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# BIOF EDBACK 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.

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### **BioE@UMD: Strong Performance in** New Ranking Study

CLARK SCHOOL ENTERS U.S. NEWS TOP 20; RANKED 13TH WORLDWIDE

A new set of rankings published September 28, 2010 by the National Research Council (NRC) places the Fischell Department of Bioengineering's (BioE) graduate program among the top 20 in the nation, which also includes institutions such as the University of California–San Diego, MIT, Rice University, and Johns Hopkins University.

The NRC, which functions under the National Academies, compiled its report over the course of five years, with data collected between 2005 and 2006. The rankings, which cover research-doctoral programs in a variety of fields, are distinct from the popular U.S. News & World Report rankings, and are based entirely on data-including number of faculty, publications, citations, student funding, program resources and degrees awarded-rather than reputation. They are also unique in that there is no school at number one, and no school is given a specific position on the list. Instead, the NRC's rankings are expressed as a range a school is most likely to fall into, based on a level of confidence or certainty at both a high (5<sup>th</sup> percentile) and low (95<sup>th</sup> percentile) value.

Each school received two overall rankings, one representing a survey of data ("S") and the other representing a regression analysis ("R"). In BioE's case, its scores in the S ranking were 7 (5<sup>th</sup> percentile) and 27 (95<sup>th</sup> percentile), meaning the NRC feels 95% certain the department's Ph.D. program should be ranked at number 27 or higher, and 5% certain it would rank as high as number 7. BioE's R scores were 12 and 27.

"This is fantastic news," says BioE Professor and Chair **William Bentley**, "especially when you consider that the Graduate Program in Bioengineering was only about four years old when the data were collected. My analysis is that if we simply count the programs with higher rankings, the Fischell Department of Bioengineering comes in at 14<sup>th</sup> overall and 6<sup>th</sup> among public schools.

"This is a tremendous accomplishment," he added. "The efforts of our faculty, staff and students, from the start of the graduate program to this point, have made our department the fastest rising in the nation."

For detailed information about the NRC rankings, including tables of information and downloadable reports, please visit the National Academies' Assessment of Research-Doctorate Programs web site at: http://sites. nationalacademies.org/pga/Resdoc

### An Exceptional Year for Clark School Rankings

BioE's home, the A. James Clark School of Engineering, has also been turning in strong results in national and international surveys:

### Clark School Enters U.S. News Top 20

In the U.S. News & World Report 2011 edition of "America's Best Colleges," the Clark School's undergraduate program is

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**BIOE@UMD** 

HAS ARRIVED.

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Maybe it's our

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since July 2006.



WILLIAM BENTLEY

it's our awardwining startup companies. No matter how you add it all up, one thing is clear: at only four and a half years old, the Fischell Department of Bioengineering is getting noticed and rising in the national ranks. (See cover story.) As always, this issue of *Biofeedback* features the latest news about our faculty and students, but I also want to give you a preview of what's coming up this spring:

Our next Fischell Festival will be held on Thursday, April 28, 2011. Save the date and watch your e-mail or our web site, fischellfestival.umd.edu, for more information!

Also in April, Professor **Yu Chen** will be hosting the third Metropolitan Biophotonics Symposium here at Mayland. Yu and his research group recently gave some literal hands-on demonstrations of optical coherence tomography at the USA Science and Engineering Festival. *(See p. 4.)* 

We're still growing! We will be seeking highly talented individuals in the fields of devices (from diagnostic devices to implants and imaging/ treatment devices), or in biosystems biotechnology, for tenure-track or tenured faculty positions. Our search kicked off in September 2010, but the positions will be open until filled. You can learn more about them by visiting www.bioe.umd.edu/employment.

#### With Best Regards,

Mr. EBut

William E. Bentley Robert E. Fischell Distinguished Professor and Chair bentley@umd.edu (301) 405-4321

### RANKINGS, from page 1

ranked 19<sup>th</sup> in the nation among all engineering programs—the first time the school has entered the Top 20 in this survey. The Clark School was tied at 19<sup>th</sup> with Rice University and UCLA.

Among public programs, the Clark School ranked 9<sup>th</sup>—also the first time it has entered the Top 10 public schools.

