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BIOFEEDBACK

THE FISCHELL DEPARTMENT *of* BIOENGINEERING
A. JAMES CLARK SCHOOL *of* ENGINEERING

www.bioe.umd.edu

A NEWSLETTER FOR ALUMNI AND FRIENDS OF THE FISCHELL DEPARTMENT OF BIOENGINEERING AT THE A. JAMES CLARK SCHOOL OF ENGINEERING, UNIVERSITY OF MARYLAND, COLLEGE PARK.

IN THIS ISSUE:

Chen Bioimaging Research Wins Prestigious NSF CAREER Award

A proposal to create a system that combines the power of two biomedical imaging technologies to produce more detailed, near-live images of brain activity has earned Fischell Department of Bioengineering (BioE) assistant professor **Yu Chen** a 5-year, $400,000 National Science Foundation Faculty Early Career Development (NSF CAREER) Award.

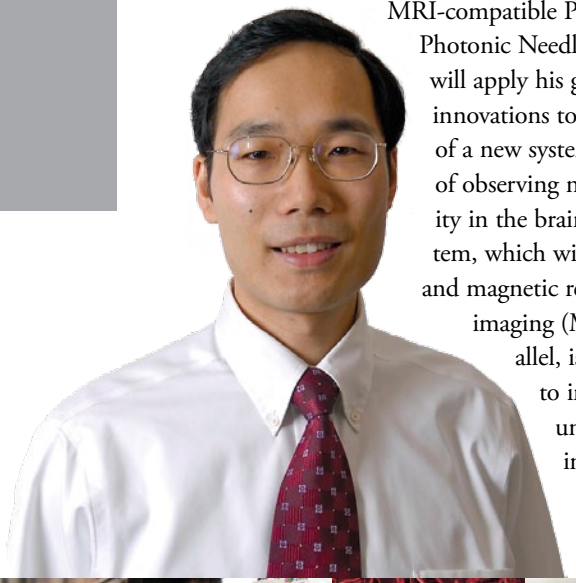
Chen specializes in the advancement of optical coherence tomography (OCT), a micron-scale imaging technology that allows doctors to examine changes to tissues in the body and in real time, without the need for a biopsy to acquire a sample. OCT is similar in concept to ultrasound, but creates images by measuring the echo time delay and intensity of back-reflected light rather than sound.

Chen's award-winning project, "Multi-Scale Imaging of Neural Interconnects Using MRI-compatible Parallel Photonic Needle Interface," will apply his group's innovations to the design of a new system capable of observing neural activity in the brain. The system, which will use OCT and magnetic resonance imaging (MRI) in parallel, is expected to improve our understanding of fast neuronal activation and the slower changes in blood flow that occur in response.

"Functional MRI is particularly useful for visualizing the location of neural activity, but has limited spatial resolution and temporal response—about one millimeter and one second, respectively," explains Chen. "Optical techniques such as OCT offer high spatial and temporal resolutions—about one to ten microns and one to ten milliseconds, respectively. A system that combines and correlates large field-of-view MRI and high-resolution optical imaging can enhance our understanding of brain function and improve the accuracy of image-guided neurosurgery."

The new system is based in part on the Needle OCT/Doppler (DOCT) probe, a long, slender bioimaging device Chen's Biophotonic Imaging Laboratory designed for neurosurgeons. The needle imaging probe, which measures less than 1mm in outside diameter, is capable of accompanying surgical tools into the brain inside a tube called a cannula, looking ahead and interpreting the biological landscape for the surgeon, who can then make course corrections that avoid damaging blood vessels while en route to a tumor or injury.

Chen is excited about the project's potential. "The MRI/parallel optical imaging platform will enable multi-scale imaging of neural structure and function deep within the living brain for the first time," he says. "It has the potential to link the microscopic



YU CHEN ▶

continues pg. 2

NSF CAREER, continued from page 1

neurovascular functions discovered in animal models with the macroscopic signals relevant for human imaging, thereby enabling translation of basic biomedical research insights to clinical applications."

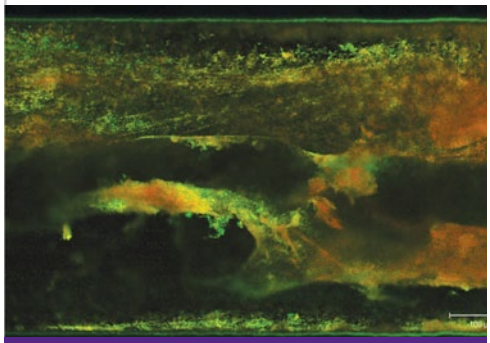
The NSF CAREER program supports the career development of outstanding junior faculty who most effectively integrate research and education within the goals and missions of their programs, departments, and schools. Chen is the fifth BioE assistant professor since the department's launch in 2006 to receive a CAREER Award, preceded by **Ian White** in 2012, **Joonil Seog** (now with the Department of Materials Science and Engineering) in 2011, **Adam Hsieh** in 2009, and **Helim Aranda-Espinoza** in 2007.

NEW MICROFLUIDIC DEVICE COULD SPEED DRUG EVALUATION

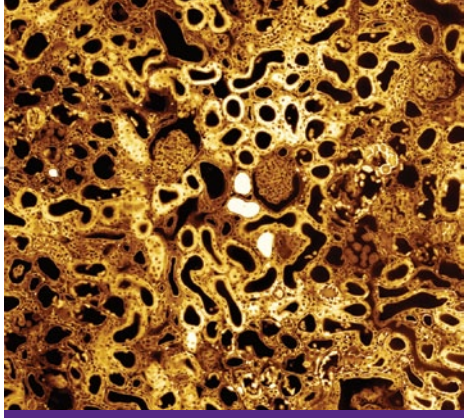
A poster presented by BioE graduate student **Mariana Meyer** won the Bioengineering division at the university's Bioscience Research & Technology Review Day.

Meyer's poster, "Multi-Depth Microfluidic Biofilm Reactor Fabricated With ALD Passivaton of a Photoresist Mold," described the design of a microfluidic device in which bacterial biofilms—a collection of cells that adhere to each other across a surface—can be studied. The device is capable of separating the film into isolated sections, allowing researchers to simultaneously perform multiple tests on the same sample.

Meyer's device uses channels with varying depths to accommodate both the biofilms and the tiny pneumatic valves used to separate them. She developed a new technique to create the different levels by alternating layers of photopatterned polymer with thin layers of aluminum oxide within her device mold. The aluminum oxide protects the polymer layer below as a new one is fabricated above.



AN *E. COLI* BIOFILM GROWN IN A MICROFLUIDIC CHANNEL OF MARIANA MEYER'S DEVICE, STAINED WITH FLUORESCENT DYES.



BIOIMAGING FROM THE CHEN GROUP: TWO-PHOTON MICROSCOPY OF A RAT KIDNEY.

Her ultimate goal, she says, is to use the device to examine how biofilms respond to new antibacterial treatments being developed in response to the growing number of antibiotic-resistant bacterial infections.

"This platform would help streamline the drug evaluation process," she explains. "Its small size means that you do not need large samples of new drugs for evaluating efficacy, and the ability to perform multiple [tests] on one biofilm allows for gathering more information more quickly."

Meyer says what she enjoys most about the project is how it requires her to use knowledge and skills from a number of disciplines—including microbiology, electrical engineering, bioengineering, and materials science—to produce an effective device. "I am constantly discovering different aspects to the project and [have] the opportunity to work [on it] with students and experts in a variety of fields," she says.

Meyer, who conducts her research at the MEMS Sensors and Actuators Laboratory, is advised by Institute for Systems Research (ISR) director and Department of Electrical and Computer Engineering professor **Reza Ghodssi**. Her work is funded by the Robert W. Deutsch Foundation.

In addition to Ghodssi, Meyer's co-authors on the poster are ISR graduate students **Young Wook Kim**, **Hadar Ben-Yoav**, and **Markus Gnerlich**; and BioE professor and chair **William E. Bentley**.

Bioscience Research & Technology Review Day is a special event that features research talks, presentations, mini-symposia and demonstrations by university scientists. The program provides a unique opportunity for executives and professionals in industry and government to discover the most recent advances in bioscience and biotechnology at the University of Maryland.

FASTER, EASIER WAY TO DIAGNOSE METABOLIC DISORDERS IN INFANTS

A proposal to create an inexpensive sensor for the rapid, point-of-care diagnosis of metabolic disorders in infants has earned BioE professor and associate dean **Peter Kofinas** the Clark School's first Translational Sciences Grant from the National Institutes of Health's National Center for Advancing Translational Sciences.

The project, conducted in collaboration with the Children's National Medical Center, will develop a system capable of detecting diseases such as hyperammonemia (a urea cycle disorder resulting in excess ammonia in the body) and phenylketonuria (an inability to metabolize an enzyme found in many foods) based on the analysis of a blood sample.

Left untreated, hyperammonemia and phenylketonuria can lead to a lack of cognitive development, behavioral and neurological problems, seizures, encephalopathy, and even death. Early diagnosis and management of these diseases are critical for a child to develop normally and remain healthy in adulthood, but afflicted babies may not express obvious symptoms until they are several months old.

Kofinas' goal is to make screening for these metabolic disorders easy and cost-effective enough to perform in any doctor's office, well before the conditions advance to the point of doing substantial harm.

"Our sensor device will be based on inexpensive components that require minimal training to operate," he says, "leading to reduced health care costs for the patient and the prevention of complications that impair mental health."

