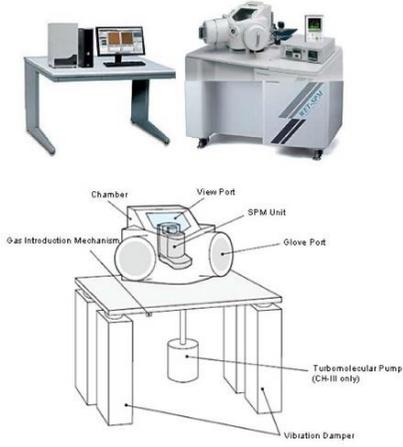


I2CNER Equipment List

As of R4.4.1

ID	Equipment/Model	Overview	Specifications
50	<p>Automatic X-ray Diffraction System/SmartLab 9kW AMK</p> 	<p>This high-resolution automated X-ray diffraction system (SmartLab) can be used for nanoscale characterizations of various kinds of materials, including metals, semiconductors, ceramics, organic materials, and polymers. SmartLab allows us to perform advanced measurements critical to materials research from X-ray diffraction (XRD) to X-ray reflectivity (XRR) to small-angle X-ray scattering (SAXS).</p>	<ul style="list-style-type: none"> • X-ray Target: Cu target • Goniometer: Sample flat goniometer • Goniometer movement range: 2θ: -3° to 160° , 2θ χ: -3° to 120° , χ: -5° to 95° , ϕ: -5° to 95° , ϕ: -360° to 360° • Detector: Scintillatometer, 2D semiconductor • Incident optical devices: Multilayer mirror
51	<p>Oxygen/nitrogen/hydrogen analyzer/EMGA-930-SKU</p> 	<p>This is a simultaneous oxygen, nitrogen & hydrogen elemental analyzer with high accuracy and repeatability. The oxygen is measured as carbon monoxide and carbon dioxide by two non-dispersive infrared detectors, the nitrogen by a thermal conductivity detector and the hydrogen with non dispersive Infra Red detector as H₂O.</p>	<ul style="list-style-type: none"> • Principle: Oxygen: Non Dispersive Infrared detector (NDIR) Nitrogen: Thermal Conductivity detector (TCD) Hydrogen: Non Dispersive Infrared detector (NDIR) • Measurement range: Oxygen: ~5% (m/m) Nitrogen: ~3% (m/m) Hydrogen: ~0.25% (m/m) • Sample weight: 1g as standard condition, possible to decrease • Sensitivity: Oxygen/Nitrogen/Hydrogen : 0.001 μg/g

<p>103</p>	<p>Field Emission Scanning Electron Microscope(SEM) /JSM-7900F</p> 	<p>JSM-7900F Field Emission Scanning Electron Microscope is equipped with a new electron optics control mechanism that can take full advantage of the characteristics of a strongly excited conical objective lens (Super Hybrid Lens), which is a hybrid of an In-Lens Schottky field emission (T-FE) electron gun and an electrostatic lens. You can easily observe the sample surface with ultra-high resolution and perform various analyzes, such as EDS, WDS, EBSD, and CLD.</p>	<ul style="list-style-type: none"> • Secondary electron image resolution: 0.7 nm (15 kV, gap method) • Magnification: × 25 to 1,000,000 (SEM mode) • Sample stage movement range: <ul style="list-style-type: none"> X: 70 mm Y: 50 mm Z: 2.0–415 mm T: -5 to 70° R: 360° • Electron gun: In-lens Schottky field emission electron gun
<p>104</p>	<p>Cross section machining apparatus/IB-19520CCP</p> 	<p>IB-19520CCP is a sample preparation device. The shield plate is placed over the specimen and irradiated with argon ions. A specimen stuck out from the shield plate is milled to obtain a smooth cross section. It can be observed on the operation panel.</p> <p>It is possible to control ion beam irradiation and low temperature prevention of the sample stage while the sample is cooled, and it is possible to create a cross-sectional sample with little damage.</p>	<ul style="list-style-type: none"> • Ion accelerating voltage: 2 to 8 kV • Ion beam width (FWHM): 500 μ m or more • Milling speed: 500 μ m/h (the average value over 2 hours. At acceleration voltage: 8 kV, specimen: Si, 100 μ m from edge) • Specimen stage ultimate cooling temperature: -120 °C or lower • Specimen stage cooling temperature setting range: 120 °C to 0 °C • Specimen cooling hold time: 8 hours or more • Coolant: Liquid nitrogen • Cooling tank capacity: 1 L • Maximum specimen size: 11 mm(W) x 8 mm(L) x 3 mm(T) • Specimen movement range: ± 6 mm (X-axis), ± 2.5 mm (Y-axis) • Monitoring camera: Magnification at approximately 20 x to 100 x

