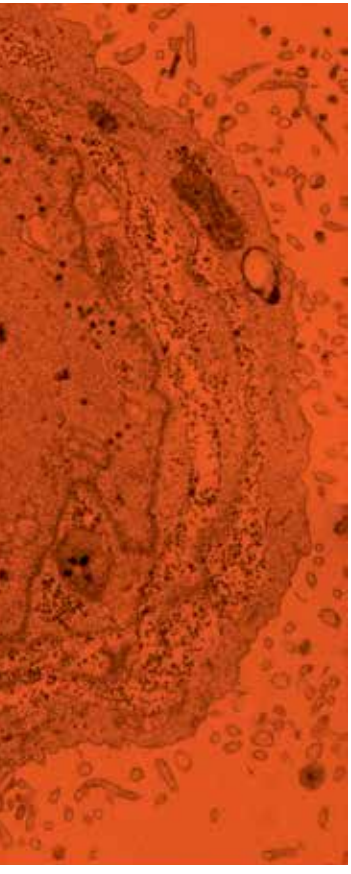
BINA
Bar-Ilan Institute
of Nanotechnology
& Advanced Materials



Bar-Ilan Institute of
Nanotechnology & Advanced Materials

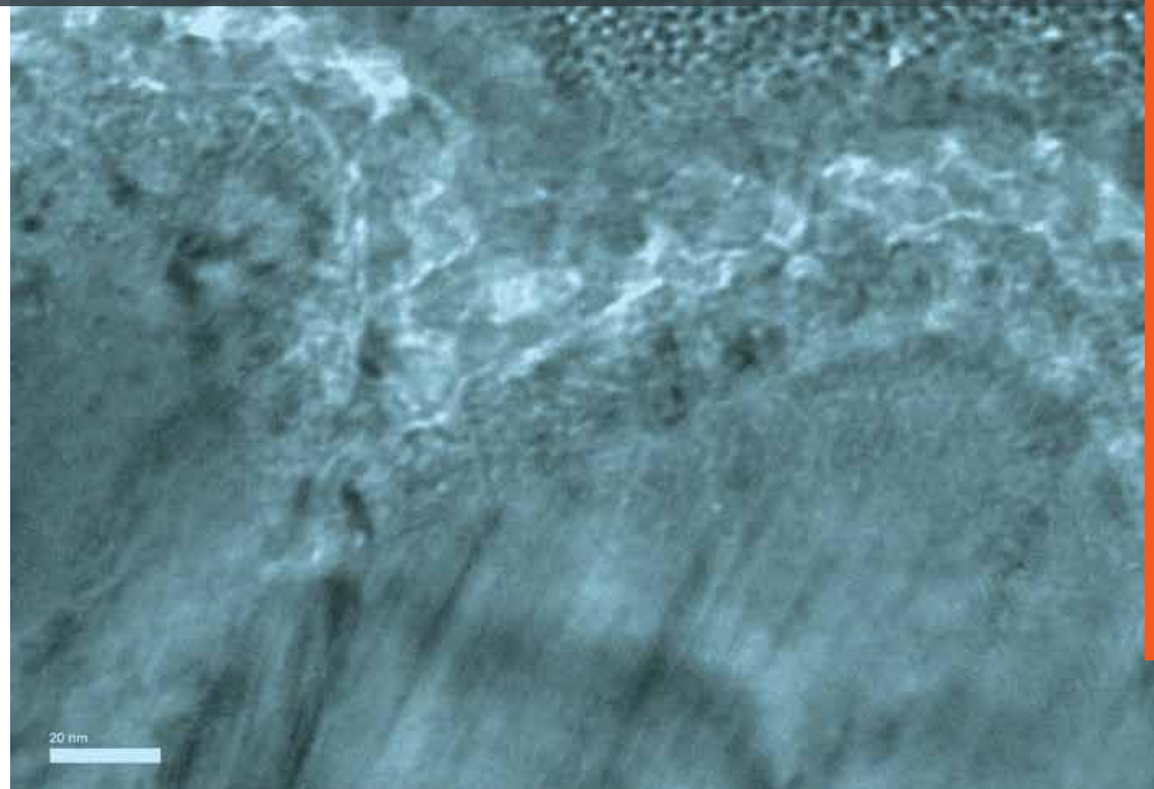
# Center for Scientific Instrumentation

# One facility

## for all your nano-research needs

# BINA Center for Scientific Instrumentation

World-class state-of-the-art laboratory facility provides all the essentials for scientists in the fields of **Nanoscience** and **Nanotechnology**




