Instant replay technology captures the cause of behavior

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Research News

Gregory Abowd, professor in the School of Interactive Computing, researches human-computer interaction — the study of how best to design computer systems and applications to be useful to people.

He was motivated to develop BI Capture because he has two children with autism. He has seen firsthand the need for being able to capture evidence of behavioral problems without imposing any further burden on caregivers.

“As a scientist, I wondered if the therapy sessions my oldest son was receiving were effective because much of the discussion with his therapists about his progress was subjective,” Abowd said. “And, as a parent, I wanted to be able to see what triggered certain behaviors such as tantrums or why some therapy sessions were less successful.”

Once Abowd began videotaping his son’s therapy sessions, he saw how the technology could help him and other caregivers make better decisions about how to improve his treatment.

BI Capture was developed at Tech and is now commercially available.

Ocean creatures provide foundation for electronics

Researchers convert shells of diatoms to silicon for sensors, electrodes

The three-dimensional shells of tiny ocean creatures could provide the foundation for novel electronic devices, including gas sensors able to detect pollution faster and more efficiently than conventional devices.

Using a chemical process that converts the shells’ original silica (silicon dioxide, SiO2) into the semiconductor material silicon, researchers have created a new class of gas sensors based on the unique and intricate three-dimensional (3-D) shells produced by microscopic creatures known as diatoms. The converted shells, which retain the 3-D shape and nanoscale detail of the originals, could also be useful as battery electrodes, chemical purifiers and other applications requiring complex shapes that nature can produce better than humans.
"If you could have so many little things working for you, there is a great possibility that you could have significant impact on the properties of the soil."

—Carlos Santamaria, a professor in the School of Civil and Environmental Engineering, on so-called geotechnical construction — techniques that use the bacteria present in soil to improve the ground for sturdier building. (Sacramento Bee)

Materials Science and Engineering Professor Sandhage and his research collaborators would like to conduct such conversion reactions on genetically-modified diatoms that generate microshells with tailored shapes. However, to precisely alter and control the structures produced, further research is needed to learn how to manipulate the genome of the diatom.

Centennial Campaign Steering Committee. He is an emeritus member of the School of Industrial and Systems Engineering Advisory Board.

John P. Imlay Jr. recently made a gift of $1 million that will support various campus units. Of that total, $250,000 is designated for addition to the endowment for the school chair in the Sam Nunn School of International Affairs (honoring his friend, former U.S. Senator Sam Nunn); $250,000 is designated for the Athletic Director’s Discretionary Fund in the Athletic Association; and $250,000 is designated for the Dean’s Discretionary Fund within the College of Computing. The designation of the remaining $250,000 is currently undetermined.

Imlay is chairman of Imlay Investments. He and his wife, Mary Ellen, live in Atlanta. A member of the Campaign Georgia Tech Steering Committee, Imlay is a trustee emeritus of the Georgia Tech Foundation Board of Trustees. He is an honorary member of the College of Computing Advisory Board and has served on the Georgia Tech Advisory Board and the Leadership Gifts Committee for Georgia Tech’s Centennial Campaign. The Imlay Foundation, which he founded in 1989, has made grants to numerous worthy causes in the metro Atlanta area.

"Georgia Tech is fortunate indeed to have friends such as Russ Chandler and John Imlay," said President Wayne Clough. "These men have been loyal and active members of the Tech community for many years, and their most recent acts of philanthropy will be a tremendous benefit for both our academic and athletic enterprises. They have set a wonderful example of thoughtful, strategic philanthropy for all Tech alumni."

"When we conducted measurements for the detection of nitric oxide, a common pollutant, our single diatom-derived silicon sensor possessed a combination of speed, sensitivity and low voltage operation that exceeded conventional sensors,” said Kenneth Sandhage, a professor in the School of Materials Science and Engineering. “The unique diatom-derived shape, high surface area and nanoporous, nanocrystalline silicon material all contributed towards such attractive gas-sensing characteristics.”

The unique devices, part of a broader long-term research program by Sandhage and his research team, were described in the March 8 issue of the journal Nature.

Scientists estimate that roughly 100,000 species of diatoms exist in nature, and each forms a microshell with a unique and often complex 3-D shape that includes cylinders, wheels, fans, donuts, circles and stars. Sandhage and his research team have worked for several years to take advantage of those complex shapes by converting the original silica into materials that are more useful.

“Diatoms are fabulous for making very precise shapes, and making the same shape over and over again by a reproduction process that, under the proper growth conditions, yields microshells at a geometrically increasing rate,” Sandhage noted.

“Diatoms can produce three-dimensional structures that are not easy to produce using conventional silicon-based processes. The potential here is for making enormous numbers of complicated 3-D shapes and tailoring the shapes genetically, followed by chemical modification as we have conducted to convert the shells into functional materials such as silicon.”

Silicon is normally produced from silica at temperatures well above the silicon melting point (1,414 degrees Celsius), so that solid silicon replicas cannot be directly produced from silica structures with such conventional processing. So the Georgia Tech researchers used a reaction based on magnesium gas that converted the silica of the shells into a composite containing silicon and magnesium oxide. The conversion took place at only 650 degrees Celsius, which allowed preservation of the complex channels and hollow cylindrical shape of the diatoms.

The researchers then connected individual diatom-derived silicon structures to electrodes, applied current and used them to detect nitric oxide. The highly porous silicon shells, which are about 10 micrometers in length, could also be used to immobilize enzymes for purifying drugs in high-performance liquid chromatography (HPLC) and as improved electrodes in lithium-ion batteries.