ENGAGING COMMUNITIES FOR A CLEANER BAY

Story courtesy of and adapted from the original by Sara Gavin, AGNR.

Researchers from the University of Maryland, including BioE associate professor **Hubert Montas**, have been awarded a three-year, $700,000 Science to Achieve Results (STAR) grant from the Environmental Protection Agency (EPA) for an innovative proposal designed to help Maryland communities contribute to the protection of the Chesapeake Bay. The funding will allow researchers to develop a strategic plan for reducing stormwater runoff from communities in the bay's watershed, the fastest growing source of pollution for the bay and its tributary rivers, including the Anacostia and the Patuxent.

The UMD research team, which will partner with a number of community-based organizations, includes members from the College of Agriculture and Natural Resources, the University of Maryland Extension, the School of Public Health, and the A. James Clark School of Engineering.

The project will focus on improving the management of stormwater in Howard County, Md.'s Wilde Lake watershed and the District of Columbia's Watts Branch watershed. The group will use a unique and comprehensive approach that includes surveys, interviews, photo documentary and cutting-edge diagnostic software to identify problem areas, increase the use and awareness of best management practices, and develop solutions.

Montas will spearhead the development of the diagnostic decision support system (DDSS) that will be used to guide the implementation of the best management practices (BMP) for the watersheds.

"[The system] will be developed to support precise spatial targeting of pollution hot spots in the study watersheds, and provide effective BMP recommendations for each," he explains, adding that it is also designed to include data reflecting community response. "The DDSS will be validated against existing monitoring data and will be applied to assess

HUBERT MONTAS

BMP adoption patterns and their long-term water quality impacts… Mobile platforms will also be developed to provide internet-based remote access to the DDSS for watershed stewards and stakeholders.

"The development and application of the DDSS, within the framework of this study," Montas adds, "is expected to provide the crucial coupling between social sciences and pure sciences that is critically needed to successfully improve stormwater quality and quantity in urban and suburban environments."

"These are very competitive grants—they're very difficult to get," remarked Senator **Ben Cardin** at a public ceremony announcing the grant in September 2012. "This speaks volumes to the fact that the University [of Maryland] has the capacity, as well as the relationships with the private sector and local governments, to be able to make a difference here and give confidence, so it's a real feather in the cap of the university."

support for BIOE

CANON VISIT

Canon Worldwide CTO Dr. **Toshiaki Ikoma** visited the UMD campus in November 2012 to tour facilities and speak with campus officials about the ongoing research partnership between Canon U.S. Life Sciences and the Fischell Department of Bioengineering, now in its second year. The BioE/Canon team is developing a system capable of performing rapid, automated infections disease diagnosis using genetic matching technology.

DEUTSCH FOUNDATION

Faculty, students, visiting scholars and postdoctoral research associates whose work is funded by the Robert W. Deutsch Foundation (RWD) met with Foundation trustees in December 2012 to report on the progress of their research. Among those in attendance were RWD President and Executive Director **Jane C. Brown**; RWD Trustee **David Deutsch**; RDW COO **Neil W. Didriksen**; and RWD Director and former RWD Technologies President and CEO **Laurens ("Mac") MacLure**. Presenters included BioE graduate students and RWD Fellows **Jordan Betz**, **Sheryl E. Chocron**, **Tanya Gordonov**, **Mariana Meyer**, **Jessica Terrell**, and **Thomas Winkler**. RWD Post-Doctoral

PHOTO BY AL SANTOS

Fellows **Eunkyoung Kim** and **Yi Liu** and RWD Visiting Professor **Xianwen Hu**, who work with BioE professor **Gregory Payne**'s research group at the Institute for Bioscience and Biotechnology Research, also presented their results. RWD currently supports research conducted by Payne, BioE professor and chair **William E. Bentley**, Professor **Reza Ghodssi** (ECE/ISR), and Professor **Gary Rubloff** (MSE/ECE/MD NanoCenter), all of whom are members of the Maryland Biochip Collaborative. For more information, see **biochip.umd.edu**.

LEFT TO RIGHT: EDMUND T. KNIGHT (CLARK SCHOOL ASSISTANT DEAN OF COMMUNICATIONS), HIROSHI INOUE (SENIOR FELLOW, CANON U.S.A. AND CANON U.S. LIFE SCIENCES, AND BIOE PROFESSOR OF THE PRACTICE), PROFESSOR PATRICK O'SHEA (V.P. AND CHIEF RESEARCH OFFICE, UNIVERSITY OF MARYLAND), PROFESSOR WILLIAM E. BENTLEY (CHAIR, BIOE), DR. TOSHIAKI IKOMA (EXECUTIVE VICE PRESIDENT & CTO, CANON INC. HEADQUARTERS), MR. MICHITANI SETANI (GROUP EXECUTIVE OF NEW BUSINESS TECHNOLOGY, R&D GROUP, CANON INC., SENIOR GENERAL MANAGER OF RDT STRATEGY CENTER, CANON INC.), MR. TORU NISHIZAWA (PRESIDENT & CEO CANON VIRGINIA INC.), AND MS. AKIKO TANAKA (SENIOR DIRECTOR OF CORPORATE PLANNING DIVISION, CANON U.S.A. INC.). PHOTO BY TRACEY BROWN.

researchNEWS *continued*

SPINNING ENGINEERED SILK, continued from back cover

Left alone, silk-elastin peptide polymer will naturally self-assemble into a hydrogel in a solution at body temperature. The Seog Group was the first to discover that the AFM's tapping action not only stimulated the formation of SELP fibers, but could also be used to direct them into specific patterns or shapes perpendicular to the microscope's scanning direction. While it has not yet been firmly established why interaction with the AFM's cantilever has this effect on SELP—that's the subject of the group's next study—Johnson's recent paper outlines the scanning conditions that optimize the fibers' growth, the relationship between scanning speed and growth rate, and what is known about the growth mechanism to date.

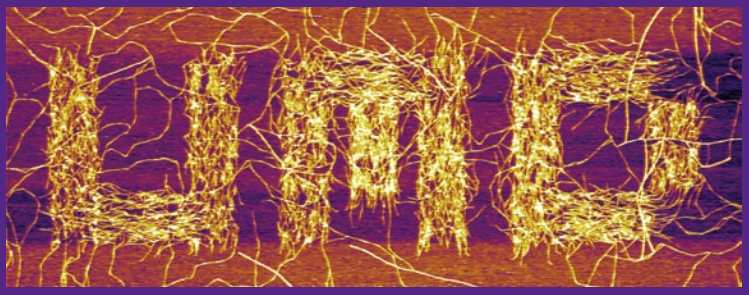
The three things that affect SELP assembly and direction, Johnson explains, are the AFM's scanning speed, cantilever tip pressure, and how many times the tip is scanned across the width of the sample, a variable known as line density. Johnson and her colleagues found that while using the AFM in tapping mode, lower scanning speeds, higher pressure, and increased line density (particularly once each line equals the width of a SELP molecule) resulted in the fastest and most directed growth. They also discovered that a SELP molecule on a mica subsrate must be tapped multiple times to stimulate nucleation, the process that causes the nanofibers to grow. The creation of the miniature letters "UMD," says Johnson, was "the conglomeration of the best conditions [the team] found."

Going forward, the Seog Group hopes to understand the nucleation mechanism that occurs at the cantilever's tip, both why it happens and why the SELP fibers grow in the specific direction they do. Once that knowledge has been perfected, Johnson adds, she and her colleagues can begin to explore practical biomedical applications of structures made out of SELP.

Johnson says working on the project over the past two years and publishing her first paper have been fulfilling, and have inspired her to continue her education. "Coming into the undergraduate program, I didn't have any intent of going on to graduate school," she says. "I just wanted to get out there and make medical devices. Working with grad students and postdocs really allowed me to see that I could obtain [their] level of knowledge. Learning more about the research process can be very challenging, but you also have those exciting moments where you discover something new...and it's pretty rewarding!"

For More Information:

See: "Directed patterning of the self-assembled silk-elastin-like nanofibers using a nanomechanical stimulus." Sara Johnson, Young Koan Ko, Nitinun Varongchayakul, Sunhee Lee, Joseph Cappello, Hamidreza Ghandehari, Sang Bok Lee, Santiago D. Solares and Joonil Seog. Chem. Commun., 2012, 48, 10654-10656.



BIOE SENIOR SARA JOHNSON AND HER COLLEAGUES IN PROFESSOR JOONIL SEOG'S RESEARCH GROUP USED AN ATOMIC FORCE MICROSCOPE TO MECHANICALLY GUIDE SELP NANOFIBERS, FORMING THE LETTERS "UMD."

facultyNEWS

KOFINAS NAMED ASSOCIATE DEAN FOR FACULTY AFFAIRS AND GRADUATE PROGRAMS

In Fall 2012, BioE professor **Peter Kofinas** took on a new role as the A. James Clark School of Engineering's Associate Dean for Faculty Affairs and Graduate Programs.

PETER KOFINAS

Kofinas has stepped down from his position as BioE's Associate Chair and Director of Graduate Studies, but will continue with his research and teaching responsibilities.

As an associate dean, Kofinas now manages Clark School faculty activity and workload reports, merit reviews, and overload requests; serves as an equity officer; coordinates the Appointments, Promotions and Tenure (APT) process and unit reviews; directs the Future Faculty Program; and performs many other administrative tasks.

Over the course of his 16 years with the Clark School, he has been active in administrative service outside of his past and present departments, including serving a term as Chair of the Clark School's APT committee, and serving as a member of both a Tenure Appeals Committee and the Provost's Academic Planning and Advisory Committee. Kofinas feels experiences like these, and his work as BioE's Associate Chair and Director of Graduate Studies, have prepared him for his newest administrative challenge.

