Volume 11, Issue 1 Spring 2009

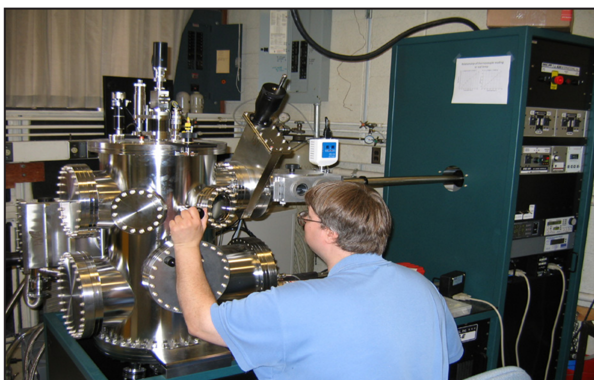
INTERFACES

The Newsletter of the Nebraska Center for Materials and Nanoscience at the University of Nebraska - Lincoln

Facility Focus: Materials Preparation Facility

by Dr. Steven Michalski

The Materials Preparation Facility, currently housed in Behlen and Brace Laboratories, features state-of-the-art equipment for faculty and students to prepare novel nanostructured thin films from a variety of materials. The facility is divided into two areas; thin-film deposition and heat treatment.



The facility provides three thin-film deposition systems: two systems recently purchased from AJA international: a sputtering system and an E-beam evaporator and a home-built sputtering system based on equipment obtained from the 3M Corporation. The AJA sputtering system is a multi-gun, co-sputtering system which contains 4 magnetron sputtering guns which are of a true UHV design allowing baking to 200 °C without disassembly. The sputtering guns allow in-situ tilting of their heads without breaking vacuum. This permits the user to optimize either uniformity or rate in a very short amount of time without venting, resetting the angle, pumping down and testing. The system can handle substrates up to 4 inches in diameter and the substrate holder will allow simultaneous rotation, heating, RF bias and deposition at up to 850 °C in a suitable sputtering environment (600 °C in a pure oxygen environment). A load-lock chamber and cassette

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From the Director

The end of the spring semester and beginning of summer gives us the chance to reflect on recent research and scholarly accomplishments of the faculty, staff and students in NCMN. First, we are delighted to welcome Terese Janovec and Cindia Carlson-Tsuda to our NCMN staff. Terese is Assistant Director and Education-Outreach Coordinator. She will promote and oversee education and outreach programs, diversity, graduate-student recruitment, seminars and related activities for NCMN, the MRSEC and associated science and engineering departments. Cindia is the new Program Associate who will provide administrative support on website maintenance, brochures, reports, proposals and other duties. Cindia replaces Verona Skomski whom we thank for many years of excellent service.

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In This Newsletter...

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University of Nebraska Lincoln

Recent Achievements of Center Researchers

Awards, Honors

David Berkowitz (Chemistry) Awarded a Japan Society for the Promotion of Science Fellowship for 2008-09.

Peter Dowben (Physics) "Certificate of Recognition for Contributions to Students" from the UNL Parents Association.

Stephen DiMagno (Chemistry) Elected Vice-Chair/ Membership of the ACS Division of Fluorine Chemistry, 2009.

Ruqiang Feng (Mechanical Eng.) Elected Fellow of the American Society of Mechanical Engineers, December 2008.

Gerard Harbison (Chemistry) Bomb detection featured at national American Chemical Society news conference, March 2009.

David Sellmyer (Physics) Elected to Exec. Committee of the American Physical Society's Division of Materials Physics

Jeff Shield (Physics) College of Engineering Holling Family Master Teacher Award.

Ralph Skomski (Physics) Invited lectures in Greece on magnetism, September, 2008

Robert Smith (UNO Chemistry) UNO Outstanding Research and Creative Activity Award , March 2009.

James Takacs (Chemistry) Reappointed to another term as a Charles E. Bessey Professor, Spring 2009.

Li Tan (Department of Engineering Mechanics) Edgerton Innovation Award, December 2009. First recipient in the College of Engineering to earn an Edgerton.

Evgeny Tsymbal (Physics) Named Fellow of the American Physical Society, October 2008 and appointed a Charles Bessey Professor, April 2009.

Xiao Cheng Zeng (Chemistry) Journal of the American Chemical Society highlights research in JACS Select website on "Self-Assembly of Surfactants and Polymorphic Transition in Nanotubes", Arai, N., Yasuoka, K., Zeng**, X.C.**, J. Am. Chem. Soc., 2008, 130 (25), 7916–7920, Publication Date (Web): May 30, 2008 Article) DOI: 10.1021/ja7108739.

Outstanding Papers/Books

"Magnetism of FePt Surface Alloys", J. Honolka, T.Y. Lee, K. Kuhnke, **A. Enders, R. Skomski**, S. Bornemann, S. Mankovsky, J. Minar, J. Staunton, H. Ebert, M. Hessler, K. Fauth, G. Schütz, A. Buchsbaum, M. Schmidt, P. Varga, and K. Kern, Phys. Rev. Lett. 102, 067207 (2009).

