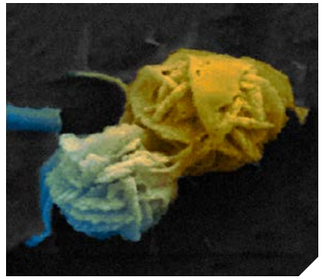
EMSL Quiet Wing Science

Lack of Iron

The release of wastes associated with nuclear reprocessing from storage facilities into the underlying sediments and groundwater is an important environmental concern at the Hanford Site. An international team of scientists conducted a study that used EMSL capabilities showed iron-bearing minerals that are naturally abundant in sediment can react with and immobilize contaminants such as technetium. The findings have implications for the Hanford Site and other remediation efforts.

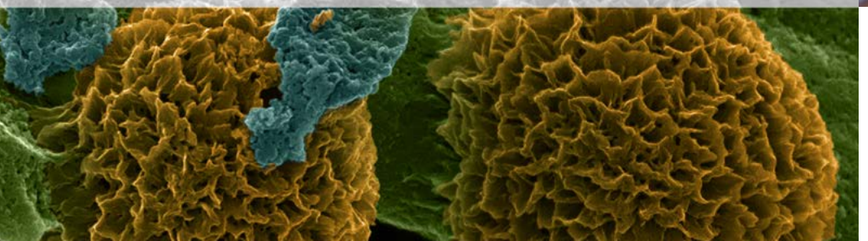
Reference: Pearce C, J Liu, D Baer, O Qafoku, S Heald, E Arenholz, A Grosz, J McKinley, C Resch, M Bowden, M Engelhard and K Rosso. 2014. "Characterization of natural titanomagnetites ($Fe3_{-x}Ti_xO_4$) for studying heterogeneous electron transfer to Tc(VII) in the Hanford subsurface." *Geochimica et Cosmochimica Acta*. DOI: 10.1016/j.gca.2013.12.010.

Chromium Detoxification



Hexavalent chromium is a major environmental contaminant. Researchers using ultra-sensitive microscopy and spectroscopy instruments in the Quiet Wing were able to better understand how bacteria reduce ferric iron in clay minerals, resulting in ferrous iron that could then immobilize and detoxify chromium. This strategy could potentially enable long-term remediation of heavy metal-contaminated sediments and groundwater aquifers worldwide.

Reference: Bishop, M, P Glasser, H Dong, B Arey and L Kovarik. 2014. "Reduction and immobilization of hexavalent chromium by microbially reduced Fe-bearing clay minerals." *Geochimica et Cosmochimica Acta*. 133, DOI: 10.1016/j.gca.2014.02.040.



About EMSL

EMSL is a Department of Energy national scientific user facility located at Pacific Northwest National Laboratory in Richland, Wash. EMSL 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.

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

Become an EMSL User

EMSL invites researchers to access the world-class capabilities and collaborate with the internationally recognized experts through its peer-reviewed proposal process. More information about becoming an EMSL user is available at www.emsl.pnnl.gov.

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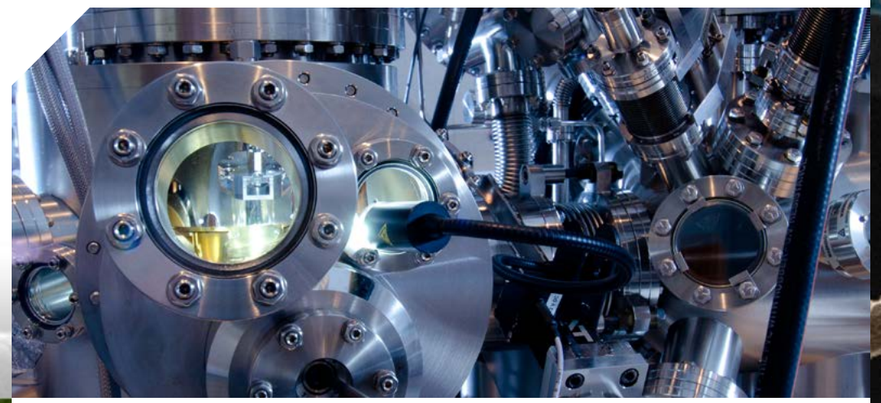

