Department of Chemical and Biomolecular Engineering (ChBE) sophomore Lisa Wiest has been awarded a Boren Scholarship to spend the 2012-2013 academic year studying Korean at Yonsei University in Seoul, South Korea.

The prestigious Boren Scholarship, awarded by the U.S. Department of Defense, provides up to $20,000 for two or more semesters of language-focused study abroad in regions important to U.S. interests. This year, over 1000 students from around the country applied for one of the 161 scholarships available. Wiest was one of eight students from the University of Maryland, and the only one from the A. James Clark School of Engineering, to receive one.

Wiest, who minors in international engineering, is currently a member of ChBE professor Kyu Yong Choi’s research group, in which she works on a project synthesizing carbon nanotubes on silicon substrates for use as anodes in lithium-ion batteries.

Choi, who routinely encourages students to study abroad, has supported her interest in learning Korean, and helped her apply for the Boren Scholarship. He originally met Wiest during her freshman orientation when she approached him after he gave a talk on the subject.

“Lisa came to me and she said she wanted to study abroad in Asia,” he recalls. “I suggested that if she wanted to go to Korea, I could help because I have many friends in academia and industry there.” Wiest accepted, asked to become his advisee, and joined his research group soon after.

While Wiest had previously formally studied French, Chinese, and Japanese, she decided to learn Korean on her own over the
GREETINGS TO ALUMNI AND FRIENDS OF CHEMICAL AND BIOMOLECULAR ENGINEERING AT THE UNIVERSITY OF MARYLAND!

I’m excited to report that our faculty has continued to grow and develop: Srinivasa Raghavan has been promoted to the rank of Professor, Chunsheng Wang has been promoted to Associate Professor with tenure, and our newest Assistant Professor, Amy Karlsson, has just arrived! You can read about Srin and Chun on page 4, and learn more about Amy, who specializes in protein engineering, biomolecular recognition, and fungal disease, on page 5. We’ve also got a recap of the International Symposium on Mesoscale and Fluctuation Thermodynamics, held in honor of Professor Mikhail Anisimov’s 70th birthday, on page 5.

Did you know that Maryland is a hot spot for launching new technologies and businesses? Citing a top-ranked public school system and resources for entrepreneurs, the U.S. Chamber of Commerce has ranked the State of Maryland first in the nation for entrepreneurship and innovation in its “Enterprising States” report, up from 7th place last year. (See tinyurl.com/ca8zj95 for more information.) Our faculty and students have access to excellent programs that help them launch successful startups, patent and license intellectual property, and win funding at competitions and from venture capital firms.

One of our most recent success stories is SafeLiCell, whose co-founders include ChBE graduate student Aaron Fisher. You can read about their novel lithium-ion battery electrolyte on page 3.

We’ll be back at AIChe presenting our research, fielding our Chem-E Car team (see p. 8), and welcoming alumni, friends, and anyone interested in learning more about the department at our third annual Bagels & Grits Breakfast! Watch your e-mail, see our web site, or check the official AIChe program for details. See you there!

Don’t want to wait for the next issue of Columns to find out what’s new? You can always read the latest news online at: www.chbe.umd.edu/news

Go Terps!
Sheryl H. Ehrman

Keystone Professor and Chair

NEW BARRIER GEL WILL IMPROVE ANALYSIS OF BLOOD SAMPLES

If you’ve ever had your blood drawn, you may have noticed that the collection phials don’t start out completely empty. Or maybe you didn’t notice, because you don’t like to look.

There is a small amount of gel at the bottom of each slender tube, and it has a very important job to do: When blood samples are put into a centrifuge and spun to separate the heavier cells from the lighter underlying liquid (called plasma or serum), the gel, which has a density between them, ends up in the middle, creating a barrier. Since lab tests typically require only the serum, this allows doctors and technicians to easily draw it off for analysis. But the barrier is soft, and can leak during storage or transportation, contaminating the sample.

Frustrated by the problem and armed with an idea for a solution, Dr. Jane Emerson, a clinical pathologist from the University of Southern California, sought out Clark School Department of Chemical and Biomolecular Engineering (ChBE) professor Srinivasa Raghavan, whose Complex Fluids and Nanomaterials Group specializes in soft “smart” materials. Together with ChBE graduate students Kunshan Sun (Ph.D. ’09) and Hyuntaek Oh, the team developed an innovative new separator gel capable of forming a permanent, solid barrier between cells and serum.

“Dr. Emerson approached us with some specifications and a great technical challenge,” Raghavan explains. “Using our knowledge of polymer science, colloid/nano science, and self-assembly, we designed a material that initially has the consistency of ketchup or paint, but after exposure to ultraviolet light converts to a consistency of stiff rubber. The initial state is essential for it to flow between the layers of blood—the cells and serum—during centrifugation and form a soft barrier, like existing separator gels. The secondary state ensures that it remains permanent and leakproof.”

The “ketchup-like” consistency was achieved by the self-assembly of a sorbitol-based gelator (a substance capable of forming a gel) into a nano-fibrous network within a UV curable oligomer (a material whose molecules consist of a few monomer units, as opposed to being made of long polymer chains), which can be hardened by exposure to ultraviolet light. The bonds within the nano-fiber are weak, non-covalent bonds that are susceptible to shear (the force applied by the centrifuge), allowing it to migrate to the middle of the phial during the separation process. The “rubber-like” consistency was achieved by curing (hardening) the oligomer with UV light, which solidifies the separator gel into a cross-linked polymer network held together by strong covalent bonds.

