Unlocking Secrets of Titanium
New research may lead to better catalysts for hydrogen fuel cells

Scientists at BNL and the New Jersey Institute of Technology (NJIT) have taken steps toward understanding how a titanium compound reacts with a hydrogen-storage material to catalyze the release and reabsorption of hydrogen. Their results, appearing in the July 19, 2004, issue of Applied Physics Letters, may help scientists learn how similar catalysts work, how to improve the catalyst, and how to use it to reversibly release and reabsorb hydrogen.

In a sense, the titanium acts like a molecular “key,” a crucial component of the compound — individual crystalline grains — disrupts the flow of electrons, said Yimei Zhu of BNL’s Center for Functional Nanotechnology (CFN), who led the research.

But for practical applications in which large electric currents need to be transported, such as power cables, the polycrystalline forms must be used. These polycrystalline materials carry a very low current compared to their single-crystal counterparts,” he said.

(continued on page 2)

On the Fast Track
International Symposium on Ultrafast Accelerators for Pulse Radiolysis

The International Symposium on Ultrafast Accelerators for Pulse Radiolysis was held on June 25-28, at BNL’s Chemistry Department. The meeting’s purpose was to review the state of the art in ultrafast accelerators for pulse radiolysis, a technique that uses a pulsed beam of high-energy electrons to initiate and explore chemical reactions.

Participants met to discuss common experiences and challenges that various groups have encountered, to disseminate solutions that have been developed, and to look forward to new developments and capabilities. Forty people attended, representing 14 institutions in seven countries. The meeting, which was sponsored by Advanced Energy Systems of Medford, NY, and Brookhaven Science Associates, was organized by James Wishart and colleagues, including John Miller, Andrew Cook, Alison Funston, and Diane Cabelli, all of Chemistry.

Chemistry’s Laser-Electron Accelerator Facility (LEAF) was the first ultrafast pulse radiolysis facility in the world to be based on the radio-frequency (RF) photocathode electron gun accelerator technology pioneered by the BNL Accelerator Test Facility and other groups. There are now eight RF photocathode accelerator-based pulse radiolysis facilities in operation or under construction worldwide, and more have been proposed. In addition, there are several high-power laser-based radiolysis systems under development. Said Wishart, “The new technologies are making ultrafast pulse radiolysis accessible to more chemists in more countries than ever before, and leading to a resurgence in the field of radiation chemistry.”

The symposium included technical sessions on the design and performance of accelerator systems, experimental detection systems for ultrashort pulse radiolysis, experimental applications of these facilities, and technical round tables on operating experiences, problems and solutions in particular areas of concern for these specialized facilities. For more information and PDF files of the presentations, go to www.chem.bnl.gov/SciTech/PRC/ultrafast-accel.html.
Teachers, Students Build Cosmic Ray Detectors at BNL for Data Collection During School Year

A part of QuarkNet, an educational outreach program sponsored by the National Science Foundation and the Division of High Energy Physics within DOE’s Office of Science, 21 high school students from across Long Island will spend a week at BNL in early July building cosmic ray detectors that they will use to capture cosmic rays and collect data. The goal of QuarkNet is to introduce high school students and teachers to the frontier of 21st century research that seeks to learn about the mysteries and structure of matter.

Helio Takai, a scientist in the Physics Department, is leading the team of 21 students and three student coordinators through the QuarkNet program. Assisting Takai are Denis Damazio, Linda Feierabend, Ken Sexton, and Andrew Hoffmann, all of Physics; Tom Feierabend, Physics guest consultant; Tara Falzone, Office of Educational Programs (OEP); and Kenneth White, OEP Manager.

“We have been mentoring the teachers for the last four years. This is the first year the students have joined the program and it’s been a wonderful experience for all,” said Takai. “We are all looking forward to the data collection and analysis portion of the program. This is just the beginning of a long-term partnership linking scientists, teachers, and students with the physics community.”

Suffolk County Community College (SCCC) Among the program participants, Joe Sudemier, a teacher at Deer Park High School, worked side by side with his daughter Julie, a student coordinator for the program who attends Renaissance Polytechnic Institute. Sudemier’s daughter, a junior at BNL, is also part of the QuarkNet program and it’s been a wonderful experience for all, he said.

“Working together on building a cosmic ray detector are: (clockwise, from left) Dan O’Sullivan, Ward Melville High School student; Hello Takai, BNL Physicist; Michelle Kooi, Deer Park High School student; Harry Stuckey, Garden City High School physics teacher; and Jennifer Corbin, Roosevelt High School student.”

Unlocking Secrets of Titanium Aluminate

Both of NJIT’s first prepared two titanium-doped samples by mechanically mixing titanium chloride and sodium aluminate using a planetary mill, a device that grinds substances together using marble-sized metal spheres. They then prepared two additional samples from each doped sample (for a total of six): a dehydrogenated (containing no absorbed hydrogen) and a hydrided sample. By working with both types, the researchers were able to study the titanium’s properties before and after hydrogen absorption. This gave them one more way to determine the titanium’s role in the reaction.

