NanoBio News

The newsletter of the Institute for NanoBioTechnology at Johns Hopkins University

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Johns Hopkins NanoBio Symposium Set for May 1-2: New workshop focuses on nanotechnology for cancer

All facets of research relating to the emerging discipline of nanobiotechnology—a science that operates at the scale of one-billionth of a meter—will be explored at the second annual Johns Hopkins NanoBio Symposium, May 1-2, 2008. This year’s event will be held at the Johns Hopkins School of Medicine in Baltimore, Md. and is hosted by the Institute for NanoBioTechnology (INBT).

Nearly 400 people attended the inaugural Johns Hopkins NanoBio Symposium. Due to this enthusiastic response, institute leaders chose to expand the 2008 event to two days. “Nanotechnology for Cancer” will be the focus of Thursday’s workshop, co-hosted by the Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins. This workshop features short presentations and engaging discussions with several Johns Hopkins faculty experts working in areas relating to nanobiotechnology. It will be held in the Koch Cancer Research Building’s Owens Auditorium from 2-5 p.m.

“Advances in nanotechnology coupled with our increasing understanding of cancer make it a uniquely exciting time for a Nanotechnology for Cancer workshop. Nanotechnology promises powerful new tools for both the study and management of this deadly disease,” says Kenneth Kinzler, professor of oncology in the School of Medicine, director of the Ludwig Center, and INBT executive committee member. Along with Kinzler, INBT-affiliated Johns Hopkins faculty who plan to present at the Nanotechnology for Cancer workshop include Justin Hanes and Konstantinos Konstantopoulos, associate professors in the schools of Engineering and Medicine; Anirban Maitra, associate professor in the School of Medicine; Martin Pomper and Jonathan Schneck, professors in the School of Medicine; and Peter Searson and Denis Wirtz, professors in the School of Engineering. Luis Diaz, assistant professor of oncology at the

Invited speakers include

1 - Paras N. Prasad, Ph.D., director of the Institute for Lasers, Photonics, and Biophotonics at the University at Buffalo
2 - Jennifer L. West, Ph.D., professor of bioengineering at Rice University
3 - Donald E. Ingber, M.D., Ph.D., professor or vascular biology from the Harvard Medical School
4 - Andrew D. Maynard, Ph.D., chief science advisor for the Project on Emerging Nanotechnologies at the Woodrow Wilson International Center for Scholars
5 - Jeffery A. Schloss, Ph.D., from the National Human Genome Research Institute

See Web site for profiles.
Kimmel Cancer Center, will present a talk on clinical cancer.

On Friday, the symposium continues in the Turner Auditorium from 9 a.m. to 12:30 p.m., with talks from internationally recognized scholars who specialize in various aspects of nanobiotechnology.

Invited speakers include Donald E. Ingber, M.D., Ph.D., professor of vascular biology from the Harvard Medical School; Andrew D. Maynard, Ph.D., chief science advisor for the Project on Emerging Nanotechnologies at the Woodrow Wilson International Center for Scholars; Paras N. Prasad, Ph.D., director of the Institute for Lasers, Photonics, and Biophotonics at the University at Buffalo; Jeffery A. Schloss, Ph.D., from the National Human Genome Research Institute; and Jennifer L. West, Ph.D., professor of bioengineering at Rice University.

“Symposium attendees will have the opportunity to learn about leading-edge technologies and recent scientific breakthroughs from experts using nanoscale solutions to solve problems in health care and medicine, all at one meeting,” says Peter Searson, institute director and professor of materials science and engineering in the Whiting School of Engineering.

The symposium will conclude with a Friday afternoon poster session displaying research from across Johns Hopkins University, as well as from government and industry. The poster session will be held in Turner Concourse from 2-4:30 p.m.

“This is a terrific opportunity for those engaged in nanobiotechnology related research in an academic or commercial setting to showcase their research together at one of the leading medical institutions in the world,” says Denis Wirtz, associate director of INBT and professor of chemical and biomolecular engineering in the Whiting School of Engineering.