The new material had to meet stringent requirements to ensure it would perform physically while not interfering with blood components, clotting, or clinical laboratory assay methods.

According to Raghavan, he and Emerson have filed a patent on the separator gel. Emerson is currently working with Polymer Solutions, Inc. an independent laboratory, to develop a commercial version of the product. The gel also has potential industrial applications in which the separation of materials within the same container is required.
SAFELICELL TAKES 2ND IN $100K ACC CLEAN ENERGY CHALLENGE

A young company’s pitch to commercialize a safer electrolyte for lithium batteries won second place and $15,000 at the inaugural $100K ACC Clean Energy Challenge business plan competition, held in April 2012.

SafeLiCell, founded by Clark School Department of Chemical and Biomolecular Engineering (ChBE) graduate student Aaron Fisher, Fischell Department of Bioengineering (BioE) junior Mian Khalid, and their advisor, BioE professor Peter Kofinas, represented the University of Maryland in the competition, which also included teams from the seven other universities in the Atlantic Coast Conference, as well as two additional teams from regional non-conference schools.

“As portable battery-operated devices decrease in size, there is a greater need for batteries to have more power and longer lifetimes, along with versatility of size, shape and weight,” Fisher explains.

But the power advantages lithium-ion batteries offer sometimes come at a price, he adds, noting that the leakage of flammable and corrosive battery components has resulted in “catastrophic failures” and costly recalls by major manufacturers with millions of customers, including BMW, Chevy, Dell, HP, and Nokia.

SafeLiCell has developed a patent-pending, solid-state polymer electrolyte material, called Lithium Flex, for use in lithium-ion batteries. The material takes the form of a light, strong, flexible film that can be wrapped or bent into different shapes without breaking, and contains no combustible or corrosive materials. At present, the SafeLiCell hopes to enter the market by targeting the battery needs of biomedical and other miniature devices, but the technology could also be used in consumer electronics.

Fisher says SafeLiCell plans to use the prize money to continue the development and testing of Lithium Flex as they pursue additional fundraising activities. “We are very excited about the win, and look forward to publicizing our research and its possible economic impact,” he says.

Watch SafeLiCell’s pitch, narrated by Aaron Fisher, atyoutu.be/buukCzA-DEM

LESS PRECIOUS: BIG COPPER PARTICLES COULD MAKE YOUR ELECTRONICS CHEAPER

The fine network of lines on every circuit board, the rear window defrosters on cars, and current carriers on solar panels are all printed on their surfaces with conductive pastes, whose key ingredients include powdered gold, silver, palladium, or platinum. But with the prices of these precious metals soaring, manufacturers are looking for high-performing, cost-effective alternatives. Recently published research conducted by the Department of Chemical and Biomolecular Engineering (ChBE), in collaboration with DuPont, outlines a crucial first step toward a solution.

Base metals, such as copper and nickel, are good conductors of electricity and heat and cost far less than gold, but unlike precious metals are subject to oxidation, which results in a drop in conductivity. If pure, non-oxidized base metal powders could be produced for use in conductive pastes, the cost of electronics and solar cells could be reduced. ChBE professor and chair Sheryl Ehrman and her research group have not only discovered a way to manufacture oxide-free copper particles with the required properties, but also a way to do it relatively safely, and without toxic by-products.

Ehrman’s group developed a new technique in which a double alcohol called ethylene glycol is added to an aqueous solution of copper salts. The solution is converted to a mist inside a furnace. As the ethylene glycol decomposes in the heat, it produces a small amount of hydrogen—enough to reduce the copper salts to pure copper particles. The process takes place at a temperature below hydrogen’s flammability limit, meaning the reaction environment is not explosive, and it doesn’t leave behind the contaminated solvent stream created when particles are produced using a precipitation reaction. It also does not generate any significant amount of carbon monoxide.

The copper particles produced by the reaction are both smooth and “big,” measured at he micro- rather than nanoscale. Ehrman stresses that while the trend in electronics increasingly leans toward intricate products created at the nanoscale, in this situation, bigger and smoother are better.

“The paste is supposed to melt and flow when fired,” she explains. “We don’t want our particles to have the porosity or high surface area nanoscale structures have, because we don’t want nooks and crannies the other ingredients can get into. We want the dominant ingredient in the paste to be metal, with as little binder or filler as possible.”

The oxide free copper particle research was funded by DuPont and by the National Science Foundation’s Grant Opportunities for Academic Liaison with Industry program.

RAGHAVAN PROMOTED

The Department of Chemical and Biomolecular Engineering (ChBE) and the A. James Clark School of Engineering extend their congratulations to Srinivasa Raghavan, who was promoted to the rank of Professor. Raghavan, the Patrick and Marguerite Sung Professor in Chemical Engineering, currently serves as one of the department’s two Associate Chairs and as its Director of Graduate Studies.

“I feel fortunate to count Professor Raghavan as a colleague and friend,” says ChBE professor and chair Sheryl Ehrman. “His scholarly contributions to the field of complex fluids are significant. He’s an amazing mentor whose current and former students continue to have great impact as professors, leaders in industry employed at major corporations, and entrepreneurs who have started their own companies.”

