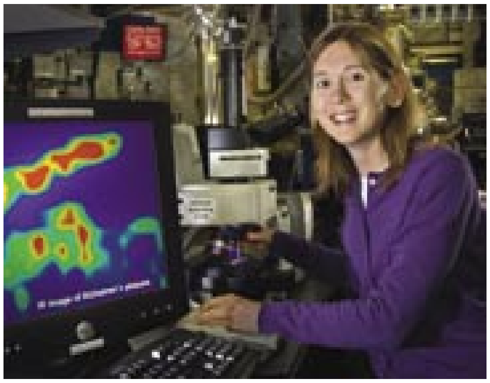
411TH BROOKHAVEN LECTURE 'SHINING LIGHT ON THE CAUSE OF ALZHEIMER'S DISEASE'

January 18, 2006

Alzheimer's disease is a progressive brain disorder that gradually destroys a person's memory and ability to learn, reason, communicate, and carry out daily activities. An estimated 4.5 million Americans have it, a number that is expected to triple over the next 50 years. Today, one in ten people aged 65 and half of people over 85 are affected.



Lisa Miller

The cause of Alzheimer's disease is thought to involve the formation of "plaques" — tiny aggregates of a naturally occurring, but misfolded or misshapen protein — in the brain. Recently, the formation of these plaques has been associated with the binding of metal ions such as iron, copper, and zinc. Yet the function of these metal ions and the misfolded proteins in the disease process is not well understood.

Now, synchrotron infrared and x-ray microscopes are used to image the protein structure and metal content in the Alzheimer's-affected brain tissue, providing a better understanding of how the disease occurs and potential ways of preventing it in the future.

Biophysical chemist Lisa Miller of the National Synchrotron Light Source Department (NSLS) gave the 411th Brookhaven Lecture on this research in her talk "Shining Light on the Cause of Alzheimer's Disease," on January 18, 2006 in Berkner Hall.

Lisa Miller obtained her B.S. in chemistry from John Carroll University in 1989, her M.S. degree in chemistry from Georgetown University in 1992, and her Ph.D. in biophysics from the Albert Einstein College of Medicine in 1995. Rejoining Albert Einstein in a faculty position, she worked with BNL scientists to develop new tools using synchrotron light to study biological and medical problems.

She joined the NSLS in 1999 and uses x-ray and infrared imaging to study diseases such as osteoarthritis, osteoporosis, and Alzheimer's. She is also an adjunct Assistant Professor in the Department of Biomedical Engineering at Stony Brook University, and she heads the NSLS Information & Outreach Office, which communicates NSLS science to other scientists, government officials, and the community.

— Liz Seubert

NSLS ONE OF 10 BNL ORGANIZATIONS TO ACHIEVE OHSAS 18001 REGISTRATION

January 19, 2006

Lab Director Praveen Chaudhari and Safety & Health Services Division Manager Pat Williams held a celebration on January 19, 2006 to show BNL's appreciation to the many dedicated employees who worked for 12 months to prepare seven organizations — the Superconducting Magnet Division (SMD), Basic Energy Sciences (BES) Directorate, Instrumentation Division, Physics Department, National Synchrotron Light Source (NSLS), Environmental & Waste Management Services (EWMS) Division, and Staff Services (SS) Division — for successful registration of their occupational safety management systems to Occupational Health & Safety Assessment Series (OHSAS) 18001.

OHSAS 18001 is widely acknowledged as offering one of the best guidelines available for safety

Among those who celebrated the successful registration of seven more BNL organizations to the OHSAS 18001 safety management standard are hosts Praveen Chaudhari (front, second from left) and Pat Williams (front, second from right); and, between them, from left: BNL organization representatives Tom Kirk, Sally Dawson, John Taylor, Robert Casey, Michael Clancy, and Veljko Radeka, with Jeff Swenson (front, left).

management systems and it is a significant enhancement of the Integrated Safety Management System that was already in place on site. In addition to the certificates of appreciation presented to all those in attendance, framed OHSAS 18001 Certificates of Registration were presented to Chaudhari as representing BNL, and to Tom Kirk for SMD, John Taylor for BES, Veljko Radeka for Instrumentation, Sally Dawson for Physics, Robert Casey for NSLS, Michael Clancy for EWMS, and Jeff Swenson for SS.

Together with the three pilot organizations that were successfully registered in September 2004 — the Central Fabrication Services Division, Collider-Accelerator Department, and Plant Engineering Division — BNL now has a total of 10 organizations' occupational safety management systems that have achieved OHSAS 18001 registration.

Regarding future plans for the Lab, Jim Tarpinian, Assistant Laboratory Director for Environment, Safety, Health, & Quality, explains, "In 2006, we will expand the OHSAS 18001 registration to include the balance of BNL organizations. The important thing for BNL is not the registration itself, but the processes of job-risk assessments, employee involvement, goals and objectives, management review, and continual improvement. OHSAS 18001 is a significant enhancement to our Integrated Safety Management System."

