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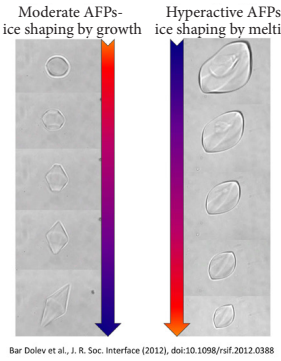
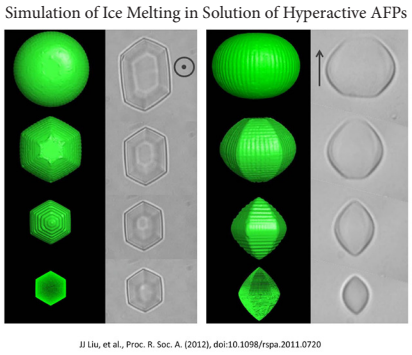
AFP's provide insight to ice growth

For many plants, the first frost can be an icy kiss of death--unless the plants have freeze tolerance properties due to antifreeze proteins (AFP's). AFP's influence and control the growth of ice crystals, although not all AFP's behave the same.

NQPI member Dr. Ido Braslavsky and colleagues (including Dr. Maya Bar Dolev) recently wrote an article entitled "New insights into ice growth and melting modifications by antifreeze proteins," published by the Royal Society in July, in which the team focused on how the presence of hyperactive AFP's influence ice crystal shape and proved that ice shapes not only form during growth, but also during melting.



Bar Dolev et al., J. R. Soc. Interface (2012), doi:10.1098/rsif.2012.0388



JJ Liu, et al., Proc. R. Soc. A. (2012), doi:10.1098/rspa.2011.0720

Plant AFP's often serve the purpose of freeze resistance, but the antifreeze proteins found in insects prevent the organism from freezing altogether. This slight, but important difference is due to varying structures, sequences and sizes.

"They have even evolved in separate routes and there is no evolutionary correlation between most of them. Therefore their activities with ice differ," said Bar Dolev.

The team utilized moderately active AFP's from several arctic fish as well as a sample of an antifreeze glycoprotein (AFGP) extracted from the blood plasma of rock cod. As a member of the expanding group of ice-binding proteins more closely associated with freeze tolerance than with freeze resistance, an ice-binding protein of ryegrass was analyzed. The hyperactive AFP's studied were taken from a beetle, a spruce budworm, an Antarctic bacterium and a snow flea.

A fluorescent protein marker was attached to the tail of the AFP's which allowed the visualization of the chimera protein on ice. After a drop of the protein solution was injected into an oil-filled well, the sample was placed on a temperature-controlled stage and observed beneath the lens of a microscope.

"We can freeze and thaw our samples in a highly controlled manner, which allows us to inspect directly the interactions of the proteins with ice,"

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Kaya's NanOstUdio receives NSF grant

A new state of the art NanOstUdio will soon find its home in Stocker Center. As you can see here, the name of the new studio exercises the creative side of the brain, which is just what proposer Dr. Savas Kaya (professor at Russ College of Electrical Engineering and Computer Science) intends.

The proposal, made two years ago, sought to build an interactive learning space for undergraduate students that would emphasize the creative sides of nanotechnology. While creativity may not be a term explicitly associated with the nanoworld, Kaya wants to change this notion and bring a more comprehensive aspect to nanotechnology.

"I want to show students why nanotechnology affects their lives each day" Kaya said, "and still make it fun."

Dr. Kaya's initial interest in the creation of such a place began with this question: "How do you turn research into education?" After suggested alterations to the plans and bylines, he was officially offered a grant from NSF this year.

