

Case School of Engineering  
2010 Annual Report

# Envisioneering



CASE SCHOOL  
OF ENGINEERING

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CASE WESTERN RESERVE  
UNIVERSITY

Encompass

Enlighten

Enhance

Endure

Enliven

Energize

Encourage

Envision

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engineering

# Envisioneering

How do you enhance Mother Nature's work with custom-made materials based on her designs?

Can you energize new industry by building a better capacitor?

How can a bridge safely endure not just the test of time, but a surge of rushing waters?

At the Case School of Engineering, we do more than simply innovate. We ask big questions to envision a better world. The researchers featured in these pages understand that vision often starts small—with underlying mathematical codes, thin lines between positive and negative and single strings of atoms—and grows into new realities.

A better world starts with a better vision. You need to see what others don't. Whether on the subatomic level or at the waterline, researchers at the Case School of Engineering get the big picture by understanding the underlying agents of change.



**Norman C. Tien, PhD**

Dean and Nord Professor of Engineering  
Ohio Eminent Scholar, Physics

In the pages ahead, you'll experience the faculty's unique point of view on how their ideas interact with the everyday. From fire blankets and platelets that protect our loved ones to smarter power grids that light our cities, the products of their work not only enhance, encourage and enlighten our daily lives, but they encourage, enliven and energize our future.

At Case Western Reserve University, we do more than engineer. We envision.

We do so with the help of alumni and friends like you. I deeply appreciate your ongoing commitment to the school and its vision of the future. On behalf of our 2,500 faculty, staff and students, thank you for your support in making this another successful year at the Case School of Engineering.

Sincerely,

A handwritten signature in black ink, reading "Norman C. Tien".

# Encompass

## Threads envelop a house in a blanket of protection

Each summer in the western states, wildfires burn through neighborhoods built in the perilous border between forests and towns. In 2003 and 2004, it was estimated that the cost of fighting fires to protect these homes was upward of \$547 million.

Fumiaki Takahashi, along with fellow professor of mechanical and aerospace engineering James S. T'ien and other Case Western Reserve researchers, has teamed up with NASA scientists to find a way to limit fire's devastating effects—and save money.

The team is on a quest for a fire-resistant material with the right design, thickness and weight to cover a house in the event of a wildfire.

They have tested more than 40 strategically designed composites and materials—including woven fiberglass, amorphous silica, pre-oxidized carbon and aramid-based fiber, which is used in firefighters' protective uniforms. Aluminized materials perform best, Takahashi says, but concerns remain about weight: One such material was only 1 millimeter thick, but a 1,000-square-foot blanket made of it weighed more than 150 pounds, making it too cumbersome a cover. The team is also designing mechanisms that can spread the blanket over a house.

