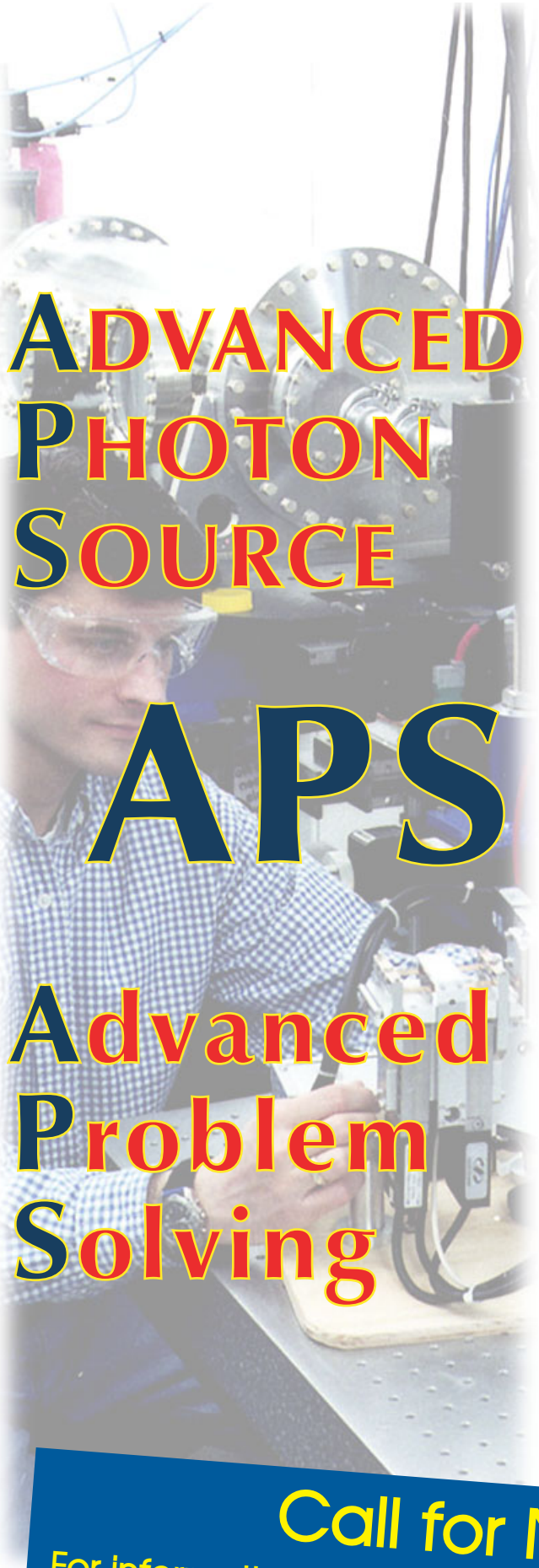


Advanced Photon Source

APS

Advanced Problem Solving

Bringing the power of this hemisphere's brightest synchrotron x-ray beams to problem solving for modern technology

COM-CAT

The commercial beamline at Argonne National Laboratory's Advanced Photon Source was funded for construction by the State of Illinois to provide a state-of-the-art research resource for the business community

Call for New Contractor

For information on applying to operate COM-CAT, contact Gary Edgell
630/252-8318 or GWEDGELL@aps.anl.gov

As the scale at which materials can be controlled continues to shrink, it has become necessary to develop new analytical techniques.

When today's technology-oriented companies look for a competitive edge, they must look at the molecular level: The structure of a protein; the interface between a film and a surface; the elemental information hidden deep within a sample.

Major industries engaged in technical pursuits, such as new-materials discoveries, chemical production, semiconductor device fabrication, environmental remediation, and pharmaceutical drug development have made long-term investments to gain access to the Advanced Photon Source (APS) at Argonne National Laboratory, where extreme-brilliance x-ray beams are providing answers to questions that unlock new technologies.

