

Specifications

- Detector : wavelength range is 400 ~ 800 nm
- Stage size : 300 mm x 300 mm (12 inch wafer)
- Lens : m 5 x, m 10 x, m 50 x
- Reflection probe : choose wavelength (300 ~ 800 nm)
- Thickness measurement range : 100 Å ~ 50 μm

Applications

- Semiconductor : Poly-Si, GaAs, GaN, ZnS, SiGe, ONO, SOI, SiLk
- Dielectric material : SiO_2, Si_3N_4, ITO, TiO_2, ZrO_2, BTS, HfO_2
- Polymer : PVA, PET, PP, PR



SiO_2 thickness measure

19 Surface profiler | Full auto 4-Point probe system

Model • P-6 [KLA Tencor, USA] | CMT-SR2000N [AIT, Korea]

Principle

Surface profiler have function of stylus-based scanning to measures step height, roughness, and waviness on sample surfaces.

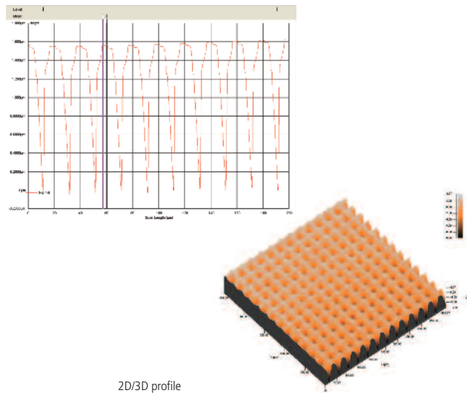
108 Room #B101

Specifications

- 2D & 3D scanning profiler
- 150 mm diameter vacuum sample stage
- Optical camera, stylus module (move Z-axis), stage (move X-Y axis)
- Scan length : 150 mm
- Stylus force : 1 ~ 15 mg
- Stylus type : 2 um radius 60 degree

Applications

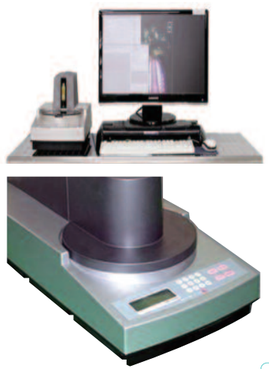
- Measurement of line, 3D profile
- Measurement of thickness



2D/3D profile

Principle

Full automatic 4-point probe system measures sheet resistance and resistivity of silicon wafer, metal, and solar cell, etc. This system can be operated by itself. Furthermore, remote control is available using a PC.



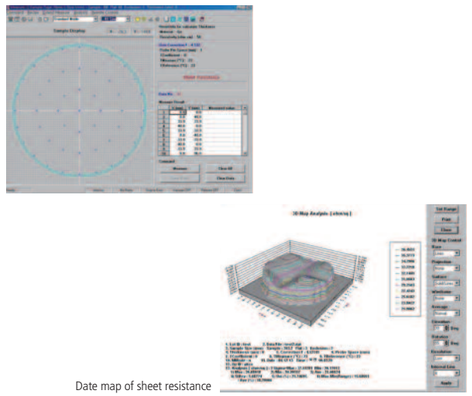
108 Room #B101

Specifications

- Measurement range : 1 mΩ/sq ~ 2 MΩ/sq
- Measurement accuracy : ± 0.5 %
- Measurement time : 3 sec/point
- Measurement unit : Ω, Ω/sq, Ω·cm
- Current source : 10 nA ~ 100 mA
- Voltage : 0 ~ 2,000 mV
- Stage size : 8inch (200 mm)
- Data analysis : data map, contour & 3D mapping

Applications

- Sheet resistance measurement of thin film



Date map of sheet resistance

20 Substrate sawing machine

Model • AR06DM [Aaron, Korea]

Principle

Device to cut Silicon wafer into small chips using high-speed rotating diamond blade.

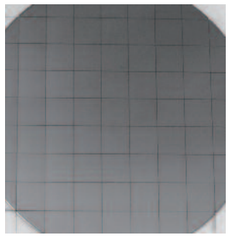
108 Room #B101

Specifications

- Substrate size : Piece ~ 6 inch
- Cutting materials : silicon, glass, quartz & GaAs
- X-axis blade (chuck table horizontal movement)
- Work-piece width setting range : 0.01 ~ 160 mm
- Cut speed : 0.05 ~10 mm/s or more

Applications

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



Wafer sawing

Piece sawing

21 Substrate bonder

Model • SB-6L [SUSS MicroTec, USA]

Principle

Anodic bonder performs fine alignment and permanent bonding between 2 wafers by heat, voltage and pressure in a vacuum chamber

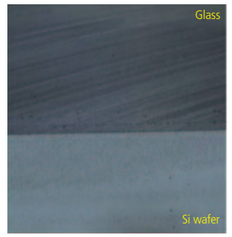
108 Room #B101

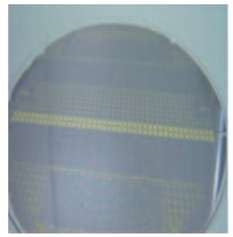
Specifications

- Wafer size : 6inch only
- Pressure regulation accuracy : ± 2 %
- Maximum temperature : 500 °C
- Temperature uniformity : ± 3 %
- Maximum bond force : 8 kN
- Maximum voltage : 2,000 V ± polarity
- Maximum current : 60 mA

Applications

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





UNIST Maker Lab

UNIST Maker Lab is instituted to supporting professors, graduates, collegians as well as to provide with precise experiment equipment, any material test or etc., which are required by local industry or institute at appropriate time. Maker Lab building was completed in December 2009 in building next to engineering building after having manufacture machines such as Ultra-Precision Nano Machine, 3-axes and 5-axes machining center, lathe and bench drilling machine, surface grinding and band saw which can cut materials and arc welder to produce iron structure. It offers measuring equipment such as coordinate & vision measurement machine, laser interferometer, surface microscope and various products including material testing machine, detail machine parts, precise experiment equipment and 3D Print, which is a physical model as the same as 3D CAD Data.

List of Instruments

Lab	No.	Equipment	Model	Maker	Page
CNC Manufacture	1	Ultra-Precision Nano Machine	Robonano α-OiB	FANUC, Japan	55
	2	CNC 5-Axis Machining Center	C40U	Hermle, Germany	56
	3	CNC 3-Axis Machining Center	B300V	Hermle, Germany	56
	4	Multi Tasking Machine	Integrex I-100st	Mazak, Japan	57
	5	CNC Lathe	TLS-6	S&T, Korea	58
	6	CNC Surface Grinding Machine	DGS-630	Daesan, Korea	58
Special Manufacture	7	Metal 3D Printer	M290	EOS Gmbh, Germany	59
	8	SLS 3D Printer	P770	EOS Gmbh, Germany	60
	9	3D Print	sPro60 SLS	3DSystems, USA	61
	10	CNC Wire-Cut EDM	SL 400G	Sodick, Japan	62
	11	Fiber Laser Cutting Machine	K2CMS1	K2Laser System INC., Korea	62
	12	Electron-Beam PIKA Machine	PF-32B	Sodick, Japan	63
	13	ULTRASONIC Machine	ULTRASONIC 20	DMG MORI, Germany	64
Manufacture	14	Milling	STM-2VM	Sodick, Japan	65
	15	Lathe	TIPL-410	S&T, Korea	65
	16	Band Saw	SH-4030	COSEN, Taiwan	66
	17	CO_2 Welding Machine	MAGIC ARC 350	SEIL, Korea	66
Measure-ment	18	Non-contact 3D Scanner	Rexcan 4	Solutionix, Korea	67
	19	Coordinate Measuring Machine	PGS	Dukin, Korea	68
	20	Three-Dimensional Measurement	NV-3000	Nanosystem, Korea	68
	21	Semi Auto Formtracer System	SV-C3100	Mitutoyo, Japan	69
	22	Multi-Component Dynamometer	2825A	Kistler, U.K	69
	23	Laser Interferometer	XL-80	Renishaw, U.K	70
	24	Powerful Microscope	MF-1010B	Mitutoyo, Japan	70
	25	Box type 3D Scanner	Rexcan DS2	Solutionix, Korea	71
	26	Universal Testing Machine	AGS-100NX	Shimadzu, Japan	71

Office Phone Number : 4066, 4069
Office Email : machine-shop@unist.ac.kr

CNC Manufacture

01 Ultra-Precision Nano Machine

Model • Robonano α-OiB [FANUC, Japan]

Principle

Ultra-Precision Nano Machine is combining nano servo technology with the newest linear motor and on same machine built in motor and air bearing technology, measures the slope by using rotation axes, and controls 5-axes (3 of linear curve axes : X, Y, Z and 2 of rotation axes : B, C) simultaneously. It is convenient to install spindles or manufacture materials in all tables, as its tables of rotation axes B and C have the same structure and function.

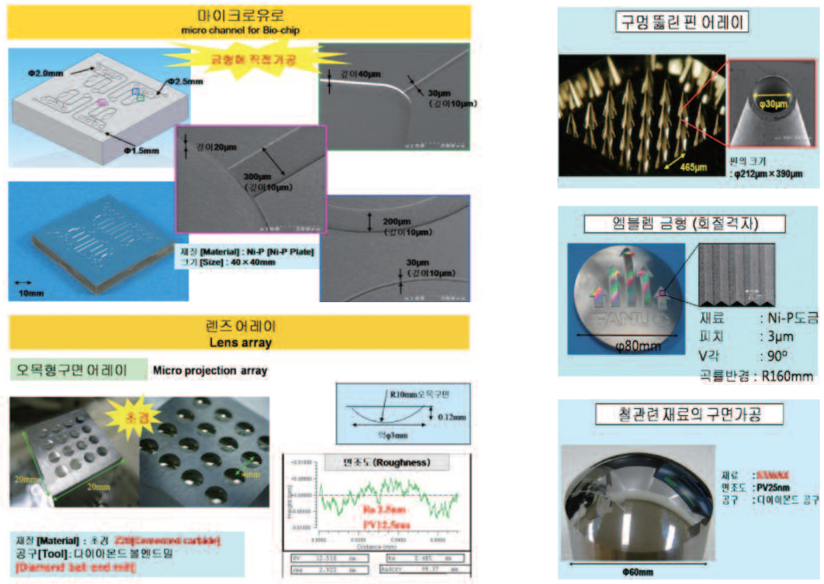
Room #106

Specifications

- Stroke - axes (X-Z-Y) : 280 x 150 x 40 mm - axes (B-C) : 360 °
- Command resolution - axes (X-Z-Y) : 1 nm - axes (B-C) : 0.000001 °
- Bearing type : Hydrostatic air bearing
- Milling spindle
  - diameter of shank : Φ6 mm
  - maximum rotation speed : 50,000 min
  - size/mass : Φ74 x 84 mm / 1.5 Kg
- Turning spindle
  - diameter of shaft table : Φ72 mm
  - maximum rotation speed : 7,000 min
  - size/mass : Φ184 x 77 mm / 4.8 Kg
- Nanochecker
  - maximum measuring angle 3-axes : ± 60 °/ 5-axes : ± 90 °

Applications

- Diffraction grating
- Prism groove
- Lens array
- Micro channel for Bio-chip
- Free curved surface
- Spherical process



02 CNC 5-Axis Machining Center

Model • C40U [Hermle, Germany]

Principle

A numerically controlled milling machine can improve accuracy and efficiency by attaching the automatic tool changer. It is capable of perform ing up to 5-axes simultaneously.

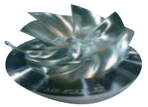
Room #105

Specifications

- Table
  - size : over than Φ800 mm
  - swivel range : + 25 ° ~ - 110 °
  - max. load capacity : over than 1,200 Kg
  - speed-swiveling axes A : over than 25 rpm
  - speed-rotary axes 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 Φ90 mm

Applications

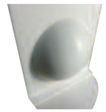
- Geometric image processing
- Round cam, Propeller, Ship screw, Tire mold



Compressor impeller

Tire mold

Mirror



Lens

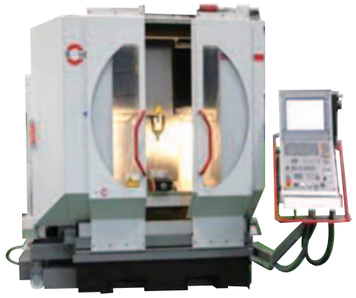
Shipping Screw

03 CNC 3-Axis Machining Center

Model • B300V [Hermle, Germany]

Principle

The CNC general milling machine equipped with an automatic tool changer enables a series of multiple processing tasks automatically.



Room #105

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 Φ80 mm

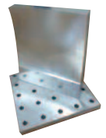
Applications

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

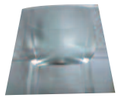
Tube mold

Sample test

Aircraft mold



Mirror



Bonnet mold

04 Multi Tasking Machine

Model • integrex I -100st [Mazak, Japan]

Principle

Multi Tasking Machine is the integrated equipment for turning, milling, drilling, tapping, and etc, controlling multi-axis with a single set-up and producing the final products.

Room #105

Specifications

- Capacity
  - Maximum Swing : 530 mm
  - Maximum Bar Work Capacity : 51 mm
  - Maximum Machining Length : 854 mm
- Main Spindle
  - Chuck Size : 6 in
  - Maximum Speed : 6,000 rpm
  - Motor Output : 11 kw / 15 hp
- Second Spindle
  - Chuck Size : 6 in
  - Maximum Speed : 6,000 rpm
  - Motor Output : 11 kw / 15 hp
- Milling Spindle
  - B-Axis Travel : 240 °
  - Magazine Capacity : 36 EA
  - Maximum Speed : 12,000 rpm
  - Motor Output : 8 kw / 10 hp

Applications

- Aerospace industry_ Turbine blade
- Automotive industry_ Cylinder block
- Semiconductor industry_ Vacuum chamber
- Medical industry_ knee joint
- Die & Mold industry
- Construction industry

Special Manufacture

05 CNC Lathe

Model • TLS-6 [S&T, Korea]

Principle

The rotation of the servo motor is transferred into the linear translation by the ball screw, which makes the movement of the work piece or ATC. This relative movement between the work piece and ATC manufactures the parts ordered by customers.

Room #105

Specifications

- Capacity
  - max. bar working dia : Φ42 mm
  - spindle speed : 50 ~ 5,000 rpm
- Travel
  - X-axes travel : 170 mm
  - Z-axes travel : 480 mm
- Rapid traverse
  - X-axes rapid traverse : 20 m/min
  - Z-axes 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

- The mass production of various kinds
- Round machining
- Geometric image processing

06 CNC Surface Grinding Machine

Model • DGS-630 [Daesan, Korea]

Principle

This machine tool is capable of producing the accurate flat surface or grooving other shapes using a cylindrical wheel.

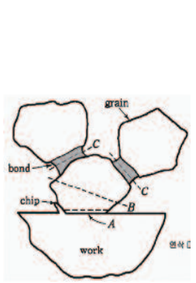
Room #108

Specifications

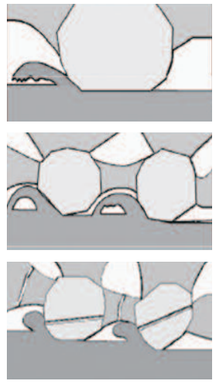
- Capacity
  - working surface of table : 650 x 300 mm
  - max. travel : 750 x 340 mm
  - distance from table surface to wheel center : 550 mm
  - electro magnetic chuck : 600 x 300 x 110 mm
  - graduation of hand wheel : 0.001, 0.01, 0.1 mm
- Grinding wheel
  - speed : over than 1,800 rpm
  - diameter x width x bore : Φ305 x 38 x 127 mm
- Motor grinding wheel spindle : 3.75 KW / 4 p

Applications

- Precision machining flat
- Precision grooving



Structural elements



07 Metal 3D Printer

Model • M290 [EOS Gmbh, Germany]

Principle

The Benchmark for the industrial 3D printing of High-Quality Metal Parts - with Enhanced Quality Management Features
With a building volume of 250 x 250 x 325 mm, the EOS M 290 allows a fast, flexible and cost-effective production of metal parts directly from CAD data. An intuitive user interface, the intelligent software concept with a combination of open and standardized parameter sets and the improved filter system are specially designed for the industrial production.

