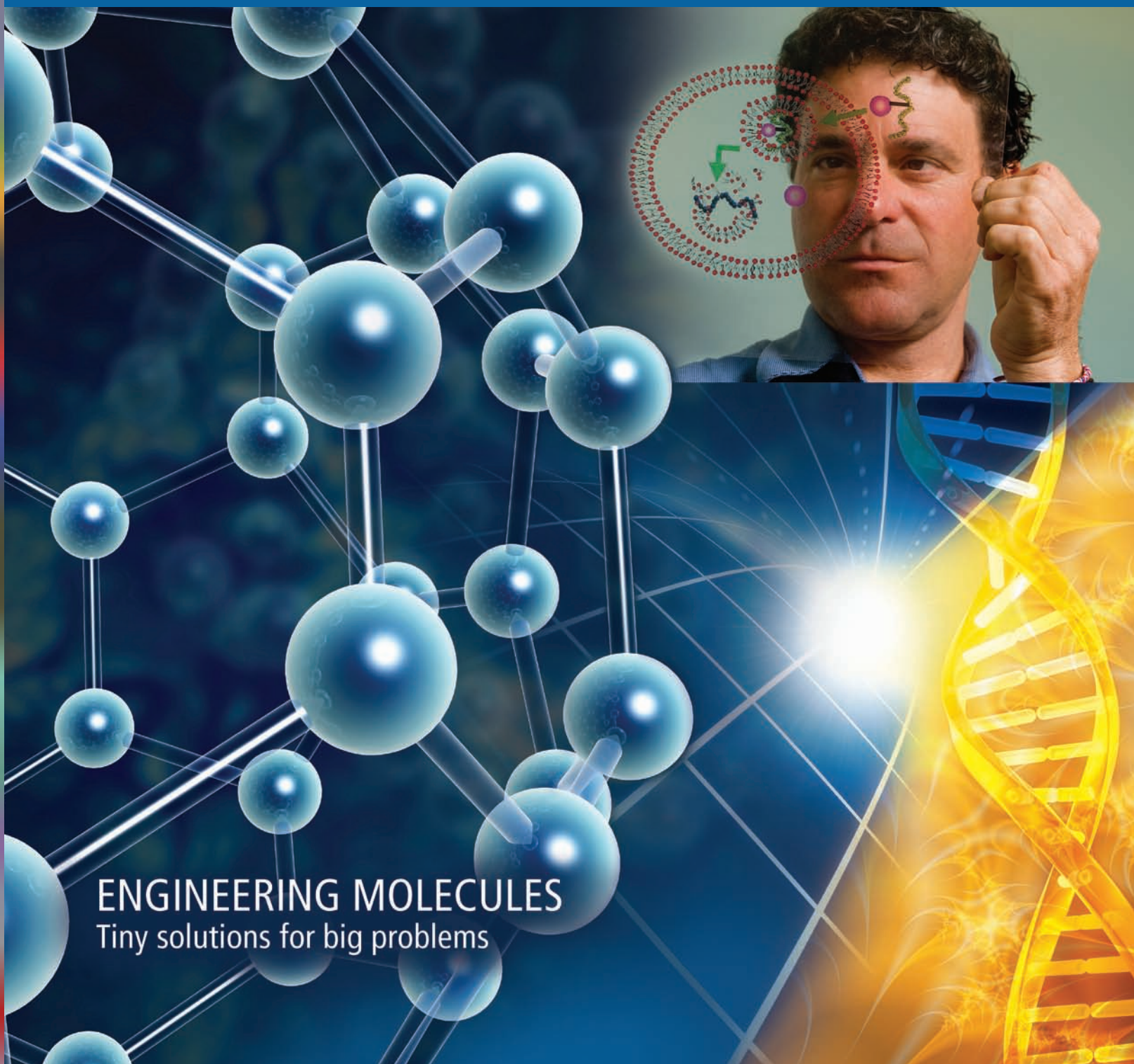
UNIVERSITY OF WASHINGTON
COLLEGE of ENGINEERING
A Community of Innovators

the Trend in engineering

Spring 2009: Volume 59, Issue 1



ENGINEERING MOLECULES

Tiny solutions for big problems

A Bright Spot in the Economic Gloom

We all can use more good news these days, so I'm eager to report some from the college. During the first six months of the current fiscal year that began July 1, our federal research awards increased by a whopping 25 percent. By June we will clearly exceed $100 million, our largest total in history. These are standard government awards from agencies such as NSF and NIH, and do not even include the funds that will be available in the federal stimulus package.

