CHARACTERIATION, TESTING, AND QUALITY CONTROL OF NANOTECHNOLOGY-BASED PRODUCTS:

THE PHILIPPINES' CAPABILITIES

by
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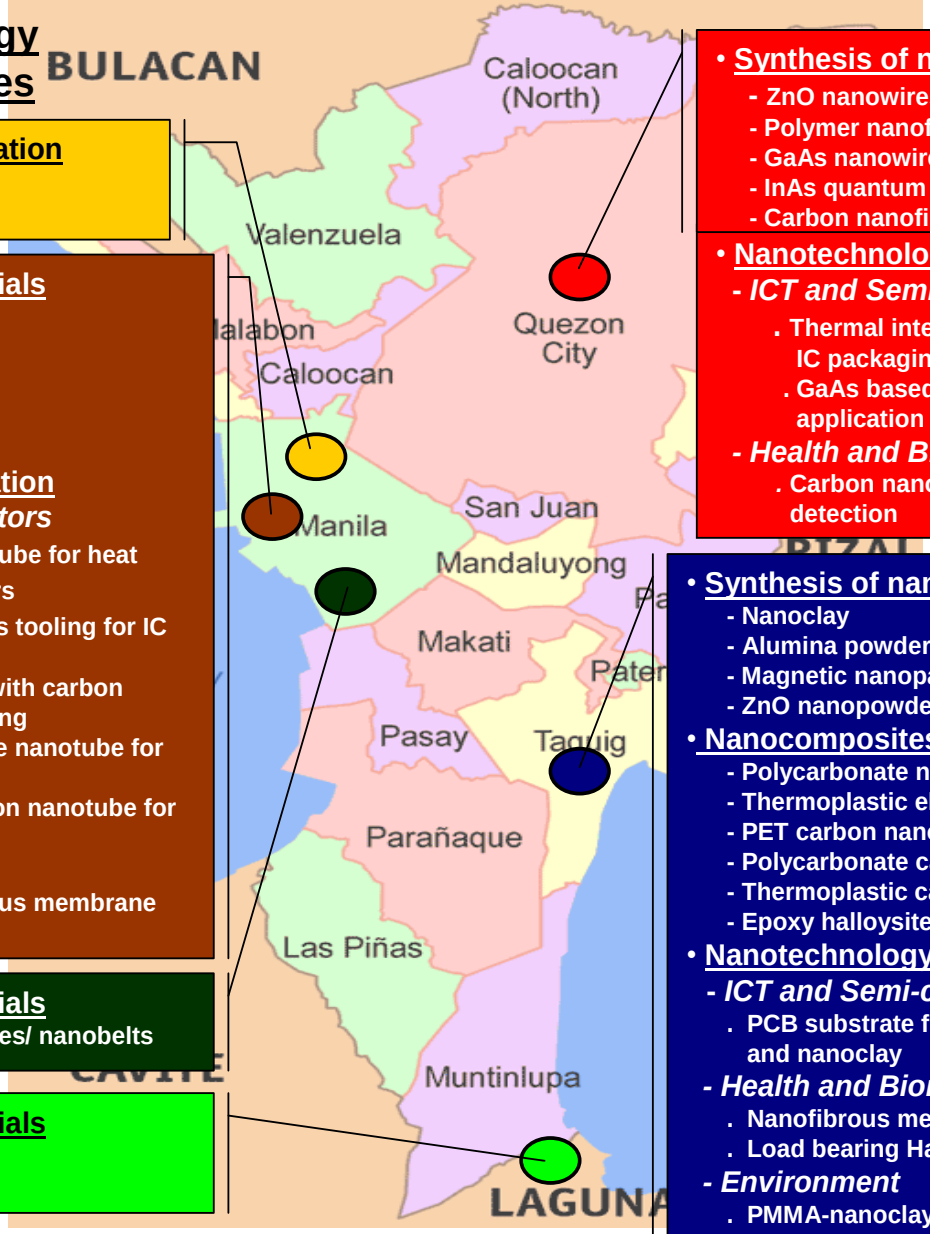
Some Nanotechnology R&D in the Philippines



- **Nanotechnology Application**
  - *Environment*
    - . nanosensors

- **Synthesis of nanomaterials**
  - ZnO nanowires
  - Polymer nanofibers
  - GaAs nanowires
  - InAs quantum dots
  - Carbon nanofibers
- **Nanotechnology application**
  - *ICT and Semi-conductors*
    - . Thermal interface material with nanoclay for IC packaging
    - . GaAs based quantum well devices for RF application
  - *Health and Biomedical*
    - . Carbon nanotubes for cancer diagnosis detection

- **Synthesis of nanomaterials**
  - Carbon nanofibers
- **Nanocomposites**
  - Natural rubber nanoclay
- **Nanotechnology Application**
  - *ICT and Semis-conductors*
    - . Aluminum carbon nanotube for heat sinks in microprocessors
    - . Nanotungsten carbide as tooling for IC fabrication
    - . Lead-free solder paste with carbon nanotube for IC packaging
    - . CNT doped boron nitride nanotube for optical light source
    - . Epoxy multiwalled carbon nanotube for IC encapsulation
  - *Health and biomedical*
    - . PVA-chitosan nanofibrous membrane for drug delivery

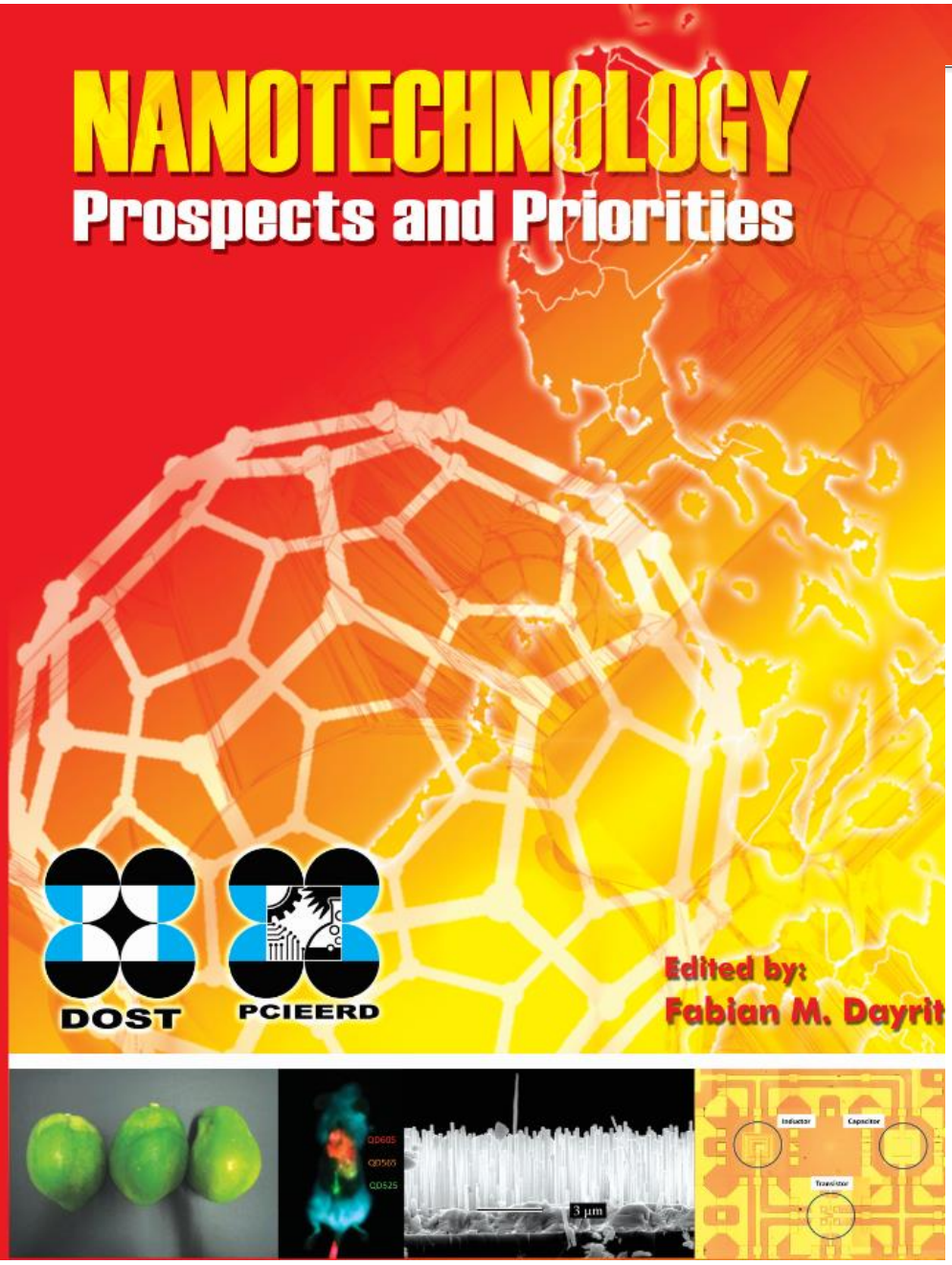
- **Synthesis of nanomaterials**
  - Nanoclay
  - Alumina powder
  - Magnetic nanoparticles (Fe)
  - ZnO nanopowder
- **Nanocomposites**
  - Polycarbonate nanoclay
  - Thermoplastic elastomer nanographite
  - PET carbon nanotubes
  - Polycarbonate carbon nanotubes
  - Thermoplastic carbon nanotube nanographite
  - Epoxy halloysite nanotubes
- **Nanotechnology aplication**
  - *ICT and Semi-conductors*
    - . PCB substrate from recycled polycarbonate and nanoclay
  - *Health and Biomedical*
    - . Nanofibrous membrane for tissue engineering
    - . Load bearing Hap-Alumina biocomposite
  - *Environment*
    - . PMMA-nanoclay nanofibrous membrane for waste treatment
    - . Chitosan biosorbent and membrane for industrial application

- **Synthesis of nanomaterials**
  - SnO nanocarbons/ nanowires/ nanobelts

- **Synthesis of nanomaterials**
  - ZnO nanowires
  - Polymer nanofibers

UPD UPLB MAPUA DLSU UST ITDI-DOST

Some Nanotechnology R&D in the Philippines



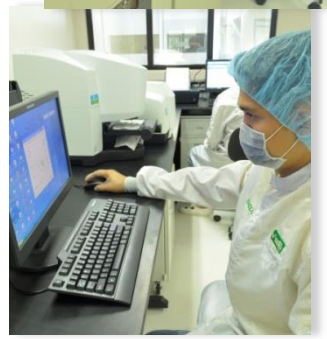
Advanced Device and Materials Testing Laboratory (ADMATEL)

Office Hours:
8AM – 5PM, Monday - Friday

Class 100K Cleanroom Facility
Standard ESD Safety Compliance
ISO 17025 ACCREDITED LABORATORY
ISO 9001:2015 Certified

Advanced Device and Materials Testing Laboratory (ADMATEL)

ADMATEL is a DOST national testing facility equipped with advanced analytical instruments for Failure Analysis and Materials Characterization



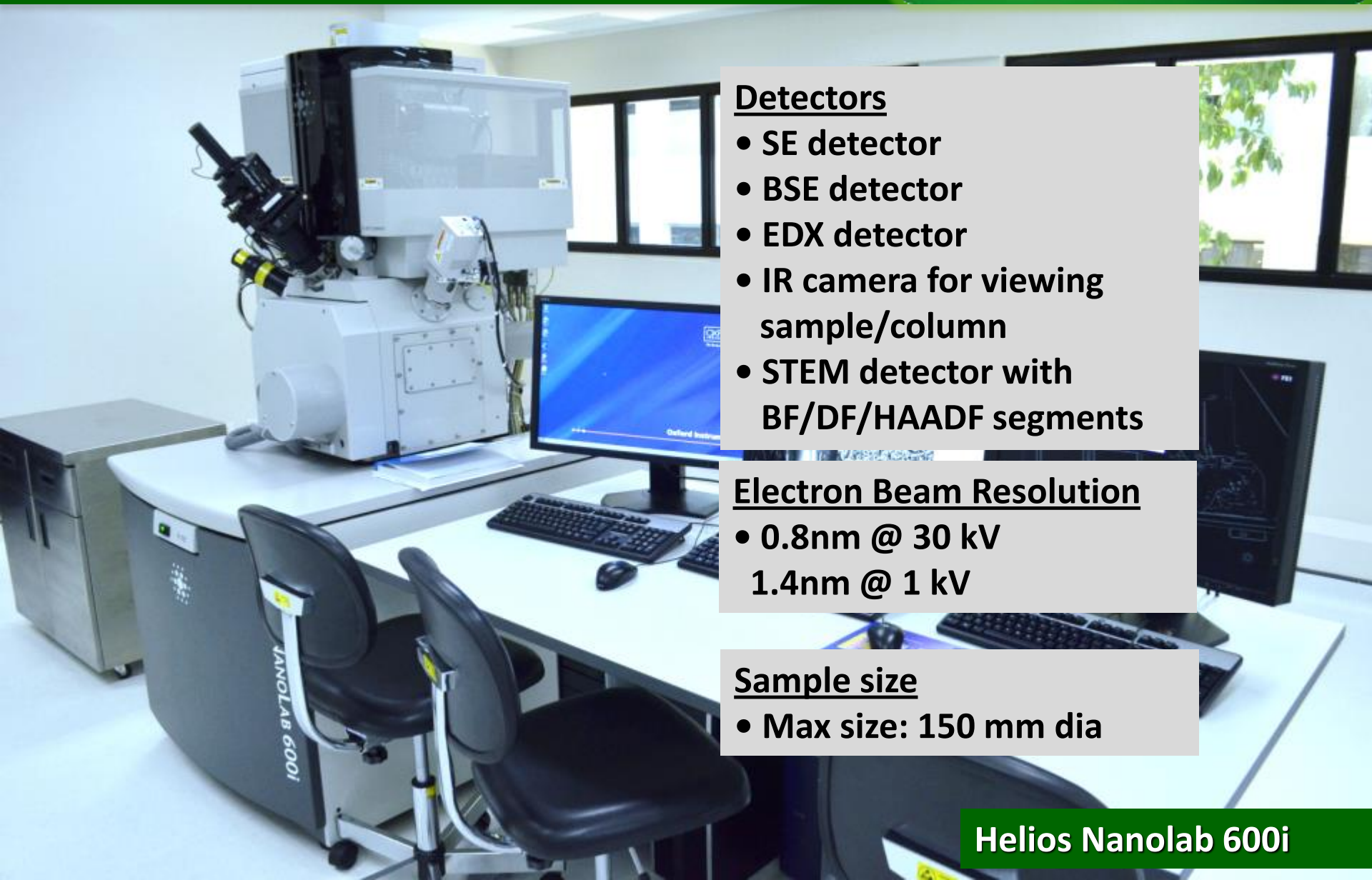
IT WAS ESTABLISHED:

- To reinforce/ upgrade FA and Materials Testing Facilities of our local industry
- To provide shorter turn-around time
- To provide less expensive analysis
- To attract potential investors seeking for a more conducive business environment

ADMATEL LABORATORIES

Class 100k clean room laboratories
Standard ESD safety compliance

FOCUSED ION BEAM (FIB) – FIELD EMISSION SCANNING ELECTRON MICROSCOPE (FESEM)



Detectors

- SE detector
- BSE detector
- EDX detector
- IR camera for viewing sample/column
- STEM detector with BF/DF/HAADF segments

Electron Beam Resolution

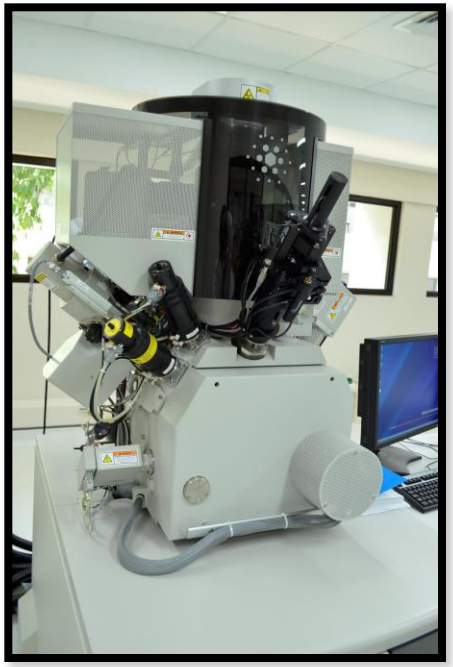
- 0.8nm @ 30 kV
  1.4nm @ 1 kV

Sample size

- Max size: 150 mm dia

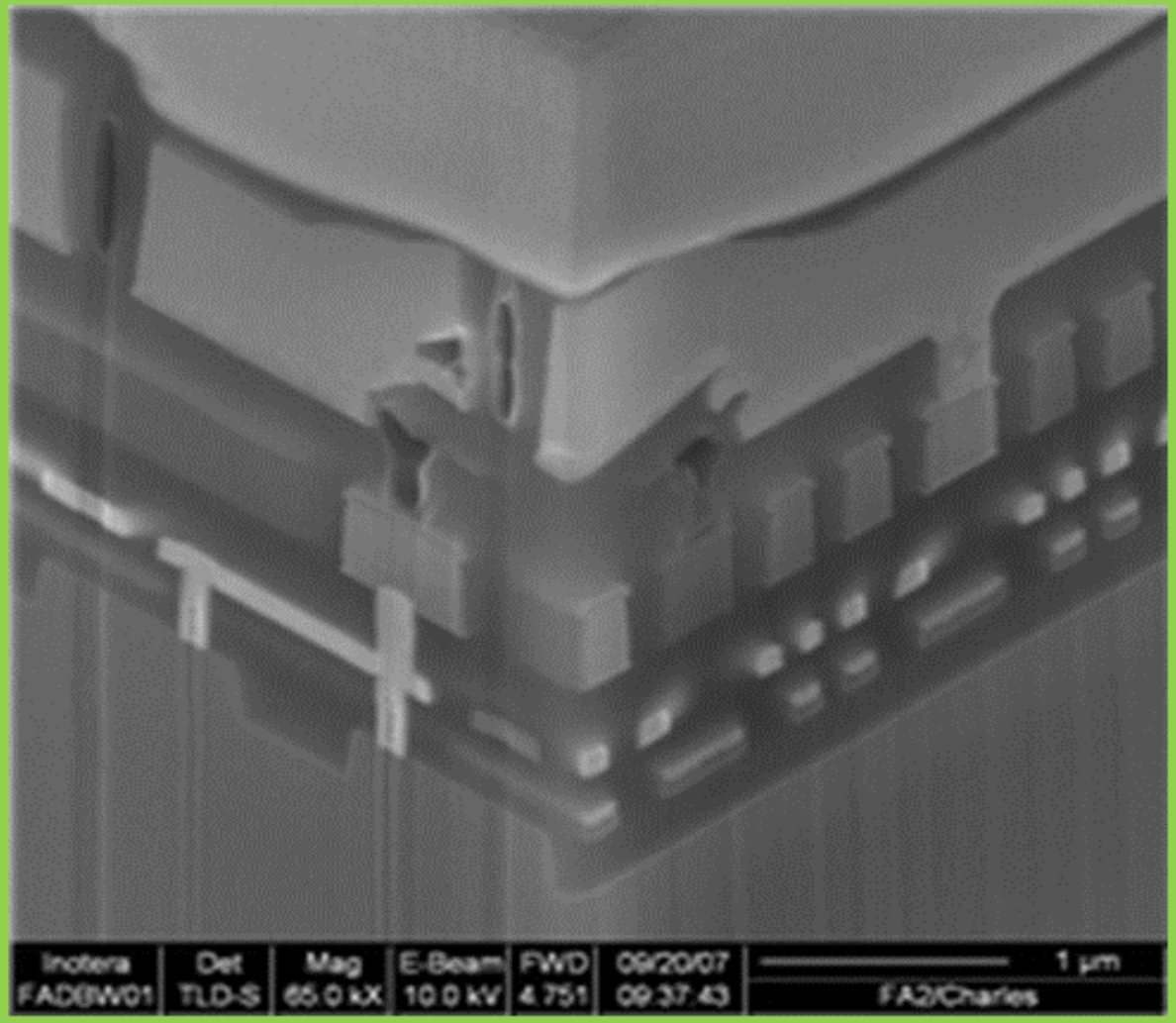
Helios Nanolab 600i

FIB-FESEM SERVICES



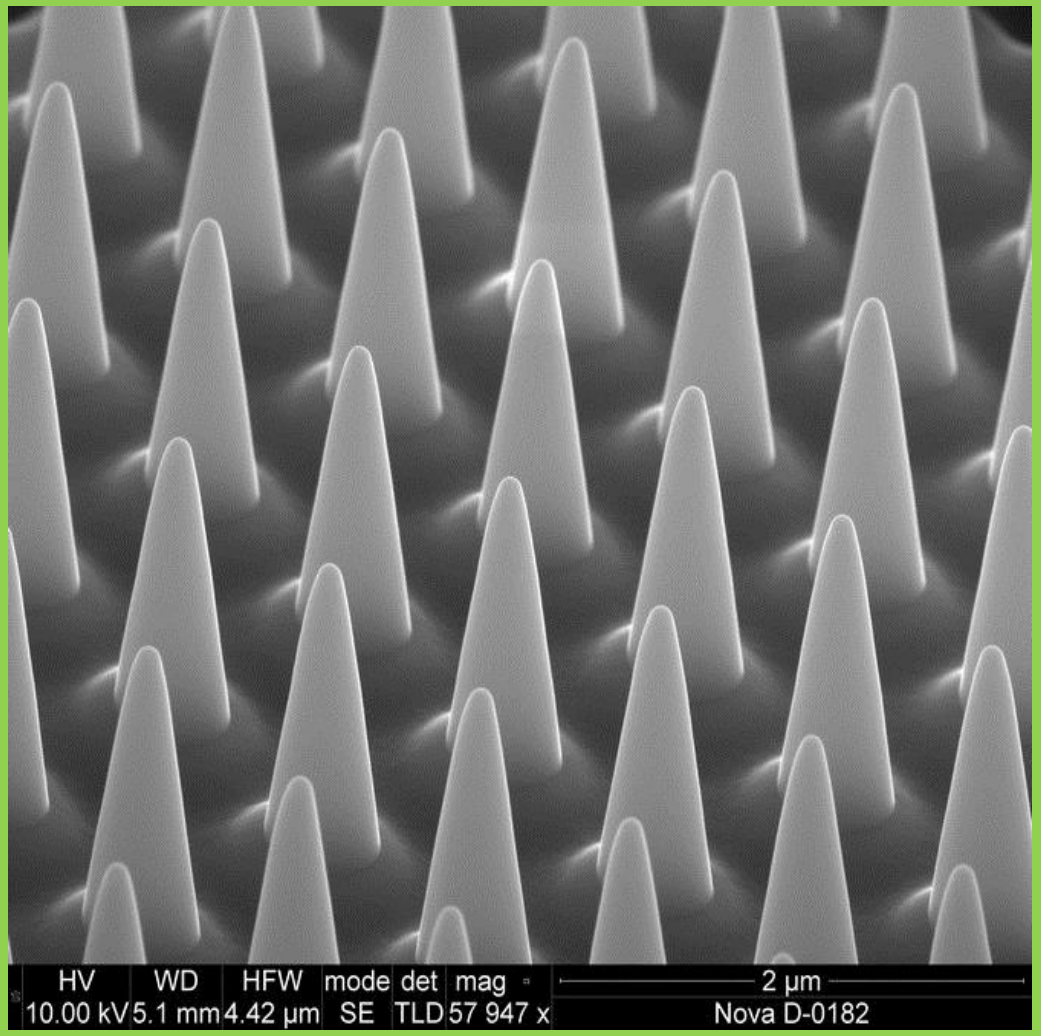
- Defect Analysis
- Failure Analysis
- TEM Lamella Preparation
- Metrology at Nano scale
- STEM analysis
- EDS Analysis
- Site Specific Sample Preparation
- Prototyping for MEMS and NEMS

Site Specific Sample Preparation



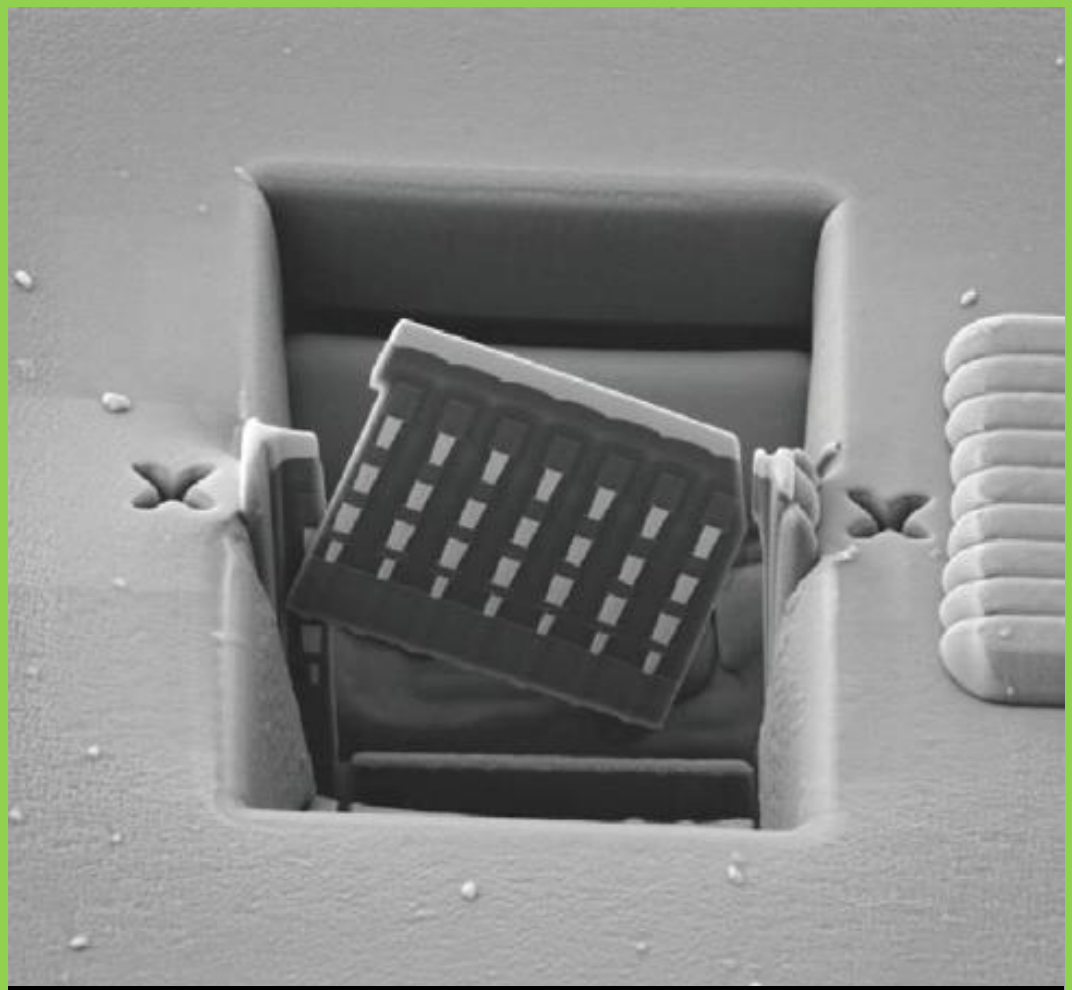
Bi-directional cross-section through an IC device.