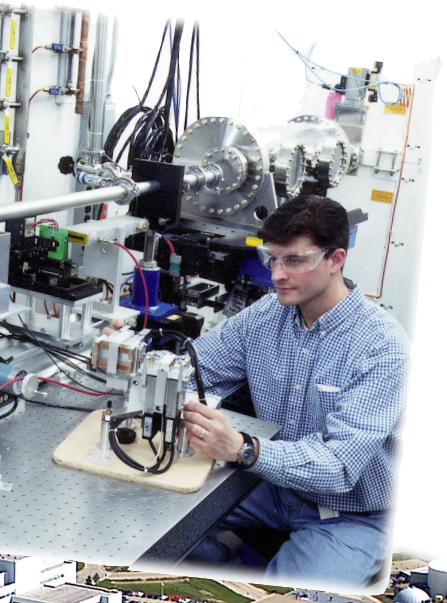
Now, companies without the resources of large firms, but whose need for this unparalleled analytical tool is just as great, can avail themselves of synchrotron x-ray research on an as-needed, fast-turnaround, fee-for-service basis. The key is COM-CAT (the Commercial Collaborative Access Team) at the APS, which will address problems that can be solved via x-ray analysis.

The synchrotron x-ray facility at COM-CAT provides the equipment and expertise needed for ongoing materials characterization and structure determination using the unique spectral brilliance of APS x-ray beams.

The capabilities implemented at COM-CAT include instrumentation for spectroscopy (absorption and fluorescence), small-angle scattering, reflectivity measurements, powder diffraction, and macromolecular crystallography. This broad range of capabilities meets the needs of traditional as well as high-technology industrial organizations.

The COM-CAT research station in the APS experiment hall

Inside the COM-CAT research station



At COM-CAT, a variety of synchrotron x-ray techniques can be applied to problem solving

Absorption Spectroscopy

In both crystalline and amorphous materials, whether solid or liquid, the bonds between adjacent atoms result in extremely short-range order. X-ray absorption spectroscopy, performed at energies near the binding energy of an electron within a constituent atom, probes this local structure. These spectra provide information on the oxidation state of an atom and the distance and identity of its nearest neighbors. Since the binding energies of electrons within elements are unique, the properties of one element in a material can be examined without interference from the other components of the sample. Such spectra have proven invaluable in the study of a variety of materials, including catalysts, superconductors, and magnetic materials, as well as for the characterization of environmental samples.

The Advanced Photon Source facility

Crystallography and Structural Biology

X-rays have an unexcelled capability for determining the structures of crystalline lattices. Synchrotron x-ray sources have made the solution of the structures of even large biological molecules almost routine. The high intensity from synchrotrons mitigates the effects of large unit cells found in enzymes and proteins. In addition, the ability to select the energy of the x-ray permits anomalous diffraction, in which the energy is tuned to the absorption edge of an element native or introduced into the protein structure. The result is knowledge of both the phase and intensity of diffraction from this element, instead of just the intensity measured in traditional x-ray diffraction. Such data provide an anchor for analysis that reduces the time needed to determine a biological structure to a matter of weeks, instead of months or years.

The recent addition of a remote sample changer significantly reduces data collection time, enhancing sample throughput.

The COM-CAT control room

Synchrotron radiation techniques provided by COM-CAT present unique advantages to industry for materials analysis and structure determination

Technique	Length Scale	Samples	Information	COM-CAT Advantages
Macromolecular crystallography	0.1 to 200 nm	Small molecules & biological structures	Atomic structure	Small crystal size, use of anomalous dispersion greatly reduces time required to solve structure
Powder Diffraction	0.1 to 5 nm	Small molecules, alloys, composites, thin films, etc.	Atomic structure, strain distribution, texture, etc.	Full structure solution of small to midsize molecules that cannot be grown in single-crystal form.
X-ray absorption spectroscopy	0.1 to 1 nm	Materials containing elements with Z > = Ti	Element-specific determination of coordination number & chemical state	Rapid screening of samples

For technical information on the Commercial Collaborative Access Team, contact:

Dr. Dennis M. Mills
Bldg. 401, Room A4117
Advanced Photon Source
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439
630.252.5537
fax 630.252.4599
e-mail dmm@aps.anl.gov

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