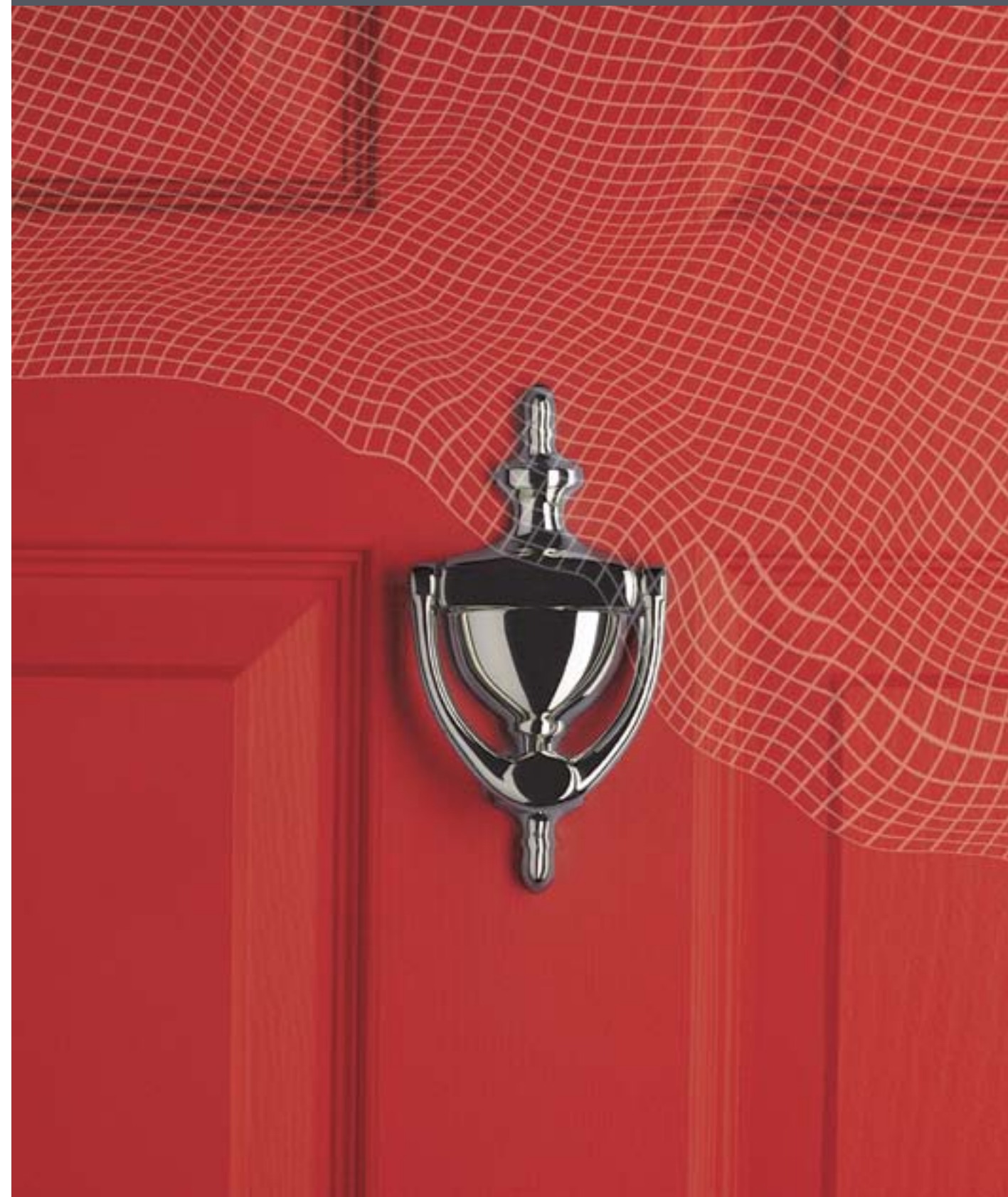
"By finding an appropriate material that can save a house, we can protect homeowners and firefighters, too," Takahashi says.

"Fire blankets would be more effective and environmentally friendly than traditional measures, such as dropping fire retardants from airplanes or helicopters. It could save lives, property and money."



**Fumiaki Takahashi, PhD**

Research Professor  
Mechanical and Aerospace  
Engineering







# Enlighten

## Computational models usher in a brighter future

Adapting America's power grid to accept and manage renewable energy sources has proven a challenge. Disturbances like changing weather conditions and variations in demand can cause serious fluctuations in the grid's voltage.

These changes force renewable energy technologies, like wind turbines and solar panels, to disconnect from the grid. Their exit further exacerbates the instability, potentially leading to large-scale power outages.

Working with Draper Laboratories and other partners through the Alliance for Smart Energy Innovation, Kenneth A. Loparo is devising new methods to stabilize this power struggle. His team's technologies manage renewable energy sources to more effectively integrate them into a regional or national grid and improve sensing, communications and control. This work allows the grid to sense swings in power and manage the system's response.

The researchers devised mathematical and computational models of renewable energy generation and storage to better understand power fluctuations and their effects. Using simulations and real-world systems, the team is gathering data that will allow it to manage voltage swings and stabilize the grid.

"As we start adding more renewable energy sources to the grid, it becomes more and more important that we manage the power from all generating sources to maintain the balance between supply and demand," Loparo says. "Wind and solar power are the energy sources of the future, and effectively integrating them into our power grid will allow us to have a brighter, more sustainable future."



**Kenneth A. Loparo, PhD**

Nord Professor of Engineering  
Electrical Engineering and  
Computer Science



# Enhance

## Nature's secrets fortify tailor-made materials

Nature is full of fascinating phenomena. Take the spiderweb, for example. It has been suggested that a strand of web as thick as a pencil could stop a Boeing 747 mid-flight. Or consider that the tip of a squid's beak is harder than most metals, or that mother of pearl is 3,000 times tougher than limestone.

So different on the surface, these heavy-duty marvels are surprisingly similar deep down, the result of varying levels of organization of amino acids—the ingredients that make up proteins—and other inorganic components.

Inspired by the world around her, LaShanda Korley draws on strategies found in nature to build synthetic materials that reflect naturally occurring properties.

By changing the way the amino acid building blocks are configured and processed, she is tailoring new materials for their mechanical properties. Using this method, she is looking to create scratch-resistant coatings for paint technology, scaffolding for tissue engineering and wall panels for absorbing the impact of an explosion.

Rather than simply parroting these natural wonders, Korley's bio-inspired materials take cues from a variety of naturally occurring materials, mixing and matching their characteristics to create completely unique synthetics.