Student posters will be judged, and prizes include 2-year and 1-year subscriptions to the peer-reviewed journal Nature Nanotechnology (valued at $259, and $152 respectively).

All attendees are encouraged to present posters, subject to INBT approval. There is no cost for JHU-affiliated faculty, staff, students and postdoctoral fellows to attend, but online registration is required. Non-affiliated individuals must pay a registration fee, which is listed on the registration form. Registration and guidelines for poster submission are available at http://inbt.jhu.edu. The deadline for poster submissions is April 17, 2008, and the deadline for general registration without a poster is April 24, 2008.

“Nanoparticles in Biomedical Imaging,” is the title of a new book co-edited by Jeff W.M. Bulte, professor in the Johns Hopkins School of Medicine and affiliated faculty member of the Institute for NanoBioTechnology.

Hai-Quan Mao, assistant professor of materials science and engineering and affiliated faculty member of the Institute for NanoBioTechnology received a $500,000 National Science Foundation Faculty Early Career Development (CAREER) award.

Professor of materials science and engineering and INBT affiliate Howard E. Katz recently was honored with the title of inaugural Fellow of the Materials Research Society (MRS). He was one of 34 distinguished scholars who received this lifetime designation.

Go to http://inbt.jhu.edu for the full articles.
Cancer can’t hide from light of nanobiophotonics

2008 NanoBio Symposium Preview: Paras Prasad

People reap the benefits of the harvesting of photons every day. Printers, DVD players, remote controls, lasers, sensors, and other similar devices all are based on photonics. But Paras Prasad, director of the Institute for Lasers, Photonics, and Biophotonics (ILPB) at the University at Buffalo, says there is much more to learn about the interaction of light with materials and its role in biomedical research. Prasad will discuss this topic at the Johns Hopkins 2008 NanoBio Symposium on May 1-2, hosted by the Institute of NanoBioTechnology.

“Photonics, in a broad sense, deals with the emission, transmission, amplification, detection, modulation, and switching of light,” says Prasad. Through this manipulation of light, scientists and engineers are using photonics to discover new ways to deal with problems such as the diagnosis and treatment of disease or the generation and storage of energy.

For example, researchers at the University of Buffalo’s Institute for Lasers, Photonics, and Biophotonics have developed special kinds of plastic-based nanocomposites that can be fabricated into many structures and designs, including more efficient and larger-scale solar panels to gather the sun’s energy over the entire spectrum, including ultraviolet and infrared.

“Such hybrid nanocomposites can be used to harvest solar energy from larger structures in the form of tents, panels and coatings,” Prasad says. Patents in this area are on file and a California-based company is now working to develop its commercial applications.

Also exciting, Prasad says, are the scientific advances in areas that marry biology, nanotechnology and photonics—nanobiophotonics. At this interface of disciplines, scientists and engineers are breaking new ground in the realms of health care and medicine, he says.

(Left) Quantum dots targeting pancreatic cancer cells in vitro, and (right) Quantum dot biodistribution in tumor-bearing mouse following systemic injection. Credit: Paras Prasad
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For instance, Prasad says, funding from the National Cancer Institute supports a partnership between the UB institute and researchers at Hopkins to develop better ways to diagnose and treat pancreatic cancer. Prasad’s group, together with teams lead by INBT affiliated faculty members Anirban Maitra of the Sol Goldman Pancreatic Cancer Research Center and Martin Pomper at the In Vivo Cellular and Molecular Imaging Center, are working on a project that “accelerates the advance of photonics and nanotechnology out of the lab and into the cancer clinic,” he adds.

Pancreatic cancer is especially deadly, says Prasad, because survival rates are poor, even when a tumor is just barely observable at microscopic scales. Therefore early detection is critical to improve outcomes. The ILPB researchers have shown effective early detection of pancreatic cancer with quantum dots and metallic nanorods that have been conjugated with antibodies that specifically target pancreatic cells.

