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THE WHISTLE

FACULTY/STAFF NEWSPAPER | Volume 31, Number 17 • May 1, 2006 | THE GEORGIA INSTITUTE OF TECHNOLOGY

International research unit formed at Georgia Tech Lorraine

Megan McRainey
Institute Communications and Public Affairs

Georgia Tech and France's Centre National de la Recherche Scientifique (CNRS) have partnered to create a joint international research unit (unité mixte internationale, or UMI) to focus on telecommunications and innovative materials research.

The UMI, which is the first of its kind in France, will be based at Georgia Tech Lorraine, the European campus located in Metz, France. Created in 1990, GT Lorraine excels in secure networks and innovative materials research.

Two large and select French engineering schools, Arts et Métiers and Supélec, and two universities, Franche Comté University and Paul Verlaine University in Metz, are associate members.

Abdallah Ougazzaden, a GT Lorraine professor of electrical and computer engineering, will direct the UMI.

With a budget close to $3 billion and a workforce of more than 26,000 people, the CNRS is an influential scientific organization that helps coordinate research in government, university and corporate laboratories.

"The fact that the UMI was officially signed in Paris at the CNRS headquarters in the presence of Dr. Catherine Brechignac, president of

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Graphite-based circuitry may offer a foundation for nanoscale devices

John Toon
Research News and Publications

A study of how electrons behave in circuitry made from ultra-thin layers of graphite — known as graphene — suggests the material could provide the foundation for a new generation of nanometer-scale devices that manipulate electrons as waves — much like photonic systems control light waves.

In a paper published April 13 in Science Express, an online advance publication of the journal Science, researchers at Georgia Tech and the Centre National de la Recherche Scientifique (CNRS) in France report measuring electron transport properties in graphene that are comparable to those seen in carbon nanotubes. Unlike carbon nanotubes, however, graphene circuitry can be produced using established microelectronics techniques, allowing researchers to envision a "road map" for future high-volume production.

"We have shown that we can make the graphene material, that we can pattern it, and that its transport properties are very good," said Walt de Heer, a professor in the School of Physics. "The material has high electron mobility, which means electrons can move through it without much scattering or resistance. It is also coherent, which means electrons move through the graphene much like light travels through waveguides."

The results should encourage further development of graphene-based electronics, though de Heer cautions that practical devices may be a decade away.

"This is really the first step in a very long path," he said. "We are at

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Three undergraduates named Goldwater Scholars

David Terraso
Institute Communications and Public Affairs

One's a film director turned physicist, another is a second-generation engineer and another is a mathematician who's studied the relationships between members of the U.S. House of Representatives. Sophomores Jonathan Diaz, Andrew Marin and A.J. Friend are Tech's latest recipients of the prestigious Barry M. Goldwater Scholarship, a national award designed to foster and encourage select students to pursue careers in the fields of mathematics, the natural sciences and engineering.

Jonathan Diaz is proof that good high school teachers can change students lives, or at least their minds. He had planned to go to film school to become a director, but after taking a high school astronomy class he decided that his future lay in cosmology.

"I was always good in science," said Diaz, a physics major from Alpharetta, "but the thought that I would spend my life devoted to it didn't occur to me until I took an astronomy course. I realized that there is something more than what I see in front of my eyes."

photo by Rob Felt

Sophomores A.J. Friend (Mathematics), Andrew Marin (Chemical and Biomolecular Engineering) and Jonathan Diaz (Physics)

At Tech, Diaz is working in the PicoForce lab under Assistant Professor Elisa Reido, studying the atomic origins of friction and other phenomena on the nanoscale.

But just because he's an aspiring physicist, doesn't mean he's turned his back on filmmaking. He recently

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Research group gets $3 million boost

David Terraso
Institute Communications and Public Affairs

Last week, Georgia Tech's Center for Organic Photonics and Electronics (COPE) announced a new partnership that will provide $3 million for research funding.

Solvay, an international chemical and pharmaceutical group headquartered in Brussels, Belgium, signed a three-year commitment with Georgia Tech to fund research in organic light-emitting diodes (OLEDs).

"Solvay's partnership represents a substantial investment in Georgia Tech and signifies the company's confidence in Tech's ability to provide end-to-end resources encompassing modeling, synthesis, fabrication and testing," said Seth Marder, director of COPE.

