

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
TRIP REPORT

SUBJECT: Advanced Light Source Users' Association Annual Meeting
(20-5704-073)

DATE/PLACE: October 20-21, 1994
Lawrence Berkeley Laboratory
Berkeley, CA

AUTHOR(S): Roberto T. Pabalan

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PERSONS PRESENT: See attendance list (Attachment 1)

BACKGROUND AND PURPOSE OF TRIP:

The purpose of the trip was to attend the Annual Meeting of the Advanced Light Source (ALS) Users' Association and to visit the ALS facility at the Lawrence Berkeley Laboratory (LBL). The ALS facility opened in the spring of 1993 and provides the world's brightest beams of ultraviolet and soft x-ray synchrotron radiation for use in a variety of fields spanning materials science to biology. Because the ALS is a DOE national user facility, it is free to industrial and academic users conducting nonproprietary research. The objective of the trip was to investigate the possible use of the ALS facility for studies related to the CNWRA Sorption Research Project.

Meeting Summary:

Presentations on the morning of the first day focused on recent highlights on the ALS facility. William Oosterhuis of the Office of Basic Energy Sciences at the U.S. Department of Energy provided an overview of government funding climate for experimental facilities and for research at synchrotron-radiation facilities. He stated that the future holds continued tight funding for basic research and increased emphasis on applied research. He encouraged participants to be aggressive in submitting proposals that respond to national needs. Brian M. Kincaid, director of the ALS, gave an overview of the ALS facility. The ALS is currently operating at 60% of the maximum operating hours (9 eight-hour shifts per week); plans to achieve 100% operation is on hold because of budgetary constraints. Fiscal year 1995 total budget is \$24.4 million and requested funding for 1996 is \$37.7 million, which most likely will be reduced. He acknowledged the difficult budgetary outlook and stated that he believes the key to increased funding is for the various U.S. synchrotron facilities to demonstrate to the Office of Management and Budget that there is user demand for all of the facilities, not just for the most advanced ones, and that these facilities are being fully utilized (which is true for the ALS). He also talked about the ALS program to conform with the ISO 9000 quality assurance program, which he said is important for attracting ALS users from U.S. and European industry. A. Jackson, leader of the accelerator group, discussed in some detail the performance of the accelerator and how this is measured. He indicated that 7% of available beamtime was lost during the past year and provided a causal analysis of this loss. H. Padmore, leader of the experimental systems

group, discussed improvements in the ALS that occurred in the past year, such as new beam lines/workstations and their applications, and changes planned during the current fiscal year.

During the rest of the meeting several speakers presented results of their work using synchrotron radiation sources, either at the ALS or at another institution. B. Tonner (Univ. of Wisconsin, Milwaukee) presented results using the ALS beamline 7.0 as applied to spectroscopic study of small samples or small areas of samples. Beamline 7.0 was designed to take advantage of the high flux and small spot size (50 microns) of the ALS light source for studies of materials by ultra-ESCA (electron spectroscopy for chemical analysis) techniques. One study he showed was the characterization of minute radioactive curium oxide. The amount of curium oxide analyzed was less than 5 ng, which had a level of radioactivity considerably lower than that of a household smoke detector. The technique provided a safer alternative to other techniques which require working with larger amounts of material and could be useful for applications such as analyzing soil from contaminated waste sites.

Joseph Nordgren (Uppsala Univ.) discussed their research in the field of resonant inelastic x-ray scattering (RIXS) spectroscopy. The technique was applied by his research team to study benzene with respect to the symmetries of its molecular orbitals.

K. Jackson (LBL) discussed potential applications of the ALS for micromachining devices that can be used as microsensors for detecting pressure, acceleration, vapors, temperature and sound. Applications could be in medicine (microsensors to measure pressure gradients at heart valves or the velocity of blood vessels), automobiles (acceleration detectors for triggering air bags or adjusting engine performance), or as "chemical plants on a chip" - tiny reaction chambers only as big as a few grains of sand built into a silicon wafer, e.g., for DNA replication. The ALS facility can provide micromachining capability through deep-etch x-ray lithography. LBL research teams are planning a deep-etch x-ray lithography facility where users can fabricate micromachines on an industrial scale.