Raghavan is the director of the Complex Fluids and Nanomaterials Group, which studies the spontaneous self-assembly of molecules and nanoparticles and uses this behavior to create new “smart” materials. The lab is well-known for the variety and quality of its research, which has wide-ranging applications in wound care, drug delivery, micromanufacturing, remediation, and clinical procedures. Raghavan and his group have published extensively and have participated in a variety of business plan competitions aimed at commercializing new products they have developed in the lab.

Raghavan has also consistently been recognized for his efforts as an educator and advisor. In 2007, he was named “Best Teacher” by the University of Maryland’s student chapter of the American Institute of Chemical Engineers, and in 2010 received the A. James Clark School of Engineering’s E. Robert Kent Outstanding Teaching Award for Junior Faculty. In 2011, he has one of the first six professors elected to the Clark School’s first class of ENGAGED Faculty, part of a National Science Foundation-sponsored program designed to increase the undergraduate student retention rate in engineering. He was also selected from a highly competitive pool of applicants to attend the National Academy of Engineering’s Frontiers of Engineering (FOEE) symposium. He teaches both core chemical engineering courses and popular, specialized engineering electives at the undergraduate and graduate levels.

Raghavan earned his Ph.D. in chemical engineering from North Carolina State University in 1998 and joined the University of Maryland faculty in 2001.

CHUNSHENG WANG PROMOTED

The Department of Chemical and Biomolecular Engineering (ChBE), the A. James Clark School of Engineering, and the University of Maryland Energy Research Center (UMERC) extend their congratulations to Chunsheng Wang, who has been promoted to the rank of associate professor with tenure.

Since his arrival in 2007, Wang has been at home in the University of Maryland’s energy research community, both in the department and at UMERC, establishing himself as one of the Clark School’s battery experts. His group, which specializes in new and improved technologies for lithium-ion batteries, has worked to produce more efficient anodes, create a tougher silicon-based electrode, and develop electroanalytical techniques for characterizing the performance of new battery materials. The group has also worked to improve the performance and cost of low temperature alkaline fuel cells.

In 2010, Wang and his colleagues received national media attention for their development of a high surface area anode made from a “forest” of tobacco mosaic virus coated with silicon and nickel ions. The inexpensive and biorenewable technology can be used to produce millimeter- or sub-millimeter-sized energy storage devices for sensors or other tiny devices.

Wang has brought his passion for better batteries into the classroom, creating new coursework and research opportunities for both undergraduate and graduate students, including managing the upgrade of and creating a battery station for the department’s Unit Operations Laboratory. He is also a mentor for the university’s Gemstone program, a four-year living-learning community for selected undergraduate honors students that explores the interdependence of technology and society. For the past two years, he has coached Team Thirsty Turtles, the department’s American Institute of Chemical Engineers Chem-E Car team. Under Wang’s mentorship, the Thirsty Turtles won the mid-Atlantic regional championship in 2011 and placed second in 2012. (See related story, p. 8)

“I’m thrilled for Professor Wang,” says ChBE professor and chair Sheryl Ehrman. “He has made important advances toward improving battery technology, both fundamental and applied, and he’s such a great departmental citizen, serving as the Chem-E Car advisor and as a Gemstone mentor.”

Wang received his Ph.D. in Materials Science and Engineering from Zhejiang University, China, in 1995. Prior to joining the University of Maryland, he was an assistant professor at the Center for Manufacturing Research, part of the Department of Chemical Engineering at Tennessee Technological University.
KARLSSON JOINS CHBE FACULTY

The A. James Clark School of Engineering and the Department of Chemical and Biomolecular Engineering (ChBE) are pleased to welcome Assistant Professor Amy Karlsson to the faculty.

Karlsson, who received her Ph.D. in chemical engineering from the University of Wisconsin–Madison in 2009, specializes in the engineering of proteins and peptides used to study and improve the diagnosis and treatment of human diseases caused by fungal pathogens.

Fungal infections are especially dangerous to patients whose immune systems have been compromised by a disease such as AIDS, or by chemotherapy treatments. The number of available antifungal drugs is limited, and like bacteria, fungi can become drug-resistant.

“The proteins and peptides my group engineers will be designed to specifically recognize fungal cells or fungal cell proteins,” Karlsson explains. “This specific interaction could allow us to use them to target molecules such as antifungal agents to fungal cells, to detect fungal cells, or to study the role of proteins in fungal cell viability.”

She will initially work to combat a fungal pathogen called Candida albicans, the culprit behind common human ailments such as vaginal yeast infections and diaper rash. In immunocompromised patients, however, it is difficult to treat, and can be fatal.

Karlsson utilizes two approaches in peptide and protein engineering. The first, rational design, draws on existing knowledge of a peptide or protein’s structure and function to guide the creation of new ones, using selected amino acid sequences that improve on the original’s characteristics. The second technique, directed evolution, enlists bacteria as living factories that produce millions of new peptides and proteins by randomly varying the amino acids in their sequence. Their output is then screened to find those with the desired properties.

