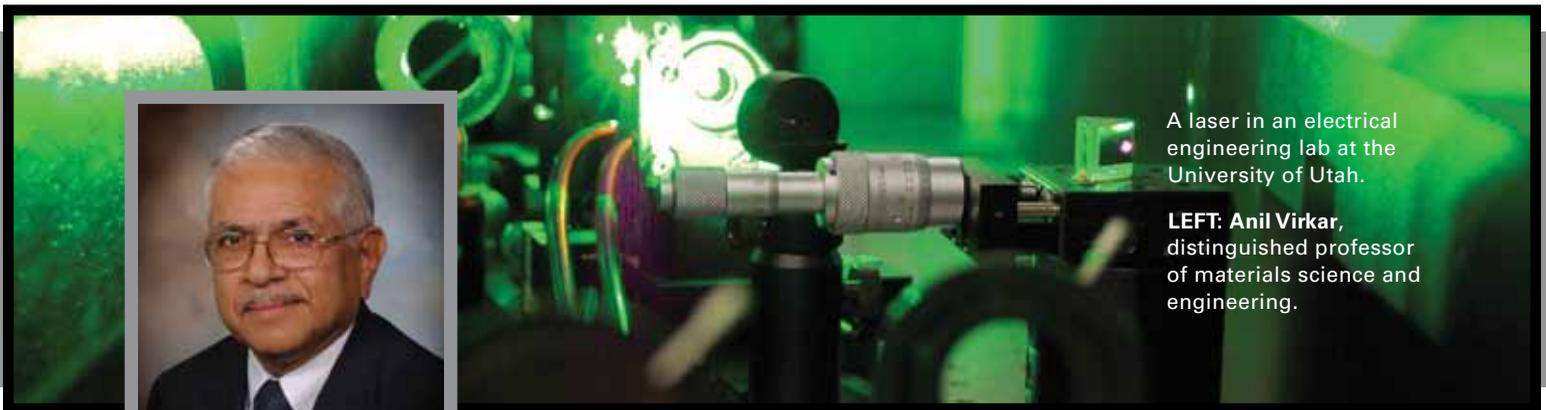


WINTER 2011

# UTAH ENGINEERING

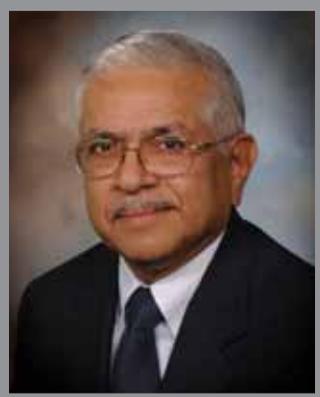
## New Center For Materials Research

\$21.5M EFFORT MAY LEAD TO FASTER COMPUTERS AND DEVICES



A laser in an electrical engineering lab at the University of Utah.

**LEFT: Anil Virkar,** distinguished professor of materials science and engineering.



The University of Utah is launching a six-year, \$21.5 million effort to conduct basic research aimed at developing new materials for uses ranging from faster computers and communications devices to better microscopes and solar cells.

The new Materials Research Science and Engineering Center is being established and funded for six years by a \$12 million grant from the National Science Foundation (NSF), \$6.5 million for major equipment from the Utah Science Technology and Research (USTAR) initiative and \$3 million from the University of Utah.

The coveted NSF Materials Research Science and Engineering Center grants are obtained only by the nation's best research universities, says Anil Virkar, director of the new center and a University of Utah distinguished professor and former chair of materials science and engineering.

"At the federal agency level, this is about the most prestigious award possible," Virkar says. "Securing a grant of this size and scope really inaugurates our academic membership in the Pac-12."

Other universities included in the new round of NSF materials research grants include Yale, Columbia, Cornell, Northwestern and Michigan.

The new Utah center involves more than two dozen researchers from seven departments in the College of Engineering, College of Science, and College of Mines and Earth Sciences.

NSF says the new center will focus on "next-generation materials for plasmonics and spintronics."

"We are among the world leaders in these two fields," Virkar says. >>

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The center's two interdisciplinary research groups will focus on these areas.

- Electrical engineer Ajay Nahata will lead the plasmonic metamaterials research team. Plasmonics involves using light that propagates in the interface between a metal and nonmetal. A metamaterial is a material that is structured artificially by etching, drilling, milling or other methods, thus allowing engineers to manipulate how various wavelengths of light propagate on the surfaces of such materials.