Karolina Janicka, Julian Velev, and **E. Y. Tsymbal's** paper "Quantum Nature of Two-Dimensional Electron Gas Confinement at LaAlO3=SrTiO3 Interfaces", Phys. Rev. Lett. 102, 106803 (2009) was featured on PRL's cover page.

Book chapter: "Designed Magnetic Nanostructures" **A. Enders, R. Skomski and D. Sellmyer**, in: "Nanoscale Magnetic Materials and Applications", Edited by Ping Liu/E. Fullerton, O. Gutfleisch, **D. Sellmyer,** Springer, 2009 (ISBN: 038785598X).

Patents

Li Tan - Provisional patent for "Self- organized nanolayer structures and methods of making same," filed March 30, 2009

Anthony N. Caruso, **Jennifer I. Brand, Peter A. Dowben,** "Boron carbide particle detectors", United States Patent 7,368,794, issued May 6, 2008.

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Inelastic Deformation and Failure of Polycrystalline Ceramics Under Impact Loading

By Ruqiang Feng

Dense polycrystalline ceramics are increasingly being used in advanced armor structures because of their light weight and superior ballistic performance over conventional armor steels. Their dynamic behaviors under impact loading are, however, complex and difficult for model prediction which is necessary for simulation-based armor design. A polycrystalline ceramic in a plate impact, shock wave experiment (a typical method to test material under the loading conditions relevant to ballistic impact) may display extremely high effective strength in the initial compression phase but fail catastrophically as the load reverses subsequently to tension. To understand when and how the material loses its strength in such a loading sequence, we have developed a modeling technique for simultaneous simulations of intragranular microplasticity and intergranular microdamage in a polycrystal model based on the Voronoi tessellation. A two-dimensional (2-D) modeling study on polycrystalline □-6H silicon carbide (SiC) is summarized below as an example.

Figure 1(a) shows the model configuration, which is a square plate subjected to the loading conditions that mimic a macroscopically uniaxial-strain shock-spallation loading sequence. The polycrystalline microstructure is modeled by meshing the plate with the 2-D Voronoi tessellation and assigning each polygonal prism cell with a randomly selected crystallographic orientation. A small isotropic con-

Professor Ruqiang Feng

traction is applied to each Voronoi grain and the resulting intergranular space forms the boundaries. A finite element (FE) mesh is then grain-wise constructed in such a way that it preserves the polycrystalline microstructures. For material

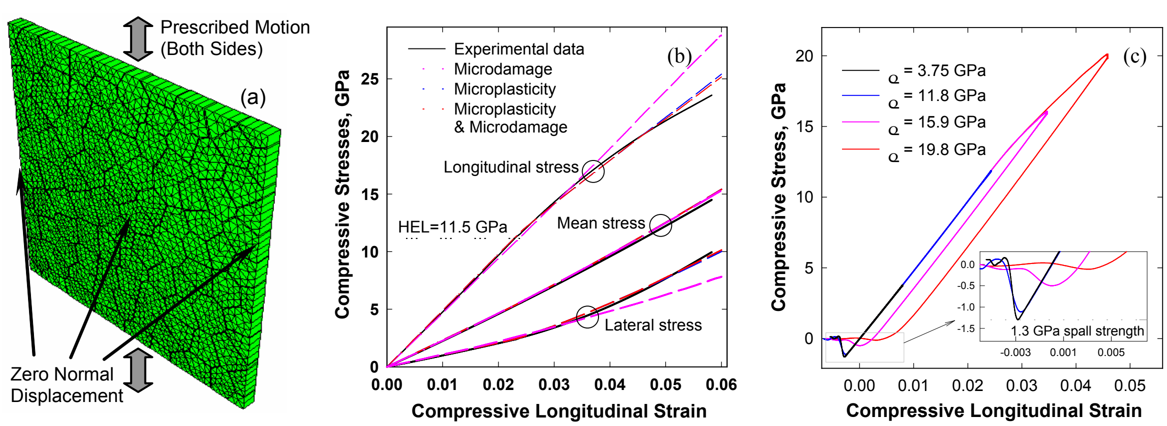

Fig. 1: (a) Schematic of polycrystal model and loading conditions; (b) Macroscopic compression responses in comparison with experimental data; and (c) Release-spallation behaviors from four shock states (3.75, 11.8, 15.9, and 19.8 GPa).

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Inelastic Deformation and Failure of Polycrystalline Ceramics Under Impact Loading

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modeling, we consider intragranular microplasticity via basal slips, intergranular shear damage under compression, and intergranular mode-I cracking under tension. For solving these highly nonlinear constitutive relations efficiently, a stress-based Newton-Raphson iteration algorithm is developed and implemented into the ABAQUS/Explicit FE code used for numerical solution.