“I decided to join ChBE at Maryland because the department and university environment will help me develop a strong research program,” says Karlsson, noting the availability of high-quality students to join her group, common and complimentary interests with other faculty members, and the ability to collaborate with colleagues throughout the university. ChBE’s strong commitments to excellence in teaching and mentoring junior faculty were also important factors in her decision. The move to College Park, she adds, comes with the added bonus of bringing her closer to family; her husband, Fischell Department of Bioengineering professor Christopher Jewell, is originally from western Maryland.

This fall, Karlsson will be co-teaching ChBE’s Unit Operations Laboratory course, CHBE 437, with ChBE associate professor Chunsheng Wang.

Prior to joining the University of Maryland, Karlsson was a postdoctoral research fellow at Cornell University, where she was a member of associate professor and ChBE alumnus Matthew DeLisa’s (Ph.D. ’00) research group. Her work was supported by a Ruth Kirschstein National Research Service Award from the National Cancer Institute.

ANISIMOV CELEBRATED AT INTERNATIONAL SYMPOSIUM

Experts in soft condensed matter systems from around the world met at the International Symposium on Mesoscale and Fluctuation Dynamics, held in honor of the 70th birthday of their friend and colleague, ChBE and Institute for Physical Science and Technology (IPST) professor Mikhail A. Anisimov.

The event, which was held April 27 at the Clark School’s Jeong H. Kim Engineering Building, focused on contemporary issues in thermodynamics and statistical physics emerging at mesoscales in a variety of soft condensed matter systems. After the symposium, guests joined Anisimov at a reception and banquet, where they were treated to a performance by Anisimov’s daughter, world- renowned cellist Tanya Anisimova.

“Dr. Anisimov has made major contributions to the thermodynamics of phase transitions in simple and complex fluids, both theoretically and experimentally,” says his longtime collaborator, ChBE and IPST Distinguished University Professor Emeritus Jan Sengers, who chaired the symposium. “He is a bridge between Russian and American traditions in thermodynamics, a bridge between theory and experiment, and a bridge between science and chemical engineering.”

“Dr. Anisimov has had a long and distinguished career that has inspired future generations,” Clark School Dean Darryl J. Pines adds. “We are proud of his accomplishments.”

Anisimov received his Ph.D. in Physical Chemistry and Chemical Physics from Moscow State University in 1969, and a D.Sc. in Molecular and Thermal Physics from the Kurchatov Institute of Atomic Energy, Russia, in 1974. Prior to joining the University of Maryland, his numerous academic appointments included serving as professor and chair of the Moscow State Academy of Oil and Gas Department of Physics and department head of the Russian Academy of Sciences’ Institute for Oil and Gas Research.

Anisimov’s research interests include critical phenomena and phase transitions in fluids, fluid mixtures, liquid crystals, and surfactant and polymer solutions. He also studies the applications of photon-correlation spectroscopy and high-resolution adiabatic calorimetry to soft condensed-matter materials.

He arrived in College Park in 1994 as a visiting professor at IPST, and became a research scientist and affiliate professor at the institute in 1996. He has been a full-time faculty member with ChBE and IPST since 2002, and currently holds affiliate appointments in the Department of Chemistry and Biochemistry and the university’s Chemical Physics Program. During his tenure, he has also served as a Distinguished Visiting Professor at The Petroleum Institute in Abu Dhabi, UAE. In 2007, he received the Clark School’s Poole & Kent Teaching Award for Senior Faculty.

Anisimov is the author or co-author of over 200 publications, including books, chapters, refereed journal articles, and...
reviews. He is an elected fellow of the American Association for the Advancement of Science, the American Institute of Chemical Engineers, The American Physical Society, International Academy of Refrigeration, and the Newtonian Society. He is also a member of the New York Academy of Sciences and the Washington, D.C. Cosmos Club.

The International Symposium on Mesoscale and Fluctuation Dynamics was sponsored by IPST, ChBE, and the University of Maryland’s Institute for International Programs.

PAST AIChE PRESIDENT JOINS CHBE, ISR AS VISITING PROFESSOR

National Science Foundation (NSF) program director, past president of the American Institute of Chemical Engineers (AIChE) and former Clark School faculty member Dr. Maria Burka has joined the faculties of the Department of Chemical and Biomolecular Engineering (ChBE) and the Institute for Systems Research (ISR) as a visiting professor.

Burka, the NSF engineering directorate’s Director of Process and Reaction Engineering in the Division of Chemical, Bioengineering, Environmental and Transport Systems, is engaged in a Long Term Development project with Professor Ray Adomaitis (joint, ChBE and ISR) involving process engineering and reaction control in atomic layer deposition. She has also met with students to discuss careers in chemical engineering.

At the NSF, Burka reviews proposals submitted for funding in the areas of chemical reaction engineering, process design and control, and reactive polymer processing. She is active in NSF-wide initiatives including cyber-enabled discovery and innovation (CDI).

Burka says her decision to return to the University of Maryland for her personal Long Term Development project grew out of her interest one of Adomaitis’ studies, which is currently funded by her division of the NSF.

“It seemed like an ideal project for me to [get] some hands-on involvement,” she says. “I have not done any research since I left the Maryland faculty almost 30 years ago, so I am going back to the basics...relearning programming...There are unique facilities here...that make it ideal for me at this time.”