R. Stroud (Univ. of California, San Francisco) discussed the applications of the ALS to protein x-ray crystallography, which is currently the most successful way to get structural information about complex molecules in the human body. One example he showed was their study of the *ras* gene, the mutation of which can result in the formation of a cancer causing *ras* oncogene. Proteins created by the oncogene, known as oncoproteins, lose their ability to turn off the cell division signal, a disaster that can lead to the formation of deadly tumors. The research team derived highly accurate data on the position of the atoms in the normal and mutated forms of the *ras* proteins and discovered how the on-off switch works and what happens when it goes awry. This understanding will allow the pharmaceutical industry to focus on designing and synthesizing therapeutic molecules to counteract the disease-causing mechanism. The potential demand for the technique is so large that ALS management is putting substantial financial and human resources into building a protein crystallography facility at LBL that will offer analytical services to industry.

Several posters were also on exhibit at the ALS facility. Two posters showed the application of the x-ray fluorescence microprobe equipment on Beamline 10.3. At present the elemental sensitivity of the microprobe reaches the femtogram (10^{15} g) level for elements from potassium to zinc in the periodic table. Additional detection sensitivity is imparted by the ability to select the x-ray photon energy to avoid interfering fluorescence from other elements. A major advantage of the x-ray microprobe is that specimens do not have to be kept in vacuum or subjected to special contrast-enhancing preparation. One of the two posters showed results of a study designed to determine why a previously successful fabrication process for solar cells had begun turning out non-functional photovoltaic cells. The fluorescence microprobe is able to detect trace elements in a bulk sample, whereas techniques involving electron photoemission are sensitive only to the elements on the surface. This capability, along with the high sensitivity and spatial resolution of the microprobe, revealed that extremely small

elements on the surface. This capability, along with the high sensitivity and spatial resolution of the microprobe, revealed that extremely small quantities of iron impurities present at and below the surface were probably introduced during fabrication and led to the cell's failure. The other poster presented the results of x-ray microprobe analysis of sediments from the San Francisco Bay and showed the distribution of toxic metals on the sediment surface. The study attempted to correlate toxic metal distribution with sorption sites on the sediments.

I had discussions with Eric Hudson (Lawrence Livermore National Laboratory) about uranium sorption studies. He is interested in using the synchrotron source at the Stanford Synchrotron Radiation Laboratory to study uranium sorption on mineral surfaces, particularly on clinoptilolite, and in a possible collaborative work in this area. We agreed that I should do some calculations to determine if it is experimentally feasible to load clinoptilolite or some other mineral with 5,000 ppm of U and investigate the availability of beam time at Stanford.

SUMMARY OF ACTIVITIES:

See attached meeting program.

IMPRESSIONS/CONCLUSIONS:

The meeting was well-organized and provided an opportunity for researchers from different scientific disciplines to present and discuss their work using synchrotron radiation. However, the potential application of the various techniques using the ALS to studies relevant to the CNWRA sorption research is not clear at this time. The technique that has been used for sorption studies (EXAFS, or extended x-ray fine-edge structure spectroscopy) is not available at the ALS facility, but is being utilized at the Stanford facility. Further contacts with ALS investigators are needed to pursue the potential use of the facility.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

R. Pabalan will investigate the possibility of collaborating technically and programmatically with E. Hudson of LLNL in using the Stanford Synchrotron Radiation Laboratory beam source for spectroscopic studies of uranium sorption on mineral surfaces. R. Pabalan will request information from ALS investigators about potential applications to sorption studies.

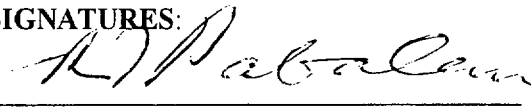
RECOMMENDATIONS:

None.