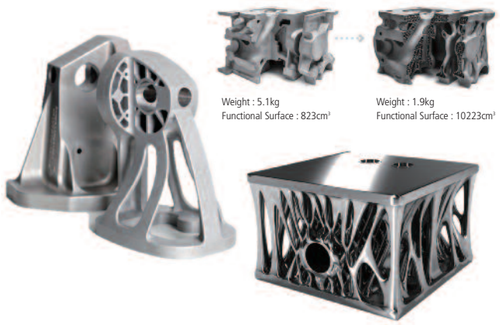
Room #110

Specifications

- Laser type : Yb-fiber laser; 400 W
- Building volume : 250 mm x 250 mm x 325 mm
- Scan speed : 7 m / sec
- Focus diameter : 100 µm
- Software : EOS RP Tools; EOSTATE; EOSPRINT;
- Input data file format : .STL
- Nitrogen generator : integrated

Applications

- Durable part
- Functional optimization part
- Custommized part
- Component simplication



Transforming to Additive Design

08 SLS 3D Printer

Model • P770 [EOS Gmbh, Germany]

Principle

If there is input 3D CAD data into SLS machine, machine make slice date automatically and CO_2 laser scans the surface of deposited PA12.
The powder that is scanned by laser is sintering / solidifying and the powder that is not scanned remain the statue of powder. If there is continuously working layer by layer like the above, there is able to make 3D physical models as the same as 3D CAD Data.

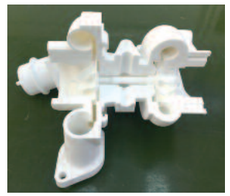
Room #110

Specifications

- Technology : Selective laser sintering process
- Laser & Scanning : 70 watt CO_2 Laser X 2ea
- Build rate : up to 32 mm/h ; up to 10.5l/h
- Build envelope : 700 x 380 x 580 mm (X, Y, Z)
- Precision optics : F-theta lens, surface module, high-speed scanner
- Input data file format : .STL
- Scan speed during build precess : up to 2 X 10 m/s
- Calculates scale and offset-factors

Applications

- Functional end-use part
- Widest prototypes
- Durable part
- Industrial plastic part
- Design prototype
- Functional prototype
- Rapid manufacturing part



09 3D Print

Model • sPro60 SLS [3DSystems, USA]

Principle

With an input 3D CAD data into SLS machine, machine makes slice date automatically and CO_2 laser scans the surface of deposited nylon powder. The powder scanned by laser sintered / solidified and the powder that is not scanned remains the statue of powder. If the machine works correctly as the description above, it is able to build 3D physical models coresponding to 3D CAD data.

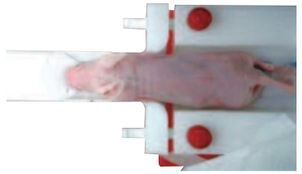
Room #110

Specifications

- Technology : Selective laser sintering process
- Laser & Scanning : 30 watt CO_2 Laser
- Scan speed : 5 m/sec
- Minimum layer thickness : 0.08 mm
- Build envelope : 330 x 381 x 457 mm (X, Y, Z)
- Powder layout : precision counter rotating roller
- Input data file format : STL
- Smart feed calculations outside of preview
- Caculates scale and offset factors
- STL add & delete on the fly software

Applications

- Design prototype
- Functional prototype
- Rapid manufacturing part
- Metal part
- Q.D.M
- Master precision casting



10 CNC Wire-Cut EDM

Model • SL 400G [Sodick, Japan]

Principle

A material is manufactured by series of current discharges between the material (+) and a wire (-). A servomotor, which is controlled by CNC (Computerized Numerical Control), receives signals from a control device and moves X-Y table. The wire cuts through the material with work ing fluid (water) and makes desired shape by electrical discharges.

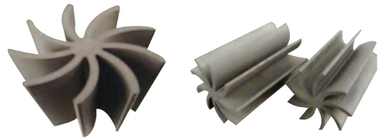
Room #105

Specifications

- X/Y/Z axes travel : 400 x 300 x 250 mm
- U/V axes travel : 150 x 150 mm
- Max. workpiece weight : 500 Kg
- Taper angle : ± 25 °
- Wire diameter : Φ0.1 ~ Φ0.3 mm
- Wire tension : 3 ~ 23 N
- Max wire speed : 420 (mm/sec)
- Machine tool dimensions : 2,115 x 2,490 x 2,330 mm
- Machine weight : 3,350 Kg

Applications

- Graphite cutting
- Medical equipment part cutting
- Mold cutting



Material : TTK5, Diameter : 50 mm, Roughness : 0.57 μm (Rz)
Cutting time : 10 hour 40 min, Cutting liquid : Water

Material : SKD 11, Diameter : 70, 100 mm
Roughness : 2.5 μm (Rz), Geometric tolerance : ± 3 mm
Wire : Φ 0.02 mm, Cutting liquid : Water

11 Fiber Laser Cutting Machine

Model • K2CMS1 [K2Laser System INC., Korea]

Principle

Fiber Laser cutting machine is a precise cutting equipment of metal and nonferrous metals by the fiber optic system with 3 axes motion control.

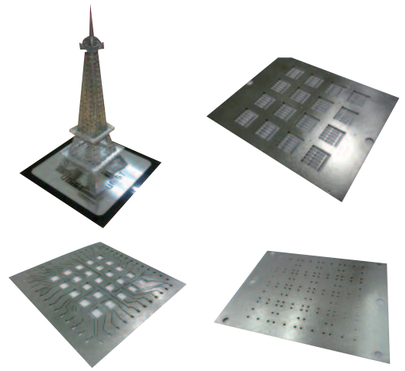
Room #108

Specifications

- Stroke : axes (X-Y-Z) : 900 x 600 x 30 mm
- Laser oscillator : ytterbium pulsed fiber laser
- Output : 500 W
- Wavelength : 1,070 nm
- Positioning accuracy : 0.012 mm / 300 m
- Repeatability : 0.002 mm
- m^2 : 1.05 (Typical) / 1.1 (Max)
- Beam parameter product (BPP) : <0.38 mm. mrad
- X axes, Y axes linear motor stage
  - positioning accuracy : 10 μm
  - repeat accuracy : 5 μm
- Feed rate : up to 1,000 mm/sec
- Compressed air : 4 ~ 6 Kg/cm^2

Applications

- Design prototypes
- Functional prototypes
- Precise cutting for sheet metal
- Precise cutting for nonferrous metal



12 Electron-Beam PIKA Machine

Model • PF-32B [Sodick, Japan]

Principle

The appratus is used for surface clearance and hardening by repeated cooling and anealing of the metal surface, as the argon plasma is applied to the metal surface with the pulse state of high electron beam.

Room #105

Specifications

- Machine dimensions (W × D × H) : 1500 × 1600 × 1800 mm
- Table stroke : 300 × 200 mm
- Z-axes stroke : 100 mm
- Max. workpiece size (W × D × H) : 350 × 250 × 100 mm
- Electric capacity : 1.5 KVA/h
- Input voltage : 3-phase, 200/220 VAC, 30 A, 50/60 Hz
- Beam energy density : 10 J/cm2
- Beam diameter : Φ60 mm

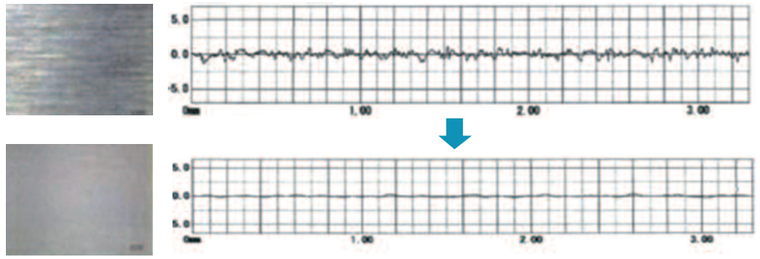
Applications

- Improvement of metal surface roughness
- Metal surface hardening
- Surface toughness relaxation of injeted mold product

[Effect of surface dissolution by the electron beam energy]

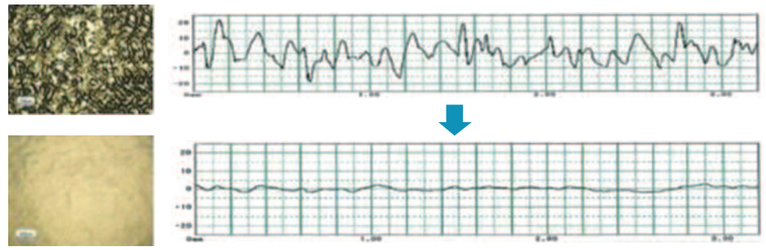
< Surface roughness 2.0 → 0.5 μm Rz Polishing surface >

Roughness curve
Magnification : X 2,000.00 / Magnification : X 50.00



< Surface roughness 28 → 3 μm Rz electrical discharge machining surface >

section curve
Magnification : X 1,000.00 / Magnification : X 50.00



Manufacture

13 ULTRASONIC Machine

Model • ULTRASONIC 20 [DMG MORI, Germany]

Principle

The ULTRASONIC series is a unique and pioneering machine tool that offers not only ordinary cutting operations but also high-speed, high-precision, high-efficiency grinding by means of ultrasonic oscillation. It achieves high-precision machining of a wide range of materials from standard metals to difficult-to-cut materials of ceramics and high-tech materials of carbides. The ULTRASONIC 20 linear is based on the HSC series machines. It comes with linear drives and offers both HSC milling and ultrasonic machining on one machine.

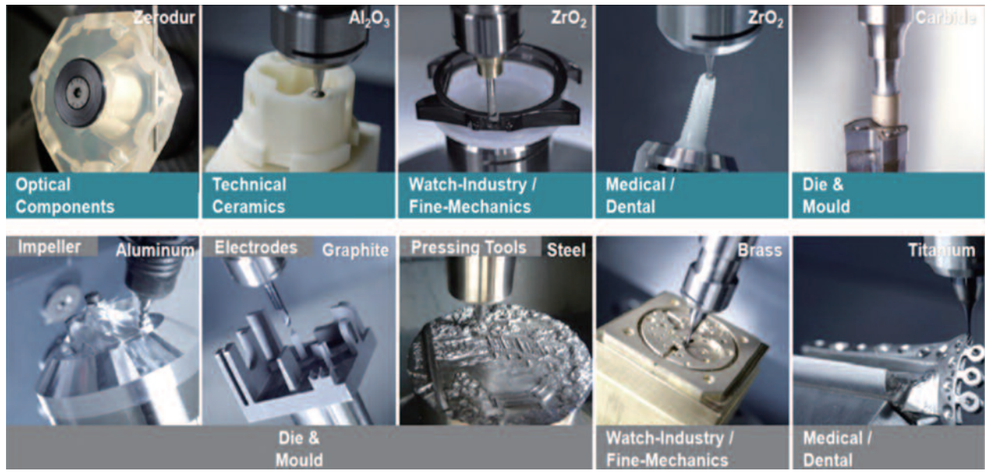
Room #105

Specifications

- Table
  - size : 200 - 200 280 mm (X-Y-Z)
  - swivel range : -15 ° ~ -130 °
  - max. load capacity : over than 15 Kg
  - speed-swiveling axes A : over than 50 rpm
  - speed-rotary axes C : over than 150 rpm
- Work area
  - traverse X-Y-Z : over than 200 x 220 x 280 mm
- Main spindle speed : over than 50,000 rpm
- Automatic tool changer
  - magazine pockets : over than 24 pockets
  - max. tool length : over than 200 mm
  - max. tool diameter : over than Φ50 mm

Applications

- Difficult to cut part
- Engineering part
- Joint implant / Zirconium
- Class ceramics



14 Milling

Model • STM-2VM [Sodick, Japan]

Principle

The vertical milling machine uses that the milling cutters with that are placed at regular intervals. Materials can be adjusted vertically, hori zontally, back and forth, by moving the feed table.

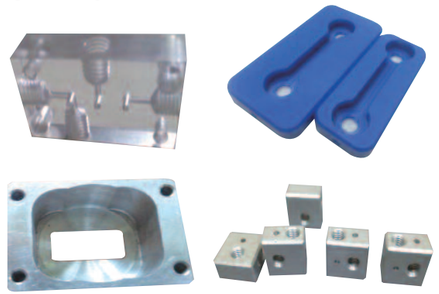
Room #104

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 : ± 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

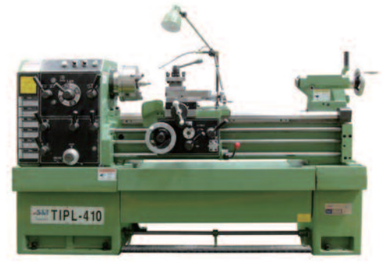


15 Lathe

Model • TIPL-410 [S&T, Korea]

Principle

This machine is primarily designed to produce the cylindrical shape from the raw metal. The machine is also able to create conical, oval, curved and screw shapes and perform operations such as cutting and grinding.



Room #104

Specifications

- Capacity
  - swing over bed : Φ410 mm
  - swing over carriage : Φ220 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

Measurement

16 Band Saw

Model • SH-4030 [COSEN, Taiwan]

Principle

Used to cut sheet metal, pipe, etc.
The circular band saw rotates and cuts the material.

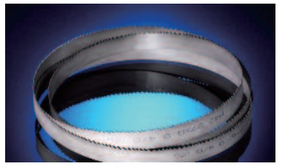
Room #104

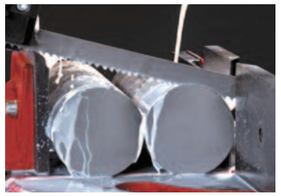
Specifications

- Capacity
  - size : over than 300 x 400 mm
- Blade
  - speed : 21, 38, 55, 68, 81 m/min (70, 127, 180, 224, 267 fpm)
  - size (L x W x T) : 3,820 x 34 x 1.1 mm
  - motor : 5HP (3.75 kW)
- Motor
  - Blade Motor : 5HP (3.75 kW)
  - Hydraulic Motor : 1HP (0.75 kW)
  - Coolant Motor : 1/8HP (0.1 kW)
- Workbed Height : 740 mm
- Gross Weight : 1,200 kgs
- Floor Space (L x W x H) : 800 x 1,905 x 1,700 mm

Applications

- Cutting processing





17 CO_2 Welding Machine

Model • MAGIC ARC 350 [SEIL, Korea]

Principle

This machine uses heat from the electric arc to melt and weld the joints and uses CO_2 to shut off oxygen.

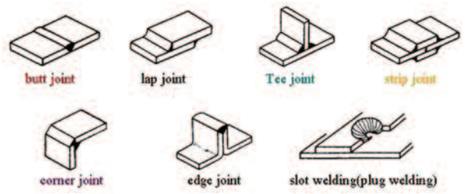
Room #109-1

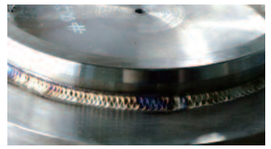
Specifications

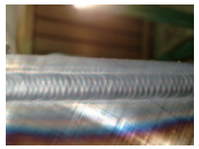
- Rated output current : 350 A
- Rated input voltage : 220 V
- Rated Input : 15.5 KVA
- Output current range : 40 - 350 A
- Rated load voltage : 36 V
- Rated utilization : 60 %
- Output voltage range : 14 - 36 V
- Maximum no-load voltage : 59 V
- Rated Frequency : 60 Hz
- External dimension (W x L x H) : 360 x 488 x 632 mm
- Weight : 45 kg

Applications

- Plate Welding
- Pipe welding







18 Non-contact 3D Scanner

Model • Rexcan 4 [Solutionix, Korea]

Principle

Using the CCD camera and the LED light beam, the apparent coordinate values of machined products are extracted. The 3D data with an accuracy of 0.01 mm is scanned, and the 3D modeling is obtained by reverse engineering.