### Clark School Ranked 13th Worldwide

The Institute of Higher Education and Center for World-Class Universities has ranked the Clark School 13<sup>th</sup> in the world among all engineering programs for 2010 in its Academic Ranking of World Universities (ARWU).

The Clark School was tied at 13<sup>th</sup> with Purdue University. Among public university programs, the Clark School ranked 8<sup>th</sup>.

Since 2003 Shanghai Jiao Tong University has been publishing the ARWU, which is primarily based on research productivity and academic scholarship including the number of highly cited researchers on faculty, the number of articles by faculty published in the journals *Nature* and *Science*, and the overall quality of journals in which other articles have appeared.

More information about the rankings can be found at the institute's web site at http://www.arwu.org.

### Clark School Ranked 3rd Nationwide in Recruiter Survey

The *Wall Street Journal* published its first "Top 25 Recruiter Picks" listing, which identifies those universities from which large employers most heavily recruit graduates to fill entry-level jobs. In that survey the University of Maryland is ranked 8th in the nation, and the A. James Clark School of Engineering is ranked 8<sup>th</sup> overall and 3<sup>rd</sup> among engineering programs (behind Georgia Tech and Purdue).

"This is outstanding news for our students," says Clark School Farvardin Professor and Dean **Darryll Pines**. "In a tough job market, they can be assured that major employers will be looking for new hires at the Clark School."

According to the *Journal*, the survey queried 479 of the largest public and private companies, nonprofits and government agencies in the U.S. Further, "The Journal research represents a systematic effort to assess colleges by surveying employers' recruiters who decide where to seek out new hires instead of relying primarily on measures such as student test scores, college admission rates or graduates' starting salaries. As a group, the survey participants hired more than 43,000 new graduates in the past year."

# researchnews

### PLASMA FOR DISINFECTION STUDY WINS DOE GRANT

A new study that seeks to explain how and why plasma (a gas containing charged, reactive molecules) is so effective at deactivating toxic proteins and biomolecules could lead to its broader use in the medical community. The project, a unique blend of plasma science and bioengineering, will be the first to explore the mechanistic effects of plasma on bacteria at the monolayer level.

Professors **Gottlieb Oehrlein** (Department of Materials Science and Engineering [MSE]) and **Joonil Seog** (joint, Fischell Department of Bioengineering and MSE) have received a three-year, \$330,000 grant from the Department of Energy's Office of Science for Fusion Energy Sciences for their proposal, titled "Fundamental Science of Low Temperature Plasma-Biological Material Interactions."

Plasma is commonly used in the production of electronic devices at low pressure. Plasma at room temperature and atmospheric pressure, however, is used to sterilize surgical equipment and to disinfect clothing or surfaces. Its antibacterial and

### researchnews

antimicrobial properties also mean it can be used for wound care, a treatment that has been tested but is not widespread. Exactly why and how these treatments work, however, it not yet understood.

Conventional plasma treatment of surgical instruments and biomedical devices completely removes biomolecules, but the harsh reaction conditions may also remove surface layers from the equipment, degrading their performance. Oehrlein is developing a "gentle and selective" means of plasma application that will allow Seog, who specializes in molecular mechanics, to observe exactly which reactive plasma molecules interact with individually targeted biomolecules in a biological assay designed specifically for this research.

"If we understand exactly how plasma deactivates biomolecules we'll have many opportunities to extend and customize the technology," says Seog. "It could be used in a variety of laboratory and hospital procedures, target different kinds of toxins from bacteria or viruses, and possibly facilitate tissue regeneration. Using this technique, we may be able to deactivate toxic molecules by altering their molecular structure in a selective manner."

"Researchers have been excited by the potential advantages of plasma-based treat-



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SERS ON THE CHEAP: ABOVE: DROPLETS OF A FLUO-RESCENT DYE BEAD UP ON PAPER SPOTTED BY AN INK-JET PRINTER WITH SILVER NANOPARTICLES. BELOW: AN ELECTRON MICROGRAPH SHOWS NANOPARTICLES EMBEDDED WITHIN THE PAPER'S CELLULOSE FIBERS.

#### continued

ments over traditional disinfection methods." Oehrlein adds. "The plasma approach only requires electrical energy and simple gases, like air. Working at low temperature and atmospheric pressure means the devices used in treatment could be small, portable, and easy to operate. It may also help in cases where an infection is resistant to antibiotics."