In Fig. 1(b), the compressive stresses computed assuming intergranular microdamage (pink lines), or intragranular microplasticity (blue lines), or both (red lines) are plotted against the compressive strain and compared with the experimental data on SiC (black lines). The measured Hugoniot elastic

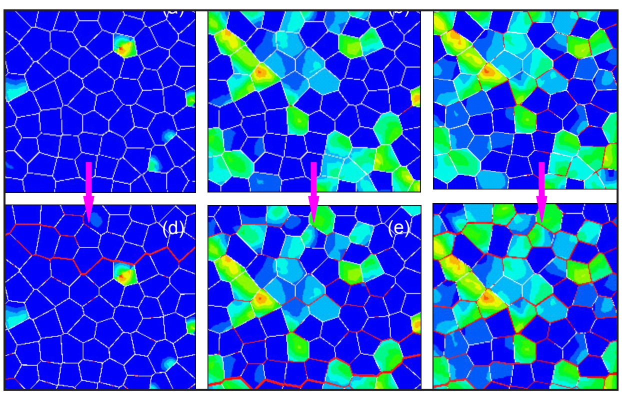

Fig. 2: Distributions of intragranular plastic strain and intergranular slipping (more intense towards red) at shock states of 11.8 GPa (a), 15.9 GPa (b) and 19.8 GPa (c), and corresponding distributions of microcracks (in red) at spallation (d–f).

limit (HEL) is 11.5 GPa. The microdamage results apparently overpredict the post-HEL strength even though the HEL is underpredicted. In contrast, the responses predicted with the microplasticity or the both mechanisms match the data well. Clearly, intragranular microplasticity is more plausible under shock compression than intergranular microdamage. We therefore treat the former as the primary mechanism and the latter the secondary one in the rest of calculations. In Fig. 2, (a), (b) and (c) show the plastic strain distributions (more intense towards red) and grain boundary shear damages (in red) at three post-HEL shock states, 11.8, 15.9 and 19.8 GPa, respectively. The plastic deformation starts in isolated grains (a) and grows in number of sites and in intensity (b & c) as the shock stress increases. However, many grains remain elastic (in blue) even at 19.8 GPa. This results in high shock strength on one hand but heterogeneous deformation and thus intense stress concentrations on the other hand.

The dynamic responses during shock compressions to 3.75 GPa and the aforementioned three post-HEL states and then load reversals to spallation are presented in Fig. 1(c). Intact grain boundaries are assumed to have an intrinsic strength of 1.6 GPa so that the peak tensile stress (spall strength) during the load reversal from 3.75 GPa matches the measured value of 1.3 GPa (finer-scale insert). The spall strength is below the intrinsic strength even for elastic shock compression and diminishes with increasing stress for post-HEL shock compression. In Fig. 2, (d), (e) and (f) show the distributions of intergranular cracks (in red) at the ends of load reversals from 11.8, 15.9 and 19.8 GPa, respectively. As the preceding shock stress increases from the HEL up, the sites of mode-I microcracks change from mostly between grains that are intact under shock compression (a & d) to mostly in the boundaries of plastically deformed grains (b & e) and in already shear-damaged grain boundaries (c & f). As a consequence of intense heterogeneous deformations of these regions under shock compression, the local releases with unloading are highly heterogeneous too. The stresses in many places become tensile and even initiate tensile cracks before the macroscopic load switches to tension. This effectively erodes the spall strength. An implication of these results is that the duration of compressive confinement on a ceramic armor needs to be maximized for its optimum ballistic performance.

Facility Focus: Materials Preparation Facility

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allows the samples to be removed and changed without venting the chamber. The system features a user friendly LabView-based computer control system which includes many common features such as: gun power supplies, shutters, gas flow and pressure, and substrate heater.

The E-beam system contains four material pockets and has many of the capabilities of the sputtering system The system can handle 4-inch substrates which can be rotated and heated up to 850 °C. The system also has a load-lock chamber for quick removal and insertion of samples.

The heat-treatment facility has two tube furnaces with working tube of diameter 2 inches which can reach temperatures of 1200 °C. Both furnaces have programmable power supplies/temperature controllers and associated pump stations. Applications include: sintering, crystallizing, annealing, etc. The tube furnaces are used for crystal growth because of their small volume and precision with which the temperature can be controlled. The ends of the tubes are kept near room temperatures and various adapters may be placed on the ends. This permits reactions under controlled atmosphere using reactive/un-reactive gases or a vacuum.

Future planned improvements for the Facility include purchasing a pulsed-laser deposition system, and replacing one of the tube furnaces with a new three-zone furnace and possibly adding another furnace. The Facility is looking to expand into chemical synthesis/preparation of nano-particles, tubes and wires using methods such as electrochemical deposition.

Nanotech Center Earns $8.1M Grant

UNL Scarlet, October 2, 2008

UNL has received an $8.1 million grant from the National Science Foundation to support the Materials Research Science and Engineering Center and its nanotechnology research through 2014.

UNL's center focuses on quantum and spin phenomena in nanomagnetic structures and is one of 26 such elite Materials Research Science and Engineering Centers in the nation. This grant continues support for the interdisciplinary research by UNL scientists and engineers associated with the center, which was established in 2002 with a $5.4 million NSF grant.