The exceptional new faculty members we have brought in over the past few years are beginning to win prestigious awards, an encouraging sign for the future. On page 7 you can read about four who have won NSF early career awards.

More good news will arrive with the economic stimulus grants. The college is in excellent shape to take advantage of this new money. Federal agencies are starting to fund grants that scored well in scientific review but could not be funded in the last round.

Several faculty members are involved in new federal grant applications for instrumentation. If we get our fair share, it could be four times the usual level of support. The submission deadline was tight, but the faculty hustled, again demonstrating their entrepreneurial energy.

Impact of State Fiscal Crisis

The new federal government money is cause to cheer, but it will not alleviate the state fiscal crisis, particularly its effect on undergraduate education. We had increased engineering enrollment, expecting to hire more state-funded faculty, but under current budget limitations we will be hard-pressed to keep up with teaching demands. Thus, enrollment will likely remain flat or drop.

We may need to limit introductory engineering classes to declared majors and cancel classes with small enrollments. The quality of instruction will remain high, but students will have less flexibility in scheduling classes and may need extra quarters to complete their degrees.

State funding cuts also mean eliminating many teaching assistant (TA) positions for graduate students. TAs assist faculty with large classes by conducting lab sections, grading exams, and performing other duties. Faculty will step up to cover the gaps, but again, the big problem is reduced flexibility.

We cannot always guarantee that graduate students will have four years of financial support as research assistants (RAs) on federally funded research studies. We often use state-funded TA positions to fill gaps in graduate student RA support. With fewer TA slots, we will not be able to make multi-year funding offers to all deserving students. It is a double whammy because the University's endowment also has taken a significant hit, which likely means fewer or smaller fellowships available to recruit and support top students.

The many new scholarship and fellowship endowments created during Campaign UW are balancing some of the gloom about student support. Our situation would be far worse without that money, and we cannot thank our alumni and friends often enough. Private support to attract and retain the best students has never been more important.

We will survive, but maintaining educational quality in the short term requires reducing flexibility now and looking to the long-term for the economy and the endowment to recover.

Our new work in the emerging field of molecular engineering is the feature story in this newsletter. Molecular engineering (MolE) is an important component of our future and represents the next generation of nanotechnology.

Matthew O'Donnell
Frank and Julie Jungers Dean
of Engineering

Ostendorf Assumes College Leadership Role

Mari Ostendorf, professor of electrical engineering, became associate dean of research and graduate studies in late 2008. She will foster multidisciplinary collaborations within and outside the college, work with new faculty to develop successful research programs, and strengthen programs to recruit and mentor top graduate students.

Yager Named Chair of Bioengineering

Paul Yager, professor of bioengineering, was appointed department chair in fall 2008. A long-time faculty member, he also holds the W. Hunter and Dorothy L. Simpson Endowed Chair and had been serving as acting chair.

IE Now Industrial & Systems Engineering

The UW Board of Regents recently approved departmental status for the Industrial Engineering program. It also has a new name — Industrial & Systems Engineering. Professor Richard Storch now holds the title of chair.