Oehrlein and Seog will collaborate with professors Jhih Wei Chu and David Graves (Department of Chemical and Biomolecular Engineering, University of California–Berkeley), who have received a similar grant to perform complimentary experiments and model and interpret the data. The study is also funded in part by the National Science Foundation.

### SERS ON THE CHEAP

SPECTROSCOPY: AN INK-JET PRINTER COULD MAKE THE TECHNIQUE MORE AFFORDABLE AND ACCESSIBLE

by Rajendrani Mukhopadhyay

The following story originally appeared on the Chemical & Engineering News web site on 17 November 2010, and is reproduced by kind permission of C&EN and the American Chemical Society.

A printer and paper may soon become scientific equipment. Investigators at University of Maryland, College Park, have demonstrated that a store-bought ink-jet

> printer can turn paper into a substrate for surface-enhanced Raman spectroscopy (SERS). They hope the advance will make this highly sensitive technique more accessible to non-specialists (*Anal. Chem.*, DOI 10.1021/ac102475k).

In the past decade, SERS has become a hot technique for biomedical and chemical analyses. After researchers mix metal nanoparticles with their samples, the electronic properties of the particles amplify the characteristic Raman signals of the sample molecules. These amplified signals open the door to many applications: For instance, a



PLASMA FOR DISINFECTION: AFTER EXPOSING HIS SAMPLES TO PLASMA, GRADUATE STUDENT ELLIOT BARTIS (MATERIALS SCIENCE AND ENGINEERING) TRANSFERS THEM TO AN X-RAY PHOTOELECTRON SPECTROMETER TO EXAMINE THE CHEMICAL COMPOSITION CHANGES THAT OCCUR ON THE SURFACE.

scientist can identify pigment compounds in pastel chips from a 19<sup>th</sup>-century painting or track the rise and fall of blood glucose in a live mouse. The technique is so sensitive that researchers can even detect single molecules.

But there is a hurdle: Fabrication of SERS substrates, the nanoparticle-laced materials that scientists apply their samples to, often requires expensive, technically challenging methods, which makes the process impractical for non-specialists. And when scientists purchase them instead of making them, the substrates have a shelf life of only a few days, which makes them impractical for studying environmental samples out in the field.

Maryland bioengineer **Ian White** had an epiphany one day on how to simplify the production of SERS substrates. His graduate student **Wei Yu** was describing how engineers can deposit silver nanoparticles on paper with a store-bought printer to make miniature electronic circuits. White realized that the paper could have a completely different application: a cheaper SERS substrate.

To test the idea, White and Yu surveyed 21 different types of paper, including coffee filters and napkins, but found that optical signals from the chemical additives in most paper products were too strong and would drown out sample signals. Chromatography filters worked best because they consist only of cellulose, which does not produce a strong signal.

Next the investigators grabbed a \$60 ink-jet printer and replaced the ink in its cartridge with a silver-nanoparticle

### studentn≡ws

### BIOE STUDENTS SHOW KIDS HOW BIOMEDICAL IMAGING COULD SAVE TRANSPLANT PATIENTS' LIVES

Children attending the USA Science and Engineering Festival received some literal firsthand experience with an advanced biomedical imaging device that produced live, high-resolution images of the tissues beneath their skin, courtesy of Fischell Department of Bioengineering assistant professor **Yu Chen** and students from his Biophotonic Imaging Laboratory.

Over 500,000 people attended the festival, held October 10-24, 2010 on the National Mall in Washington, D.C. The free event featured over 1500 exhibits, celebrity appearances, 25 Nobel Laureates, and activities for children.

Chen's entire research group—including graduate students **Chao-Wei Chen**, **Chia-Pin Liang**, and **Jeremiah Wierwille** interacted with enthusiastic visitors of all ages, explaining their research and giving hands-on demonstrations of their optical coherence tomography (OCT) system.

OCT produces detailed, micron-scale imaging of soft tissue *in situ* (in place in the body) and in real time, a task X-ray machines cannot perform. It enables what Chen refers to as an "optical biopsy"—visualization of changes to tissues without the need for surgery to acquire a sample.