Outside of the NSF, Burka serves on the chemical engineering advisory committees of both Cornell and Princeton University. During her tenure as the president of the AIChE in 2011, she stressed the need for the society to foster international collaborations and helped launch student chapters at universities around the world. She has also been active in AIChE’s public affairs program, which has arranged congressional briefings on high-profile energy-related issues such as the use of “fracking” to extract natural gas from shale deposits, and the cleanup of the BP oil spill in the Gulf of Mexico. Burka is also member of the American Chemical Society, the American Association of University Women, and the Society of Women Engineers.

Prior to joining the NSF and in addition to her experience on the (then) Department of Chemical Engineering faculty, Burka was a senior scientist with the United States Environmental Protection Agency and a process design engineer with Scientific Programming...There are unique facilities here...that make it ideal for me at this time.”

University of Maryland Energy Research Center director Eric Wachsman (Departments of Materials Science & Engineering and Chemical & Biomolecular Engineering) has received the Electrochemical Society High Temperature Division’s 2012 Outstanding Achievement Award.

Wachman will accept the award at a ceremony at the society’s 2012 Pacific Rim Meeting on Electrochemical and Solid-State Science (PRIME) in Honolulu, Hawaii, in October, where he is also scheduled to deliver a talk.

Wachman’s research interests include the development of solid oxide fuel cells (SOFCs), gas separation membranes, solid-state gas sensors, electrocatalytic conversion of CH₄, and the post-combustion reduction of NOₓ using advanced ion conducting materials.

ADOMAITIS: SHINING STAR HONORABLE MENTION

Professor Ray Adomaitis has received an Honorable Mention for the 2012 Shining Star Volunteer of the Year Award from the American Institute of Chemical Engineers (AIChE).

Each year, the society’s Shining Star awards recognize members who have gone above and beyond the call of duty in volunteering for their local section while exhibiting exemplary leadership.

Adomaitis, an elected Fellow of the AIChE, has served as the secretary of the National Capital Section of the organization for over 10 years. His duties include editing the section’s newsletter and managing its web site.

In recognition of his efforts, Adomaitis will receive complimentary registration for an upcoming AIChE conference.
U. OF MARYLAND WINS DOE HYDROGEN DESIGN CONTEST

A team of Clark School students, including members of the Department of Chemical and Biomolecular Engineering (ChBE), was selected by a panel of 16 judges from industry, government and national laboratories to receive the grand prize in the 2012 U.S. Department of Energy Hydrogen Design Contest.

The team, mentored by Professor Greg Jackson (Department of Mechanical Engineering and associate director, University of Maryland Energy Research Center), traveled to Toronto, Canada in June, where they received their award and presented their work at the Young Scientist Symposium of the World Hydrogen Energy Conference 2012. ChBE team members included graduate student Will Gibbons (advised by Jackson) and undergraduates Chetali Gupta and Meron Tesfaye.

The Hydrogen Design Contest, which attracted entries from 28 universities in nine countries, challenged students to plan and design a tri-generation system that produces heat, hydrogen, and power for their university campus, using locally available waste resources for primary energy input.

The Clark School team’s proposed power plant design would deliver a net output of 1.2 megawatts of power to the campus grid—the equivalent of taking 2,300 cars off the road—and utilizes organic and municipal solid waste via gasification and anaerobic digestion technology. The team worked closely with university facilities managers, including campus-wide energy manager Joan Kowal and recycling coordinator Bill Guididas, to assess the campus energy infrastructure, local waste streams, and possible processing methods.

The team’s calculations indicate that implementation of the proposed system could reduce the University of Maryland’s carbon emissions by more than 4%, while saving it over $2 million per year in combined heating, electricity, and hydrogen costs.

A paper on the work has been submitted to the International Journal of Hydrogen Energy, the leading peer-reviewed publication in its field.

Organized by the Hydrogen Education Foundation, the annual Hydrogen Student Design Contest challenges university students to develop innovative solutions to key issues facing the hydrogen and fuel cell industries. The competition is supported by the U.S. Department of Energy, the National Renewable Energy Laboratory, the U.S. Combined Heat and Power Partnership, the World Hydrogen Energy Conference, and the International Association for Hydrogen Energy.

HOLLINSHEAD WINS OUTSTANDING ASPIRE STUDENT RESEARCH AWARD

Department of Chemical and Biomolecular (ChBE) senior (now alumna) Whitney Hollinshead, advised by Assistant Professor Ganesh Sriman, received the 2012 Outstanding ASPIRE Student Research Award for her work on isotope labeling experiments to determine the fluxes in metabolic pathways within plant cells. ASPIRE, A Scholars Program for Industry-Oriented Research in Engineering, run by the A. James Clark School of Engineering, offers students the opportunity to move beyond the classroom by working with faculty or staff on real-world engineering projects.

Hollinshead had been a member of Sriman’s Metabolic Engineering Laboratory since June 2010, and worked on her ASPIRE-funded project, “An Integrative Study of Nitrogen Cycling and Storage in Poplar,” since fall 2011. For the past several years, the Sriman Group, in collaboration with Prof. Gary Coleman (Plant Science and Landscape Architecture) has investigated how poplar trees can be modified into a high-yield, cost-effective and renewable biofuel crop.

“One of the major issues in science and engineering is finding affordable and viable alternative energy sources,” says Hollinshead. “That this project addressed this issue is what first drew me to [it].”