Site Specific Sample Preparation



- **Field emitters formed by focused ion beam milling.**
- **Diameter of tip - less than 100 nm.**

STEM Preparation



Magnification: 57,947x | **Voltage:** 10 kV |**Detector:** SE
Spot: 3.0 nA |**Working Distance:** 5.1 mm

- **Created with focused ion beam and ready for transfer to TEM grid.**

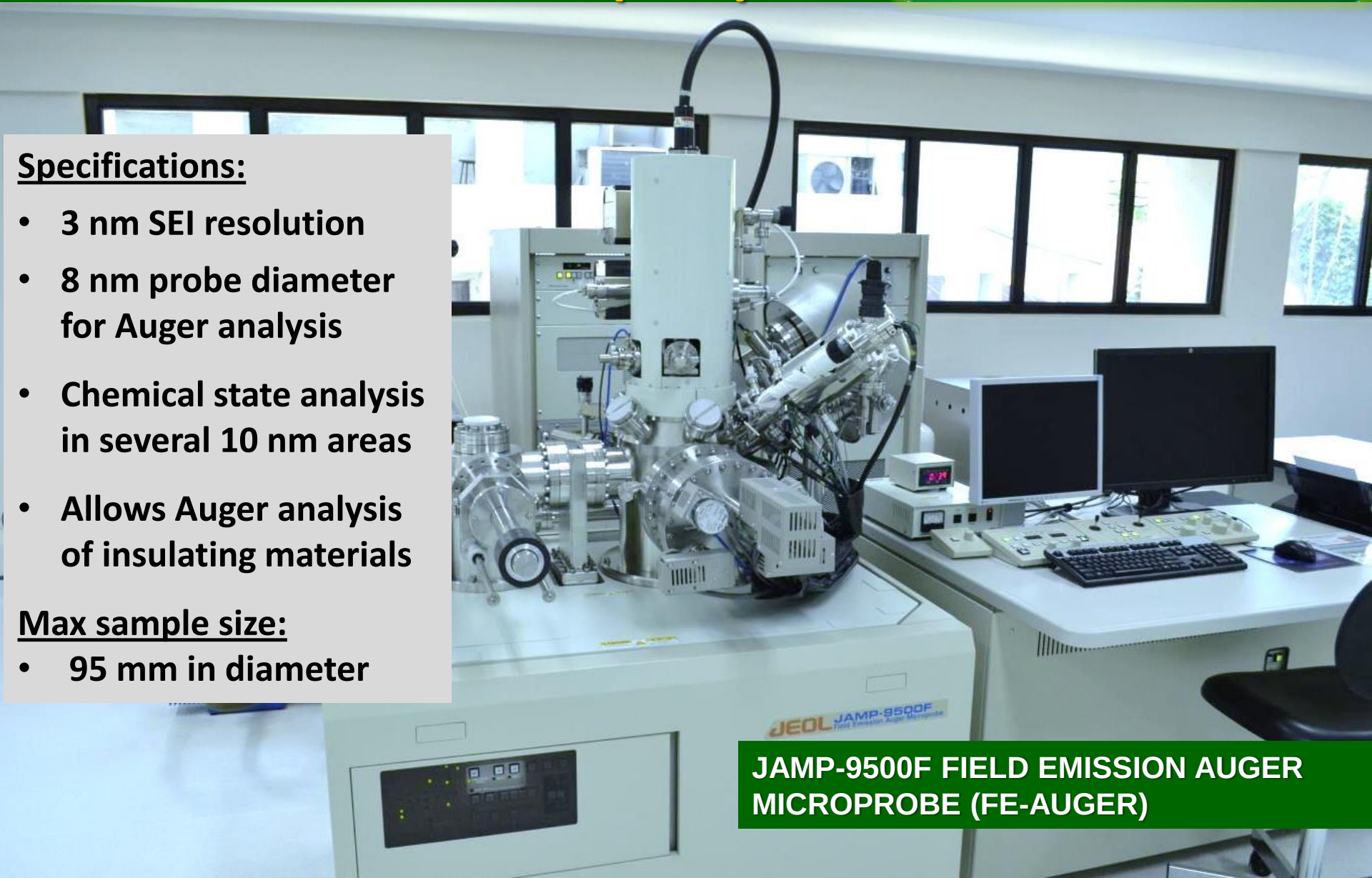
AUGER ELECTRON SPECTROSCOPE (AES)

Specifications:

- 3 nm SEI resolution
- 8 nm probe diameter for Auger analysis
- Chemical state analysis in several 10 nm areas
- Allows Auger analysis of insulating materials

Max sample size:

- 95 mm in diameter



JAMP-9500F FIELD EMISSION AUGER MICROPROBE (FE-AUGER)

AES TESTING SERVICES

- Depth profile analysis
- Spectrum Measurement
- Surface map analysis
- Line analysis measurement
- Element identification
- Insulator material analysis
- Elemental microanalysis (≤1 atomic percentage)
- Imaging of part analysis (max magnification 500k)

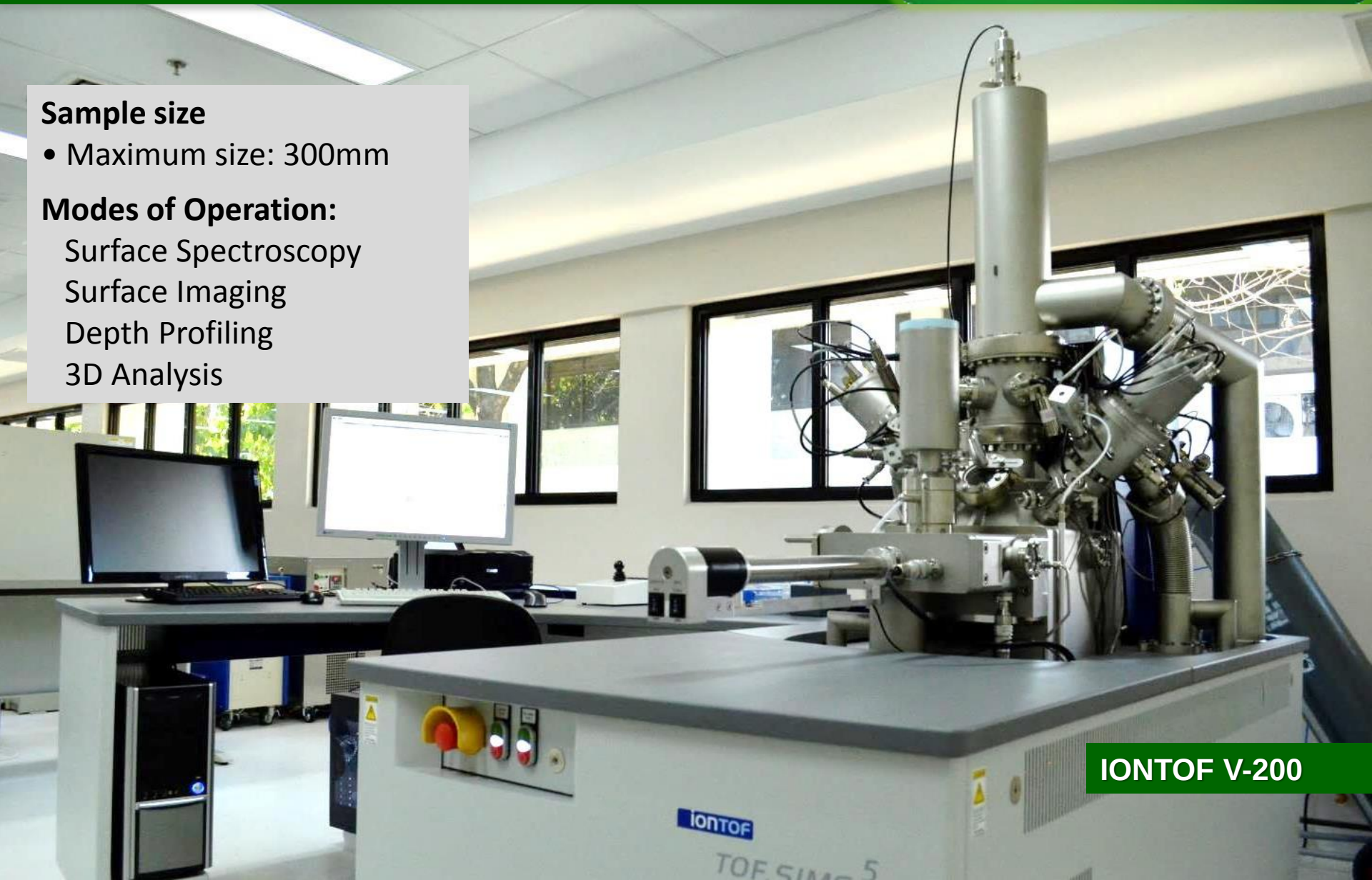
TIME-OF-FLIGHT SECONDARY ION MASS SPECTROMETER (TOF-SIMS)

Sample size

- Maximum size: 300mm

Modes of Operation:

Surface Spectroscopy
Surface Imaging
Depth Profiling
3D Analysis



IONTOF V-200

TOF-SIMS SERVICES

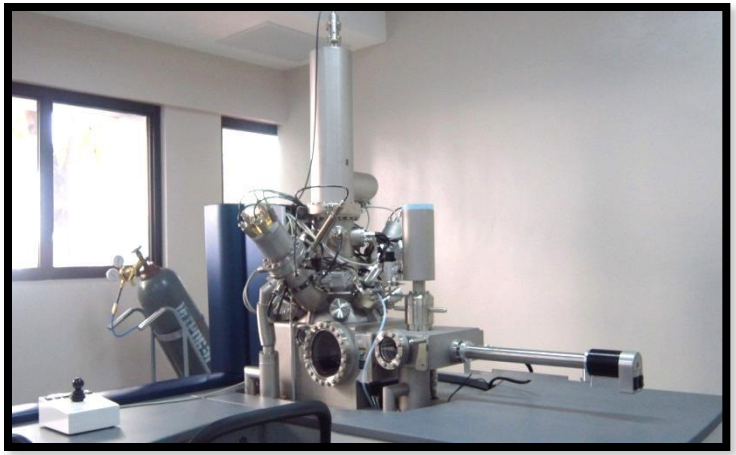
- Trace Metal Detection / Quantification
  - simultaneous detection of all elements (ppm/ppb range)
  - small surface areas (patterned wafers)
  - in depth distribution
  - backside contaminants

- Screening for Contaminants
  - inorganic and organic
  - particle analysis

- Gate Oxide analysis
  - Ultra-thin dielectric layers (Oxinitrides, High-k)
  - nitrogen content, oxide thickness

- Analysis of shallow Implants
  - high sensitivity
  - parallel mass detection (contaminant screening)

  - Failure analysis
    - Interface, bond pad, test pad analysis
    - Defect and particle analysis