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EMSL

EMSL QUIET WING

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www.emsl.pnnl.gov

SCIENTIFIC INNOVATION THROUGH INTEGRATION

EMSL Quiet Wing

A specialized environment for the study of atmospheric, biological, environmental, biogeochemical, surface and material sciences

EMSL's Quiet Wing is among the most advanced quiet laboratories in the world. It was designed to help accelerate critical science by allowing state-of-the-art ultrasensitive microscopy equipment to operate at optimal resolution.

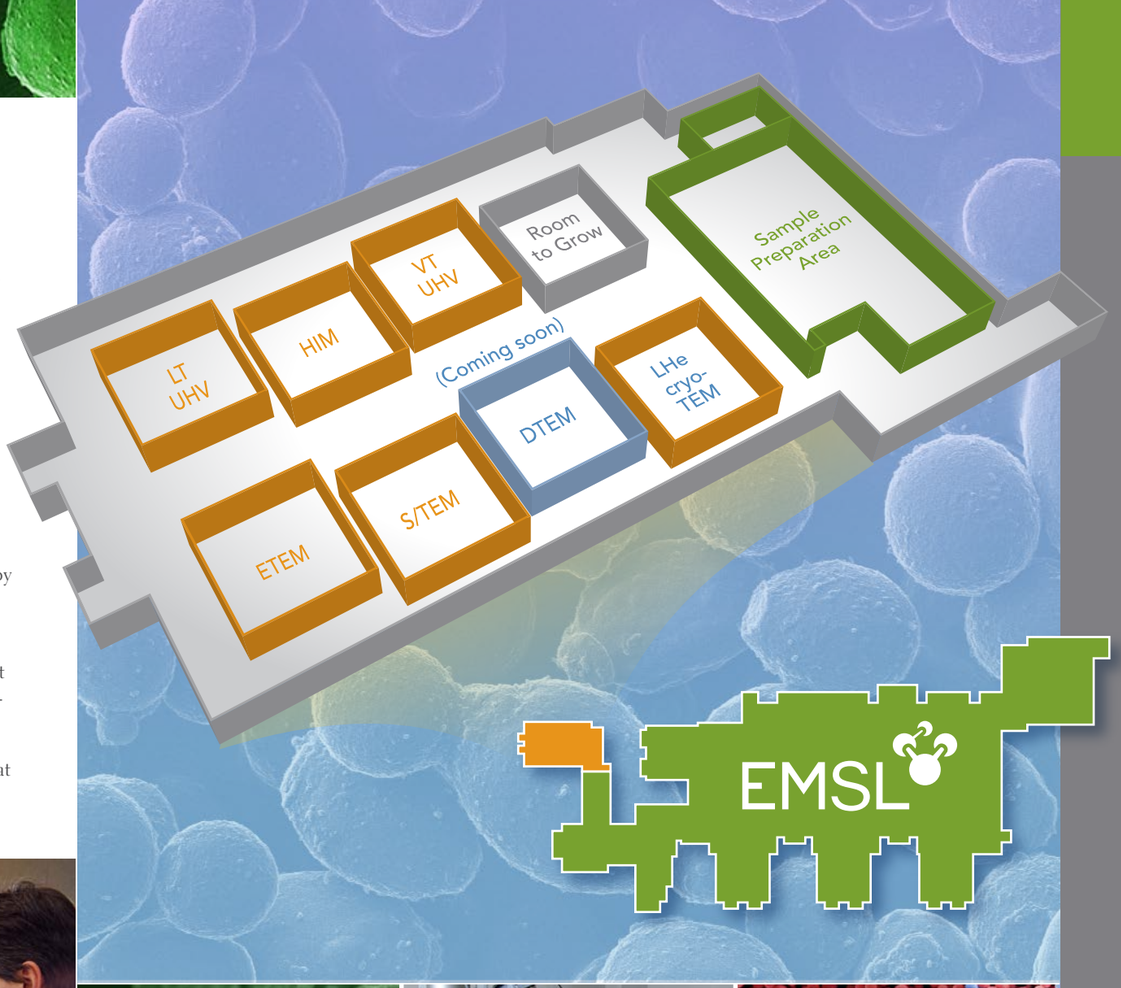
The wing's design eliminates or reduces to a minimum the vibrations, acoustics and electromagnetic noise that can interfere with the resolution of ultra-sensitive scientific instrumentation. This temperature-controlled facility and its unique collection of microscopy and scanning instruments will benefit a wide range of research areas, including climate, biological, environmental and energy systems.