Hollinshead grew poplar cells on media laced with specific concentrations of a carbon isotope, 13C, a carbon atom containing one extra neutron. The difference in mass between ordinary carbon and 13C allowed her to use gas chromatography-mass spectrometry to display the mass distribution of fragments of compounds present in the plant cells which have absorbed 13C and other compounds, like glucose, from the medium. This information was then used to determine the isotope distribution in individual compounds and to identify the biomass composition of the cells.

“[U]sing carbon isotope-labeled media allows a picture to be developed of the internal metabolism of cells, in both plants and bacteria,” Hollinshead explains. “This technique can be [applied to] biosystems to allow better engineering of cells....[Our group’s] goal is to develop a model of the metabolism of poplar cells to further modify pathways to promote faster growth and crop yield.”

“Whitney’s projects required experimental skills ranging from cell culture to separations, analytical chemistry and mass spectrometry,” says Sriman. “She helped develop and optimize a number of methodologies related to these. What impressed me was her perseverance and determination in the face of experiments and analyses that did not work.”

Outside of class, Hollinshead was a member of the Thirsty Turtles, the Clark School’s Chem-E Car team. (See related story, p. 8.) Her work in the team’s structures group helped two of the team’s chemical reaction-powered vehicles, Raphael and The Pride of Maryland, turn in strong performances at the mid-Atlantic regional competitions in 2011 and 2012.

Hollinshead is now a Ph.D. student at Washington University in St. Louis, Mo. There, she hopes to continue her research on biologically based energy solutions, an interest she says was sparked by her experiences in the ASPIRE program and the Sriman Group. “The techniques and knowledge I continuously acquire while working on this project,” she adds, “[are what] challenge me to continue.”
A group of Clark School students known as "Team Thirsty Turtles" took second place in the American Institute of Chemical Engineers' (AIChE) mid-Atlantic regional Chem-E Car Competition, held in Hoboken, N.J., in April 2012. The team also won the competition’s Best Poster Design award.

The contest challenges teams of students to design and construct a small, chemically powered model vehicle. The cars must carry a specified cargo over a distance only revealed at the competition, and stop as close to a finish line as possible. Any kind of chemical reaction may be used to power the cars, which are not remotely-controlled. Each team must carefully calculate the duration of the reaction required when they are told how far their vehicle must travel.

AIChE officials announced a target distance of 60 feet at the finals. Team Thirsty Turtles’ zinc-air battery-powered car, The Pride of Maryland, traveled 64 feet, 10 inches, finishing several feet farther from the finish line than the car fielded by the first place team from the University of Pittsburgh. Johns Hopkins University came in third. All three teams earned a spot at the national competition, to be held at the AIChE’s annual meeting this fall in Pittsburgh, Pa.

In 2011, the team and its car, Raphael, debuted at AIChE’s mid-Atlantic regional conference competition, where they surprised even themselves with a first place win over more experienced teams from the University of Pittsburgh, Bucknell, and Rutgers.

This year, the Thirsty Turtles designed and built a new car based on lessons learned from their work with Raphael, and with fresh perspective from new team members.

“We worked to improve our zinc-air cells,” says team member Kevin Bates. “We changed our stopping mechanism reaction to [make it] more adjustable compared to last year’s reaction. We re-designed our battery enclosure case, and we re-designed our reaction chamber to make it more modular.

Our circuitry systems were ‘cleaned up’ and wired much more efficiently and reliably.”

At the regional competition, Team Thirsty Turtles included Department of Chemical and Biomolecular Engineering (ChBE) seniors (now alumni) and returning members Kevin Bates, John Weston “Battery Guy” Breda, Whitney Hollinshead and Leslie Mok; Department of Electrical and Computer Engineering senior (now alumnus) and returning member Lucas Hedinger; ChBE juniors Nick Lepak, Amy Nutis, and Wesley Yan; ChBE sophomore Dao Huang; and ChBE freshmen Trae Vanaskey and Isaac Zaydens. The team is advised by ChBE assistant professor Chunsheng Wang and sponsored by the W.R. Grace Foundation.

CHBE UNDERGRADUATES WIN 5 OF 29 PRESTIGIOUS NATIONAL INDUSTRIAL INTERNSHIPS

Five of the Clark School’s Department of Chemical and Biomolecular Engineering (ChBE) undergraduates earned summer internships at top companies through a program offered by the Society of Chemical Industry (SCI), the America International Group (AIG), the American Chemical Society (ACS), and the American Institute of Chemical Engineers (AIChE).

Karen Dunford, Yelena Leznik, Justin Owens, Meron Tesfaye and Majid Waheed were selected from a nationwide field of “exceptional sophomores and juniors” majoring in chemistry and chemical engineering to receive five of the twenty-nine positions offered by the SCI Scholars program. SCI Scholars receive $6000–$10,000 for a ten-week industrial internship and $1000 in discretionary funding.