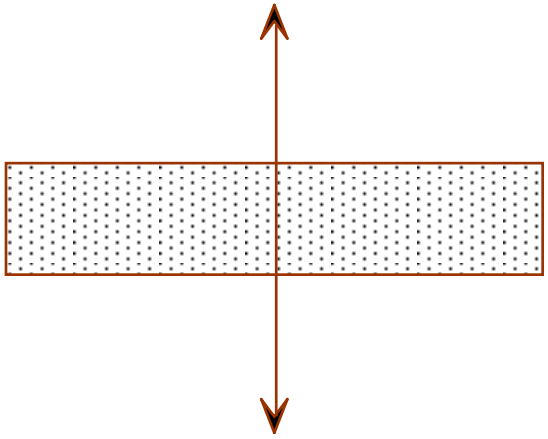
FTIR SPECTROSCOPY AND IMAGING

- Failure analysis
- Micro-contamination identification
- Adhesive performance
- Material delamination
- Corrosion chemistry
- Chemical analysis of samples down to about 10 x 10 µm : fibers, particles, crystals
- Analysis of inhomogenieties in a larger matrix
- Surface studies/characterization

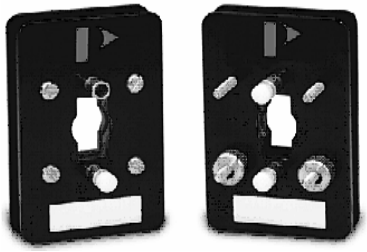
Spectrum Spotlight 200

INFRARED SAMPLING MODES

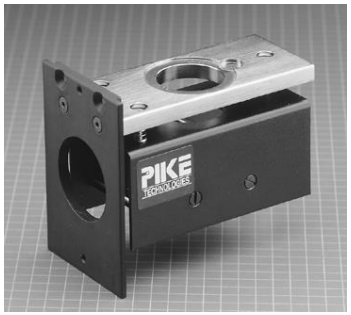
Transmission



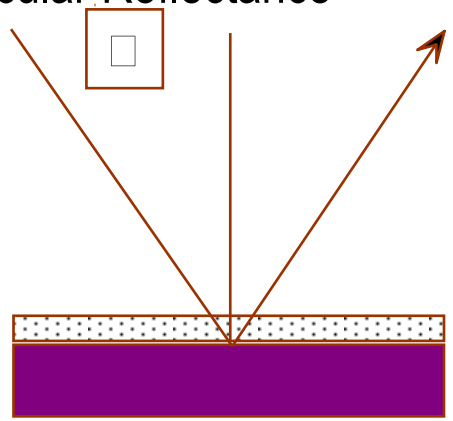
Transmission



Evacuable KBr Die

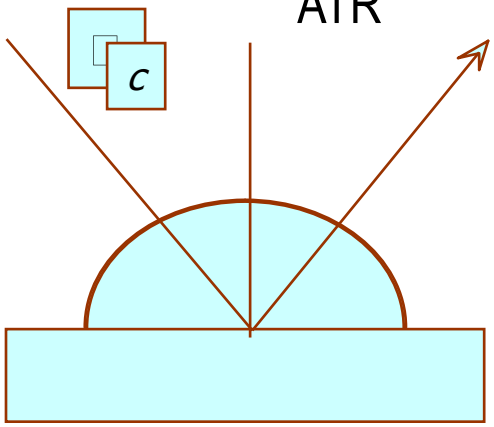


Specular Reflectance



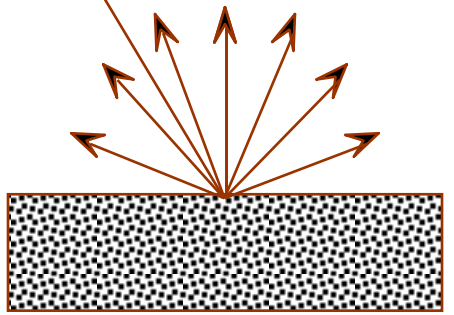
Reflection-absorption

ATR



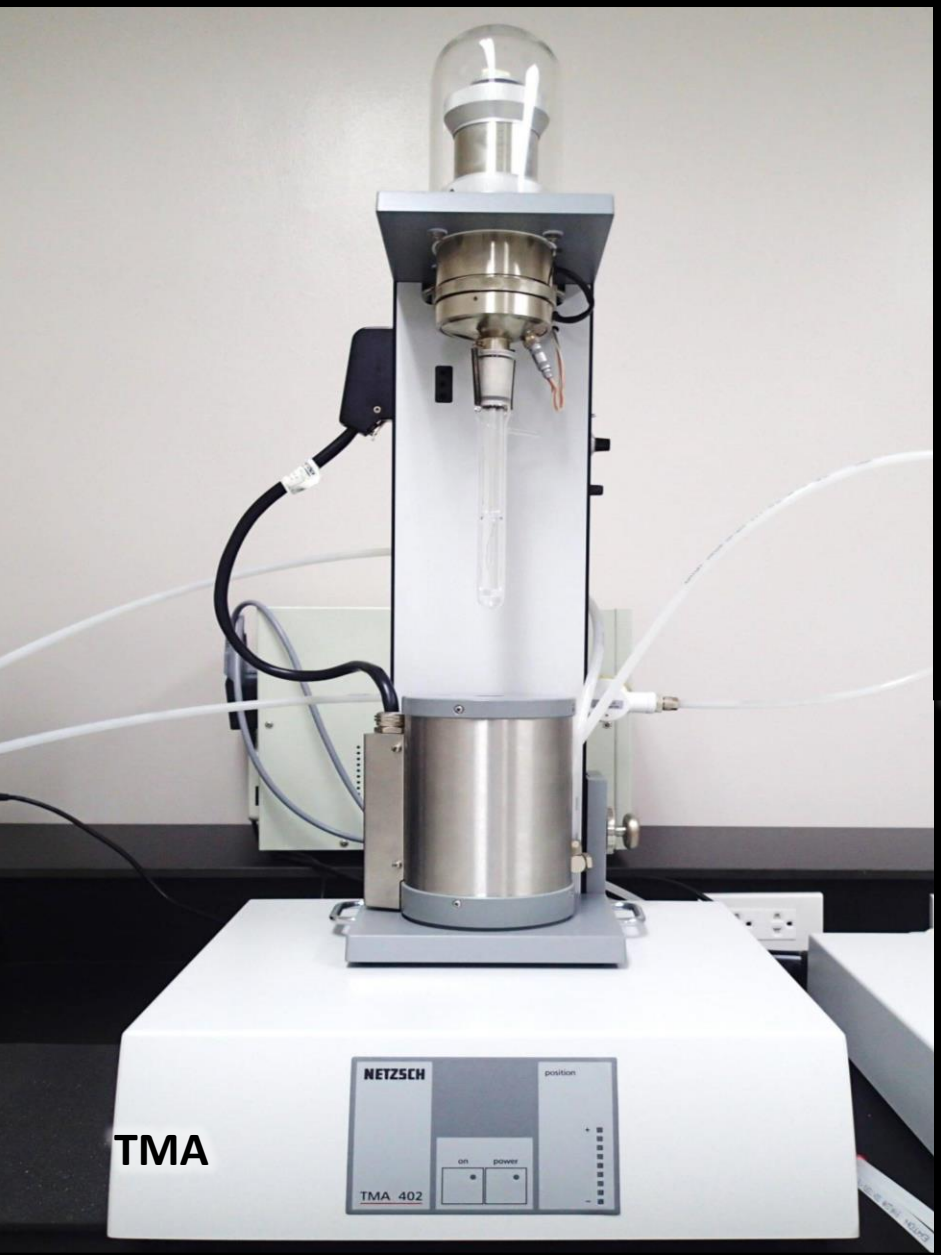
Internal reflection

Diffuse Reflectance

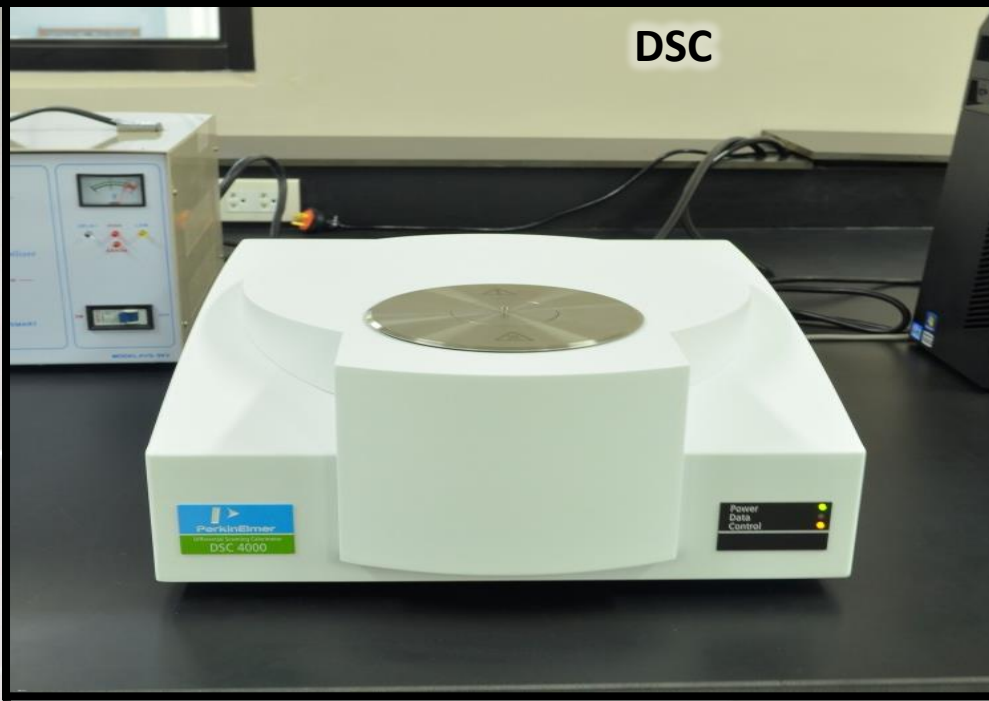


Diffuse reflection

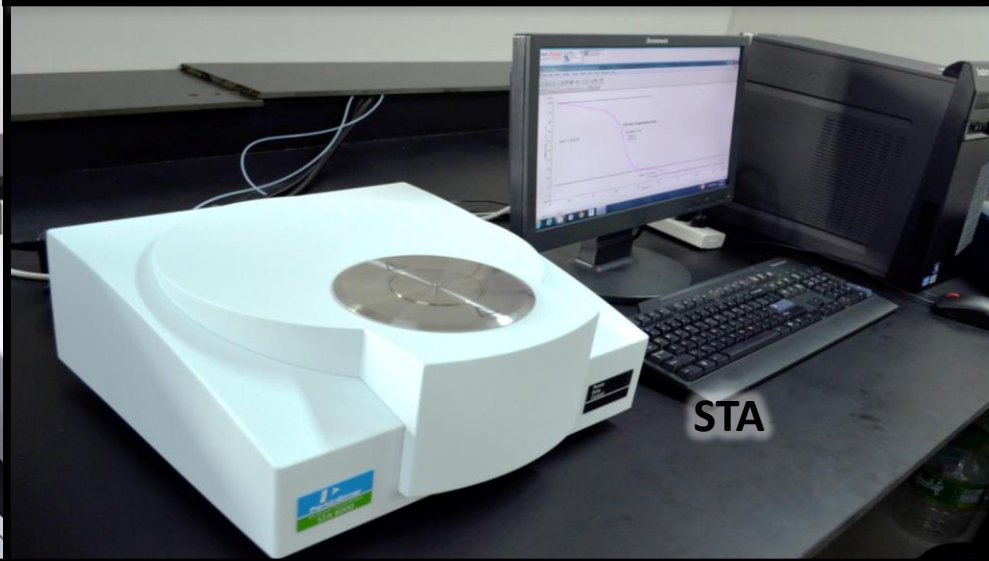
THERMAL ANALYSIS EQUIPMENT



TMA



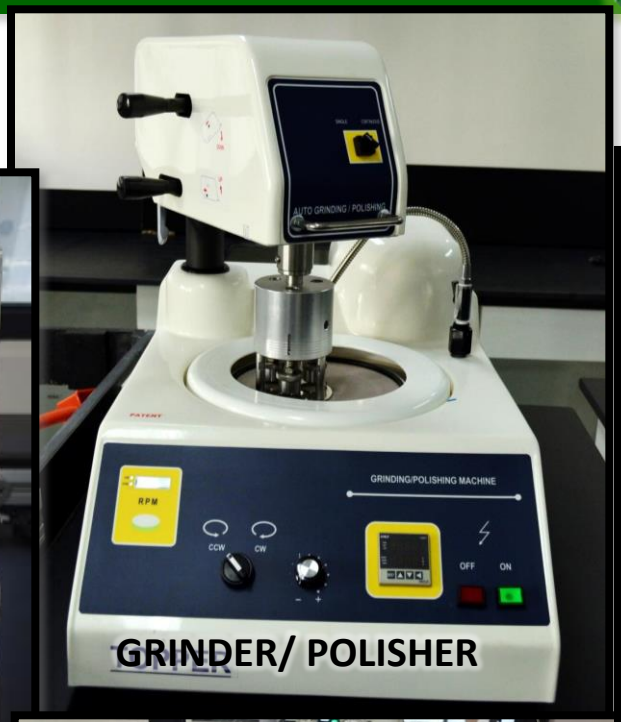
DSC



STA

SAMPLE PREPARATION AND EXTERNAL VISUAL INSPECTION

DIAMOND SAW

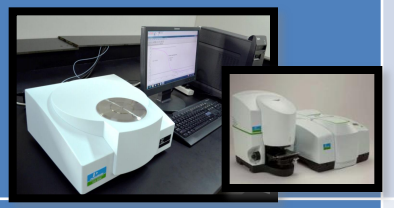
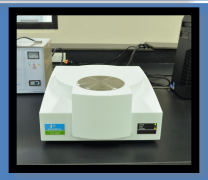