"I am very excited for this opportunity to serve the college," he says.

KOFINAS, MURO HONORED FOR RESEARCH

BioE faculty were honored with both of the A. James Clark School of Engineering's 2012 Outstanding Research Awards.

Professor **Peter Kofinas** received the Senior Faculty Oustanding Research Award for his work on the synthesis,

characterization and processing of novel polymer-based nanostructured systems that have a variety of uses across medicine, energy storage and microelectronics. His current research includes novel blood coagulation-inducing polymer hydrogels, sensors for the detection of chemical and biological threats, nanocomposites for flexible antennae and design of shape-conforming nanostructured polymeric battery energy storage systems.

In his 16 years at the Clark School, Kofinas and his students have published 57 peer-reviewed publications, which have been cited 966 times, with a steep climb in citations over the past 5 years. He has filed nine patent applications, speaks extensively at other academic institutions and serves annually on review panels for several federal agencies.

Kofinas has earned more than $11 million in federal research grants. He is a NSF CAREER Award winner, a two-time recipient of the UMD Outstanding Invention of the Year award, and the 1999 recipient of the Clark School's Junior Faculty Outstanding Teaching Award. He is also a Keystone Professor, one of a group specialized in early engineering education and student retention.

Associate Professor **Silvia Muro**, BioE's only molecular and cell biologist, received the Junior Faculty Outstanding Research Award. Muro has established herself as an innovator in the field of targeted therapeutic and drug delivery, particularly for the treatment of rare lysosomal diseases such as Fabry, Pompe, and Niemann-Pick. She and her group members have won numerous grants and awards for their work, including a $1.72 million National Institutes of Health (NIH) R01 grant to develop new treatments for genetic diseases affecting lungs and brain; the Controlled Release Society's 2011 Outstanding Consumer and Diversified Products Paper Award for the design of safe, efficient and noninvasive strategies to transport drugs across the blood/brain barrier; the 2010 University of Maryland Life Sciences Invention of the Year award; and first place in the 2012 Professor Venture Fair for the development of a novel drug delivery strategy that uses targeted carriers capable of crossing the gastrointestinal epithelium via natural vesicular transport mechanisms (see p. 9). She has published close to 50 high quality manuscripts in top-tier journals. The members of her research group have also received numerous accolades, including best paper and best poster awards, graduate research awards, and articles featured on the covers of high-impact publications. Prior to joining the Clark School and the Institute for Bioscience & Biotechnology Research (IBBR), Muro's efforts to understand diseases such as propionic acidemia, a life-threatening metabolic disorder affecting newborns, led to the world's first genetic prenatal diagnosis and multiple awards from the European and Spanish Societies for the Study of Inborn Errors of Metabolism.

TAO: FELLOW OF AMERICAN SOCIETY OF AGRICULTURAL AND BIOLOGICAL ENGINEERS

BioE extends its congratulations to Professor **Yang Tao**, who was elected to Fellowship in the American Society of Agricultural and Biological Engineers (ASABE).

Tao was cited for his nationally and internationally recognized expertise "in cutting-edge research programs, [for] achievements in the applications of machine vision and bio-imaging, [for] developing innovative and practical high-tech systems and technologies for food safety and quality, and for cost-effective production of poultry, fruit, vegetables, and other products."

After earning his Ph.D. from Penn State in 1991, Tao served as the Vice President and Director of R&D of AGRI-TECH, Inc., where he led the development of machine vision, non-invasive inspection, packing, and optical-electronic and robotic sorting systems. These included the award-winning Merlin® color vision sorting system, capable of handling and grading up to 44 tons of fruits or vegetables per hour. He was a member of the engineering faculty of the University of Arkansas from 1996–2000. In 2000, he joined the University of Maryland's Department of Biological Resources Engineering, and in 2006 was appointed to the faculty of the newly created Fischell Department of Bioengineering.

Tao's current research projects include the development of a new system for de-capping up to 120 strawberries per second while increasing worker and product safety, and a hyperspectral imaging system used to help separate the meat of the North American black walnut—a more difficult nut to crack than the familiar English walnut—from its shell.

A PROTOTYPE OF PROFESSOR YANG TAO'S STRAWBERRY DE-CAPPING SYSTEM, WHICH USES MACHINE VISION AND SAFE, BLADE-FREE OPERATION TO PROCESS UP TO 120 PIECES OF FRUIT PER SECOND.

Outside of the lab, Tao leads the BioE's two-semester, senior year Capstone course, in which teams of students design and construct a prototype medical device designed to address a real-world problem. In addition to teaching students about the invention process, market research and patent procedures, Tao coordinates matching each team with both a faculty advisor and an external mentor from the University of Maryland School of Medicine, a regional hospital, or a biotech company. He also teaches the department's medical instrumentation course.

Tao joins former BioE professor and College of Agriculture and Natural Resources Associate Dean for Research **Adel Shirmohammadi** on ASABE's roster of Fellows.

"Yang is a dedicated researcher and educator," says Shirmohammadi. "He connects with both undergraduate and graduate students in a friendly and enthusiastic manner. He is a true scholar and academician...He has several patents to his credit, including an apple sorting machine that sorts more than 50 percent of the golden delicious apples in U.S. As a colleague, he is a true friend and inspiration to me."

Tao will be formally inducted at the ASABE's national meeting, to be held in Kansas City, Ks., in July 2013.

continued

BENTLEY: AICHE DIVISION AWARD

The American Institute of Chemical Engineers (AIChE) awarded BioE professor and chair **William E. Bentley** its 2012 Food, Pharmaceutical and Bioengineering Division (FP&BE) Award in Chemical Engineering.

The award "recognizes an individual's outstanding chemical engineering contribution in the food, pharmaceutical and/or bioengineering industry," government, academia, or with other organizations.

Bentley was invited to speak at the FP&BE Division's plenary session at the 2012 national meeting of the AIChE, held in October in Pittsburgh, Pa. His talk, titled "Building the Biotechnology Toolbox: At the Intersection of Biofabrication and Synthetic Biology,"discussed his group's work in using a form of intercellular communication known as quorum sensing to control and direct cell populations, particularly in the area of facilitating interaction between electronics and synthetic biology.

HEROLD CO-EDITS NEW BOOK ON CANCER DIAGNOSTICS

BioE associate professor **Keith Herold** is the co-editor of a new book on the use of biosensors for cancer diagnostics, part of the "Series In Sensors" produced by CRC Press. **Avraham Rasooly** (National Cancer Institute, FDA) is Herold's co-editor.

Biosensors and Molecular Technologies for Cancer Diagnostics explores the latest alternatives to standard methods of genomic and proteomic cancer detection. The book's goal is to bridge a gap between current research and clinical application, and to make biosensor technology—which is poised to provide faster screening and earlier diagnoses—more accessible to oncologists, pathologists, engineers and molecular biologists.

The book covers major areas of biosensor technology and functionality, including optical technologies (such as surface plasmon resonance, evanescent wave, spectrometry, fluorescence, and photoacoustic), electrochemical detection, electronic and magnetic technologies, thermoelectric sensing, and cantilever-based technologies.

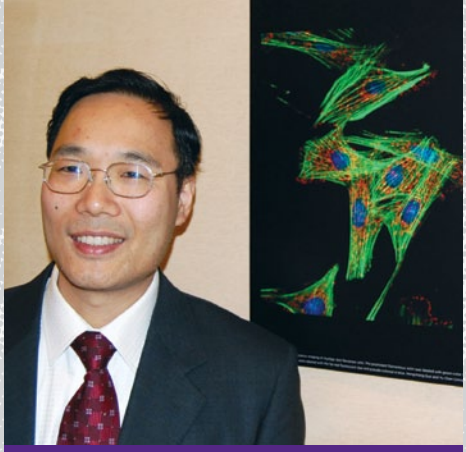
CHEN'S BIOMEDICAL IMAGING FEATURED IN AMERICAN CENTER FOR PHYSICS ART EXHIBIT

The delicate microanatomy of brains and kidneys, captured in rich color and detail using techniques found in the laboratory rather than an artist's studio, are simultaneously technology and art, literal slices of life and abstractions.

The images, produced by BioE assistant professor **Yu Chen** with visiting research assistant professor **Hengchang Guo** and Burke Rehabilitation Center assistant professor **Jian Zhong**, were presented alongside sculptures and paintings inspired by science in a show called *From Here to Infinity*, which ran from October 2012 until April 2013.

Twice annually, the ACP hosts shows that explore the relationship between science and art by exhibiting paintings, sculpture, photography, prints, or drawings inspired by technology, math, medicine, or other technological trends. After attending a previous exhibit focusing on natural phenomena, Chen approached curator **Sarah Tanguy** with an idea for a biomedical imaging-themed show, and found she shared his interests.

"Biomedical imaging is grounded in physics, and is a more sophisticated way of producing 'photography,'" says Chen. "I have always been fascinated by the images produced by my research, and teaching people about them, so I thought it might be a good way to present some biomedical images and attract interest from the general public."



ASSISTANT PROFESSOR YU CHEN WITH ONE OF HIS PIECES AT THE AMERICAN CENTER FOR PHYSICS GALLERY.

In *From Here to Infinity*, Tanguy combined Chen's biomedical imaging with sculptures by former research chemist **Susan Van der Eb Greene** and cell-staining-inspired paintings by **Jeffrey Kenwhose** to present a body of work that "…[sought] to harness energy and exploit the dynamic relationship between abstraction and representation" and that "suggest[ed] movement, real or imagined, exploring transition over time and immortality within change."