The group probed the samples with high-energy x-rays at beam line X19A at the National Synchrotron Light Source, a BNL facility that produces intense beams of x-ray, ultraviolet, and infrared light for research. Because every compound and element on Earth absorbs x-rays differently, having a unique “signature,” the researchers were able to compare the six sample signatures to those of different titanium compounds and pure titanium. From this, they determined that the chloride is bonded with sodium aluminate to titanium aluminate.

“Our finding is the first step toward an even more interesting discovery: determining exactly how hydrogen bonding to titanium aluminate helps the hydride release and re-absort hydrogen,” Graetz said. “Understanding that mechanism may help us identify better catalysts for the reverse reaction and help us fund dopants for new compounds that are currently impractical energy-storage materials, due to the high temperature and pressures required for the release and re-absorption of hydrogen.”

— Laura Mgrdichian

For more information, see www.bnl.gov/bnlweb/pubaf/pr/2004/bnlpr060704.htm.

Teaching Strategies

A good teaching strategy is to create an engaging and interactive learning environment that encourages students to participate actively in the learning process. This can involve using a variety of teaching methods, such as group discussions, problem-solving activities, and hands-on experiments. Additionally, it is important to create a supportive and inclusive classroom culture where all students feel valued and are motivated to learn. This can be achieved by fostering a positive relationship with students, providing clear and consistent expectations, and creating opportunities for students to reflect on their own learning and growth.

— Laura Mgrdichian

For more information, see www.bnl.gov/bnlweb/pubaf/pr/2004/bnlpr060704.htm.

Calendar of Laboratory Events

• The RIKEN Institute is located in Berkeley and offers two-week workshops on research in advanced areas of laboratory science. Contact: RIKEN Institute, 5101 University Ave, Berkeley, CA 94704.

• Additional information for Rikagaku (RIKEN) Institute is available online at www.riken.org.

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The U.S. Department of Energy (DOE) is seeking public comment on the proposed cleanup plan for the Brookhaven Graphite Reactor (BGRR) at BNL. The public comment period will be open from Monday, August 2, to Friday, September 3, 2004. The Proposed Remedial Action Plan for the Brookhaven Graphite Reactor and its accompanying Feasibility Study will be available starting next Monday on the BNL website at www.bnl.gov/rgrr and in local libraries.

The BGRR, which was the first reactor in the U.S. built solely to perform scientific research on peaceful uses of the atom, operated from 1950 to 1969. Deposition of the facility was initiated in September 1969, and the last BGRR fuel element was removed in March 1972. The BGRR complex consists of several structures and systems that were used to operate and maintain the research reactor. Some parts of the equipment, structures, and soils are still contaminated.

As a result of these conditions, the BGRR currently contains approximately 8,047 curies of radioactive contaminants, including hydrogen-3 (tritium) and carbon-14, and fission products cesium-137 and strontium-90. The pile and biological shield contain over 99 percent of the remaining radiological inventory in the BGRR complex. Over the past five years, several interim cleanup actions have been completed, and others are now planned or under way.

Based on earlier investigations and input received from Brookhaven Lab's regulatory agencies and members of the public, DOE developed four cleanup alternatives for the graphite reactor. All four alternatives include the completion of actions that are currently under way or planned, followed by long-term response actions, including water-infiltration management, surveillance and maintenance, and institutional controls.

Early input received from the community and regulatory agencies indicated a strong preference for removal of the reactor pile and biological shield. After considering that and all other input, the U.S. Department of Energy is recommending Alternative "C" as the preferred cleanup remedy because it represents the best balance of the U.S. Environmental Protection Agency's criteria for selecting remedies and it best protects the surrounding environment.

The final cleanup agreement, which will be e-mailed to tellDOE@bnl.gov, or faxed to Ext. 3444.

Anyone who is thinking about buying new tires should refer to the U.S. Department of Transportation's online Tire Safety Guide before purchasing.

Arrivals and Departures

None

Retirement Counseling

A TIAA-CREF representative will visit BNL on Friday, August 7, to answer employees' questions regarding the TIAA-CREF retirement plan, such as: TIAA and CREF options, options with financial advisor, and retirement options. For an appointment, call 800-842-2733, Ext. 7980.

On-Site Service Station Tip of the Month

Anyone thinking about buying new tires should remember that mixing tire types or sizes, or new with partially worn tires may cause unpredictable handling, braking, or loss of vehicle control. New tires should be installed on the rear axle. The Upton Services Inc., service station will be pleased to obtain and fit tires for you while you are at work. Call Ext. 4904 for more information.