Plasmonics can allow tighter focusing than is possible using conventional microscopes, which may lead to better microscopic methods for biologists, Nahata says.

The plasmonic metamaterials team also will study the potential of uncommonly used wavelengths, such as terahertz radiation, to develop faster devices for use in future communication and computing systems.

- Physicist Brian Saam will lead the organic spintronics research effort, which will work on developing organic semiconductors that can be used to carry and store information not only electronically by exploiting the electrons in atoms, but also "spintronically" by using a characteristic of subatomic particles known as spin.

Organic semiconductors are aimed at developing faster, more efficient computers, displays and communications, as well as better solar cells, says Valy Vardeny, distinguished professor of physics and associate director of the new center.

"These are very promising materials," Vardeny says. "If we can understand their electronic, magnetic and spintronic properties, they can be fabricated far less expensively than standard silicon electronics, and can be engineered with an enormous variety of other favorable characteristics, for example, as lightweight, flexible displays, or with resistance to harsh chemicals or extreme temperature."



Virkar says the kind of basic research conducted at the new center contributes to a crucial broad base of knowledge, and produces the kind of discoveries that lead to major technological revolutions, new practical applications and the new frontiers of research. He says that the long-term commitment for the center also will allow the basic research to mature into applications, devices, intellectual property and even start-up companies.

In addition to training university graduate and undergraduate students, the new center will include outreach programs dealing with its research to K-12 students and teachers, says mechanical engineer Debra Mascaro, the center's education and outreach director. "We will also actively recruit students, postdoctoral researchers and faculty with a goal of providing equal opportunities to underrepresented groups."



**ABOVE: Ajay Nahata,** professor of electrical and computer engineering, will lead the plasmonic metamaterials research team in the new Center.

***"We are among the world leaders in plasmonics and spintronics," says Anil Virkar.***

# Targeting HIV's Sugar Coating

NEW MICROBICIDE MAY BLOCK AIDS VIRUS FROM INFECTING CELLS



Patrick Kiser,  
associate professor of  
bioengineering

University of Utah researchers have discovered a new class of compounds that stick to the sugary coating of the AIDS virus and inhibit it from infecting cells – an early step toward a new microbicide treatment to prevent sexual transmission of the virus.

Despite years of research, there is only one effective microbicide to prevent sexual transmission of HIV, which causes AIDS, or acquired immune deficiency syndrome. Microbicide development has focused on gels and other treatments that would be applied vaginally by women, particularly in Africa and other developing regions.

To establish infection, HIV must first enter the cells of a host organism and then take control of the cells' replication machinery to make copies of itself. Those HIV copies in turn infect other cells. These two steps of the HIV life cycle, known as viral entry and viral replication, each provide a potential target for anti-AIDS medicines.

*"Most of the anti-HIV drugs in clinical trials target the machinery involved in viral replication," says Patrick Kiser, associate professor of bioengineering at the University of Utah. "There is a gap in the HIV treatment pipeline for cost-effective and mass-producible viral entry inhibitors that can inactivate the virus before it has a chance to interact with target cells."*

Lectins are a group of molecules found throughout nature that interact and bind with specific sugars. HIV is coated with sugars that help to hide it from the immune system. Previous research has shown that lectins derived from plants and bacteria inhibit the entry of HIV into cells by binding to sugars found on the envelope coating the virus. However, the cost of producing and purifying natural lectins is prohibitively high. So Kiser and his colleagues developed

and evaluated the anti-HIV activity of synthetic lectins based on a compound called benzoboroxole, or BzB, which sticks to sugars found on the HIV envelope.

Kiser and his colleagues found that these BzB-based lectins were capable of binding to sugar residues on HIV, but the bond was too weak to be useful. To improve binding, they developed polymers of the synthetic lectins. The polymers are larger molecules made up of repeating subunits, which contained multiple BzB binding sites. The researchers discovered that increasing the number and density of BzB binding sites on the synthetic lectins made the substances better able to bind to the AIDS virus and thus have increased antiviral activity.

Depending on the strain, HIV displays significant variations in its viral envelope, so it is important to evaluate the efficacy of any potential new treatment against many different HIV strains. Kiser found that the synthetic lectins were specific to a broad spectrum of HIV strains and didn't affect other viruses with envelopes. The researchers also tested the anti-HIV activity of the synthetic lectins in the presence of fructose, a sugar present in semen, which could potentially compromise the activity of lectin-based drugs because it presents an alternative binding site. However, the researchers found that the antiviral activity of the synthetic lectins was fully preserved in the presence of fructose.