Chen, Greene and Kent, Tanguy suggested in the exhibit's brochure, "…share a thrill of discovery and a quest to channel energy [by] probing the structural beauty hidden in plain sight."

These descriptions seem particularly applicable to Chen's work with optical coherence tomography (OCT), fluorescence confocal microscopy (FCM), and two-photon microscopy (TPM), which enables him to catch living tissue just below the skin in the act of transitioning to or from a disease state, without having to remove it from the patient's body.

In addition to OCT, FCM, and TPM, Chen and his colleagues produced their contributions to the exhibit with technologies including magnetic resonance imaging (MRI) and electron microscopy. BioE associate professor **Silvia Muro**, Maryland Neuroimaging Center magnetic resonance physicist **Wang Zhan**, and University of Maryland School of Medicine associate professor **Rao Gullapalli** also contributed their images for the exhibit, which reflected biological structures ranging from organelles to cells and organs.

SOLID POLYMER ELECTROLYTE: LITHIUM FLEX IS NEARLY TRANSPARENT, FLEXIBLE, CAN BE MOLDED INTO ANY SHAPE, AND IS NOT FLAMMABLE OR CORROSIVE.

PARTNERSHIP WITH UM SCHOOL OF MEDICINE YIELDS NEW START-UP

By Beth Panitz. Reproduced with permission from E@M, 12(2):20, Fall 2012.

It's a winning combination: teams of talented Clark School bioengineering students working closely with physician-mentors from one of the nation's leading healthcare institutions to solve pressing medical problems. A partnership between the Clark School's Fischell Department of Bioengineering and the University of Maryland School of Medicine is pairing undergraduates with physicians in a two-semester Senior Capstone Design course in which students must create innovative engineering solutions to problems that impact patient care.

The partnership is yielding impressive results. Mentored by **Jeffrey Hasday**, M.D., professor of medicine and the head of pulmonary and critical care at the University of Maryland School of Medicine, five bioengineering students have created a patent-pending device to deliver drugs to patients with respiratory failure, the third leading cause of death in the United States. Their invention led to the launch of Wesk Medical, LLC, a start-up company specializing in medical device development.

"Bioengineering and medicine are so intricately and inexorably tied together that it makes for a natural collaboration," says team member **Kaiyi Xie** (B.S. '12). "Through the partnership, we were able to identify a real medical problem and take off from there."

Aerosol Catheter to Improve Patient Care

Drawing on his 26 years of critical care experience, Hasday helped the students identify the need: Patients experiencing respiratory failure are often intubated—an endotracheal tube is placed through their mouth or nose, bringing them oxygen from a respirator. When those patients require inhaled medications, the endotracheal tube poses physical obstacles, making drug delivery to the lungs inadequate and unpredictable.

"Academic studies show that only one to four percent of drugs reach patients' lungs, and we are not sure how much is absorbed," says Xie.

With Hasday's guidance, the students developed a solution: the endotracheal aerosol-generating catheter (ETAG). The tiny catheter—only a couple millimeters wide—is threaded down the endotracheal tube, delivering droplets of liquid drugs to a microchip at the innermost tip of the tube. The chip uses surface acoustic waves to vibrate the droplet, nebulizing it into consistently and optimally sized aerosol particles for delivery to patients' lungs.

The students also are collaborating with University of Maryland School of Pharmacy Professor and Associate Dean **Richard Dalby**, whose lab specializes in evaluating aerosol-based drug delivery systems. "There is real value in these types of collaborations," says Dalby. "The engineers bring the ability to design devices, while the medical school and pharmacy school bring a sensitivity to patient-use issues."

Hinman and Citrin Programs Help Students

Hasday, a member of Wesk Medical's management team, describes the start-up as "the perfect example of bioengineers creating and implementing ideas with clinical solutions. As we move through the product development phase, our long-term goal for this product and others is to reach the marketplace and improve the quality of care for patients."

The team relied heavily on the entrepreneurial experience of members **Esmaeel Paryavi** and **Bernard Wong** (both B.S. '12), who were enrolled in the Hinman CEOs program, the nation's first living/learning entrepreneurship program. The program, which is part of the Clark School's Maryland Technology Enterprise Institute (Mtech), gives entrepreneurially-minded students from all disciplines the tools for launching a new venture.

"We were passionate about starting this company," says **Walter Beller-Morales** (B.S. '12). "While we were working out the engineering aspects of the device, we were going through the steps of getting the company off the ground."

The bioengineering capstone course also gave the students a basic primer on how to bring a medical device to market, covering such topics as obtaining Food and Drug Administration approval, seeking venture capital, and addressing legal concerns. In addition, the team was inspired and motivated by bioengineering department benefactor and namesake **Robert E. Fischell**, who offered advice on biomedical entrepreneurship as a guest lecturer for the course.

A $5,000 grant from the Warren Citrin Impact Seed Fund and a $500 prize in the 2012 University of Maryland $75K Business Plan Competition are helping to fund the startup. "We look forward to licensing our invention and producing a revenue stream that will help us design other life-changing biomedical devices," says Xie.

SAFELICELL TAKES 2ND AT GREEN BUSINESS PLAN COMPETITION

An undergraduate's pitch for a patent-pending, solid polymer electrolyte designed to make lithium-ion batteries safer won second place and a $10,000 prize in the American Chemical Society's (ACS) Green Chemistry Institute Inaugural Business Plan Competition, held in 2012 in Washington, D.C.

BioE junior **Mian Khalid** represented SafeLiCell, the startup company he co-founded with his advisor, BioE professor **Peter Kofinas**, and fellow Kofinas Group member, Department of Chemical and Biomolecular Engineering graduate student **Aaron Fisher**.

continues pg. 8

FROM LEFT, WESK MEDICAL TEAM MEMBERS STEPHEN ROBINSON, ESMAEEL PARYAVI, KAIYI XIE, BERNARD WONG AND WALTER BELLER-MORALES CELEBRATE CAPTURING FIRST PLACE IN THE FISCHELL DEPARTMENT OF BIOENGINEERING 2012 CAPSTONE DESIGN COMPETITION.

SAFELICELL, continued from page 7

SafeLiCell's product, Lithium Flex, is a light, strong film that can be wrapped or bent into different shapes without breaking, and, unlike current lithium-ion battery electrolytes, contains no combustible or corrosive materials.

By the time the team received their invitations to the ACS's Green Chemistry & Engineering Conference, where the final round of the competition took place, Kofinas and Fisher were scheduled to attend conferences in Korea. They encouraged Khalid to take reins.

"I was very excited to have an opportunity to present SafeLiCell's business plan on my own," says Khalid, "[but] it was definitely a bit unnerving to compete with full-time professionals in the field." Although he felt confident he had delivered a solid presentation and successfully fielded questions from the judges, he admits he was "stunned" to learn he'd earned the $10,00 second prize.

"I am very grateful to have had a chance to present at the conference and to have won the confidence of the judges and the audience," he says, adding that his participation in the competition was an "invaluable experience."

"Mian was the youngest person in the competition by far," says Kofinas. "He's a great example of the caliber of our undergraduates, who have demonstrated they can compete and win in events held at professional and national levels. I am very proud of him."

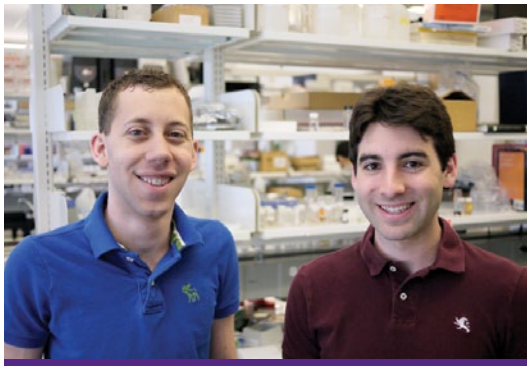
The Green Chemistry Institute award is SafeLiCell's second significant win. In April 2012, the company took second place in and received a $15,000 prize at the inaugural $100K ACC Clean Energy Challenge business plan competition.

Khalid's work in Kofinas's Functional Macromolecular Laboratory is funded by an Undergraduate Research Fellowship from Howard Hughes Medical Institute. He also majors in English and is a member of the Clark School's Engineering Honors Program and the College Park Scholars' Global Public Health program.

DIAGNOSTIC ANSERS PITCHES DINGMAN...AND WINS!

What if a sensor capable of detecting the smallest traces of pesticides, explosives, drugs and toxins in food and water could be manufactured anywhere using a modified inkjet printer, for a fraction of the cost of the currently available technology? That question, posed and answered by Clark School startup company Diagnostic anSERS, won October's **Pitch Dingman** competition.

Administered by the Dingman Center for Entrepreneurship at the Robert H. Smith School of Business, the Pitch Dingman competition gives students from any major six minutes to convince a panel of Entrepreneurs-in-Residence that their idea is worth funding with the $2500 prize. Prior to the competition, participants attend informal presentation sessions to learn how to craft a pitch, practice their presentations, and receive feedback. The Dingman Center runs two competitions each semester.