At the festival, the Chen Group presented one of their projects, which



GRADUATE STUDENT CHAO-WEI CHEN SHOWS A YOUNG VISITOR HOW OPTICAL COHERENCE TOMOGRAPHY CAN REVEAL THE TISSUES IN HIS HAND AT THE USA SCIENCE AND ENGINEERING FESTIVAL. promotes the use of OCT as an imaging tool to monitor the condition of a donor kidney in real time, prior to and immediately following transplant surgery. OCT could provide doctors with immediate feedback about how the kidney

is responding to its new environment. The Chen Group recently received approval to begin pilot studies during human kidney transplant procedures performed at the Georgetown University Medical Center.

Wierwille, who was interviewed about the group's work for a story in the *Washington Post*, enjoyed participating in the festival.

"This was a great opportunity for us to participate in an excellent national event," he says. "I think the best part was being able to meet lots of young students who were interested in science and engineering. I enjoyed explaining our work on a very fundamental level, so that even elementary students could understand how OCT could help save people's lives. I also had the opportunity to speak to people from the medical field about our research. They were very interested in OCT and its potential as a diagnostic tool during transplant procedures."

#### MALINOWSKI NAMED ARCS FELLOW

Graduate student **Kate Malinowski**, advised by Associate Professor **Warren D'Souza** (Department of Radiation Oncology, University of Maryland School of Medicine), was presented with an Advancing Science in America scholar award at a ceremony sponsored by the Achievement Rewards for College Scientists (ARCS) Foundation on Oct. 21 at George Washington University.

Malinowski's research is focused on improving radiation therapy outcomes by developing partial-least-squares-based

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methods for non-invasively localizing lung tumors that move with each breath. The ability to focus on a "moving target" ensures that more of the radiation goes directly to the site of the tumor, increasing the therapy's effectiveness, and decreasing side effects by reducing the f sections required

total number of sessions required.

The ARCS Foundation provides science, medicine and engineering scholarships to outstanding students who are U.S. citizens contributing to the advancement of science and technology. Fellows are selected by representatives of the 52 U.S. academic institutions that the foundation supports, based on strict criteria and recommendations from departmental advisers and faculty, and receive a renewable award of \$15K per year.

### HUNG, VILARINO COMPLETE SURF FELLOWSHIPS AT NIST

Two Fischell Department of Bioengineering seniors returned to school after a researchfilled summer at the National Institute of Standards and Technology (NIST). **Stevephen Hung** and **Martin Vilarino** were both awarded Summer Undergraduate Research Fellowships (SURFs) to study bioengineering and nanofabrication at the federal lab. They presented the results of their work at NIST's SURF Student Colloquium in Gaithersburg, Md. in August.

Vilarino worked in the Center for Nanoscale Science and Technology, part of NIST's Energy Research Group, where he was advised by Dr. **Alec Talin**. In his talk, titled "The Production of Nanoparticle Arrays with Nanosphere Lithography," he described work in which he used selfassembling polystyrene nanospheres to create patterns used in the production of electronics. The goal of his project was to develop a method of assembling the nanostructures over large areas. The research, he explained, will advance the techniques

▲ AN OCT IMAGE OF BIOE GRADUATE STUDENT JEREMIAH WIERWILLE'S FINGER. OCT USES BACK-SCATTERING-THE IMAGE IS PRODUCED WHEN LIGHT, WHICH CAN PENETRATE TO A DEPTH OF 2-3MM, BOUNCES OFF THE SUBJECT'S CELLS. used in nanoscale lithography and enable scientists to develop highly advanced chemical and biological sensors.

Hung conducted his research with the Biomaterials Group at the Material Science and Engineering Laboratory, part of NIST's Polymers Division, where he was advised by Dr. Kaushik Chatterjee and Dr. Carl Simon, Jr. Hung's presentation at the Colloquium, titled "Measuring Cell Response to Polymeric Scaffolds in 3-D Culture for Tissue Engineering of Bone," described his work in characterizing cellular response to biomaterials intended for use in scaffolds to support the growth of new tissue or bone. While most studies to date have imaged or observed cells' reactions to and growth rate in biomaterials on a flat surface, Hung observed them in the 3-D environment of an actual scaffold, which more closely replicates the conditions the cells would experience once implanted in the human body.