Dunford, a junior, headed to DuPont’s Chambers Work Site in Deepwater, N.J. She applied to the SCI Scholars program because she wanted industrial experience. “[I] would like to see...what a Chemical Engineer can do outside of academia,” she says. “I hope to have a better understanding of the job I would like [to have] after graduation.” Dunford’s prior research experience includes a summer in Associate Professor Srinivasa Raghavan’s group, where she studied vesicles, photo-acid generators, and gels. Her Gemstone team currently works in Assistant Professor Chunsheng Wang’s lab, where they are developing a silicon-graphene composite that could be used in an anode with a long cycle life and high capacity. Dunford says she chose to study at the Clark School because of the many opportunities for undergraduate research, and because the in-state tuition allows her to study abroad in the summer and winter terms.

Leznik, a junior, has been researching careers in engineering since high school, where math and science classes were always her favorites. She chose chemical engineering, she says, because if its flexibility, and because she was inspired by her father, who works as a chemical engineer for W.R. Grace. Leznik traveled to Newark, Del., where she served as a manufacturing technology engineer for DuPont. “I wanted to get a traditional internship in industry so I can decide what I like and don’t like about
chemical engineering, and better shape my future career goals," she explains. The SCI Scholars program gave her the opportunity to explore her options by presenting her strengths and experience to many potential employers with one application. Prior to earning her internship at DuPont, Lesnik worked in ChBE professor and chair Sheryl Ehrman's group, conducting research on functionalizing pH responsive nanoparticles for drug delivery to cancerous tumors.

Owens, a sophomore and self-proclaimed "die-hard Terps fan," headed to Allentown, Pa., where he worked for Air Products’ Division of Manufacturing and Operations Engineering. There, he was involved in plant operations, including quality assurance, project engineering, and safety compliance. "I [was] practically...a full time engineer for three months, which is an opportunity I do not think I could find anywhere else," he says. "...hopefully [it will] give me a step up for the future." This was his second summer in the field; last year, he worked for General Dynamics, Jacobs Engineering, and Science and Technology Corporation in Aberdeen, Md. on a project for the U.S. Army. Owens has always loved math and science, but it was his high school AP chemistry class that inspired him to become a chemical and biomolecular engineer. While at the moment he's planning on a career in industry, Owens hopes to find a research mentor on campus, and would like to continue his education at the graduate level in the future.

Tesfaye, a junior, traveled to the Eastman Chemical Company in Kingsport, Tenn., where she worked in manufacturing and process control. Before becoming an SCI Scholar, she completed two Research Experiences for Undergraduates programs, one on biofuels at National Renewable Energy and one on titanium photovoltaic cells at Washington University. Tesfaye decided to become a chemical and biomolecular engineer because it would prepare her to pursue many different career opportunities. She enjoys the challenge and breadth of knowledge her studies have provided. She transferred to the Clark School to complete her degree because she felt that it offered her excellent career, research, and leadership opportunities, and because its location makes it an "ideal" and diverse place to live and work. After earning her B.S., Tesfaye is interested in pursuing a graduate degree in environmental engineering. Ultimately, she says, "I would like to do environmental work, especially in remote and underdeveloped countries like my home country, Ethiopia."

Waheed, a junior, spent his summer working for DuPont's research and development division in Newark, Del. His prior research experience includes a summer internship at the Naval Research Laboratory in Washington, D.C, where he studied flame extinguishing systems. He applied to be a SCI Scholar because he felt the program offered the most targeted internship opportunities. "I knew I would be placed in a position that was meant for a chemical engineer rather than a general engineer," he says, "and as such would be able to most effectively utilize what I have been taught in [my] classes." Waheed chose to become a chemical and biomolecular engineer because of the many career paths it offers, including energy, process design and even medicine. He chose to study at the Clark School for its "strong reputation and value." After graduating, he plans to work for a few years before attending graduate school, either for a master's degree, Ph.D., or M.B.A.

ChBE and the Clark School extend their congratulations to all of these excellent young engineers.
Hulka Energy Research Fellowship from the University of Maryland Energy Research Center (UMERC) for his proposal to engineer photosynthetic marine algae to produce advanced carbon-neutral biofuels and chemicals.

Hulka Energy Research Fellowships support graduate students engaged in selected fields of alternative energy research, including solar energy conversion, biofuels, wind energy, wave energy, and ocean thermal or geothermal energy. Hulka Energy Research Fellows receive up to $20,000 to complete a one-year personal project distinct from the research they perform for their advisors.

Currently, most biofuels are manufactured by using yeasts or bacteria that convert sugars derived from crops like corn and sugarcane into alcohols, or by harvesting oil from crops like soybeans for conversion into biodiesel. Quinn is studying a third option: using a single-cell marine alga called *Phaeodactylum tricornutum* (Pt) to produce isoprene, a reduced-carbon compound that is a precursor to biofuels, including true diesel. Quinn chose to pursue his graduate studies at the Clark School for its thriving energy research community, and joined ChBE because it offered him the “broadest toolset” to use to pursue his personal interests and goals. “Because of the wide range of energy initiatives underway here,” he says, “and because of the resources available, I am already collaborating with experts from other departments. I hope to work with some of the energy-based companies on campus with unique facilities and instrumentation that could advance my research.”

“It was a great personal honor to have my work selected by the Hulka Fellowship committee as having great potential to meaningfully contribute to the field of energy research,” Quinn adds, noting that the support he receives will allow him to remain engaged in research full-time throughout the year. He looks forward to publishing and presenting his results.

“In the future, we hope to move our process out of the lab and scale it up to analyze the potential for commercial success. We believe that marine algae will eventually replace fossil fuels as the main source of numerous products, including diesel fuel and rubber.”