— Maria Beckman

JOINT PHOTON SCIENCES INSTITUTE ESTABLISHED

January 23, 2006

A new initiative in photon sciences will capitalize on the unique capabilities of NSLS-II.

A partnership between the DOE and New York State, the Joint Photon Sciences Institute (JPSI), will serve as an intellectual center for development and application of the photon sciences and as a gateway for NSLS-II users. It will enhance scientific programs that use the powerful photon beams by cultivating and fostering collaborative, interdisciplinary R&D.

New York State Governor George Pataki recently committed to providing $30 million for the JPSI building, which will be located next to NSLS-II and provide office space, meeting areas, and specialized state-of-the-art laboratories. The operating expenses of the institute and its research programs will be covered by funding from the federal government, including the Department of Energy,

New York State Capitol Building, Albany

the National Institutes of Health, the Department of Defense, and others. Research will be focused around several multi-year scientifically and technologically relevant research initiatives.

Over the past few decades, the power of photon sources has increased dramatically, and they are now used for a broad spectrum of research. Modern research increasingly requires interdisciplinary work that either spans multiple scientific disciplines or falls at the boundaries between them. JPSI will be an interdisciplinary institute devoted to basic research in areas of the physical sciences, engineering, and the life sciences that are united in employing synchrotron-based methods. JPSI will also develop new methods and applications that exploit the unique capabilities of NSLS-II.

JPSI will have great flexibility in making scientific appointments, encompassing both Brookhaven scientists and faculty from universities. Junior and senior fellowships and sabbatical programs will draw the best photon scientists from institutions worldwide for interactions with the resident staff and user communities. An important element of the institute's mission will be training new researchers and enabling established researchers to embark on new directions in interdisciplinary research. JPSI will also host interdisciplinary workshops that highlight new opportunities, foster new collaborations, and promote JPSI initiatives in emerging areas of photon science.

— Steve Dierker

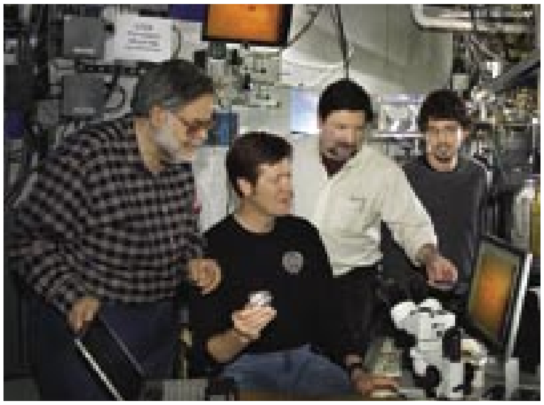
NSLS EXAMINES PIECES OF STAR DUST

January 25, 2006

Launched on February 7, 1999, Stardust's mission was to collect dust and carbon-based compounds from a passing comet, as well as tiny amounts of interstellar dust streaming toward Earth from deep space. Its delivery of this material marks the first time since Apollo 17 that a NASA spacecraft has successfully brought back a space-matter sample.

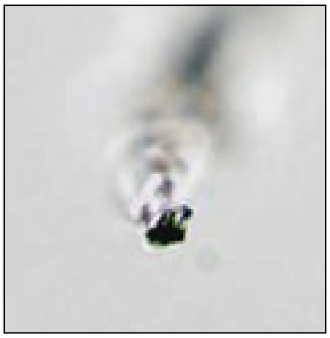
At the NSLS and other synchrotron facilities, portions of that teaspoonful-sized amount of comet and star dust was studied to determine its composition and properties. The variety of research techniques available at the NSLS allowed researchers to maximize the amount and type of information learned about the dust particles. The information scientists gather could help answer some very important, very fundamental questions about the formation of the solar system and the Earth in particular.

The initial analysis of these samples, known as the Preliminary Examination Period, began in the Stardust Laboratory at NASA's Johnson Space Center. Following these first studies, the samples were divided, prepared, and distributed to qualified investigators, including those at the NSLS, for more intensive studies. These scientists are members of the Stardust Preliminary Exam Team.



(From left) George Flynn (SUNY Plattsburgh), Lindsay Keller (NASA), Larry Carr (NSLS), and Randy Smith (NSLS) examine samples from the Stardust mission at beamline U10A.

At the NSLS, analyses took place at beamline X26A, led by physicist and Stardust co-investigator George Flynn (SUNY Plattsburgh). Flynn is leading a worldwide group of scientists who will perform chemical composition measurements on the comet samples collected by Stardust. The extremely tiny and bright x-ray beams produced at beamline X26A are an excellent tool for analyzing the particles, which are just 10-20 millionths of a meter in diameter (so small that five particles fit across the width of a single human hair). Using these capabilities, the X26A scientists were able to extract chemical and mineralogical information from the sample without the need to remove the dust particles from the "aerogel" substance used to capture them in space.



