# ICTAS News

http://www.eng.vt.edu/ictas/

*To the community of Virginia Tech and to the families of the victims, we extend our heartfelt thoughts and prayers to help sustain us all during the healing process.*

# Top Virginia Officials to Speak at Dedication of Virginia Tech's Nanotechnology Building

Virginia Tech's Institute for Critical Technology and Applied Science (ICTAS) will dedicate its first building which will house the Nanoscale Characterization and Fabrication Laboratory (NCFL) and related office space at the Corporate Research Center on Sept. 21, 2007. The NCFL will allow Virginia Tech to have capabilities on a par with the best nanotechnology labs in the world.

The keynote speakers for the dedication will be: **The Honorable Aneesh Chopra**, Virginia's Secretary of Technology; **The Honorable Joe May**, the head of Virginia's Joint Commission on Technology and Science (JCOTS); and **Ray Martin**, retired Chief Executive Officer of Schnabel Engineering, and former co-chair of Virginia Tech's ICTAS Task Force.

## *Grand Opening: ICTAS Building A*

*Home of the Nanoscale Characterization and Fabrication Laboratory (NCFL)*

**Virginia Tech Corporate Research Center**
**September 21, 2007**
**4:00-6:00 p.m.**

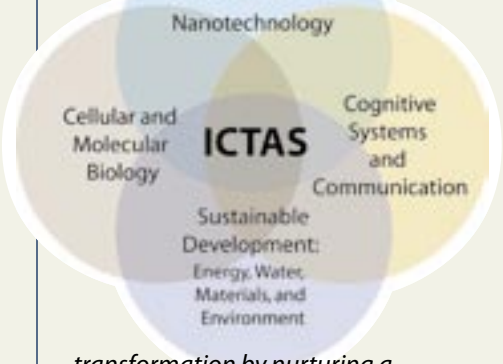
The building will provide 16,000 square feet for the NCFL laboratory plus 16,000 square feet for related office space. It will provide a collaborative home to existing and new state-of-the-art tools for fabrication, characterization and testing materials at the macro, micro, and nano scale as well as office space for faculty, staff, and students involved in these efforts.

The second ICTAS building, currently under construction, is expected to open during summer 2008, and will serve as headquarters for ICTAS and include approximately 100,000 square feet of research labs, offices, and workspaces. A third research building of approximately 77,000 square feet is in the design stages.

*The NCFL will allow Virginia Tech to have capabilities on a par with the best nanotechnology labs in the world.*

## WHAT IS ICTAS?

*The Institute for Critical Technology and Applied Science (ICTAS) was founded on the premise that Virginia Tech's existing research strengths should be leveraged and promoted to position the university as a leader in research on the state, national, and international level. The institute will accomplish this through coordination of the university's talented and creative faculty in the pursuit of interdisciplinary and multi-disciplinary research. Entrepreneurial and dynamic in nature, ICTAS will lead technology*




*transformation by nurturing a proactive, responsive, and nimble research culture, ultimately positioning Virginia Tech as an agent of discovery and problem solving in the technological and scientific global environment. In particular, ICTAS will foster the exploration of opportunities for societal enhancement and preservation for future generations.*

message from the university president

# Reaching World-Class Excellence Through Research

*Charles W. Steger*
*President, Virginia Tech*

Virginia Tech is involved in one of the most profound transformations in the institution's history. The transformation will be accomplished through long-term investment in building world-class excellence in faculty, students, scholars, and researchers and recognition of the capability to make a difference in a dynamic global environment. The basis for our transformation has been established through refinement to strategic and campus master plans. These plans focus our resources on key elements and identify innovative leaders to coordinate implementation and ensure success.

ICTAS is a major component of the university's overall blueprint for successful transformation. With recognition of the need to maintain economic competitiveness while sustaining quality of life, ICTAS will lead the university to new ideas, discoveries, partnerships, and productivity through interdisciplinary collaboration and skillful leveraging of resources.

On July 1, 2006, Dr. Roop Mahajan joined ICTAS as the first full-time director. Mahajan is an internationally known researcher with expertise ranging from nanotechnology to bio- micro-electro-mechanical systems. He gained significant research and management experience through three decades with AT&T Bell Labs and the University of Colorado at Boulder. His experience as founder and leader of research teams and centers of excellence has contributed to his strong vision of the future for university research and a well-evolved sense of what needs to be done to keep the university at the forefront of technological development.

