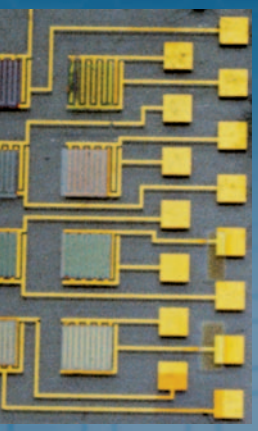
IMPACT

RESEARCH AT THE UNIVERSITY OF MARYLAND

Vol. 1 No. 1 | April 2006



Welcome to the premier issue of *Impact*,

a quarterly research digest from the University of Maryland showcasing the breadth, quality and interdisciplinary nature of research undertaken by our scientific community. As a top public research university, we are continually advancing the state of knowledge in matters that affect our daily lives, including important topics involving the biosciences and public health; energy use and transportation; homeland security and food safety; local and worldwide environmental issues; education in our public schools; and much more.

Each semester, *Impact* will examine several high-priority areas of research, detailing both our scientific discoveries and our interaction with government agencies and private industry. This issue highlights the interdisciplinary collaboration among our faculty in the new Maryland NanoCenter, where researchers in chemical and life sciences, engineering, and computer, mathematical and physical sciences are exploring many facets in the exciting field of nanotechnology.

We encourage you to visit our Web site at www.umresearch.umd.edu for a more detailed look of ongoing research at the University of Maryland. Your comments and suggestions are welcome; please use the contact information on the back of this publication to give us your feedback.

Jacques S. Gansler
Vice President for Research

Research in nanoscale

science and engineering is unveiling a whole new world of ideas and applications, while also promoting rapid advances in the miniaturization of technologies already in use. To see what's new in nanotechnology research, take a look inside ...

researchTRENDS

The University of Maryland is recognized as a leader in research that impacts the world we live in. In the past fiscal year, the university received approximately $325 million in research awards and grants. Here are a few recently funded projects, listed with the principal investigator:

EARTH AND SPACE SCIENCES

Roald Sagdeev, Distinguished University Professor of Physics and director, East-West Space Science Center, received $2.3 million from NASA to develop a Lunar Exploration Neutron Detector, which in 2008 will create a high-resolution map of the hydrogen content of the lunar soil.

DEFENSE AND HOMELAND SECURITY

William Fourney, professor of mechanical engineering, received $1.1 million from the Department of Defense to develop design tools and technology for a light armored vehicle and other logistic vehicles that are more survivable in a blast environment than the current generation.

INFORMATION TECHNOLOGY

Bonnie Dorr, professor of computer science, will receive up to $750,000 for two five-year contracts, one for her work on machine translation of foreign-language texts and the other for her work on summarization of translated texts.

TRANSPORTATION

Michael Pack, laboratory director, Center for Advanced Transportation Technology, received $1.9 million from the Maryland Department of Transportation to integrate the existing transit and transportation management system data in Maryland, Virginia and Washington, D.C., in order to improve transportation efficiency, safety and security.

researchPROFILES

For a closer look at three faculty researchers associated with the Maryland NanoCenter, go to www.umresearch.umd.edu.

JOHN FOURKAS

This professor of chemistry is discovering new ways—including multiphoton fabrication—to better construct the next generation of micro machines.