"Grants for these centers are extremely competitive," said Harvey Perlman, Chancellor. "Our continued success is indicative of the high quality of our faculty's research. They've put UNL on the map in the exciting field of nanomagnetics."

The center includes 20 UNL faculty from the departments of physics and astronomy, chemistry, chemical and biomolecular engineering, electrical engineering and mechanical engineering and one physicist from the University of Nebraska at Omaha who collaborate to study new magnetic structures and and materials at the nanoscale level - as small as one-billionth of a meter. The center's research focuses on understanding the properties and performance of nanomaterials, a key step toward their use in a host of advanced technologies, said physics professor Evgeny Tsymbal, the center's director.

The center's research has potential applications in areas such as computing, data storage, energy production, handheld electronic devices, sensors and medical technologies. It also has a strong education and outreach program and has built ongoing collaborations with industry, national laboratories and scientists internationally.

"Our long-term goal is to be the leading interdisciplinary center for integrated research and education in nanomagnetism," Tsymbal said.

Since 2002, research and discoveries by the center's faculty have garnered international attention, expanded understanding of magnetic nanostructures and phenomena and opened new possibilities for developing nanotechnology tools and techniques.

"Thanks to the center's collaborative research environment, we have researchers with diverse expertise studying critical questions that must be answered to harness the potential of nanomagnetic materials," said Prem Paul, UNL Vice Chancellor for Research and Economic Development. "We expect UNL's growing nanotechnology expertise and the center's ongoing work with industry will lead to additional partnerships that benefit Nebraska's economy."

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Li Tan Earns Edgerton Award

by UNL Scarlet, January 29, 2009

Li Tan, Assistant Professor of Engineering Mechanics received the College of Engineering's first Edgerton Innovation Award. Tan was selected by a vote of professors in the college. The new award includes $2,500 for the faculty member selected, $10,000 for research and $10,000 to recruit doctoral students to assist with research projects. Tan came to UNL in 2005 when the department, led by Joseph Turner, sought to develop new areas in materials and nanoscience. His doctorate focused on materials. At UNL, Tan works in the area of organic electronics and self-assembly. His research includes: synthesizing novel electronic molecules with self-assembly capabilities; working with UNL physicist Peter Dowben to create a "molecular resonator" to identify chemical threats; and building nanostructures that capture light particles and may be used for solar cells.

The award is named for Harold Edgerton, a 1925 electrical engineering graduate of NU who taught at the Massachusetts Institute of Technology and pioneered strobe photography.

Belashchenko Honored for Magnet Study

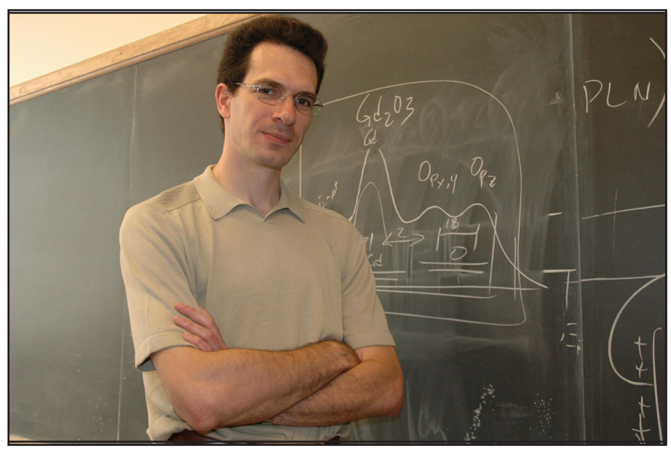
by University Communications, July 17, 2008

Kirill Belashchenko sees more to magnets and spin than just MP3s and iPods. His work on a new theory may lead to spin-based devices that will be faster than ever at reading and analyzing data. The Assistant Professor of Physics at UNL has received a $100,000 Cottrell Award from the Research Corporation, which will support his research on magnetic materials.

As a researcher in the Nebraska Center for Materials and Nanoscience, Belashchenko focuses on the theory for computers that use spintronics, which is based on quantum spin of electrons rather than charge.

Belashchenko is developing a new technique for studying magnetic materials at finite temperatures. He will design techniques to describe the magnetic, electronic, and transport properties of magnetic materials, like iron, at temperatures starting from absolute zero and up to the Curie point, which is the temperature above which a ferromagnetic material loses its characteristic ferromagnetic ability.

Breakthroughs in this area of nanotechnology won the Nobel Prize in physics in 2007. Two scientists discovered an effect called giant magnettoresistance,or GMR, for the big changes in electrical resistance that are linked to small changes in a magnetic field. The discovery made possible MP3 players and other devices that store data or video appearing since the late 1990s



Prof. Belashchenko teaches courses in graduate quantum mechanics and statistical physics

Belashchenko's work may play a role in the design of smaller, denser memory storage devices that use electron spin in scanning heads that are no thicker than a few nanometers (one billionth of a meter). But many questions remain about how magnetic fields affect the flow of current - or resistance - in materials, especially iron and other magnetic metals, or ferromagnets.