<p>57</p>	<p>Film resistance measuring system + Impedance analyzer/MTS740-C</p> 	<p>The 740 MTS is ideally suited for development of new ionomers and solid electrolytes. It offers rapid and accurate measurement of the through-thickness membrane resistance and conductivity as a function of temperature, humidity level and pressure.</p> <p>740 MTS eliminates the time-consuming approach of catalyzing a membrane and assembling a fuel cell to evaluate the ionomer performance.</p>	<ul style="list-style-type: none"> • Temperature range: 30°C to 120°C(humidifier) 30°C to 180°C(sample) • Sample film: thickness 10 to 200 μ m Size 6 mm \times 30 mm • Humidity range: \pm2% @20%–95%RH • Pressure range: 1 to 3
<p>60</p>	<p>Laser diffraction Particle Size Analyzer/SALD-2300</p> 	<p>Applicable to a Wide Range of Applications Using Optional Units and Application Software Packages.</p> <p>Provides Accurate Evaluation of the Change in Particle Size Distribution.</p>	<ul style="list-style-type: none"> • Measurement range: 17 nm(0.017 μ m) to 2500 μ m • Light detector: Detector elements for UV semiconductor laser Total 84 elements (78 forward, 1 side, 5 back) • Light source: Red Semiconductor laser (Wavelength 680 nm) • Sampler SALD-MS23: Sample amount (Suspension): 100/200/300 mL Concentration range: 0.1 ppm~several 10 ppm Measurement of circulating samples between flow cell and dispersion bath of sampler.
<p>61</p>	<p>Scanning Probe Microscope/SPM-9700</p> 	<p>Scanning probe microscope (SPM) is a generic term for microscopes that scan sample surfaces with an extremely sharp probe to observe their three-dimensional image or local properties at high magnifications. The SPM-9700 offers higher performance, faster speeds, and easier operation.</p>	<ul style="list-style-type: none"> • Observation Modes: Contact, Dynamic, Phase, Lateral Force (LFM), Force Modulation, Surface Potential (KFM) • SPM Head: Displacement detection system: Light source/optical lever/detector Light source: Laser diode (ON/OFF) Resolution: X, Y: 0.2 nm, Z: 0.01 nm Detector: Photodetector • Accessories : Environment Controlled Chamber CH-III Temperature and Humidity Controller Sample Heating and Cooling Unit

62	<p>Surface Characterization Analyzer/3Flex</p> 	<ul style="list-style-type: none"> • A new advanced dosing method that allows you to mix both pressure and volume increments • Advanced manifold design and embedded control provide an ultra-stable environment for pressure and temperature measurements, extending the limits of resolution. • The 3Flex is ideally suited for the characterization of MOFs, zeolites, activated carbons, absorbents, and a wide variety of porous and non-porous materials. 	<ul style="list-style-type: none"> • Sample Analysis Ports: 3micropore ports • Minimum Measurable Surface Area: 0.01 m²/g(nitrogen) 0.0005 m²/g(krypton) • Adsorptive Gas Inputs: 6 • Degas: 3 in situ • Dewar: 3.2 L capacity, >70 hrs (3 sampletubes, isothermaljackets, P0 tube) • Gasses: Helium, nitrogen, argon, or any other gas that does not adsorb at room temperature • Sample Preparation Systems: The VacPrep™ 061 <ul style="list-style-type: none"> • Flowing gas method • Vacuum mode which prepares samples by heating and evacuation
63	<p>Cold-Spray Ionization TOF MS System/JMS-T100LP</p> 	<p>Cold Spray MS spectra is one of the techniques which were separated using an electric field or magnetic species ionized and identified. To ionize the chemical substance by a strong energy, MS will not be able to see the unstable intermediate, and metal complexes in standard condition. Ionizing the chemicals under milder conditions by using nitrogen gas with low temperature, Cold Spray MS is measurable in solution in the metal complex, supramolecular system, amino acids, and nucleic acids.</p>	<ul style="list-style-type: none"> • Resolution: 6000(FWHM) Ion peak m/z=609 • Mass range: 10,000 • Sensitivity: 100 pg/ μ L • Response speed of spectrum: Max 16,000 spectrum/S • Record speed of spectrum: Max 10 spectrum/s • Mass accuracy: 3 ppm