Stardust particle (crystalline object with dark borders), embedded in the aerogel collector. (Photo courtesy of NASA)

After the particles were extracted from the aerogel, they were analyzed at other beamlines using both x-rays (X1A1), and infrared light (U10A and U10B). At beamline X1A1, a powerful imaging device called a scanning transmission x-ray microprobe (STXM) was used to collect detailed images of the particles. The STXM employs a technique known as x-ray absorption near-edge structure (XANES) to gather information about the elemental makeup of the particles, especially the carbon found in organic compounds. Flynn's studies using the STXM can identify organic compounds within some of the smallest Stardust particles - compounds that may have formed at the birth of our solar system.

In a concurrent set of studies, Flynn and Stardust co-investigator Lindsay Keller used infrared light to identify specific minerals within the dust particles. Keller, who leads the group of scientists who will perform optical studies of the Stardust samples, is a lunar and planetary scientist with NASA's Johnson Space Center. The far-infrared microscope at beamline U10A, which can sense the unique vibrations of atoms in crystalline solids, is an excellent tool for identifying specific minerals within the Stardust sample. The mid-infrared light produced at beamline U10B was also used to characterize any organic material found in the particles. Unlike x-ray methods, the information collected using these infrared techniques can be compared with the astronomical observations of distant interstellar dust clouds, including those involved with the formation of planetary systems like ours.

— Laura Mgrdichian

TWO NSLS STAFF MEMBERS AWARDED FOR JOBS WELL DONE

February 2, 2006

Congratulations are due to Peter Siddons and Nick Gmur, who, respectively, recently were honored with a Science & Technology Award and a Brookhaven Award at the Fiscal Year 2006 BNL Employee Recognition Award Ceremony on February 2.

Peter Siddons

Siddons, a physicist at the NSLS, was cited for his outstanding contributions to developing detectors for use in synchrotron sources. His ideas were recognized as innovative and original, resulting in new and unique detectors that make new experiments feasible. He is a strong advocate and leader in the U.S. for detector development and has made significant advances possible despite the lack of funding in this area. Over the last several years, Siddons has directed the NSLS detector and control group and, in collaboration with BNL's Instrumentation Division, has developed a suite of detectors. These included fast photon counting detectors for different energy ranges and applications, linear array detectors, and two-dimensional detectors. The detectors have been delivered to users with great success, and have made significant impact on scientific programs at the NSLS and elsewhere. Also, the detector group under Siddons' direction has gained worldwide recognition for the NSLS and BNL. For example, recently BNL was awarded a multi-year project to construct two imaging detectors for the Linear Coherent Light Source project at Stanford Linear Accelerator Center. Facilities in England, Australia and Taiwan as well as at Argonne National Laboratory are interested in or already actively collaborating with Siddons' group. He received his Ph.D. in physics at Kings College, London, and joined BNL in 1985.

Peter Siddons (second from left) at the BNL Employee Recognition Award Ceremony with the other Science & Technology Award winners. They are Stephen Schwartz of the Environmental Sciences Department (far left), James Alessi of the Collider-Accelerator Department (second from right), and Peter Vanier of the Nonproliferation & National Security Department (far right). Not pictured: Alexei Tsvelik of the Condensed Matter Physics & Materials Science Department.

The Science & Technology Award (presented by Peter Bond, Deputy Interim Director for Science & Technology) recognizes distinguished contributions to BNL's science and technology mission over one or more years. Nominations for the Science & Technology Award are made by organization heads. The three criteria considered for this award are the exceptional nature of the employee's contributions, their level of difficulty, and their benefit to BNL.

Nick Gmur

Gmur was cited for his outstanding work as the NSLS Environmental Safety & Health (ESH) Coordinator. In this role, he is involved in many activities within the department that carry into almost every part of all programs. He has been a key contributor to challenging ESH issues at the NSLS that include implementing requirements for BNL's Integrated Safety Management program and the internationally recognized ISO 14001 and OHSAS 18001 programs. Other major achievements included writing, conducting, and coordinating reviews and implementing the accelerator authorization basis documents for the Deep-Ultraviolet-Free Electron Laser, the NSLS and Accelerator Test Facility, and the NSLS Environmental Assessment required by the National Environmental Policy Act. In addition, Gmur resolves many smaller issues daily. He is recognized for his leadership, for bringing great attention to quality and detail, and for always getting the job done on schedule. He is widely respected throughout BNL for his efforts and is an excellent representative of the NSLS. Gmur, who came to BNL in December 1975, has a B.S. in zoology and chemistry from McGill University and an M.S. in biology from the University of Michigan.

Brookhaven Award winner Nick Gmur (second from left) at the awards ceremony with the other Brookhaven award winners. Also presented with Brookhaven awards were (from left) John DiNicola (Plant Engineering Division), Raymond Karol (Collider-Accelerator Department), Gerard Shepherd (Safety & Health Services Division), and Peter Stelmaschuk (Plant Engineering).