ATTACHMENTS:

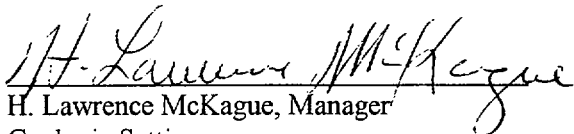
1. Attendance List
2. Meeting program

SIGNATURES:

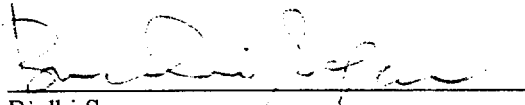

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**ADVANCED LIGHT SOURCE
USERS' ASSOCIATION ANNUAL MEETING
October 20-21, 1994**

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October 20-21, 1994

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Program
ALS Users' Association Annual Meeting
Lawrence Berkeley Laboratory
October 20-21, 1994

Thursday, October 20:

7:30 - 9:00 a.m.	Special Shuttle Bus Service (Approximately every 20 minutes)	Shattuck Hotel to LBL Building 50 Auditorium
7:30 - 9:00	Registration and Coffee	Building 50, Auditorium Lobby

Recent Highlights from the ALS

(Chair: Michael White, Brookhaven National Laboratory)

8:30 - 8:45	Welcome	C. Shank, Director, LBL
8:45 - 9:00	Report from the DOE	W. Oosterhuis, DOE/BES
9:00 - 10:00	Overview of the ALS	B. Kincaid, Director, ALS
10:00 - 10:30	<i>BREAK</i>	
10:30 - 11:00	Accelerator Performance	A. Jackson, Leader of Accelerator Group, ALS
11:00 - 11:30	Experimental Systems	H. Padmore, Leader of Experimental Systems Group, ALS
11:30 - 12:00	Scientific Program	N. Smith, Scientific Program Head, ALS
12:00 - 14:00 p.m.	Box Lunch and Vendor Exhibit	Building 6

Recent Results from User Beamlines at the ALS

(Chair: Nora Berrah, Western Michigan University)

14:00 - 14:30	Report on First Results from the Beamline 7.0 Spectromicroscopy Facility	B. Tonner, U. of Wisconsin, Milwaukee
14:30 - 15:00	Soft X-Ray Fluorescence (SXF) Studies on the Tennessee/Tulane Endstation on Beamline 8.0	T. Callcott, U. of Tennessee
15:00 - 15:30	<i>BREAK</i>	
15:30 - 16:00	SXF from C ₆₀ and Other Systems	J. Nordgren, Uppsala U.
16:00 - 16:20	Micromachining	K. Jackson, Center for X-Ray Optics, LBL
16:20 - 16:40	High-Resolution Photoemission from Simple Atoms and Molecules	D. Caldwell, U. of Central Florida
16:40 - 17:00	Resonant Photoemission from Ni	A. Nilsson, Uppsala U.
17:00	Adjourn	Special Shuttle Bus Service

ALS Users' Association Annual Meeting

Program (continued)

Friday, October 22:

7:45 - 9:00	a.m.	Special Shuttle Bus Service (Approximately every 20 minutes)	Shattuck Hotel to LBL Building 50 Auditorium
7:45 - 8:30		Coffee	Auditorium Lobby Area

New Opportunities at the ALS (Chair: Steve Cramer, U.C. Davis)

8:30 - 9:00		Atomic Physics	F. Wuilleumier, University of Paris
9:00 - 9:30		Protein Crystallography	R. Stroud, U.C. San Francisco
9:30 - 10:00		Surface Analysis	R. Brundle, Consultant
10:00 - 10:30		BREAK	
10:30 - 11:00		Polymer Microscopy	H. Ade, North Carolina State U.
11:00 - 11:30		Infrared Microscopy	G. Williams, NSLS
11:30 - 11:50		How to Use the ALS	F. Schlachter, ALS User Liaison
11:50 - 12:00		Users' Association Meeting	M. White, Chair UEC
12:00 - 3:00	p.m.	Box Lunch, Vendor Exhibit, and Posters	Building 6
3:00		Adjourn	Special Shuttle Bus Service to Shattuck Hotel

Additional program (Building 2, Room 100B)

2:30 - 5:00 **Workshop on Infrared Microscopy**