98 Differential Scanning Calorimetry/DSC204



Differential scanning calorimetry, DSC, is the most-employed thermal analysis method for soft matter. DSC allows to measure the amount of energy absorbed or released by a sample when it is heated or cooled, providing quantitative and qualitative data, such as melting temperature, heat of fusion, glass transition temperature, crystalline phase transition temperature and energy.

- Furnace type: silver furnace
- Temperature range: -180°C to 700°C
- Sensitivity: 1 μ W (3 μ V/mW)
- Cooling/heating rate: 0.001 to 200 K/min
- Enthalpy accuracy: <1%
- Precision of specific heat capacity determination: <2.5%

65 3D Measuring Laser Microscope/OLS4000-SAT



The machine is designed for nanometer level height imaging and roughness measurement.

[LSM Section]

- Light Source: 405 nm Semiconductor Laser
- Detector: Photomultiplier
- Total Magnification: 108x–17,280x

[Planar Measurement]

- Repeatability: 100x: $3\sigma n-1=0.02 \mu$ m
- Accuracy: Measurement Value $\pm 2\%$

[Height Measurement]

- System: Revolving Nosepiece Vertical-drive System
- Stroke: 10 mm • Scale Resolution: 0.8 nm
- Display Resolution: 1 nm
- Repeatability: 50x: $\sigma n-1=0.012 \mu$ m
- Accuracy: $0.2+L/100 \mu$ m or less
(L=Measuring Length μ m)

[Color Observation Section]

- Light Source: White LED
- Detector: 1/1.8-inch 2-megapixel Single-panel CCD
- Digital Zoom: 1x–8x
- Revolving Nosepiece:
 - Motorized BF Sextuple Revolving Nosepiece
- Differential Interference Contrast Unit :
 - Differential Interference Contrast Slider: U-DICR,
 - Polarizing Plate Unit Built-in
- Objective Lens:
 - BF Plan Semi-apochromat 5x, 10x,
 - LEXT-dedicated Plan Apochromat 20x, 50x, 100x
- Z Focusing Unit Stroke: 100 mm
- XY Stage: 100x100 mm (Motorized Stage)

105 Matrix-assisted laser desorption ionization time-of-flight mass spectrometer /microflex LT-KCN



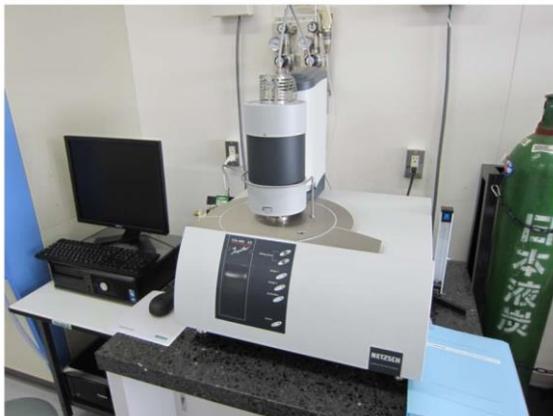
66 High Pressure Isothermal Gas Adsorption Apparatus (Hydrogen Adsorption Measurement) /BELSORP-HP-1-MS



Isothermal gas adsorption gives an information on adsorption site, chemical state and also surface area. This equipment can measure the isotherm gas adsorption curves up to 0.9MPa. There is basically no limitation of gas species, but the machine is currently equipped for hydrogen gas absorption.

- Measurement method: Volumetric adsorption method
- Adsorptive: H₂
- Measurement/pretreatment port: 1 port
- Measurement temperature range: 10°C to 60°C
- Pretreatment temperature range: Max. 400°C

67 Simultaneous Thermal Analysis Apparatus (TG-DSC)+Quadrupole Mass Spectrometer Coupling/STA 449F3 Jupiter+ STA-QMS/GC



Thermal stability, decomposition behavior, composition, phase transitions, melting processes to be analyzed with this instrument comprehensively and quickly.