SEAN VIRGILE & ERIC HOPPMANN

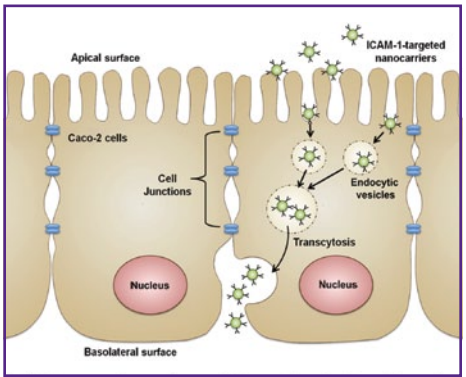
Diagnostic anSERS, founded by BioE graduate students **Eric Hoppmann** and **Sean Virgile** (both advised by BioE assistant professor **Ian White**), uses a novel ink jet printing process to fabricate inexpensive substrates for surface enhanced Raman spectroscopy (SERS), a molecular fingerprinting technique. The result is a low-cost, on-demand, and portable version of an advanced sensor technology that is typically a high-end investment and confined to a lab.

Virgile says Pitch Dingman presented a new challenge for him and Hoppmann despite their previous experience.

"[The pitch] is evaluated solely on business [merit], not science," he explains. "This makes it incredibly hard. We're used to talking about science and engineering, and we're developing a scientific company. To strip the whole presentation of any and all science was difficult, but that did allow us to focus on exactly what they were looking for: the business."

Virgile says his and Hoppmann's experiences in Pitch Dingman and other business plan competitions have been inspiring and beneficial as they've moved forward with product development.

"Not only have they provided valuable funding, more importantly, they provided validation," he says. "It's a common belief that entrepreneurship is extremely risky. But if you perform the technical and market research, talk to potential customers, and find your minimum viable product, before you invest all of your time and money into your business, then the risk is dramatically reduced…The competitions have shown us that we did do all of our homework, and that this is a worthwhile project, and a needed product."



BIOE GRADUATE STUDENT RASA GHAFFARIAN'S ILLUSTRATION APPEARED ON THE COVER OF THE *JOURNAL OF CONTROLLED RELEASE*. IT SHOWS ANTI-ICAM NANOCARRIERS BEING TRANSPORTED ACROSS CACO-2 CELL MONOLAYERS VIA A VESICULAR TRANSCYTOSIS PATHWAY RELATED TO CELL ADHESION MOLECULE-MEDIATED ENDOCYTOSIS, WITHOUT AFFECTING THE PARACELLULAR PERMABILITY.

DRUG DELIVERY SYSTEM WINS PROFESSOR VENTURE FAIR

A pair of researchers from the Fischell Department of Bioengineering were honored at the University of Maryland's 2012 Bioscience Research & Technology Review Day for their presentation of a novel drug delivery strategy that uses targeted carriers capable of crossing the gastrointestinal (GI) tract into the circulation. Associate Professor **Silvia Muro** (joint, BioE and Institute for Bioscience and Biotechnology Research) and her advisee, graduate student **Rasa Ghaffarian**, won first place in the annual event's Professor Venture Fair.

Hosted by the Maryland Technology Enterprise Institute, the university's Office of Technology Commercialization, and the College of Computer, Mathematical, and Natural Sciences, the annual Professor Venture Fair gives faculty inventors the opportunity to pitch their new technologies to a team of regional venture capitalists and entrepreneurs. The competition encourages scientists to consider the commercial viability of their work and challenges them to translate their ideas into a presentation for a general, non-technical audience.

The pair's innovative solution uses the GI tract's built-in transportation system, the transepithelial pathway, to move orally administered therapeutic or diagnostic molecules into the bloodstream.

Although oral administration of drugs and therapeutics is preferred due to its simplicity, low cost, comfort, and higher level of patient compliance, in many cases, only a fraction of the dose swallowed ever reaches its target due to the harsh environment of the digestive system. Some biological treatments, such as vaccines or antitoxins, cannot currently be administered orally at all.

Drugs can be "pushed through" junctions between the epithelial cells lining the gastrointestinal (GI) tract, but this may result in side effects if other substances cross the junctions when they are opened. Muro and Ghaffarian created a delivery system in which drugs are loaded in nanocarrier particles that are targeted to cell surface receptors that control natural transport across the GI epithelial cells. Using the cells' natural behavior to do the work results in a safe, fast and efficient passage into the circulation without "using force" or negatively affecting GI permeability.

"This is a culmination of years of effort in what we believe to be a very important contribution to the scientific community," says Ghaffarian. "Our research addresses a practical need to transport macromolecular therapeutics."

"It holds great potential as a general platform for gastrointestinal delivery into the circulation and for the treatment of gastrointestinal epithelial cells involved in infections, inflammatory conditions, and cancer," Muro adds. "There is no doubt that this discovery will be able to enhance oral biological therapies as well as the safe targeting of drug delivery carriers."

The system also holds promise for other applications, including the oral delivery of therapeutics for lysosomal storage disorders and for Alzheimer's disease, small molecular drugs for the treatment of genetic conditions, and treatments against inflammation, thrombosis and oxidative stress.

In addition to the win at the Professor Venture Fair, a paper on the delivery system was featured on the cover of the *Journal of Controlled Release*, one of the top publications focusing on drug and gene delivery, tissue engineering, and related diagnostics. The research also won the American Society of Nanomedicine's Best Poster Award in 2011.

Muro and Ghaffarian's team is the third led by or including members of the Fischell Department of Bioengineering that has taken first place in the Professor Venture Fair competition. In 2009, Professor John Fisher won for his presentation of a bioreactor used to help generate new bone tissue for patients with serious injuries; and in 2008, former Fischell Fellow **Matthew Dowling** was part of team that won for its presentation of Velcro-like "biobandages" capable of clotting blood and administering drugs.

SILVIA MURO (LEFT) AND RASA GHAFFARIAN (RIGHT)

FERLIN ELECTED COMMUNICATIONS OFFICER INTERNATIONAL SOCIETY

BioE graduate student **Kimberly Ferlin**, co-advised by Professor **John Fisher** (BioE) and Dr. **David Kaplan** (FDA), was elected to a three-year term as the communications Officer for the Americas Branch of the Student and Young Investigator Section of TERMIS, the Tissue Engineering and Regenerative Medicine International Society (TERMIS SYIS-AM).

KIMBERLY FERLIN

She will be responsible for increasing the online and social media presence of SYIS-AM on networks and sites including Facebook, LinkedIn, and Twitter.

Ferlin conducts her research in both Fisher's Tissue Engineering and Biomaterials Laboratory and at the FDA's Center for Devices and Radiological Health, where she is an ORISE Fellow. She is currently investigating the impact of cell/substrate interactions on mesenchymal stem cell enrichment, proliferation, and differentiation.

Ferlin joined SYIS-AM after attending a TERMIS conference in December 2011. She plans to attend the Third TERMIS World Congress in Vienna, Austria this fall, and looks forward to meeting SYIS members from the society's worldwide branches.

MERRILL PRESIDENTIAL SCHOLARS HONORED

The Merrill Presidential Scholars Program honors the University of Maryland's most successful rising seniors and their mentors from both the University faculty and their K-12 education. Each academic year, scholars and their mentors are recognized in a special ceremony, and teachers and faculty participate in a workshop designed to strengthen relationships between the university and K-12 schools. To continue the legacy of academic excellence and mentoring, scholarships are awarded in the K-12 mentors' names to new first year students from their respective high schools or school districts.

This year, two BioE undergraduates were among the 2012 Merrill Presidential Scholars:

Joshua Thompson was chosen for his excellence in scholarship; research achievements in projects focusing on stem cells, biomaterials, and tissue engineering, including publishing in peer-reviewed journals and presenting at professional societies; and commitment to volunteering in local and international hospitals. He is also a teaching assistant for the Department of Chemistry, a Maryland Images Campus Tour Guide, an Eagle Scout, and the 2011 winner of the Outstanding ASPIRE Student Research Award. Thompson's mentors are BioE professor **John Fisher** and Loyola High School chemistry teacher **Lakeisha O'Keiffe**.

Janina Vaitkus was chosen for her excellence in academics in bioengineering and honors curricula, leadership in research on neuronal cell structure and function, volunteerism including bilingual assistance in clinics, commitment to teaching, and leadership in club athletics. She is a former member of the campus' student government association, an undergraduate researcher and teaching fellow, a volunteer at Shanahan Children's Clinic, and has worked in a local emergency department. Outside of class, she plays on the school's club lacrosse team, where she has been co-captain for the past two years. She will be studying abroad in Guatemala while running sports clinics for the children in the area, and after graduation, she will be entering the University of Maryland School of Medicine to earn dual M.D./Ph.D. degrees and pursue her goal of becoming a physician-scientist. Vaitkus' mentors are BioE professor **Helim Aranda-Espinoza** and South River High School assistant principal **Ryan Sackett**.

UMD AND JHU STUDENTS JOIN FORCES FOR RESEARCH DAY

Undergraduates from the Clark School's Fischell Department of Bioengineering (UMD BioE) and Johns Hopkins University's Department of Biomedical Engineering (JHU BME) recently participated in a new annual event designed to showcase the impact and quality of undergraduate research, and to encourage classmates to pursue their own laboratory experiences.

"Amplifying the Field: Undergraduate Contributions to Biomedical Research," held March 1 on the JHU Homewood campus in Baltimore, was conceived by the two universities' student chapters of the Biomedical Engineering Society (BMES). Chapter presidents **John Kim** (JHU BME) and **David Peeler** (UMD BioE) hosted the event, which included guest speakers from BMES and both schools' faculties, a poster session, dinner, and an awards ceremony.

Speakers included BMES' **Isabel Regena Borkoski**, who discussed the benefits of becoming involved with a professional society, whether one planned for a future in research or industry; and professors **Jordan Green** (JHU BME) and **Ian White** (UMD BioE), both of whom stressed that in both the job market and graduate school applications, "undergraduate research trumps straight As."