Prof. Belashchenko studied at the Institute of Steel and Alloys in Moscow, received a doctorate at the Kurchatov Institute and spent three years at the Ames Lab, a U.S. Department of Energy site in Iowa.

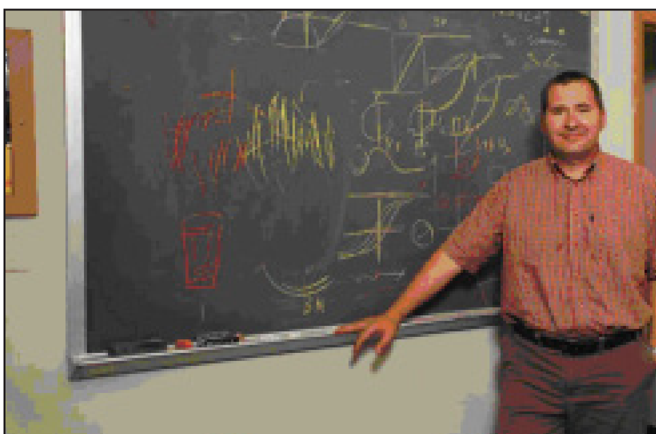
Faculty Members Receive CAREER Awards

(A&S Columns Newsletter) ***excerpt from the UNL Scarlet, April 9, 2009***

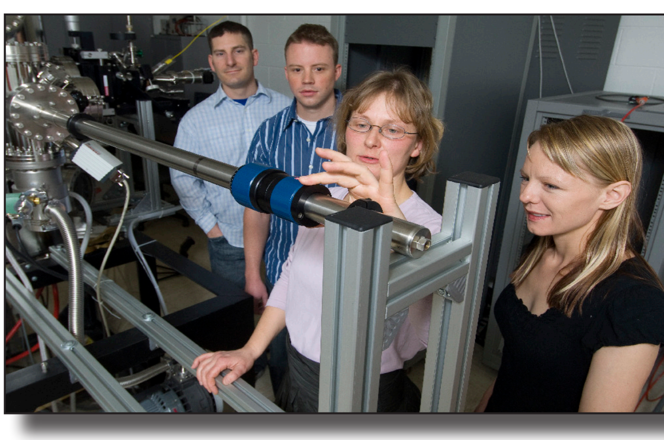
Physicist Axel Enders, a recent arrival at UNL, has already landed a Faculty Early Career Development Award from the National Science Foundation. The news is so fresh, it's still sinking in for Enders. "I'm still in the process of realizing what a big deal this is," he said. He will use his award to study advanced magnetic nanostructures, which could be used in computer hard drives and other high-density data storage devices. By better understanding the functional properties of magnetic elements,engineers could make recording media that hold 10 to 100 times more data than current technologies, Enders said.

As part of the grant's educational component, Enders will organize a conference for undergraduate women in physics and coordinate activities to encourage networking for women physics students nationwide. The long-term goal is to recruit and retain more women students, improve their opportunities for success and boost the percentage of women studying physics at UNL.

Courtesy photo A & S Columns.



Professor Axel Enders



Eva Schubert's laboratory is brimming with possibilities. Schubert, a UNL materials scientist, is one of a handful of people in the world studying the potential for harnessing a unique type of nanomaterial known as hybrid chiral nanostructures. Her complex basic research could lead to diverse practical applications in advance computing, electronics and solar cells or batteries.

"Right now, there is so much that is unknown," said Schubert, an Assistant Professor of Electrical Engineering. "And hybrid chiral nanostructures have a tremendous potential for making new materials and for unique applications."

Schubert earned a five-year, $400,000 Faculty Early Career Development Award for this research. The National Science Foundation gives CAREER awards to outstanding pre-tenure faculty to help them develop as teacher-scholars and researchers.

Her research aims to improve the functionality of chiral hybrid nanomaterials and to test how they perform in new types of electronic devices. She's designing novel hybrid nanomaterials by combining chiral materials and polymers and is studying how to use the unique properties of these new materials. She's focusing on using these materials in electromagnetic devices, such as terahertz antennas and magnetic memory systems for computers.

Examples of potential commercial applications include storage for library databases, security scanners and biomedical devices."It's a hot research field that people are really excited about. I hope we can make a contribution," she said.

In addition to research, the CAREER funding will enable Schubert to promote education in the science, mathematics and technology fields. She will lead a nanotechnology workshop for the LPS Bright Lights summer enrichment program, create an e-mentoring system for middle school and high school girls, and develop an international student exchange program with the University of Linkoping in Sweden.

HANDS-ON TEACHING - Eva Schubert (second from right), Assistant Professor of Electrical Engineering, works with her graduate students (from left), Eric Montgomery, Daniel Schmidt and Ann Kjerstad.
Courtesy photo/Research.

