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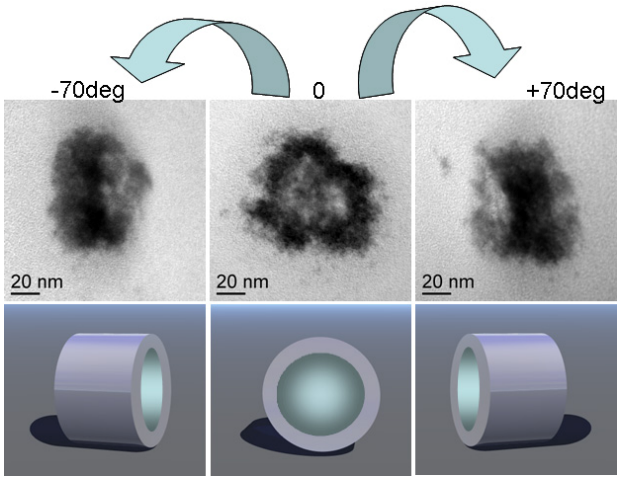
EMSL In Brief
Environmental Molecular Sciences Laboratory

Microbe-Metal Interaction Yields Novel Mineral Nanostructures

Novel mineral nanostructures formed via microbe-metal interaction were observed in nano-detail and three dimensions, thanks to a transmission electron microsope (TEM) tomography capability at the Environmental Molecular Sciences Laboratory.



3-D reconstruction of arsenic-sulfide precipitates by TEM tomography reveals nanotube-like features.

EMSL users from the Gwangju Institute of Science and Technology and Pohang Accelerator Laboratory—both located in the Republic of Korea—as well as the Pacific Northwest National Laboratory; University of Minnesota; and University of California, Riverside teamed to produce and characterize these novel nanostructures, which were grown using dissimilatory metal-reducing bacteria (DMRB).

DMRB refer to some soil bacteria that can use metals for electron transfer during anaerobic respiration. This microbe-metal interaction affects the chemical properties of metals and, ultimately, plays a key role in the fate and transport of minerals in the environment.

Taking advantage of this natural process, the team grew the DMRB, *Shewanella* HN-41, in the absence of oxygen and in the presence of sulfur-containing thiosulfate and arsenic-containing arsenate. The microbe-metal interaction yielded a precipitate, which the team characterized using EMSL resources, including Tecnai T-12 TEM tomography.

The team found that the precipitate consisted of extracellular, filamentous, arsenic-sulfide nanotubes, 20 to 100 nm in diameter and up to 30 μm in length. Further tests for conductivity and photoluminescence revealed that the arsenic-sulfide nanotubes possessed the chemical properties of metals and semiconductors, giving promise for their application as novel nano- and opto-electronic devices.

The team published their work in the December issue of the *Proceedings of the National Academy of Sciences* [104(51):20410-20415], in the article "Biogenic Formation of Photoactive Arsenic-Sulfide Nanotubes by *Shewanella* sp. Strain HN-41." Authors are Ji-Hoon Lee, Min-Gyu Kim, Bongyoung Yoo, Nosang V. Myung, Jongsun Maeng, Takhee Lee, Alice C. Dohnalkova, James K. Fredrickson, Michael J. Sadowsky, and Hor-Gil Hur. The first author, Ji-Hoon Lee, recently joined PNNL's Microbiology group as a visiting scientist.

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