Presented by Laboratory Director Praveen Chaudhari, the Brookhaven Award recognizes key contributors in support functions whose performance and achievements represent outstanding service to the Laboratory. Nominees for the Brookhaven Award are evaluated by the exceptional nature and difficulty level of the contributions, their benefit to the Laboratory, and the length of time over which the contributions were made.

— Laura Mgrdichian

NSLS RESEARCHERS PRODUCE A PRAISEWORTHY POSTER

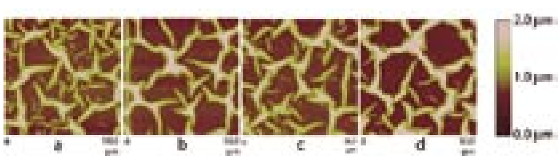
March 1, 2006

At the Materials Research Society semi-annual meeting, an NSLS research group received a special honor. Its meeting poster, one of hundreds, was chosen as one of only six to receive a “best poster” award.

Elaine DiMasi (left) and poster presenter Karthikeyan Subburaman.

The group, which includes scientists from Stony Brook University, Brookhaven National Laboratory, and the City University of New York, is studying “biomineralization,” the process by which organisms create mineralized tissues, such as bones, teeth, and shells. The collaboration includes NSLS scientist Elaine DiMasi, as well as Karthikeyan Subburaman (SBU), Nadine Pernodet (SBU), Seo-Young Kwak (BNL), Shouren Ge (SBU), Nan-Loh Yang (CUNY), and Miriam Rafailovich (SBU). They presented their poster at the MRS Fall 2005 meeting, held November 27 through December 1 in Boston, Massachusetts.

Biominerals are interesting, in part, because they are typically much stronger than ordinary minerals. As such, they may one day be used to create a new class of nanoscale composite materials. First, however, the underlying mechanisms of biomineral formation and structure must be better understood.



Elastin protein networks imaged by AFM (a) before mineralization and after (b) 30, (c) 60, or (d) 120 minutes of exposure to mineral. The fibrous parts of the protein become thicker and stiffer as they induce calcium carbonate mineralization.

The group’s winning poster is a summary of their research on eggshell protein mineralization. They use this as a model to study biomineralization in general, since the formation of an eggshell can be thought of as a process that includes a series of steps. First, the shell’s support membrane is formed and proteins are deposited onto it. Then, the minerals that make up the shell begin to form and grow, using the protein deposits as nucleation points. Finally, the mineral forms a crystal structure on top of the protein-fiber network.

The researchers studied this process using real “extracellular matrix proteins” — the type of proteins that make up skin tissue, for example. They used networks of these proteins as the basis of the mineralization process and then studied the mineralized proteins using a powerful imaging device called an atomic force microscope (AFM).

As described in their poster, their results show that, at the eggshell’s early growth stages, only the fibrous portions of the proteins accepted calcium carbonate, the mineral. The fibers became thicker as the calcium was incorporated and, ultimately, large mineral crystals appeared. The group hopes to build on these results by learning exactly how the proteins induce the mineralization process.

— Laura Mgrdichian

GENERAL BARRY MCCAFFREY TOURS THE NSLS

March 1, 2006

During a visit to BNL on March 1, Barry McCaffrey, a retired four-star general from the U.S. Army, toured the NSLS.

McCaffrey came to BNL with a view to using his specialized experience to help the Laboratory focus on ideas to increase its sponsorship in areas related to homeland security and the understanding and treatment of drug addiction.

At the NSLS, he was guided on a tour of the beamline floor by NSLS scientist Peter Siddons, who explained how the facility works and gave an overview of the science done. McCaffrey expressed interest in the range of scientific research that is performed at the NSLS, the type of users (academic, industry, etc.), and how the NSLS facility is organized.

McCaffrey’s visit also included tours of the Positron Emission Tomography imaging facility, the Radiation Detector Testing and Evaluation Facility, and labs developing nuclear-detector instrumenta-

From left, General Barry McCaffrey, Ralph James (BNL-EENS), Gabriella Carini (BNL-EENS), Peter Siddons (BNL-NSLS), and Alexey Bolotnikov (BNL-EENS).

tion. This gave him first-hand contact with several BNL scientists and an opportunity to learn more about some of the Lab's research and development programs.

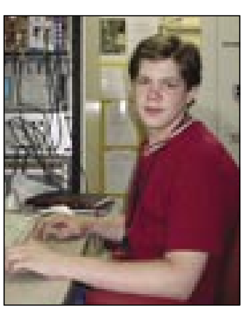
McCaffrey, who served as the Commander in-Chief of the U.S. Armed Forces Southern Command, coordinating all national security operations in Latin America, also served as the Director for Strategic Plans and Policy on the Joint Chiefs of Staff. In addition, he followed this distinguished record by serving as Director of the Office of National Drug Control Policy under President Bill Clinton from 1996-2001.