"I want to understand what nature's strategies are and utilize its toughening mechanisms," she says. "Nature has had forever to figure these things out, and we have a lot to learn from it."



**LaShanda Korley, PhD**

Nord Distinguished Assistant Professor  
Macromolecular Science and Engineering







## Endure

### Sensors monitor integrity with each passing wave

Floods cut down more bridges every year than any other natural or man-made disaster. The influx of water scours away river bottoms—which provide the footing for the structures—causing collapses that cost lives and hundreds of millions of dollars in damage.

River bottoms are made up of sand, clay, shale, sandstone or a mix of materials that, over time, are eroded by passing waters. Because each of these materials acts differently when it gets caught up in a current, it has been difficult to measure the damaging effects of soil erosion on underwater structures until it's too late.

Enter Xiong “Bill” Yu, whose team is developing underwater sensors that relay real-time information about how much river bottom has been stripped away and how stable, or unstable, a bridge remains.



**Xiong “Bill” Yu, PhD**

Assistant Professor  
Civil Engineering

The sensors capture sediment erosion by constantly measuring where the water meets the river bottom around bridge supports. The sensors emit guided radar waves, which return at different speeds depending on the materials they encounter and the distances they travel. The radar is then analyzed to reveal changes in the depth and density of the substrate sediments.

“The individual particles carried away by each passing flood current eventually add up,” Yu says. “Being able to monitor the development of bridge scour that leads to monumental disasters will allow us to effectively mitigate the risk of bridge failure and save the lives of the people who depend on them.”



# Enliven

## Synthetic elements speed the natural healing process

Platelets are the structural and chemical foundation of blood clotting, a complex cascade of events that allows the body to heal naturally. Unfortunately, this process can be overwhelmed by serious injury.

Donor platelets can enhance clotting but can cause serious complications. Because natural platelets must be refrigerated and have a short shelf life, the options to halt internal bleeding on the battlefield are limited. Erin Lavik and her former doctoral student, James P. Bertram, have found a way to save soldiers and victims of other traumatic injuries by boosting their natural healing.

The team designed synthetic platelets from biodegradable polymers that join forces with natural platelets at the wound site. Activated by injury, the natural platelets emit chemicals that bind them to the synthetics, forming a larger clot that stems the bleeding quickly.

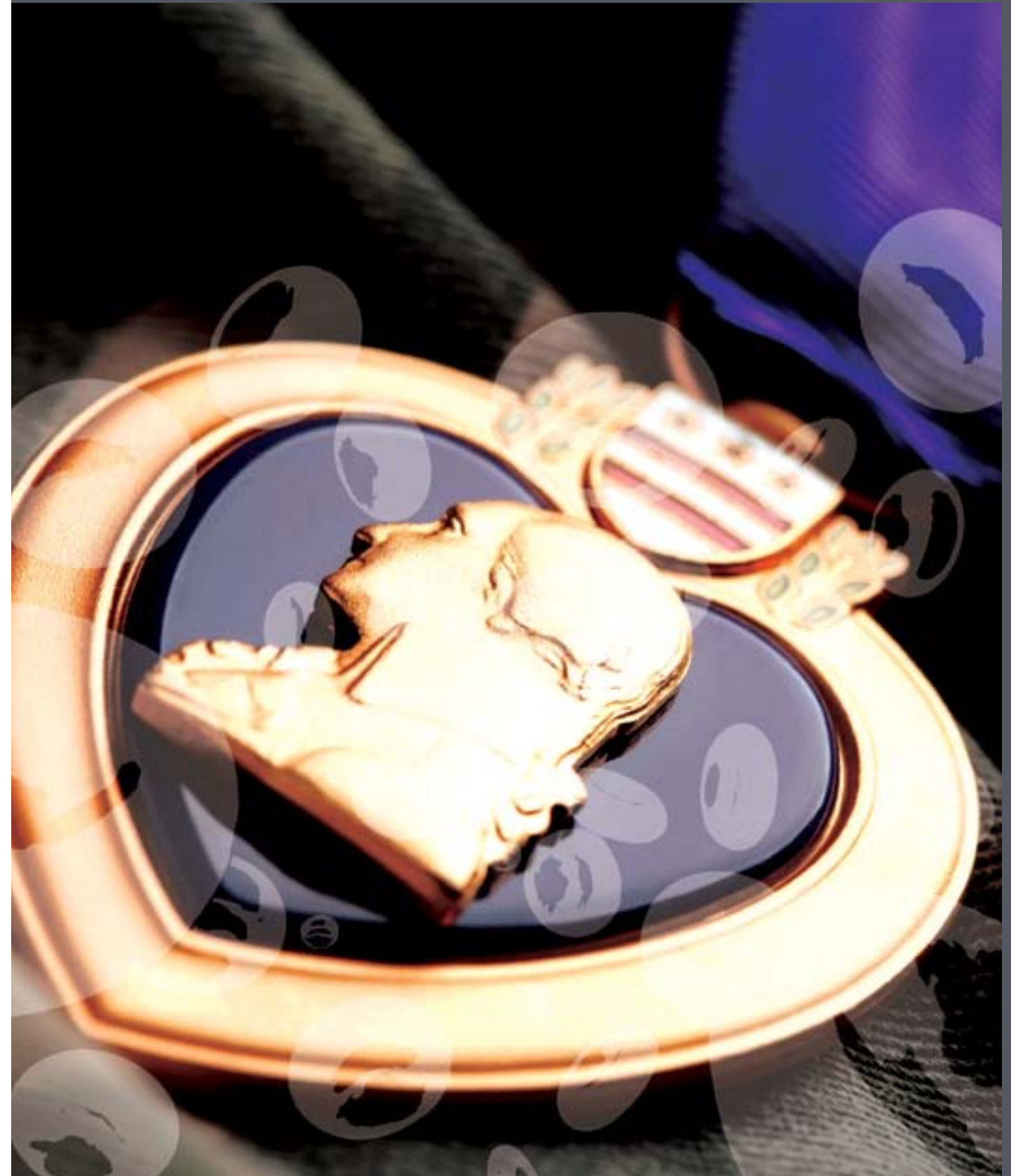
Studies published in the December issue of *Science Translational Medicine* show that victims injected with the artificial platelets 20 seconds after injury stop bleeding 23 percent faster than those left untreated. And Lavik's platelets remain viable after sitting a shelf for more than two weeks.