The Commonwealth of Virginia has committed to significant investment in academic research. This commitment was recently demonstrated through the investment of more than $250 million in seed money distributed among the public universities in the state. This investment — known as the Commonwealth Research Initiative — is a revolutionary undertaking for the state and is undeniable evidence that our political leadership is recognizing the link between academic leadership and an economically strengthened future for the Commonwealth.

Through ICTAS, the Commonwealth Research Initiative funding has enabled purchase of specialized equipment that will allow researchers to examine and manipulate materials and organisms existing at the cellular, atomic, and sub-atomic levels. This equipment will be housed in the first of three ICTAS buildings in a collaboration-friendly environment. This positive, intellectual climate is a natural lead to productive exploitation of our intellectual capital, resulting in the generation of ideas and innovation that will spawn business development for many years into the future.

It is with great pleasure, pride, and expectation that I extend hearty and enthusiastic support to one of our greatest assets in our quest for excellence.

message from the director

# ICTAS: Investing in Transformation at Virginia Tech

*Roop Mahajan*
*Director, ICTAS*

It is a great honor and responsibility to have accepted the position of Director of the Institute for Critical Technology and Applied Science last fall. The key factor in my decision was the opportunity offered by ICTAS to bring interdisciplinary talents at Virginia Tech to bear on society's scientific and technological challenges of our times. To this end, we have identified and embarked on a number of strategic research initiatives consistent with our philosophy of investing a majority of our resources in a few selected areas in which we can aspire to be among the top in the nation. These include:

**Nanoscale Science and Engineering** including nanomaterials, carbon nanotubes and fullerenes, nanosensors, nanocomposites and molecular transistors.

**Cellular- and Bio-engineering** including targeted delivery of nanomedicine, cellular electro-mechanical systems (CEMS), nanobio devices, bioimaging, and biomedicine.

**Sustainable Energy** solutions with focused research on solid oxide, chemically and biologically derived fuel cells, nanophotovoltaic cells, and renewable energy systems.

**Renewable Materials, Water, and Environment** including research on management of metropolitan bodies of water, utilization and development of renewable materials, Green Engineering, and environmental nanoscience and technology.

**Cognitive Systems and Communications** including human-computer interfaces and interactions, spatial cognition, immersive virtual environment, cognitive radio and networks, and advanced computing.

In addition to investments in the strategic research initiatives, ICTAS is invested in other ongoing initiatives such as the School of Biomedical Engineering and Sciences (SBES), Virginia Center for Autonomous Systems (VaCAS), Wireless at Virginia Tech (W@VTech), Virginia Tech Transportation Institute (VTTI), Center for Innovation in Construction Safety and Health (CICSH), Materials Center of Excellence (MCOE), and Next Navy Composites ($N^2C$).

In support of the ongoing and new cutting-edge areas of research, two new ICTAS research facilities are currently under construction and a third is in design.

Recognizing that faculty and graduate students form the life blood of a top ranked research university, ICTAS is working with and assisting departments across the campus to recruit highly talented young faculty for sustained excellence in strategic areas of research. We have also initiated the new ICTAS Doctoral Scholars program to honor exceptional Ph.D. applicants.

Finally, to honor our top-notch faculty, we plan to initiate an ICTAS Faculty Fellow Program. Designed after the prestigious Fellow Awards in Bell Labs and other institutions, it will be limited to 0.1 percent of the faculty per year with a lifetime cap of 1 percent. This program is still in the early stages of formulation and details will be announced as we sort through the resources to fund it.

During this year, we have planned a number of activities to enhance communication with the university community, state and federal funding agencies, Virginia Tech alumni and industry. These include, among others, this quarterly newsletter, a series of Technology Alerts, a seminar series, and intellectual /social get-togethers among the ICTAS Awardees.

ICTAS has embarked upon an exciting journey to help Virginia Tech reach higher level of excellence and performance in research and education. We invite you to join us and we seek your active support to reach our destination.

message from the chair of the ICTAS stakeholders' committee

# ICTAS – A Remarkable Growth Story

*Richard C. Benson*
*Dean of Engineering;*
*Chair, ICTAS Stakeholders Committee;*
*Paul and Dorothea Torgersen Chair of Engineering*

Dear Friend of ICTAS:

At Virginia Tech, we have ambitious goals in research and graduate education, and ICTAS, under the leadership of director Roop Mahajan and led by the College of Engineering, is helping us realize our aspirations.

ICTAS is a remarkable growth story for Virginia Tech. Permit me to elaborate.

In the early part of this decade, the University made the decision to proceed with the idea of creating a research institute. A devoted core of engineering and science alumni helped to provide the groundwork to launch this new model of conducting research at Virginia Tech. Committees composed of faculty and administrators from several of Virginia Tech's colleges as well as the central administration planned the Institute's financial model and governing structure. With the groundwork done, we went to work.