### HYLAND TAKES THIRD IN BIOMATERIALS SYMPOSIUM POSTER COMPETITION

Graduate student **Laura Hyland**, advised by Associate Professor **Bruce Yu** (joint, University of Maryland School of Pharmacy) won third prize in a poster competition at the Society for Biomaterials' Biomaterials Day Symposium, held at the Johns Hopkins Institute for NanoBioTechnology in October 2010.

Hyland's presentation, titled "Mutually Reinforced Multi-Component Polysaccharide Networks," described the development of a biocompatible scaffold an environment designed to support the growth of new cells—for different tissue engineering applications, including cartilage replacement. The materials Hyland used to create the scaffold are inexpensive, derived from natural materials, safe, and easy to work with.

"Our scaffolds were initially made of chitosan, a bipolymer found in crustaceans, and alginate, a material extracted from algae and seaweed used to create flexible molds," Hyland explains. "Other research groups have made similar scaffolds but we added a third component to ours called chondroitin, a complex sugar that forms a gel-like material found in cartilage. We discovered that the chondroitin made the scaffolds stronger and more flexible."

Hyland conducted the research in Yu's Drug Delivery and Biomaterials Engineering Laboratory. Her next step is to observe how well cells grow and differentiate once implanted in the scaffold.

"The symposium was a great learning experience," she says. "The speakers were inspiring and presented interesting solutions to some of the problems surgeons are currently encountering."

### FISCHELL SHOWS STUDENTS HOW TO SUCCEED IN BIOMEDICAL DEVICE DESIGN

Bioengineering department benefactor and namesake Dr. **Robert E. Fischell** discussed

the challenges and rewards of biomedical device design with the Class of 2011 in a recent senior Capstone Design lecture.

In his talk, "Engineering for Humanity, Fun and Profit," Fischell described his personal take on engineering and entrepreneurship, stressing that "humanity, fun and profit" are in his opinion the correct order in which bioengineers should approach their research. He discussed the history and approval process of several of the products he has created with his colleagues and

his sons, including the drug eluting Svelte coronary stent; the AngelMed Guardian, an implant that detects the early warning signs of a heart attack; Neuropace, a transcranial magnetic stimulation implant used to treat epilepsy; and the Neuralieve, a handheld device capable of canceling a migraine headache before it can fully develop.

Fischell described biomedical device entrepreneurship as a very challenging field, particularly in the United States, which has stringent rules for the approval of any new product, and where venture capitalists who might fund the development of new technology are increasingly reluctant to do so as a result.

"The faint of heart should not apply," he advised.

Fischell outlined the six requirements he applies to his own ideas when determining whether they should be developed into



LAURA HYLAND'S POLYSACCHARIDE SCAFFOLDS MADE FROM CHITOSAN, ALGINATE AND CHONDROITIN. ABOVE: A SCANNING ELECTRON MICROSCOPY (SEM) IMAGE OF THE MATERIAL SHOWING ITS STRUCTURE. BELOW: A PHOTO OF A DRY SCAFFOLD.

products. A prospective device, he says, must be good for the patient, serve a large and growing population, be implantable using technology and procedures already familiar to surgeons, make money for the prescribing physicians, increase the net income of hospitals, and save money for the healthcare system.

Despite the difficulties, he explained, he would never give up his path. "I can't imagine a better life than being a bioengineer who makes lives better," he told the audience.

### entrepren URSHIP

### TRAUMA SOLUTIONS AND **CLOUDSOLAR ADVANCE R&D**

In previous issues of Biofeedback, we've told you about Trauma Solutions, an awardwinning startup company based in the Fischell Department of Bioengineering that has developed and is working to commercialize a synthetic, cost-effective hemostatic (blood clotting) polymer hydrogel that can be used to quickly staunch heavy bleeding and is also capable of delivering therapeutics to a wound. The gel contains a fibrous polymer called acrylamide, which stimulates the effects of a factor VII, a protein crucial to the bloodcoagulation process in humans and animals.

We've also reported on CloudSolar Inc., a startup company co-founded by alumnus Michael Armani (Ph.D. '10), which won a 2010 Warren Citrin Social Impact Award for its design of a rooftop solar energy system that can be used to heat swimming pools 62% more efficiently than currently available products.