"Early intervention increases the chances of survival, and we hope that synthetic platelets can contribute to treatment in the field," says Lavik, one of the newest additions to the school, "but there's a lot of work to be done before that's possible."



**Erin Lavik, ScD**

Elmer Lincoln Lindseth  
Associate Professor  
Biomedical Engineering







# Energize

## Impermeable film delivers an efficient power surge



**Gerhard Welsch, PhD**

Professor  
Materials Science and Engineering

Hybrid electric cars may not be as efficient as you'd think. They draw power from a battery and gasoline engine and rely on a capacitor to provide an energy boost to accelerate and to absorb power when they brake.

Gerhard Welsch could change this with his plans for powerful, small and highly efficient capacitors that could reduce the need for large batteries—saving space and fuel-gobbling weight.

The advancement lies in an improved dielectric—the thin barrier that separates the capacitor's positive and negative charges—that could increase energy storage over ceramic capacitors by as much as 1,000 times. Welsch says the trick is to make the dielectric film as homogenous and impermeable as possible. By using titanium oxide glass instead of a crystalline form, Welsch has reduced the size and number of flaws in the layer that forms the dielectric.

If tiny imperfections do occur, however, Welsch's capacitors are able to heal themselves by drawing ions from the anode's titanium and the cathode's electrolyte, forming a new oxide in the defect, effectively sealing the gap and allowing the capacitor to continue working at high efficiency.

With a \$2.2 million grant from the U.S. Department of Energy's Advanced Research Projects Agency—Energy, Welsch hopes to identify partners in industry and have the capacitor, which he began work on a decade ago, on the market within the next three years.

"The capacitor will deliver energy faster and more reliably at a fraction of the size and weight," he says. "It could become a reliable power source for a range of uses, including in electric cars, electronic devices, computers, cell phones and medical devices, like implantable defibrillators."



# Encourage

## Tiny conductors straighten up with the right stimulus

Stronger than the strongest steel and 10,000 times thinner than a human hair, carbon nanotubes have the potential to conduct electricity 1,000 times better than copper.

Made of a lattice of carbon just a single atom deep, nanotubes also hold promise to deliver medicine directly to a tumor, replace costly platinum in fuel cells and make transistors much faster.

Building the conductors, however, has proven a challenge because, with nanotubes, form is function.

Carbon nanotubes are essentially single sheets of graphite rolled up into a tube. Depending on the diameter of the tube and the direction in which the sheet is rolled, nanotubes could act like a metal—where current easily passes through—or like a semiconductor—where the current can be switched on and off. When nanotubes are grown, one-third of them are usually metallic, with the remaining two-thirds semiconducting. The cause of the inconsistency was unknown.