Port Jefferson Sunset Cruise With Music, 8/7

Jazz guitarist Craig Boyd, performing with his ten-piece band, will appear in concert at Brookhaven Hall on Friday, August 20, at 8 p.m. Boyd will play selections from his debut CD, called "Back on Track," his first solo concert, which is sponsored by the BNL Music Club. All visitors to the Lab age 16 and over must bring a photo ID.

Craig Boyd started taking guitar lessons at the age of six and after playing in bands since 11, chose music as his career. He has worked as a composer, arranger, producer and studio guitarist for various groups and recording artists. Currently he is a faculty member of the Music at Suffolk County Community College, and he is also a producer and engineer for numerous musicians, including Grammy Award winning artists.

Buy tickets for the show, at $20 each in advance at the BERA Bistro Office, weekdays, 9 a.m. - 4 p.m. The door ticket costs will be $25 each. For more information, call Ext. 3846.

Dream Cruise Round Manhattan, 8/7

Dockside cocktail reception, dinner, dancing, sailing past city lights under the stars . . .

Picture yourself on a glamorous dinner-buffet evening cruise around Manhattan. At 4:30 p.m., you join a luxury bus at BNL to be driven to attend a dockside cocktail reception that starts at 7:30 p.m. Then, you board the ship for the sailing time of 8:30 p.m. and, now, as the boat moves smoothly through the water, here you are, mesmerized by the changing patterns of the city lights which glow brightly while the twirling of the DoD-authorized stars overhead. You’ll soon be dining at a splendid buffet and dancing or watching others dance, as you prefer. Then, instead of having a long return car drive, you’ll be soaring on the comfortable bus to get back to BNL.

This dream, unlike most, can come true! Join BERA’s dinner/dance trip to the Spirit Cruise on Saturday, August 7, for not much more than a very good dinner at a local restaurant. Buy tickets at BERA Store, $82 per person, which includes the bus, cocktail reception, dinner, and entertainment. A cash bar is available on the cruise ship.

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Roll Up Your Sleeve: Blood Drive, 9/9

To replenish Long Island’s blood supply, BNL is holding a blood drive on Thursday, September 9, from 9:30 a.m. to 3 p.m. in the Brookhaven Interns’ Center. Those eligible to donate are people in good health between the ages of 17 and 75 who weigh at least 110 pounds. Restrictions may apply to individuals from the United Kingdom and Europe. Donors should have a photo ID and know their social security number.

To make an appointment, contact Susan Foster at Ext. 2888, or e-mail donateblood@bnl.gov. In your message, include your name, phone extension, and preferred time to donate.
On Sunday, August 11, visitors at BNL’s Summer Tours will learn about “Seeing With Infrared Light and Raman Spectroscopy” at the Synchrotron Light Source, one of the world’s brightest sources of x-ray and ultraviolet beams. Powerful beams of invisible light have enabled scientists to make discoveries that impact everyday life. Used by the 2003 Nobel laureate in chemistry, Dr. Martin Karplus, researchers from around the world, the Light Source has contributed to advances in medicine, materials, space and much more.

Tours are free and no reservations are needed. Visitors may arrive at any time between 10 a.m. and 3 p.m. All ages of 16 and over must bring a photo ID.

Additional attractions are: a new hands-on “Light & Color” exhibit produced by the Science Museum of Science & Industry; and an exhibit on the 2003 Nobel Prize in Chemistry, researched and developed in part at BNL, a bomb by high-school students of a robot they built; and the “Whiz Bang Sci- ence” show with new special effects, to be given at 10 a.m., noon, 1:30 p.m. and 3 p.m.

Bicycle – Trek 220, boy’s 18” w/24” wheels, for 8-12 yr old, $85. Scott, 874-3652.

PANTHER GUN – JT 3.5 auto, semi-automatic, 200 rd., 12” hi-carb, .204 Tact, .51 cal, magnum, take down, $100. John, Ext. 7018.

PAPA'S - 410 Ga. semi-auto, $100. Judy, Ext. 5263 or 209-0709.

SATURN SL2 - 4 door, a/c, p/s, p/w, 6.5’ bed, 5 spd., orig. owner, $8,900. John, Ext. 5263 or 209-0709.

FARMINGVILLE - 2-bdrm. house, avail. 8/1. Peter, Ext. 4877 or 344-1034.

SHOES: – 2 pairs, 1) size 8, $20, 2) size 9, $10. William, Ext. 3799 or 754-3469.

RUBBER – 2 pairs, $5 each. Karen, 286-6133.

WANTED – Strictly confidential, fee pro- visioned. Women, ages 18 and over, are needed for a PET study. Strictly confidential, fee pro- visioned. Women, ages 18 and over, are needed for a PET study. Strictly confidential, fee pro- provisioned. Women, ages 18 and over, are needed for a PET study. Strictly confidential, fee provisioned. Women, ages 18 and over, are needed for a PET study.