"I was with my kids at COSI," Kaya said, "when I realized how much we needed a relaxed atmosphere for students to interact on a nanoscale." Sterile lab settings can seem unapproachable to undergraduates and this, coupled with the daunting notion of nanotechnology, could shun students from the field entirely. Nano-

See **NanOstUdio**, page 3

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Director's Corner

Dear Colleagues,

Welcome to the 8th Edition of the NQPI Newsletter. As Fall is soon to give way to winter in Southeast Ohio, the University's first term under its new semester calendar is about to conclude. A month-long break from classes will then give faculty and students alike, time and energy to focus on their research.

On a longer-term horizon is the anticipated expansion and renovation of Clippinger Laboratories, home to many NQPI members. While still in a preliminary stage, discussions at the highest levels of University administration have taken place, and investigative work is being done to examine both the detailed program requirements as well as the financing aspect. On November 18, 2011, the OU Board of Trustees approved a 6-year Capital Improvement Plan (FY 2013-2018), authorizing the borrowing of up to $87.8 Million for the 2-phase Clippinger Laboratories project.

The need for state-of-the-art research and teaching space has become increasingly evident over the past 5-10 years, as growing nanoscience research needs for low-vibration-, temperature-, and humidity-controlled spaces have gone largely unmet, and NQPI researchers constantly battle with these uncontrolled parameters. This situation motivated a team of NQPI researchers to write and submit proposals for a new nanoscience facility, in two successive rounds of construction grant competitions held by the Department of Commerce (NIST).

With that groundwork already laid, a detailed planning document exists which should prove helpful to OU administrators in assessing the needs of the NQPI group. Of course, the envisaged Clippinger project would be on a considerably larger scale.

In the meantime, the NQPI group will continue to make optimal use of its existing resources and facilities in order to achieve the best possible outcomes. May your time be well spent, and your work prove highly successful.

Best Wishes,
Arthur R. Smith, NQPI Director

NanoBytes

Grants

Saw-Wai Hla received $135,172 from the DOE for "Investigation and Manipulation of Nanoscale Molecular Superconductivity and Molecule Manipulation and its Application to Nanoscience and Nanotechnology."

Nancy Sandler and Sergio Ulloan received $95,777 from NSF for their grant titled, "Symmetry, Local-Environment and Time-Dependent Effects in Nanoscale Systems: A Synergistic Approach"

Wojciech Jadwisienczak received $82,178 from the NSF for the engineering of III-nitride quantum heterostructures doped with lanthanides

Arthur R. Smith's and Jeongihm Pak's NSF grant supporting the study of magnetic bilayers at the atomic scale has conducted its first outreach program, "Science Investigators," for local elementary students.

For a full list of grants, please visit www.ounqpi.org

NQPI's first "Science Investigators" held for local 5th and 6th graders

With Dr. Pak's instruction, the students observe the difference between types of homemade thermometers.

Sophomore Helen Cothrel and students preparing for the egg drop activity.

The students measure the sling shot angle under the instruction of sophomore Preston Brooks.

Sophomore Taylor Grueser and students investigate waves using the cradle.

NQPI Outstanding Dissertation Award

In an effort to recognize the exceptional work performed by doctoral students, NQPI is opening up its wallet. One NQPI Outstanding Dissertation award (and a $500 gift certificate) will be given out each year to a doctoral student who embodies the highest levels of scholarship, research, and writing.

The four requirements of eligibility for the award are that the student author of the dissertation works in one of the groups belonging to NQPI, the research reported in the dissertation falls within the scope of NQPI research, the dissertation is submitted in its final form to Ohio University's Graduate College within the academic year under consideration and an NQPI faculty member of the PhD dissertation committee nominates the dissertation for this award.

Though the committee planning is still in its early stages, NQPI is accepting nominations via e-mail.

Jeff Rack organizes photochromics workshop

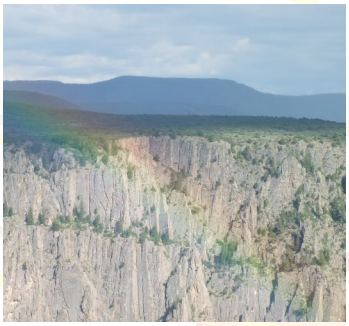
"Breaking and Making Bonds with Light"

When asked what prompted him to organize a Photochromics workshop in Telluride, Colorado this July (2-6th), Jeff Rack responded "I was going to all of these workshops and conferences in Photochemistry, and I was never meeting the people whose research I had been reading." Thus the "Breaking and Making Bonds with Light" workshop at the Telluride Science Research Center was born.