TC Takes a New Name to Reflect a Rapidly Evolving Discipline

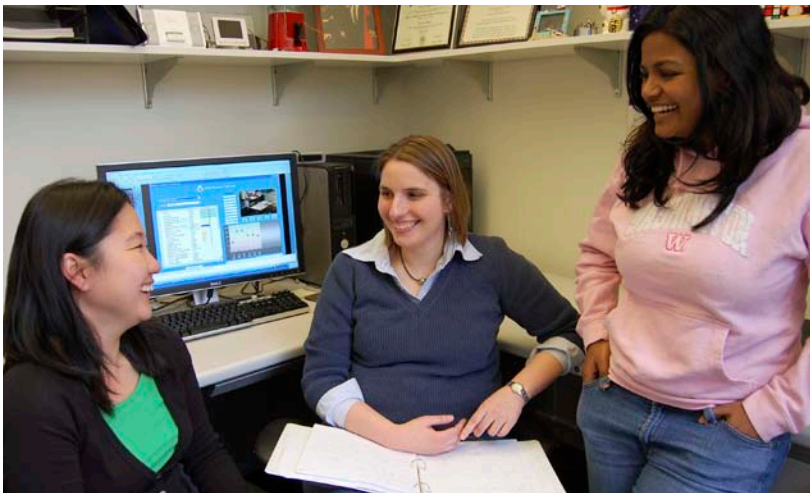
Human Centered Design & Engineering

First-year graduate students Dawn Sakaguchi and Sajanee Halko are excited about conducting research in the hot fields of human-computer interaction and user-centered design. And they are happy that their future diplomas will record their discipline as "Human Centered Design & Engineering." This is the new name for Technical Communication, a 20-year-old engineering department at the forefront of a rapidly evolving field centered on the technologies that are revolutionizing personal and business communications.

"Computing is moving off desktops and into mobile computers and handheld devices such as smart phones, and is becoming embedded in everyday technologies," said Jan Spyridakis, professor and chair of the Department of Human Centered Design & Engineering (HCDE). "The field is much broader than our original focus on writing, editing, and creating user manuals. Our graduates are designing and engineering communication solutions that work for individuals and communities in varying social and cultural environments."

Alumni are working in usability evaluation, product development, game design, and software user assistance. "People are jazzed about the new name. Now the degree title will better match our students' knowledge sets," Spyridakis said.

The new name reflects departmental research and academic programs. Research interests of new faculty span the use of computers in the developing world and of technology in doctor-patient relationships, engineering education, and human-computer interaction — the latter an important new direction for department research.



New HCDE Assistant Professor Julie Kientz (center) meets with graduate students Dawn Sakaguchi (left) and Sajanee Halko.

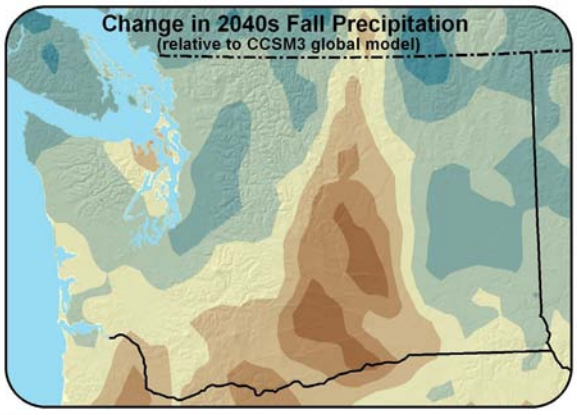
"The recent 10-year review of our program says it is one of the best, if not the best of its kind in the country," said Dean Matthew O'Donnell. "The new name reflects what our alumni, faculty, and students really do."

The curriculum is increasingly interdisciplinary and includes new courses on cognitive aspects of communication systems and on qualitative evaluation of how users behave in their own environments, which involves anthropological-style observations.

The department is collaborating on human-computer interaction with three other units across campus — the Department of Computer Science & Engineering, the Information School, and the Division of Design in the School of Art. They have jointly established an undergraduate concentration in this field.

HCDE will offer bachelors, masters, and doctoral degrees, and, through UW Educational Outreach, an evening masters degree and certificate programs in user-centered design and in technical writing and editing.