GRINDER/ POLISHER

OPTICAL MICROSCOPES

ION CROSS-SECTION POLISHER

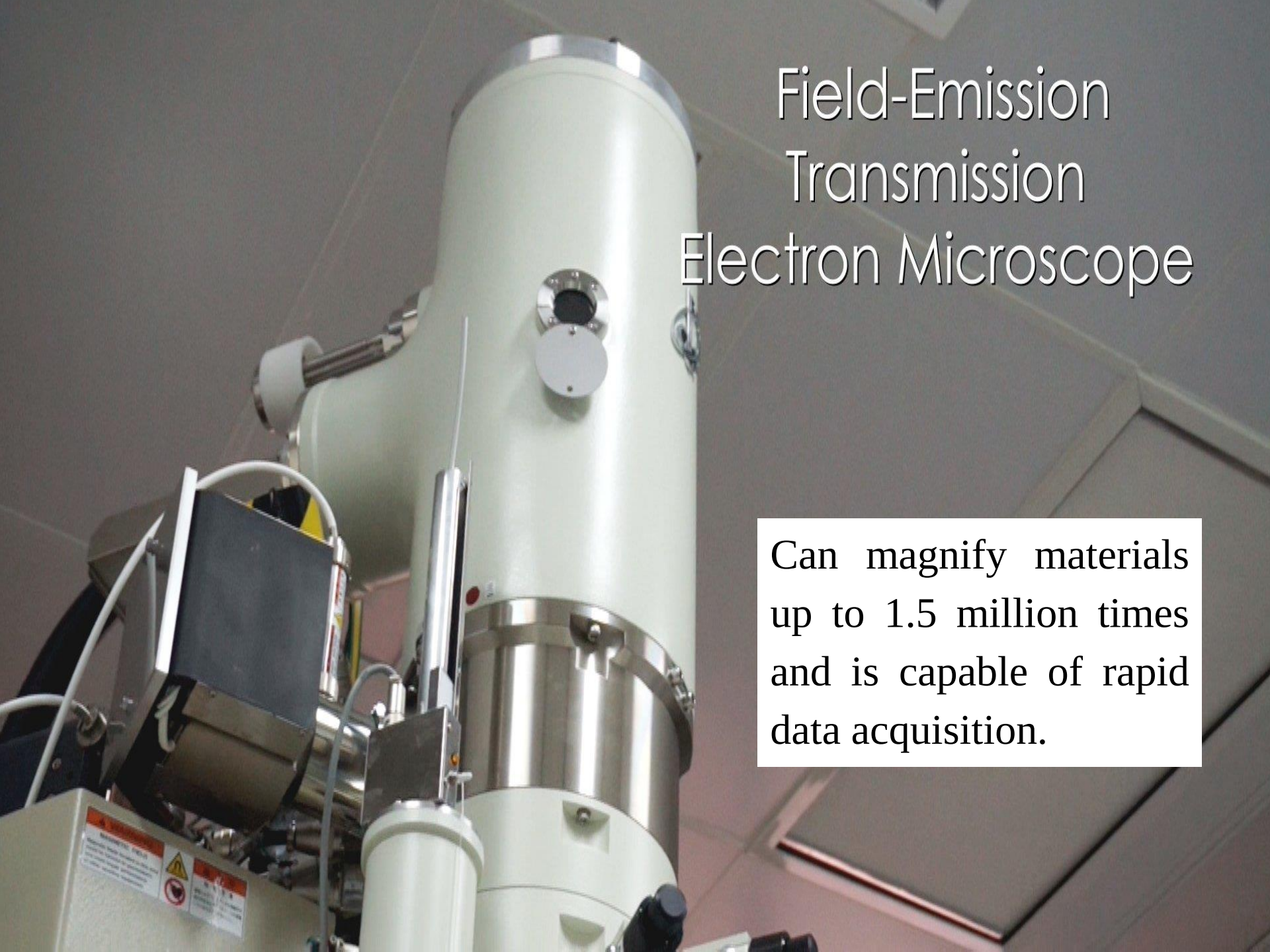
TESTING SERVICES

Equipment	Services	Description	Application
TG-DTA and FTIR 	Hyphenated TG-FTIR analysis	Simultaneous analysis of evolved gases and % weight loss during heating.	Compositional Analysis of Materials, Reverse Engineering
Auger Electron Spectroscopy 	Chemical State Analysis	Determines the chemical state of selected elements	Used to verify the composition of oxide layer found in leadframe pads or delaminated interface.
DSC 	Kinetics Study	Thermal analysis study by varying the soak time at constant temperature	Determination of curing time for epoxies.
TMA 	Determination of Coefficient of Thermal Expansion	Measures the dimensional change of sample in one (1) axis during heating	Determination of CTE and Tg for Metals, ceramics, polymers, and composites.

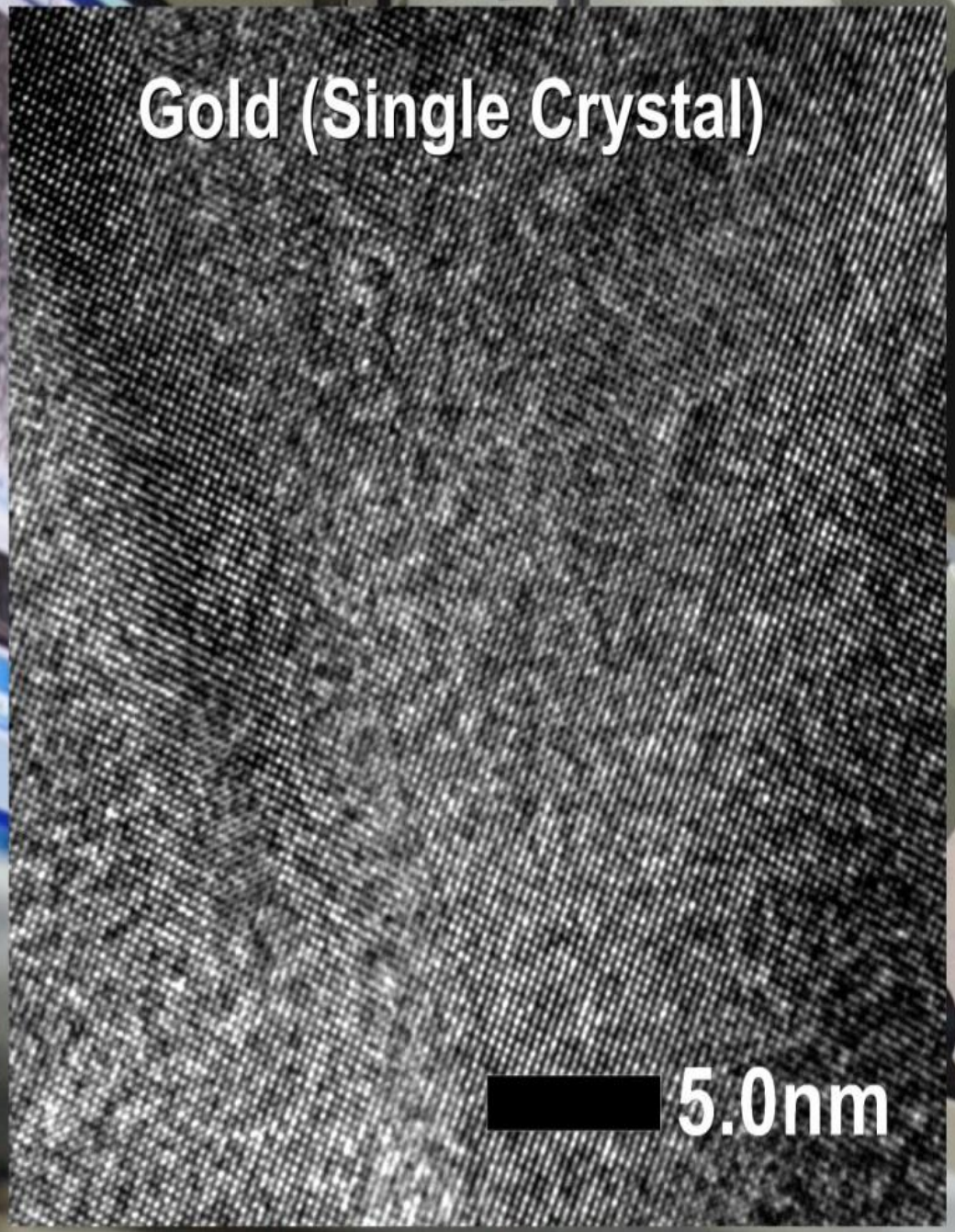
TESTING SERVICES

Eqpt	Services	Description	Application
TMA 	Determination of Glass Transition Temperature	Measures the dimensional change of sample in one (1) axis during heating	Polymeric materials
FIB-FESEM 	STEM Imaging with EDS analysis	Determines the elements present in the sample	Defect analysis
TOF-SIMS 	Depth Profiling at Wide Mass Range	Depth Profile Analysis at >400 mass units	Defect analysis

The NANOTECHNOLOGY LABORATORY (NanoLab) is the premier nanotechnology research facility in the Philippines.



Can magnify materials up to 1.5 million times and is capable of rapid data acquisition.

