Accomplishments and Look-Ahead

October

- Fall 2011 call for proposals closed October 5th. Eleven new proposals were received and are out for review.
- Drexel University experiment capsule was inserted into the ATR.

November

- ATR NSUF hosted a booth at the ANS Winter Meeting in Las Vegas November 7 – 9, 2010.
- ATR NSUF hosted an offsite, mini-Users Week course titled "Conducting Irradiation Experiments," after the ANS meeting in Las Vegas Nevada. 35 people attended this experimenters course in a day-long event in UNLV on November 12, 2010. Presentations included an overview of the advanced test reactor and the INL's post irradiation examination capabilities. Participants also heard a short lecture on experiment design and thermal analysis, and were given a demonstration of new tools available for neutronic analysis.

December

- ATR NSUF will host three faculty members from the University of Nevada-Reno and give them tours of the facilities available to users.
- ATR NSUF will pilot two projects in the Center for Advanced Energy Studies (CAES) building with the University of Florida and the University of Michigan utilizing the newly purchased atom probe.

January

- The University of California Berkeley experiment is scheduled for insertion in the MIT reactor.
- ATR NSUF will host Paul Gannon from Montana State University as the colloquium speaker January 13, 2011.

Noteworthy News

- User Week 2011 is scheduled for the week of June 6 – 11, 2011. Registration will open in January.
- ATR NSUF researchers are in the initial stages of forming a user's working group. User's Working Groups provide feedback to the user facility management and the Department of Energy on all matters concerning the operation of the user facility. In addition, the User's Working Groups typically provide advocacy throughout the federal budget process. User's Working Groups typically meet once a year. Typically, the user's group consists of all interested users and is represented by an executive committee. If you are interested in participating in this group, please email Mary Catherine Thelen (mary.thelen@inl.gov) and your name will be added to the list!

- The ATR NSUF is a member of the National User Facility Organization which represents the interests of all users who conduct research at a national scientific user facility. The NUFO page has information on all the NSUFs across the U.S., along with activities, upcoming meetings and a newsletter. The link to the webpage is: http://nufo.org. We encourage you to save this link and check in on activities from time to time. The NUFO annual meeting is scheduled for late June at Brookhaven. This meeting is a great opportunity to hear about activities at other user facilities, and to network with users across the nation!

FIRST ROUND OF ATR NSUF SYNCHROTRON RADIATION EXPERIMENTS COMPLETE

Advanced Photon Source, Argonne National Laboratory

The final synchrotron radiation experiment was completed in August, bringing the first round of experiments of this type to a successful completion. In FY10, ATR NSUF formed a partnership with the Illinois Institute of Technology (IIT) which runs the Materials Collaborative Access Team (MRCAT) section of the Advanced Photon Source (APS) beamline located at Argonne National Laboratory. The MRCAT (pronounced M.R. "cat") is a multiple-institution consortium for building and operating x-ray beamlines. The partnership with IIT offers ATR NSUF users access to synchrotron radiation techniques including x-ray diffraction, x-ray absorption, x-ray fluorescence and 5µm spot size fluorescence microscopy. ATR NSUF initially offered these capabilities to its Users in FY10 to determine interest and received six proposals in the first round, four of which were awarded.

The principal investigators (PIs) for each of the four awarded experiments shared their first-hand experience working with the ATR NSUF through the partnership with IIT.

Jeff Terry, Ph.D., Illinois Institute of Technology

Jeff Terry, Assistant Professor in the Physics Division of the Illinois Institute of Technology (IIT), has the unique perspective as both an experimenter and as the program manager for the MRCAT.

"The best thing about the partnership between ATR NSUF and APS/IIT is the collaboration," expressed Terry. "Through this partnership we had access to lots of different facilities and expertise."
The goal of Dr. Terry's experiment, "Synchrotron XRD and XAFS Study of Irradiated Binary Carbides," was to look at initial radiation damage in binary materials. His research team was comprised of individuals from Idaho National Laboratory (INL), University of Wisconsin, and IIT. The team performed synchrotron radiation experiments at Argonne National Laboratory's Advanced Photon Source using two techniques: 1) x-ray absorption, and 2) x-ray diffraction probes.

After a successful first-round experiment, Terry's next steps are to continue the collaboration process. Utah State University has asked to participate in the ongoing experiment, but would like to run tests at different temperatures. Terry is also interested in using the ATR Irradiated Sample Library. The Library has upgraded its capabilities over the last few years and Terry predicts it will offer samples with a higher radiation damage level in the near future. Terry would also like to experiment with tensile testing.

"Overall," said Terry, "collaboration is the best thing about working with the NSUF."

In addition to being an experimenter, Jeff Terry also shared his unique experience as the MRCAT beamline manager. One of the biggest challenges he faced as MRCAT manager was working with the varying safety protocols at the different partner facilities. "I learned a lot about coordination between institutions through the experiment process this year. Each institution has a different reporting process." According to Terry, these challenges are not exclusive to the User experiments. "You can never predict all the safety issues that come about when doing an experiment," he said.