“We are developing diagnostic and treatment methods for pancreatic cancer that capitalize on our expertise in designing targeted hybrid ceramic-polymeric nanoparticles to better image pancreatic cancer in vivo and to deliver drugs more effectively to treat it,” says Prasad. “It is very exciting to see that these photonic technologies developed at the University at Buffalo are being applied to a disease where the need for earlier detection and more effective treatment is so pressing.”

During his talk, Prasad also plans to highlight other nanobiophotonics research at ILPB including nanoparticles for photodynamic therapy of cancer and the use of nanoparticles in gene therapy particularly in the brain and liver. Prasad says these nanoparticles hold exciting prospects for developing new approaches for dealing with health care concerns with high societal impact, such as obesity, drug addiction and new infectious diseases.

Metallic Nanoshells Shine Light on Cancer

2008 NanoBio Symposium Preview: Jennifer West

Clinicians may soon be able to add metallic nanoshells to the arsenal of weapons that they can use to preserve and protect human health. Metallic nanoshells—super tiny spheres composed of layers of differing materials—allow light to safely penetrate deep within tissues to help diagnose or treat disease, says bioengineer Jennifer West. West will discuss her current work with nanoshells at the second annual Johns Hopkins NanoBio Symposium, hosted by the Institute for NanoBioTechnology, on May 1-2 at the School of Medicine.

West is the Isabel C. Cameron Professor of Bioengineering at Rice University in Houston, Texas. She was previously named one of the world’s 100 Top Young Innovators by Technology Review.
Nanoshells continued...

the innovation magazine of the Massachusetts Institute of Technology, where she earned her undergraduate degree.

Nanoshells have the ability to be “optically tuned,” West says. “Depending on their size and composition, we can make them either absorb or scatter light anywhere in the electromagnetic spectrum.”

This property of optical tuning means nanoshells can either heat up locally to destroy tumor tissue or reflect light back to improve imaging—or both—over a range of light wavelengths. The materials used for each layer of the nanoshell determine the wavelengths over which the device can be tuned. A typical nanoshell can be fabricated by fusing an outer layer of a biocompatible metal, such as gold, over an inner core of silica, West says, though other materials also are used.

Since the nanoshells typically “tune” over a very narrow range of near infrared light (from 700-900 nanometers in the spectrum), they will neither heat up the water in tissues nor will they be absorbed by hemoglobin in blood or melanin in the skin, West explains. This property prevents the nanoshells from causing collateral damage to the surrounding tissues.

“A light shone from outside the body can pass harmlessly through tissue,” West says. “There is such deep penetration of light that this technology can be used for whole breast biopsy and whole brain imaging.”

The property of optical tunability also makes nanoshells an excellent tool for detecting viruses and bacteria in whole blood, West adds. Nanoshells with antibodies attached to their surfaces interact with the antigen in question and form clumps. The clumps diffuse the light reflected by the nanoshells, West explains, and one can determine the concentration of whatever is being studied by the degree of diffusion.

West says that she and the inventor of the nanoshell—Naomi Halas, the Stanley C. Moore Professor of Electrical and Computer Engineering and Professor of Chemistry at Rice—are currently working with a Texas firm to commercialize the use.

Nanoparticle Clusters Offer Surprises for Physical Chemists

Faculty profile: Kit Bowen Jr.

Extremely small scale materials behave differently than one might expect when they come into close proximity to one another. The principles of basic physical chemistry are not quite as clear cut as one might imagine. And it is these properties that inspire the research of Kit Bowen Jr., the E. Emmett Reid Professor of Chemistry in the Krieger School of Arts and Sciences and affiliated faculty member of the Institute for NanoBioTechnology.

Bowen studies the intermolecular action of nanoparticles and of clusters—aggregates of atoms and molecules. The study of size specific clusters provides an insightful means of addressing fundamental problems in physical chemistry, Bowen explains, and his lab is developing techniques to look at a very wide range of cluster
Nanoparticle clusters continued...

components in biological systems, chemistry problems and material science.