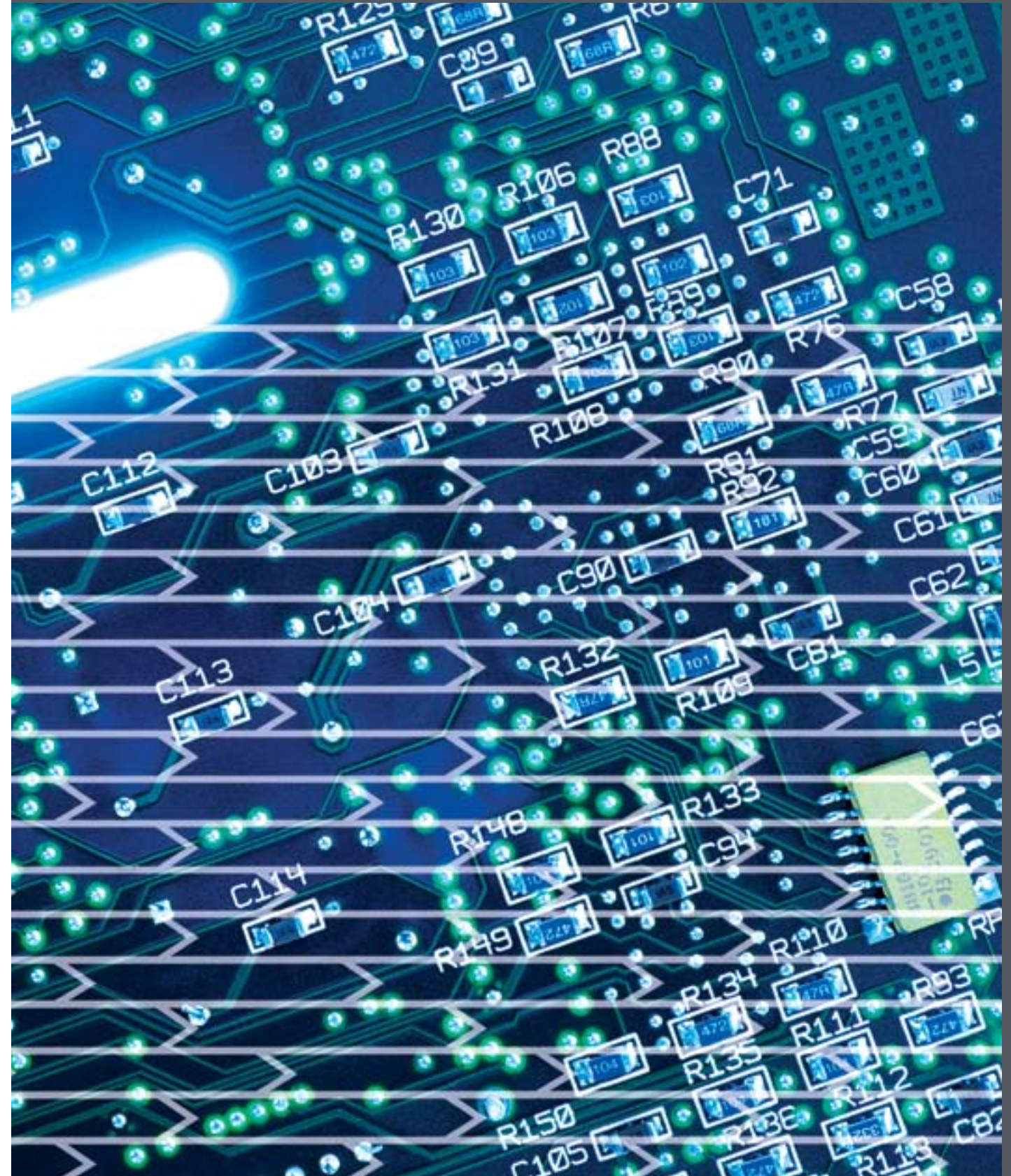


**R. Mohan Sankaran, PhD**

Associate Professor  
Chemical Engineering

R. Mohan Sankaran and his team, however, recently found a way to yield a more desirable result. Using a catalyst made of a mixture of nickel and iron—as opposed to nickel alone, which has commonly been used—the researchers were able to produce semiconducting nanotubes 91 percent of the time. Their research was published in *Nature Materials* in October.

“This finding has opened the door to experimenting with other elements and combinations as catalysts,” Sankaran says. “Ultimately, these tests will allow us to capitalize on nanotubes’ seemingly endless possibilities.”





## Faculty Honors

### Durand Named IEEE Fellow

The world's largest professional association dedicated to the advancement of technology—the Institute of Electrical and Electronics Engineers—elevated Dominique M. Durand, PhD, to IEEE Fellow, the organization's highest grade of membership.