**Since 2008, BINA Center for Scientific Instrumentation has served scientists from academia and the industry, providing guidance, creative solutions, and sophisticated instrumentation, and reaching among the highest levels of scientific expertise Israel has to offer.**

**The Center, located conveniently in the City of Ramat Gan in the Tel Aviv District of Israel, is housed within a large nanotechnology complex with advanced labs and equipment that comply with the highest international standards of scientific performance.**

### Comprehensive range of services

- Consulting, analysis, sample preparation
- Sophisticated measurement capabilities
- Scientific support from start to finish
- Active participation in the experimental design process
- State-of-the-art instrumentation
- Optimal lab conditions
- Available for academia and industrial companies

### Scientific facilities

- Charged-Particle Microscopy
- Nano Fabrication
- Surface Analysis

### Staff

The Center is staffed with expert Ph.D.-level scientists who work closely with each research team, providing guidance on experimental design, optimal equipment operation, sample preparation, and analysis of results.

### Infrastructure

The infrastructure includes a vibration-free invariant zone, offering reliably stable laboratory conditions for all aspects of nanotechnology research.

# Gain invaluable input on your experiments

## Staff

**The personnel of the BINA Center for Scientific Instrumentation has extensive experience in the design and implementation of complex nanoscale analysis and fabrication.**

The staff, comprised predominantly of Ph.D.s in chemistry, physics, life sciences and engineering, is responsible for operating the equipment and interpreting results, in which they are highly skilled.

To achieve the best results possible, they work together as a team, designing experimental protocols, performing painstakingly precise measurements, and providing all the necessary scientific feedback. The team is readily available to guide researchers through the entire experimental process from start to finish, in order to guarantee the success of each project.

The staff works with each scientist to:

- Define experimental design protocols
- Determine measurement types and fabrication tools
- Advise on sample preparation and experimental conditions

# Facility

**The Leslie and Susan Gonda (Goldschmied) Nanotechnology Triplex, founded in 2009, is home to the BINA Center for Scientific Instrumentation - a modern complex dedicated entirely to nano-research. The range and quality of the Center's advanced instrumentation makes it a leading facility for nanotechnology research and development.**