▶ **For more information, http://www.hcde.washington.edu/**



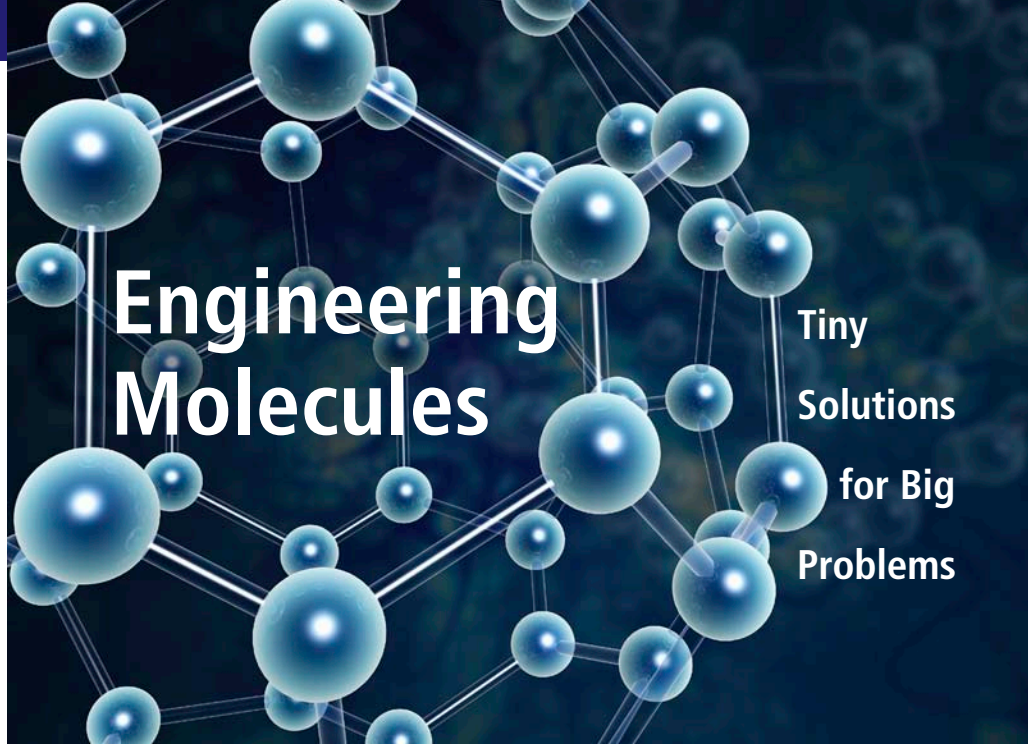
The climate model predicts an 11.7% average increase in precipitation for the state, but the areas in brown will be drier than that and the areas in green will be wetter.

Climate Change Report Paints Stark Picture

The most detailed report ever on how climate change could affect Washington paints a stark picture and provides information critical to planning for climate change over the next 50 years. The State Legislature funded the study by the UW Climate Impacts Group (CIG), led by co-principal investigators Dennis Lettenmaier, professor of civil and environmental engineering, and Edward Miles, professor of marine affairs and head of the interdisciplinary group.

The study considered the impacts of climate change on human health, agriculture, energy supply and demand, and urban storm sewers and systems. Under a medium-warming scenario, energy demand for summer cooling is expected to increase 400 percent by 2040 compared to the average demand for 1971–1999.

▶ **The report is available at: http://cses.washington.edu/cig/**



Engineering Molecules

Tiny Solutions for Big Problems

Molecular engineering is an emerging discipline that is generating excitement and questions. How will it shape UW Engineering? How will it help solve tough problems in energy, health care, and other fields?

Imagine giving doctors the tools to pinpoint the exact location of disease molecules inside your cells. Imagine curing disease by sending safe biologic agents on a direct attack against these targets.

The power to do so is coming through the work of molecular engineers. They are capitalizing on a decade of advances in nanotechnology to design new molecules and systems of molecules that may not exist in nature. With great precision, they manipulate structure and function, often one molecule at a time, an exceedingly difficult challenge. They are making breakthroughs via advanced synthesis and characterization tools such as nanolithography.