When reflecting on all of the ATR NSUF experiments that utilized the MRCAT beamline, Terry commented that all four of the APS experiments were very complicated. One experiment even had the added complexity of multiple levels of encapsulation. "All of the experiments ended up being challenging because they were performed on actual radioactive material. There were challenges getting all the work done, but all four experiments got in [the APS]."

Donald Reed, Ph.D., Los Alamos National Laboratory

Donald Reed was the principal investigator (PI) for the experiment titled, "Investigation of the Thermodynamics of Plutonium/Iron Solubility in Brines Using X-Ray Absorption Spectroscopy." The project goal was to establish the oxidation state of plutonium in Fe-saturated brine under conditions relevant to the Waste Isolation Pilot Plant (WIPP) which is the DOE Transuranic Waste Repository." The research team performed several analyses during the course of the experiments. "It had already been demonstrated that Pu(VI) was reduced to Pu(IV) in these experiments," said Reed, "and the goal of this final analysis was to confirm the long-term stability of these initial phases."

The team, comprised of members from LANL and IIT, analyzed seven samples using the APS and discovered some fairly significant results. "[We] were surprised to find that the samples were mostly Pu(III)," commented Reed. "This important result will likely change our thinking in our performance assessment and challenges current environmental actinide chemistry assumptions that Pu(IV) phases predominate under environmental conditions. This is also key information for DOE programs in nuclear waste management… [It provides] very critical support for both EM and NE programs in this area."

Dr. Reed has been involved in many beamline runs at MRCAT in the past, but found the IIT/ATR NSUF partnership very beneficial to the experiment process. "The partnership not only provided needed beam time but the analyses were greatly strengthened by the collaboration with IIT researchers. This [interaction] was the key that made this an unusually successful beamline run."

The biggest challenge Reed faced in the experiment process was the stringent ANL safety protocols for doing radioactive materials work at the APS. Despite this challenge, he cited several benefits to working as a NSUF user such as "collaboration with IIT researchers, the availability of good and usable beam time, and the collective aspect of the work with other scientists who are all working on nuclear end-cycle issues."

Reed said his next steps involve publishing the results of the plutonium experiments as part of an extensive LANL-series report and abstracting the results into a peer-reviewed article. In exchange for use of NSUF facilities, user facility project proposal experiments are required to be non-proprietary in nature and research must be made available to others.

Maria Okuniewski, Ph.D., Idaho National Laboratory

Maria Okuniewski served as principal investigator for a team of ten researchers and students from INL, LANL, IIT and ANL on a project titled, "Synchrotron X-ray Diffraction Measurements of Spatially Resolved Strain Fields in Nuclear Fuel Plates." The objective of this research was to compare the spatially resolved residual strain as a result of various process parameters for hot isostatic pressing on monolithic U-10 wt%Mo fuel plates. The researchers aimed "to identify trends in the residual strain of the fuel for the various processing parameters for specific plate locations," said Okuniewski. "These experiments were the first of their kind conducted on these fuel plates."

While there were a few challenges encountered in the experiment process, Okuniewski said working with NSUF was beneficial. "The biggest advantages of conducting this work through the NSUF were the quick access to the MRCAT and the extended amount of beam time allotted for the project. [This] is not traditional for typical user proposals at the APS," said Okuniewski.

Although the beam intensity was not optimal for their experiment, the research team was still able to obtain successful spatial mapping of the residual strains present in the fuel plates."

Dr. Okuniewski already has plans for the next steps in the experiment. She would like to run additional experiments to analyze other processing parameters. “Also, we are working with finite element models to complement the results obtained at APS,” she remarked.

Meimei Li, Ph.D., Argonne National Laboratory

Meimei Li, of Argonne National Laboratory, served as the principal investigator for an experiment titled, “Study of an Irradiated Ferritic Steel by Synchrotron XRD and XAS.” According to Dr. Li, the goal of the experiment was “to conduct x-ray absorption (XAS) and x-ray diffraction (SRD) measurements on specimens irradiated to various dose levels.” She worked with about 15 people including team members at LANL, IIT, and ANL.

Meimei Li had used the APS for experiments in the past; however she said this time the process was slightly different. Her biggest challenge was “[coordinating] with a large group of people from different organizations to handle radioactive material and to complete high quality work safely and timely.”

The results of the experiment have been presented at several workshops and conferences and have been submitted to the *Journal of Nuclear Materials.* Future plans for the research team include “expand[ing] the work to neutron-irradiated ferritic model alloys and ferritic steel irradiated at different temperatures to different irradiation doses.” They also plan to do “several complementary experiments to develop a better understanding of damage in the material.”

Like the other researchers who worked with the ATR NSUF, Meimei Li had a good experience. “We received unconditional support from NSUF. The NSUF Sample Library is highly valuable to users. The NSUF/IIT partnership allows state-of-the-art characterization capability to be applied to the radiation materials science field for new discovery and breakthroughs,” said Dr. Li.

Congratulations to the first four ATR NSUF/MRCAT experiment teams! The ATR NSUF Spring Call for Proposals closes on April 5, 2011. For information on the proposal process, visit http://www.atrnsuf.inl.gov.