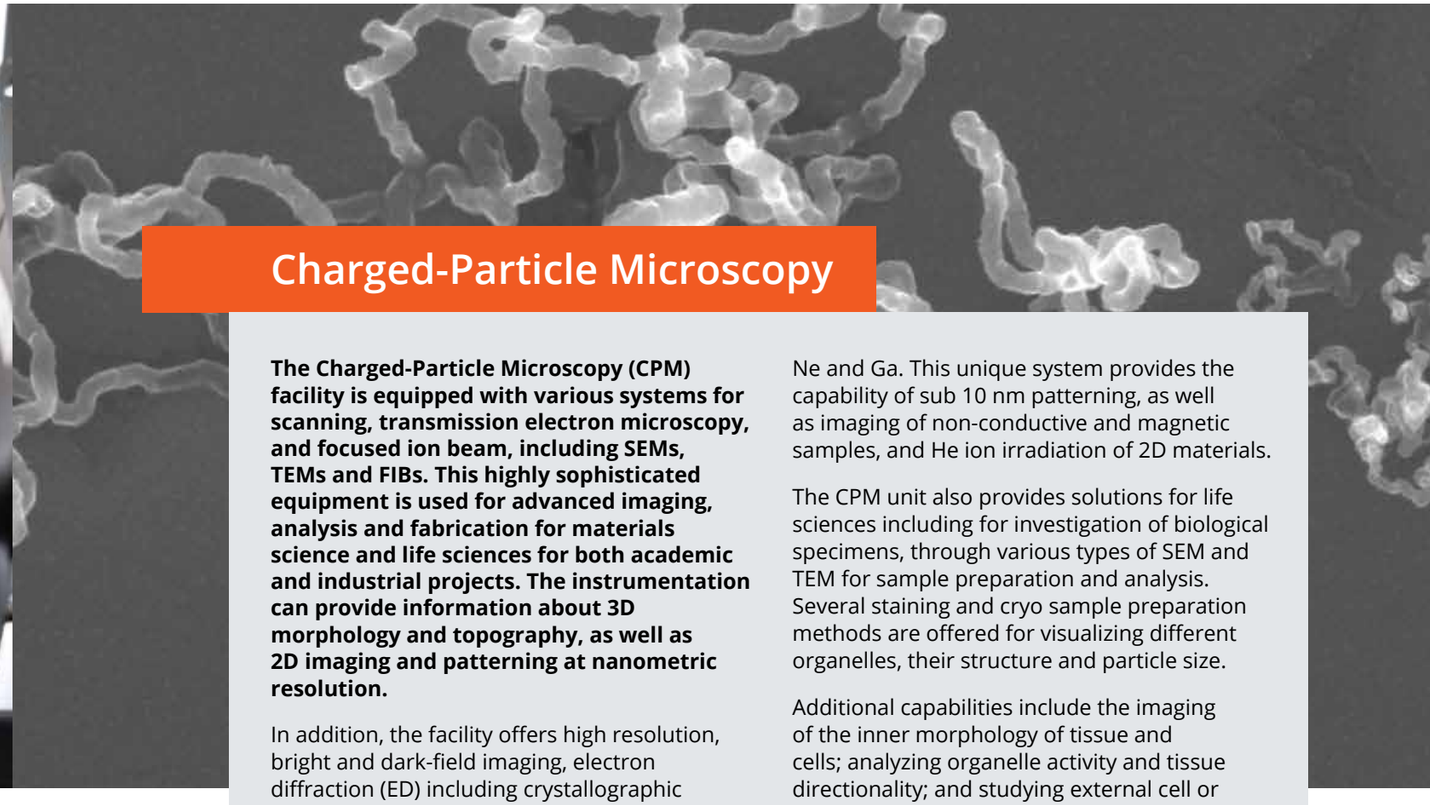
The complex includes the Aharon and Rachel Dahan Nanotechnology Invariant Zone – a 1,100 square meter state-of-the-art vibration-isolation lab facility. This carefully controlled environment, located in the basement and ground floor, is optimized for nanoscale precision instruments requiring total isolation from acoustic noise and vibrations. The invariant zone is uniquely engineered, utilizing a series of 20 square meter concrete slabs resting on air pockets, which keeps the structure free from environmental perturbations that could undermine sensitive experiments. This maximizes the stability of the equipment, and thus, the resolution of its output. An additional 250 square meter lab, suited for instruments that do not require such stringent stabilization, is housed on the fifth floor of the Nano Triplex.

**The Center comprises three main facilities:**

- **Charged-Particle Microscopy**
- **Nano-Fabrication**
- **Surface Analysis**

Each facility has its own scientific and technical staff dedicated to maximizing the performance and productivity of its equipment.


# World-class
## research instrumentation



# Charged-Particle Microscopy

**The Charged-Particle Microscopy (CPM) facility is equipped with various systems for scanning, transmission electron microscopy, and focused ion beam, including SEMs, TEMs and FIBs. This highly sophisticated equipment is used for advanced imaging, analysis and fabrication for materials science and life sciences for both academic and industrial projects. The instrumentation can provide information about 3D morphology and topography, as well as 2D imaging and patterning at nanometric resolution.**

In addition, the facility offers high resolution, bright and dark-field imaging, electron diffraction (ED) including crystallographic information, phase and structure identification, as well as determination of unit cell parameters and analytical capabilities using Energy Dispersive X-ray Spectrometry (EDS).

The Focused Ion Beam (FIB) unit includes a dual beam FIB-SEM system, in addition to the He FIB, which enables triple ion beam focus by combining three separate ion sources−He, Ne and Ga. This unique system provides the capability of sub 10 nm patterning, as well as imaging of non-conductive and magnetic samples, and He ion irradiation of 2D materials.

The CPM unit also provides solutions for life sciences including for investigation of biological specimens, through various types of SEM and TEM for sample preparation and analysis. Several staining and cryo sample preparation methods are offered for visualizing different organelles, their structure and particle size.

Additional capabilities include the imaging of the inner morphology of tissue and cells; analyzing organelle activity and tissue directionality; and studying external cell or tissue surface.