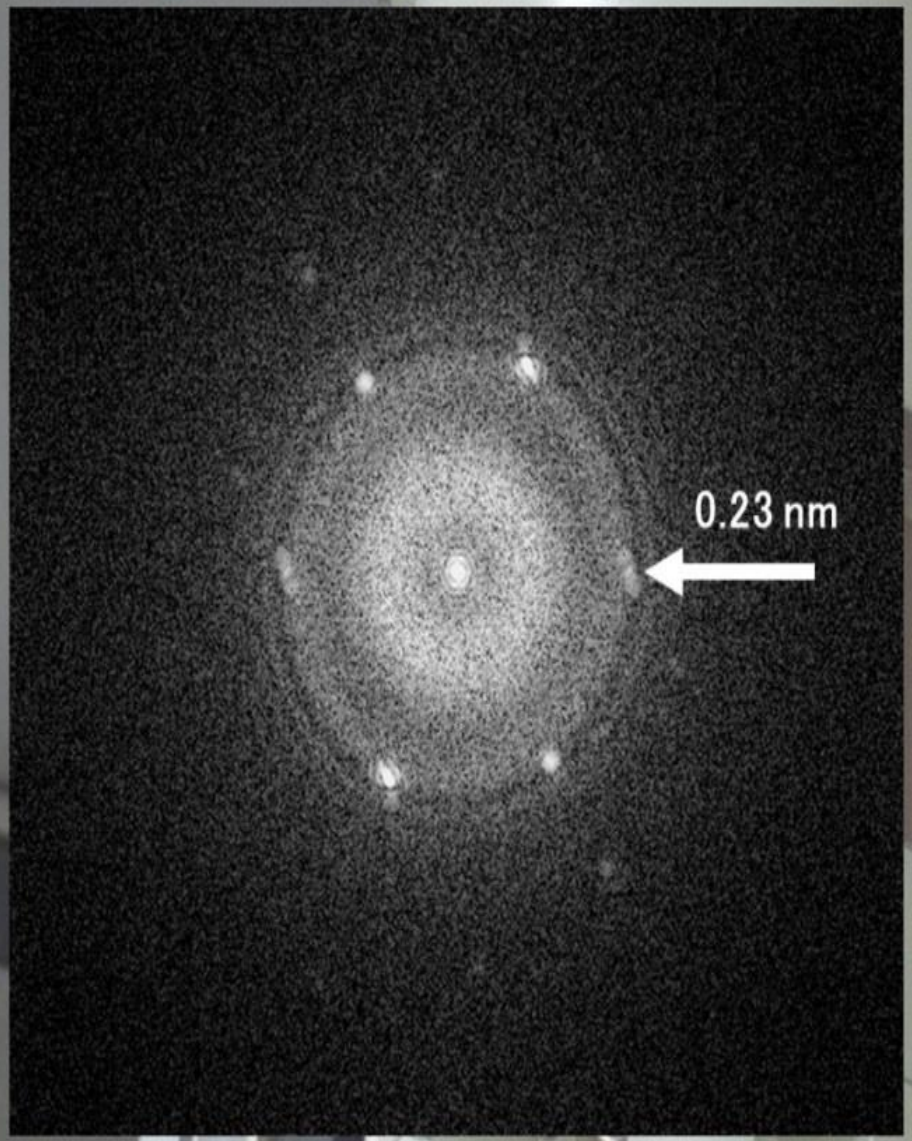


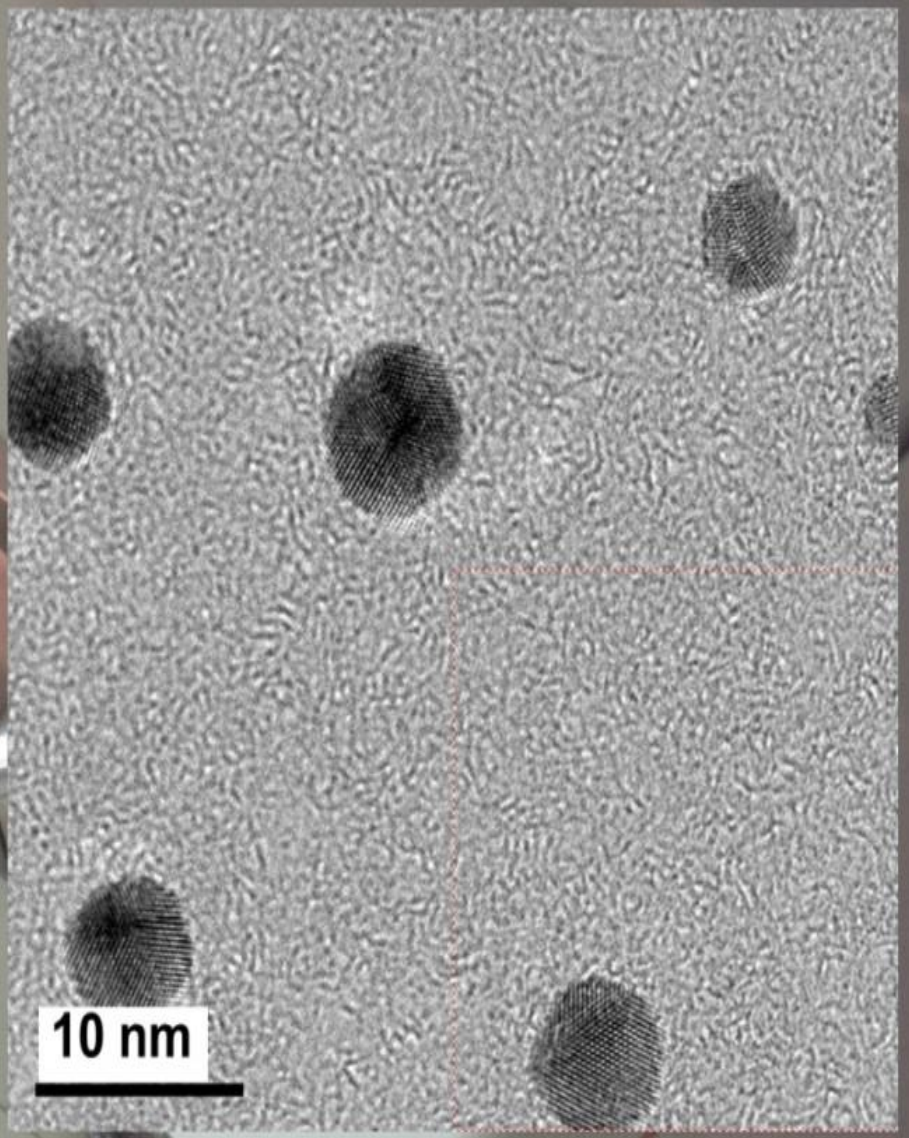
A point resolution of 0.23 nm and lattice resolution of 0.1 nm.

FE-TEM can perform secondary and back-scattered electron imaging.

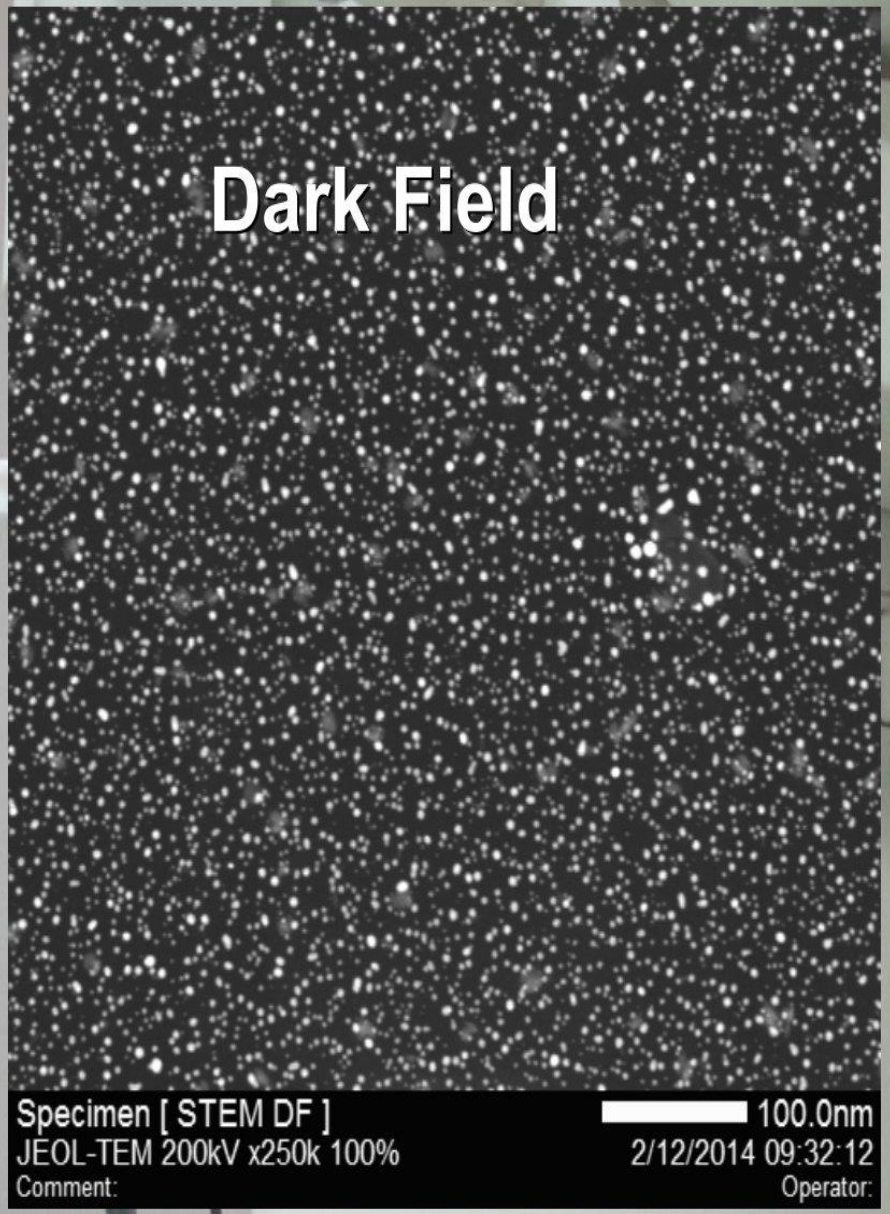
Gold Nano Particles

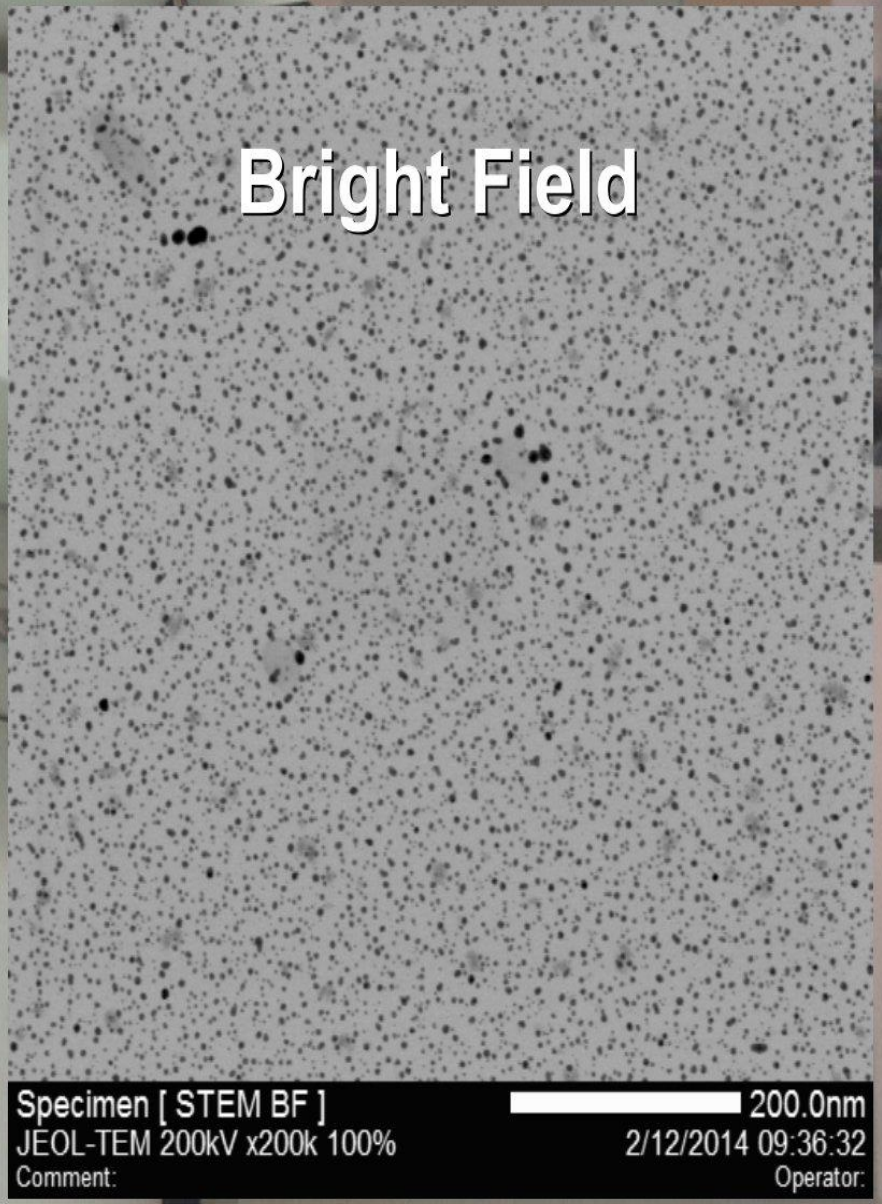
Selected Area Electron Diffraction Capability