Solvay's commitment to Tech will help fund research in OLEDs, thin-films of organic molecules that give off light when electricity is applied. OLEDs could be used in everything

COPE continued, page 3

"QUOTE-UNQUOTE"

"When you walk, you generate 67 watts. Your finger movement is 0.1 watt. Your breathing is one watt. If you can convert a fraction of that, you can power a device. From the concept we've demonstrated, we can convert 17-30 percent of that."
—Zhong Lin Wang, a professor in the School of Materials Science and Engineering, whose research shows that zinc oxide nanowires has a piezoelectric effect such that, if incorporated into things such as shoes, could provide a continuous power supply to portable electronic devices.
(Technology Review)

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the proof-of-principle stage, comparable to where transistors were in the late 1940s. We have a lot to do, but I believe this technology will advance rapidly."

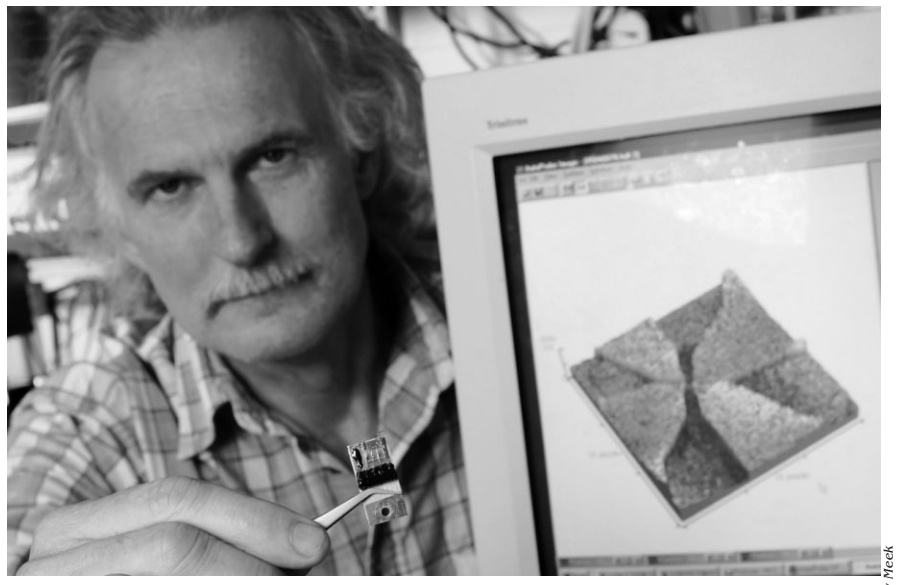
The research, begun by de Heer's team in 2001, is supported by the U.S. National Science Foundation and the Intel Corporation.

'A promising material'

In their paper, the researchers report seeing evidence of quantum confinement effects in their graphene circuitry, meaning electrons can move through it as waves. "The graphene ribbons we create are really like waveguides for electrons," de Heer said.

Because carbon nanotubes conduct electricity with virtually no resistance, they have attracted strong interest for use in transistors and other devices. However, the discrete nature of nanotubes — and variability in their properties — pose significant obstacles to their use in practical devices. By contrast, continuous graphene circuitry can be produced using standard microelectronics processing techniques.

"Nanotubes are simply graphene that has been rolled into a cylindrical shape," de Heer explained. "Using narrow ribbons of graphene, we can get all the properties of nanotubes because those properties are due to the graphene and the confinement of the electrons, not the nanotube structures."



Georgia Tech Physics Professor Walt de Heer holds a proof-of-principle device constructed from graphene. He calls graphite "a very promising electronic material ... as a platform, a canvas on which we can work."

photo by Gary Meek

de Heer envisions using the graphene electronics for specialized applications, potentially within conventional silicon-based systems.

"We have shown that we can interconnect graphene, put current into it, and take current out," he said. "We have a very promising electronic material. We see graphene as a platform, a canvas on which we can work."

Established techniques

de Heer and collaborators Claire Berger, Zhimin Song, Xuebin Li, Xiaosong Wu, Nate Brown, Tianbo Li, Joanna Hass, Alexei Marchenkov, Edward Conrad and Phillip First of Georgia Tech and Didier Mayou and Cecile Naud of CNRS start with a wafer of silicon carbide, a material made up of silicon and carbon atoms. By heating the wafer in a high vacuum, they drive silicon atoms from the surface, leaving a thin continuous layer of graphene.

Next, they spin-coat onto the surface a photo-resist material of the kind used in established microelectronics techniques. Using electron-beam lithography, they produce patterns on the surface, then use conventional etching processes to remove unwanted graphene.