— Laura Mgrdichian

NSLS STUDENT-RESEARCHER TALKS AT THE MARCH APS MEETING

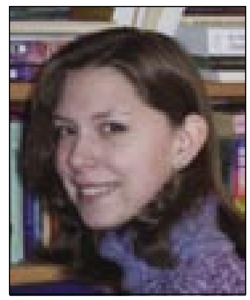
March 13-16, 2006

Each year, the NSLS hosts several high school and college students, who come to the facility to perform research using its bright beams of x-ray, ultraviolet, and infrared light. This year, four of these students presented the results of their research at the March meeting of the American Physical Society (APS) in Baltimore, Maryland.



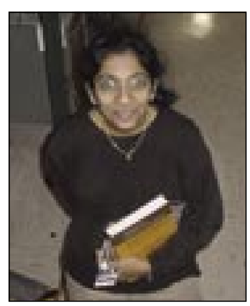
Michael DiBiccari

Michael DiBiccari, a senior at Hauppauge High School in Hauppauge, New York, worked with NSLS biophysicist Elaine DiMasi. His project was part of a wider research effort on the study of biomineralization, the process by which living organisms produce minerals, such as shell and bone. He studied diatoms — single-celled algae with outer shells composed of biosilica, a type of biomineral. DiBiccari used x-rays to identify the atomic structure of the biosilica, which he then compared to the structure of synthetic silica. His results showed that the structures of both materials were identical. He discussed this research and its implications on March 16, 2006, at 1:15 p.m. in Room 323 of the Baltimore Convention Center.



Kathryn Krycka

Two graduate students working at the NSLS also gave talks on their research. **Kathryn Krycka**, from Stony Brook University, works with NSLS scientist and chair Chi-Chang Kao and Professor Sara Majetich of Carnegie Mellon University. Using an x-ray technique known as small-angle resonant x-ray scattering, she studied the size and internal structure of magnetic nanoparticles, which often consist of metal-only cores surrounded by thin metal-oxide shells. This work is important for understanding the magnetic properties of nanoparticle systems. In her talk, on March 14, 2006 at 9:24 a.m. in Room 319 of the Baltimore Convention Center, she discussed her recent work on cobalt-oxide nanoparticles.



Raji Sundaramoorthy

Raji Sundaramoorthy, a student of NSLS user scientist and collaborator Alex Weiss from the University of Texas at Arlington, worked with NSLS scientist Steve Hulbert. She studied photon-stimulated "Auger" decays in solids, a type of multi-electron decay. In this process, an incoming x-ray photon creates a "hole," or positively charged electron vacancy, in one of the atom's core levels. The hole then is filled by an electron that jumps down from a higher electron orbital, which in turn causes an electron (the Auger electron) to be ejected from the solid. An Auger decay often results in a cascade of additional decays, leaving the atom ionized. At the NSLS, Sundaramoorthy closely studied this process in the compound manganese oxide, and compared her results to that of silver and palladium. Her talk took place at 10:12 a.m. on March 13 in Baltimore Convention Center Room 311.

Samantha Palmaccio, another high school student working with DiMasi, attends Sachem High School in Farmingville, New York. She investigated the biomineralization of protein fibers, which is one step in the process by which many organisms form shells. Recently, she studied the “growth” of the mineral calcium carbonate on a protein-fiber network. Her results show that the strength of the mineral increases over time as it covers the fibers. This is unlike stand-alone calcium carbonate. Additionally, using a powerful microscope, she was able to study the crystal structure formed by the mineral. Palmaccio presented her results on March 13, 2006, at 8:24 a.m. in Room 326 of the Baltimore Convention Center.

“The NSLS considers education to be an important part of its scientific program and mission,” said Kao. “As is also evident by these talks, students at the NSLS are working on a wide range of exciting research topics.”

— Laura Mgrdichian

NEW WRINKLE IN THE MYSTERY OF HIGH-T_C SUPERCONDUCTORS

March 13-16, 2006

In the 20 years since the discovery of high-temperature (Tc) superconductors, scientists have been trying to understand the mechanism by which electrons pair up and move coherently to carry electrical current with no resistance. “We are still at the beginning,” says Tonica Valla of the Condensed Matter Physics & Materials Science Department (CMPMS), who gave a talk on his group’s latest results at the March American Physical Society meeting in Baltimore, Maryland. “If anything,” he adds, “it looks as if the story is getting more complicated.”

The research of Valla and his group, which includes Alexei Fedorov, now of Lawrence Berkeley National Laboratory’s Advanced Light Source, and Peter Johnson and Genda Gu, both of CMPMS, was funded by the Office of Basic Energy Sciences within DOE’s Office of Science. In 1999, Valla’s group was the first to observe a “kink” in the energy level of electrons in high-Tc superconductors just as they went through the transition temperature from their normal to superconducting state. The kink was the first clue to explaining what the mechanism of electron pairing might be. “The kink gave us the hope that we could identify the interaction that was responsible for the electron pairing,” Valla said. Some groups hold that the mechanism is the same as in conventional superconductors — that is, that phonons, or vibrations in the crystal lattice, are responsible for electron pairing. Other scientists believe that changes in the spin alignment, or magnetic polarity, of adjacent electrons — known as magnons — are responsible. “The problem is that there are both phonons and magnons in the crystal with the energy where we see the kink, so it is still not clear,” Valla says.

