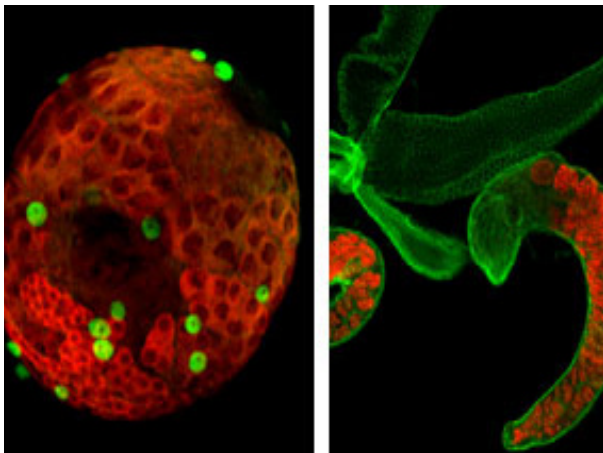


## Integrated Imaging Center Brings It All Into View

Seeing something as small as a nanometer—just about three to five atoms wide—requires highly advanced imaging techniques.

Faculty affiliated with Johns Hopkins University's Institute for NanoBioTechnology and researchers from a wide range of disciplines across divisions at JHU will find advanced, comprehensive, and highly precise methods of imaging at the Integrated Imaging Center (IIC) at JHU's Homewood Campus.

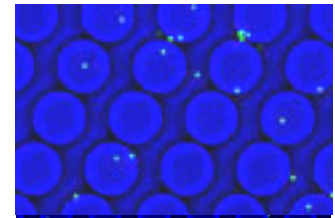
Everyone is invited to see firsthand what IIC has to offer at the center's annual open house, co-sponsored by Carl Zeiss and FEICO, on Sept. 21, 2007 from 3 to 6 p.m. IIC's 2,500 square-foot facility is located on the first floor of Dunning Hall.



*Confocal images. Left: Early stage (third larval instar) wild-type (normal) Drosophila testis showing germ cells (red) and cell surface and pigment cell nuclei (green).*

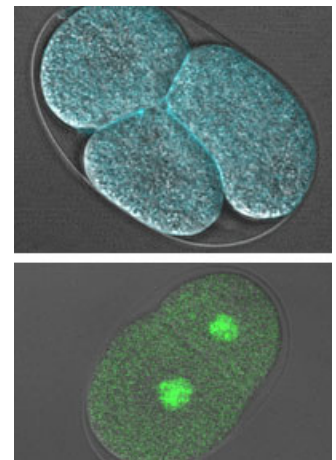
*Right: Mutant Drosophila adult testis showing germ cells (red) and cell surface and fusome (green).  
Credit: Van Doren Lab/JHU*

IIC's facilities help scientists and engineers characterize nanomaterials at very small length scale as well as biologists studying complex cellular and subcellular interactions. Microscopy services at IIC also aid developers of medical applications investigate the interface between materials and biological systems and basic biomedical researchers describe nano-sized drug delivery systems.



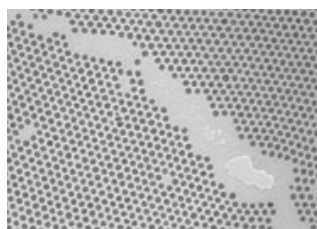
*Confocal image. Observation of green fluorescent nanoparticles (~90 nm in diameter) traveling through a micropost obstacle course.  
Credit: Drazer / JHU*

The center boasts more than \$3.5 million worth of state-of-the-art imaging equipment, including one of only two uniquely configured laser scanning microscopes in the United States. The goal of IIC, says center director J. Michael McCaffery, an associate research professor in the Department of Biology, is to provide the Johns Hopkins community, as well as other academic institutions, industry, and government, with resources for both conventional and advanced methods of light and fluorescence microscopy services. IIC's 2,500 square-foot facility is located on the first floor of Dunning Hall.



*Confocal image. Developing embryo of C. elegans. PIE-1 protein tagged with green fluorescent protein to monitor asymmetric cell division.  
Credit: Wirtz Lab/JHU*

“As rapid advances have been made in the development of new techniques of fluorescence and electron microscopy, visualization and localization of biomolecules at the light and electron microscope level has become an essential component of any comprehensive study of molecular cell biology,” McCaffery says. “This is because light and electron microscopy observations provide detailed information on the distribution, movement, and interaction of biomolecules or proteins within the cell that cannot be obtained by other methods.”