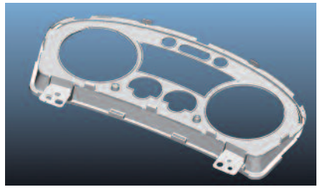
Specifications

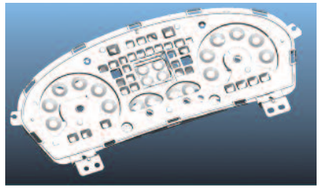
- Cameras : 1.4 / 2.0 / 5.0 MP
- 3D Scanning area : 55 mm ~ 1545 mm
- Point spacing : 0.03 mm ~ 0.71 mm
- Scanning principle : Phase-shifting optical triangulation
- twin cameras Triangulation angle : 10 ° / 25 °
- Scanning distance : 430 ~ 1,330 mm
- Size (W x H x D) : 560 mm x 240 mm x 170 mm
- Light source : White LED
- Weight : 5 kg

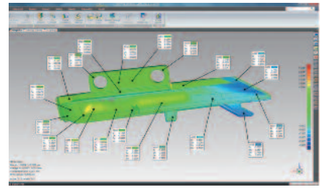
Applications

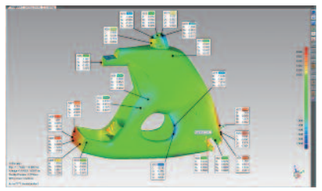
- Product Scanning
- Reverse engineering
- Comparative measurement
- Part inspection

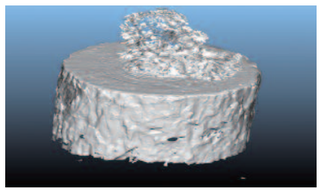
Room #107

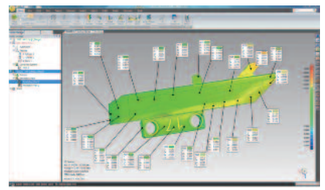












19 Coordinate Measuring Machine

Model • PGS [Dukin, Korea]

Principle

This coordinate measuring machine measures numerical values precisely digitalizing an object's position in space by using a probe.

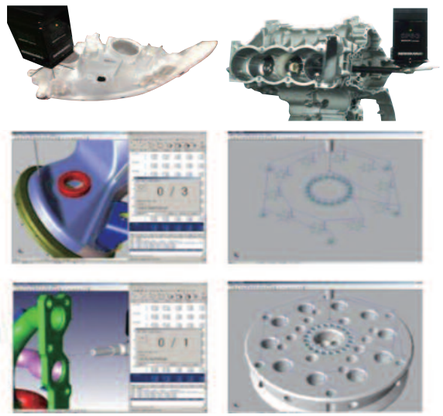
Room #107

Specifications

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

Applications

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



20 Three-Dimensional Measurement

Model • NV-3000 [Nanosystem, Korea]

Principle

Probe system moves towards an optical axes at very small intervals of scores of nm. It inspects whether interference is generated from all pixels in image. height in an optional pixel point is set on a place where in terference signal is maximized, and by preforming this in pixel an entire image, this method produces three dimensional form.

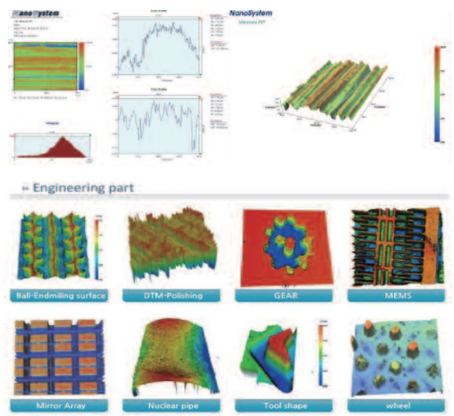
Room #107

Specifications

- Interferometric objective : 5 lens available
- Scan range : 0 ~ 180 μm (option 270 μm, 5 mm)
- Vertical resolution : WSI < 0.5 μm / PSI < 0.1 μm
- Lateral resolution : 0.2 ~ 4 μm
- Tip/tilt : ± 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



21 Semi Auto Formtracer System

Model • SV-C3100 [Mitutoyo, Japan]

Principle

The form tracer is a surface roughness tester and surface outline measuring device embedded in a single unit. In total, two kinds of sur face roughness and facets are measured.

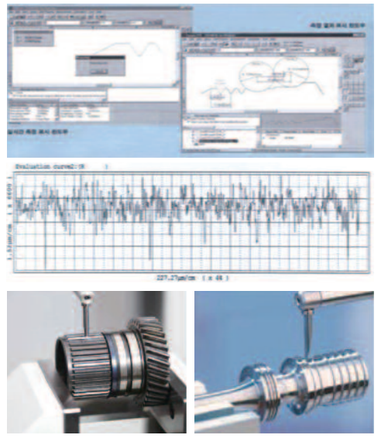
Room #107

Specifications

- X-axes measuring range : 100 mm
- Measuring force of detector : 0.75 mN
- Vertical travel : 300 mm power column
- Granite base size (W x D) : 610 x 450 mm

Applications

- Surface roughness measurement
- Profile measurement
- Height measurement
- Cylindricity measurement



22 Multi-Component Dynamometer

Model • 2825A [Kistler, U.K]

Principle

This instrument measures the force of machinery. when the charge to the voltage amplifier is raised the signal transition occurs through the final measurement, which will be converted into a physical description.

Room #107

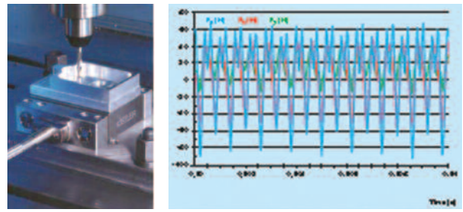
Specifications

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

Applications

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

High speed milling of aluminum with Dynamometer type 9256C2



Material : Hardend steel HRC 56
Tool : Carbide spherical Endmilling cut,
r = 1 mm Twin cutters
N : 50,000 1/min, Vf : 40 mm/s, Ap : 0.3 mm, Ae : 0.3 mm

23 Laser Interferometer

Model • XL-80 [Renishaw, U.K]

Principle

This machine measures accuracy of movement in the machine tool through the use of a laser (Helium and neon gas combination). This is made possible by the laser wavelength and precise measurement.

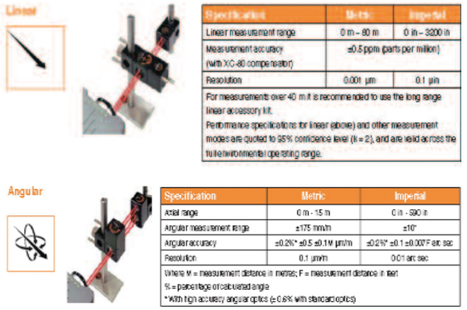
Room #107

Specifications

- Accuracy : ± 0.5 ppm
- Linear resolution : 1 nm
- Maximum 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



Specification	Metric	Imperial
Linear measurement range	0 m - 80 m	0 in - 3200 in
Measurement accuracy (with XC-80 compensation)	±0.5 ppm (parts per million)	
Resolution	0.001 µm	0.1 µin
For measurements over 40 m it is recommended to use the long range linear accessory kit. Performance specifications for linear (above) and other measurement modes are quoted to 95% confidence level (k = 2), and are valid across the full environmental operating range.		

Specification	Metric	Imperial
Axial range	0 m - 15 m	0 in - 590 in
Angular measurement range	±175 mm/m	±10°
Angular accuracy	±0.2%* ±0.5 ±0.1M µm/m	±0.21%* ±0.1 ±0.007F arc sec
Resolution	0.1 µm/m	0.01 arc sec

Units: M = measurement distance in metres; F = measurement distance in feet
% = percentage of calculated angle
* With high accuracy angular optics (±0.6% with standard optics)

24 Powerful Microscope

Model • MF-1010B [Mitutoyo, Japan]

Principle

This microscope has a fine moving table which can move in every direction. The user can recognize how far it moves through a standard microscope or micrometers.

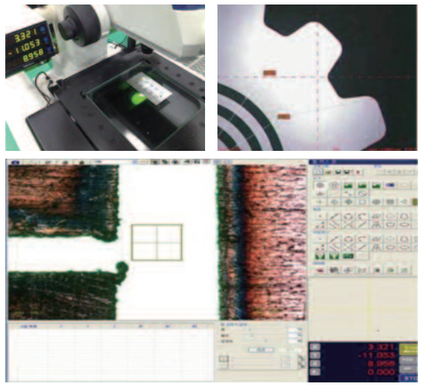
Room #107

Specifications

- Measuring range : X- 100 mm, Y- 100 mm
- Z-axes 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



25 Box type 3D Scanner

Model • Rexcan DS2 [Solutionix, Korea]

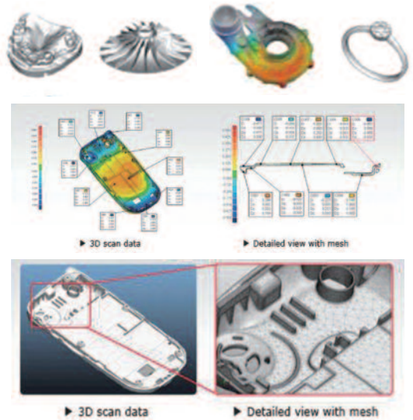
Principle

The compact, automatic 3D scanner that can only be obtained with precision detail with the three-dimensional shape measurement of water and a small jewelry and two cameras equipped with high resolution scanner.

Room #107

Specifications

- Camera resolution : 1.3 mega pixels
- 3D scanning area : 80 mm x 60 mm x 60 mm
- Point spacing : 0.05 mm, 0.065 mm
- 3D scanning principle : phase shifting optical triangulation
- Triangulation angle : 15 °
- Rotary stage : 2 axes movement
- Size (W x H x D) : 212 mm x 370 mm x 449 mm
- Light source : LED
- Interface : USB 2.0 High-speed
- Output data format : STL



26 Universal Testing Machine

Model • AGS-100NX [Shimadzu, Japan]

Principle

This is a test equipment to construct systematic database by examining the tension and flexural strength of electronic components, graphene, and advanced materials.

Room #107

Specifications

- Max load capacity : 100 N
- Crosshead to table distance : 1200 mm
- Effective specimen width : 425 mm
- Dimensions : W 653 x D 520 x H 1603
- Weight : 85 kg
- Power supply capacity : 1.2 KVA
- Drive motor : 400 W AC Servo motor
- Power consumption : 300 W
- Position control resolution : 0.033 um
- Testing speed range : 0001 mm/min to 1000

Applications

- The tensile test of lamination, rubber, graphene device
- Indirect measurement of the tensile strength
- Compression, bending cycle test

UNIST Environmental Analysis Center (UEAC)

The UNIST Environmental Analysis Center (UEAC) 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 Center obtained "Accreditation of POPs Sampling & Analysis" which was authorized by the Minister of Environment. 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 outsourcing of contracts.

List of Instruments

Lab	No.	Equipment	Model	Maker	Page
UEAC	1	GC/HRMS	Autospec premier	Waters, USA	73
	1	GC/HRMS	JMS-700(2)	JEOL, Japan	73
	2	GCxGC/TOFMS	Pegasus 4D	LECO, USA	74
	3	GC/MS	7890 GC/5975C MS	Agilent, USA	75
	4	GC/u-ECD	7890 GC/u-ECD	Agilent, USA	75
	5	LC/MS/MS	Xevo TQ-S	Waters, USA	76
	6	ICP-MS	ELAN DRC-II	Perkin Elmer, USA	77
	7	ICP-OES	720-ES	Varian, USA	77
	8	LIBS	J200	Applied Spectra, USA	77


인 정 서
Accreditation of
2014년 12월 3일
국 립 환 경 과 학 원 장
National Institute of Environmental Research

< Accreditation of POPs Sampling & Analysis >

Office Phone Number : 4067, 4068
Office Email : u-eac@unist.ac.kr

UEAC

01 GC/HRMS

Model • Autospec premier [Waters, USA] | JMS-700(2) [JEOL, Japan]

Principle

GC/HRMS incorporates Waters' unique EBE, double-focusing geometry with the extra-wide gap magnet of the proven Ultima NT System. This latest development in magnetic sector technology provides an unmatched combination of high sensitivity, high resolution, and low background noise. The AutoSpec Premier is a powerful platform for high-resolution selected ion recording applications, such as dioxin, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), or drugs-of-abuse analysis.

Room #B103

Specifications

- Sensitivity
  - 5 x 10^{-7} C/ug for methyl stearate at m/z 298.3, EI, 1,000 resolution
  - 5 x 10^{-8} C/ug for methyl stearate at m/z 298.3, EI, 10,000 resolution
- Mass range : 2-1,200 Daltons or more at full sensitivity
- Resolution : Continuously variable above 60,000(10% valley) or more, ducts

Applications

- Trace analysis of persistent organic pollutants(Dioxins. PCBs, OCPs etc.)
- Quantitative analysis of various pollutants in environmental samples.
- Identification of impurities and by-products

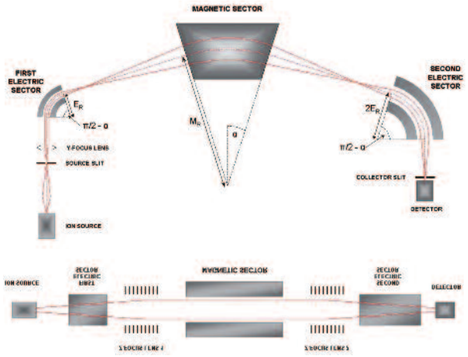


Figure 1. Lens geometry

Principle

A high resolution mass spectrometer featuring full-control by computer, equipped with auto-tuning of various parameters including the ion source. A resolution exceeding 60,000 can easily be obtained with the MStation. Exact mass determination can be obtained over the entire mass range of the instrument when required. The main, intermediate, and collector slits are computer controlled by the action of a single program.

Room #B103

Specifications

1) Resolution
   a. EI mode : R>60,000 (10% valley) or more m/z=84 doublet (CH_2Cl_2, $CDCl_2$) of dichlormethane and deutrochloroform
   b. Dynamic Resolution with any sample : 40,000
2) Sensitivity
   a. EI (GC/MS) mode : 0.2 ng, S/N ≥ 400, M+m/z=298 of methylstearate (R=1,000)
   b. HR-SIM (EI, GC/MS) : S/N ≥100, with 100 fg of 2,3,7,8-TCDD in 4 Standard Deviation(4σ) condition with EPA1613 method
3) Mass Range : 2,400 dalton at Maximum Accelerating Voltage
4) Max. acceleration voltage : 10 kV
5) Magnetic Field Scan Speed : 0.1 s/cyclic (m/z 50 to 500)

Applications

Use of the high-resolution SIM (selected ion monitoring) method allows ultra-trace quantitative analysis of the femtogram (10-15 g) order.
All higher-order aberrations are minimized for allowing high-resolution spectra (resolution : 60,000) to be obtained easily.
This is a mass spectrometer system for promptly and properly performing high-sensitivity qualitative and quantitative analyses of very small amounts of multi-component mixtures in dioxin analysis using the high-resolution quantitative analysis method (HRGC/HRMS) coupled the high-resolution gas chromatography.

analysis data

DIP-probe

02 GCxGC/TOFMS

Model • Pegasus 4D [LECO, USA]

Principle

- GCxGC provides high peak capacity by trapping compounds eluting from the first chromatographic column and then systematically injecting them into the second column to obtain the second separation.
- LECO's LN_2 modulator delivers the ability to modulate these volatile analyses.
- The Pegasus 4D, data acquisition rates of 100 to 500 spectra/second are commonly utilized, giving sufficient data density to obtain spectral deconvolution of the chromatographic peaks, using acquired data.

