Poster #H4

U.S. Synchrotron Capabilities for Environmental System Science

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Synchrotron X-rays provide the capability to penetrate solid matter and hydrated tissue to study electronic and physical structure at scales ranging from molecular to millimeters. The ability to obtain spatially and temporally resolved molecular fingerprints and mechanistic and dynamic understanding of *in situ* processes within heterogeneous biological and environmental media is enabling unprecedented characterization and imaging of interactions among plants, microbes, and the environment and strongly complement capabilities available at other national user facilities. The Department of Energy's Office of Basic Energy Sciences supports the operation of DOE synchrotron user facilities that enable experiments for studying and understanding structural and functional processes of importance to BER-funded investigators and centers. Within this complex, the Office of Biological and Environmental Research supports technologies, methodologies, and instruments of particular impact in biological and environmental sciences.

The major synchrotrons within the United States that are supported by the DOE provide access via General User proposal systems. These include the Advanced Light Source, the Advanced Photon Source and Stanford Synchrotron Radiation Lightsource. As a result of differing accelerator circumference and energies, each synchrotron provides x-ray beams with general characteristics such as energy range, timing structure, and brilliance, suited to the investigation of specific types of biological and environmental questions and samples. Each offers a range of X-ray based methods through individual experimental stations (beamlines) that optimized for specific types of experiments. Key techniques used by ESS scientists include: i) x-ray absorption spectroscopy to obtain element-specific valence state and molecular structure information; ii) x-ray microscopy to determine spatial distributions of elements, elemental chemistries, and mineralogy in heterogeneous biological and environmental samples; iii) small angle x-ray scattering to determine physical structures and features of nanoparticles, proteins, and thin films; iv) x-ray computed tomography to obtain three-dimensional physical, elemental, and chemical information within opaque media such as soil at nano- to micrometer-scale resolution; and v) x-ray powder diffraction for advanced mineralogical analysis of samples.

We seek to promote and expand collaborations between light sources and the BER research community in order to enable and facilitate fundamental science to understand, predict, manipulate, and design biogeochemical processes. Here we will present information on the facilities and their capabilities, how to access them, and highlights of scientific accomplishments.