*Transmission electron microscope (TEM) image of self-assembled monolayer of spherical cobalt nanoparticles (~12 nm diameter) from a solution of hexane/octadecene. Credit: Searson Lab/JHU*

To anticipate the changing demands of research in a variety of disciplines, McCaffery says, IIC has added new equipment in recent months. A highlight includes a Zeiss laser scanning microscope (LSM) 510 VIS confocal with a Confocor 3 fluorescence correlation spectroscopy (FCS) module.

“There is only one other system of its kind in the U.S. that combines the FCS with confocal imaging and that is capable of cross-correlation,” McCaffery says. “FCS allows for high-resolution spatial and temporal analysis of single biomolecules with respect to diffusion, binding, and enzymatic reactions in vitro and in vivo.”

Other new additions include a FEI Tecnai 12 TWIN 120kV high resolution (<2 nm) transmission electron microscope (TEM); a FEI Quanta 200 environmental scanning electron microscope (ESEM), and a dual camera Marianas 4D light microscope (LM) live cell imaging workstation.

The ESEM has proved to be very popular, McCaffery says, because of its ability to “image fully hydrated/wet samples with minimal preparation.” In traditional scanning electron microscopy, samples must be dehydrated and coated with a metal prior to imaging. In the ESEM mode, McCaffery explains, “you can use a peltier stage to achieve relative humidity at any temperature or pressure in order to image live samples with minimal surface tension induced drying artifacts.”

The center features five suites devoted to specific imaging functions. These include a ultramicrotomy/tissue culture/cell prep room; a wet laboratory; “scanning room,” which includes the Quanta ESEM and Typhoon phosphorimager; a transmission electron microscopy suite with two TEMs; and a multifunctional light microscopy suite, which includes the Marianas 4D LM, Zeiss LSM 510 VIS confocal with Confocor 3 FCS, LSM 510 META UV confocal, and two Zeiss epifluorescence microscopes. Knowledgeable IIC staff members are available to answer questions or assist with the use of all equipment. Grants from the National Institutes of Health, National Science Foundation, and Howard Hughes Medical Institute help fund the additions to IIC.

The Homewood campus IIC was established in 1998. Additional advanced imaging services have been available at the Montgomery County Campus IIC since 2004.

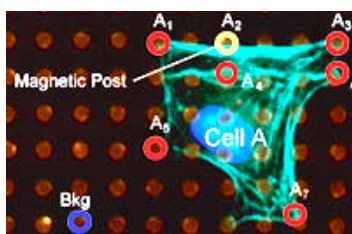
*To learn more about the Integrated Imaging Center at JHU or to schedule an appointment to use the facilities, please go to the IIC Web site:*  
<http://www.jhu.edu/~iic/>.

*To view images from the IIC visit:*  
<http://www.jhu.edu/iic/gallery.htm>.

*For other JHU research facilities visit our facilities page:* <http://inbt.jhu.edu/facilities.php>. ○

## Nanowire Device Gives Insight into Cell Forces

A nanoscale device, developed by a team of researchers from Johns Hopkins University and the University of Pennsylvania, provides previously unknown information on how cells react to environmental forces.



*Immunofluorescent micrograph of cell A under force stimulation by a magnetic micropost. (PNAS, Sept. 5, 2007)*

The device offers a better understanding of cell mechanics and a potential means for scientists to compare how healthy and diseased cells react to forces. This knowledge, in turn, could spur the develop-

ment of novel drug therapies, researchers say.

The team's findings are reported in Proceedings of the National Academy of Sciences (Early Online Edition, Sept. 5, 2007).

Daniel Reich, Johns Hopkins University professor of physics and Institute for NanoBioTechnology affiliated faculty member, explains that the device uses an array of microposts that are 3  $\mu\text{m}$  (micrometers) in diameter and 10  $\mu\text{m}$  in length.

To this "carpet," the team introduced magnetic cobalt nanowires. To measure the cells' reaction to forces, a magnetic field was applied to the array. The nanowire enhanced (magnetic) microposts pushed on the cells as the posts attempted to align with the magnetic field. Changes in the deflections of the surrounding nonmagnetic posts were used to report on the individual cells' reaction to external force.

In much the same way that the whole human body

would react if poked with a pin in one part, the entire surface of the cell reacted in response to forces applied remotely.

"The contractile tension of a cell is a complex thing," Reich says. "This system allows you to stimulate one spot but to measure reaction globally."

Surprisingly, the response of the cells in the experiments was strongest, not at locations close to the point of force application, but at remote points on the periphery of the stimulated cells.

With this nanowire-based system, Reich adds, "We can see how the whole cell responds to a locally applied force. This technique has the potential to open up new lines of research into how mechanical changes in cells are transduced into cell function."