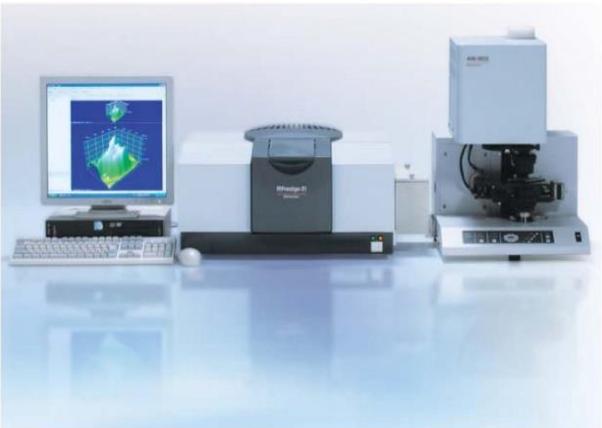
- Temperature range: -150 °C to 2400 °C
- Heating and cooling rates: 0.001 K/min-50 K/min (dependent on furnace)
- Weighing range: 35000 mg
- TGA resolution: up to 0,00001 %
- DSC resolution < 1 μ W (dependent on sensor)
- Atmospheres: inert, oxidizing, reducing, static, dynamic
- Switch valve for 2 purge gases and 1 protective gas
- Vacuum-tight assembly up to 10⁻² mbar

55 Spectro Fluorophotometer/RF-5300PC



Compared to absorbance methods, fluorescence sensitivity is tens to thousands times better. Fluorescence can be used also to identify a specific molecule in a complex background. The synchronous scanning mode allows mixtures of fluorochromes to be analyzed. The personal computer directly controls the instrument for data acquisition and processing.

- Light source: 150 W Xenon lamp.
Ozone resolving type lamp housing
- Measuring wavelength range: 220-750 nm and 0 order
- Spectral bandwidth:
6-step selection of 1.5, 3, 5, 10, 15 and 20 nm.
- Sensitivity:
The S/N ratio is 150 or higher for the Raman line of distilled water (350 nm excitation wavelength, 5 nm spectral bandwidth)
- Measurement mode:
 - Excitation, emission and synchronous spectrum measurement
 - time-course measurement
 - quantitation
 - automatic search of optimal excitation and emission wavelengths
 - PopUp Scan.TM
- Option:
Solid (Powder) Sample Holder
Provides a means to examine the fluorescence of a solid sample.

<p>56</p>	<p>UV-VIS-NIR Spectrophotometer/UV-3600</p> 	<p>The UV-3600 can handle measurement with highly precise transmittance and reflectance, and uses three detectors to handle a range going from the ultraviolet region to the near-infrared region. Using a high-performance double monochromator makes it possible to attain an ultra-low stray-light level with a high resolution.</p>	<ul style="list-style-type: none"> • Wavelength range: 185 to 3,300 nm • Resolution: 0.1 nm • Wavelength accuracy: Ultraviolet and visible regions: ± 0.2 nm Near-infrared region: ± 0.8 nm • Noise: 0.00005 Abs max. (500 nm), 0.00008 Abs max. (900 nm), 0.00003 Abs max. (1,500 nm), determined using RMS values for 1-second responses, 2 nm slit width • Stray light: 0.00008% max. (220 nm, NaI) 0.00005% max. (340 nm, NaNO₂) • Monochromator: 2 × 2 grating-type double monochromator • Accessories: ISR-3100 Integrating Sphere Attachment, 60 mm dia. This attachment is used for measurement of diffuse/specular reflectance and measurement of transmission of liquid or solid sample
<p>53</p>	<p>Fourier Transform Infrared Spectrophotometer + Infrared Microscope/IRPrestige-21 + AIM-8800</p> 	<p>[AIM-8800] right side</p> <p>It is an intelligent infrared microscope that can control stage movement, aperture setting, and focusing from the PC screen.</p>	<ul style="list-style-type: none"> • Optics: 15 × Cassegrain objective 15 × Cassegrain condenser mirrors w / inlet for purging • MCT detector: w / liquid nitrogen monitoring system Wavelength range: Type 1 - 5000 – 720 cm⁻¹ Type 2 - 5000 – 650 cm⁻¹ • Accessory: Temperature control stage
<p>[IRPrestige-21] center</p> <p>A highly sensitive and highly functional Fourier transform infrared spectrophotometer. It is possible to measure from the near infrared region to the far infrared region.</p>		<ul style="list-style-type: none"> • Resolution: (0.5 cm⁻¹, 1 cm⁻¹), 2 cm⁻¹, 4 cm⁻¹, 8 cm⁻¹, 16 cm⁻¹ • Wavenumber range: 7800 to 350 cm⁻¹ • S/N ratio: 40,000: 1 or higher • Interferometer: Michelson interferometer (30 degree incident angle) Advanced Dynamic Alignment system (Patent pending) Sealed and desiccated interferometer with an automatic dryer (Patent pending) • Accessory: Heat chamber 	

