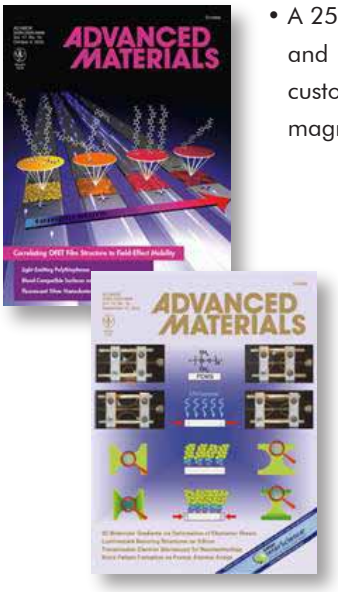
Synchrotron Beamline Operations

Objective

Our objective is to ensure that the NIST beamlines U7A, X23A2, and X24A, located at the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory, operate efficiently, effectively, and safely to enable customers to conduct their experiments. The Department of Energy (DOE) is our partner in this endeavor. One of our main goals is to meet DOE's requirement that 25% of the beam time for each beamline is reserved for general users.

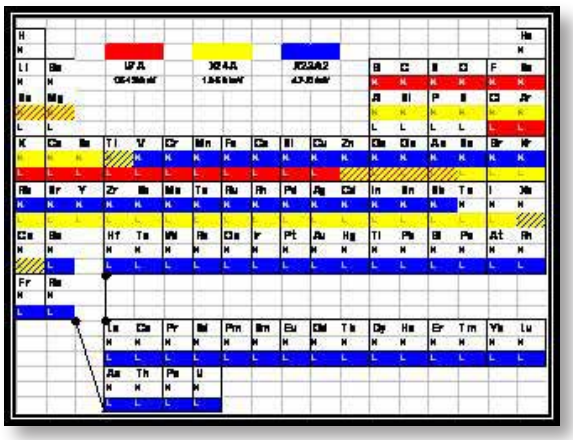
Impact and Customers



- A 25 year NIST-DOE partnership at the NSLS has developed beamlines, specialized detectors, and endstations; most importantly, it has enabled industrial, academic, and government customers to perform state-of-the-art local structure measurements for electronic, energy, and magnetic storage applications.
- NIST operates a suite of three synchrotron beamlines that, in concert, can interrogate the structure of materials comprised of every element in the Periodic Table. With our partners, we develop and apply new synchrotron X-ray measurement methods to establish structure-property relationships for intelligent materials design.
- An FY2007 NIST Budget Initiative, "Synchrotron Measurement Science and Technology: Enabling Next-Generation Materials Innovation", will enable us to develop world-class capabilities to measure the electronic, chemical, and structural properties of materials with sub-nanometer resolution.

Approach

Synchrotron beamlines are widely used to determine structure of materials and devices that cannot be measured by more common, conventional methods. Such measurements enable the development of new materials and devices in a broad spectrum of industries. The NIST NSLS beamlines are fully operational and in use about eleven months of the year. There are 108 fully trained beamline users who conduct over 84 experiments each year. Examples of technology advancements in multimillion dollar industries that have been enabled by synchrotron measurements include: development of next-generation catalysts for chemical production; optimization of semiconductor and organic materials for microelectronics; and development of lubricants for magnetic hard drives.



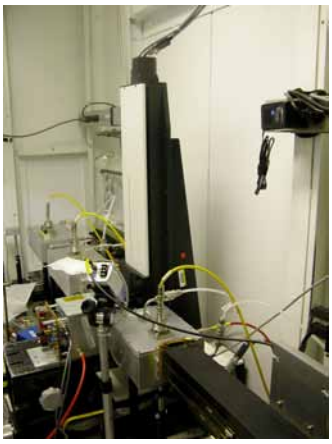
NANOMATERIALS

852-06-63b

Accomplishments

Over the past 15 years, we have established the following measurement capabilities at three beamlines at the NSLS: (1) near-edge X-ray absorption fine structure spectroscopy (NEXAFS) at beamline U7A; (2) extended X-ray absorption fine structure spectroscopy (EXAFS) at beamline X23A2; and, more recently, X-ray photoelectron spectroscopy (XPS) at beamline X24A. Although these beamlines operate 24 hours per day, seven days per week, the demand for beamtime far exceeds the time available. We continuously strive to maximize beamline accessibility and ease of operation for beamline users by developing new and improved operating practices. Further, we provide service to the synchrotron community by working with NSLS and DOE to optimize beamline operations and transfer our best practices to other beamlines at the NSLS. Members of our team have chaired the NSLS Users' Executive Committee and have served on its Science Advisory Committee. Our team has served on DOE synchrotron proposal review panels at the NSLS, at the Advanced Photon Source, and at the Canadian Light Source.

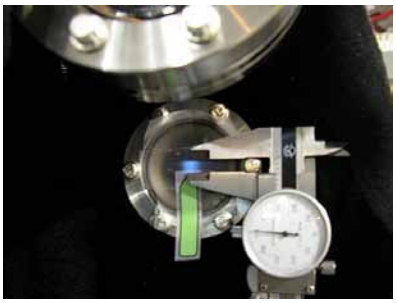
EXAFS hutch before modifications



Reconfigured EXAFS hutch and components

Major modifications were made to the EXAFS hutch at beamline X23A2 to allow full utilization of the newly commissioned sample stage to accommodate our state-of-the-art low temperature closed cycle helium refrigeration system, which should be commissioned in FY10. This modification provides additional room to all other experiments as well.

The EXAFS hutch also has new ion chambers and a new optical rail for maintaining alignment of the detector systems.



Large beam from U7A wobble mirror

Major vacuum modifications of beamline U7A to allow the installation of a new parallel process, full-field imaging NEXAFS endstation were completed. The imaging endstation makes full use of the wobble mirror system which can deliver a 20 mm x 20 mm beam at the sample position of the new imaging NEXAFS endstation.

Integration of the imaging NEXAFS endstation into the U7A beamline allows pass-through of the monochromatic beam to the downstream endstations by raising the wobble mirror (in situ), enabling rapid switching between endstations to optimize beamtime usage.

Full-field imaging NEXAFS endstation

The imaging NEXAFS endstation includes a sample load lock and computerized sample manipulator for a bar holding up to 10 samples. The same sample bar and handling hardware is also used at our other NEXAFS and XPS endstations, thus enabling rapid sample exchange between endstations.

Learn More

Bruce Ravel
Barry Karlin
Cherno Jaye
Zugen Fu
Johnny Kirkland

Daniel Fischer and
Joseph Woicik
(Ceramics Division)
631-344-5177/4247
daniel.fischer@nist.gov
joseph.woicik@nist.gov
www.nist.gov/ceramics

Publications

NIST U7A beamline publication lists;
http://www.nsls.bnl.gov/beamlines/publications.asp?blid=U7A

NIST X24A beamline publication lists;
http://www.nsls.bnl.gov/beamlines/publications.asp?blid=X24A

NIST X23A2 beamline publication lists;
http://www.nsls.bnl.gov/beamlines/publications.asp?blid=X23A2