Advanced Light Source

A U.S. Department of Energy, Office of Science, User Facility at Lawrence Berkeley National Laboratory

Under the Advanced Light Source (ALS) dome, **brilliant beams of light** travel down beamlines that radiate from a central ring like fins on a pinwheel.

Low-energy **soft x-ray light is the ALS specialty**, filling an important niche and complementing other Department of Energy light source facilities.

Soft x-rays **reveal the atomic and electronic structure** of matter—the first step toward designing new materials with which to develop new technologies.

The ALS's optimized capabilities and knowledgeable experts **attract researchers (users) who lack the advanced scientific tools** available at a national laboratory.

National user facilities, such as the ALS, are a **critical and unique part of the nation's scientific infrastructure** underpinning the innovations that spur economic growth and benefit society.

ALS in Profile

40 beamlines

- Soft x-rays
- Hard x-rays
- Infrared light

Around-the-clock operation

- 200 staff members

2500 users each year

- Academia, national labs, industry
- Industrial users include semiconductor and pharmaceutical companies
- 900 publications per year

One of an array of LBNL facilities

- National Energy Research Scientific Computing Center
- National Center for Electron Microscopy
- Molecular Foundry
- Joint Genome Institute

Materials by Design

- Longer-lasting lithium-ion batteries for electric vehicles and mobile electronics
- Nanoscale magnetic imaging for compact data storage
- Plastic solar cells that are flexible and easy to produce

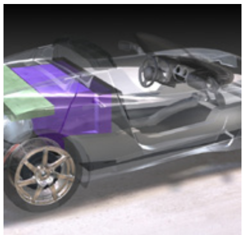
Chemistry of Energy

- Harnessing "artificial photosynthesis" for clean, renewable energy
- Fine-tuning combustion for cleaner-burning fuels
- More effective chemical reactions for fuel cells, pollution control, or fuel refinement

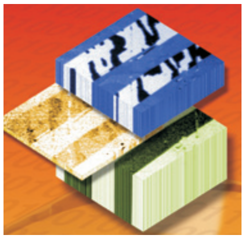
Environment & Health

- Using microbes to clean up toxins in the environment
- Cheaper biofuels from abundant, renewable plants
- Solving protein structures for rational drug design

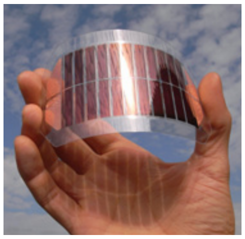
Materials by Design



Lithium-ion batteries can power a wide variety of mobile devices, from cell phones to electric cars. X-ray studies at the ALS can reveal what electrode materials perform best, providing a rational basis for the design of longer-lasting batteries.

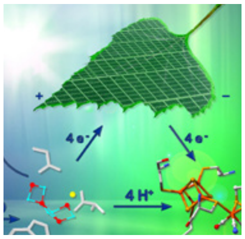


Magnetic imaging at the ALS reveals how magnetic materials behave at the nanoscale. With such information, researchers can discover new ways to encode and manipulate data for faster, smaller, and more reliable digital applications.

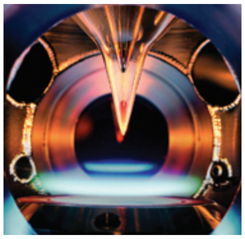


Plastic solar cells are light, flexible, and inexpensive. At the ALS, it is possible to determine the amount of molecular mixing in the active materials, a key to improving the cells' efficiency at converting sunlight into electricity.

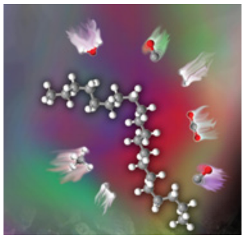
Chemistry of Energy



Artificial photosynthesis could be a promising way to convert sunlight into clean, renewable fuel. X-ray experiments at the ALS can help researchers to understand and re-create the chemical processes that occur naturally in all plants.

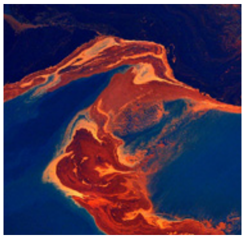


Understanding combustion at a detailed level can help control pollution and improve efficiency. ALS flame chemistry studies have yielded surprising insights that have caused researchers to rethink their models for combustion processes.



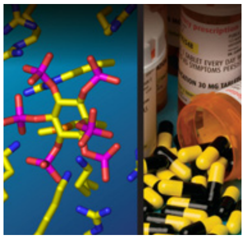
More effective chemical reactions are the ultimate goal of ALS studies of how catalysts perform under realistic reaction conditions, such as feeding hydrogen fuel cells, sweeping toxins from emissions, or driving fuel-refinement techniques.

Environment & Health



Bioremediation is a neat solution to a difficult problem: toxins, such as oil, are broken down into less-harmful form by microbes. At the ALS, we can study this process by correlating the form and location of the toxin with that of the microbe.

Cheaper biofuels from plant matter may be possible if we can learn how to break down the cellulose in plant cell walls more efficiently. Promising new solvents and their effects can be studied using various ALS capabilities.



Rational drug design requires knowledge of the molecular structures of the proteins in our bodies so that we can understand how drug molecules interact with them. At the ALS, researchers have the tools they need to study protein form and function.

CSO 22947