Quinn’s marine algae cultures growing in a photosynthetic laboratory shaker.

**DEVELOPING CATALYSTS FOR RENEWABLE FUEL PRODUCTION**

ChBE graduate student Will Gibbons, advised by UMERC associate director Professor Greg Jackson (Department of Mechanical Engineering), was named a 2012 John and Maureen Hendricks Energy Research Fellow for his proposal to create low-cost, durable, and efficient materials for solar power-driven production of renewable fuels.

Established by the John and Maureen Hendricks Charitable Foundation in 2008 to support UMERC’s efforts, the John and Maureen Hendricks Energy Research Fellowship program supports students engaged in research that advances the frontiers of energy science and technology, particularly forward-looking approaches to alternative energy generation and storage.

The splitting of water and carbon dioxide into carbon monoxide and hydrogen, particularly through the use of carbon-neutral solar thermal cycles, provides a promising path to renewable fuel production. The technique, however, has been hampered by the high temperature requirements (>1300° Kelvin, or 1880° Fahrenheit) of the oxidation and reduction cycles, and a lack of long-term cycle stability.

**ENGINERIEING ALGAE TO PRODUCE BIOFUEL**

ChBE graduate student Andrew Quinn, co-advised by ChBE assistant professor Ganesh Sriram and Cell Biology and Molecular Genetics professor Steve Hutcherson, received a 2012 Hulka Energy Research Fellowship from the University of Maryland Energy Research Center (UMERC) for his proposal to engineer photosynthetic marine algae to produce advanced carbon-neutral biofuels and chemicals.

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Gibbons will explore the characterization and optimization of ceria-based nanofiber materials for use as catalysts in the solar thermal splitting of water and carbon dioxide. The ceramic nanofibers, developed at UMERC, already show potential as catalysts because of their lower required operating temperature. Gibbons’ research will focus on the development of cost-effective, simplified nanofiber fabrication strategies and improving their cycle-to-cycle stability.

“You can think about it very much as biofuel production in which a plant takes carbon dioxide, water and sunlight and produces some biomass that we could then use as a fuel,” explains Gibbons.

While we have the potential to produce liquid fuels from carbon dioxide, sunlight and water, existing processes and materials are still inefficient. The combination of an optimized nanofiber catalyst and concentrated solar energy, says Gibbons, could change that. A field of heliostats—arrays of mirrors that reflect light—could be placed in the desert, concentrating sunlight into towers used to heat the ceria nanofiber catalyst without having to burn other fuel. Once heated and exposed to water and carbon dioxide, the catalyst will split them into hydrogen and carbon monoxide. The hydrogen/carbon monoxide gas mixture could then be taken through another process to convert it into liquid fuel that could be handled by our existing energy infrastructure.

Gibbons’ interest in energy research came from a childhood fascination with engines. He read about fuel cells for the first time as a high school student, and sought out fuel cell research opportunities as an undergraduate. “It just kept pulling me deeper and deeper in,” he says.

Now, as a graduate student, Gibbons says the Hendricks Fellowship will provide him with the support and freedom he needs to make his energy research truly his own. “It’s actually really liberating to be able to know that if I want to take this research in a slightly different direction, I can…that it’s OK to explore. I’d really like to thank the Hendricks family for this opportunity to further my research at the University of Maryland.”
COLUMNS is published for alumni and friends of The Department of Chemical and Biomolecular Engineering at the A. James Clark School of Engineering. Your alumni news and comments are welcome. Please send them to:

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ABOUT THE COVER IMAGE

THE BLUE IMAGE USED ON THE COVERS, FROM THE RESEARCH GROUP OF CHBE PROFESSOR AND CHAIR SHERYL H. EHRMAN, SHOWS OXIDE-FREE, MICROMETER SIZED COPPER PARTICLES GENERATED BY A SPRAY PYROLYSIS PROCESS WITH A COSOLVENT OF ETHYLENE GLYCOL AT 1000°C. THESE HOLLOW, SMOOTH-SURFACED PARTICLES WERE DESIGNED TO REPLACE THE PRECIOUS METAL PARTICLES USED IN CONDUCTIVE PASTES, WHICH ARE ESSENTIAL TO THE ELECTRONICS INDUSTRY. FOR MORE INFORMATION, SEE P. 3.

AICHE: BAGELS & GRITS 3, CHEM-E CAR, & MORE!

The Department of Chemical and Biomolecular Engineering at the A. JAMES CLARK SCHOOL OF ENGINEERING, UNIVERSITY OF MARYLAND invites you to join us at the annual meeting of the AIChe in Pittsburgh, PA for:

OUR BAGELS AND GRITS BREAKFAST!
It’s back—our casual event for alumni and friends attending AIChe. Meet our faculty and students and learn more about our programs. No RSVP required—see you there!

Monday, Oct. 29, 7:00–8:30 a.m., Location: TBA
(Please see our web site or visit us at AIChe for the most up-to-date information.)

CHEM-E CAR FINALS!
Cheer on our team, Thirsty Turtles, at the finals! (See related story, p. 8.)
See the AIChe web site for more information.

WHERE ELSE WILL WE BE AT AICHE?
VISIT www.chbe.umd.edu/aiche FOR MORE INFO!