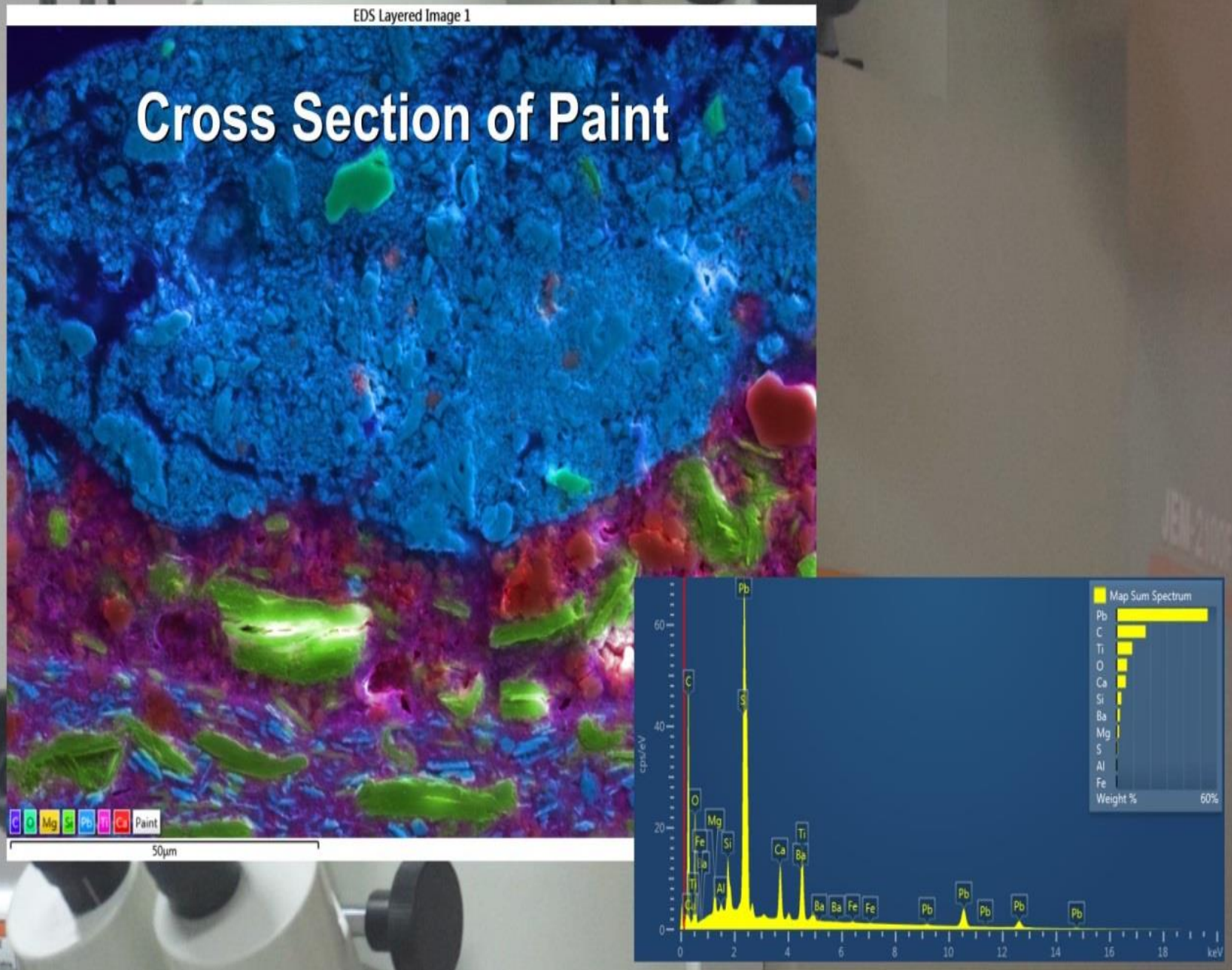


Gold Nano Particles



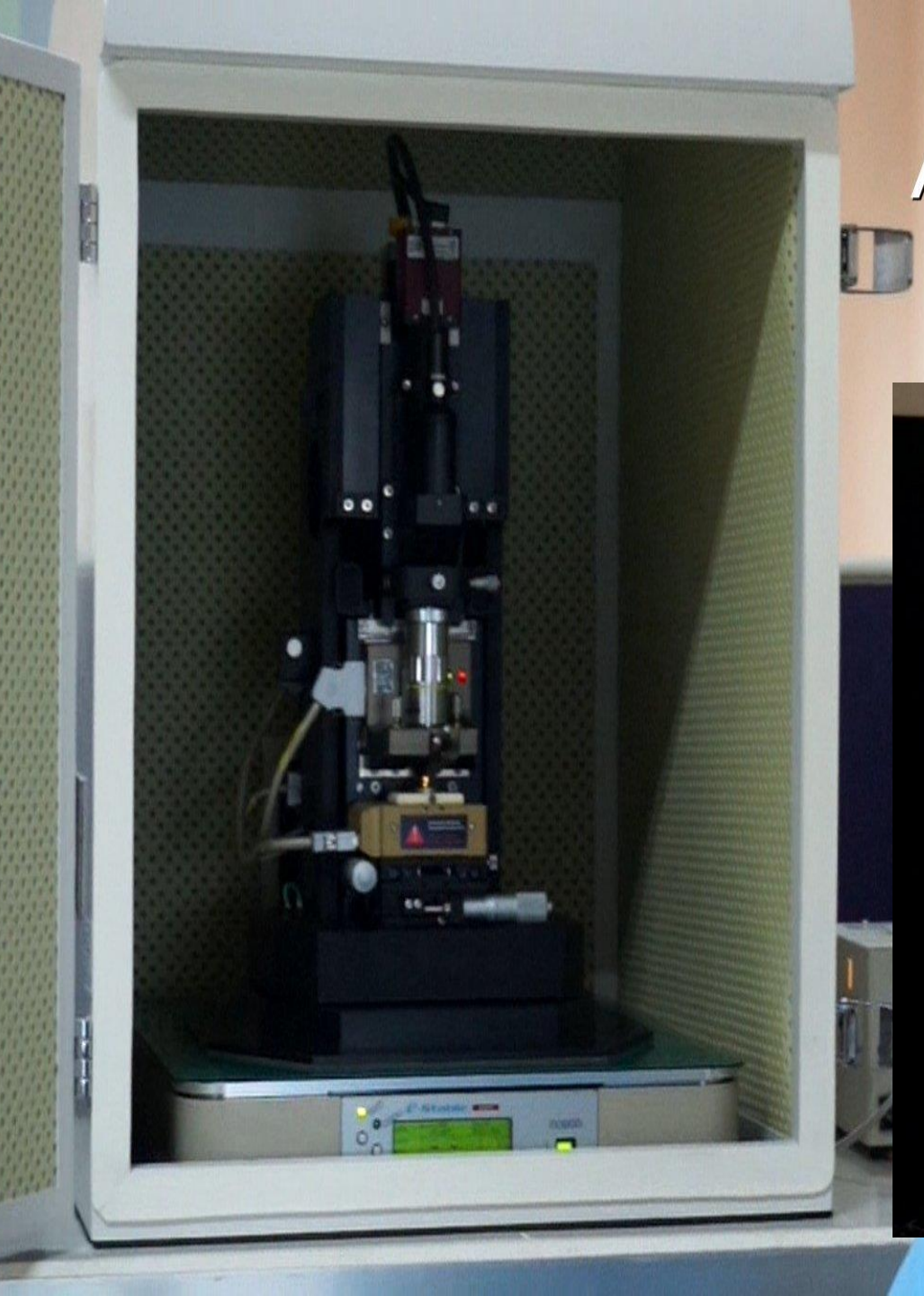


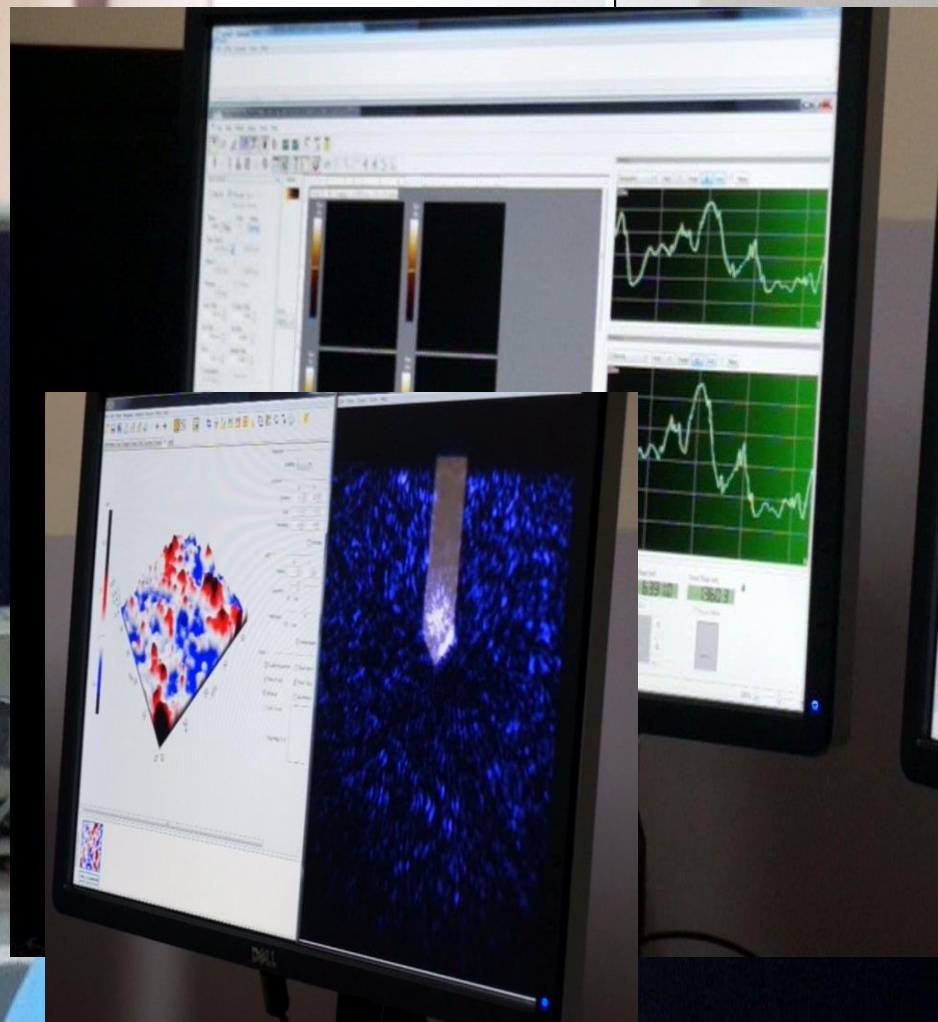
Gold Nano Particles



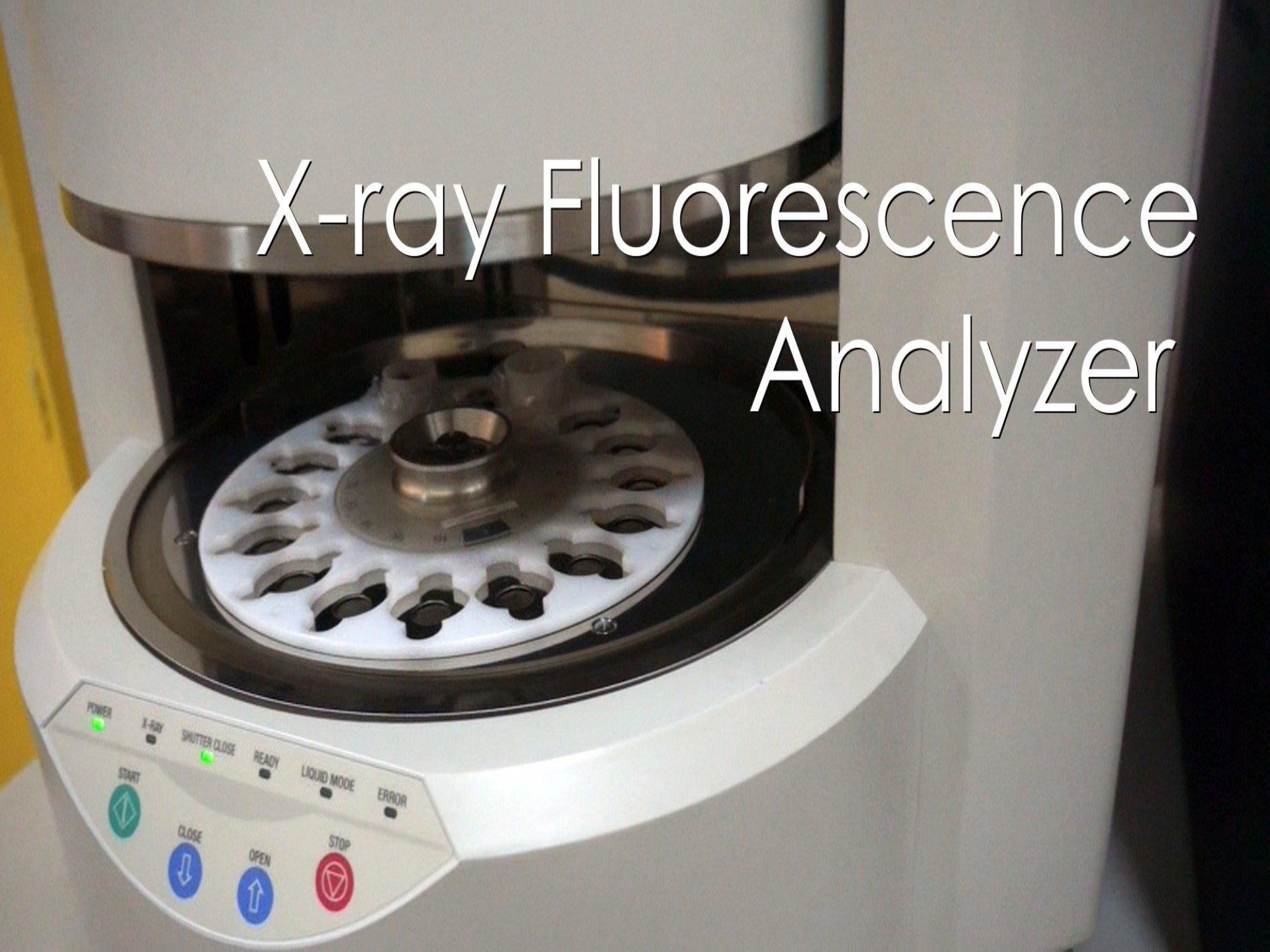
Energy Dispersive X-ray Spectrometer

Atomic Force Microscope

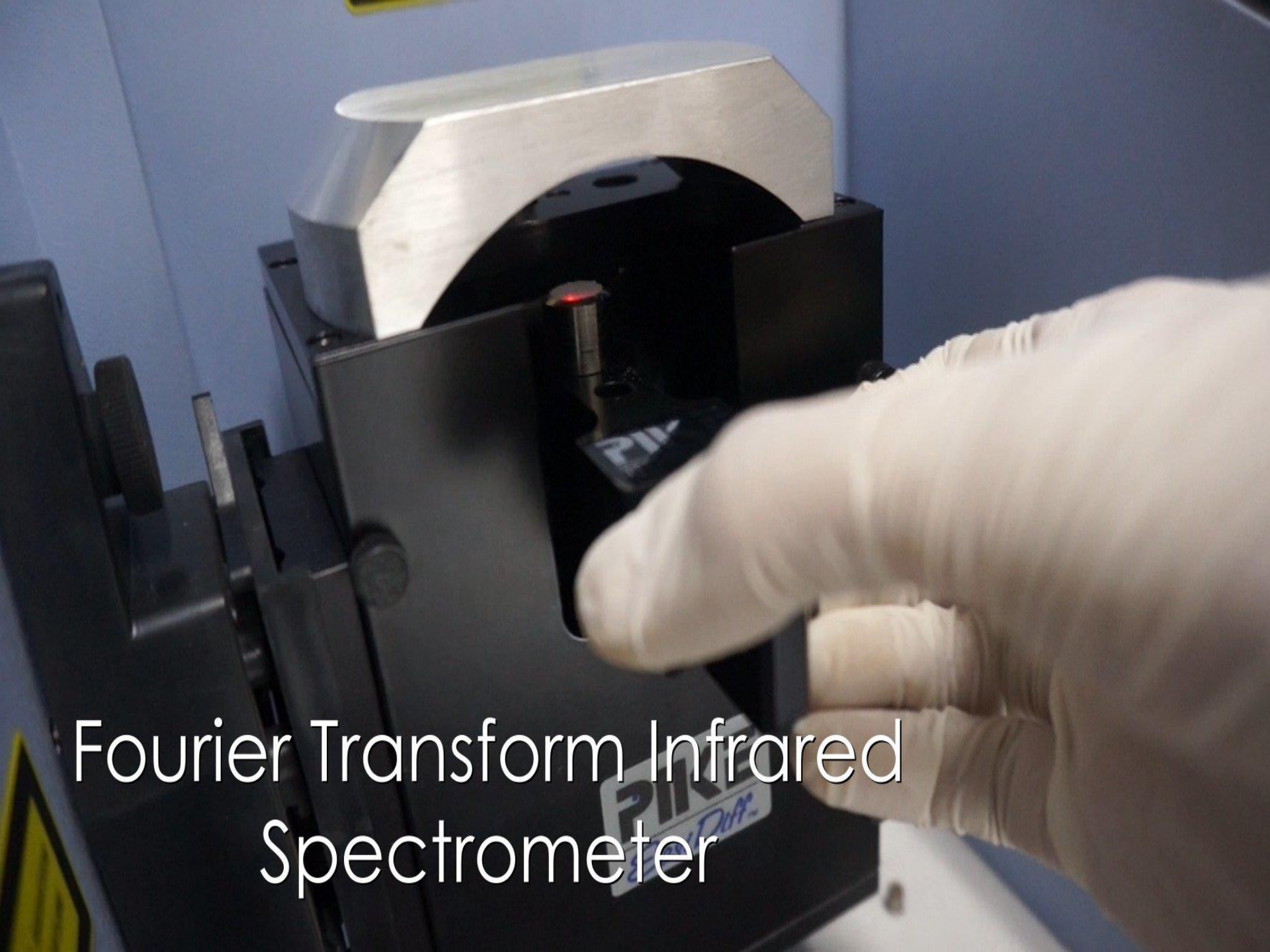


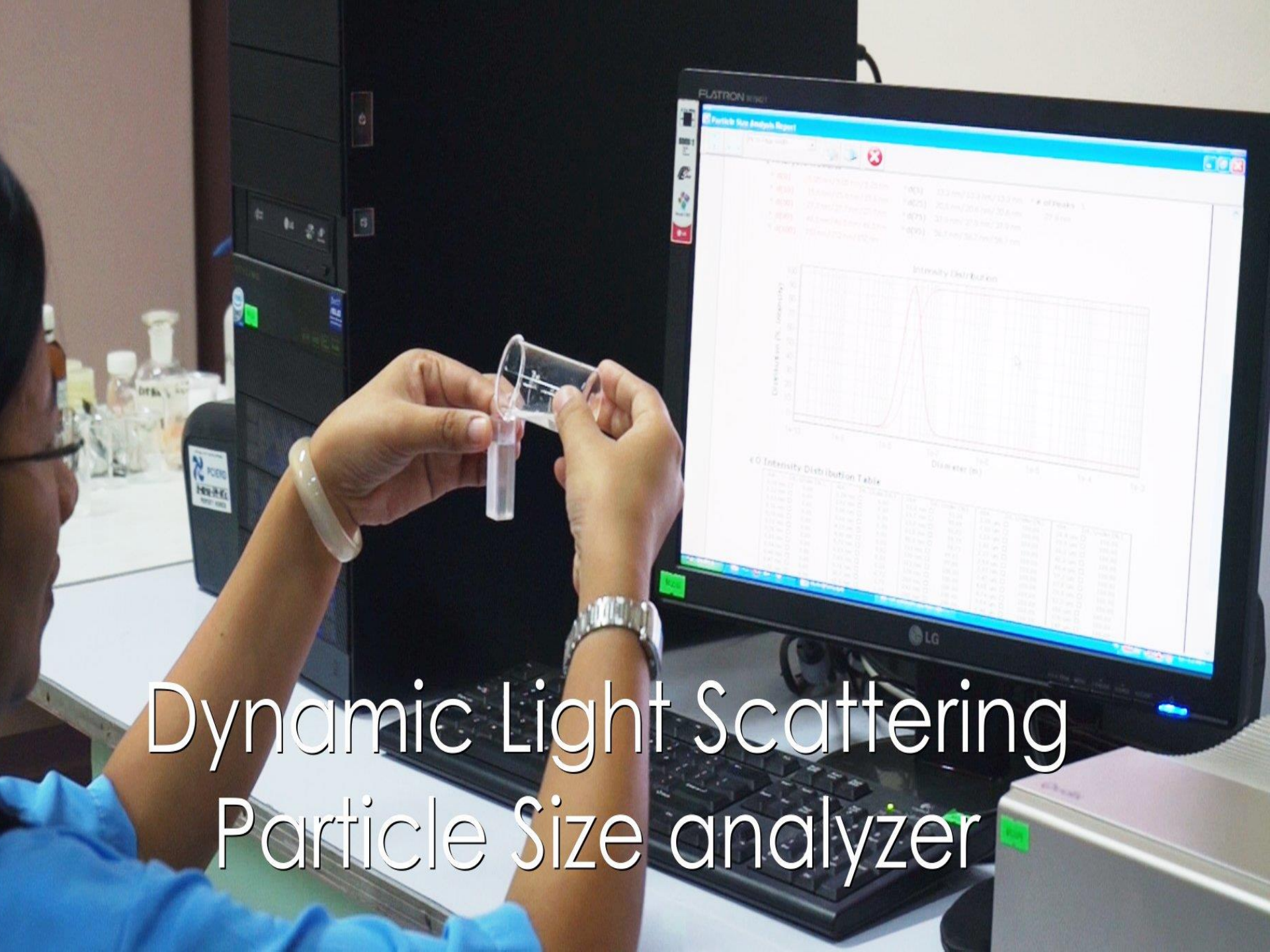


X-ray Diffractometer



X-ray Fluorescence Analyzer


Fourier Transform Infrared
Spectrometer

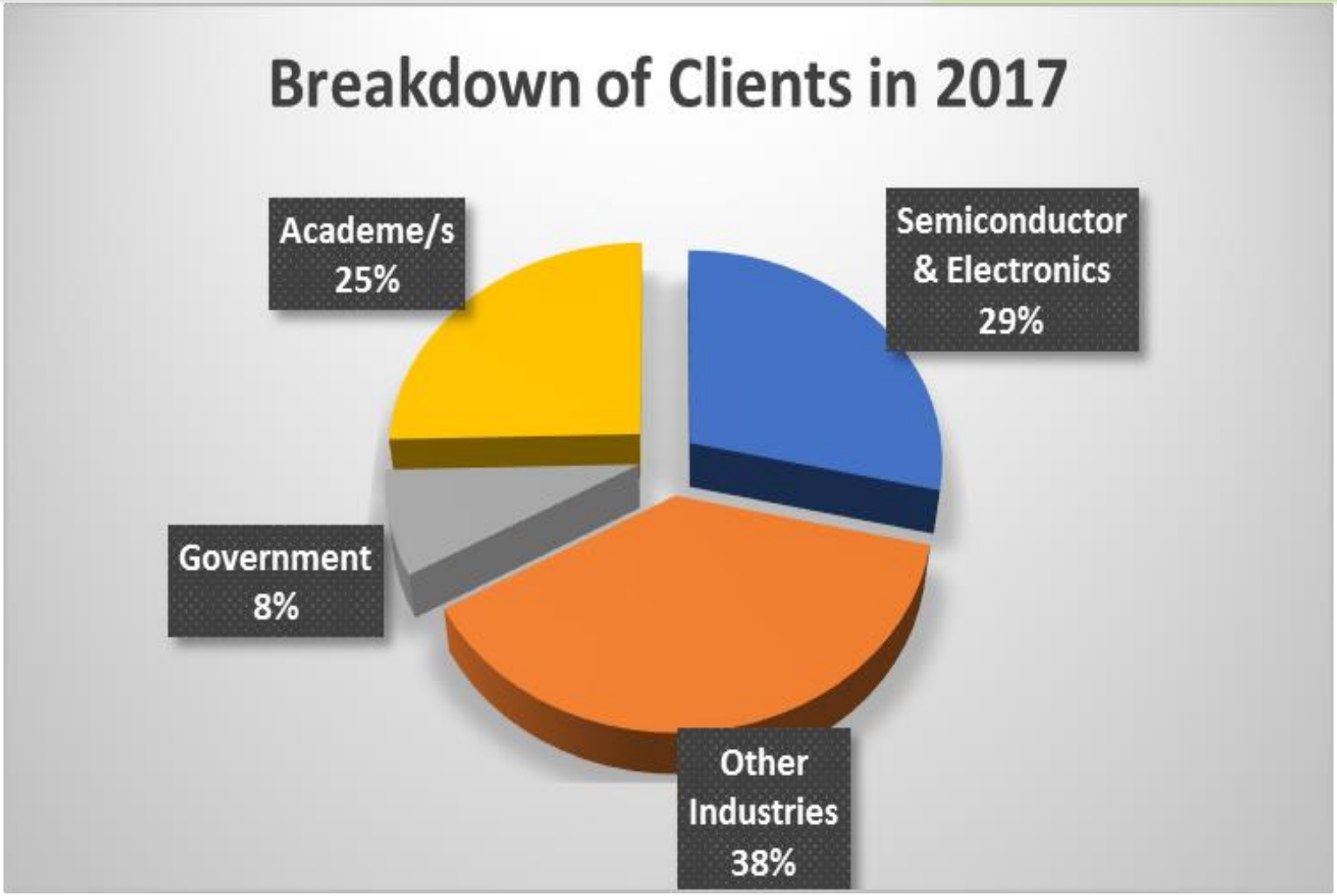

Dynamic Light Scattering
Particle Size analyzer


Brunauer, Emmett and
Teller Surface Area Analyzer