To study clusters, Bowen uses a very sensitive chemistry probe known as negative ion photoelectron spectroscopy, which is based on the fact that it takes a certain amount of energy to knock an electron from a negatively charged ion.

“The technique uses light to ionize excess electrons from negative ions,” Bowen says. “The measurement of the electrons’ energies gives information about the electronic structure of the neutral species produced when an electron leaves its anion.” Using this method, recent studies have discovered whole groups of chemical species, such as types of aluminum hydrides, not previously known to be possible. Another study co-authored by Bowen and published in *Science* (Feb. 15, 2008) examined electron-induced proton transfer in acid-base reactions.

“In terms of application of this research, it is more oriented toward fundamental principle studies,” Bowen says. “However, it could possibly be useful for future hydrogen storage applications, magnetic tapes, and as catalysts.”

In an academic setting, Bowen has been able to freely pursue novel ideas, something that might not be possible in industry. “Industry needs science to guide their production development just like sailors need the North Star to navigate at night,” he says, adding that collaboration has been important for his academic endeavors. “Every professor has different skills.”

Bowen’s passion for science is contagious and he is devoted to scientific outreach, realizing the importance of being exposed to science at a young age. In the past, some high school and even middle school students have spent time over the summer in Bowen’s lab. Some of the students chose to further their education in science as a result. Several have gone on to earn their PhD’s in chemistry or physics, he says.

Ziqiu “Tommy” Tong, pre-doctoral student in INBT’s NanoBio Med program, contributed to this article, which was written as part of the Intersession 2008 course requirements of Science Writing for Scientists and Engineers.
NanoBio IGERT Profile: Tania Chan

Tania Chan is a first year PhD student in materials science at Johns Hopkins University and member of the NanoBio IGERT with the Institute for NanoBioTechnology. IGERT stands for Integrative Graduate Education and Research Traineehip and is funded by the National Science Foundation.

Working with Michael (Seungju) Yu, associate professor of materials science and engineering and INBT affiliated faculty member, Chan has synthesized a protein, called QK, which mimics VEGF, the natural growth factor responsible for new blood vessel growth. The QK will be paired with a synthetic peptide that mimics natural collagen—a protein found in connective tissues, bone, muscle and skin. This synthetic combination will be used to modify collagen scaffolds with the long term goal of controlling microvasculature formation in artificial tissue and wound healing.

Born in Hong Kong, Chan spent most of her childhood in Southern California. She graduated from the Massachusetts Institute of Technology in June 2007 with a B.S. in materials science and a minor in biomedical engineering. Chan is especially interested in biomaterials. “It’s fascinating to me how we can make materials and put them into the human body to help a person heal and to regenerate tissue,” Chan says.

Chan enjoys research. As a sophomore, she worked in MIT’s bioengineering department, studying DNA mutation in yeast cells and its effects in colony formation and another project on DNA mutation in mice and its effects on colon tumors formation. As a junior, Chan worked at Harvard on a project on semiconductor nano-patterning, as well as a separate project at MIT that examined different collagen scaffold processing techniques.

Chan interned with Schlumberger, an oil field services company and helped develop a swellable elastomer, now patent pending. After one semester as a visiting scholar at Oxford, she returned for her final semester to “work on developing a polymeric vaccine delivery vehicle,” she adds. Chan presented her results at the Fall 2007 Materials Research Society meeting.

INBT’s NanoBio IGERT has afforded Chan the opportunity to indulge what she calls her “endless pursuit of knowledge.” When not in the lab, Chan loves to play and listen to music and is a classically trained pianist and singer.

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

INBT brings together 159 Johns Hopkins faculty and their students using nanotechnology to generate new knowledge, tools, and techniques in medicine and health. Visit http://inbt.jhu.edu for more information.

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