In the next ten years, complex molecular nanosystems and devices will allow scientists to penetrate ever deeper into molecular and atomic processes. UW Engineering is leading the way, particularly in medical and energy research, as described in the sidebar examples.

Molecular engineering, MolE for short, also will develop self-repairing materials for a wide range of equipment and construction uses, as well as for electronic, photonic, and optical consumer goods. The environment will benefit too. MolE solutions will help us address global warming, monitor environmental pollutants, and safeguard food, water, and other resources.

▶ MolE in Medicine

Transforming mass medicine into precise, personalized diagnostics and therapeutics

- **Earlier Diagnosis:** Molecular imaging tools will help lead to preventive techniques that also help reduce health care costs.
- **Better Treatments:** New drugs working inside cells will treat the most life-threatening diseases with fewer side effects.
- **Care for the Poorest:** Portable diagnostic tools that withstand extreme environmental conditions will enable better health care in the poorest and harshest regions of the world.

▶ MolE in Energy Delivery

Tapping renewable resources, reducing energy waste and pollution

- **Solar Power:** Advanced solar cells and systems will produce efficient, cost-effective energy for many applications.
- **Smart Materials:** Reconfigurable materials will reduce energy waste by improving energy generation, storage, and transport.
- **Biomass Fuel:** New molecular processes will turn logging wastes and algae into inexpensive, widely used renewable energy resources for land, air, and water transport.

MolE's Universe

Molecular engineering is highly interdisciplinary, tapping expertise in engineering, chemistry, biology, the medical sciences and computation/modeling. Dozens of UW faculty members, many international leaders in their fields, are helping to define what it means to be molecular engineers. Engineering faculty members have secured major federal grants and work in teams that also include experts in the basic sciences, researchers at Fred Hutchinson Cancer Research Center, and representatives from the high-tech sector.

"We envision UW Engineering, the University, and the Puget Sound region leading molecular engineering," Dean Matt O'Donnell said. "The UW ranks second among all universities in federal research funding, and the Puget Sound region

is a magnet for biotech and high-tech innovation."

A new UW molecular engineering building will further the work. The $120-million, 160,000-square-foot facility, to be constructed in two phases, features large laboratories, faculty offices, conference rooms, and space for graduate students.

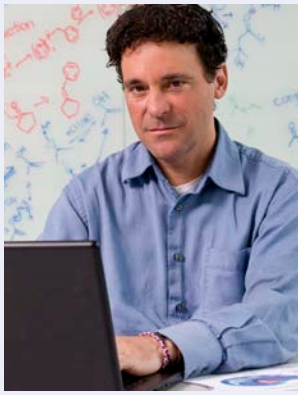
The 2009–2011 biennium budget Governor Gregoire presented to the legislature proposes $57.5 million for the building. Other funding for Phase 1 includes $16 million from bonds and $9 million to be raised in the private sector.

"The MolE building is a job creator, so it fits well with economic stimulus goals," O'Donnell said. "Innovations that emerge from its laboratories will provide an economic boost for the region via spin-off technologies and startup companies. If the funding comes through, we plan to break ground in late summer."

"We want the UW to be at the forefront of MolE innovation, attracting both the best students and the best faculty," O'Donnell said. ■

Health Challenge

Deliver Sharpshooter Drugs into Cells

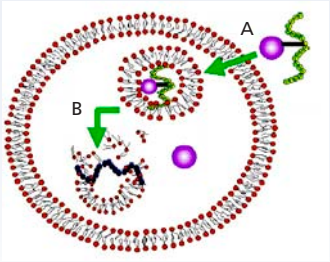


Professor Pat Stayton.

Bioengineering Professor Pat Stayton and his team want to treat disease at its most fundamental level. They devise ways to transport therapeutic proteins into cells while avoiding toxic side-effects caused by many small-molecule drugs.

"Fewer new small-molecule drugs are entering the pharmaceutical pipeline, and the industry is eager to develop safer macromolecule biologics to treat cancer and inflammatory diseases," Stayton said. "It is one of the hottest areas in biotechnology."