Room #B103

Specifications

- Carrier Gas Flow : 0 to 10 mL/min Helium
- LN_2 Modulator Volatility Range : C_4 to C_{40} n-alkane at amounts equal to or Less than column sample capacity
- LN_2 Modulator Maximum Temperature : 400 °C
- LN_2 Modulator Maximum Heating Rate : 40 °C/min
- Modulation Periods : 1 to 65 seconds
- Ionization Source : Electron Impact
- Mass Range : 5 ~ 1,000 amu
- Spectral Generation Rate : 1 to 500 spectra/second

Applications

- Petroleum
- Environmental
- Food and Flavors
- Forensics
- Geological
- Metabolomics
- Pharmaceutical
- Identify of complex

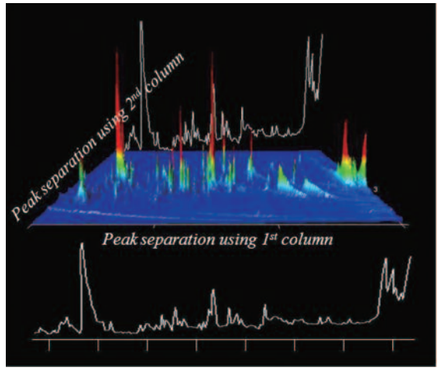


Figure 1. 4D face sample chromatogram

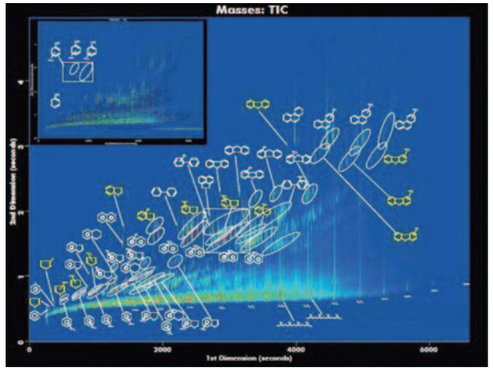


Figure 2. 4D flat sample chromatogram

03 GC/MS

Model • 7890 GC/5975C MS [Agilent, USA]

Principle

GC/MS makes an effective combination for chemical analysis. Mixtures of volatile substances are separated by gas chromatograph. Via a transfer line, the fractions of each peak are transferred into the ion source where the ionization takes place. After acceleration, the ions pass through a magnetic-field which causes deviation of their linear flight curve according to their respective mass. After this magnetic field the detector counts the ions.

Room #B103

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

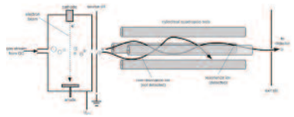


Figure 1. Schematic of quadrupole mass filter

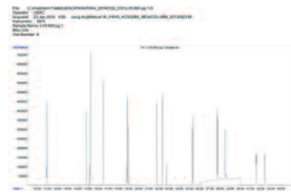


Figure 2. Sample chromatogram (PAHs)

04 GC/u-ECD

Model • 7890 GC/u-ECD [Agilent, USA]

Principle

Chromatograph is a method separating complex compounds with components. Target compound to separate is distributed to both stationary phase and mobile phase, so it makes separation of the difference between the two. This case of using gas to mobile phase is called Gas chromatograph. It has a Little restraint that compound is volatility and thermal safety, but it is widely used for its high resolution and its prompt and simple operation.

Room #B103

Specifications

- Column oven
- 35 ~ 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, pesticides and halogen compounds.

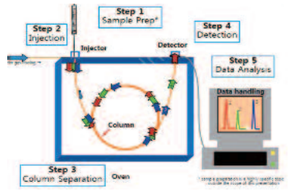


Figure 1. Separation flow chart

Figure 2. Sample chromatogram (PCBs)

05 LC/MS/MS

Model • Xevo TQ-S [Waters, USA]

Principle

LC/MS/MS is a powerful and widely used tool in qualitative and quantitative residue and contaminant analysis. The mixture is separated with HPLC prefer ably using a reversed-phase column. The analyses can be ionized with a suitable ion source by various methods, followed by partial fragmentation. After acceleration, they are deflected by a magnetic field which resolves them according to their mass.

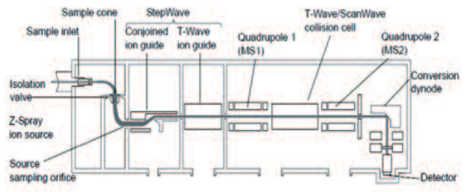
Room #B103

Specifications

- Ion source : ESI, APCI
- Mass range : 2 - 2048 m/z
- Dynamic range : 4 X106
- Collision cell : Two-wave collision cell
- Detector : Dynolite photomultiplier detector
- Sensitivity : ESI (S/N ration = 300 :1)
  ACSI (S/N ration = 100:1)
- Scan speed : 10,000 amu/sec
- Mass stability : within ± 0.05 Da
- Number of MRM channels
  : Up to 16,384 MRM channels

Applications

- Analysis of environmental samples (water, waste, soil, PPCPs)
- Analysis of organic composition
- Identification of molecular weight
- Analysis of DNA, RNA, proteins



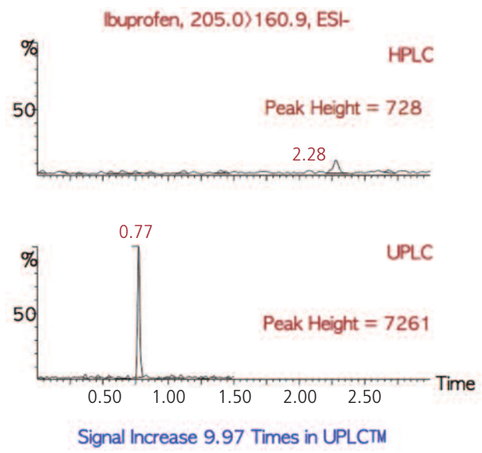


Figure 2. Comparison of HPLC and UPLC for analysis of ibuprofen

06 ICP-MS

Model • ELAN DRC-II [Perkin Elmer, USA]

Principle

ICP-MS combines a high-temperature ICP (Inductively Coupled Plasma) source with a mass spectrometer. The ICP source converts the atoms of the elements in the sample ions. These ions are then separated and detected by the mass spectrometer.

Room #B103

Specifications

- Dual turbo-molecular pumps with ceramic bearings
- Vacuum levels : 1 x 10^{-6} Torr
- 27.12 MHz ~ 40 MHz RF Generator
- Dynamic Reaction Cell
- Thermal stabilization of the quadrupole power supply(QPS) at > 2.5 MHz mass spectrometer

Applications

- Quantitative analysis of various atoms
- Analysis of samples in the life sciences
- Isotope ratio measurement

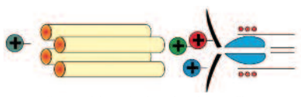


Figure 1. Schematic of quadrupole mass filter

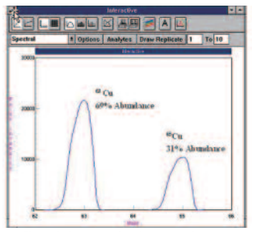


Figure 2. Spectrum showing copper isotopes

07 ICP-OES

Model • 720-ES [Varian, USA]

Principle

ICP-OES is based on the introduction of the liquid sample to be analyzed towards an argon plasma, created by a radio frequency generator. The plasma energy (more than 6000 K) is transferred to the atoms of every sample elements, promoting the excitation of their electrons to higher energy levels. The decay of these electrons from excited states to low energy levels, the additional energy is emitted as electromagnetic radiation in the ultraviolet/visible range of the radiation spectrum.

Room #B103

Specifications

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

Applications

- Qualitative analysis of various atoms
- Analysis of trace element in environmental samples
- Compositional analysis of metals and alloy

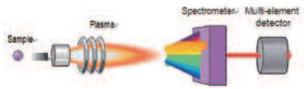


Figure 1. Schematic of an ICP-OES

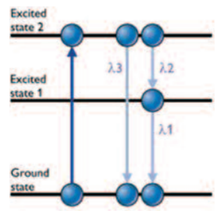


Figure 2. Process of excitation of atoms resulting in generation of element characteristic wavelengths

08 LIBS

Model • J200 [Applied Spectra, USA]

Principle

Laser Induced Breakdown Spectroscopy(LIBS) is a fully integrated laser ablation and optical spectrometer system. The laser source is a highly reliable Q-switched, Nd:YAG laser with its wavelength down to 213 nm. LIBS could have the capability to analyze virtually all elements in the periodic table with the exception of noble gases.

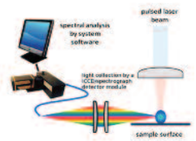
Room #B103

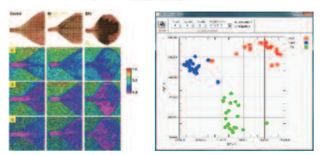
Specifications

- Laser Source : Nd-YAG laser
- Laser Pulse Energy : < 25 mJ/pulse@266 nm
- Spot Size : 10 to 150 Mmicrons@266 nm
- Automated X-Y Stage : 100 mm X 100 mm trabel range (0.2 micron resolution)
- Ablation Spot Targeting : Red laser@670 nm (automatic adjustment of sample height)
- Sample Imaging : Dual CMOS cameras (Zoom upto 60X)
- Communication with ICP-MS : Bi-directional control between the LIBS and ICP-MS instruments
- LIBS Detector : 6 channel CCD detector (spectral range from 190 nm to 1040 nm)

Applications

- Bulk analysis
- Micro analysis
- Depth profiling
- Elemental mapping (gridding & scanning)
- PCA analysis





Mapping PCA

UNIST Optical Bio-Med Imaging Center (UOBC)

The UNIST Optical Bio-Med Imaging Center (UOBC) was established in 2009 with the aim to enhance research capabilities and achieve global competitiveness using state of the art equipment.

- UOBC is located on the 9th floor of Engineering building 4 (110-908). The center provides state-of-the-art technologies in the area of optical equipment and advanced imaging tools including systemic microscopes, general microscopes and imaging analysis system.
- The center 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.

List of Instruments

Lab	No.	Equipment	Model	Maker	Page
Super Resolution Microscope	1	Photoactivated Localization Microscope	ELYRA P.1	ZEISS, Germany	79
	2	Structured Illumination Microscope	ELYRA S.1	ZEISS, Germany	79
Multiphoton & Enhanced Confocal Microscope	3	Multiphoton & Enhanced Confocal Microscope	LSM780NLO OPO	ZEISS, Germany	80
Confocal Laser Scanning Microscope	4	Confocal Laser Scanning Microscope	FV1000	OLYMPUS, Japan	81
	5	Confocal Laser Scanning Microscope	LSM700	ZEISS, Germany	81
	6	Confocal Laser Scanning Microscope	FV10i	OLYMPUS, Japan	82
	7	Confocal Laser Scanning Microscope	OLS3100	OLYMPUS, Japan	82
Selective Plane Illumination Microscope (SPIM)	8	Lightsheet Fluorescence Microscope	Lightsheet Z.1	ZEISS, Germany	83
System Microscope	9	Total Internal Reflection Fluorescence Microscope	Cell^TIRF	OLYMPUS, Japan	84
	10	Live cell System Microscope	Cell^R	OLYMPUS, Japan	84
	11	Full Motorized Inverted Microscope	FSX100	OLYMPUS, Japan	85
	12	Fluorescence Inverted Microscope	IX71	OLYMPUS, Japan	85
Histological System Microscope	13	Virtual Microscope	dotSlide	OLYMPUS, Japan	86
	14	Laser Capture Microdissection Microscope	LCM	ZEISS, Germany	86
Macro Zoom System Microscope	15	Full Motorized Macro Zoom Microscope	Axio Zoom V16	ZEISS, Germany	87
	16	Macroview Imaging Microscope	MVX10	OLYMPUS, Japan	87
Analysis Software	17	3D Measurement Software	Imaris 8.0	Bitplane, UK	88
	18	3D Measurement Software	Vision 4D	Arivis, Germany	88
	19	2D Measuremnet Software	Metamorph	MD, USA	89
	20	2D, 3D Deconvolution Software	AutoQuant	Media Cybernetics, USA	89

Office Phone Number : 4161, 4181
Office Email : biomed-imaging@unist.ac.kr

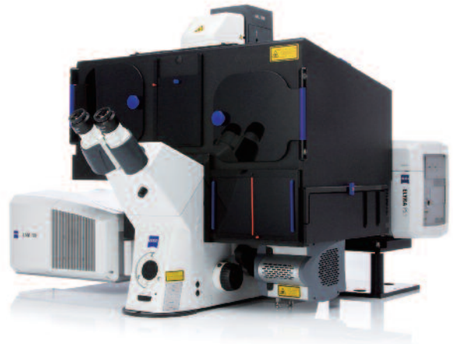
Super Resolution Microscope

01 Photoactivated Localization Microcsopy (PALM)

Model • ELYRA P.1 [ZEISS, Germany]

Principle

PALM, Detection with an effective resolution down to 20nm can show you substructure and patterns where conventional microscopy will reveal "merely" co-localization. you can achieve effective lateral resolutions down to 20-30 nm and 50-80nm axially.