*Read the full-text article: Nathan J. Sniadecki, Alexandre Anguelouch, Michael T. Yang, Corinne M. Lamb, Zhijun Liu, Stuart B. Kirschner, Yaohua Liu, Daniel H. Reich, and Christopher S. Chen. Magnetic microposts as an approach to apply forces to living cells. PNAS, (Sept. 5, 2007, online before print) at <http://www.pnas.org>. ○*

## Risk Assessment Minor in Development at JHU

Nanotechnology involving materials and devices at extremely small length scales—sometimes just a few atoms wide—is providing novel solutions to health and environmental problems. Nano-sized components are found in hundreds of applications, from targeted cancer therapies to stain-resistant clothing.

So that the scientists and engineers of the future will be better prepared to answer questions regarding nanotechnology, Johns Hopkins University faculty members specializing in disciplines rang-

ing from engineering to public health are collaborating to develop a new undergraduate minor in nanotechnology risk assessment and public policy. Funding for development comes from a two-year, \$200,000 National Science Foundation grant and will be administered through the Johns Hopkins Institute for NanoBioTechnology (INBT). If their work goes as planned, faculty members anticipate that the minor will be ready to accept its first students by the fall of 2009.



*Funding for development of the minor comes from a two-year, \$200,000 National Science Foundation grant*

with the development of nanotechnological solutions, as well as come to understand the risks presented by not developing some of these nanoscale solutions,” says Justin Hanes, associate professor in the Whiting School of Engineering (WSE), who co-authored the grant with Edward Bouwer, WSE professor and director of the Center for Contaminant Transport, Fate, and Remediation, and Jonathan Links, professor in the Bloomberg School of Public Health (BSPH). All are INBT affiliated faculty members.

“Nanoparticles are small enough to cross cell membranes. They also possess a large surface area, which enhances their reactivity,” Links says. “However, little research has been done to examine the toxicity potential of these ultrafine particles. Some concerns have been based only on the extrapolation of studies on other substances such as quartz, asbestos or particulate air pollution.”

Students in the nano-risk minor will explore both the scientific properties of nanomaterials and the public policy ramifications of their use.

“We want them to learn about the potential risks associated

Bouwer adds, “The proposal makes clear that the effects of nanoparticles on public health or the environment are not well understood. The program’s goal is to train scientists who are better prepared to lead research, development, and eventual commercialization of safe nanotechnologies.”

The new minor will likely involve a suite of courses on topics such as risk science and public policy; nanotechnology ethics, law and policy; environmental engineering; emerging environmental issues; environmental health; public health; and public health toxicology. Faculty members who will develop or teach the courses are affiliates of INBT, WSE, and BSPH, as well as the Risk Sciences and Public Policy Institute, Berman Institute of Bioethics, Center for Law and the Public’s Health, and Center for Educational Outreach (CEO).

“The program complements with the large group of students in the Public Health Studies major who also explore environmental health, health policy and other public health-related topics, but from a broader perspective,” says James Yager, senior associate dean for academic affairs at BSPH.

A new course to be offered in the spring of 2008—Nanobiotechnology 101—and developed by INBT co-directors Peter Searson, professor of Materials Science and Engineering and Denis Wirtz, professor of Chemical and Biomolecular Engineering, will likely be a prerequisite of the nano-risk minor.

“The combination of leading faculty from across disciplines in the University exemplifies the mission of INBT by blending and leveraging expertise,” Searson says. “It is a marvelous opportunity to bring together pre-existing, but largely separate, activities in nanotechnology within the university to impact our students and beyond.”

## **Additional INBT Training Opportunities**

In addition to this new minor, INBT administers three other educational programs including the graduate Nano-Bio Medicine program funded by the Howard Hughes Medical Institute, the Integrative Graduate Education and Research Traineeship in Nanobiotechnology funded by the National Science Foundation, and a summer Research Experience for Undergraduates program.

Part of the proposal for the nano-risk minor requires that students from these graduate training programs be involved by training of K-12 classroom instructors through the Center for Educational Outreach (CEO). CEO will translate components of the coursework for use in science, technology, engineering, and mathematics curriculums in underprivileged school settings. ○

## **Writer, Media Relations Coordinator Joins INBT Staff**

The Institute for NanoBioTechnology welcomes Mary Spiro as its science writer and media relations coordinator. Her duties include creating copy for the Web site, writing articles for the INBT newsletter, working with internal and external media outlets to promote INBT activities, and coordinating media relations for INBT-affiliated faculty members.