His research team, working with fellow Bioengineering Professor Alan Hoffman, is developing drug delivery systems — innocuous synthetic polymers that will mimic the ways pathogens cross cell membranes. Once inside, this "smart" delivery tube would head to a precise target and release a biologic drug, such as a gene-silencing RNA, to knock out disease.

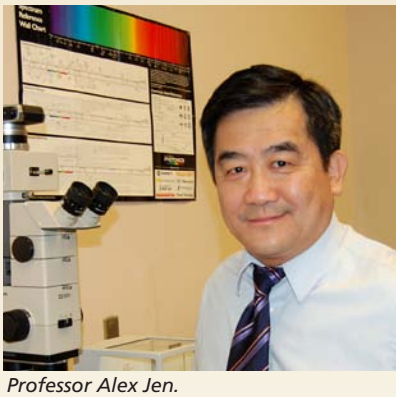


Stayton recently received a four-year, $7.2-million grant from the Washington Life Sciences Fund to create the Center for the Intracellular Delivery of Biologics. UW engineers, pharmaceutical scientists, and clinical researchers will team up to develop these intracellular sharpshooters. Stayton and Hoffman also recently formed a company, PhaseRX, to develop RNA-based drugs.

Above: A biotherapeutic "smart" carrier (A) transports a drug into the cell and releases it when it reaches (B), the disease-bearing target endosome.

Energy Challenge

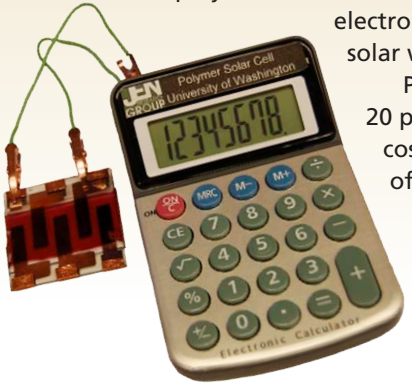
Design Efficient and Cheap Organic Solar Cells



Professor Alex Jen.

Imagine turning an entire outside wall of your home into a solar collector or powering your cell phone with light-enhanced batteries. Materials Science & Engineering Professor Alex Jen and his team are developing technologies that help meet energy needs with less environmental impact.

Conventional solar panels made of silicon are expensive, and the energy generated costs five to six times more per watt than fossil fuels. Jen's team aims to lower costs by combining organic and inorganic nanostructures into photovoltaic devices. These thin polymer solar cells can be incorporated into flexible plastic films for walls or electronic devices. Semi-transparent versions could be used for solar windows.



Polymer solar cells have reached energy conversion levels of 6 percent, still below the 20 percent efficiency of silicon-based cells. Once efficiency reaches 10 percent, they will be cost-effective for large-scale manufacturing. "The possibilities are exciting. We want to offer low-cost solar cells to every home," Jen said.

The U.S. Departments of Energy and Defense have invested $2 million in this research. Also, UW Tech Transfer is helping Jen launch Soluxra, a startup company.

Left: A prototype polymer solar cell powers a calculator in the Jen lab.

Doors Opened Magically for the Varanasis, Now They Open Them for Grad Students

Usha and Rao Varanasi received their doctorates in 1968 and happily made Seattle their home.

A great engineering program, fellowship support, and a warm climate with palm trees drew S. Rao Varanasi to California Institute of Technology in 1960. He had just earned his BSME from Andhra University and wasn't ready to settle into a career in India.

The following year, Usha Shah left the University of Mumbai with BS degrees in chemistry and physics, planning to do her graduate work in significantly colder environs at Michigan State University. Fate intervened in the form of a family friend who convinced her to accept Caltech's offer of admission and a fellowship in the chemistry program.

When Rao heard about Usha, one of seven women grad students admitted that fall and the first from India, he showed up at registration, offering to guide her through the process. Math study sessions soon followed, the first steps in a life partnership infused with their zeal for science and with educational and career opportunities that seemed to open by magic, though exceptional talent and hard work clearly had a catalyzing effect.