When you participate in undergraduate research, White told the audience, "you learn to think like a researcher, gain confidence, interpret information, and relate what you've learned to other things. Those benefits apply to many future career paths."

About two dozen posters were exhibited, and six authors among those who submitted were selected to deliver oral presentations. A team of faculty judges representing both schools gave awards to the top three presentations, while students voted for the best poster.

The winners, who received certificates and cash prizes, were:

- **Mary Natoli** (UMD BioE), who took 1st Place for her oral presentation, "Point of Care Diagnostics for Aminoacidopathies in Infants;"
- **Hyun Sung Park** (JHU BME), who took 2nd place for his oral presentation, "Formation of Neuromuscular Junction in a Microfluidic Device;"
- **Jeff Rappaport** (UMD BioE), who took 3rd Place for his oral presentation, "Characterizing the Uptake of Targeted Nanocarriers for Drug Delivery Across the Blood/Brain Barrier;" and
- **Maxwell Collard** (JHU BME) and **Mythili Mandadi** (UMD BioE), who tied for the Best Poster Award for "Toward Real-Time Decoding from Directed Functional Connectivity of the Electrocorticogram" and "Characteristics of Polyurethane vs. Natural Rubber Latex Condoms in the Presence of Primary Ingredients in Commercial Personal Lubricants," respectively.

Peeler says despite the effort it took to organize the event across two campuses, working with his counterparts at JHU was a pleasure.

THE CLARK SCHOOL'S MERRILL PRESIDENTIAL SCHOLARS AND THEIR MENTORS. FROM LEFT TO RIGHT: JOSHUA THOMPSON (BIOE), LAKEISHA O' KEIFFE (LOYOLA HIGH SCHOOL), RYAN SACKETT (SOUTH RIVER HIGH SCHOOL), MATTHEW RICH (AEROSPACE), THOMAS SANKEY (MT. HEBRON HIGH SCHOOL), JANINA VAITKUS (BIOE), JOHN FISHER (BIOE), HELIM ARANDA-ESPINOZA (BIOE), AND MARY BOWDEN (AEROSPACE).

BIOE PROFESSOR SILVIA MURO (LEFT) DISCUSSING RESEARCH WITH A STUDENT AT THE JHU/UMD POSTER SESSION.

"Faculty support is what made the event happen, though," he adds, "and I was happiest that the judges from both sides were as impressed by our students as I was!" He hopes the joint event continues to grow and generate interest when it is held on the College Park campus next year.

"I was very proud of the students of both universities for investing tremendous energy into organizing this," says UMD BioE associate professor and director of undergraduate studies **Adam Hsieh**. "It was particularly rewarding to see the excitement with which all of the students presented their work, the depth of knowledge and skill they gained from their [research] experiences, and the cross-campus sharing of ideas. These are the reasons why we, as scientists and engineers, embark on a research career, and it was just great to observe the students reflecting the same ideals at the event. It was a remarkable inaugural effort."

"Amplifying the Field" was made possible by sponsorship from BMES, NanoString, Johns Hopkins University, Tau Beta Pi, and the University of Maryland. The organizers and attendees also wish to thank the judges for their time and participation: **Feilim Mac Gabhann**, **Xingde Li**, **Raimond Winsolow** and **Rene Vidal** from JHU BME; and **William E. Bentley**, **Adam Hsieh**, **Silvia Muro** and **Ian White** from UMD BioE.

In addition to Peeler and Kim, the event's organizers included JHU BMES chapter members **Anvesh Annadanam** (Treasurer), **Luis Herrera** (Secretary) and **Melissa Sajnani** (Chapter Development Chair); and JHU BME Undergraduate Program Manager **Cathy Jancuk**.

CHOI NAMED 2012-2013 FISCHELL FELLOW

The Fischell Department of Bioengineering is pleased to announce **Mina Choi** as the recipient of the 2012-2013 Fischell Fellowship in Biomedical Engineering. The annual award supports talented and innovative graduate students interested in applied research and product design in the biomedical industry.

Fischell Fellows are among the Clark School's best and brightest students, who not only exemplify outstanding academic achievement, but also department namesake Dr. **Robert E. Fischell**'s (M.S. '53, physics) entrepreneurial spirit and drive to put life-changing technology into the hands of clinicians and patients around the world. Previous Fischell Fellows have gone on to patent and license their inventions, launch companies, and work for venture capital firms.

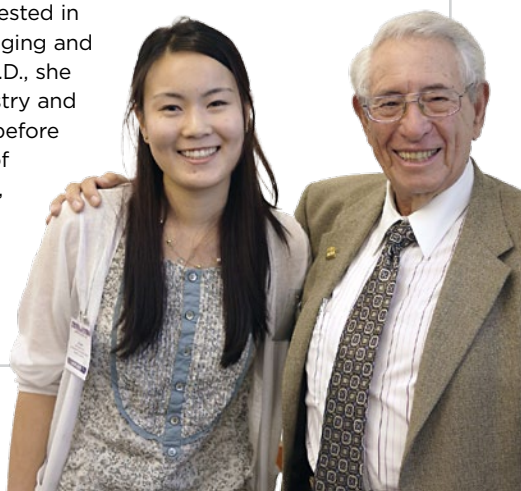
"When I first heard of bioengineering, I did not have the slightest clue what it entailed," Choi admits. "I chose [it] because I like a good challenge and was attracted to the idea of job security upon graduation... But upon completion of more specialized biomedical courses I began to appreciate how various sciences and mathematics fit together. I learned that the importance of biomedical engineering is to bring together these otherwise isolated subjects to solve practical problems in medicine."

Choi earned her B.S. in biomedical engineering and her M.S. in electrical engineering from The George Washington University (GWU). Her previous research experience includes a project that visualized the effects of violent computer games on the brain using EEG at Iowa State University; the design of a neonatal seizure detection algorithm in collaboration with neurologist Dr. **Taeun Chang** at the Children's National Medical Center; modeling traumatic brain injury using high intensity focused ultrasound under the guidance of Dr. **Vesna Zderic** (GWU) and Dr. **Matthew Myers** (U.S. Food and Drug Administration [FDA]); and her master's thesis under Dr. **Aldo Badano** (FDA), measuring veiling glare in high-dynamic-range displays and in the human eye. After completing her M.S., she continued her work with Badano as an ORISE Fellow for two years before returning to graduate school.

Choi chose the Clark School and the Fischell Department of Bioengineering for their strong reputations and location near biomedical companies and government agencies.

"UMD has had a long-standing research relationship with the FDA, and I was attracted to the idea that I could continue my current work [there] while networking for future opportunities...I was impressed by the research collaborations the school has with various companies. This potential to apply my studies and research to real-life applications was particularly appealing, and I believe UMD will prepare me to succeed in a rapidly growing and competitive field."

At the Clark School, Mina is interested in pursuing research in medical imaging and simulations. After earning her Ph.D., she would like to spend time in industry and try to launch her own company before returning to academia. Outside of the lab, she enjoys playing guitar, gaming, hiking and travel. Her past trips include missions to assist dentists in Gambia and to farm and teach in Kyrgyzstan.



MINA CHOI & DR. FISCHELL ▶

BIOENGINEERING SENIORS LEARN ABOUT PATENT PROCESSES

BioE seniors recently learned more about how patents are submitted, reviewed, approved or rejected, and disputed on a field trip to U.S. Court of Appeals for Federal Circuits. The visit was organized by Professor **Yang Tao**, and hosted by Judge **Pauline Newman** and her aides.

The seniors were members of the two-semester Capstone Design course, in which teams of students utilize what they have learned throughout their undergraduate studies to conceptualize and develop a prototype biomedical device or process. In the fall semester, while developing their project plans, students also study entrepreneurship, ethics, regulatory issues, and intellectual property. Learning about the patent process has become increasingly important as more teams file for provisional patents on their Capstone inventions by the end of their senior year.

Judge Newman, her aides and her clerks explained how patent-related litigation ends up in court, and the judicial process applied to disputes, by breaking down the cases the students observed. She also explained her own role in what can be a complicated decision-making process. Newman and her staff estimated that approximately half of all patent-related appeals are overturned.

"The main thing that she mentioned was that being informed and understanding the [case] brief is key," whether one is a judge, lawyer, or simply an observer, says BioE senior **Janina Vaitkus**. She adds that for her, the trip underscored the necessity of understanding just how complex applying for a patent, and defending it, can be.

Fellow BioE senior **Chrissy O'Keefe** agrees. "One thing I learned was the importance of using very precise vocabulary when writing a patent, [because] the definition of even a common word can be debated."

KHALID WINS COLLEGE PARK SCHOLARS TRI-STAR AWARD

College Park Scholars, the University of Maryland's interdisciplinary living-learning program for select freshmen and sophomores, selected program alumnus and BioE junior **Mian Khalid** as the recipient of its 2012-2013 Tri-Star Award.

"The Tri-Star Award honors the student who exemplifies the qualities that are essential to all College Park Scholars participants: academic excellence, contribution to one's community, and valuing the contribution of diversity to one's learning," says **Brent Hernandez**, Assistant Director of the College Park Scholars program. "Mian embodies these very elements, and he's excelled in every area."