Kiser says future research will focus on evaluating the ability of synthetic lectins to prevent HIV transmission in tissues taken from the human body, with later testing in primates. Kiser and his colleagues are also developing a gel form of the polymers, which could be used as a topical treatment for preventing sexual HIV transmission.

# ARCS Utah Chapter Shines a Light on U.S. Competitiveness

In electrical engineering, an arc is an electric current—often strong, brief, and luminous—in which electrons jump across a gap. Electric arcs can produce very bright light and are used for illumination. At the University of Utah, the dedicated women members of the ARCS Utah Chapter are producing a very bright light through their support for graduate education in engineering, while illuminating the need for our nation's best and brightest students to excel at the graduate

17 member chapters across the United States, exists to advance our nation's competitiveness by strengthening the country's capacity for scientific and technological innovation through supporting the individual potential of science and technology scholars. Only U.S. universities whose departments are ranked in the top 100 in the country are eligible to receive ARCS Foundation scholar awards. The University of Utah is one of 53 university partners.



FROM LEFT: ARCS Utah Scholars Nicolas Nolta, Joshua Sewell, Shannon Hanson, Shannon Reynolds, Daman Bareiss, Andrew Fisher

level. Established just two years ago, the ARCS Utah Chapter has so far donated \$90,000 in graduate fellowships for six outstanding students.

The national ARCS Foundation (Achievement Rewards for College Scientists), of which the Utah Chapter is one of

The real story of the ARCS Utah Chapter, however, is the determination and commitment of its dedicated women members who donate their time, energy and dollars to help engineering students achieve their potential. Judith Miller, former national ARCS Foundation president, approached former President Michael Young and Engineering Dean Richard Brown about establishing a chapter.

Thanks to the formidable leadership of former Commissioner of Higher Education Cecelia Foxley, former Salt Lake Community College Vice President for Academic Affairs Anne Erickson, and about 30 other women leaders, the Chapter became

established and productive in just two years time. For her service, Dr. Foxley was recognized with the ARCS Light Award at the ARCS 2011 National meeting.

In addition to its fundraising component, ARCS Chapter activities engage members in learning about the applications

## NEW FACULTY MEMBERS



**Amanda Bordelon**  
Civil & Environmental  
Engineering

RESEARCH INTERESTS:  
Fiber-reinforced concrete, concrete pavement design, concrete overlay on asphalt, fracture mechanics, and x-ray CT imaging



**Feifei Li**  
School of Computing

RESEARCH INTERESTS:  
Query processing in streaming and relational database systems; processing, managing and indexing large-scale data; and modeling and querying probabilistic data



**Miriah Meyer**  
School of Computing

RESEARCH INTERESTS:  
Design of visualization systems that support exploratory, complex data analysis tasks for scientific research



**Shelley Minter**  
Materials Science &  
Engineering

RESEARCH INTERESTS:  
Enzyme cascades for bioelectrocatalysis and organelle bioelectrocatalysis for sensing and energy conversion applications

of engineering, science and medicine at the University and in industry. Chapter-sponsored tours, field trips and lectures create an understanding of our need to remain competitive in the technology and science disciplines.



LEFT: Dr. Anne Erickson  
RIGHT: Dr. Cecelia Foxley with student

The rising stars of the Utah ARCS Chapter are its scholars, who are selected by the College of Engineering for their academic and intellectual potential. Each scholar receives a first-year ARCS Scholar Award of \$15,000, which is matched by the College in years two through five of their PhD programs.

#### 2011-2012 ARCS Scholars:

- *Daman Bareiss, mechanical engineering, whose ARCS Scholar Award was donated by Dr. Cecelia H. Foxley in honor of her daughter Dr. Stacy K. Firth*
- *Andrew Fisher, electrical and computer engineering, whose ARCS Scholar Award was donated by Beverley Taylor Sorenson in honor of her son James Lee Sorenson*
- *Shannon Reynolds, civil and environmental engineering, whose ARCS Scholar Award was provided through donations to the Utah Chapter*

#### 2010-2011 ARCS Scholars:

- *Shannon Hanson, civil and environmental engineering, whose research interests are concrete materials and structures*
- *Nicholas Nolta, bioengineering, whose research interests are advanced neural interfaces*
- *Joshua Sewell, chemical engineering, whose research interests are energy recovery and usage*

The October luncheon signaled the passing of the presidential gavel to incoming Chapter president Dr. Anne Erickson. For additional information about chapter activities or membership, go to: [www.arcsfoundation.org/utah](http://www.arcsfoundation.org/utah).