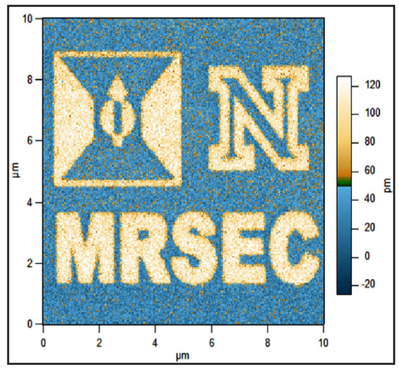
NCMN Welcomes Alexei Gruverman

Dr. Alexei Gruverman joined the University of Nebraska-Lincoln in 2007 as an Associate Professor at the Department of Physics and Astronomy. During his career span he has worked in various research environments, both academic and industrial. Dr. Gruverman received his PhD degree in 1990 from the Ural State University in Ekaterinburg, Russia. In 1993 he was awarded a prestigious grant from the Science and Technology Agency of Japan and spent the following years working in one of the first world nanotechnology centers - Joint Research Center for Atom Technology in Tsukuba. While at JRCAT, he was introduced to Atomic Force Microscopy, which at that time was a relatively new technique. Since then, Dr. Gruverman's research has closely related to the development and application of scanning probe microscopy (SPM) techniques for investigation of nanoscale properties of electronic and functional materials.

Professor Alexei Gruverman

Dr. Gruverman has pioneered piezoresponse force microscopy (PFM) - a technique that became a standard tool for high-resolution characterization of ferroelectric and piezoelectric materials. Ferroelectrics possess a spontaneous electric polarization that can be switched by an applied electric field, which opens a possibility of electrical control of their physical properties - electrical, optical, mechanical, etc. Since polarization is stable in the absence of the electric field, one of the most important applications of ferroelectrics is related to non-volatile memory devices where information can be written and stored in the binary form as positive and negative domains. Among various non-volatile memory technologies, ferroelectric random access memory (FeRAM) is one of the most promising and technologically advanced. Because of his expertise in PFM, Dr. Gruverman was asked to join a group at Sony Corporation involved in development of high-density FeRAM. The PFM technique played a critical role in examining the dynamic switching behavior and reliability of individual microscopic memory cells by imaging spatial variations in their polarization state with nanoscale resolution.

After several years in Japan, Dr. Gruverman moved to the US where became a research faculty member at North Carolina State University. There he continued his research focusing on electromechanical properties of functional materials, including semiconductors, electroactive polymers and, most notably, biomaterials. The ubiquitous presence of electromechanical coupling in biosystems makes the PFM method applicable to a wide variety of biomaterials such as protein molecules, dental and bone tissues, plants and bacteria providing resolution in structural imaging down to the molecular level.



Ferroelectric polarization patterns showing logotips of UNL and MRSEC generated and imaged by PFM in the 10x10 µm2 region on the ferroelectric surface

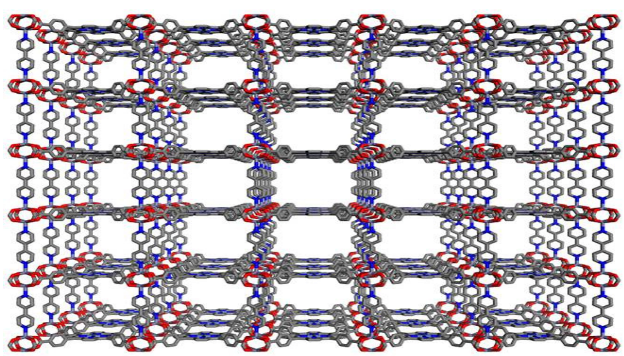
At UNL, Dr. Gruverman is involved in SPM studies of ferroelectric nanostructures and novel class of materials – multiferroics, which exhibit both ferroelectric and ferromagnetic behavior. His recent results include experimental demonstration, in collaboration with researchers from UNL and University of Wisconsin-Madison, of a giant change in electric resistance in ferroelectric tunnel junctions upon reversal of polarization direction - effect that was theoretically predicted by the UNL scientists several years ago.

Dr. Gruverman maintains active collaboration with research groups in the US, Canada, Japan, Korea, Germany, Switzerland, UK, Portugal, Russia, Israel, which gives him an opportunity to interact with world-class scientists. His research results have been published in over 80 peer-reviewed papers, several book chapters and invited reviews. He has given numerous invited presentations at international conferences and edited two books on scanning probe microscopy published by Springer.

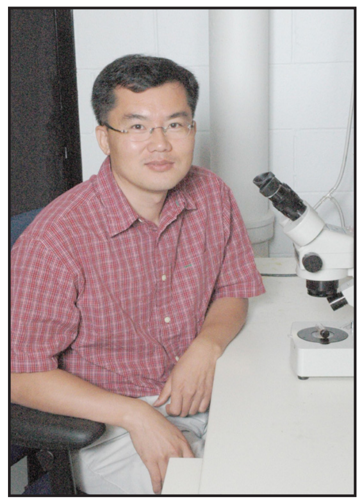
Research Spotlight: Wonyoung Choe

One of the fastest growing areas in materials chemistry is metal-organic frameworks, emerging as a new class of inorganic-organic hybrid materials. These materials are potentially useful in many applications ranging from gas storage to catalysis. The research group led by Prof. Wonyoung Choe in the Chemistry Department focuses on porphyrin-based metal-organic frameworks with nanopores.