Since our last issue, both young companies have made strides in research and development:

### CASEY, BEHRENS PUBLISH IN BIOMACROMOLECULES

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Graduate students Brendan Casey and Adam Behrens, advised by Professor Peter Kofinas, are the authors of a paper on their research group's bloodclotting polymer hydrogel published in the American Chemical Society's (ACS) high-impact Biomacromolecules journal. Casey originally presented the work at ACS's fall meeting in August 2010, where he was also interviewed by CNET News and for the September 2010 issue of ACS's ScienceNews.

The paper, "FVII Dependent Coagulation Activation in Citrated Plasma by Polymer Hydrogels," describes the most recent advances in the development of a hemostatic gel designed to quickly stop hemorrhaging from deep wounds encountered in surgery or emergency situations in which hospital care is not immediately available. Trauma Solutions, an award-winning startup company co-founded by Kofinas, Casey, and Behrens, hopes to commercialize the product.

The current work explains how the mechanical properties and chemical composition of the gel act together to stimulate the effects of factor VII (a protein crucial to the blood-coagulation process), speed up clotting, and ensure the robustness of the clot.

"This manuscript represents years of experiments that Brendan performed with the assistance of Adam," says Kofinas. "I am excited that all this hard work finally paid off with a high-impact publication in one of the top-cited journals in the area of interactions of polymers with biological systems and their environments."

Casey and Behrens' co-authors on the paper include Professor John R. Hess, M.D. (Department of Pathology, University of Maryland School of Medicine), Associate Professor Zhongjun J. Wu and Professor Bartley Griffith, M.D. (Department of Surgery, University of Maryland School of Medicine), and Kofinas.

Science News

New gel can seal wounds quickly Low-cost synthetic material speeds up blood clotting



A PAD CONTAINING TRAUMA SOLUTION'S HEMOSTATIC POLYMER HYDROGEL, WHICH HAS SUCCESSFULLY CLOTTED BLOOD FROM A WOUND AND HAS BEEN SAFELY REMOVED.

formerly advised by Associate Professor Benjamin Shapiro and Elisabeth Smela [Department of Mechanical Engineering]), was recently the subject of the Washington Post's "Business Rx" column.

"CloudSolar is ready to heat up its business" describes how Armani, the company's president and CTO, used his expertise in biofluid design to create a more efficient, environmentally friendly version of the liquid used in solar panels to collect, retain and distribute heat. Armani teamed

up with Ramik Chopra (M.B.A. '10), who became CloudSolar's COO, to market a better solar heating system for swimming pools. Their product is patentpending.

> CloudSolar has now identified nine additional commercial applications for their product and is developing other kinds of fluids that can be used in a variety of heat transfer and heat exchange processes.

The company is currently working on narrowing its focus and searching for licensing partners.

In the *Post* column, Asher Epstein, managing director of the Dingman Center for Entrepreneurship, responds to CloudSolar's questions about how to proceed with advice about licensing, prioritizing, looking beyond the technology to marketable "end to end" solutions, and reducing perceived risks for potential investors.

### ALUMNUS' COMPANY FEATURED IN WASHINGTON POST STORY

CloudSolar Inc., a startup company co-founded by Fischell Department of Bioengineering alumnus Michael Armani (Ph.D. '10,

studentnews continued

Armani is optimistic about the future, and encourages other engineering students to consider making entrepreneurship part of theirs.

"Now that I've completed my Ph.D. and have more time, I think you'll see much more progress from CloudSolar," he says. "I'd like to take this as opportunity to [tell] current engineering students [that] jobs are tough to get and this is a great time to get back to our roots of a hard-working entrepreneurial America. UMD has been an especially kind place for us to start a company and meet other entrepreneurs."

CloudSolar is expanding—Armani says he and Chopra are currently looking for a part-time intern to join the team. "We're looking for someone with lab experience to help us characterize thermodynamic material properties and to develop novel heat transfer fluids over for the next six months. This is a great opportunity for anyone looking to improve his or her resume if their goal is to get a job in the green-tech industry."

To learn more about the position, visit the CloudSolar web site at www.cloud-solar. com/jobs.html.

### STUDENTS VISIT WALTER REED **PROSTHETICS LAB**

Fifteen students in the University of Maryland's Science, Technology and Society (STS) University Certificate Program, including bioengineering senior Andrew Zayac, recently toured the Walter Reed Army Medical Center's fabrication laboratories and its Military Advanced Training Center to learn about prosthetics and rehabilitation procedures for injured soldiers. BioE professor Yang Tao accompanied the group.