71	FT-IR Imaging Microscope/Nicolet iN10 MX 	<p>Fourier Transform Infrared Spectroscopy with 2D mapping capability to characterize the chemical composition and microscopic structure of polymer composite surfaces. It can be used to analysis the surface reaction products and deposited materials arise from sliding between polymer and metals.</p>	<ul style="list-style-type: none"> • Analyze samples as small as 50 microns • Standard single element MCT detector • Spatial resolution better than 10 microns • Built-in intelligence minimizes the learning process, automates instrument validations and provides chemical, physical and distribution information
69	Ar Cluster Ion Beam XPS/PHI5000VersaProbe II 	<p>XPS (X-ray Photoelectron Spectroscopy) is for the elemental analysis of a specimen and can measure elemental compositions, chemical and electronic state quantitatively. In this equipment, Ar cluster ion beam system is attached to etch the sample surface mildly for intentionally exposure of deeper layers of the sample in depth-profiling XPS.</p>	<ul style="list-style-type: none"> • Minimum X-ray Beam Size: $< 10 \mu\text{m}$ • Minimum Energy Resolution: $< 0.50 \text{ eV (Ag3d}_{5/2})$ • Maximum Sensitivity: $> 1,000,000\text{cps}$ above background (Ag3d_{5/2}) • Options: Ar Gas Cluster Ion Beam Gun (GCIB), C60 Ion Gun, Dual Anode X-ray Source, Ultra Violet Source (UPS), Sample Transfer Vessel, Hot/Cold Stage, Scanning Auger Microscopy, etc.
73	Nuclear Magnetic Resonance (NMR) Spectroscopy System/AVANCEIII600 	<p>NMR is a way to detect spin states of a target nucleus contained in a material. This technique is possible to predict the type and structure of the elements present in the unknown materials. This 600 MHz Bruker ultra shielded magnet equipped with a 5 mm liquid probe and 3.2 mm CP MAS probe can access the wide range of experiments to determine the elements and structures. Bruker Icon NMR also facilitates all of the measurement processes, which can broaden the users of this equipment.</p>	<ul style="list-style-type: none"> • 600MHz NMR spectrometer • Magnetic field intensity: 14.1 Tesla • Standard bore: 54 mm • Liquid State Probe: 5mm Smart Probe 600 (1H/19F, 15N-31P) Temperature Range: $-150 \text{ }^\circ\text{C}$ to $+150 \text{ }^\circ\text{C}$, TopShim and auto tune, matching (ATMA) for Liquid State • Solid State Probe: 3.2mm CP MAS 600 SB (15N-31P) MAS rate 24 kHz, Temperature Range: $-50 \text{ }^\circ\text{C}$ to $+ 80 \text{ }^\circ\text{C}$