The latest wrinkle uncovered by Valla’s group is the observation of similar energy scales and gaps in a material that is not a superconductor. The material is a special form of a compound made of lanthanum, barium, copper, and oxygen, where there is exactly one barium atom for every eight copper atoms. With less or more barium, the material acts as a high-Tc superconductor (in fact, this was the very first high-Tc superconductor discovered). But at the 1:8 ratio, the material momentarily loses its superconductivity.

Tonica Valla

“The fact that this system, which is not a superconductor, has similar properties to the superconducting system is not helping to solve the mystery,” Valla says. But then he notes that 20 years since the discovery of high-Tc superconductors is still not that long. “For conventional superconductors,” he says, “it took about 50 years to come up with a good explanation for the behavior.

”Valla’s talk was part of a session on the use of angle-resolved photoemission spectroscopy in the study of high-Tc superconductors. It included a discussion of advances in this technique. His group uses bright beams of ultraviolet light at beamline U13UB at BNL’s National Synchrotron Light Source to emit electrons from the samples they are studying. Using high-resolution spectrometers, the scientists measure the energy and the angle at which the electrons exit the crystal, allowing them to reconstruct the electrons’ state while in the crystal — their energy level and whether they had any interactions with phonons and/or magnons.

— Karen McNulty Walsh

CERIUM OXIDE NANOTUBES GET NOTICED

March 28, 2006

Chemists and materials scientists often study "nanotubes" — capsule-shaped molecules only a few billionths of a meter (nanometers) in width. In nanotube form, many materials take on useful, unique properties, such as physical strength and excellent conductivity. Carbon nanotubes are the most widely investigated variety. Now, in pioneering research, scientists at Brookhaven National Laboratory have created and investigated the properties of nanotubes made of a different, yet equally interesting material: cerium oxide.

"Cerium oxide nanotubes have potential applications as catalysts in vehicle emission-control systems and even fuel cells," says Brookhaven chemist Wei-Qiang Han, the lead scientist involved in the work. "But until very recently, they haven't been studied."

Han and his colleagues are in the midst of ongoing research into the structure and properties of cerium oxide nanotubes. As part of this, they have devised a method to synthesize cerium oxide nanotubes of high quality. First, they allow the compounds cerium nitrate and ammonia hydroxide to chemically react. Initially, this reaction forms "one-dimensional" nanostructures, such as rods and sheets, made of the intermediate product cerium hydroxide. The intermediate product is then quickly cooled to zero degrees Celsius, which freezes those structures into place. By letting the chemical reaction proceed over a long period of time, a process called "aging," the hydrogen is eventually removed from the intermediate product and a large quantity of the desired end product — cerium oxide nanotubes — is formed.

Han discussed this synthesis method at the American Chemical Society National Meeting in Atlanta, Georgia. During his talk, Han also discussed his group's recent study — how cerium oxide nanotubes release oxygen ions when immersed in a low-oxygen environment, a process that is critical to the nanotubes' effectiveness as catalysts. To do this, the researchers used several techniques. These include "transmission electron microscopy," a very powerful imaging technique, and two x-ray techniques, which they performed at NSLS beamline X19A.

Wei-Qiang Han

"We're interested in studying oxygen-atom vacancies in cerium oxide nanotubes because, when combined with their other surface features, these vacancies may make them more functional and effective in the applications mentioned," Han said.

This work was funded by the Office of Basic Energy Sciences within the U.S. Department of Energy's Office of Science.

— Laura Mgrdichian

FUTURE CRYSTALLOGRAPHERS ATTEND RAPIDATA 2006 AT NSLS

April 23-28, 2006

Once again, 48 future crystallographers from around the world gathered at BNL for RapiData 2006. This week-long course is designed to introduce students to the best and latest equipment and techniques. The students also get to meet and learn from the leading developers of software for macromolecular x-ray crystallography.

The students and instructors, RapiData class of 2006

The course has been offered annually since 1998 by BNL's Biology and National Synchrotron Light Source (NSLS) departments. It reflects the educational component of the PXRR (Macromolecular Crystallography Research Resource), funded jointly by the National Center for Research Resources — a branch of the National Institutes of Health (NIH) — and DOE's Office for Biological & Environmental Research. The course's usefulness to the nearly 400 participants since its inception is apparent from the constant numbers of new students who sign up each year. Many of these budding crystallographers are now becoming experts in the field and sending others from their institutions to BNL to learn the initial steps of this highly specialized area of interest.

This year's course, which ran from April 23-28, began with three days of lectures and tutorials taught by scientists from BNL, industry, academia, and other national labs. Then the beamline staff and other teachers guided the students through a marathon, 60-hour data-collection session, which eventually employed six NSLS beamlines for the whole time, and three others to help out as needed. At the same time, nine different tutorials were underway. As usual, half of the students came with their own specimens to analyze, while the other half learned as observers.