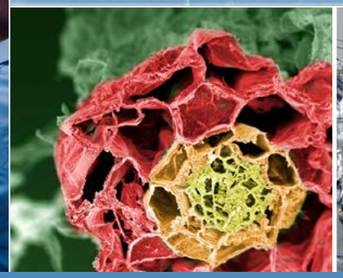
The 9,500-square-foot facility features eight quiet laboratory cells and a sample preparation area. The wing currently houses seven microscopy instruments, and has room for one more. These microscopes are just a few of the extensive suite of microscopy instruments at EMSL available for scientific inquiry.

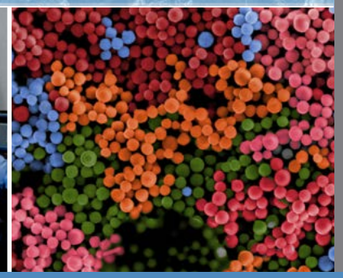
The Quiet Wing is another resource supporting EMSL's commitment to providing an environment where researchers can utilize an integrated, cross-disciplinary approach. At EMSL, scientists combine experimental and computational capabilities to deliver high-impact science.

Like all of EMSL's capabilities, the Quiet Wing is available to the scientific community at typically no cost for openly published research. Scientists gain access to instruments and collaborate with onsite experts through a peer-reviewed proposal process.

- Accelerates critical sciences
- Ultrasensitive microscopes
- Minimizes interference
- Optimal resolution
- Typically no cost for openly published research







State-of-the-Art Instruments in a Unique Research Environment

The Quiet Wing currently houses seven instruments for EMSL's scientific user community. Available instruments include:

- HIM, or helium ion microscope
  - Useful for high-resolution imaging of organic/inorganic microstructures and chemical analysis using a sub-nanometer probe.
- UHV LT SPM, or ultra-high vacuum, low temperature scanning probe microscope
  - The preeminent system with molecular doser for probing single-site chemical reactivity.
- UHV VT SPM, or ultra-high vacuum, variable temperature scanning probe microscope
  - A state-of-the-art surface science tool comprising multiple complementary probes of surface phenomena.
- S/TEM, or aberration-corrected scanning/transmission electron microscope
  - A high-demand, multipurpose research instrument offering superior structural imaging and chemical analysis at an atomic level.
- ETEM, or environmental transmission electron microscope
  - Provides *in situ* capabilities that enable atomic resolution imaging and spectroscopic studies of materials under dynamic operating conditions.
- LHe cryo-TEM, or liquid helium cryogenic transmission electron microscope
  - Ideal for atomic resolution biological imaging of two-dimensional protein crystals and single particle reconstruction of macromolecular complexes.
  - Ultra-low temperature mitigates beam damage to organic samples.
- DTEM, or dynamic transmission electron microscope (Available in FY2015)
  - Simultaneous high spatial- and high temporal-resolution to study dynamic processes at molecular-resolution.

"The Q-Wing will provide optimized conditions for one of the most comprehensive and advanced microscopy facilities anywhere in the world." — *Nigel Browning, Chief Scientist for Chemical Imaging and Laboratory Fellow, PNNL*