### Faculty Earn \$2.9 Million in NSF CAREER Awards

The National Science Foundation honored six junior faculty members with CAREER Awards this year. The recipients are LaShanda Korley, PhD; Mehmet Koyuturk, PhD; Pedram Mohseni, PhD; Horst von Recum, PhD; Xiong "Bill" Yu, PhD; and Xinmiao Zhang, PhD.

### Rimnac and Manas-Zloczower Lead National Organizations

Case Western Reserve faculty members are heading two of the largest engineering research societies: Clare Rimnac, PhD, is president of the Orthopaedic Research Society, and Ica Manas-Zloczower, PhD, is president-elect of the Polymer Processing Society.

### Heuer Recognized as MRS Fellow

Distinguished University Professor and Kyocera Professor of Ceramics, Arthur Heuer, PhD, was selected as a 2010 Materials Research Society Fellow in recognition of his sustained and distinguished contributions to the field.

### Sankaran Wins National Teaching Award

R. Mohan Sankaran, PhD, is one of just 14 scholars nationwide to be awarded a Camille Dreyfus Teacher-Scholar Award, which supports the research and teaching of young faculty in the chemical sciences.

### Knothe Tate Lauded as AIMBE Fellow

Melissa Knothe Tate, PhD, was named a fellow of the American Institute for Medical and Biological Engineering—a distinction held by the top 2 percent of the medical and biological engineering community.

## Student Highlights



David Ramsay, a double major in electrical engineering and music with a minor in biomedical engineering, will travel to Dublin, Ireland, as a **Fulbright scholar**, where he plans to build an interface that will allow a disabled person to play a musical synthesizer.



Caitlin Powell, a biomedical engineering student, was awarded a **Goldwater Scholarship**. She intends to earn a PhD in biomedical engineering and to research and develop new drug delivery and tissue engineering therapies for cancer.



Chad R. Fusco, who recently earned a BS/MS in civil engineering with a minor in theater, was named one of four 2009 **Tau Beta Pi Laureates** in the honor society's annual recognition of gifted engineering students who have excelled in areas beyond their technical majors.



For the second year in a row, Case School of Engineering students earned first prize in the annual Institute on Navigation's **Autonomous Robotic Lawn Mower Competition**. The team topped the field of 14 competitors from Canada, California, Florida, Alabama and Ohio.

# Administration and Faculty

The Case School of Engineering has been renowned for excellence in teaching and research for 130 years. Upholding this tradition are more than 100 dedicated faculty members who pride themselves on their unique student-teacher research collaborations, which are often formed as early as the freshman year. To follow is a list of the administrators and faculty who foster these relationships.

## Administration

### Case Western Reserve University

Barbara R. Snyder  
President

William “Bud” Baeslack III  
Provost and Executive Vice President  
Professor of Materials Science  
and Engineering

### Case School of Engineering

Norman C. Tien  
Dean and Nord Professor of Engineering  
Ohio Eminent Scholar, Physics

Patrick E. Crago  
Associate Dean  
Professor of Biomedical Engineering  
Ica Manas-Zloczower

Associate Dean of Faculty Development  
Professor of Macromolecular Science  
and Engineering

Clare M. Rimnac  
Associate Dean  
Wilbert J. Austin Professor of Engineering

Lisa Camp  
Assistant Dean for Special Initiatives

Deborah J. Fatica  
Assistant Dean  
of Engineering Student Programs

## Faculty

### Biomedical Engineering



Jeffrey L. Duerk  
Chair and Allen H. and Constance T. Ford Professor in Biomedical Engineering



Eben Alsberg  
Assistant Professor



James Basilion  
Associate Professor\*



Jeffrey R. Capadona  
Assistant Professor



Patrick E. Crago  
Associate Dean and Professor



Dominique Durand  
Elmer Lincoln Lindseth Professor of Biomedical Engineering



Steven J. Eppell  
Associate Professor



Miklos Gratzl  
Associate Professor



Kenneth J. Gustafson  
Associate Professor



Efsthios “Stathis” Karathanasis  
Assistant Professor\*



Robert F. Kirsch  
Professor



Melissa Knothe Tate  
Professor



Erin B. Lavik  
Elmer Lincoln Lindseth Associate Professor of Biomedical Engineering