Both the scope and sophistication of its equipment have positioned the CPM facility as an invaluable resource for researchers of semiconductors, ultrafine-grained materials for thin films, 2D materials, solar cells and other fields that are based on nanotechnology, nano devices, and materials science.

## Charged-Particle Microscopy

### ESEM (Environmental Scanning Electron Microscope), FEI, Quanta

- Field Emission Gun (Schottky field emitter )
- High/low vacuum
- High vacuum with beam deceleration
- Extended vacuum mode (wet-ESEM)
- High and low temperature imaging in the range of -20°C - +1000°C
- Detectors : SE, BSED, vCD, EDS, STEM
- Resolution 1.2nm

### XHR-SEM (High Resolution Scanning Electron Microscope), FEI, Magellan 400L

- Field Emission Gun Schottky field emitter UC (UniColore)
- High vacuum
- Detectors: TLD, Vcd, SE, EDS, EBSD, STEM
- Resolution 0.6nm

### Cryo TEM (Transmission Electron Microscope), FEI, Tecnai™ G2, High Contrast

- Accelerating voltage 120kV
- Bottom CCD camera 1Kx1K
- Top CCD camera 1Kx1K
- Cryo TEM - direct-imaging at cryogenic temperatures
- Resolution 0.46 nm (Lattice resolution)

### TEM (Transmission Electron Microscope), JEOL 1400, Analytical TEM

- Accelerating voltage 120 kV
- Bottom CCD 2 X 2k camera
- Specimen tilt +/- 70°
- Detectors: BF/DF, STEM, EDS (UltraDry SDD)
- STEM image resolution 2.0nm
- Resolution 0.38 nm (point to point), 0.20 nm (lattice)

### HR-TEM (High Resolution Transmission Electron Microscope), JEOL, JEM-2100

- Accelerating Voltage 200kV
- Gatan USC 4000 4 X 4k camera
- Specimen tilt +/- 70°
- Double Tilt (+/- 45°) Vacuum Transfer Holder
- Detectors: BF/DF STEM, EDS, 3D Tomography
- Resolution 0.23 nm (point to point), 0.14 nm (lattice)

### FIB (Focused Ion Beam), FEI, Helios NanoLab

- Dual beam FIB
- TEM sample preparation
- Cross section
- Failure analysis
- Patterning
- Micro probing

