William R. Wiley
EMSL
Environmental Molecular Sciences Laboratory

The W.R. Wiley Environmental Molecular Sciences Laboratory, a national scientific user facility at Pacific Northwest National Laboratory, provides integrated experimental and computational resources for discovery and technological innovation in the environmental molecular sciences to support the needs of the U.S. Department of Energy and the nation.

Through its mission, EMSL staff and capabilities enable multidisciplinary approaches to complex scientific problems and provide a climate for advancement and education in the molecular and computational sciences. The user facility offers the research community, at one location, a comprehensive array of leading-edge resources available to users on a peer-reviewed proposal basis.

To submit a proposal for use of EMSL or to learn more about the science conducted at EMSL and the instruments and expertise available to users, visit http://www.emsl.pnl.gov. If you have any questions, please contact EMSL User Services at emsl@pnl.gov.

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The W.R. Wiley Environmental Molecular Sciences Laboratory (EMSL) is a U.S. Department of Energy (DOE) national scientific user facility located at Pacific Northwest National Laboratory (PNNL) in Richland, Washington. EMSL is operated by PNNL for the DOE Office of Biological and Environmental Research.

Pacific Northwest National Laboratory
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Office of Science
U.S. DEPARTMENT OF ENERGY

Interfacial and Nanoscale Science Facility

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Interfacial and Nanoscale Science Facility

The Environmental Molecular Sciences Laboratory's Interfacial and Nanoscale Science Facility (I&NSF) offers researchers worldwide a unique combination of surface and bulk-sensitive capabilities to study interfacial and thin film phenomena, with an emphasis on oxide and mineral research. I&NSF allows users to focus research on films and interfaces; surface chemistry and catalysis; material interfaces; as well as microsensors, microfluidics, and new biotechnologies. Through these studies, users can address national needs in environmental health and restoration, waste management, pollution prevention, energy production and storage, as well as national and homeland security. In 2007, a five-year process to upgrade and refresh some capabilities was initiated.

Surface Analysis Suite

provides users with high-resolution surface and interface science capabilities, including X-ray photoelectron spectroscopy (XPS), ultraviolet photoelectron spectroscopy, Auger electron spectroscopy (AES), and time-of-flight secondary ion mass spectrometry (TOF-SIMS). Side chambers with limited deposition, catalytic processing, and electrochemical capabilities can be used in combination with these instruments for users' research. C60 sputtering capabilities for analysis of organic materials by XPS and TOF-SIMS are being added in 2007.

Electron Microscopy Suite

currently consists of a LEO 982 field-emission scanning electron microscope (SEM), a high-resolution transmission electron microscope (TEM), and another TEM dedicated to frozen sample and biological work. A state-of-the-art focused ion beam/SEM and aberration-corrected TEM with an environmental cell and a monochromator will be available for users late 2007 and 2008, respectively.

Transmission electron microscope

Thin Film Deposition Capabilities

include oxygen plasma-assisted molecular beam epitaxy systems capable of growing high-quality, uniform, complex oxide thin films with abrupt interfaces; a metal organic chemical vapor deposition system specially designed for epitaxial growth of oxide thin films; and a pulsed laser deposition system.

Ion Beam Laboratory

allows users to perform material modification and analysis using high-energy ion beams. Ion beam analysis capabilities include Rutherford backscattering spectrometry/channeling, nuclear reaction analysis, heavy and light ion elastic recoil detection analysis, and proton-induced X-ray emission. Micro-beam capabilities with a beam size of approximately 10-20 μm are also available for environmental analyses of atmospheric samples on approximately 180-mm long filters and for biological material characterization.

Ion Beam Laboratory

Surface Chemistry and Catalysis Laboratories

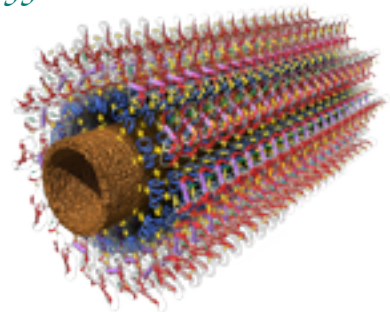
house several systems designed to allow users to perform molecular-level chemistry studies of adsorbates on metal and metal-oxide surfaces, including a combined ultrahigh vacuum (UHV) surface analysis system with an elevated pressure reaction chamber that allows work on surface chemistry/catalysis problems; another UHV system with high-resolution electron energy loss spectroscopy, secondary ion mass spectrometry, temperature program desorption, and molecular dosing capabilities; and an *in situ* high-pressure system for steady state isotopic transient kinetic analysis.

Scanning Probe Laboratory

provides users access to vacuum, solution, and ambient environment scanning probe microscopy. A variable-temperature UHV non-contact atomic force microscope/scanning tunneling microscope is integrated into a surface studies system for single-site photochemistry, catalysis, and oxygen plasma assisted-molecular beam epitaxy-based nanomaterials synthesis. Capabilities in the vacuum instrument include XPS, AES, and plasma-source materials deposition. Also available is a Digital instrument multimode scanning probe microscope, which can be operated in air or liquid environments.

Nanobiotechnology and Sensor Capabilities

include tools users can apply to synthesize and characterize functionalized nanostructured materials, single-enzyme nanoparticles, and chemical and biological sensors as well as tools to research and develop microstructures, microsensors, and microanalytical systems.



Functionalized carbon nanotube-based sensor

Other Capabilities

include a clean room with several tools for thin film deposition, thermal treatment, micro-photolithography, chemical etching, inspection and characterization, bonding and packaging, and testing and measurement. I&NSF also houses an X-ray diffraction facility with general purpose and special applications systems.