Before coming to Johns Hopkins University, Spiro was an editor in the Office of External Affairs for the University of Maryland, Baltimore where she helped edit the university's research and scholarship publication, Maryland magazine, and the School of Pharmacy's alumni publication, Capsule.

She has several years experience in corporate communication, including serving as public relations specialist for Carroll Hospital Center in Westminster, Md. and as writer-editor for Sinai Hospital in

Baltimore. Spiro worked as a newspaper reporter for a daily paper in Manhattan, Kan. and as a radio announcer for a National Public Radio affiliated station at the University of Illinois at Urbana-Champaign. She also has published freelance lifestyle articles in Carroll Magazine, book reviews in ForeWord Magazine, and feature articles in Kansas City's alternative newspaper Pitch Weekly.

Originally from San Diego, Calif., Spiro grew up in Oxon Hill, Md. She was recently admitted to the Krieger School of Arts and Sciences Advanced Academic Programs M.S. in Biotechnology. She earned a B.S. in journalism from the University of Maryland, College Park and an additional B.S. in agronomy, also from UMCP.

Spiro is ready to assist INBT-affiliated faculty with the promotion of their research to internal (JHU) and external media outlets. Please feel free to contact her to discuss possible story ideas. She may be reached at [mSpiro@jhu.edu](mailto:mSpiro@jhu.edu) or by phone at 410-516-4802. ○

## **Second JHU NanoBio Symposium Set for May 2008**

Nanotechnology applications for treatment and research in cancer, neuroscience, and radiology will be the focus of a new workshop program planned for the second annual Johns Hopkins University Nano-Bio Symposium, scheduled for May 1-2, 2008, at the School of Medicine on the East Baltimore campus.

Academic and clinical faculty members are invited to join students, staff, and representatives from nanobiotechnology related business and industry for a stimulating and enriching two-day event. The 2008 symposium also features talks by the world's leading experts in nanobiotechnology, a poster session representing research from four Hopkins

divisions, and the newly added Thursday afternoon workshop.

“The 2007 inaugural Nano-Bio Symposium drew nearly 400 attendees, and the 2008 event is expected to draw even more participants,” says Peter Searson, a professor of Materials Science in the Whiting School of Engineering and director of the Institute for NanoBioTechnology, which organizes the symposium.

To date, confirmed speakers for the 2008 Johns Hopkins University Nano-Bio Symposium include:

Donald E. Ingber, M.D., Ph.D.  
Judah Folkman Professor of Vascular Biology  
Department of Pathology, Harvard Medical School  
Vascular Biology Program, Children’s Hospital

Andrew D. Maynard, Ph.D.  
Chief Science Advisor, Project on Emerging Nanotechnologies  
Woodrow Wilson International Center for Scholars

Jennifer L. West, Ph.D.  
Isabel C. Cameron Professor of Bioengineering  
Rice University

Participant registration and guidelines for poster submission will be available soon at INBT’s Web site, <http://inbt.jhu.edu>.

Sponsorships opportunities are available now. For information about sponsorship opportunities, contact Mary Spiro, INBT’s media relations coordinator, at [mSpiro@jhu.edu](mailto:mSpiro@jhu.edu), or call 410-516-4802. ○

## More Online

The following articles can be accessed through the INBT Web site at <http://inbt.jhu.edu>.

### **INBT Affiliates to Present at Vascular Medicine Meeting**

Several affiliated faculty members of the Institute for NanoBioTechnology will present during the Johns Hopkins Vascular Medicine Research Initiative Inaugural Conference on Monday, Sept. 24.

### **INBT Grant Proposal Service: Formula for Funding Success**

In an effort to maximize the possibilities for nanobiotechnology research at Johns Hopkins University, INBT not only brings faculty together but offers them help to prepare and submit nanobiotechnology related proposals.

### **Public Health Effects of Nanobiotechnology Discussed on Video**

Jonathan Links, professor at the Johns Hopkins Bloomberg School of Public Health and executive committee member of the Johns Hopkins Institute for NanoBioTechnology, recently spoke with editor Brian W. Simpson about the public health aspects of this new technology. The entire interview was captured on video. ○

Hopkins NanoBioNews is the bimonthly newsletter published by the Institute for NanoBioTechnology at Johns Hopkins University.

INBT brings together more than 145 Johns Hopkins faculty and their students using nanotechnology to generate new knowledge, tools, and techniques in medicine and health. Research and education is focused in three core areas: diagnostics and therapeutics, cellular and molecular dynamics, and health and the environment. Visit our Web site for more information. <http://inbt.jhu.edu>.

Have a story idea or feedback? Contact our editor Mary Spiro at [mSpiro@jhu.edu](mailto:mSpiro@jhu.edu).

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