### HIM (Orion NanoFab), Zeiss

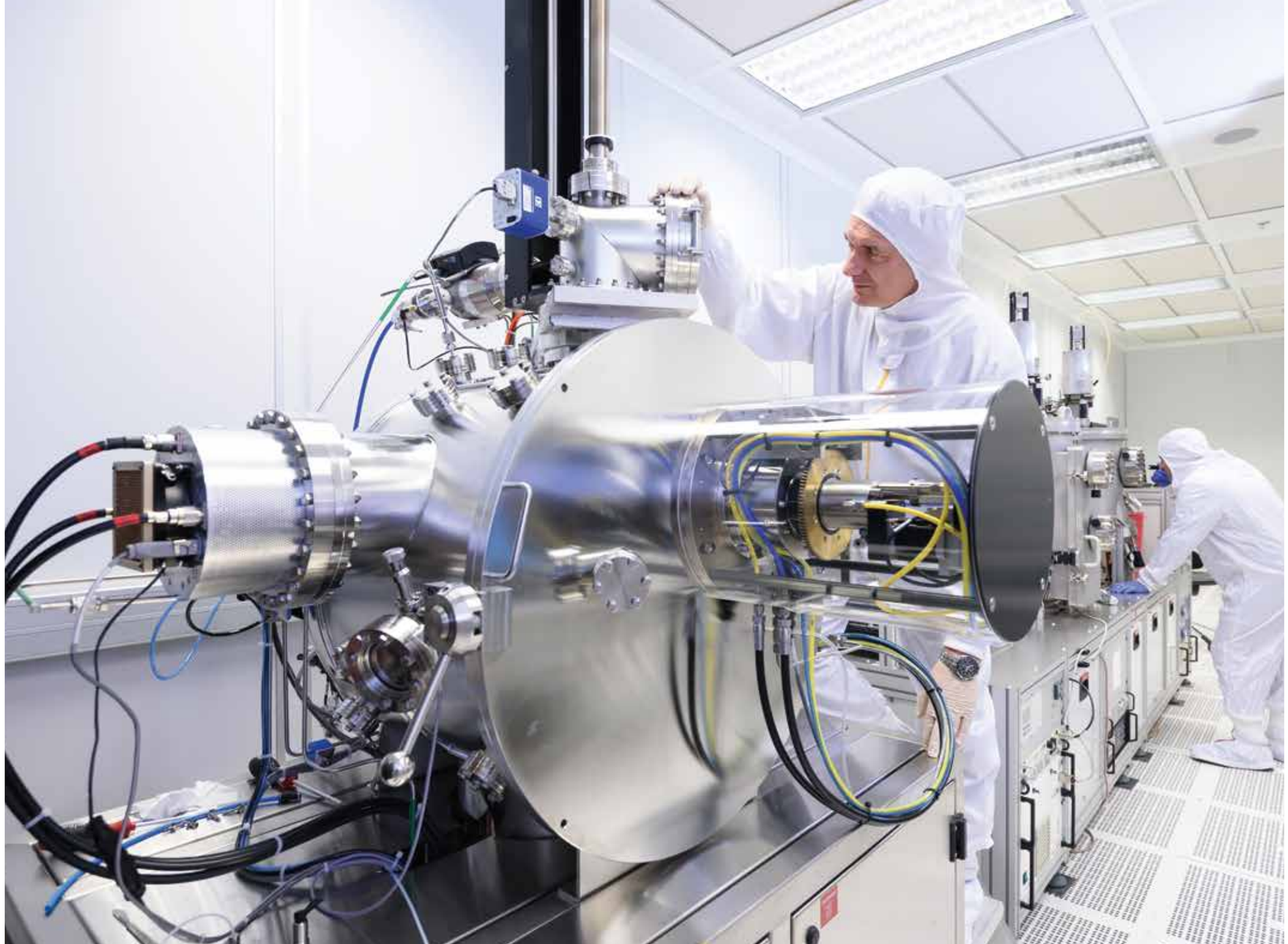
- Triple beam FIB (He+, Ne+, Ga+)
- Cross section
- TEM sample preparation (cleaning Ga contamination)
- Image resolution 0.4nm
- Writing resolution lines 4 nm, spots 2 nm
- Non-conductive/magnetic sample imaging
- He ion Irradiation of 2D materials

# Nano Fabrication

**The BINA Nano Fabrication Facility provides state-of-the-art tools for patterning and crafting nanoscale devices. These include Class 100 and Class 1000 clean rooms equipped for a variety of fabrication processes including e-Beam lithography, photolithography, and direct laser lithography.**

Additionally, there is a range of tools for PVD (Physical Vapor Deposition), ALD (Atomic Layer Deposition), wafer bonding and ICP-RIE (Reactive Ion Etch) capabilities. We also offer process analysis and packaging tools, such as optical and stylus profilers, XRF, ellipsometer and dicing saw.

In addition to operating the equipment, our professional staff provides ongoing support for a broad range of fabrication processes, and offers creative solutions and suggestions where needed.



### e-Beam Lithography, CRESTEC, CABL-9500C

- Acceleration voltage 50KeV
- Minimum beam diameter -2 nm
- Minimum line width -8 nm
- Stitching accuracy <10 nm
- 4” wafer sample holder

### Evaporation & Sputtering, Bestec, GMBH

- Sputtering chamber with 4 targets, 1 DC Source, 2 RF sources and Ion beam source for milling
- Evaporation chamber with 2 thermal sources (high and low temp) and 1 e-beam source with 4 crucibles and a thickness monitor
- Joined load lock chamber with sample caste for 6-sample holder up to 4” sample/wafer
- 4” wafer sample holder

### ALD – Atomic Layer Deposition, Cambridge, Fiji F200

- 6 precursor lines with heated sources
- Turbo pump with APC mechanism for high aspect ratio samples
- Load lock chamber
- 8” sample holder

### ICP/RIE – Reactive Ion etcher, Plasma-Therm, VERSALINE

- Semi-Automatic Load Lock for single wafer
- ICP-II source with 2.5KW/2MHz RF source
- Low temperature heat exchanger down to -40C
- 12 gas lines for chlorine and fluorine processes
- OES and laser Endpoint for process control