OPERATION UPDATE

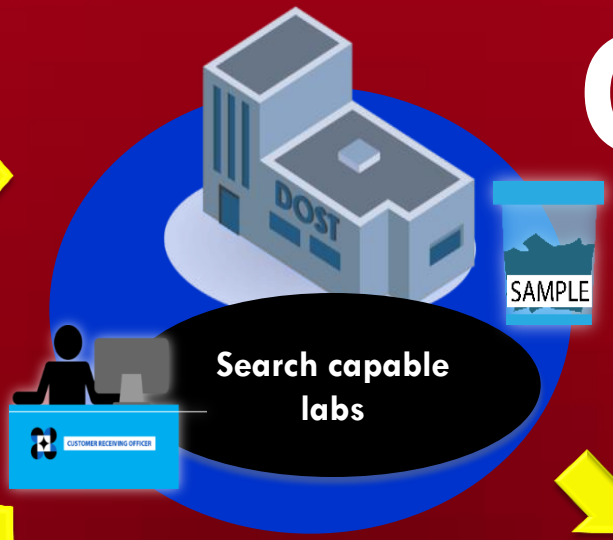
- Roll-out of **20% reduction** and **socialized rates (academe)** for testing services

CLIENTS



Objectives of test request: Quality Assurance, Materials Qualification, Reliability, Market Quality and Research

OneLab

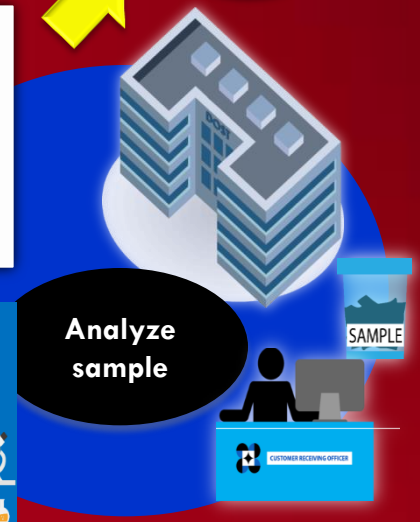


Receiving Laboratory

Refer Sample

Courier Services

Accept Sample



Testing Laboratory

Test Result

Sends Test Report

- *E-mail, Mail, Fax*
- *Download Test Result*
- *Claim Personally*

Come and visit us!

DOST-ITDI

NanoLab

Nanotechnology for every Juan

dmaTeL