

# Microscopy and Characterization Suite

CENTER FOR ADVANCED ENERGY STUDIES

## Microscopy and Characterization Suite (MaCS)

Understanding the complex nature of materials has always been one of the great challenges of science, but in the world of energy it is critical to improving the safety and operating efficiency of everything from nuclear power plants to automobiles to medical imaging. Microscopy and Characterization Suite (MaCS) at the Center for Advanced Energy Studies (CAES) offers researchers top-of-the-line microscopy and analysis equipment for delving into radiological and nonradiological materials at the atomic level.

### Unique Capabilities

MaCS contains several high-end pieces of equipment. These include:

- **Two Scanning Transmission Electron Microscopes (STEM)** *ThermoFisher Spectra 300 - monochromated, double-corrected, 30 - 300kV and Tecnai TF30-FEG* – Images materials structurally and chemically down to sub-Angstrom scale. Equipped with HAADF, EDS, EELS, EFTEM, Electron Tomography, ASTAR/TopSpin, PicoIndenter, Heating Stage, etc.
- **Local Electrode Atom Probe (LEAP)** *(LEAP 4000X HR, CAMECA Instruments)* – Creates atom-by-atom maps and images 3-D construction of up to hundreds of millions of atoms.
- **Dual Focused Ion Beam (Quanta 3D FEG, FEI)** – High-resolution, high-vacuum dual-beam SEM/FIB for 2-D and 3-D material characterization and analysis. Equipped with EDS, EBSD and STEM detector.
- **Scanning Electron Microscope (SEM)** *(JSM-6610LV, JEOL)* – Images material surfaces ranging from micrometer to nanometer scale under high-vacuum and low-vacuum environment. Equipped with EDS, EBSD and CL.
- **NanoIndenter/Atomic Force Microscope (NIAFM)** *(TI-950 Triboindenter, Hysitron)* – Nanomechanical test instrument for measuring the hardness and elastic modulus of materials, and imaging surface morphology down to atomic scale.
- **X-Ray Diffractometer (SmartLab, Rigaku)** – Includes standard and parallel beam for use with thin films, powders, nanomaterials.
- **NanoMill (Model 1040, Fischione)** – Low-energy, low-angle argon ion milling instrument used for preparing ultra-thin, high-quality transmission electron microscopy (TEM) specimens.
- **Microhardness Tester (LM247AT, LECO)** – Measures and evaluates microhardness of materials.



*Getting a specimen ready for the Nano Indenter Atomic Force Microscope.*

## Types of Analysis That Can Be Done In MaCS

MaCS has the capabilities to characterize a wide range of materials, including metals, semiconductors, ceramics, coal and minerals in bulk or powder forms, as well as some organic cellular materials. It can provide 2-D/3-D morphology, chemical information, and mechanical testing data from micron to atomic scale.

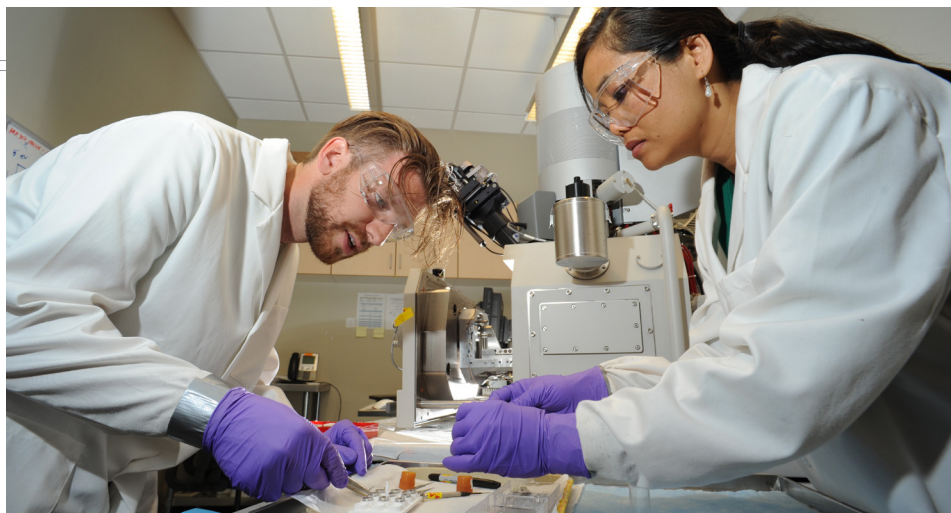
## How to Access MaCS

MaCS has established hourly rates for customers and a staff that can provide full-service work. It also offers customers the option to operate equipment. Researchers can also access MaCS by proposing a Rapid Turnaround Experiment through Idaho National Laboratory's Nuclear Science User Facilities (NSUF). To learn more, go to <http://atrnsof.inl.gov>.

## Who uses MaCS?

MaCS provides the organization and infrastructure to make materials characterization capabilities available to research, academia and industry. Academic institutions from all parts of the country regularly use the laboratory. National laboratories and many different industrial customers, in fields ranging from microchips, medical isotopes and commercial steels, have also been users.

Research includes analysis of nuclear fuels and materials, geological samples, feedstocks for biofuels, stainless steel alloys, ceramics and more.



*Researchers prepare specimens for examination under the Focused Ion Beam in the MaCS Lab at CAES.*

## About CAES

*CAES is a research, education, and innovation consortium consisting of Idaho National Laboratory, Boise State University, Idaho State University, and University of Idaho that provides research capabilities, energy-related educational opportunities, and industry assistance to fuel economic growth.*

## FOR MORE INFO

**Dr. Yaqiao Wu**  
MaCS Director/  
Lab Lead  
(208) 533-8112  
[yaqiaowu@boisestate.edu](mailto:yaqiaowu@boisestate.edu)

**Jeremy Burgener**  
Business and  
Operations Manager  
(208) 533-8161  
[jeremyburgener@boisestate.edu](mailto:jeremyburgener@boisestate.edu)

**Matthew Evans**  
Communications  
(208) 526-6225  
[matthew.evans@inl.gov](mailto:matthew.evans@inl.gov)