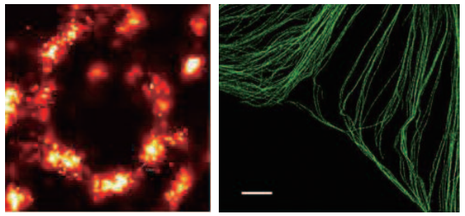
908-#11

Specifications

- Body : ZEISS Axio Observer Z.1
- Objectives : 10x, 20x, 40x(oil), 63x(oil), 100x(oil)
- Transmitted Light Source : 100 W Halogen
- Fluorescence Light Source : 120 W Metal Halide
- Observation : Bright Field, TIRF, Fluorescence, Super Resolution Imaging
- Laser : 405, 488, 561, 640 nm
- Resolution : XY 20 nm, Z 50 nm

Applications

- Up to Three-Color SR Imaging
- PALM, dSTORM, NSTORM imaging
- Map protein localization onto a structural context
- Track many molecules and retrieve diffusion behavior



02 Structured Illumination Microscope

Model • ELYRA S.1 [ZEISS, Germany]

Principle

Super resolution structured illumination(SR-SIM) - you image fine structural details while remaining free to label your samples with conventional dyes. SR-SIM images any fluorophore with up to twice the resolution of a conventional light microscope(XY-120nm, Z-300nm)

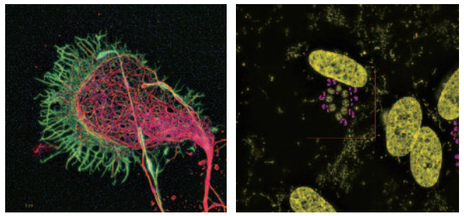
908-#12

Specifications

- Body : ZEISS Axio Observer Z.1
- Objectives : 10x, 20x, 40x(Water), 63x(oil), 100x(oil)
- Transmitted Light Source : 100 W Halogen
- Fluorescence Light Source : 120 W Metal Halide
- Observation : Bright Field, Fluorescence, Super Resolution Imaging
- Laser : 405, 488, 561, 640 nm
- Resolution : XY 120 nm, Z 300 nm

Applications

- Multi-Color SR Imaging (4ch)
- Live cell imaging (1ch DIC)
- Investigate arrangement of cellular components and proteins
- Study structural changes of slower dynamics
- Explore interaction of molecules



Multiphoton & Enhanced Confocal Microscope

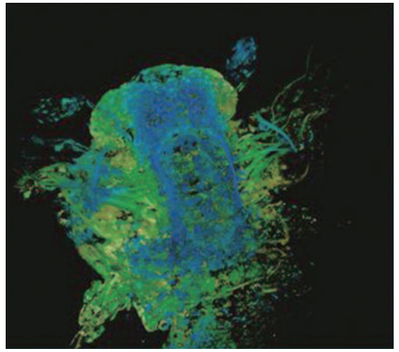
03 Multiphoton & Enhanced Confocal Microscope

Model • LSM780NLO OPO [ZEISS, Germany]

Principle

The point excitation with a pulsed IR laser is minimally invasive with a low level of phototoxicity, thereby creating the ideal conditions for the examination of living specimens. The infrared excitation light penetrates deeper into tissue due to low scattering

908-#2

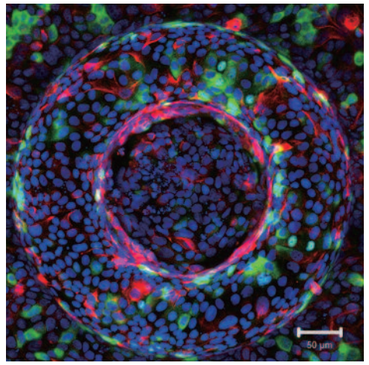


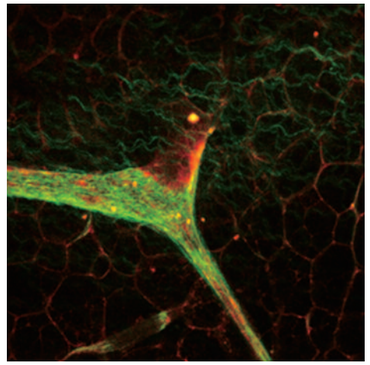
Specifications

- Body : ZEISS Axio Observer Z.1
- Objectives : 10x, 20x, 40x(Water, Oil), 63x(Water, oil), 100x(oil)
- Transmitted Light Source : 100 W Halogen
- Fluorescence Light Source : 100 W Metal Halide
- Observation : Bright Field, DIC, Fluorescence, Deep Imaging
- Laser : 405, 458, 488, 514, 561, 640 and 700-1300nm(IR)

Applications

- Deep Imaging with subcellular level
- the more specific excitation of red fluorescent proteins/dyes increases the amount of possible fluorescent markers being used in the same preparation
- Manipulating cells using photoactivation or conversion; labelling and monitoring their development (dividing, interaction)





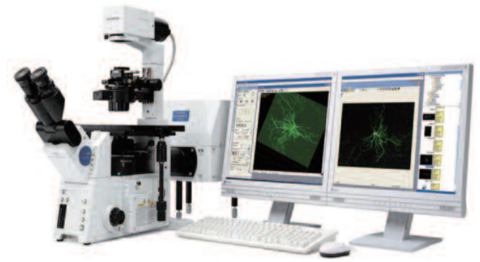
Confocal Laser Scanning Microscope

04 Confocal Laser Scanning Microscope

Model • FV1000 [OLYMPUS, Japan]

Principle

The Confocal laser scanning microscope is a powerful tool for high resolution multi-dimensional observation of cell and tissue morphology, and precise molecular localization. The innovative, SIM Scanner incorporates two independent, fully synchronized laser scanners in a single compact design for simultaneous laser stimulation and confocal observation



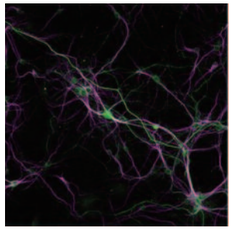
908-#1

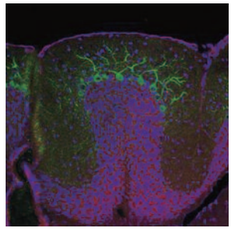
Specifications

- Olympus motorized inverted microscope IX81
- Spectral detector : 1 ~ 100nm band-pass (emission)
- Objectives : 10x, 20x, 40x, 60X(oil), 100x(oil)
- Observation : BF, DIC, Fluorescence, 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)





05 Confocal Laser Scanning Microscope

Model • LSM700 [ZEISS, Germany]

Principle

Simple & Strong. The Confocal is equipped with low-noise PMT detectors for high signal to noise ratio imaging. Intuitive software lets researcher to handle with easiest manners using 'Smart Setup' for multi-color confocal fluorescence imaging

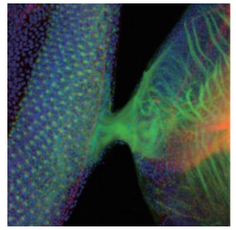
908-#1

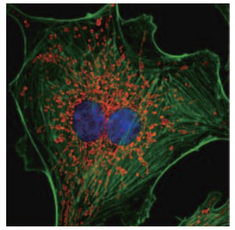
Specifications

- Body : ZEISS Axio Observer Z.1
- Objectives : 10x, 20x, 40x(water), 100x(oil)
- Transmitted Light Detector : DIC Imaging
- Fluorescence Detector : 2ch Confocal Detector
- Observation : BF, DIC, Confocal Fluorescence
- Laser : 405, 488, 555, 639 nm

Applications

- Confocal Fluorescence Imaging
- DIC Imaging
- Protein Colocalization Analysis
- Resolution : XY 200 nm, Z 500 nm
- 3D Reconstruction from Optically Sectioned Images
- Whole Slide Scanning or Tile Scanning





06 Confocal Laser Scanning Microscope

Model • FV10i [OLYMPUS, Japan]

Principle

Its compact design can fit where you work, on a desktop or lab bench, without the need for a dedicated darkroom, bringing the power and clarity of confocal imaging to your side. Designed with ease-of-use in mind, the software has a navigator to guide even novice users to high quality data acquisition. With a powerful set of standard capabilities, the value for your research is clear.

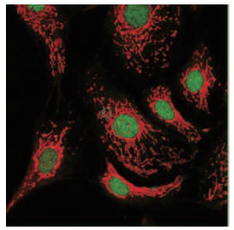
908-#4

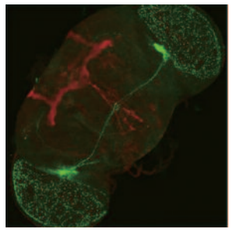
Specifications

- 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_2 Incubator

Applications

- Confocal Imaging with Live cell imaging (1ch Phase Contrast, 2ch Fluorescences)
- 3-Dimensional image
- Multi time-lapse image
- Stitching image





07 Confocal Laser Scanning Microscope

Model • OLS3100 [OLYMPUS, Japan]

Principle

Confocal laser scanning microscopes allow for observations of three-dimensional shapes, such as high-density semiconductors and micro-fabricated MEMS. The Confcoal microscope uses a laser scanning head for both direct imaging of the surface and for surface profile measurements

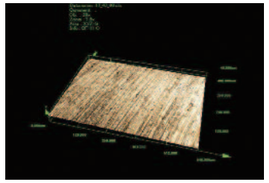
908-#3

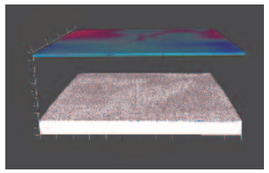
Specifications

- Objectives : 5x, 10x, 20x, 50x, 100x
- Resolution : XY-120 nm, Z-10 nm
- Laser : 405 nm / 0.9 uW (JIS Class2)
- Frame size : 1024 x 1024 pixel
- Observational Method : Bright Field, Dark Field, DIC, Reflected Confocal

Applications

- 3D Visualization & Measurement
- Area Roughness & Waviness
- Volume Measurement
- Profile Measurement
- Height Measurement
- Automotive / Metal Processing, Materials,
- Electronic Components ETC.





Selective Plane Illumination Microscope (SPIM)

08 Lightsheet Fluorescence Microscope

Model • Lightsheet Z.1 [ZEISS, Germany]

Principle

Imagine you had access to an imaging system that could deliver optical sections of large samples, with virtually no phototoxicity or bleaching and with high temporal resolution. that is exactly what SPIM. The unique Multiview light sheet fluorescence microscope allows you to record the development of large, living samples and gently image them to deliver exceptionally high information content. It is also fast: The SPIM is the tool you need to get optical sections at unprecedented speed. Acquire images of your whole sample volume at sub-cellular resolution –in a fraction of the time it takes using other techniques.

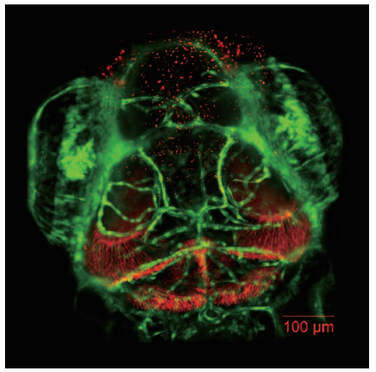
908-#7

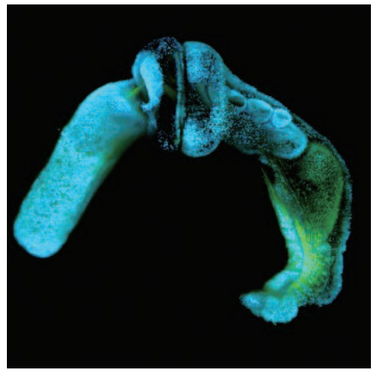
Specifications

- Objectives : 5x, 10x, 20x, 40x
- Laser : 405, 488, 561, 638 nm
- Dual sCMOS camera System for simultaneous 2 color imaging
- Observational Method : Bright Field, Fluorescence

Applications

- Morphogenesis and embryogenesis in developmental biology and systems biology
- Orgaogenesis and cell dynamics: blood flow, cascular development, neuro development
- Live imaging or 3D cell Culture, spheroids and cysts, tissue cultures
- Large volume imaging of fixed sample with high speed





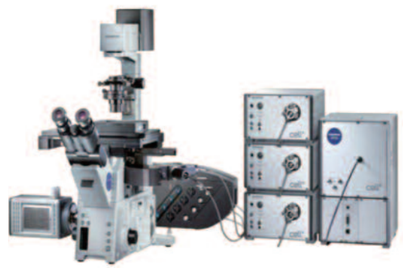
System Microscope

09 Total Internal Reflection Fluorescence Microscope

Model • Cell^TIRF [OLYMPUS, Japan]

Principle

The TIRF illuminator offers four motorized channels for simultaneous image capture. Intuitive software control of TIRF parameters allows instant setting and confirmation of TIRF angle and seamless transition back and forth to widefield fluorescence. With the TIRF illuminator, each laser wavelength is optimally focused and each angle is individually set, allowing different wavelengths to have the same penetration depth.



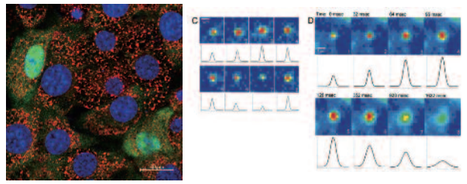
908-#5

Specifications

- Olympus motorized Inverted Microscope IX81
- Objectives : 0x, 20x, 40x, 60x(oil), 100x(oil)
- Transmitted light source : 100 W halogen
- Fluorescence light source : 150 W Xe
- Observation : BF, DIC, fluorescence, TIRF
- Laser : 405, 491, 561 nm

Applications

- Single molecule and membrane research
- Exocytosis, endocytosis
- Dynamic imaging



10 Live cell System Microscope

Model • Cell^R [OLYMPUS, Japan]

Principle

The xcellence platform combines optical quality with high-speed real-time control. This powerful, comprehensive platform features an intuitive graphical interface to set up experiments in a convenient and efficient way. It also offers a wide range of advanced functions, including spectral unmixing, image analysis and a sophisticated database for archiving and documentation.

908-#6

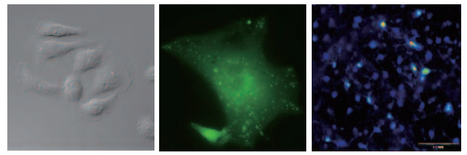
Specifications

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

Filter	Ex [nm]	DM [nm]	Em [nm]
Fura	340, 380	409	510/84
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
- Calcium ratio analysis - Fura-2, Fluo-3 or 5
- Fluorescence imaging (DAPI, GFP, RFP)

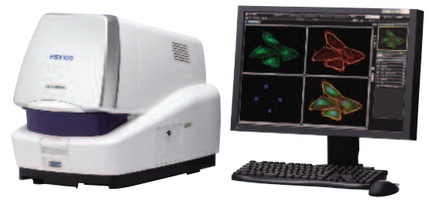


11 Full Motorized Inverted Microscope

Model • FSX100 [OLYMPUS, Japan]

Principle

Bio Imaging Navigator all-in-one microscope system: a compact, innovative fluorescence and brightfield microscope and camera system that allows you to capture high quality microscope images with load-and-go simplicity, just by following the intuitive workflow displayed on the screen.



908-#10

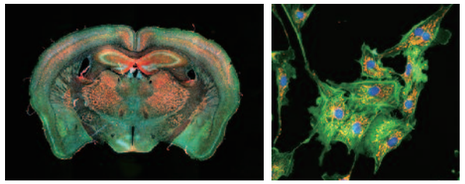
Specifications

- 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	530 - 550	570	575

Applications

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



12 Fluorescence Inverted Microscope

Model • IX71 [OLYMPUS, Japan]

Principle

Inverted research microscope is designed to accommodate a wide range of advanced research techniques. The IX71's modular frame and optical design provides 9 access ports for multiple input or output devices. Up to four ports can have simultaneous access to a primary image. The IX71 system can easily accommodate multi-wavelength, advanced fluorescence techniques.

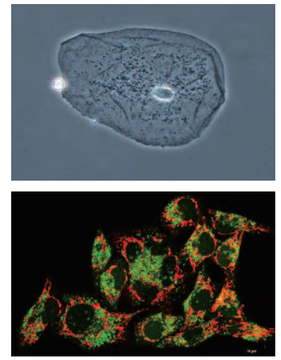
908-#8

Specifications

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

Applications

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



Histological System Microscope

13 Virtual Microscope

Model • dotSlide [OLYMPUS, Japan]

Principle

Virtual Microscopy is computer-based technology that offers the full range of traditional microscope functionality and more. A virtual slide is a digitally captured glass slide which is comprised of high-resolution images. The convenience of a computer is then used to view, navigate, change magnification and focus through the virtual slide with speed and ease.

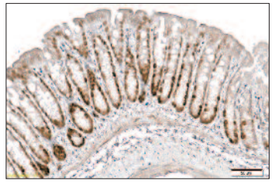
908-#4

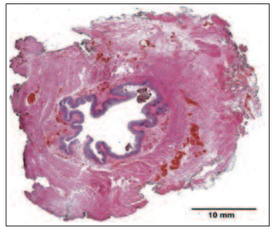
Specifications

- 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



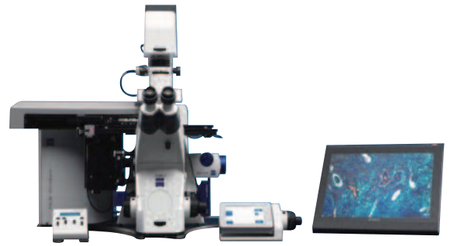


14 Laser Capture Microdissection Microscope

Model • LCM [OLYMPUS, Japan]

Principle

Laser Capture Microdissection is a contact-free method of isolation & manipulation of live cells and fixed materials with precision.
Researchers can obtain region of interests without contaminations and even images of superior quality.