Zheng-Rong Lu  
M. Frank and Margaret Domiter Rudy Professor



Roger E. Marchant  
Professor



P. Hunter Peckham  
Distinguished University Professor and Donnell Institute Professor of Engineering



Andrew M. Rollins  
Associate Professor



Gerald M. Saidel  
Professor



Anirban Sen Gupta  
Assistant Professor





Nicole Steinmetz  
Assistant Professor\*



Dustin J. Tyler  
Associate Professor



Horst von Recum  
Assistant Professor



David L. Wilson  
Robert J. Herbold  
Professor



Xin Yu  
Associate Professor

Electrical  
Engineering  
and Computer  
Science



Michael S. Branicky  
Chair and Professor



Swarup Bhunia  
Assistant Professor



Marcus R. Buchner  
Associate Professor



M. Cenk Cavusoglu  
Associate Professor

Chemical  
Engineering



Uziel Landau  
Chair and Professor



Harihara Baskaran  
Associate Professor



Liming Dai  
Kent Hale Smith  
Professor



Donald L. Feke  
Vice Provost and  
Professor



Vira Chankong  
Associate Professor



Philip X.L. Feng  
Assistant Professor



Mario Garcia-Sanz  
Milton and Tamar Maltz  
Professor in Energy  
Innovation



Steven L. Gaverick  
Professor



Shudong Jin  
Associate Professor



Daniel J. Lacks  
C. Benson Branch  
Professor of Chemical  
Engineering



Chung-Chiun "C.C." Liu  
Wallace R. Persons  
Professor of Sensor  
Technology and Control



J. Adin Mann Jr.  
Professor



Heidi B. Martin  
Associate Professor



Syed Qutubuddin  
Professor



Mehmet Koyuturk  
Theodore L. and Dana  
J. Schroeder Assistant  
Professor in Computer  
Science and Engineering



Michael Lewicki  
Associate Professor



Jing Li  
Associate Professor



Vincenzo Liberatore  
Associate Professor



Wei Lin  
Professor

Civil  
Engineering



R. Mohan Sankaran  
Associate Professor



Robert Savinell  
George S. Dively  
Professor of  
Engineering



Xiangwu "David" Zeng  
Chair and Frank H.  
Neff Professor



Dario A. Gasparini  
Professor



Kenneth A. Loparo  
Nord Professor of  
Engineering



Behnam Malakooti  
Professor



Mehran Mehregany  
Goodrich Professor for  
Engineering Innovation



Francis L. Merat  
Associate Professor



Pedram Mohseni  
Assistant Professor



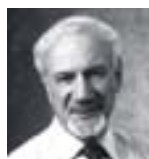
Arthur A. Huckelbridge Jr.  
Professor



Aaron A. Jennings  
Professor



Michael Pollino  
Assistant Professor



Adel S. Saada  
Professor



Xiong "Bill" Yu  
Assistant Professor



Wyatt S. Newman  
Professor



Gultekin Ozsoyoglu  
Professor



Z. Meral Ozsoyoglu  
Andrew R. Jennings  
Professor of Computing  
Sciences



Christos A. Papachristou  
Professor



H. Andy Podgurski  
Professor



Michael Rabinovich  
Professor



Soumya Ray  
Assistant Professor



Daniel G. Saab  
Associate Professor



Narasingarao Sreenath  
Professor



Norman C. Tien  
Dean and Nord Professor  
of Engineering  
Ohio Eminent Scholar,  
Physics



Jiong Yang  
Associate Professor



Guo-Qiang "G.Q." Zhang  
Professor



Xinmiao Zhang  
Timothy E. and Allison  
L. Schroeder Associate  
Professor in Computing  
Science and Engineering



Christian A. Zorman  
Associate Professor

### Macromolecular Science and Engineering



David Schiraldi  
Chair and Professor



Eric Baer  
Leonard Case  
Jr. Professor of  
Engineering



John Blackwell  
Leonard Case  
Jr. Professor of  
Engineering



Elena Dormidontova  
Associate Professor



Hatsuo "Ken" Ishida  
Professor



Alexander M. Jamieson  
Professor



LaShanda T.J. Korley  
Nord Distinguished  
Assistant Professor



João Maia  
Associate Professor



Ica Manas-Zloczower  
Associate Dean of  
Faculty Development  
and Professor



Stuart J. Rowan  
Kent Hale Smith  
Professor



Gary E. Wnek  
Joseph F. Toot Jr.  
Professor



Lei Zhu  
Associate Professor

### Materials Science and Engineering



James D. McGuffin-Cawley  
Chair and Arthur S.  
Holden Jr. Professor  
in Engineering



William "Bud" Baeslack III  
Provost and Executive  
Vice President  
Professor



Mark R. Deguire  
Associate Professor



Frank Ernst  
Leonard Case  
Jr. Professor of  
Engineering



Roger French  
F. Alex Nason  
Professor



Arthur H. Heuer  
Distinguished  
University Professor  
and Kyocera Professor  
in Ceramics