Said Bob Sweet of Biology, who, with Denise Robertson and Alex Soares, primarily organized the course, “This program excites both the students and the teachers by providing a short ‘total immersion’ in this technology. Students learn how to obtain and process real data, learning how to locate and fix problems as they arise. It’s a gripping experience. About half a dozen of the students left with potentially publishable results. This is inspiring to everyone in the course.

“The students find that there is always a hands-on scientific supervisor available to give expert help, so they can set up experiments in the optimal way, or find out the next step without wasting time,” continued Sweet. “We depend on so many team members for the program’s success: many members of the PXRR (the Biology and NSLS Macromolecular Crystallography Research Resource), NSLS staff members, and about 18 outside teachers.”

In addition to the DOE and NIH funding, a special grant was provided by the International Union for Crystallography and the US National Committee for Crystallography to assist half a dozen Latin American students in attending the course. Additional support is provided by Brookhaven Science Associates, the NSLS, and several very generous equipment vendors and drug companies.

— Liz Seubert

STUDENTS EXPERIENCE THE NSLS VIA WEBCAST

April 25, 2006

More than 20 chemistry and earth-science students from Sayville High School participated in a unique data-analysis project at NSLS beamline X15B — without ever entering the NSLS. Via webcast, they watched as their teachers, assisted by scientists from Stony Brook University’s (SBU) Geosciences Department and Brookhaven Lab’s Environmental Sciences Department, analyzed soil samples from a creek near the school. This arrangement, which could become a model for other schools nationwide, allowed an entire classroom

Participants in the X15B webcast, from left: Janet Kaczmarek, Paul Northrup, Adriana Adler, Mirza Beg, and Jen Clodius.

of students to remotely observe and interact with their teachers in real time. Thus, they were able to share in the research experience without being present.

The soil samples were taken from various locations along the creek, from wetlands to uplands, and from various depths. The students have studied water and soil samples from the creek in past work, but this exercise provided the first molecular-scale information about the soils.

On April 25, as the students watched over the web (using VRVS, the Virtual Room Videoconferencing System), teachers Adriana Adler and Janet Kaczmarek analyzed the samples at the NSLS to determine what types of sulfur compounds were present in the soils, and in what amounts. Adler and Kaczmarek (who teach chemistry and earth science, respectively) mounted the samples into the “hutch box” located at the beamline and scanned each sample with a beam of x-rays. This resulted in a set of x-ray absorption “spectra” for sulfur — measurements that show how the sulfur compounds in the soils absorbed the x-rays. Since every compound absorbs x-rays differently, this analysis uncovered the identity and relative amount of each sulfur compound present. The proportions of these compounds reveal important information about the soil samples and the wetlands ecosystem, such as how organic matter decays in soils at different depths and under different conditions. The sulfur compounds can also indicate how environmental contaminants will behave in the wetlands.

As Adler and Kaczmarek worked at the beamline, they were able to see their students. Simultaneously, their students could see them. Thus, the webcast provided valuable two-way interaction.

“The webcast was a fantastic experience for students,” said Adler. “We attempt to provide many opportunities for hands-on laboratory exercises for our students. Bringing the NSLS beamline ‘into the classroom' and allowing students to direct experiments at the NSLS from the classroom opened a valuable teaching tool for us at Sayville High School."

Kaczmarek commented, "This was an invaluable experience both for myself and the high school students involved with the webcast. I don't think many high school students can say that they were part of an experiment run at world-known BNL. I see much potential with this type of educational outreach and the benefits to all parties involved. It is all very exciting."

The webcast stems from a Research Experience for Teachers (RET) project called "High School Teacher Training in an EMSI: Bringing First-Hand Research Experiences from the Lab to the Classroom," which is being conducted at the Center for Environmental Molecular Science (CEMS) at SBU. This project is a collaboration between CEMS and an initiative within the Brookhaven Lab Office of Educational Programs (OEP) called "Building Leadership to Expand Participation in Environmental Molecular Science." Both programs are funded through National Science Foundation (NSF) supplements to CEMS, which is a collaboration between SBU Geosciences and BNL Environmental Sciences departments and is co-funded by the NSF and the U.S. Department of Energy. As part of the RET program, both Adler and Kaczmarek have undergone research training at CEMS, focused on the integration of molecular-scale approaches for studies of environmental chemistry. Both teachers also attended an NSLS-sponsored introductory seminar on x-ray absorption spectroscopy applications.

The CEMS personnel who enabled this project include Richard Reeder (Director of CEMS and Professor of Geoscience at SBU), Mirza Beg (Environmental Education Specialist at CEMS), Paul Northrup (CEMS Principal Investigator from BNL's Environmental Sciences Department), and Marianna Kissell (a CEMS graduate student conducting research at NSLS beamline X15B). The project was also enabled by OEP personnel, including Ken White (OEP Manager), Jen Clodius (Senior Educational Programs Representative), and Scott Bronson (Educational Programs Administrator). OEP provided guidance on the use of the VRVS technology and made the broadcast successful. Clodius coordinated the webcast at the beamline, while Bronson managed it at the school.