### MASKLESS LASER WRITER – Heidelberg MLA 150

- Exposure area 6” X 6”
- Minimum Feature size of 1um
- Diode laser light source of 8W at 405nm, and 2.8W at 375
- Speed: 4min 50 X 50 mm^2irrespective of fill factor

### IBS – Ion Beam Sputtering

- Up to 4” wafer
- 4 cm sputtering ion source
- 10 cm etching and assist ion source
- 4 different targets, 4” diameter

### Profilers

- Lext Olympus optical profiler
- Bruker Stylus profiler

# Surface Analysis

**BINA's Surface Analysis facility has an established reputation for overcoming complex challenges and solving intricate problems in materials science. The unit provides the means for analyzing polymers, metals, semiconductors, corrosion coatings, thin films, glass and metal-oxide ceramics.**

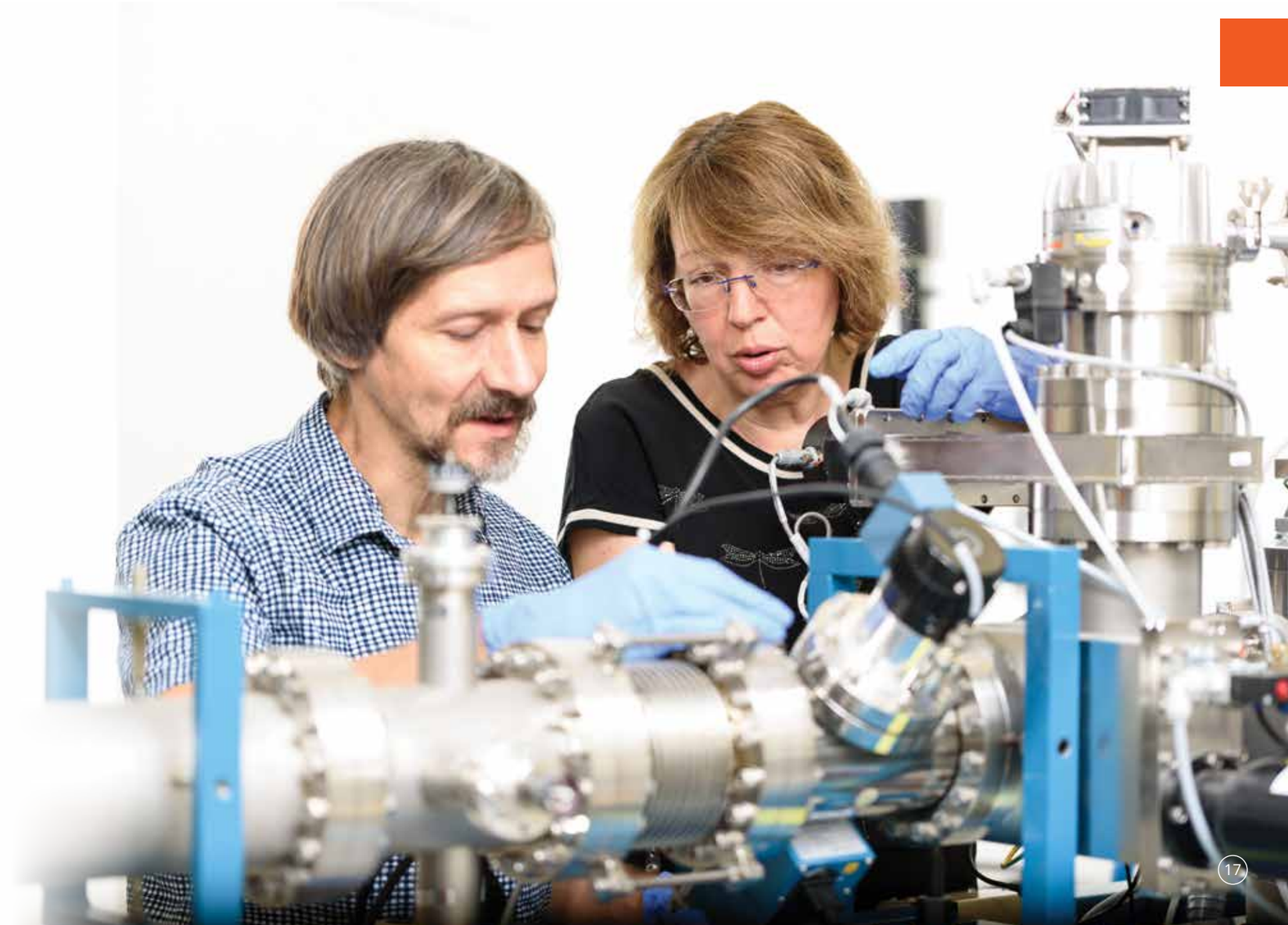
Its state-of-the-art instrumentation, combined with the team's extensive experience, high scientific level, and its expertise in data interpretation and materials knowledge, ensure the selection of the best combination of techniques for investigating diverse materials.