Rao traded sun and palm trees for rain and pines when he entered the UW's PhD program in aeronautics in 1962, encouraged by former department chair John Bollard. Usha headed north a year later for a doctoral program in organic chemistry. By 1965, they were ready to marry and Rao was close to finishing his PhD, but he felt marriage mandated landing a job, so he deferred his degree until he and Usha could graduate together.

"I called Boeing about an opening, was told to come for lunch, and they hired me that day," Rao recalled. After 13 years researching computational and fracture mechanics, he moved to the application side to work on wing design and analysis for the 757. Next, he managed structural technology for military craft such as AWACs. Now he is chief engineer, In-Service Structures and Aging Fleet, for commercial airplanes and a technical liaison with the FAA and European regulatory agencies.

The 1969 economic downturn led Usha to an unconventional postdoctoral position analyzing the composition of oil in marine mammals. "I didn't even know what a porpoise was," Usha recalled, "but this open door led to my life's calling to unite chemistry and molecular biology in efforts to protect marine mammals and fisheries." Her big break came when NOAA hired her in 1975. She rose in the ranks to become the first woman to direct science and research at the Northwest Fisheries Science Center. She represents NOAA for the West Coast Governors' Agreement on Ocean Health and on the science panel for the Puget Sound Partnership, and is a UW adjunct professor in Chemistry and Fisheries.

The Varanasis are passionate about education as the path to a fulfilling life and about encouraging students to study the physical sciences, engineering, and math as a solid base for a successful career.

"We love the UW and this country and are so grateful for the training and support we received and the opportunities that opened," Rao said.

That's why they created two endowed fellowships for graduate students, in Aeronautics & Astronautics and in Chemistry. "The gift of education is better than the gift of money," Usha emphasized.

"With the Varanasi Fellowship we can attract exceptional graduate students, which strengthens our research and educational programs," said AA chair Adam Bruckner. "We deeply appreciate their generosity, particularly at this challenging fiscal time."

Wherever you are ... Link to UW Engineering's Web

We are expanding digital connections for alumni and friends. Get news faster, keep up with classmates, save trees too!

Email Please provide or update your email address at: **www.engr.washington.edu/signup**

As a thank you, 10 respondents will be randomly selected to receive $50 Amazon.com gift certificates and one will be offered the opportunity for a breakfast meeting with Dean O'Donnell. (We will not share your address outside the UW community.)

Trend Newsletter & e-Trend What interests you and how do you prefer to receive college news? Take a brief survey at: **https://catalysttools.washington.edu/webq/survey/sandymar/74007**

Facebook Become a fan, find friends, and stay on top of what's going on across the college. To link directly to our new Facebook page, visit: **www.engr.washington.edu**.

Engineering's Highest Honor

Kudos to Newest National Academy of Engineering Fellows

Matthew O'Donnell, dean and professor of bioengineering, was elected to NAE for his contributions to biomedical ultrasonics and real-time ultrasound imaging technologies. His research ranges over ultrafast optics, in-vivo microscopy, catheter imaging of coronary arteries, optoacoustic arrays, and elasticity and molecular imaging. O'Donnell holds some 55 patents and is associate editor of *Ultrasonic Imaging*.

The academy cited **David Auth**, affiliate professor of bioengineering, for inventing minimally invasive devices to treat gastrointestinal bleeding and coronary artery obstructions. Auth was a professor of electrical engineering from 1969 to 1982. He developed the Rotablator, a tool that removes calcified plaque from coronary arteries, and then founded and until 1995 led Heart Technology Inc. Auth holds some 100 patents in the medical-device field.

NAE recognized alumnus **Jeffrey Dean** (CSE PhD, '96) for contributions to the science and engineering of large-scale distributed computer systems. He now works at Google Inc. in Mountain View, Calif. The college honored him with the 2006 Diamond Award for early career achievement.