Photochromism is a reversible chemical transformation between two forms. This transformation is dependent on the absorption of electromagnetic radiation, in which both forms have differing absorption spectra. In order for the compound to be declared photochromic, the absorption band must undergo a drastic change within a visible part of the electromagnetic spectrum.

Photochromism is present in both organic and inorganic compounds and is often studied in terms of quantum yield. Quantum yield is a measure of color change with respect to how much light is absorbed, but is difficult to study because it is heavily dependent on three tricky factors: fatigue resistance, photostationary state, and polarity/solubility.

Fatigue refers to the loss of reversibility of the reaction. All photochromics experience fatigue to some extent. The rapidity of fatigue can impede experimentation and thus needs to be mitigated—hence the study of photochromics in inorganic compounds which have much better resistance to fatigue.



Scenic mountain view nearTelluride, CO.

The interconversion between the two states of photochromism can be controlled using different wavelengths of light. A mixture of the two states will present itself as a specific ratio called the photostationary state once a material is excited with a particular wavelength of light.

Photochromics are also difficult to study within working systems because they are often charged in one or more states and have high and changing polarities which limit solubility as well. Up until this summer, the International Symposium on Photochromics (held every three years) was the only gathering of scientists who study these interesting compounds. Rack first started with a list of scientists he wished to invite.

"I tried to get a wide array of people," he said. "Everyone I invited came." Twenty-five researchers attended the workshop and represented an assortment of fields including computer science, physics, and chemistry.

The workshop was organized into eight daily 50 minute sessions in which speakers were grouped into clans of four. Split between mornings and afternoons, sessions took on an informal atmosphere almost immediately.

"It was more of an open dialogue," Rack confirmed.
Everyone attended each session and the relaxed structure of the presentation allowed speakers to explain their research while being questioned by interested listeners.

NanOstUdio

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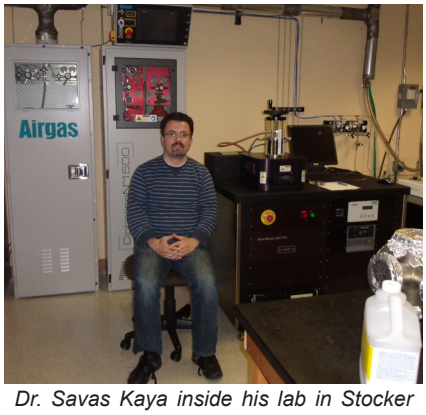
technology has a huge impact on our lives, and unfortunately many students have not been given the opportunity to delve into it.
"They don't know why it matters, yet" Dr. Kaya states, "the only way is to show them."
Though the plans for the studio are still in the beginning stages, Dr. Kaya hopes to have a working SEM system, a table top AFM, and other forms of spectroscopy teaching equipment.
"Most undergraduate students do not get to work with these types of equipment until their senior year"—which is hardly enough time for a seed of passion in microscale and nanoscale studies to sprout.
The studio is intended to be a comfortable place where undergraduates can lead seminars and teach their peers how to operate different pieces of research equipment. They will be encouraged to show contrasting samples and how the nanoscale differs from those on a micro or macro scale.
"Nano is much more sensitive," Kaya said, "which is sometimes misconstrued as more difficult."
Not only will interaction between students be encouraged, but also virtual interactions will be made readily available. There could be an iPad station where students may browse through folders of information compiled on specific subjects. "We also want to have a station where we project images that can be viewed through 3D goggles."
The NanOstUdio strives to ultimately be mobile. "We could take it to high schools, show it in expos, and open houses in addition to the fixed hours we will be operating in Stocker," Kaya said.