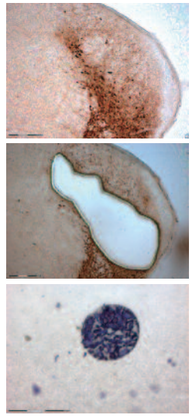
908-#9

Specifications

- Body : ZEISS Axio Observer Z.1
- Objectives : 5x, 10x, 20x, 40x, 63x, 100x(oil)
- Transmitted Light : Phase Contrast Imaging
- Reflected Light : Fluorescence Imaging
- Observation : BF, Phase Contrast, Fluorescence
- Laser Microdissection : 355nm UV (pulsed solid-state laser)

Applications

- Cell Biology & Fluorescence Imaging
- Morphology Imaging (Phase Contrast)
- Chromosome Analysis & Cytogenetics
- Forensic Study & Genetic Engineering
- Embryonic Stem Cell Cloning
- Phenotyping & Characterization
- DNA, RNA & Protein Studies



Macro System Microscope

15 Full Motorized Macro Zoom Microscope

Model • Axio Zoom V16 [ZEISS, Germany]

Principle

Axio Zoom V16 achieves a very high numerical aperture in the medium zoom range already: you get superior fluorescence brightness in large object fields. With 2.3x you achieve a numerical aperture of NA 0.5 in an object field of 1.5 millimeters. Perform your routine screenings as well as your most demanding multidimensional imaging applications with Axio Zoom V16

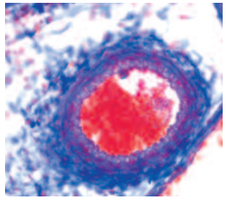
908-#9

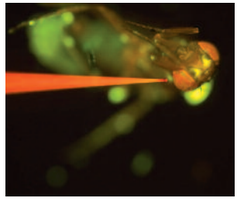
Specifications

- Total Magnification : 5.6x to 414
- Zoom ratio : 1:16
- Observation : BF(Transmitted & Reflected), Fluorescence(Blue, Green, Red)
- Detector : High Sensitivity EMCCD & Color Camera

Applications

- Observe whole living plants and small animals
- Screen a large number of whole model organisms
- Image with high fluorescence intensity





16 Macroview Imaging Microscope

Model • MVX10 [OLYMPUS, Japan]

Principle

MVX10 MacroView is a research Macro Zoom Fluorescence Microscope. The MVX10 addresses the tradeoffs between stereo and compound imaging systems, offering high numerical apertures from a compound microscope along with long working distances and larger fields of view from a stereo microscope.

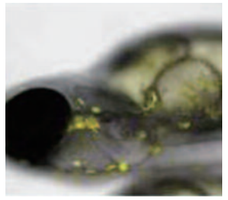
908-#9

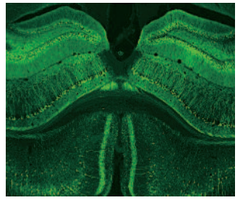
Specifications

- Magnification : 0.63 ~ 6.3x (2x : 1.26 ~ 12.6x)
- Zoom ratio : 1:10
- Magnification : 1x or 2x
- Total magnification : 12.5 ~ 125x
- 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





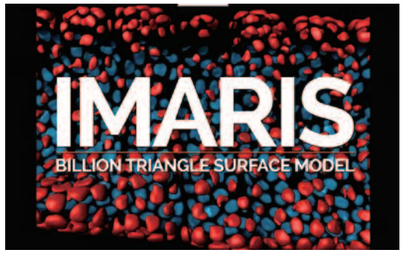
Analysis Software

17 3D Measurement Software

Model • Imaris 8.0 [Bitplane, UK]

Principle

The Imaris is ideal for researchers in several life science disciplines who require a broad range of functionalities to study cells and organisms. In addition to Imaris' proven 3D/4D visualization and analysis tools, ability to simultaneously visualize multiple 2D, 3D or 4D images with differing spatial or temporal dimensions and resolutions, Imaris for Cell Biologists provides the functionality for smart cell based segmentation, analysis on a per cell basis and discovery of intracellular relationships. The package includes automated tracking, detection of cell division and creation of interactive lineage trees along with statistical tests and a two-way interface for customization in Matlab, Java or Python.



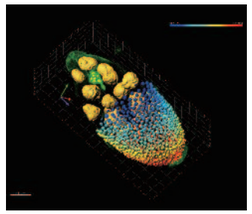
908-#10

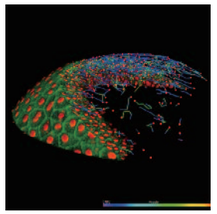
Specifications

- Surfaces : 3D Area, Volume, Intensity, Ellipticity, Sphericity measurement
- Spot : Number(count), Distance between spots, Speed measurement
- Motion Analysis : Average Speed, Acceleration, Track lengh, Cell cycle duration
- 3D Colocalization measurement

Applications

- Cell Dynamics
- 3D Animation
- 3D, 2D Measurement



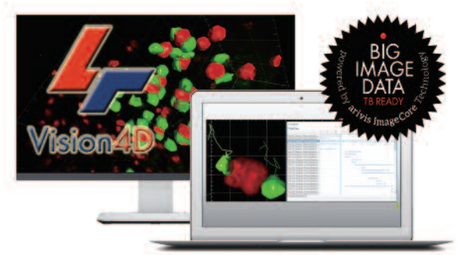


18 3D Measurement Software

Model • Vision 4D [Arivis, Germany]

Principle

Arivis Vision4D is a modular software for working with multi-channel 2D, 3D and 4D images of almost unlimited size independent of available RAM. Many imaging systems, such as high speed confocal, Light Sheet/ SPIM and 2 Photon systems, can produce a huge amount of multi-channel data, which Arivis Vision4D handles without constraints



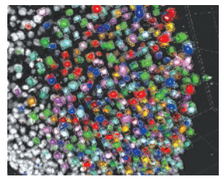
908-#10

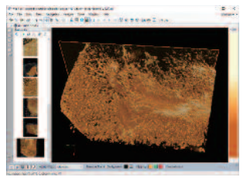
Specifications

- Easy import of most image formats from microscopes
- High performance interactive 3D / 4D rendering
- Intuitive tools for stitching and alignment to create large multi-dimensional image stacks
- Immediate 2D, 3D and 4D visualization, annotation and analysis regardless of image size
- Creation, import, and export of 4D Iso-surfaces
- Powerful Analysis Pipeline for 3D / 4D image analysis (cell segmentation, tracking, annotation, quantitative measurement and statistics, etc)

Applications

- Cell Tracking
- Colocalization Analysis
- Cell Count
- 4D Animation



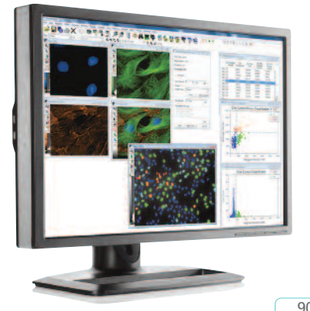


19 2D Measurement Software

Model • Metamorph [MD, USA]

Principle

MetaMorph for high-content imaging and analysis provide flexibility making it easy to evolve your system alongside your research. They feature options and modules to address your specific research including objectives, filters, imaging modes, and environmental conditions. The software support a wide range of applications, increased throughput, and streamlined workflows



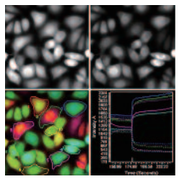
908-#10

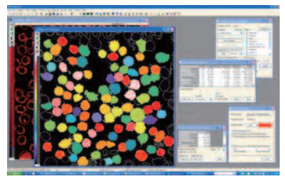
Specifications

- Cell counting, Cell cycle, Cell migration, Cell proliferation, Cell viability
- Densitometry
- Fluorescence Resonance Energy Transfer (FRET)
- Morphometry
- Motion analysis & particle tracking
- Multi-dimensional imaging
- Neurite outgrowth / process extension

Applications

- Mitosis
- Ratio and calcium imaging
- Live/Dead
- Colocalization
- Cytotoxicity and apoptosis





20 2D, 3D Deconvolution Software

Model • AutoQuant [Media Cybernetics, USA]

Principle

The easiest to use, most reliable deconvolution package on the market just got better. Microscopy experts worldwide trust AutoQuant for the accuracy and beauty of its stunning quantitative results, while newcomers to the product love the user-friendly workflow and intuitive interface that helps make learning a breeze. AutoQuant can be optimized to fit your applications and research without sacrificing your time for breathtaking results

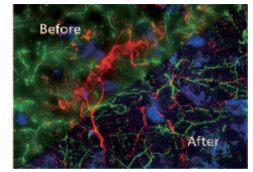
908-#10

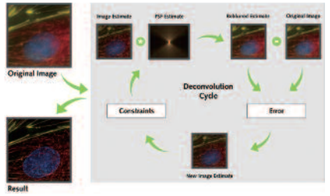
Specifications

- 2D, 3D Deconvolution
- Deconvolution Method : Nearest neighbor, Inverse, Blind, MLE Mode
- Batch Processing
- Supported Modalities : Brightfield, Widefield Fluorescence, Confocal, Multi-Photon, Spinning Disk

Applications

- 3D Reconstruction
- Image noise remove
- Improve Z-resolution of Confocal image





In vivo Research Center (IVRC)

IVRC (area of 2,500m²) opened in January 2013. IVRC is composed of 4 animal zones and 4 efficacy analysis laboratories: Animal zones consist of Strain preservation zone, Small animal zone, BSL-2 (Biosafety Level-2) zone, Return animal zone. Efficacy analysis laboratories include In vivo imaging lab, Behavior analysis lab, Histopathology lab, and Biopsy lab. The goal of IVRC is to provide a validation system using facility to raise in vivo efficacy of functional biomaterials which are newly created by advanced multi-disciplinary technology in UNIST. The primary function of IVRC is to provide facilities and equipments for animal research and to support techniques for animal care and development of animal models of various disorders.

List of Instruments

Lab	No.	Equipment	Model	Maker	Page
Animal Zone	1	Individually Ventilated Caging System (IVC system)	#5-63-9-7-1-4-5WMAL	Thoren Caging System Inc., USA	91
In vivo Imaging Lab.	2	Preclinical Magnetic Resonance Imaging (MRI)	Bio Spec® 70/16 US	Bruker, Germany	92
	3	In vivo Optical Imaging System	Xtreme	Bruker, Germany	93
	4	Micro CT (Micro computed tomography)	Skyscan 1176	Bruker, Germany	93
Histopathology Lab.	5	Tissue Processor	STP120	Thermo Scientific Microm, Germany	94
	6	Embedding Center	EG1150H+C	Leica Microsystems, Germany	94
	7	Microtome	RM2255	Leica Microsystems, Germany	95
	8	Cryostat	CM1950	Leica Microsystems, Germany	95
Behavior Lab.	9	Telemetry System	TA10EA-F20 (Neuroscore software)	DSI, USA	96
	10	Exercise system (Activity wheel, Rota-rod)	LE905, LE3806 (Activity wheel), LE8500 (Rota-rod)	Panlab, USA	96
	11	Video-tracking system	Smart 2.5	Panlab, USA	97
	12	Pain Measurement System (Tail flick, Hot plate)	TLE7106 (Tail flick), LE7406 (Hot plate)	Panlab, USA	97

Office Phone Number : 5212, 5225
Office Email : iv-rc@unist.ac.kr

Animal Zone

01 Individually Ventilated Caging System (IVC system)

Model • #5-63-9-7-1-4-5WMAL [Thoren Caging System Inc., USA]

Room #B66, #B48, #B84, #B22 Animal zone

Principle

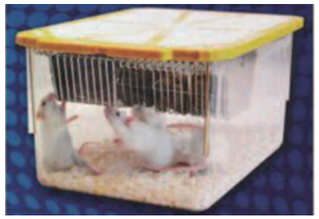
PIV Cage Air Flow Technology - Pressurized Individual Ventilation: Low velocity HEPA filtered air is supplied through our sealed shelf plenums directly into the cage through air supply orifices above the filter top. Exhaust air passes from the cage through exhaust air orifices also located above the filter top into the exhaust plenum. This design eliminates devices that penetrate the side wall of the cage that create turbulance inside the cage. Depending on your isolation requirements, the system can maintain either positive or negative pressure with respect to the room

Specifications

- Rack Size : 1,880 mm (W) X 685 mm (D) X 2,100 mm (H)
- Cage Size : 222 mm (W) X 300 mm (D) X 162 mm (H)
- Cage Floor Area : 503 cm²
- Cage capacity : Polysulfone 63 Cages Set
- Blower Unit : Supply/Exhaust HEPA filter Unit (1) Set
- Electrical Requirements : 100 - 240 V, 50/60 Hz

Applications

- Zoology
- Animal care
- Genetics
- Histology

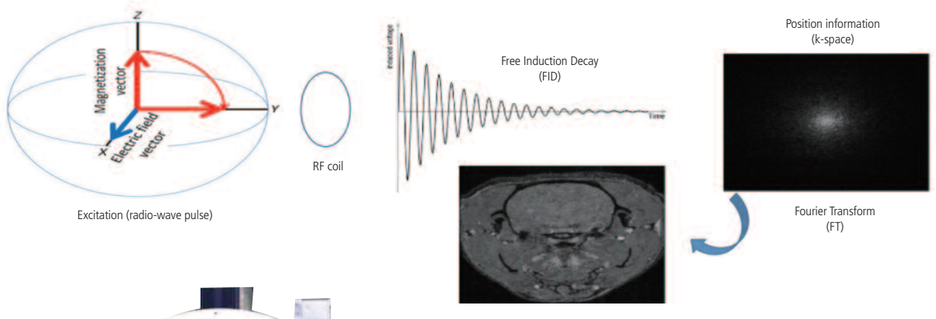


In vivo Imaging Lab

02 Preclinical Magnetic Resonance Imaging (MRI)

Model • Bio Spec® 70/16 US [Bruker, Germany]

Principle



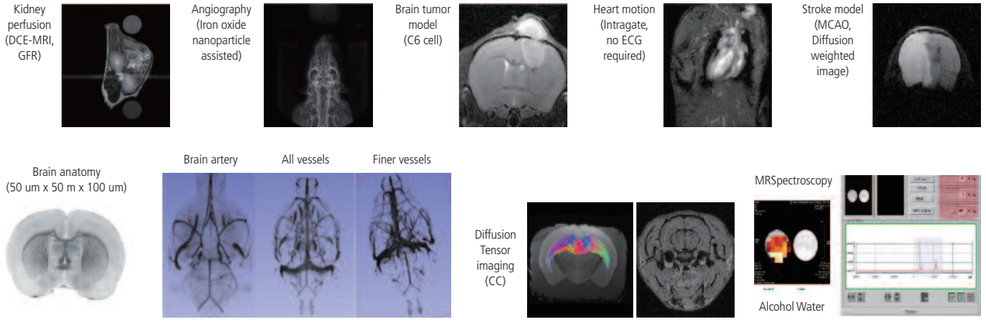
Room #B44 In vivo imaging lab.1

Specifications

- Ultra Shield superconducting magnet : 7T / bore size 160 mm
- Gradient and shim equipment (BGA-9S HP) : gradient strength, 760 mT/m; slew rate, 6840 T/m/s
- Multiple RF Transmitter Channels and one RF receiver channel for 1H/19F or X-nuclei (13C, 23Na, 31P)
- Para vision® 6 for MRI/MRS data acquisition and evaluation

Applications

- MRI/MRS research for the small rodents (~ 400 g)
- Functional MRI for rat and mouse brain
- Diffusion and perfusion research
- Relaxation measurement and Spectroscopy
- Ultra short TE imaging
- MR Contrast agent validation

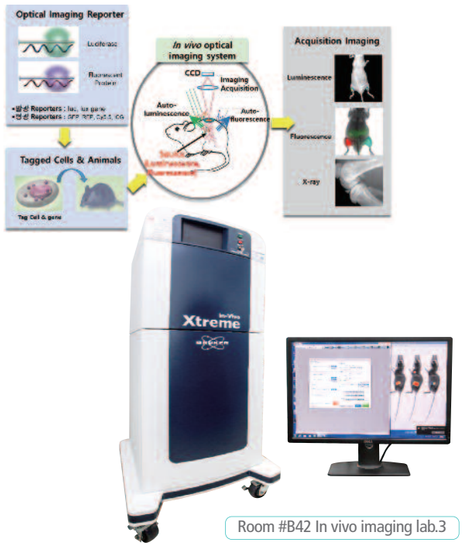


03 *In vivo* Optical Imaging System

Model • Xtreme [Bruker, Germany]

Principle

Luminescence is emission of light by a substance not resulting from heat. Luminescence due to the enzyme reaction can be captured in mice administered with luciferase.
Fluorescence is the emission of light by a substance that has absorbed light or other electromagnetic radiation.