In 2005, we started construction on the first ICTAS building. As many of you know, and as is mentioned in greater detail elsewhere in this inaugural newsletter, ICTAS A in the Corporate Research Center is home to the Nanoscale Characterization and Fabrication Lab (NCFL). It gives us capabilities in nanotechnology on a par with the best labs in the world.

A formal dedication of the NCFL is planned for the fall 2007 meeting of the College of Engineering's Advisory Board and Committee of 100. This will be an excellent opportunity for many of our greatest benefactors to see the excellent progress being made by ICTAS.

In 2006, we broke ground on ICTAS I, and the Virginia General Assembly included funding for the ICTAS II building. ICTAS II is under design.

In 2006, we also successfully recruited Roop Mahajan who emerged from a highly competitive search and brings to Virginia Tech a 27-year record of research excellence at Bell Labs and the University of Colorado. Dr. Mahajan is an internationally known researcher with expertise ranging from nanotechnology to bio- micro-electro-mechanical systems (Bio-MEMS). Dr. Mahajan's efforts in these interdisciplinary fields, as well in cellular engineering microsystems (CEMS), artificial neural networks, humanistic engineering, thermal sciences, and solar energy, makes him a true Renaissance man for the ICTAS directorship.

Later this summer, ICTAS will be the centerpiece of an August meeting of the Commonwealth of Virginia's Joint Commission on Technology and Science (JCOTS) to be held in Blacksburg. This will go a long way in showcasing Virginia Tech's growing capabilities in engineering and science with key senators and delegates of the Commonwealth.

In summary, ICTAS, in less than two years, has hired a renowned director, built a new building with the finest state-of-the-art equipment dedicated to efforts in advanced materials, begun construction of a second new building to open in 2008, and started the design of a third building. We are realizing early research successes with our School of Biomedical Engineering and Science, part of ICTAS, as well as with our nanotechnology efforts.

We hope you share in the excitement ICTAS is bringing to the Virginia Tech campus and to the Commonwealth.

# ICTAS EVENTS

## ICTAS Grand Opening

The first of three planned ICTAS buildings, ICTAS A, will be dedicated on September 21, 2007. Please see page 1 for full details.

## ICTAS Seminar Series

Renowned researchers led the way in launching the **ICTAS seminar series** this spring.

**Dr. John Lehman**, Project Leader for Laser Radiometry with the National Institute of Standards and Technology (NIST), presented "The Dark Side of Carbon Nanotubes" on February 15. A winner of the prestigious NIST Allen V. Astin Measurement Science Award "for excellence in development of state of the art standards, forming the basis of an international system for optical power and energy measurements," Dr. Lehman's current research includes investigation of the optical properties of carbon nanotubes and the development of improved optical detectors for laser and optical-fiber power measurements. This event was co-sponsored by ICTAS and the department of Engineering Science and Mechanics and Chemistry.

**Dr. R. Lee Penn**, Assistant Professor in the Chemistry Department of the University of Minnesota, presented a talk on "Chemical, Physical, and Structural Properties of Oxide Nanoparticles" on March 12. Dr. Penn has been working with nanoparticles since the early 90s and has a passion for understanding their fundamental formation and growth mechanisms, how they are involved in chemical transformations in the environment, and elucidating the link between magnetism and the physical and chemical properties of nanoparticles. This event was co-sponsored by ICTAS and the chemistry and geosciences departments.

**Dr. Tissa Illangasekare**, the AMAX Distinguished Chaired Professor of Environmental Science and Engineering at the Colorado School of Mines, Director of the Center for Experimental Study of Subsurface Environmental Processes, AAAS Fellow, and NSF Program Manager, presented "Intermediate-scale Testing for Process Understanding, Model Validation and Upscaling of Flow and Transport in Heterogeneous Subsurface Systems" on April 6. Dr. Illangaasekare has 28 years of experience with numerical modeling of saturated and unsaturated flow in soils, surface-subsurface interaction, integrated modeling of hydrologic systems, flow in snow, subsurface chemical transport, and multiphase flow and physical model testing. This event was co-sponsored by ICTAS and the civil and environmental engineering department.