Dr. Savas Kaya inside his lab in Stocker Center

OU students attend Lindau Nobel Laureate Meeting

Hundreds of researchers gathered in Lindau, Germany during the first week of July to attend the 62nd Lindau Nobel Laureate Meeting. Ohio University was represented by graduate students Greg Petersen and Andrew DiLullo who were two of only 75 students from the United States to receive an invitation. The nearly 600 young researchers united from countries all over the world to meet with Nobel Laureates.

The conference's format is unique in that its research focus is on a four-year rotation. While this year's meeting was dedicated to physics, next year's will focus on chemistry. The meeting's environment not only provides the opportunity to discuss research ideas but also to build international professional contacts. The social aspect of the meeting allowed young researchers to mingle and converse informally with the Nobel Laureates.

Andrew Dilullo dining while in Lindau

To receive an invitation, Petersen and DiLullo underwent a rigorous multi-step application process which included seeking funding through a national organization that specializes in sponsoring scientific research and the pursuit of educational development. DiLullo and Petersen were both sponsored by the National Science Foundation.

In addition to attending, DiLullo also presented his results on how molecules interact with each other and along a chain on a surface with magnetic properties. Through the SPIRE program, DiLullo has done research in Germany three consecutive times, twice in Hamburg and once in Berlin. His presentation focused on results from his first year of research.

Greg Petersen with Nobel Laureate Brian Josephson In Lindau, Germany

Petersen studied in Argentina through the SPIRE program and had hoped to gain new ideas for potential projects from the Lindau Laureate Meeting. Petersen's own work centers on new types of materials that are low-dimensional, including one-dimensional chains of atoms and nanowires.

AFP , from page 1

explained Bar Dolev.

The samples were cooled between -27 and -35 degrees Celsius, then slowly warmed until only one ice crystal remained. This single ice crystal endured several warming and cooling sessions.

During the repeated heating and cooling, it was apparent that the moderately active AFP's created bipyramidal ice crystals in growth, but when melted, the corners disappeared and the vertical tips shrank. When the temperature was again lowered, the diamond shape of the crystal reappeared.

The AFP associated with ryegrass followed suit with the other moderate AFP's in developing the bipyramidal shape and in losing its corners when melting. However, both the rate of growth and dissolution were somewhat slower due to unusual burst patterns.

The hyperactive AFP's underwent the same process and it was observed that a very precise shape develops when an ice crystal becomes small enough. Researchers found it possible to distinguish between the varying samples of hyperactive AFP's merely by monitoring the melting process and observing the resulting unique ice crystal shapes.

Without the sharp corners and points of moderate AFP's that can damage cellular membranes, hyperactive AFP's have a future in improving any field requiring ice growth control.

They also have a future in applications to frozen foods helping to maintain the desired food texture during freezing and thawing cycles. In fact, low-fat ice creams and fruit-based popsicles already take advantage of AFP's.

AFP's have a promising future in agriculture as well. With the use of these proteins crops may no longer dread the first frost or frost damage. These proteins may also increase the growing area for crops which currently cannot survive low temperatures.

NanoUpdates

Publications

Congshang "Ella" Wan and Martin Kordesch's article "Scandium oxide coated polycrystalline tungsten studied using emission microscopy and photoelectron spectroscopy" was published in *Ultramicroscopy* 119

David Ruiz-Tijerina and Sergio Ulloa's article "Dynamical Magnetic Anisotropy and Quantum Phase Transitions in a Vibrating Spin-1 Molecular Junction" was published in Physical Review B 86, 3

Kangkang Wang and Arthur R. Smith's artwork from their article "Three-Dimensional Spin Mapping of Antiferromagnetic Nanopyramids Having Spatially Alternating Surface Anisotropy at Room Temperature" landed on the cover of Nano Letters.

For a full list of publications, please visit www.ounqpi.org

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