Khalid, who double-majors in English, has been active in research since his arrival in College Park. He joined BioE professor **Peter Kofinas**' research group during his freshman year and quickly became a valuable member of Kofinas' Functional Macromolecular Laboratory, co-authoring three published papers and co-founding SafeLiCell, a startup company developing a solid-state polymer battery electrolyte called LithiumFlex. His work on the product has earned him a Howard Hughes Medical Institute (HHMI) Undergraduate Research Fellowship, and SafeLiCell $25,000 in business plan competition prizes from the Atlantic Coast Conference and the American Chemical Society *(see related story, p. 7)*. Outside of the lab, Khalid volunteers at the Muslim Community Medical Center in Silver Spring, Md. and serves as a Clark School Ambassador.

"College Park Scholars [was] a big part of the first two years of my undergraduate life," says Khalid. "I made friends, met professors who would become wonderful mentors, and learned the value of being involved in meaningful service for my community… Scholars has helped me think outside the box when it comes to applying concepts and being open minded in my engineering and English classes…[and] relat[ing] my research to a business idea in real terms. I want to thank Scholars for honoring me with such a prestigious award and I hope to maintain the vision of the [College Park Scholars] Founders' Circle by translating this into my successful dream career."

MIAN KHALID (SECOND FROM LEFT) RECEIVING THE TRI-STAR AWARD. PHOTO BY SIBIA SARANGAN.

HSU WINS BIOE OUTSTANDING GRADUATE RESEARCH AWARD

BioE graduate student **Janet Hsu**, advised by BioE and Institute for Bioscience and Biotechnology Research associate professor **Silvia Muro**, received the department's 2012-2013 Outstanding Graduate Research Award for her dissertation work to date on a targeted drug delivery system capable of crossing the blood/brain barrier to treat Niemann-Pick Disease Type A, a rare, fatal lysosomal storage disorder.

Since joining the department in 2008, Hsu has been the first author of four peer reviewed publications and the co-author of a fifth, as well as delivered numerous oral and poster presentations around the country.

MEMBERS OF THE 2012-2013 BIOE CAPSTONE CLASS WITH JUDGE PAULINE NEWMAN AND HER STAFF AT THE U.S. COURT OF APPEALS FOR FEDERAL CIRCUITS.

Her efforts have earned her several paper, poster and presentation honors, including the 2011 Controlled Release Society's Outstanding Consumer & Diversified Products Paper Award, which she shared with the work's first author and fellow group member, postdoctoral research associate **Tridib Bhowmick**. She was also selected to join the Clark School's 2011 Future Faculty program cohort. In 2012, she was one of only ten students to receive a scholarship from the World Organization for Rare Lysosomal Disorders to attend and present her work at its 8th annual meeting.

"Janet is a significant, key player in my lab and research program," says Muro. "She learned the fundamental background and technical skills necessary for her project quite fast and has proven to be a hardworking, motivated and productive young researcher… I am proud of her achievements and eager to see her moving forward with her career."

Hsu has also mentored several of the Muro Group's high school and undergraduate researchers and served as a teaching assistant for sections of BIOE 120: Biology for Engineers and BIOE 612: Physiological Evaluations of Engineering Designs. She has participated in community activities including serving as the secretary of the Bioengineering Graduate Student Society, serving on the university's Senate Academic Procedures and Standards Committee, participating in Alternative Spring Break, teaching English as a second language in Costa Rica through i-to-i, and membership in Circle K International's University of California–San Diego chapter.

SEEDS FELLOWSHIP SUPPORTS SIKORSKI'S WORK ON BLOOD CLOTTING GEL

BioE sophomore **Michael Sikorski** has received a 2012-2013 Successful Engineering Education and Development Support (SEEDS) Research Fellowship. The National Science Foundation-funded award supports Sikorski's research on blood clotting hydrogels, which he conducts in the Functional Macromolecular Laboratory under the guidance of BioE professor **Peter Kofinas**.

MICHAEL SIKORSKI

Each year, the SEEDS program funds 20 undergraduates to work on a research project under the guidance of a faculty member or mentor for one academic year. In addition to laboratory experience, SEEDS Fellows also learn to write and submit papers for publication, and have the opportunity to attend professional conferences and symposiums. At the end of the academic year, they present the results of their work at the University of Maryland Undergraduate Research Day.

Traumatic injury—whether the result of an accident, crime, or combat—is the leading cause of death of children and adults up to age 44*. Many people who are fatally injured die as the result of hemorrhaging that cannot be stopped or controlled before medical care can be obtained. Surgery also carries the risk of inducing potentially fatal bleeding.

Throughout the past decade, a number of hemostatic (blood clotting) products have been introduced that are designed to halt bleeding quickly and without the need for sutures, buying time for severely injured patients in emergency situations. These include biologically active gels for surgical use and biological or synthetic powders and foams that can be applied by first responders and military personnel. Unfortunately, high cost, lack of availability, and limited effectiveness have prevented their widespread use.

The Kofinas Group has been developing biocompatible hemostatic polymer hydrogels for traumatic and surgical settings that are inexpensive, effective, and easy to distribute, use and store.

When someone suffers an open wound, the body creates a quick clot out of fragments of blood cells called platelets. Nearby blood vessels constrict, and a cascade of enzyme-catalyzed reactions form fibrin, a tougher, more permanent plug that eventually becomes a scab. As the wound heals, the clot is broken down. The material Sikorski works with is designed to give that natural process a boost.

"Our research focuses on the synthesis, characterization, and assessment of topically applied hydrogel microparticles that will augment hemostasis by promoting the formation of a robust plug and forming a physical barrier to blood loss," he explains.

One day, he may find himself using the product he helped create.

"I volunteer as an EMT here in College Park at the Branchville Volunteer Fire Company," he says. "It is exciting to work on this research because I am reminded every week of how it directly applies to emergency medicine and how it can someday help save the lives of trauma victims."

* *"Injury: The Leading Cause of Death Among Persons 1–44." Centers for Disease Control and Prevention. www.cdc.gov/injury/overview/leading_cod.html Retrieved 19 December 2012.*

recent DISSERTATIONS

AUGUST 2012

Joshua Chetta: "Cytoskeletal Mechanics and Mobility in the Axons of Sensory Neurons." Advisor: Sameer Shah.

Bacalocostantis, Irene: "Investigation of a Thiolated Polymer In Gene Delivery." Advisor: Peter Kofinas.

Dandin, Marc-Peralte: "CMOS Single-Photon Avalanche Diodes and Micromachined Optical Filters for Integrated Fluorescence Sensing." Co-Advisors: Pamela Abshire (Electrical and Computer Engineering) and Elisabeth Smela (Mechanical Engineering).

Mariani, Angela: "Enzymatic Activity Preservation through Entrapment within Degradable Hydrogel Networks." Advisor: Peter Kofinas.

Silverstein, Joshua: "Nanopatterned Block Copolymers for Use as Vascular Biomaterials." Advisor: Peter Kofinas.

DECEMBER 2012

Liu, Haimo: "Task Specific Evaluation Methodology for Clinical Full Field Digital Mammography." Advisor: Jake Kyprianou (FDA/CDRH).

Hyland, Laura: "Mechanical, Structural and Biological Properties of Biopolymer-Based Hydrogel.s" Advisor: Bruce Yu.

studentNEWS

continued

UMD/U. TRENTO EXCHANGE BOOSTS RESEARCH ON ARTIFICIAL CELLS

BioE graduate student **Jessica Terrell** has departed for the Centre for Integrative Biology at the University of Trento, Italy, where she will spend two months working in Professor **Sheref S. Mansy**'s research group.

Terrell, a member of BioE professor and chair **William E. Bentley**'s research group, will build artificial cells equipped with the cellular machinery required to transcribe and translate genes into functional proteins. The synthetic cells are designed to interact with each other and with bacteria through quorum sensing, a form of intercellular communication based on the release and detection of signaling molecules. For the past several years, the Bentley Group has explored how manipulating this chemical language could prevent bacteria from engaging in pathogenic activity, or encourage them to take a positive action.

Prior to Terrell's visit, Mansy sent his advisee, University of Trento graduate student **Roberta Lentini**, to work with the Bentley Group. The two students' research is complimentary: Lentini's artificial cells can respond to a quorum sensing signal molecule known as AI-2, while Terrell's can synthesize and deliver it.

"This project changes the way we can program living cells," says Bentley. "Synthetic biology is largely stuck on the single viewpoint that in order to modify cellular behavior, the genetic content of the cell must be changed. Our approach changes the behavior cells by having artificial cells send chemical signals to natural cells that direct their function."

The technology, he adds, has far-reaching implications. "Cell-like systems capable of this sort of communication could be built to block bacterial transitions to virulent states, which could lead to the treatment of infections without antibiotics, and to guide stem cell differentiation, which could lead to improved tissue regeneration for people with serious injuries."

JESSICA TERRELL

Terrell's visit is part of an ongoing collaboration between the Bentley and Mansy Groups. The project is one of three funded by the Autonomous Province of Trento as part of a formal partnership established between the province and the University of Maryland in 2011.

alumniNEWS

Hyunmin Yi (Ph.D. '03, chemical engineering) has been promoted to Associate Professor in the Department of Chemical and Biological Engineering at Tufts University. At Maryland, Yi was advised by Fischell Department of Bioengineering professor and chair **William E. Bentley**, and later worked as a postdoctoral research associate for Department of Materials Science and Engineering professor **Gary Rubloff**.

John March (Ph.D. '05, chemical engineering), formerly advised by BioE professor and chair **William Bentley**, has been promoted to Associate Professor with tenure in the Department of Biological and Environmental Engineering at Cornell University.

