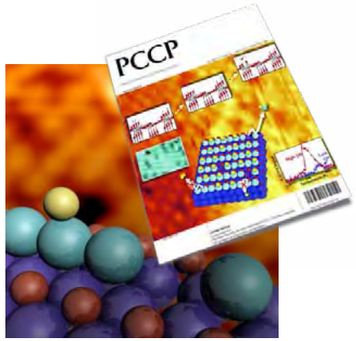
EMSL Quiet Wing Science

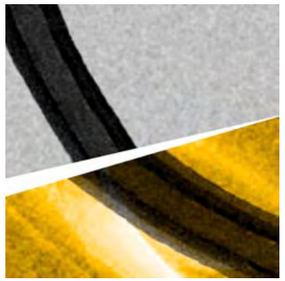
Water + Sun = Energy



EMSL users created a novel method to produce a highly reactive OH-rich TiO_2 surface and studied it at the atomic level using EMSL's UHV VT SPM. Insights from this study have implications for better understanding how to tailor TiO_2-thin films for optimal performance in various applications, including generation of clean, renewable energy by water splitting. The findings were featured on the cover of *PCCP* and move science closer to using H_2O and TiO_2 to produce energy-rich hydrogen.

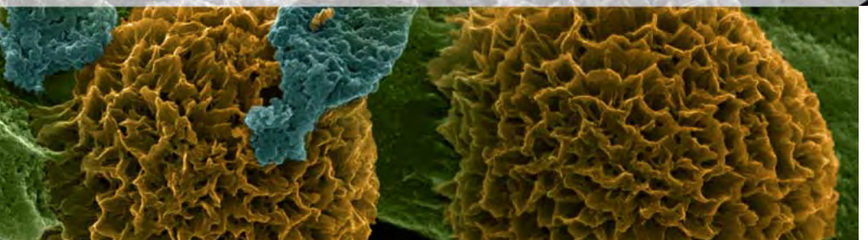
Reference: Du Y, NG Petrik, NA Deskins, Z Wang, MA Henderson, GA Kimmel, I Lyubinetsky. 2012. "Hydrogen reactivity on highly-hydroxylated TiO_2(110) surfaces prepared via carboxylic acid adsorption and photolysis." *Physical Chemistry Chemical Physics* 14(9):3066–3074. DOI: 10.1039/c1cp22515d.

Longer-Lasting, Cheaper Batteries



Researchers used EMSL's S/TEM to zoom in on a new type of silicon-carbon nanocomposite electrode lithium-ion battery to map chemical and physical changes caused by charging and discharging the anode *in situ*. With an electrical capacity five times higher than conventional lithium battery electrodes, silicon-carbon nanocomposite electrodes could lead to longer-lasting, cheaper rechargeable batteries for electric vehicles.

Reference: Wang C-M, X Lin, Z Wang, W Xu, J Liu, F Gao, L Kovarik, J-G Zhang, J Howell, DJ Burton, Z Liu, X Xiao, S Thevuthasan, and DR Baer. 2012. "*In situ* TEM investigation of congruent phase transition and structural evolution of nanostructured silicon/carbon anode for lithium ion batteries." *Nano Letters* 12(3):1624-1632. DOI: 10.1021/nl204559u.



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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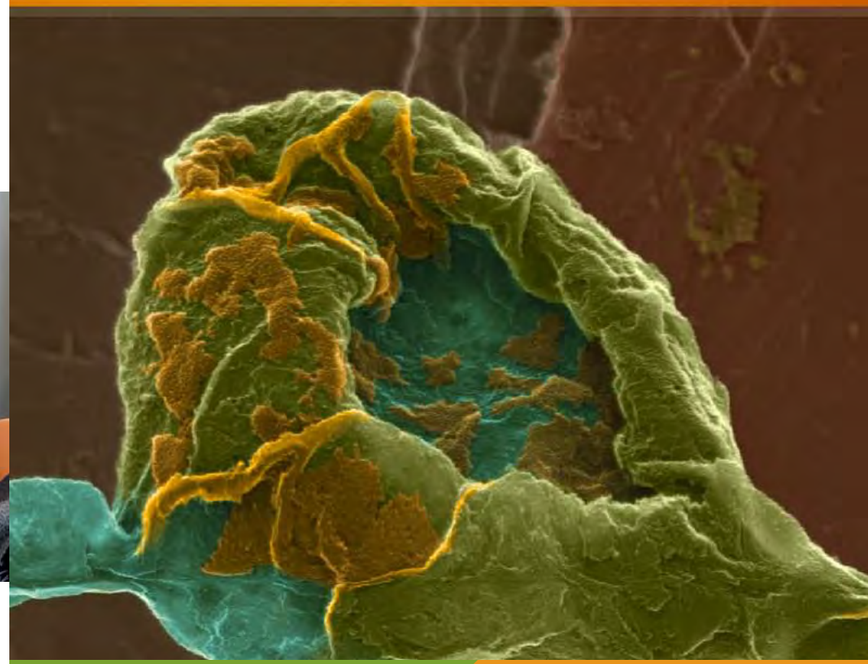
World-Leading Microscopy Facility for High-Impact Science



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SCIENTIFIC INNOVATION THROUGH INTEGRATION

EMSL Quiet Wing

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

EMSL's new 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. The facility and its unique collection of microscopy and scanning instruments will benefit a wide range of research areas, including catalysis, fuel cells, energy storage, subsurface science and health-related biology.

The 9,500-square-foot facility features eight quiet laboratory cells and a sample preparation area. The wing initially houses five microscopy instruments, and has room for an additional three. These microscopes are just a handful 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 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
- No cost for openly published research

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

The Quiet Wing will initially house five instruments for EMSL's scientific user community.

Instruments currently available in the Quiet Wing include:

- **HIM, or helium ion microscope**
  - The first HIM to be offered at a national scientific user facility.
  - 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.

"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*