



Helium Ion Microscope

EMSL's helium ion microscope is the first HIM to be offered at a national scientific user facility. It promises to advance biological, geochemical, biogeochemical, and surface/interface studies using its combined surface sensitivity and high-resolution microscopy functions. The HIM is equipped with a Rutherford Backscattering Spectrometry (RBS) capability that identifies atomic elements. In the future, the RBS capability will allow 3-D chemical analysis when paired with an improved spectrum detector.

Research Applications

Biological, geochemical, and biogeochemical samples – characterizing sample properties and behavior at nano and sub-atomic levels, including emerging novel materials with a range of scientific applications

Nanostructures of catalysts – understanding the relationship between the nature of nanostructure and chemical functionality

Energy – studying surface/interface characteristics to develop materials with novel functions, improved efficiency, and fewer pollutant byproducts

National security – developing ultrasensitive materials to detect and reduce biological and radioactive threats and chemical agents

Material modification – using a sub-nanometer He⁺ ion beam to modify and tailor material properties



Quick Specs

- ▶ Small Beam Size: < 0.1 nm
- ▶ High Resolution: ≤ 0.35 nm
- ▶ Magnification: 100–1,000,000
- ▶ Field of View: 1 mm–100 nm
- ▶ Large Depth of Field: > 10 mm
- ▶ RBS Spatial Resolution: ~10 nm
- ▶ Base Pressure:
 - 5.0×10^{-7} Torr (main chamber)
 - 3.75×10^{-5} Torr (sample introduction load-lock chamber)
- ▶ No Conductive Coatings Necessary
- ▶ High Surface Sensitivity
- ▶ High Image Contrast
- ▶ Low-Z Imaging
- ▶ Backscattered Ion Imaging
- ▶ Manufacturer: Carl Zeiss SMT AG

EMSL's HIM Offers:

Ultra-high resolution – reveals fine structure details and allows chemical visualization of nanostructures and biological samples, including those with low-Z elements

RBS – identifies atomic elements and determines material composition using a sub-nanometer He⁺ ion probe

Charge neutralization – uses an electron flood gun to neutralize charge for insulating samples based on line or frame scans

Small beam size – provides stable beam energy and current over a period of time using one of 24 selectable apertures measuring 5, 10, or 20 μm in diameter

Novel features – offers EMSL users an additional 4.5-inch center port and two 2.75-inch ports for other characterization capabilities.



To learn more about HIM and how it is being applied to EMSL users' research, see: <http://www.emsl.pnl.gov/capabilities/viewInstrument.jsp?id=34104>.

EMSL, a national scientific user facility, provides free instrument access for open-source research. Learn how to become a user and about upcoming proposal calls at <http://www.emsl.pnl.gov/access/calls/>.

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