JANIAK NAMED KAUFFMAN FELLOW

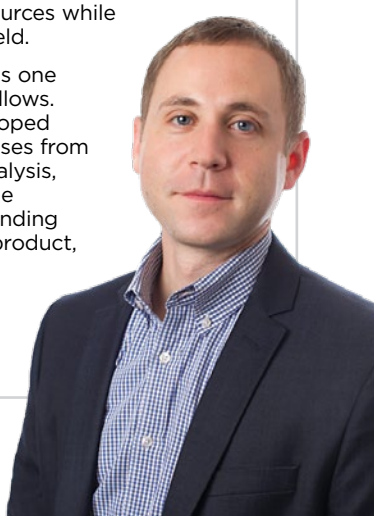
A. James Clark School of Engineering alumnus and former Fischell Fellow **Dan Janiak** (B.S. '04 and Ph.D. '09, materials science and engineering) was awarded a Kauffman Fellowship, which includes admission into an elite, two-year program designed to educate the world's most promising, up-and-coming venture capitalists.

Fellows continue to work full time at their respective venture firms while participating in an apprenticeship that includes mentoring, professional coaching, networking, and a curriculum of quarterly classes in industrial leadership.

After completing their fellowships, participants become lifetime members of the Society of Kaufmann Fellows. Society members make up a global network of expert venture capitalists who continue to share insights, opportunities and resources while mentoring the next generation of the best and brightest in the field.

Janiak became interested in entrepreneurship during his tenure as one of the Fischell Department of Bioengineering's (BioE) Fischell Fellows. Together with his advisor, BioE professor **Peter Kofinas**, he developed molecularly imprinted hydrogel polymers capable of filtering viruses from the blood into a marketable product with applications in hemodialysis, vaccine production, and diagnostics. In 2008 the pair received the university's Office of Technology and Commercialization's Outstanding Invention of the Year award in the life sciences category for the product, which was later licensed by Link Plus Corporation.

Janiak is currently an investment team associate at DFJ Mercury, where he specializes in the development of biomedical- and bioscience-based startup companies.



DAN JANIAK ▶

chair's MESSAGE

WILLIAM BENTLEY

WE HOPE YOU ENJOYED THE LATEST ISSUE OF *BIOFEEDBACK*!

In previous issues, I've explored the theme of growth: of our faculty, our student body, our facilities, awards, and our funding. I can't help returning to it now, with so many wonderful things happening now and in the near future:

BioE-based startup companies—including **Wesk Medical**, which invented a drug-delivering endotracheal tube (see p. 7); **SafeLiCell**, which produces solid-state polymer electrolytes for lithium-ion batteries (see p. 7); and **Diagnostic anSERS**, which produces printed, paper sensors (see p. 8)—are all hard at work, refining their products and marketing strategies while applying for patents and participating in business plan competitions. Associate Professor **Silvia Muro** won the university's Professor Venture Fair for a novel drug delivery system (see p. 9) that could make oral delivery of certain drugs possible for the first time.

Meanwhile, **Remedium Technologies**, co-founded by alumnus and former Fischell Fellow **Matt Dowling** (Ph.D. '10), has received a $500,000 Small Business Innovation Research grant from the NSF to support pre-clinical trials of Hemogrip™, a sprayable foam that halts bleeding caused by traumatic injuries.

We have more graduating seniors than ever. This spring, 15 Capstone design teams, advised by an ever-expanding roster of faculty and regional physicians, exhibited new biomedical devices they hope will someday improve human health around the world.

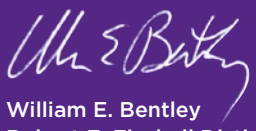
Our international partnerships are blossoming as well, including student exchanges with the Centre for Integrative Biology at the University of Trento, Italy (see p. 14), and research partnerships with Wuhan University, one of China's top ten educational institutions, where **Gregory Payne** is currently serving a guest professorship.

This summer, we'll be welcoming our newest faculty member, **Steven M. Jay**, who specializes in vascular biology, exosomal nanotechnology, and clinical translation—among many other things!

And where are we going to put our growing bioengineering community? We're thrilled to announce we'll soon break ground on a new bioengineering building, scheduled for completion in 2017. The facility will finally gather most if not all of our faculty, staff, labs and students in one place, and also serve as a home to both the Fischell Institute for Biomedical Devices and the University of Maryland's Center of Excellence in Regulatory Science and Innovation, part of our partnership with the U.S. Food and Drug Administration.

Can't wait for the next issue to keep up with us? You can always get the latest news at **bioe.umd.edu/news**.

With Best Regards,



William E. Bentley
Robert E. Fischell Distinguished Professor and Chair

AMERICA'S GOT REGULATORY SCIENCE TALENT: UNIVERSITY OF MARYLAND STUDENTS PITCH IDEAS TO FDA

University of Maryland students competed for the chance to tell U.S. Food and Drug Administration (FDA) Chief Scientist **Jesse L. Goodman** their ideas for improving the agency's reporting, information, and application systems in the University of Maryland's Center of Excellence in Regulatory Science and Innovation's (M-CERSI) first America's Got Regulatory Science Talent student competition, held in February 2013.

M-CERSI, a collaborative partnership between the University of Maryland, College Park (UMD), and the University of Maryland, Baltimore (UMB), focuses on modernizing and improving the ways drugs and medical devices are reviewed and evaluated. Researchers from both campuses work with FDA staff to support the development of new tools, standards and approaches to assess the safety, efficacy, quality and performance of FDA-regulated products, and to develop regulatory science practices that promote innovation in medical devices and pharmaceuticals. BioE professor and chair **William E. Bentley** and BioE affiliate professor **James Polli**, UMB's Shangraw/Noxell Chair of Pharmaceutical Sciences, serve as the center's co-chairs.

The competition, designed to promote student interest in regulatory science, attracted teams of graduate students who proposed better solutions for reporting side effects, sharing medication regiments among physicians and pharmacies, and increasing patient education and compliance. School of Medicine student **Curtis Gallagher** took first prize for his Interactive Medication Guides, which are designed to improve the process of reporting adverse reactions to medications to the FDA.

Goodman was impressed with the students' proposals. "Their winning ideas, and their commitment and excitement, bode well for the future of the sciences involved in ensuring that medical products are safe and effective," he wrote on the FDAVoice blog. "Perhaps above all, the problems that inspired their ideas provided powerful reminders that consumers should be engaged by health professionals and involved in their own care."

Those interested in the advancement of regulatory science are invited to attend the second UM CERSI Day, which will be held on September 5, 2013 in Baltimore, Md. The daylong event will feature presentations from special guests, faculty and students from UMD and UMB, the FDA, industry, and representatives of the CERSI Industrial Consortia. For video and photos from last year's event, as well as information about other events offered by the Center, please visit the M-CERSI web site at **cersi.umd.edu**.

A. JAMES CLARK
SCHOOL OF ENGINEERING

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ABOUT THE COVER IMAGE

THE PURPLE IMAGE USED ON THE COVERS, FROM PROFESSOR YU CHEN'S RESEARCH GROUP, SHOWS THE INTERNAL MICROANATOMY OF A RAT'S KIDNEY, INCLUDING GLOMERULI, BOWMAN'S SPACE, BLOOD VESSELS, AND PROXIMAL AND DISTAL CONVOLUTED TUBULES IN THE RENAL CORTEX. THE HIGH-RES IMAGE WAS CREATED USING AN IMPROVED 2-PHOTON MICROSCOPY SYSTEM DEVELOPED IN CHEN'S LAB THAT OFFERS A FAST FRAME SPEED AND GREATER SENSITIVITY. THE SYSTEM COULD BE USED TO OBSERVE GLOMERULAR STRUCTURE AND FUNCTION, MICROVASCULATURE, CELL VITALITY AND APOPTOSIS, AND LEUKOCYTE TRAFFICKING. CHEN RECENTLY RECEIVED A NSF CAREER AWARD FOR HIS BIOIMAGING RESEARCH. FOR MORE INFORMATION, SEE OUR COVER STORY.

BIOFEEDBACK is published for alumni and friends of The Fischell Department of Bioengineering at the A. James Clark School of Engineering, University of Maryland.

Alumni news and comments are welcome! Please contact us at:
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Department Chair: Dr. William Bentley
Editor: Faye Levine

Spinning Engineered Silk Into Tiny Designs—With A Microscope

If someone says they use a microscope in their research, most people would assume it's because they need to observe something very small. BioE senior **Sara Johnson** uses one to write messages.

Johnson, a member of Department of Materials Science and Engineering (MSE) assistant professor **Joonil Seog**'s research group, is part of a team investigating how an atomic force microscope (AFM) can be used to grow and weave threads of silk-elastin-like peptide polymers (SELPs) into specific patterns or shapes—such as the letters "UMD" at only one thousandth of a millimeter wide. She is the first author of a recent paper about the work published in *Chemical Communications*, one of the premiere journals in its field.

SELP is a polymer made out of alternating segments of genetically engineered spider silk and elastin, the protein responsible for giving skin and blood vessels their flexibility. SELP is studied because of its similarity to amyloid fibers, the suspected culprit behind certain neurological disorders such as Alzheimer's disease, and because of its potential applications in tissue engineering.

AFM employs a cantilever with a pointed tip—something like a very tiny diving board or the tone arm of a record player—to "see and feel." While the cantilever either taps or skims the surface of a sample, a laser tracks the location of its tip. As the tip's location changes, it deflects the laser, which is in turn detected by a photodiode. Ultimately, data collected about motion of the tip are translated into a three-dimensional surface map. The cantilever can also be used to measure mechanical properties at the single molecule level by pulling on a sample and characterizing force profiles.

continues page 4