**Jeff Phillips**  
School of Computing

RESEARCH INTERESTS:  
Algorithms for data analytics, computational geometry, data mining, machine learning, computational statistics, databases



**Jur van den Berg**  
School of Computing

RESEARCH INTERESTS:  
Artificial intelligence, algorithms and theory, machine learning, and pattern recognition



The new James L. Sorenson Molecular Biotechnology Building—a USTAR Innovation Center, will be completed in December 2011 and dedicated on April 19, 2012 at 11 a.m.

## UTC HALL OF FAME

The Utah Technology Council (UTC) has inducted two University of Utah alumni into its Class of 2011 Hall of Fame. **Stephen Jacobsen** (pictured left) and **Mark Fuller** (pictured right), both graduates from the U of U College of Engineering, were recently honored at a gala ceremony in Salt Lake City for their “global contributions to the information technology, life science and clean tech industries through new technology, innovation and leadership.”



“It is a great privilege to welcome these visionaries to the UTC Hall of Fame,” said Richard Nelson, founder and CEO of UTC. “Both Mark Fuller and Stephen Jacobsen are brilliant examples of the types of innovators we cultivate here in Utah and illustrate how much one can accomplish with an innovative mind and a lot of hard work.”

Stephen Jacobsen, a distinguished professor of mechanical engineering at the University of Utah, received both his undergraduate and master’s degrees at the U of U in mechanical engineering. He earned his PhD at the Massachusetts Institute of Technology. The former president of Raytheon Sarcos, Jacobsen has developed new technology that ranges from robots for the entertainment industry and the military, to breakthrough medical devices, such as the artificial kidney, high-tech prosthetic arms for amputees, and micro-catheters. Jacobsen has been elected to the National Academy of Engineering and the National Academy of Science’s Institute of Medicine.

Mark Fuller, CEO and chair of WET (Water Entertainment Technologies) Design, received a BS in civil engineering at the University of Utah. He earned his master’s degree in engineering and project design at Stanford University. He worked in the special effects department of the Walt Disney Company supervising the creation of more than 500 special effects and water projects for Disney Parks. After leaving Disney, he co-founded WET, a world leader in water feature design and technology. Notable projects include the Dubai Fountain, the Fountains of Bellagio (which were also developed by Jacobsen), the Gateway fountain, and the 2002 Olympic Games Cauldron in Salt Lake City —soon to be followed by the fountains at City Creek in SLC.

## TECHNOLOGY COMMERCIALIZATION AT THE



A radio transceiver would monitor infants at risk for SIDS or adults with sleep apnea.



University of Utah engineers who built wireless networks that see through walls now are aiming the technology at a new goal: noninvasively measuring the breathing of surgery patients, adults with sleep apnea and babies at risk of sudden infant death syndrome (SIDS).

Because the technique uses off-the-shelf wireless transceivers similar to those used in home computer networks, “the cost of this system will be cheaper than existing methods of monitoring breathing,” says Neal Patwari, assistant professor of electrical engineering. While he estimates it will be five years until such a product is on the market, Patwari says a network of wireless transceivers around a bed can measure breathing rates and alert someone if breathing stops without any tubes or wires connected to the patient.

Patwari wants to conduct research with doctors to test his method as an infant-breathing monitor, and, if it proves useful, develop it as a medical device that would need federal approval. He also says it may be useful for adults with sleep apnea, which causes daytime fatigue and impairs a person’s performance.

## NORMANN AND KOLB RECEIVE HONORARY DOCTORATE DEGREES

Richard Normann, distinguished professor of bioengineering and ophthalmology, and Helga Kolb, emeritus professor of ophthalmology, were recently awarded honorary doctorate degrees from the Miguel Hernandez University in Elche, Spain. A husband and wife team, Normann and Kolb both received Doctor Honoris Causa degrees: Normann for his pioneering work in the development of techniques for communicating with neurons in the central and peripheral nervous systems, and Kolb for her basic neuroanatomical research in elucidating neural pathways in the vertebrate retina.



## DISTINGUISHED PROFESSOR PASSES 50-YEAR MARK AT THE U

The College of Engineering congratulates Larry DeVries, distinguished professor of mechanical engineering, for reaching his 50th year as a faculty member. A specialist in materials and adhesives, DeVries received his PhD in physics and mechanical engineering from the U. He has served in several different positions, including as chair of the Department of Mechanical Engineering and senior associate dean of the College of Engineering. Now recognized as a distinguished professor, he teaches both the advanced and undergraduate levels of strengths of materials.