<p>92</p>	<p>Ultra Nanoindentation Tester/OPX-UNHT</p> 	<p>UNHT (Ultra Nanoindentation Tester) is a high precision nanoindentation tester that can be used to evaluate mechanical properties on a nanoscale.</p>	<ul style="list-style-type: none"> • Load: <ul style="list-style-type: none"> Resolution: 3 nN Maximum load: 100 mN • Indentation depth: <ul style="list-style-type: none"> Resolution: 0.003 nm Maximum indentation depth: 100 μ m • Load frame stiffness: $\gg 10^8$ N / m
<p>94</p>	<p>Spark Plasma Sintering (SPS) Systems/SPS-211Lx</p> 	<p>SPS is a device that can obtain high-quality sintered body.</p> <p>The powder to be processed is set on the sintering stage, sandwiched between electrodes, and pulsed while pressurizing.</p> <p>Within a few minutes, the temperature rises rapidly from room temperature to 1000-2500 ° C, and a sintered body can be formed in a few minutes.</p>	<ul style="list-style-type: none"> • Maximum molding pressure: 20 kN (2,040 kgf) • Minimum molding pressure: 0.5 kN (51 kgf) • Pressurized stroke: 50 mm • Open height: 200 mm • Maximum operating temperature: 2500 °C
<p>52</p>	<p>Raman Imaging Spectrometer System / in Via Raman Microscope</p> 	<p>inVia Raman microscopes are high-sensitivity systems with integrated research grade microscopes, enabling high resolution confocal measurements. inVia Raman microscopes support multiple lasers, with automatic software switching of excitation wavelength.</p>	<ul style="list-style-type: none"> • Light source: LD/YAG laser (532 nm, 150 mW) • Wavenumber range: 4000-100 cm^{-1} • Repeatability: $\pm 0.1 \text{ cm}^{-1}$ • Object lens magnification: 5, 20, 50, 100 • X-Y Positioning range: 112 \times 76 mm

<p>68</p>	<p>RF Plasma Sputtering Apparatus/TS-DC • RF303</p> 	<p>Sputter deposition is a physical vapor deposition (PVD) method of depositing thin films by sputtering, that is ejecting, material from a "target," that is source, which then deposits onto a "substrate," such as a silicon wafer. This equipment can deposit multi composition film by using simultaneous sputtering of three target.</p>	<ul style="list-style-type: none"> • Vacuum level: $\leq 5 \times 10^{-5}$ Pa • Leak rate: $\leq 1 \times 10^{-8}$ Pa \cdot cm³/sec • Substrate heating mechanism: infrared lamp heating mechanism • Substrate heating temperature: Max. 900 °C • Cathode : Magnetron cathode Target size: 1 inch Target materials: varied (mechanical chuck method or bonding method) • Cooling system: water-cooling system • Gas supply system: variable leak valve
<p>72</p>	<p>Secondary Ion Mass Spectrometry/PS02B11</p> 	<p>Time-of-Flight secondary ion mass spectrometry (TOF-SIMS) is a very sensitive surface analytical technique, well established for many industrial and research applications. It provides detailed elemental and molecular information about the surface, thin layers, interfaces of the sample, and gives a full three-dimensional analysis. The use is widespread, including semiconductors, polymers, paint, coatings, glass, paper, metals, ceramics, biomaterials, pharmaceuticals and organic tissue.</p>	<ul style="list-style-type: none"> • Vacuum system: Base pressure reached after bakeout $< 6.7 \times 10^{-8}$ mbar • EDR Analyser: Mass resolution $> 10,000$ (29amu) $M/\Delta M$ FWHM • Bi Cluster Ion Gun • Measurement range: $\mu\text{m}^2 - \text{cm}^2$
<p>106</p>	<p>Hall Effect Measurement System/HL5500PC</p> 	<p>The hall effect measurement system is suited for evaluation of electronic conductors and semiconductors. It enables measurement of resistivity, carrier concentration and mobility on a wide range of semiconductors and with minimum effort in sample preparation. It is designated as a modular system and the basis instrument can measure sheet resistivity up to a few Mohm/square and Hall voltage of a few μV.</p>	<ul style="list-style-type: none"> • Temperature range: 30°C–800°C

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Inverse Gas Chromatography/iGC-SEA

The Inverse Gas Chromatography-Surface Energy Analyzer (iGC-SEA) measures the surface energy of a sample by subjecting the sample to vapor probes of known properties and investigating the interface between the surface of the sample and other molecules. The vapor's retention time is measured by a Flame Ionization Detector (FID). Varying the vapor probe molecule, flow rate, temperature, or column conditions elucidates a surface and bulk properties of the sample.

- Sample column oven: 20°C–150°C
- Number of gas probe: 12 types
(non-polar and polar)
- Column diameter: 2 mm, 3 mm, 4 mm
- Sample type: particulate, fibre, planar
- Detector: FID (Flame ionization detector)