EMSL

THE ENVIRONMENTAL MOLECULAR SCIENCES LABORATORY

Scientific innovation through integration

EMSL, the Environmental Molecular Sciences Laboratory, is a U.S. Department of Energy (DOE) Office of Science user facility supported by the DOE Office of Biological and Environmental Research (BER). EMSL provides a problem-solving environment where research teams or individual investigators can use multiple types of premier instruments and high-performance scientific computing to investigate fundamental processes from the molecular-scale to the meso-scale, and from nanoseconds to days.

With a mission to lead molecular-level discoveries that translate to predictive understanding, EMSL enables users to investigate and accelerate solutions to national energy and environmental challenges. Specifically, EMSL helps researchers better understand molecular complexity inherent to many atmospheric, biological, catalytic and terrestrial systems. For example, EMSL's novel discoveries and technical advances have led to new approaches to clean up contaminants and to predict their movement, more efficient catalysts and energy storage devices, identification of efficient pathways for biofuel production, visualizations of molecular reactions in living cells, advances in understanding disease processes, and revelations regarding the diversity of atmospheric particles and their interactions.

EMSL Facts – *FY 2016*

644	Users worldwide
459	Peer-reviewed scientific publications using EMSL resources
317	Active projects
175+	Scientific instruments, including high-performance computer
$42M	Budget from DOE BER
234k	Square footage research facilities

For more information about EMSL: **www.emsl.pnnl.gov**

EMSL helps users from academia, government labs, research institutes and industry across the U.S. and around the world solve scientific problems. Researchers access resources at EMSL via an open, peer-reviewed proposal process. Moreover, EMSL collaborates with other BER user facilities to issue joint proposal calls to the scientific community to support scientific breakthroughs that are not possible by using capabilities at a single user facility. Located in Richland, Washington, EMSL is managed by Pacific Northwest National Laboratory.

Research at EMSL supports BER's mission to understand the biological, biogeochemical and physical principles needed to predict a continuum of processes occurring at the molecular and genomics-controlled smallest scales to environmental and Earth system change at the largest scales. EMSL focuses user projects in the following areas of science most critical to understanding larger-scale processes of interest to BER and DOE:

Atmospheric Aerosol Systems

Molecular-scale understanding of key chemical and physical properties of aerosols to improve the prediction of atmospheric system models

Biosystem Dynamics and Design

Understanding and optimizing biological pathways in plants and microbes central to biofuel production and the global carbon cycle

Molecular Transformations

Understanding the molecular transformations in biology and chemistry central to sustainable energy production, conversion and storage

Terrestrial and Subsurface Ecosystems

Understanding the dynamics of nutrients, metabolites and contaminants at biogeochemical interfaces to improve their representation in Earth system models

Pacific Northwest NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

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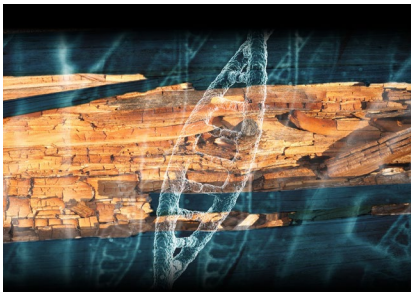
Selected EMSL Research and Capability Highlights

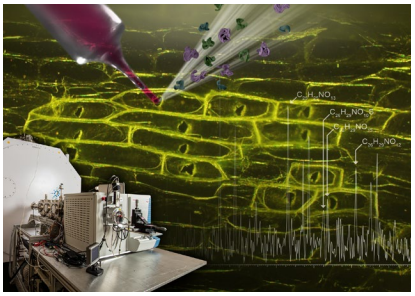


Brown Rot Fungi Efficiently Degrades Wood

Discovery of a two-step mechanism to degrade plant cell walls could lead to highly efficient and cost-effective strategies for renewable energy production. (*Proceedings of the National Academy of Sciences USA*, Sept. 27, 2016)

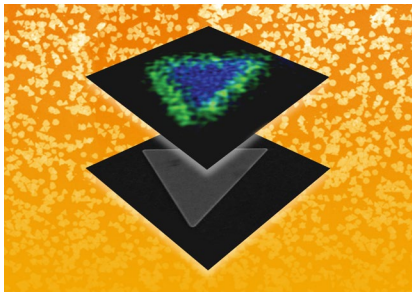
How Wetlands Naturally Clean Up Contaminants

A new perspective on geochemical processes shows iron oxide nanoparticles enriched near wetland plants roots bind natural organic matter to immobilize uranium and possibly other contaminants. (*Science of the Total Environment*, Nov. 1, 2016)



Unraveling Molecular Complexity of Natural Systems

A recent study demonstrated enormous potential for scientists to explore extremely complex molecular mixtures and systems frequently encountered in environmental, biological, atmospheric and energy research using the 21 Tesla Fourier transform ion cyclotron resonance mass spectrometer at EMSL. (*Journal of the American Society for Mass Spectrometry*, Oct. 12, 2016)



Light Strikes Gold to Create Better Catalysts

Gold nanocrystals are industrial catalysts widely used in diagnostic assays and therapeutics. A recent study revealed a photochemical strategy that enables synthesis of gold nanocrystals with desirable properties for specific industrial and medical applications. (*Nature Materials*, July 4, 2016)

For more EMSL science highlights:
www.emsl.pnl.gov/emslweb/science-highlights

EMSL Capabilities

EMSL's technical capabilities include unique suites of instrumentation such as high-resolution mass spectrometers; a wide variety of microscopes for static and dynamic imaging; a full range of nuclear magnetic resonance spectrometers; atomic-scale chemical and structural characterization instruments; single cell, microbial community, and plant growth and characterization chambers; and production high-performance computing (HPC) and optimized computational codes for molecular to continuum-scale modeling and simulation.

Cascade high-performance computer

21 Tesla FTICR mass spectrometer

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