“Silicon can form compounds that have a high lithium content,” Sandhage said. “Because diatom-derived silicon structures have a high surface area and are thin walled and highly porous, the rate at which you can get lithium ions into and out of such silicon structures can be high. For a given battery size, you could store more power, use it more rapidly or recharge the battery faster by using such structures as electrodes.”

Though Sandhage and his collaborators have demonstrated the potential of their technique, significant challenges must be overcome before they can produce useful sensors, battery electrodes and other structures.

A ceramicist by training, Sandhage would now like to work directly with electrical engineers and others who have specific interests in silicon-based devices.

"Our target diatoms of a certain shape, generate the right chemistry, and then work with applications engineers to get these unique structures into practice," he said. "We are now at the point where we have a good idea of the chemical palette that is accessible with the conversion approaches we have taken. The next step is really to start making packaged devices."
New GRA chair supports critical energy research

Dan Treadaway
Institute Communications and Public Affairs

steadily rising energy prices and ongoing unrest in the oil-rich Middle East pose a clear threat to America’s long-term security and economic health. The good news in this scenario is that this threat has sparked significant interest in research that could broaden and diversify the nation’s energy resources.

With this overarching strategy in mind, Georgia Tech and the Georgia Research Alliance (GRA) have partnered to create an endowed chair in energy, designed to foster a broad-based research and instructional program in energy including alternative and sustainable energy sources.

To date, the GRA Eminent Scholars Program has recruited more than 50 renowned scholars to Georgia universities, 22 of whom serve on the Georgia Tech faculty. GRA has a history of funding cutting-edge technology and research that leads to an economic development impact in Georgia. With energy being seen as an area for research growth and innovation, establishing an eminent scholar position in energy makes economic and academic sense.

The GRA provides half the cost of the chair endowment for eminent scholar positions. Georgia Tech is responsible for raising the other half through private philanthropy. In addition, funding for start-up laboratory costs is usually provided. The new chair augments the $400,000 in energy-related research grants that the GRA has already awarded to Georgia Tech and the University of Georgia so far in fiscal 2007.

“The energy field is broadly defined as encompassing areas within energy conversion, distribution and efficient utilization, and underlying technologies,” said Roger Webb, professor emeritus, former chair of the School of Electrical and Computer Engineering and chair of the search committee for the new energy chair. “The chair holder will be expected to initiate new programs in energy sciences and technology while enhancing the portfolio of ongoing energy initiatives that are currently under way at Tech via the Strategic Energy Institute (SEI). The chair should also foster interaction between the energy industry and Georgia Tech faculty. GRA has a history of funding interdisciplinary research in strategically critical areas.

The strategic energy initiatives at Georgia Tech are documented in an interdisciplinary Web portal (www.energy.gatech.edu) highlighting the teaching and research activities on campus in this area. Interdisciplinary research in strategically critical fields at Georgia Tech to promote technology transfer.

The chair will be expected to draw outstanding students to the program, define and stimulate innovative research, and serve as a team leader and mentor for other faculty. The chair holder will hold a tenured academic appointment in the appropriate school and will also be affiliated with the SEI.

The salary for the GRA Eminent Scholar will be provided from Institute funds; allowing funds generated by the endowment to be utilized almost entirely for program development.

“Devoting significant resources to ensuring long-term, affordable and environmentally sustainable sources of energy is not only a wise investment, but also a national imperative,” said Michael Cassidy, president and CEO of the Georgia Research Alliance. “We are very excited about the potential of this new chair in energy and the talent it will bring to bear on this long-standing challenge. Our partnership with Georgia Tech has borne much fruit so far, and we look forward to exceptional results in the field of energy.”

IN BRIEF:

Request for proposals

The National Science Foundation is soliciting proposals for its Nanotechnology Undergraduate Education (NUE) in Engineering program, which aims to introduce nanoscience, engineering and technology through a variety of interdisciplinary approaches into undergraduate education.

The focus is on nanoscale engineering education with relevance to devices and systems and/or on the social, economic and ethical issues that surround nanotechnology.

Only one proposal may be submitted by any U.S. academic institution as the lead institution with the following exception: a second proposal is allowed only if it is focused on the societal, ethical, economic and/or environmental implications of nanoscience and engineering.

The Office of the Vice Provost for Research is requesting three-page proposal summaries. A faculty committee will determine which proposals will represent Georgia Tech.

Proposals must be submitted electronically by April 6 to kathy.mims@carnegie.gatech.edu. Additional program information can be found at: www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf07554

GT Auto Show

The 4th Annual Georgia Tech Auto Show will be held Saturday, March 31, on the Georgia Tech campus. Motor vehicles of all types owned by students, former students, faculty, staff, alumni, fans, and corporate sponsors of Georgia Tech will be on display.

The 2007 speaker is expected to be Bryan Nesbitt, current chief of the General Motors European Design Center. The show is open and free to the public for viewing the cars on display. Prizes will be awarded to the best cars and motorcycles of various categories. Those interested in showing a car may enter by visiting www.gatechautoshow.com.

Earth Day committee seeks campus input

The planning committee of Georgia Tech Earth Day 2007 reminds the campus that it is collecting unwanted office supplies for its annual exchange program, to be held along Skiles Walkway during the April 20 campus celebration.

Bring your supplies to the Office of Solid Waste Management and Recycling between 11 a.m. – 1 p.m. any Monday, Wednesday or Friday until April 6. The supply exchange is open to Georgia Tech students, staff and faculty only.

The committee also seeks nominations for its Environmental Leadership Award, given annually to a student, faculty member, staff member, retiree or alumnus who is a leader in recycling, clean air initiatives, water conservation, pollution control or other environmental issues. Nominations are due by March 31.

For more information on any activities related to Earth Day, visit www.earthday.gatech.edu.

WWW.WHISTLE.GATECH.EDU