The program, administered by the A. James Clark School of Engineering, is open to undergraduates of all majors interested in the interactions of science and society or of technology and society. STS organized the Walter





JOHN WARREN (WALTER REED STAFF) DEMONSTRATES "C LEG," DESCRIBING THE MOTOR THAT ASSISTS THE RECIPIENT IN TASKS SUCH AS GOING UP STAIRS AND GETTING UP FROM A CHAIR.

of their lives."

Reed field trip around its Fall 2010 theme, "The Human Body and Technology."

Students learned how different styles of prosthetic limbs are designed and fabricated, custom fit for each patient, and subsequently adjusted to accommodate changes in their bodies throughout the recovery and rehabilitation process. The surface of a prosthetic that comes into contact with a patient's skin, for example, may be adjusted as many as 20 times. A motion capture system interprets the gaits of soldiers who require leg and foot prosthetics. Posture, weight, and additional injuries are also taken into account.

"Bioengineering is a passion of mine because it allows me to combine creativity, expertise, technical challenge, and teamwork into designing and producing products that benefit the health of the world population," says Zayac, whose interest in biomechanical devices, particularly prosthetics designed for athletes, was sparked during his years on the USA Men's National Field Hockey team, which practices in the same facility as many Paralympic athletes. But, he confesses, he still wasn't sure in which area of bioengineering he would ultimately specialize.





"The trip to Walter Reed solidified my desire to go into orthopedics and prosthetics," he says. "Every device and system we witnessed is a tribute to technology, craftsmanship, and ethical engineering design. Our soldiers deserve to have high tech resources like these to aid in their rehabilitation and improve the quality

Photos courtesy of and story adapted from the original by STS program director Betsy Mendelsohn.





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### ABOUT THE COVER IMAGE

THE PURPLE IMAGE USED ON THE COVERS IS A SCANNING ELECTRON MICROGRAPH OF A POLYSACCHARIDE SCAFFOLD MADE FROM CHITOSAN, ALGINATE AND CHONDROITIN. THE MATERIAL, CREATED BY GRADUATE STUDENT LAURA HYLAND IN ASSOCIATE PROFESSOR BRUCE YU'S DRUG DELIVERY AND BIOMATERIALS ENGINEERING LABORATORY, IS DESIGNED TO SUPPORT CELL GROWTH IN TISSUE ENGINEERING APPLICATIONS. THE ADDITION OF CHONDRITIN, A COMPLEX SUGAR FOUND IN CARTILAGE, MAKES THE SCAFFOLD STRONGER AND MORE FLEXIBLE. TO LEARN MORE, SEE PAGE 5. 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: Fischell Department of Bioengineering, 2330 Jeong. H. Kim Engineering Building College Park, MD, 20742 (301) 405-7426 / bioe@umd.edu http://www.bioe.umd.edu

Department Chair: Dr. William Bentley Editor: Faye Levine

### INKJET SPECTROSCOPY from page 3

solution. Because chromatography filters wick aqueous samples, the researchers also included a cartridge filled with a hydrophobic chemical, commonly used by printer-paper manufacturers to stop ink from blurring. They programmed the printer to deposit a line of 1-mm-diameter spots of the nanoparticle solution every 5 mm. The printer covered the rest of the paper with the hydrophobic chemical so that samples would not spread beyond the nanoparticle spots. The reagents cost about 2 cents per cellulose filter. White and Yu tested their novel substrate with a fluorescent dye called Rhodamine 6G, the gold standard for SERS. They pipetted drops of it onto the nanoparticle spots and measured signals with a conventional spectrometer. They could detect as little as 10 femtomoles of the dye in a 1-µL droplet.

White envisions inexpensive do-ityourself printer-cartridge kits that will let scientists quickly and easily print substrates when needed. To allow for medical and environmental field analyses, his group is now making the method compatible with portable spectrometers and incorporating it into cheap, disposable paper-based microfluidic devices (*Anal. Chem.*, DOI: 10.1021/ac9013989).

Biomedical engineer **Shuming Nie** at Emory University calls the work "an important technical advance" that could encourage more SERS studies. But he cautions that the femtomole detection needs improvement because it falls short of the sensitivity of conventional substrates.