## SCI INSTITUTE HOSTS RESEARCH OPEN HOUSE

The Scientific Computing and Imaging Institute hosted SCI X, an exploration of innovation in visualization, scientific computing, and image analysis. The event included live demos showing the latest research and panel discussions on the economic impact of collaborative research. The keynote speaker was John Warnock, an electrical and computer engineering alumnus and co-founder of Adobe Systems, who spoke about how early computer graphics allowed data to be visualized for the first time at the University of Utah and about the history of the personal computer.

## Catching a Breath – Wirelessly

SIDS monitors now on the market include FDA-approved medical devices that measure heart rate and respiration and are connected to babies with wires, electrodes and-or belts. Patwari says that with the new method, “the patient or the baby doesn’t have to be connected to tubes or wired to other sensors, so they can be more comfortable while sleeping.”

In 2009, Patwari and then-graduate student Joey Wilson showed how a couple dozen wireless transceivers – devices that transmit and receive radio signals – could be used to literally see through walls to detect the location of a burglar, people trapped by a fire or hostages held captive inside a building.

They formed a University of Utah spinoff company, Xandem Technology LLC, which is commercializing the wireless networks for use as motion detectors for burglar alarm systems, to help police locate hostages and even to alert

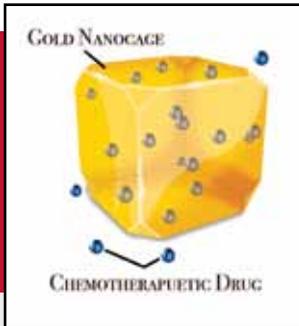
out-of-town, vacationing parents if a crowd of teenagers is partying at their home during their absence.

In a new study, Patwari looks at the pros and cons of adding wireless detection of breathing to the motion-detecting capability. For more information, go online to [http://unews.utah.edu/news\\_releases/catching-a-breath-wirelessly](http://unews.utah.edu/news_releases/catching-a-breath-wirelessly).



**Neal Patwari**, assistant professor of electrical and computer engineering

## Season's Greetings



# Nanotechnology Earns University of Utah Student National Honor

BY JON CLIFFORD, Adapted from the Salt Lake Tribune

When it comes to fighting cancer, Ryan Robinson thinks big in the smallest of environments. That microscopic outlook recently earned the University of Utah bioengineering major and former Taylorsville High valedictorian national recognition in a nanotechnology competition hosted by the University of Notre Dame. He wasn't simply honored. He took first place.



Robinson's winning idea? Create gold nano cages containing chemotherapy. Those cages, when zapped with a laser, could release cancer-fighting drugs directly into a tumor. "I wanted to work on a particle that would allow us to incorporate a drug," said Robinson. "I started doing research ... and came across Younan Xai's recent work. He came up with a method to synthesize cages."

The word "small" is an understatement when describing Robinson's cages. One would need to take a human hair and divide it by 1,000 to get an accurate measuring stick for the size of his award-winning creation. Robinson began working on creating cages in early summer and managed to advance

Xai's work on speeding up the synthesizing process. The technology would work like this: The cages would be coated with a heat-sensitive polymer. Consequently, the cages would shrink with heat, releasing the chemotherapy.

Hamid Ghandehari, co-founder and co-director of the Nano Institute of Utah, said Robinson has always been among the "higher echelon" of undergraduates since the student entered his lab three years ago. Before Robinson had even entered the U's undergraduate program, Ghandehari recalled, he stopped by the institute and expressed interest in nanotechnology. "That's remarkable for a person who is 18 years old," said Ghandehari, who served as Robinson's adviser on the project.

This year, he traveled to Notre Dame as one of nine finalists in the inaugural competition. The judging, Robinson explained, was based more on the finalists' knowledge and understanding of their subject, rather than on how much progress had been made in the field.

"Ryan's project was distinctive for its clear scientific approach and its practical potential for cancer treatment," said Alan Seabaugh, director of the Midwest Institute for Nanoelectronics Discovery and organizer of the event.

Robinson's creation remains in the early stages of development. According to Ghandehari, it typically takes 16 to 17 years for a drug-delivery method to reach patients.

Robinson's plans include graduate school and, ideally, creating nanotechnology companies around the nation. "My eventual plan is to be able to start up nanotech companies, help them grow and then move on to something else," he said. "It will probably be focused in medical-based nanotechnology, but it doesn't have to be."