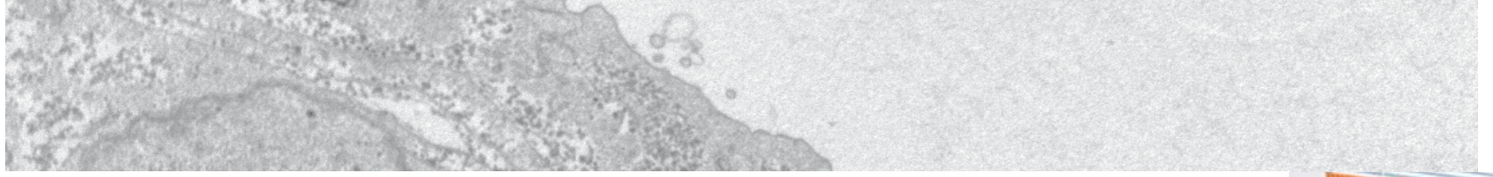
A variety of techniques are offered for measuring surface sensitivity, including, but not limited to, investigation of chemical composition of exposed atomic layers, atomic scale surface topography, electronic and mechanical surface properties, and nanoscale surface manipulation. These are achieved through product development, failure analysis, optimization of the synthesis and coating processes, identifying surface contaminants, verification of material composition and more.

The unit accommodates facilities for Scanning Probe Microscopy, Ion Beam Analysis and X-Ray Diffraction, and works closely with the BINA Charged-Particle Microscopy Unit and the Nano-Fabrication Unit.

The staff engages in a broad range of research projects, and tackles eagerly any scientific challenge, big or small, planned or unforeseen, offering creative solutions to achieve the best possible outcome that will benefit the project. The team members provide daily guidance and support, and are always available to respond to queries and specific needs.







## Surface Analysis

### AFM - Atomic Force Microscope, Bruker AXS, Nanoscope V Multimode STM/AFM

- Contact and Tapping modes AFM
- Magnetic Force Microscopy
- Electrostatic force microscopy and Surface potential AFM
- Scanning Spreading Resistance Microscopy
- TUNA (conductivity mapping)
- Electrochemistry
- Nano-indentation, nano-manipulation and HarmoniX
- Temperature control option (-30º – +100ºC)
- Capability for both ambient and liquid environments

### AFM - Atomic Force Microscope, Bruker AXS, ICON

- Contact and Tapping mode AFM
- Electrostatic Force Microscopy (EFM) and Surface Potential AFM
- Magnetic Force Microscopy (MFM)
- Nanomanipulation/nanoscratching and Peak Force QNM application
- Stage with full navigation for samples up to 8” in diameter and 12 mm thickness
- Measurement under inert atmosphere for sensitive samples

### AFM - Atomic Force Microscope, Bruker AXS, Bio FastScan

- Contact and Tapping mode AFM
- Nano-manipulation/nano-scratching and Peak Force QNM application
- Stage with full navigation for samples up to 8” in diameter and 12 mm thickness
- Simplified sample engaging and controls for immediate imaging
- Real-time panning, zooming and scanning
- Micro-volume fluid cell with controlled fluid exchange