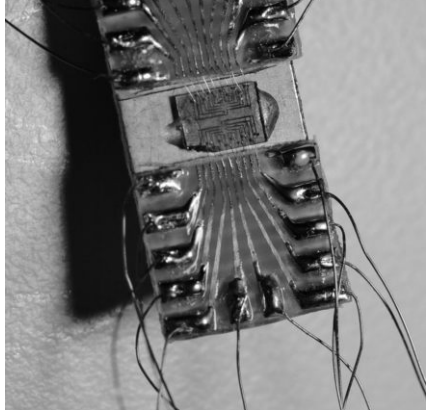
"We are doing lithography, which is completely familiar to those who work in microelectronics," said de Heer. "It's exactly what is done in microelectronics, but with a different material. That is the appeal of this process."

Using electron beam lithography in Georgia Tech's Microelectronics Research Center, they've created feature sizes as small as 80 nanometers. The graphene circuitry demonstrates high electron mobility — up to 25,000 square centimeters per volt-second, showing that electrons move with little scattering.

Beyond coherence and high electron mobility, the researchers note that the speed of electrons through the graphene is independent of energy — just like light waves. The electrons also possess the properties of Dirac particles, which allow them to travel significant distances without scattering.

Among the challenges ahead is improving the techniques for patterning the graphene, since electron transport is affected by the smoothness of edges in the circuitry. Researchers will also have to understand the material's fundamental properties, which could still contain "show-stoppers" that might make the material impractical.

de Heer has seen hints that graphene may offer some surprises. "We already have indications of some new and surprising electronic properties of this material," he said. "It is doing things that we have never seen in two-dimensional materials before."



de Heer and his collaborators created a graphene device, above, using the same techniques developed for microelectronics manufacturing.

For more information...

Small Systems Laboratory
www.physics.gatech.edu/npeg

Spring commencement returns to Georgia Dome

As class sizes continue to expand, so too the number of graduates. For the second time, the size of the graduating class will necessitate a move to a larger facility, one that can accommodate the graduates as well as families and well-wishers.

On May 6, more than 2,100 students will be awarded degrees at spring commencement, to be held downtown in the Georgia Dome. The move was prompted by the size of Tech's undergraduate student body, one that has outgrown the Alexander Memorial Coliseum for spring commencement. With insufficient room for all of the chairs on the floor and an increasing number of graduates in the stands, the Coliseum is unable to accommodate the number of graduates and guests attending this important occasion.

The move also keeps the ceremony open to public. The Home Depot co-founder Bernie Marcus will deliver the keynote address.

Georgia Tech

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from television and computer monitors to household lighting to handheld computing devices.

COPE has already developed a unique material platform for OLEDs that may be deposited over large areas by ink-jet printing and patterned using standard photolithography. Tech researchers have found that exposing the material to ultraviolet light leads to hardened materials that are insoluble and maintain stability under high temperatures, allowing researchers to build a multi-layered, solid-state device from liquid materials.

The partnership further strengthens the company's solid presence in Georgia, with offices of Solvay Advanced Polymers in Alpharetta and Solvay Pharmaceuticals in Marietta. For Tech, the partnership enhances its already strong international presence and reputation and adds an outlet for successful technology transfer and commercialization of research.

COPE, through the research group of Jean-Luc Bredas, already conducts research activities with the University of Mons-Hainaut in Belgium.

"Because Georgia Tech is an institution that is continuing to grow its reputation as a global player, this partnership helps that effort by strengthening the name recognition in the capital of Europe," said Bredas, a professor in the School of Chemistry and Biochemistry.

Leopold Demideleer, director of new business development for Solvay and Elisa Riedo, assistant professor in the School of Physics, address the audience during a symposium in honor of the partnership.

For more information...

Center for Organic Photonics and Electronics
www.cope.gatech.edu

UMI, cont'd from page 1

CNRS, and Dr. Arnold Migus, director of CNRS, shows that CNRS attaches great importance to this new venture between Georgia Tech and CNRS. It is clear that Georgia Tech Lorraine played an important role in this strategic partnership," said Yves Berthelot, director of GT Lorraine.

The partnership between GT Lorraine and CNRS started in 1998 with a mixed research unit of CNRS in the area of secure telecommunications networks through optical fibers.

The new mixed international GT-CNRS unit will be devoted to optics-based communication using the dynamics of chaos in optoelectronic components, quantum cryptography and ultrafast optical communication.

The UMI's research will also focus on innovative materials related to optics, electronics and mechanical engineering, with an emphasis on nanotechnology and intelligent materials. The research will target industrial applications for aeronautics, automotives, biomedical engineering and energy.

Abdallah Ougazzaden, a GT Lorraine professor of electrical and computer engineering, will direct the program.

For more information...