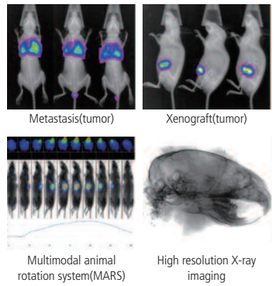
Room #B42 In vivo imaging lab.3

Specifications

- footprint (W x D x H) : 72 x 84 x 183 cm
- Back-thinned,back-illuminated (BI)3MP CCD detector
- 400W Xenon illuminator
- X-ray Spot size : < 60 um
- Energy Range : 20 - 45 kVp

Applications

- fluorescence, luminescence, radio isotopic and radiographic Imaging
- 360 ° view Multimodal Animal Rotation System
- Oncology
- Infectious Disease
- Neurosciences
- Stem cell Biology
- Cardiovascular

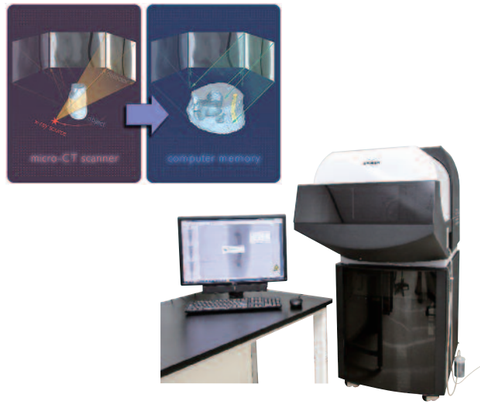


04 Micro CT (Micro computed tomography)

Model • Skyscan 1176 [Bruker, Germany]

Principle

Luminescence is emission of light by a substance not resulting from heat. A micro-focus x-ray source illuminates the object and a planar x-ray detector collects magnified projection images. Based on hundreds of angular views acquired while the object rotates, a computer synthesizes a stack of virtual cross section slices through the object. You can then scroll through the cross sections, interpolating sections along different planes, to inspect the internal structure. Selecting simple or complex volumes of interest, you can measure 3D morphometric parameters and create realistic visual models for virtual travel within the object.



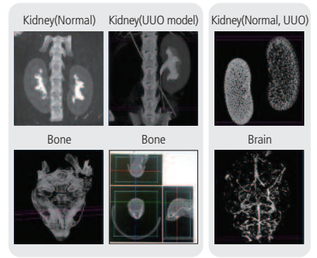
Room #B42 In vivo imaging lab.3

Specifications

- X-ray source : sealed micro-focus X-ray tube 20-90kV, 25W
- X-ray detector : 4000x2672pixels, 12bit, fiber-opticallycoupled to scintillator
- Scanning volume : 68 mm diameter, 20mm single scan length, 200mm scannable length
- Spatial resolution : <9 μm pixel size, <15μm low-contrast resolution (10 %MTF)
- Reconstructed slices : 1Kx1K ~ 8Kx8K pixels, 9 μm / 18 μm / 35 μm selectable pixel size

Applications

- 3D bone analysis
- Vascular studies
- Soft tissue research
- Food studies/fat studies
- Bone morphometry
- Cardiovascular



Histopathology Lab

05 Tissue Processor

Model • STP120 [Thermo Scientific Microm, Germany]

Principle

Once fixed, tissue is processed as follows, using gentle agitation, usually on a tissue processor, as follows :

Stage	Reagent	Period
Dehydration	70 % Ethanol	1.5 hr
	80 % Ethanol	1.5 hr
	90 % Ethanol	1.5 hr
	95 % Ethanol	1.5 hr
	Absolute Ethanol - 1, 2, 3	1 hr, 1hr, 1hr
Clearing	Xylene_ 1, 2, 3	1 hr, 1hr, 1hr
Paraffin infiltration	Paraffin_1 (at 61 °C)	1.5 hr
	Paraffin_2 (at 61 °C)	1.5 hr

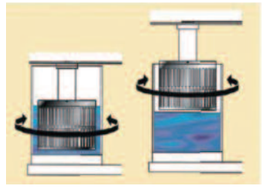
Room#106

Specifications

- Immediate and delayed start processing modes
- Programmable spinning speed of either 60 or 70 rpm
- Programmable immersion time in each station
- Basket capacity of 60~80 cassettes
- Battery backup system in case of power failure
- Electrical Requirements : 100 - 240 V, 50/60 Hz

Applications

- Histology
- Dehydration
- Paraffin infiltration
- Clearing



06 Embedding Center

Model • EG1150H+C [Leica Microsystems, Germany]

Principle

[Hot plate]

- Height-adjustable, rotary and fold-back clip for activating the paraffin flow with the embedding mold, manually or via foot switch
- Spacious, heated work surface with paraffin drain system for interim storage of molds and cassettes
- Adjustable temperatures for paraffin reservoir, working surfaces and integrated warming trays, between 55 °C to 70 °C in 5 K increments
- Programmable on and off timer

[Cold plate]

- Constant temperature of the cold plate at – 5 °C
- Approx. 70 cassette molds capacity

Room#106

Specifications

- Work Surface Dimensions : 8.26″ x 6.89″ (2x)
- Work Surface Temperature : 55 °C - 70 °C
- Paraffin Reservoir Capacity : 3 Liters
- Cold Plate Dimensions : 13″ x 14.56″
- Cold Plate Temperature : - 5 °C

Applications

- Histology
- Paraffin embedding of tissue specimens

07 Microtome

Model • RM2255 [Leica Microsystems, Germany]

Principle

Sample movement for making a cut on a rotary microtome

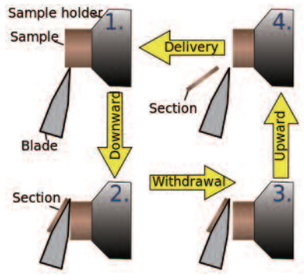
Room#106

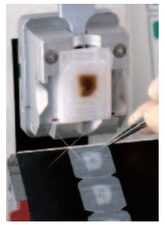
Specifications

- Range of Section Thickness : 0,5 – 100 µm
- Range of Trim Thickness : 1 – 600 µm
- Object Feed 28 mm ± 1 mm
- Vertical Specimen Stroke : 70 mm
- Sectioning Modes : 4
- Specimen Retraction Manual 5 – 100 µm
- Sectioning Speed 0,5 – 420 mm/s ± 10 %
- Specimen Orientation Horizontal : 8 °, vertical : 8 °

Applications

- Histology
- Pathology
- Paraffin block





08 Cryostat

Model • CM1950 [Leica Microsystems, Germany]

Principle

Sample movement for making a cut on a cryostat

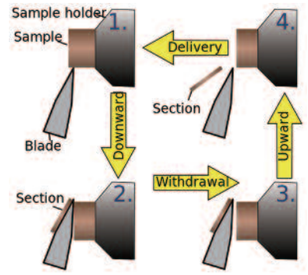
Room#106

Specifications

- Electrical Requirements : 120 V, 50/60 Hz
- Temperature Range : 0 °C to - 35 °C (chamber)
- Range of Trim Thickness : 1 - 600 µm
- Range of Section Thickness : 1 - 100 µm
- Disinfection : UVC (30 minute or 180 minute)
- Max Specimen Size : 50 x 80 mm

Applications

- Histology
- Pathology
- Frozen block



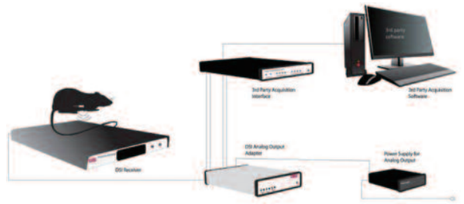
Behavior Lab

09 Telemetry System

Model • TA10EA-F20 (Neuroscore software) [DSI, USA]

Principle

Measure the EEG (Electroencephalography) and ECG (Electrocardiography) by using Transmitter



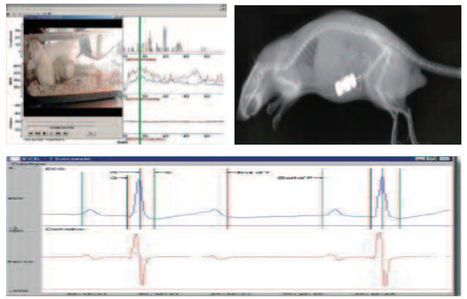
Room #46 Behavior Analysis Lab.3

Specifications

- Small animal transmitter for mice
  - Battery life : 4 months - Weight : 3.9 g
  - Min. animal weight : 20 g
- EEG analysis software
  - Data format : DQ ART, Ponemah
- Accessories
  - Sensor lead - Mouse brain matrix

Applications

- Analysis of EEG and ECG
- Monitoring of sleep behavior
- Monitoring of seizure behavior

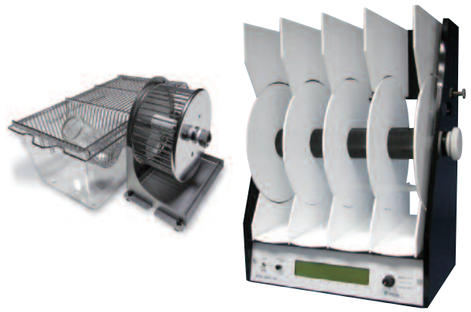


10 Exercise system (Activity wheel, Rota-rod)

Model • LE905, LE3806 (Activity wheel), LE8500 (Rota-rod) [Panlab, USA]

Principle

These provide a measuring method for lab rodents' physical activity in response to chemical or environmental stimuli.



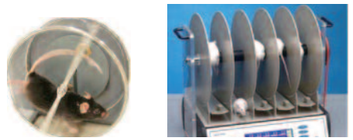
#B45 Behavior analysis Lab. 1

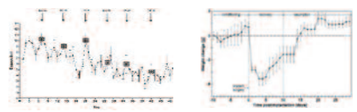
Specifications

- Activity wheel
  - Home cage : 36 (W) x 20 (D) x 1 (H) cm
  - Wheel diameter : 16 cm
- Rota-rod
  - Constant speed : 4 - 40 RPM
  - Acceleration rate : 30 seconds, 1, 2, 5, 10 minutes

Applications

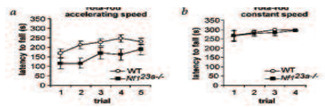
- Activity wheel
  - Circadian rhythm
  - Pharmacologic study
- Rota-rod
  - Muscle coordination
  - Cerebellum study





Hydock et al. ANTICANCER RESEARCH 2009

Mills et al. Journal of Applied Physiology 2000



Costa et al. Nature Genetics 2001

11 Video-tracking system

Model • Smart 2.5 [Panlab, USA]

Principle

Video tracking is the process of locating a moving object (or multiple objects) over time using a camera.

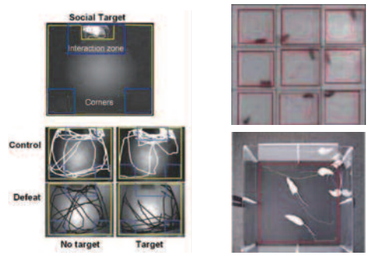
Room #B45 Behavior analysis Lab. 1

Specifications

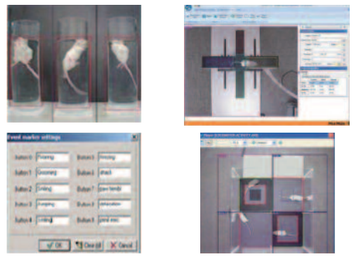
- Image sources
  - Video camera, video tape, DVD player, digital video files
- Related Hard wares
  - Open field box, circular pool, radial maze, elevated plus maze, black and white box, spatial place preference box

Applications

- Flexible and precise analysis of animal behavior
- Automated detection of head, center mass and base-tail
- Digital video analysis capabilities
- Immobility detection for forced-swimming test and freezing



"Advancing Drug Discovery for Schizophrenia"
The New York Academy of Sciences 2011



12 Pain Measurement System (Tail flick, Hot plate)

Model • TLE7106 (Tail flick), LE7406 (Hot plate) [Panlab, USA]

Principle

The animal's pain sensitivity resulting from exposure to heat or cold is tested by placing the animal on the surface of the plate or heating on the animal's tail.

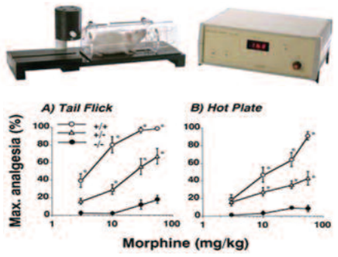
Room #B45 Behavior analysis Lab. 1

Specifications

- Tail flick
  - Dimensions : 35 (W) X 35 (D) X 13 (H) cm
  - Reaction time : Until 99 s. Resolution : 0.01 s steps
  - Heat stimulus : Halogen lamp (50 W - 12 V)
- Hot plate
  - Plate dimensions : 165 x 165 mm
  - Temperature range : - 3 °C to 65 °C
  - Temperature accuracy : ± 0.5 °C

Applications

- Pain disorders
- Hyperalgesies
- Analgesics screening
- Phenotyping



Sora I et al. PNAS 1997

UNIST Radiation Safety Lab (URSL)

The UNIST Radiation Safety Lab (URSL) has been providing a support for the management of safe and efficient radioactive substances by supervising radioactive isotopes and radioactive generators used in UNIST. The laboratory is equipped with instruments for the measurement of radioactivity and the prevention of radioactive contamination. The radiation manager provides technical assistance for the safe use of radioisotope using instruments and radiation generators.

List of Instruments

Lab	No.	Equipment	Model	Maker	Page
URSL	1	Liquid Scintillation Beta Counter	Tri-carb 2910TR	PerkinElmer, USA	99
	2	Automatic Gamma Counter	2470 WIZARD2	PerkinElmer, USA	100
	3	IP Biomolecular Imager	Typhoon FLA 7000	GE, USA	101

Office Phone Number : 2504
Office Email : radiation-safety@unist.ac.kr

UNIST Radiation Safety Lab

01 Liquid Scintillation Beta Counter

Model • Tri-carb 2910TR [PerkinElmer, USA]

Principle

Tri-carb is the most versatile and sensitive instruments available in detecting small amounts of alpha and beta radioactivities.