A daunting challenge in metal-organic frameworks has been how to 'decorate' pore surfaces with redox-active metal centers for the energy-related applications mentioned above. To address this urgent issue, porphyrins are chosen as molecular building blocks to build nanoporous materials. Porphyrins are important biomolecules, as exemplified by the iron porphyrin in hemoglobin (which is responsible for the oxygen transport in the human body), and have been extensively studied over the past several decades. However, the use of porphyrins in nanochemistry is still in its infancy. Considering the fact that many interesting physical properties of porphyrins are closely related to the metal centers incorporated inside the porphyrins, the research outcome from such biomimetic framework solids may shed new light on multifunctional nanomaterials.



The Choe group members (Paul Barron, Lucas DeVries, and Haemi Chung) have successfully demonstrated a series of crystalline 2D/3D metal-organic frameworks with fascinating topologies, built from porphyrins and paddlewheel clusters (see an example in the figure above). These solids are referred to as porphyrin paddlewheel frameworks (PPFs). Interestingly, these PPFs have large void spaces with channel sizes up to ca. 2nm. The topologies of PPFs can be systematically controlled by the coordination chemistry of the metal centers inside porphyrins. Currently, the group is working on physical characterization of these PPFs, and the topological design of new ones. These porphyrin-based materials may provide important chemical understanding in areas such as gas storage, heterogeneous catalysis, and chemical sensors. A new collaborative activity includes 2D



Dr. Wonyoung Choe

porphyrin surface structures with Drs. Enders (Physics) and Zheng (Chemistry) at UNL. Utilizing hydrogen- or coordination-bond, self-assembled porphyrins form interesting 2D surface patterns, which can be used as a basis for building surface-supported 3D hybrid structures.

Dr. Wonyoung Choe was born in Seoul, Korea. After finishing his B.S. and M.S. degrees at Seoul National University, Korea, he studied rare earth/ transition metal chalcogenides and received his Ph.D. at the University of Michigan, Ann Arbor. Before joining UNL as a faculty member, he finished his postdoctoral training at Iowa State University and Lawrence Livermore National Laboratory, where his research areas were magnetocaloric intermetallic alloys and magnetic nanoparticles.

From the Director

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Our Administrative Coordinator, Shelli Krupicka, and NCMN Faculty have been hard at work in recent months in the search for and recruitment of new Central Facility Specialists. Starting soon is Dr. Peter Daniels from Germany who will be our Crystallography Facility Specialist, and Dr. Shah Valloppilly from Indiana University who will be our Materials Preparation and X-Ray Materials Characterization Facility Specialist. Both of these scientists have a decade or more experience in their respective areas, and are expected to bring many benefits to our Facility user groups.

I am happy to report that the new Physical Sciences Building (PSB) is well on its way to completion. Present plans call for a move-in date of about April 2010. In addition to housing Physics and Astronomy research labs and classrooms, the PSB has about 5,500 square feet of space allocated to Central Facilities of NCMN. The adjacent NanoScience Facility (NSF) is completely designed but its construction has been delayed because of the recent economic situation. Efforts are underway to obtain government and private funding so that this urgently needed facility can be constructed soon. When completed the NSF will house seven NCMN Central Facilities including a Nanofabrication Cleanroom, and Nanofiber and Biomaterials labs and facilities.

The renewal of our NSF-supported Materials Research Science and Engineering Center (MRSEC) is extremely gratifying. More details are provided on p. 5 of this issue. The leadership of Evgeny Tsymbal (Director) and Roger Kirby (Associate Director) is highly appreciated, as well as the strong support of Vice Chancellor Prem Paul. We are continuing the development of NCMN Central Facilities, especially the Nanofabrication Facility, in order to provide the research infrastructure for the MRSEC and other outstanding programs in materials and nanoscience.

One positive result of our country's economic difficulties has been a strong investment in science and engineering research by the federal government. Faculty in NCMN are pursuing several opportunities for stimulus funds in instrumentation, facilities and energy-related research. In addition, a significant new project on high-sensitivity nanosensors and nanofabrication facilities will start soon with Department of Defense support. Several of these recent efforts involve collaborations with national labs and other universities to form leading national teams. We are hopeful that all of these efforts will push the annual external funding level from about $9.4 million to well above $10 million.

We are pleased that the university administration has taken the major step to develop the Nebraska Innovation Campus (NIC) on the site of the Nebraska State Fair. This involves an ambitious plan to create a private-public partnership to foster tech transfer, attract businesses, and promote economic development. It is noteworthy that five NCMN faculty already are involved in spin-off companies based on their research expertise. These include Professors John Woollam (J.A. Woollam Co.), Reuben Rieke (Rieke Metals, Inc.), Gustavo Larsen (LNK ChemSolutions), Henk Viljoen (Philisa Technology Corporation), and Jody Redepenning (Ossient, Inc.). The companies range in size from a few to about 50 employees, and involve various exciting areas of materials, nanotechnology and instrumentation. We expect that the establishment of NIC will give a big boost to further efforts of this kind.