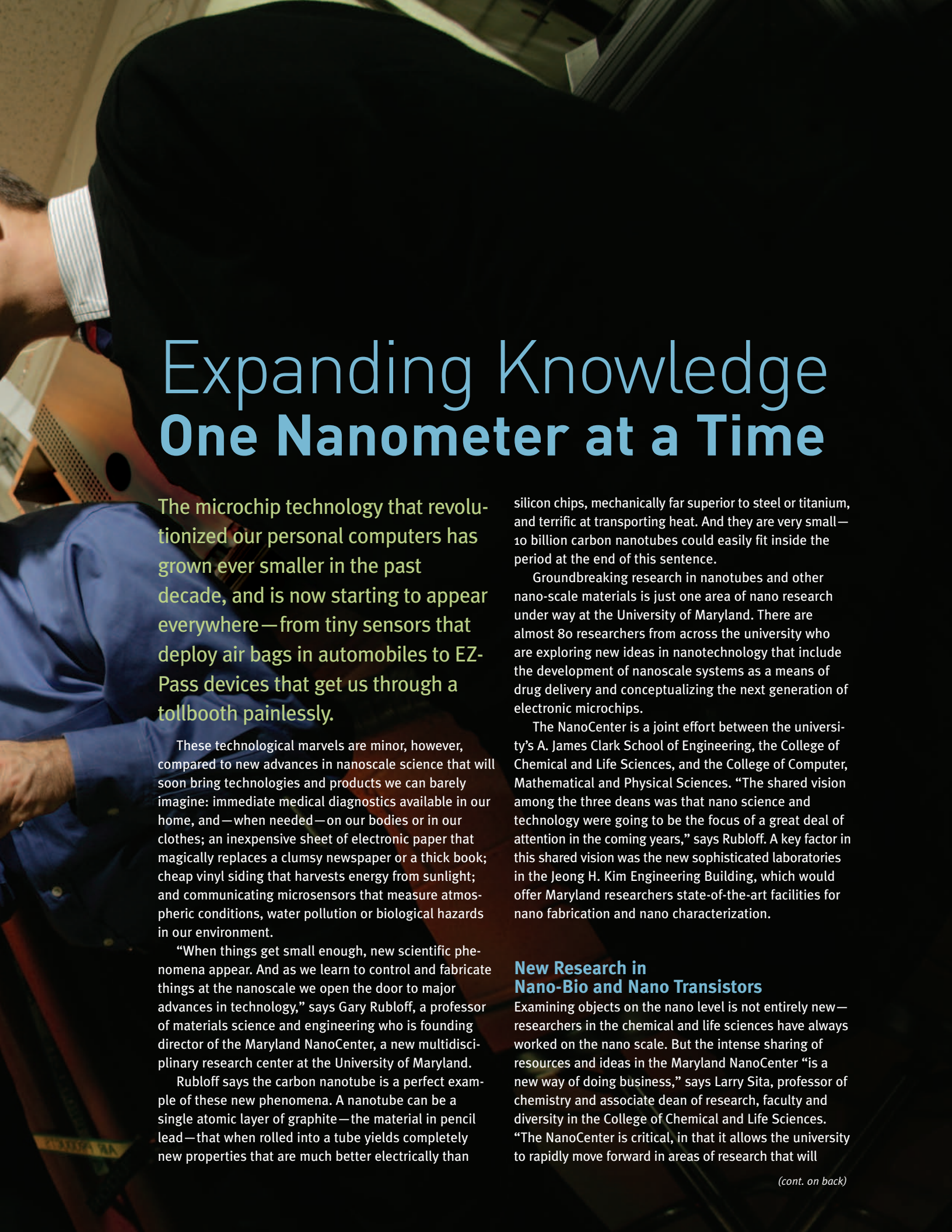
MICHAEL ZACHARIAH

This professor of chemistry and mechanical engineering is looking at new ways to analyze and measure different kinds of nanoparticles, while also looking at nanoparticle safety.

REZA GHODSSI

This associate professor of computer and electrical engineering is creating seamless units with micro-electro-mechanical systems that are more reliable than ever, and so small they are veering into nanoscale levels.

GARY RUBLOFF (CENTER), DIRECTOR OF THE MARYLAND NANOCENTER, WORKS WITH A GRADUATE STUDENT AND FACULTY COLLEAGUE TO DEVELOP CHEMICAL PROCESSES AND MANUFACTURING TECHNOLOGY FOR DEPOSITING COMPLEX NANOMATERIALS ONTO 3-D NANOSCALE SURFACE FEATURES.



Expanding Knowledge
One Nanometer at a Time

The microchip technology that revolutionized our personal computers has grown ever smaller in the past decade, and is now starting to appear everywhere—from tiny sensors that deploy air bags in automobiles to EZ-Pass devices that get us through a tollbooth painlessly.

These technological marvels are minor, however, compared to new advances in nanoscale science that will soon bring technologies and products we can barely imagine: immediate medical diagnostics available in our home, and—when needed—on our bodies or in our clothes; an inexpensive sheet of electronic paper that magically replaces a clumsy newspaper or a thick book; cheap vinyl siding that harvests energy from sunlight; and communicating microsensors that measure atmospheric conditions, water pollution or biological hazards in our environment.

"When things get small enough, new scientific phenomena appear. And as we learn to control and fabricate things at the nanoscale we open the door to major advances in technology," says Gary Rubloff, a professor of materials science and engineering who is founding director of the Maryland NanoCenter, a new multidisciplinary research center at the University of Maryland.

Rubloff says the carbon nanotube is a perfect example of these new phenomena. A nanotube can be a single atomic layer of graphite—the material in pencil lead—that when rolled into a tube yields completely new properties that are much better electrically than silicon chips, mechanically far superior to steel or titanium, and terrific at transporting heat. And they are very small—10 billion carbon nanotubes could easily fit inside the period at the end of this sentence.