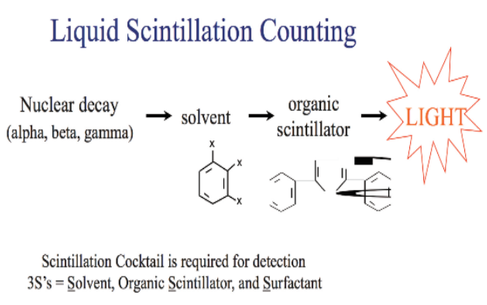
108-#B105

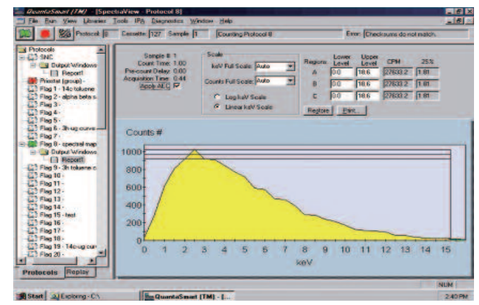
Specifications

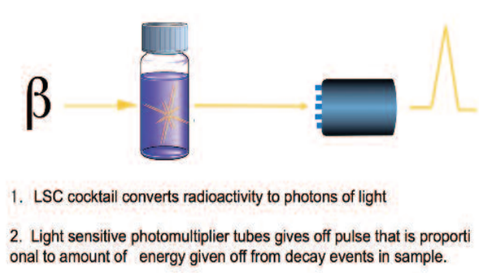
- Energy range : 0 ~ 2,000 keV
- Efficiency & (E2/B)
  - ^{3}H 60 %, 180 - ^{14}C 95 %, 380
- Background
  - ^{3}H 17.3 CPM - ^{14}C 24.3 CPM

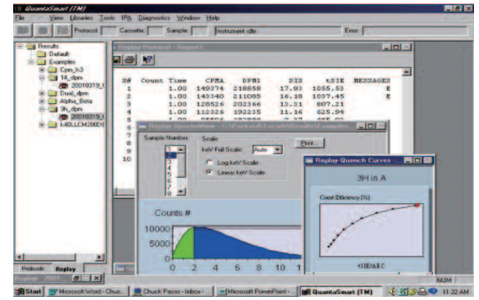
Applications

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









02 Automatic Gamma Counter

Model • 2470 WIZARD2 [PerkinElmer, USA]

Principle

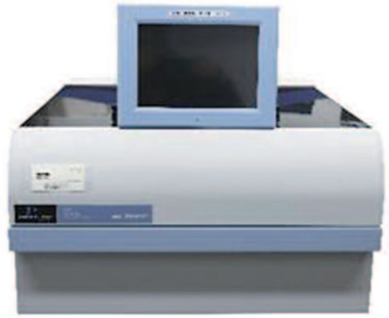
WIZARD is designed for superior counting performance with all types of samples and for every gamma counting applications.

Specifications

- Detector diameter : 2 inches
- Sample changer : 55 racks (550 samples)
- Radio library : 45 type
- Energy range : 15 ~ 1000 keV
- Max. count rate : 6 million DPM for ^{125}I

Applications

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



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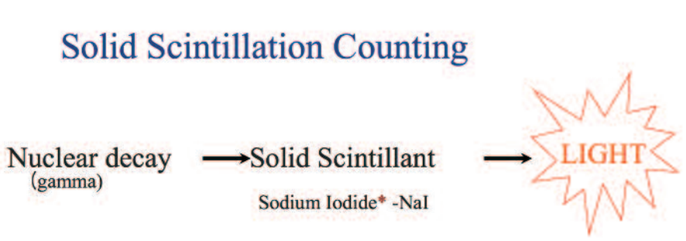
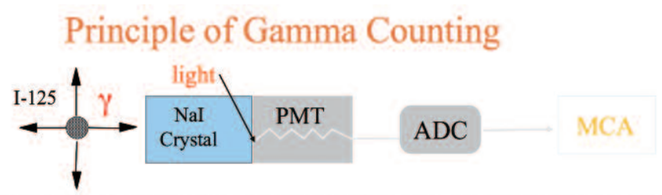




NaI crystal = Sodium iodide crystal converts nuclear decay energy into light, whose int ensity is proportional to energy

PMT = Photomultiplier tube detects and amplifies, finally converting light into an anal og electric pulse

ADC = Analog to digital converter changes pulse amplitude to a number

MCA = Multichannel analyzer categorizes pulses vs. their amplitude

03 IP Biomolecular Imager

Model • Typhoon FLA 7000 [GE, USA]

Principle

Typhoon FLA 7000 is a fast laser scanner optimized for quantitative phosphorimaging, ECL, Plus Westerns, visible single fluorescence and gel documentation.

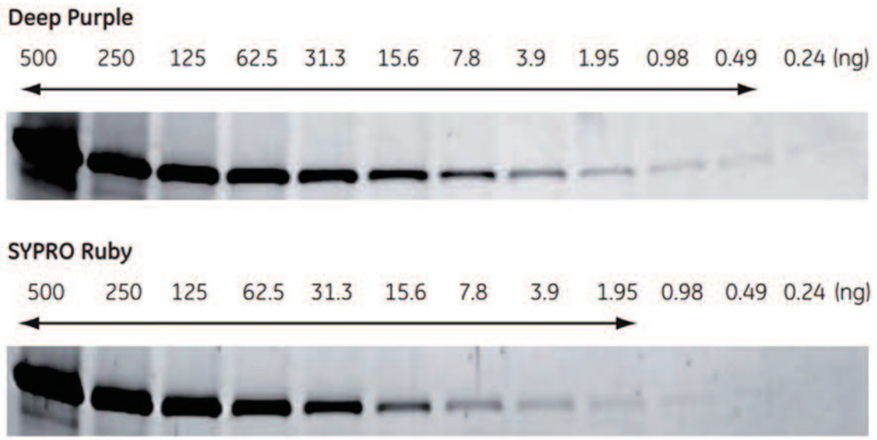
Specifications

- 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}H, ^{14}C, ^{32}P, ^{33}P, and ^{35}S

Applications

- Quantitative westerns
- Visible fluorescence
- Phosphorimaging
- Cell documentation

108-#B105



UNIST Synchrotron Radiation Research Center (USRRC)

The UNIST Synchrotron Radiation Research Center (USRRC) is based on 6D UNIST-PAL X-ray Crystallography & Scattering Beamline located at Pohang Accelerator Laboratory. USRRC will supply state of the art research opportunities using high flux synchrotron radiation source in the various scientific and industrial fields of physics, chemistry, material science, earth science, and life science.

Beamline Specifications

Specifications	6D UNIST-PAL C&S beamline
Beam energy, current	3.0 GeV, 400 mA
X-ray source	Bending magnet
Energy range	5 ~ 22 keV
Energy resolution (ΔE/E)	~ 2 x 10^{-4}
Monochromator	Double Si(111) crystals, sagittal-type 2nd Crystal (Horizontal beam focusing)
Focusing mirror	1) Toroidal & Bendable Mirror System (Rh 50 Å, Pt 450 Å coated on the 1.4 m-long Si crystal) 2) K-B focusing mirror system (0.35 m-long Si crystals)
Beam size @ sample position	XAS: 1 mm x 1 mm, SAXS: 0.5 mm x 0.5 mm, WAXD, Crystallography: 0.12 mm (Normal focusing), 0.02 mm (KB mirror focusing)
Beam flux	~ 2 x 10^{11} @ 10 keV

Multi-experimental Stations of 6D UNIST-PAL Beamline

UNIST-PAL beamline is equipped with the multiple experimental stations for X-ray Absorption Spectroscopy, Small- and wide-angle X-ray Scattering, and Crystallography experiments.

List of Beamline Instruments

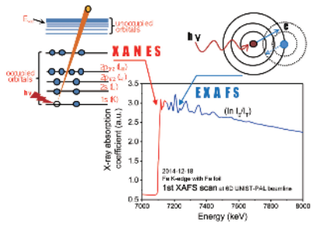
6D UNIST-PAL Crystallography & Scattering Beamline

XAS	Crystallography	SAXS/WAXD
7-Element Ge array detector	Rayonix CCD detector MX225-HS (Common)	Rayonix CCD detector MX225-HS (Common)
High-precision I.C. detectors	3-axis Goniostat	Flat Panel Detector (PE1611 xP)
PIPS detector (Fluorescence)	High resolution Microscopes	Tr-SAXS/WAXD stage (bulk)
Automatic battery cycler system	Oxford Instruments Cryojet 5	GI-SAXS/WAXD stage (film)
Multi-sample chamber	HKL 3000sm software	Linkam TS1500EVPV stage
Vacuum/Helium chamber	Data Storage & Processing Server	Temp. sample stage
Capillary solution sample stage	In-situ Raman Spectroscopy	Vacuum sample stage
		Automatic battery cycler system
		Capillary solution sample stage

Beamline Contact
Phone Number : 054-279-1772, 1664
Contact Email : tjdgns1017@unist.ac.kr

01 XAS
X-ray Absorption Spectroscopy

Principle
X-ray absorption spectroscopy (XAS) is the measurement of the X-ray absorption coefficient of a material as a function of energy. Each element has a set of unique absorption edges corresponding to different binding energies of its electrons, giving XAS element selectivity.



Information

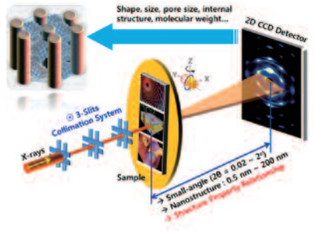
XAS (X-ray Absorption Spectroscopy)	
XANES (X-ray absorption Near-Edge Spectroscopy)	EXAFS (Extended X-ray Absorption Fine-Structure)
Oxidation state Covalency Local symmetry	Bond distance Coordination number Debye-Waller factor

Experimental station


Applications
XAS is for understanding the local structure in:
- Glass, amorphous and liquid systems, solid solutions
- Doping and ionic implantation materials for electronics
- Local distortions of crystal lattices
- Organometallic compounds, metalloproteins,
- metal clusters, vibrational dynamics, ions in solutions

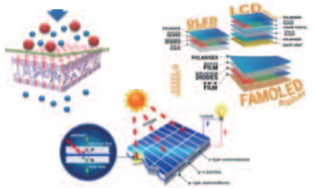
02 SAXS/WAXD
Small-angle X-ray Scattering / Wide-angle X-ray Diffraction

Principle
SAXS is a small-angle scattering (SAS) technique where the elastic scattering of X-rays by a sample which has inhomogeneities in the nm-range, is recorded at very low angles (typically 0.02 - 2°). This angular range contains information about the shape and size of macromolecules, characteristic distances of partially ordered materials, pore sizes, and other data. SAXS is capable of delivering structural information of macromolecules between 1 and 25 nm, of repeat distances in partially ordered systems of up to 150 nm.



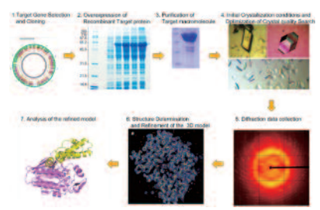
Experimental station

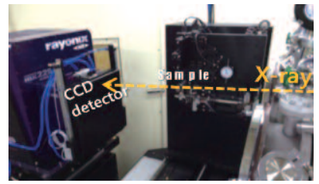

Applications
SAXS is for interpreting the structures in:
- Molecular/nano structured polymer
- Polymer blends, block copolymer
- Composite nanomaterials, inorganic systems
- Non-crystalline systems of various nature
- Biological macromolecules (protein, DNA, RNA)



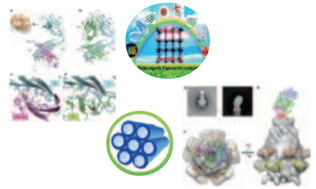
03 Crystallography
Supramolecular & Protein Crystallography

Principle
X-ray crystallography is a tool used for identifying the atomic and molecular structure of a crystal, in which the crystalline atoms cause a beam of incident X-rays to diffract into many specific directions. By measuring the angles and intensities of these diffracted beams, a three-dimensional picture of the density of electrons within the crystal can be produced. From this electron density, the mean positions of the atoms in the crystal can be determined, as well as their chemical bonds, their disorder and various other information.

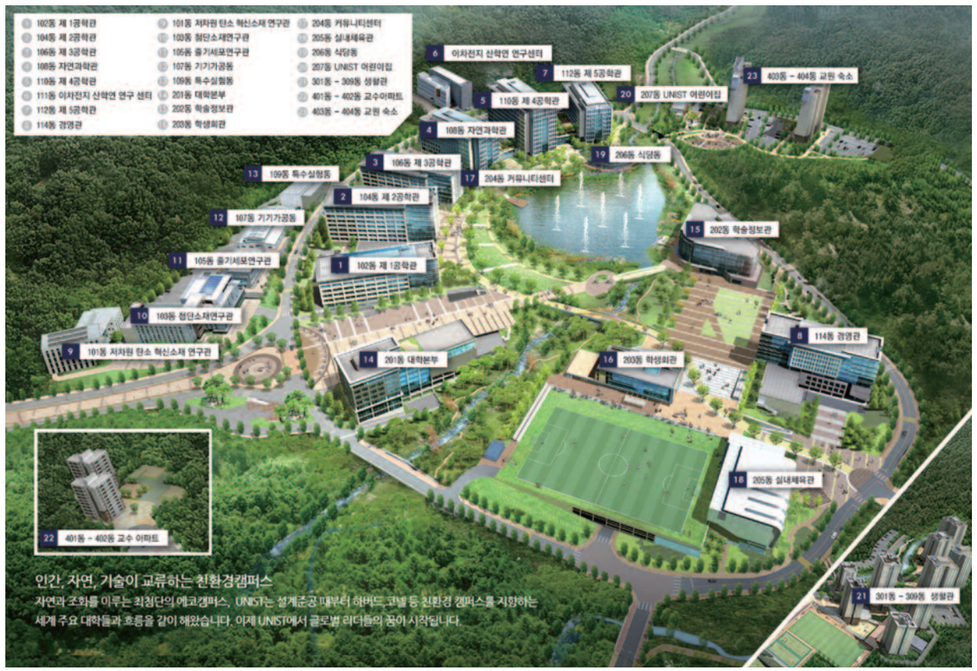


Experimental station


Applications
- Crystal structure of biological macromolecules such as protein, DNA, and RNA and their complexes in nearly physiological environments
- Crystal structure of supramolecules and small molecules
- Mineralogy and metallurgy



UNIST Campus Map



UCRF Office Location

- UNIST Mechanical Analysis Lab Office : Engineering Building I(102), Room B122, B123 (B1F)
- UNIST Nano Fabrication Center Office : Natural Science Building(108), Room U101
- UNIST Maker Lab Office : Maker Lab Building (107), Room 103
- UNIST Environmental Analysis Center Office : Engineering Building I(102), Room B122 (B1F)
- UNIST Optical Bio-Med Imaging Center Office : Engineering Building IV(110), Room 908 (9F)
- In Vivo Research Center Office : Stem Cell Research Building(105), Room 101, 109
- UNIST Radiation Safety Lab Office : Natural Science Building(108), Room U101
- UNIST Synchrotron Radiation Research Center Office : Pohang Accelerator Laboratory in Pohang, Gyeongbuk

Mail address

- *Office Location as stated above* + 50, UNIST-gil, Eonyang-eup, Ulju-gun, Ulsan, 44919 Rep. of KOREA

How to get to UNIST

By Car

Kyungbu Highway ▶ West Ulsan IC ▶ Road 24 to Ulsan ▶ UNIST (10 minutes from West Ulsan IC)

By Airplane

Take bus no. 402 or 452 from the airport and exit at Taehwaru. Take bus no. 807, to UNIST. For the 5003 KTX Limousine, exit in front of Gulhwa Jugong Apt., then take bus numbers 337 or 733, to UNIST. More information can be found on the Korean Airline or Asiana Airlines Homepages. It takes about 30 minutes by taxi.

By Train

Take bus no. 337 from Ulsan KTX Station (Tongdosa), or bus numbers 327 or 807 to UNIST. It takes about 5 minutes by taxi.or

By Express Bus

Take bus numbers 133, 733 or 337 at the Ulsan Express / Intercity Bus Terminal to UNIST, or take busses 327 or 807 to UNIST. It takes about 20 minutes by taxi.
Take bus no. 733 at Shinbok rotary (the first bus stop after entering Ulsan) to UNIST. It takes about 10 minutes by taxi.