The most important component of research and university development involves people. Because of regular retirements and occasional resignations it is extremely important to have faculty renewal through regular hiring in our interdisciplinary field. Weak economic conditions have curtailed faculty hiring this past year and may do so for the next year or two. However, we are fortunate to have in place the Nanoscale Science and Technology Program of Excellence (NST POE) which provides support for several new faculty lines and setup costs. We already are supporting several full or partial positions in Engineering and Arts and Sciences, and are hopeful that NST POE funding will be helpful in hiring urgently needed new faculty in both colleges in the coming years.

We are grateful for the support of the departments and colleges participating in NCMN, as well as the university administration. The faculty also are most appreciative of the work of their students, postdocs and NCMN staff. Especially pleasing are visits and communications from our alumni, so let us hear from you!

David J. Sellmyer

Recent Achievements of Center Researchers - *continued. from page 2]*

Promotions & Tenure

Promoted to Full Professor:
Jody Redepenning - (Chemistry)

Promoted to Associate Professor with Tenure:
Christian Binek (Physics)

Student Awards and Honors

Paul Rogge (Mechanical Engineering, Shield) National Defense Science and Engineering Graduate Fellowship
Nan Shao (Chemistry, Zeng) UNL 2008-09 Presidential Fellowship
Curtis Wray (Chemistry, Choe) 2009 UNL Folsom Masters Thesis Award

NCMN-Affiliated Graduates (May 08- May 09)

PhD Graduates:

Wei An (Chemistry, Zeng)
Andrew Baruth (Physics, Adenwalla)
John Burton (Physics, Tsymbal)
Adam Caprez (Batelaan, Physics)
Goutam Ghoshal (Engineering Mechanics, Turner)
Chunlei Guo (Chemistry, Harbison)
Yaoxuan Han (Electrical Engineering, Lu)
Shah Nurul Huda (Textiles/Cloth/Design, Yang)
Shawn Hilbert (Batelaan, Physics)
Carolina Ilie (Physics, Dowben)
Jeremy Karr (Chemistry, Redepenning)
Jihee Kim (Physics, Ducharme)
Siew Yoong Lee (Bio Systems Engineering, Hanna)
Shin Moteki (Chemistry, Takacs)
Marcus Natta (Engineering, Brand)
Srinivas Polisetty (Physics, Dowben)
Rajesh Rajasekaran (Chemistry, Redepenning)
Justin Rousek (Ind/Mgt.Syst.Engineering, Hallbeck)
Sarkar, Sabyasachi (Electrical Eng., Woollam)
Jodell Whittington (Chemistry, Parkhurst)
David Wisbey (Physics, Dowben)
Philip Yuya (Engineering Mechanics, Turner)

MS Graduates:

Leonardo Alves (Eng.Mech., Bobaru)
Ross Andrews (Chemistry, Takacs)
Sreenidhi Cherku (Ind/Mgt.Syst Eng, Rajurkar)
Ronald Chirinos (Electrical Engineering., Soukup)
Christopher Hassler (Chem/Bio Engineering, Saraf)
Ann Kjerstad (Electrical Engineering, Schubert)
Van Nguyen Mai (Chemistry, Eckhardt)
Aravinth Muthu (Ind/Mgt.Syst Eng., Rajurkar)
Benjamin Polly (Engineering Mechanics, Turner)
Konlayut Promratana (Eng. Mechanics, Bobaru)
Geoffrey Rojas (Physics, Enders)
Jamie Lynn Shamrock (Geosciences, Watkins)
Shuchi Sharma (Electrical Engineering, Ianno)
Manuela Stan (Chemistry, Takacs)
Curtis Wray (Chemistry, Choe)
Wen Yang (Textiles/Cloth/Design, Yang)
Kaijun Yi (Electrical Engineering, Lu)
Qing Zhang (Chemistry, Takacs)
Zhengzeng Zhang (Physics, Dowben)

New Jobs

Carolina Ilie (Physics) Assistant Professor of Physics, State University of New York-Oswego
David Wisbey (Physics) Staff-National Institute of Standards and Technology
Andrew Baruth (Physics) Postdoc, UNL
Wei An (Chemistry) Postdoc, Univ. of Alabama
Jeremy Karr (Chemistry) Faculty, Newman University, Wichita, Kansas
Shin Moteki (Chemistry) Postdoc, Univ. of Kyoto, Japan
Rajesh Rajasekaran (Chemistry) Lecturer, Coastal Carolina University, Myrtle Beach, S. Carolina.
Jodell Whittington (Chemistry) Postdoc, Univ. of Utah Medical School
Van Nguyen Mai (Chemistry) Streck Chemicals, Omaha, NE
Qing Zhang (Chemistry) Research Scientist, Boehringer Ingelheim

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