Students tune in to the X15B webcast.

Northrup, a beamline scientist for X15B, devoted beam time, as well as his own time and expertise, to the project. His efforts were critical to the project's success. Northrup, along with Kissell, also provided scientific support to the teachers. Administrative support was provided by the chair of the Science Department at the Sayville High School, Brian Vorwald. Mike Tabor, head of the school's Technology Department, provided computer and network support.

The outcome of the webcast was very positive. It generated considerable interest among the students. During the experiment they asked questions about x-ray absorption spectroscopy, beamline operation and safety procedures, the results of the analysis, and the NSLS in general. The organizers of the webcast are hopeful that this event could serve as a pilot for other scientific facilities and schools across the country.

Northrup and beamline X15B are supported by the Office of Biological and Environmental Research (Environmental Remediation Sciences Division) within the U.S. Department of Energy's Office of Science, through the BNL EnviroSuite initiative.

— Laura Mgrdichian

NSLS' YOUNGEST SCIENTISTS LEARN FROM LIGHT ON 'TAKE OUR DAUGHTERS AND SONS TO WORK' DAY

April 27, 2006

On April 27, more than 30 daughters and sons of NSLS users and staff learned about some of the scientific programs at the NSLS, and even performed their own scientific experiments. The one-day visit was part of the national "Take Our Daughters and Sons to Work Day."

Upon arriving at the NSLS, the children learned that the facility produces many types of light, from microwaves to x-rays, and that this light has many applications in many fields, including electronics, catalysis, microscopes, and medicine. Then the fun started!

This year's program focused on liquid nitrogen, which is used by most scientists at the NSLS. The children were taken down to the NSLS experimental floor, where they were given 30 minutes

Participants in the 2006 "Take our Daughters and Sons to Work Day" at the NSLS

to count the number of beamlines that used liquid nitrogen. They questioned beamline scientists and learned that liquid nitrogen is used for cooling samples, detectors, magnets, and monochromators. Upon summing the beamlines at the end of the tour, the children were amazed to find that more than 40 beamlines use liquid nitrogen on a daily basis.

Next, the children experienced the wonders of liquid nitrogen first-hand. By immersing an inflated balloon in liquid nitrogen, they discovered that the air inside of the balloon contracts, and then re-expands when warmed up. The children also learned that a tiny pinhole in a ping pong ball will cause the ball to spin wildly after being removed from liquid nitrogen. Other experiments included making a liquid nitrogen banana-hammer and an "ice egg" with a water balloon. They also listened to a "boiling" tea kettle and learned about the wonders of superconductivity, a phenomenon that becomes possible when certain materials are cooled to very low temperatures using liquid nitrogen.

But perhaps the most memorable experiment was the "grand finale": The students mixed cream, sugar, and strawberries with liquid nitrogen to make the fastest (and perhaps tastiest) ice cream ever.

— Laura Mgrdichian

NSLS BIOPHYSICIST LISA MILLER AWARDED TENURE

May 1, 2006

Brookhaven Science Associates (BSA) granted tenure effective May 1 to six BNL scientists: Wolfram Fischer, Collider-Accelerator Department; Frithjof Karsch, Physics Department; Lisa Miller, National Synchrotron Light Source Department; Peter Steinberg, Chemistry Department; Daniel van der Lelie, Biology Department; and Vitaly Yakimenko, Physics.

At the NSLS, Miller was awarded tenure for her outstanding research in the application of spectroscopic synchrotron imaging probes in the biomedical field, her leadership in building a new synchrotron user community, and her extensive outreach activities.

Miller earned her Ph.D. in biophysics from the Albert Einstein College of Medicine, where she is still a visiting assistant professor in the Department of Medicine. She joined the NSLS as an assistant biophysicist in 1999, rising to biophysicist by 2003. Since then, she has most fully developed her research in the areas of mineralization in bone and aberrant protein folding, which are of central importance respectively in osteoporosis and in neurological diseases such as Alzheimer's and scrapie. Concerning the scientific impact of her bone research, for example, she is recognized as having provided unique insights into the site-specific chemical composition of bone that are important for both industrial and academic researchers.

Said NSLS Chair Chi-Chang Kao, "Lisa has made major contributions to research in bone and protein-folding diseases and to the development of synchrotron-based biomedical imaging techniques. She is widely recognized for the creativity and originality of her work, which has resulted in a superb record of publications, invited talks, and funded proposals. The very active user program in biomedical imaging that she has developed at infrared beamline U10B is being emulated at other facilities. Her leadership, educational supervision, and outreach activities are outstanding, and she is truly a valuable member of the NSLS staff."

Lisa Miller

Miller was honored in 2002 with a DOE Outstanding Mentor Award and in 2005 by Brookhaven Town for outstanding contributions to science and the community. She is also an adjunct assistant professor in the Department of Biomedical Engineering at Stony Brook University.

— Liz Seubert