### Ion Beam Analysis (IBA) Laboratory

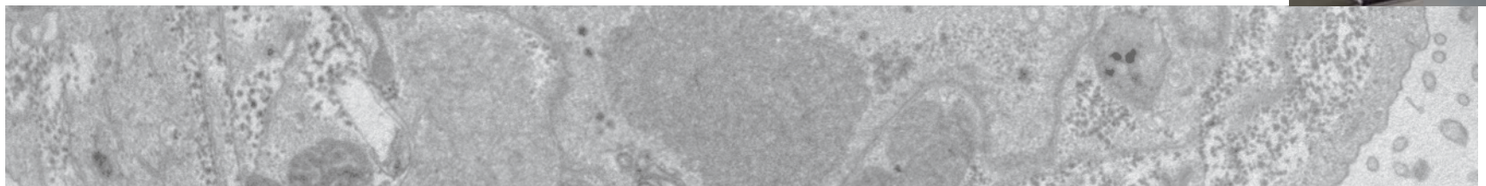
➤ 1.7 MV Tandem Pelletron, model 5SDH (NEC, USA) produces beams of protons or alpha particles at energies up to 3.4 MeV for protons or 5.1 MeV for alpha particles at currents up to 100 nA.

➤ Sample requirements:
Powder samples can be analyzed; both conducting and isolating samples can be analyzed; sample size from 10 mm X 10 mm up to 25 mm X 75 mm.

- **RBS (Rutherford Backscattering Spectroscopy):** Detail composition and thickness information from the top few micrometers of a sample; especially sensitive for heavy films on light substrates.
- **PIXE (Particle Induced X-Ray Emission)** Major element and trace element chemical analysis that is non-destructive and sensitive to heavy elements in a light matrix; minimum delectability is 100 ppm concentrations.
- **ERDA (Elastic Recoil Detection Analysis)** Quantitative concentration depth profiles for surface elements. Special ability to measure H and D content in thin films with detection limit ≥ 0.01%. Typical depth resolution is ~300-600Å.
- **NRA (Nuclear Reaction Analysis)** Measurements of light elements such as boron or fluorine, or isotopically labeled samples such as oxides enriched in 18O
- **Channeling**

### Rigaku SmartLab X-ray diffraction system (XRD)

- X-ray reflectivity measurements for thin film thickness, roughness and density determinations;
- Full pole figures and phi scans for crystallographic texture analysis
- High-resolution rocking curves for film and crystal quality measurements
- Grazing incident angle diffraction for polycrystalline thin film
- An in-plane scattering arm for collecting reciprocal space mapping (RSM), in-plane pole figures, and in-plane grazing incidence XRD scans
- Stress measurements
- Automated X-Y mapping of wafers

# About
# **Bar-Ilan University**

Bar-Ilan University is at the forefront of cutting-edge research. Its scientists are making breakthroughs that improve life around the globe in areas of drug development, nanotechnology, medical research, bioengineering, microscopy, optics, communication, energy, security, smart cities, cyber, quantum technologies and others.

As part of Israel's national program to prevent brain drain, BIU has taken the lead by absorbing dozens of experimental scientists, returning from top-ranking universities worldwide, within its world-class research infrastructure. In recent years, the University has constructed several state-of-the-art facilities for engineering, brain sciences, and nanotechnology to accommodate its numerous innovative research initiatives.

***Usage fees***

*Fees are determined per project, and vary depending on the type of instrument and the extent of support required.*



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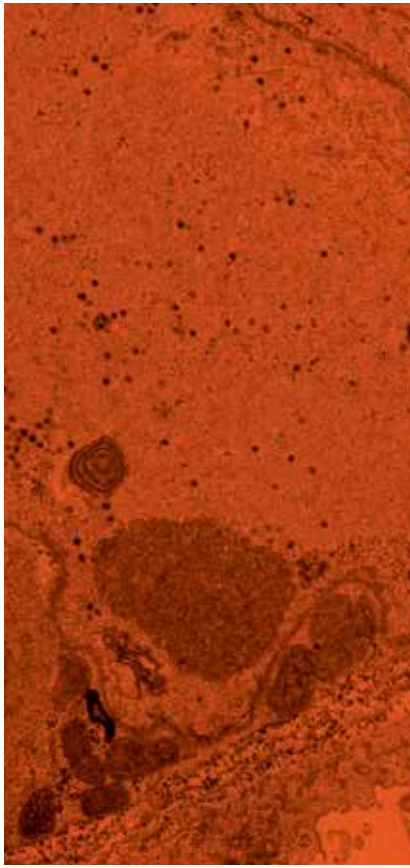

**Scientific images:**
Prof. Ronit Sarid's lab
Dr. Daniel Nessim's lab
Prof. David Zitoun's lab