Peter D. Lagerlof  
Associate Professor



John J. Lewandowski  
Leonard Case  
Jr. Professor of  
Engineering



David H. Matthiesen  
Associate Professor



Gary M. Michal  
Professor



Pirouz Pirouz  
Professor



Gerhard E. Welsch  
Professor

### Mechanical and Aerospace Engineering



J. Iwan D. Alexander  
Chair and Cady Staley  
Professor



Alexis Abramson  
Associate Professor



Maurice L. Adams  
Professor



J. R. Kadambi  
Professor



Yasuhiro Kamotani  
Professor



Melissa Knothe Tate  
Professor



Kiju Lee  
Assistant Professor



Joseph M. Mansour  
Professor



Joseph M. Prah  
Professor



Vikas Prakash  
Professor



Roger D. Quinn  
Arthur P. Armington  
Professor of  
Engineering



Clare M. Rimnac  
Associate Dean  
and Wilbert J.  
Austin Professor of  
Engineering



James S. T'ien  
Leonard Case  
Jr. Professor of  
Engineering



# Programs

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## Departments

- Biomedical Engineering
  - Chemical Engineering
  - Civil Engineering
  - Electrical Engineering and Computer Science
  - Macromolecular Science and Engineering
  - Materials Science and Engineering
  - Mechanical and Aerospace Engineering
- 

## Research Centers and Institutes

- Case Center for Surface Engineering
  - Center for Cardiovascular Biomaterials
  - Center for Layered Polymeric Systems
  - Center for Mechanical Characterization of Materials
  - Center for Modeling Integrated Metabolic Systems
  - Cleveland Functional Electrical Stimulation Center
  - Electronics Design Center
  - Great Lakes Energy Institute
  - Institute for Advanced Materials
  - Neural Engineering Center
  - Swagelok Center for Surface Analysis of Materials
  - Technology and Health Institute at Case
  - The Institute for Management and Engineering
  - think[box]
  - Yeager Center for Electrochemical Sciences
- 

# Visiting Committee

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- Robert T. Bond, Jr., (CIT '66), *chair*
  - Chi-Foon Chan (GRS '74, '77)
  - Walter J. Culver (GRS '62, '64)
  - John F. X. Daly (CWR '89, GRS '91)
  - Myra A. Dria (CIT '76)
  - Robert A. Gingell, Jr. (CIT '77)
  - Jennie S. Hwang (GRS '76)
  - William M. James (CIT '64)
  - Joseph P. Keithley
  - Martin P. Kress
  - Alexander Kummant (CIT '82)
  - Kenneth A. Loparo (GRS '77)
  - Kenneth R. Lutchen (GRS '80, '83)
  - Gerald "Mac" McNichols (CIT '65)
  - Somsak Naviroj (GRS '83)
  - Charles H. Phipps (CIT '49)
  - Claiborne R. Rankin
  - Richard T. Schwarz (MGT '78)
  - Thomas W. Seitz (CIT '70)
  - Russell J. Warren (CIT '60)
  - Gerald "Jerry" Wasserman (CIT '76)
  - Andrew Wasynczuk (CIT '79, GRS '79)
-

# At a Glance

Enrollment:  
fall 2010

991	608	1,599
declared undergraduate engineering students	graduate and professional-degree students	total* <small>* In addition, 400 undergraduate students expressed interest in engineering majors but are not expected to declare majors until the end of their sophomore years.</small>

Full-time faculty: fall 2010 111

Budget: FY 2010 \$84.1 million

Research revenue: FY 2010 \$29.4 million

Fundraising:  
FY 2010

\$13.4 million	\$1.1 million	\$14.5 million
Case School of Engineering	Case Alumni Association	total

U.S. News & World Report rankings

Top 50	11th	9th
for undergraduate and graduate engineering programs	for graduate biomedical engineering programs	for undergraduate biomedical engineering programs

Design: Lori Scheid, University Marketing and Communications, Case Western Reserve University  
Writing and Editing: Melissa Evans and Kevin Mayhood, University Marketing and Communications, Case Western Reserve University; Helen Jones-Toms, Case School of Engineering, Case Western Reserve University  
Feature Portrait Photography: Laura Webb  
Large Image Photography: Tony Gray  
Faculty Portraits: Clixfoto

Every effort has been made to ensure the accuracy of this report. If you have any questions or concerns, please contact Helen Jones-Toms, director of marketing and communications, Case School of Engineering, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, Ohio 44106-7220; 216.368.8694; hlj2@case.edu.

For more news about the Case School of Engineering, go to [engineering.case.edu](http://engineering.case.edu).



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