Radiochemistry Annex

A collaborative atmosphere of international users and EMSL scientists from different disciplines fosters an environment where research strategies and approaches benefit from a variety of perspectives.

The new Radiochemistry Annex at EMSL is designed to accelerate scientific discovery and the understanding of the fate of radionuclides in the environment.

The caliber of research, instruments, and access to EMSL staff scientists at this modern laboratory is expected to draw top radiochemistry scientists from around the world. The combination of a radiochemistry user facility with access to a full suite of state-of-the-art instrumentation co-located in one facility is unique in the United States, and it is one of just a few such facilities worldwide.

Instruments at this laboratory are ideally designed for the study of contaminated environmental materials and examination of radionuclides and chemical signatures. The Radiochemistry Annex offers nuclear magnetic resonance (NMR) capabilities and surface science capabilities, such as X-ray photo emission spectrometers, electron microscopy, electron microprobe (EMP), transmission electron microscopy, scanning electron microscopy, and more.

The Radiochemistry Annex will be an environment where multiple experimental approaches are encouraged. Investigating problems at an integrated, cross-disciplinary level encourages holistic understanding, which ultimately provides policy makers the information they need to make sound remediation choices.

The Department of Energy's (DOE) Office of Science is investing in EMSL. The $4.5 million facility is funded programmatically through DOE's Office of Biological and Environmental Research. Scientific instrumentation, meanwhile, is funded with $6 million in ARRA funds and through relocation of existing EMSL instruments.

The Radiochemistry Annex is set to fully open to the global user community in Fall 2012. Before then, selected new radiological capabilities will become available to users beginning in August 2011.

About EMSL

EMSL, a Department of Energy national scientific user facility located 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 DOE and the nation.

EMSL's distinctive focus on integrating computational and experimental capabilities, as well as collaborating among disciplines, yields a strong, synergistic scientific environment. Bringing together experts and an unparalleled collection of state-of-the-art instruments under one roof, EMSL has helped thousands of researchers use a multidisciplinary, collaborative approach to solve some of the most important and complex national scientific challenges in energy and environmental sciences.

To learn more about EMSL, the science conducted at EMSL, as well as the instruments and expertise available to users, visit www.emsl.pnl.gov.

Become an EMSL User

Researchers are invited to access the world-class capabilities and collaborate with the internationally recognized experts at EMSL via its peer-reviewed proposal process. To submit a proposal, follow the five-steps outlined on the EMSL website (www.emsl.pnl.gov) under User Access. Current and potential EMSL users are encouraged to respond to Calls for Proposals, which are announced each spring. However, unique research proposals that fall outside the Calls for Proposal focus may be submitted at any time.

Applicants are encouraged to submit proposals for use of EMSL's capabilities in combination with each other with an emphasis on integrating computational and experimental instruments. In general, users whose open research proposals are accepted may use EMSL resources free of charge. Open research is loosely defined as science and engineering research for which the resulting information is published and shared broadly within the scientific community.

Contact EMSL

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U.S. DEPARTMENT OF ENERGY

EMSL

Scientific Innovation
Through Integration

Opening 2012

EMSL Radiochemistry Annex

One-of-a-Kind Suite of Radiochemistry Capabilities

PNNL-SA-76713

December 2010

www.emsl.pnl.gov

State-of-the-Art Instruments, Unique Capabilities

Sample Receiving and Preparation/Analytical Chemistry Laboratory

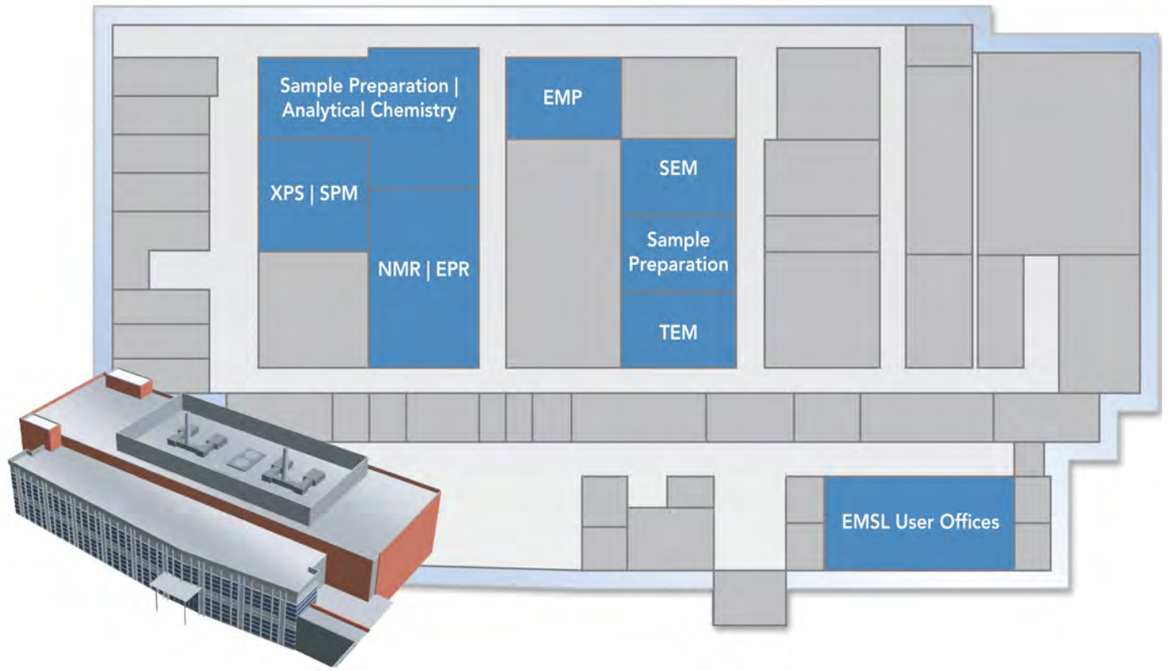
Analytical instruments for measuring chemical concentration and speciation and facilities for the preparation of both liquid and solid radiological samples for further analysis; instruments include:

- Four dual-station environmental chambers
- UV-Vis-NIR spectrophotometer
- ICP-MS
- KPA, uranium analyzer
- Liquid scintillation counter
- Micro X-ray diffractometer
- Carbon analyzer

NMR and EPR Laboratory

Chemical speciation of the contaminants in solution or solid phase; determination of the coordinating ions or complexes; instruments include:

- Bruker ESP 300E CW with X, S, Q-band
- Bruker 750-MHz 89-mm wide-bore NMR
- Magnex 100-MHz 130-mm ultra-wide-bore NMR
- Quantum MPMS XL Squid



TEM Laboratory

Atomic resolution of biogeochemical spatial associations and mineral identification; oxidation state determination; instruments include:

- JEOL 2010 FE with Gatan EELS

SEM Laboratory

Spatial associations of mineral grains, location of the contaminant within minerals, along fractures, or within the pore space between adjacent minerals; preparation of samples for TEM analysis; instruments include:

- BIB/SEM – FEI Quanta 3D FEG
- SEM – JEOL 7600F

EMP Laboratory

Spatially resolved mineral identification, associations and elemental composition; instruments include:

- JEOL JXA-8530F microanalyzer

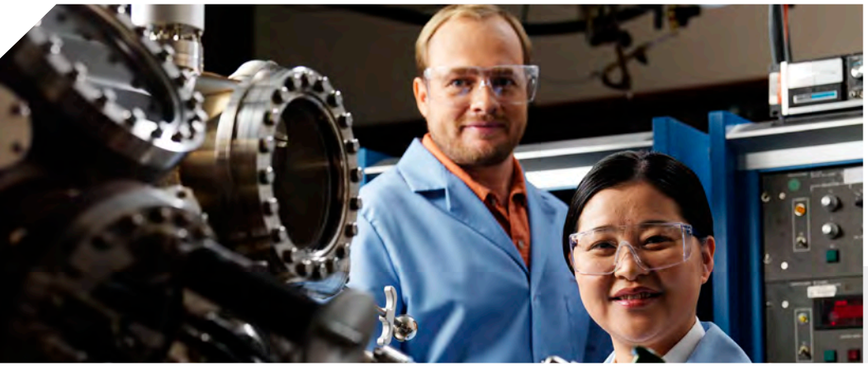
XPS and SPM Laboratory

Surface sensitive elemental and oxidation state determinations; instruments include:

- Kratos Axis 165/Ultra with attached environmental chamber
- DI Nanoscope IV AFM

Electron Microscopy Sample Preparation Laboratory

Advanced sample preparation equipment for SEM and TEM analysis, including microtomes, ion mills, sputter coater, carbon coater, and polishers



Demonstrating Indirect Microbial Bioreduction and Biomineralization

In the ground beneath our feet, bioreduction affects the ability of iron oxide to trap contaminants from surrounding materials. It occurs either by direct microbe-to-iron oxide contact or by indirect mechanisms involving soluble biogenic reactants. Simulating real-world conditions, a team of EMSL users developed a system that allows the study of indirect bioreduction. The team devised a new model system that mimics the real world where iron oxides are commonly embedded in subsurface microfractures. The team simulated these conditions by mixing a solution of iron oxide nanoparticles with highly porous silica grains. When microorganisms were introduced, bioreduction was encouraged in oxygen-free conditions. With ideal conditions established, the team developed techniques to preserve the samples for X-ray diffraction and scanning and transmission electron microscopy. This analysis answered questions about shape and mineral composition of iron precipitates and the proximity of the microbes. This research provides a greater understanding of redox transformations of iron(III) hydroxides, which influence the fate of pollutants and nutrients in certain soils, sediments, and subsurface materials.

EMSL Users: Pacific Northwest National Laboratory

Reference: Peretyazhko et al. 2010. Geochimica et Cosmochimica Acta 74(13):3751-3767.