Georgia Tech Lorraine
www.georgiatech-metz.fr

Scholars, cont'd from page 1

finished making his first feature-length film titled "Disruptions." He is currently writing his second feature-length screenplay.

Family tradition

Andrew Marin comes from scientific stock. With an engineer for a father, a mother who's a nurse, an uncle who's a geologist and another who's an ecologist, it's no surprise to his family that Marin decided to pursue engineering.

In fact, the chemical and biomolecular engineering major from Plano, Tex. said he can't remember a time when he hasn't been interested in engineering.

"It's very hands-on. I like seeing things develop from an idea to an application — that's very satisfying," said Marin.

When he's not busy playing soccer or competing in a triathlon, he's working with professors Charles Eckert and Charles Liotta on tunable solvents. Marin participated in the development of these solvents in which key properties can be rapidly changed. This could streamline the processing of chemicals such as those used in the food and pharmaceutical industry.

Order in chaos

According to A.J. Friend, mathematics is key to understanding the world. Whether it's discovering the hidden relationships between seemingly unrelated people or groups, predicting and explaining people's behavior, or solving more traditional mathematical problems such as those faced in engineering or the sciences — math is an essential tool.

While still a freshman, the discrete mathematics major from West Haven, Conn., participated in research examining the degree of partisanship and power networks of the U.S. House of Representatives.

"Network theory is going to have a huge impact," said Friend. "It's what Google and Amazon's recommendations are based on. With the direction that marketing is taking, it's the only way to understand the world."

Like Diaz, it was a high school teacher who really inspired him to utilize his natural talent for math. And like Marin, he's also competing in intramural soccer.

Concentrating in both applied and theoretical mathematics, Friend is still experimenting with the direction he wants his future to take. What he is sure of is that he wants to teach.

"Relaying mathematical ideas to others in a simple and clear fashion and then seeing the epiphany in that person's expressions have been joys of mine for as long as I knew enough math to do so," he said.

IN BRIEF:

Painting celebrates Tech's past and inspires future

For noted Charlotte, N.C., artist Peggy Simmons, the commission for a painting to hang in the School of Chemical and Biomolecular Engineering was a labor of love.

She met her husband, alumnus Jim Simmons, on campus 45 years ago.

"Georgia Tech means a lot to us, because it was there for us as we were married and provided a springboard for whatever success we've had together in life," said Jim Simmons, a member of the School of Chemical Engineering external advisory board.

Titled "Reflecting a Georgia Tech Life: The Past Inspiring the Future," the painting features the spanning windows of the Ford ES&T building's atrium. She said the painting illustrates "Jim's Georgia Tech life reflected in the building where he continues to inspire the future graduates of this institution."

Commissioned by School Chair Ronald Rousseau, the painting will adorn the walls of the seminar room named for Jim Simmons' parents, J. Harry and Myrtice Simmons.

Dates set for Homecoming, Family Weekend

A gridiron battle with Notre Dame will launch a season of football frenzy and alumni events this fall, highlighted by Homecoming, Buzz Bash and Family Weekend.

"We have set the dates alumni will want to put on their calendars for this fall," said Kara Allen, director of events for the Georgia Tech Alumni Association.

The Yellow Jackets open the 2006 football season hosting Notre Dame on Sept. 2. A tailgate party open to everyone in the Tech community is planned for the Tower lawn.

About 2,000 parents and families of students are expected to visit campus Oct. 5-7 for Family Weekend featuring seminars, tours and the Georgia Tech vs. Maryland football game.

Homecoming will be held Oct. 26-28, with milestone reunions for the classes of 1981, 1966 and 1956. The Yellow Jackets play Miami in the Homecoming game.

The Alumni Association is also sponsoring bus trips to the Clemson game on Oct. 21 and the Georgia game on Nov. 25.

Golf team named ACC co-champs

Georgia Tech and North Carolina were declared co-champions last month at the Atlantic Coast Conference Men's Golf Championship after the Tar Heels made up 11 shots in the final round and neither team could win in two playoff holes.

Freshman Cameron Tringale won medalist honors after a final round 72 that gave him a one-shot victory over Wake Forest's Kyle Riefers. Tringale had posted a 65 in the rain-delayed second round Sunday to take the individual lead, and his birdie at the par-5 18th hole gave him the victory.

Tech won its first ACC title since 2002 and ninth overall. Tringale became Tech's first ACC individual champion since Bryce Molder in 2000.

By agreement of the coaches and the ACC golf committee, Tech was awarded the conference's automatic bid to the NCAA Championship based on its higher national ranking.