Groundbreaking research in nanotubes and other nano-scale materials is just one area of nano research under way at the University of Maryland. There are almost 80 researchers from across the university who are exploring new ideas in nanotechnology that include the development of nanoscale systems as a means of drug delivery and conceptualizing the next generation of electronic microchips.

The NanoCenter is a joint effort between the university's A. James Clark School of Engineering, the College of Chemical and Life Sciences, and the College of Computer, Mathematical and Physical Sciences. "The shared vision among the three deans was that nano science and technology were going to be the focus of a great deal of attention in the coming years," says Rubloff. A key factor in this shared vision was the new sophisticated laboratories in the Jeong H. Kim Engineering Building, which would offer Maryland researchers state-of-the-art facilities for nano fabrication and nano characterization.

New Research in Nano-Bio and Nano Transistors

Examining objects on the nano level is not entirely new—researchers in the chemical and life sciences have always worked on the nano scale. But the intense sharing of resources and ideas in the Maryland NanoCenter "is a new way of doing business," says Larry Sita, professor of chemistry and associate dean of research, faculty and diversity in the College of Chemical and Life Sciences. "The NanoCenter is critical, in that it allows the university to rapidly move forward in areas of research that will

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experience tremendous growth in the near future."

Several areas of research related to human health are already under way at Maryland, Sita says, and these efforts are benefiting enormously from advances made in nanotechnology. He cites recent research in comparative and functional genomics, the study of host-pathogen interactions and the development of new bio- and chemical sensing analytical tools as examples.

"A key goal with our interdisciplinary research in the NanoCenter is to increase the effectiveness of faculty efforts in new initiatives, and also increase external funding for these efforts," says Nariman Farvardin, dean of the Clark School of Engineering. "Another goal is to provide expanded visibility of our excellence in nanotechnology, both in the media and in private industry."

One example of this increased visibility is the University of Maryland being named No. 1 in nanotechnology research and education last year by *Small Times* magazine. This industry-standard publication also ranked Maryland second in micro-technology research efforts.

New research involving nanotechnology will also determine the future of the electronics industry, says the NanoCenter's director Rubloff. Semiconductor chips have already become so small that the industry is convinced it is facing a scientific roadblock.

Michael Fuhrer, associate professor of physics, leads a research group that focuses on several aspects of nanoscale electronics. His research involves the use of "pre-assembled" nanoscale components such as carbon nanotubes or individual organic molecules to replace conventional materials like silicon in electronic devices. The goal is to develop electronics that can work anywhere—on paper, plastic, glass, fabric—not just on a silicon chip.

The NanoCenter is also involved in education; a new interdisciplinary minor in nanotechnology is available to undergraduates. "Nanotech raises the value of cross-disciplinary thinking to new heights. Our nano minor is an opportunity to meet this challenge for the future nanotech workforce," says Gary Rubloff —*Tom Ventsias*

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Impact is published four times a year by the Office of the Vice President for Research and is mailed to members of the mid-Atlantic research community and others who have an interest in the latest research at the University of Maryland.

Your comments and feedback are welcome; please email your comments to impact@umd.edu or fax them to Anne Geronimo, executive editor, at 301.314.9569.

If for any reason you would **not** like to receive this publication, contact us using the same information above.

PUBLISHER
Jacques S. Gansler
Vice President for Research

EXECUTIVE EDITOR
Anne Geronimo
Associate Director for Research Development

MANAGING EDITOR
Tom Ventsias

CREATIVE DIRECTOR AND PHOTOGRAPHER
John T. Consoli

ART DIRECTOR
Jeanette J. Nelson

RESEARCH PROFILE WRITERS
Karin Jegalian
Ellen Ternes

researchSPOTLIGHT

The pioneering leadership of **Ellen Williams**, Distinguished University Professor of Physics, has sparked the university's research efforts in nanoscience and biophysics for the past decade. Now, with a major award from the W.M. Keck Foundation, a new laboratory for combinatorial nanosynthesis and multiscale characterization allows Williams and other Maryland scientists to continue to build upon their research.

These efforts contributed to the recent $10-million, six-year renewal of funding from the National Science Foundation for the Maryland Materials Research Science and Engineering Center.

The **Keck Laboratory** is just one of three new labs in the Jeong H. Kim Engineering Building that will propel the Maryland NanoCenter to the forefront of research and education in nanotechnology. For a detailed look, including schematics and a comprehensive listing of resources, go to **www.nanocenter.umd.edu.**

Front image (top, left) courtesy of Ichiro Takeuchi, materials science and engineering.

UNIVERSITY OF MARYLAND
Office of the Vice President for Research
2133 Lee Building
University of Maryland
College Park MD 20742-5121

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