Gupta

Ceze

Kohno

Fazel

Winners: National Science Foundation Early CAREER Awards

Maya Gupta, assistant professor of electrical engineering and adjunct in applied mathematics, was among 67 scientists honored in December 2008 at a White House ceremony for winners of the 2007 Presidential Early Career Award for Scientists and Engineers. The NSF awarded her $1 million to develop theory and algorithms for estimation and statistical learning.

Luis Ceze, assistant professor of computer science and engineering, has won a five-year $450,000 NSF early career award for research that will make it much easier to program multicore processors. His work will improve software reliability and lead to energy savings in computer systems.

Tadayoshi Kohno, assistant professor of computer science and engineering, has won a five-year $450,000 NSF early career award for his work to develop the framework and applications to enhance the security and privacy of records such as email (home or business) and electronic voting audit logs.

Maryam Fazel, assistant professor of electrical engineering, has won a five-year $400,000 NSF early career award to develop mathematical tools and algorithms that apply convex optimization methods to find low-complexity models that explain observed data in a variety of engineering applications.

▶ **For more news: www.engr.washington.edu/ Click on "News" or visit department pages.**

Buddy Ratner Wins Gold

Buddy Ratner, professor of bioengineering and chemical engineering, will receive the 2009 Acta Biomaterialia Gold Medal. It honors "an undisputed world leader in the field of biomaterials, whose accomplishments ... are surpassing and known to all in the field."

Three Awards for Richard Ladner

Richard Ladner, professor of computer science and engineering, is drawing recognition for his efforts to improve electronic communications for the blind and hard of hearing. He has won an award from the Andrew W. Mellon Foundation, a Purpose Prize from Civic Ventures, and the 2009 UW Outstanding Public Service Award.

UW Honoring Wayne Quinton

In June, the UW is bestowing the 2009 *Alumnus Summa Laude Dignatus* award on bioengineering pioneer **Wayne Quinton** (BSME, '58). In May, UW Engineering is recognizing him with a Diamond Award (page 8).

CSE Student in the Stratosphere in Putnam Math Competition

Will Johnson, a computer science and engineering junior, bested more than 3,600 students from 545 colleges and universities to place sixth in the 69th annual William Lowell Putnam Mathematical Competition. Students must solve 12 difficult problems in six hours during the online test of math wits. The top five scorers were from Harvard, MIT, Stanford, and Caltech.

***HydroSense**, a team of UW engineering students, beat 15 teams from around the state to win the inaugural UW Environmental Innovation Challenge. They developed a practical solution to track water usage in the home. For details, visit http://news.cs.washington.edu/?s=HydroSense/.*

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Tom Gibbs


Ray Clough


Wayne Quinton


Max Gellert


Matt Shobe

DIAMOND AWARDS 2009

Fourth Annual Diamond Awards Dinner

Friday, May 8, 6–9 pm
Don James Center

Please join Dean Matt O'Donnell, college faculty, and community friends as we honor these exceptional engineers. For details, contact Nancy Anderson, na3@u.washington.edu or 206-685-2422.

The College of Engineering is honoring five eminent engineers for their outstanding professional and community achievements.

Charles V. "Tom" Gibbs '54 BS,'56 MS CEE ***Distinguished Achievement in Industry***
Gibbs led Seattle Metro's cleanup of Lake Washington and Puget Sound and has an outstanding record of local and national environmental stewardship.

Ray Clough '42 BS CEE ***Distinguished Achievement in Academia***
A professor emeritus at UC–Berkeley, Clough is renowned as a "legend in earthquake engineering" and the creator of finite element analysis.

Wayne Quinton '58 BS ME ***Entrepreneurial Excellence***
Recognized as the first "bioengineer," Quinton developed life-saving medical devices both as a UW staff member and as founder of Quinton Instruments.

Max Gellert ***Distinguished Service***
An electrical engineer and former CEO in the aerospace industry, Gellert is a staunch advocate for advancing engineering education at UW and nationally.

Matt Shobe '96 MS TC ***Early Career***
Shobe has co-founded three startups, including FeedBurner, which was acquired by Google, where he is a senior user experience designer.