**Dudley S. Finch**, co-founder of AISthesis LLC in Ashland, Oregon and former professor of Mechanical Engineering at the University of Colorado and NIST materials Reliability Division in Boulder, CO, presented "Experimental, Environmental and Engineering Challenges of Investigating Nano/Bio-Materials Interface" on April 6. Dr. Finch's research specialty is the application of microscopy techniques (FE-SEM, ESEM, TEM and FIB) and spectroscopic techniques (FTIR, Raman, XPS and AES) to the study of structure-property relationships and biomaterials interfaces. This event was co-sponsored by ICTAS and the materials science and engineering department.

## Other Events

### JANUARY

**Nanotechnology Day:** Dr. Roop Mahajan participated in the first "Nanotechnology Day" at the General Assembly on January 24. This event was established in response to a recommendation from the Joint Commission on Technology and Science (JCOTS) to coincide with other technology events at the Capitol on the same date.

### FEBRUARY

**ICTAS Doctoral Scholars Program:** Five colleges, the Graduate School, and ICTAS combined resources to support and announce an innovative new scholar program. Please see the article on page 7 for more details.

### MARCH

**Renewable Materials Kick-off:** More than a dozen researchers interested in renewable materials research met on March 12 to brainstorm and further establish synergy among interests, strengths, and potential.

**Engineering Faculty Organization (EFO) Meeting:** On March 16, Dr. Roop Mahajan discussed ICTAS vision, goals, and expectations with participating members of the EFO.

### APRIL

**GSA Research Symposium Award Ceremony:** Dr. Roop Mahajan delivered the April 5 Keynote Address highlighting the connections between critical technologies and graduate education and research.

### MAY

**Call for Proposals:** The ICTAS annual call for proposals, released in mid-May, offers the opportunity to submit proposals for funding during the 2007-08 fiscal year.

**Proposal Evaluation:** Reviewer evaluation of proposals received in response to the annual ICTAS call for proposals occurs during May and June.

### JUNE/JULY/AUGUST

**Funding Opportunities:** Funding decisions for 2007-08 to be announced in late June.

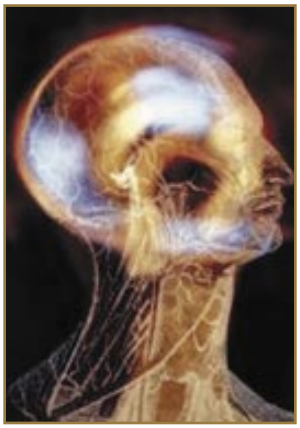
**JCOTS Visit:** Officials of the Joint Commission on Technology and Science (JCOTS) meet at Virginia Tech on August 13, 2007. ICTAS will be featured.

FEATURE ARTICLE

# The School of Biomedical Engineering and Science (SBES) – A Stellar Partnership

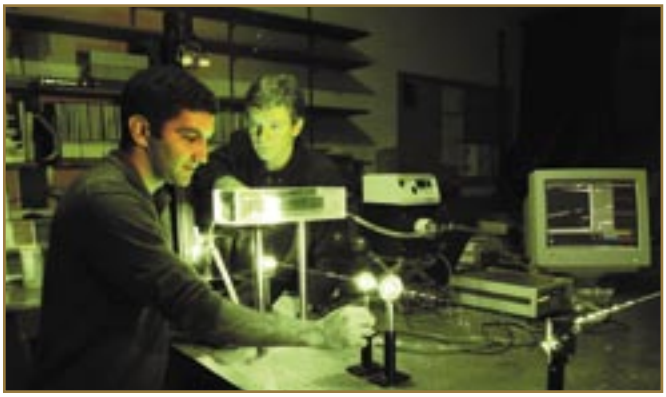
The School of Biomedical Engineering and Science, a collaborative partnership between Virginia Tech and Wake Forest University School of Medicine, exemplifies the premise upon which ICTAS was founded – a collaborative interdisciplinary environment that encourages researchers and ideas to prosper across conventional disciplinary lines.

Originally, both Virginia Tech and Wake Forest recognized a need to strengthen existing research focus in biomedical engineering. Virginia Tech lacked a medical school and Wake Forest lacked an engineering college and veterinary program. Teaming to offer what each needed posed a win-win opportunity. This pioneering conclusion is now well implemented through the establishment of a school that is uniquely structured to facilitate interaction. Virginia Tech is connected to research and development at the clinical level, while Wake Forest builds on the quantitative perspective that access to research engineering and veterinary faculty provides. Both universities are better positioned to respond quickly to surfacing needs — the very essence of critical technologies — those that advance the industry, often leading to other applications that may not be apparent early in the process, and frequently require a jump forward in the understanding of the underlying science and engineering.



*Enhanced image of an MRI scan of the human head and neck region.*

SBES is a strong component of the ICTAS cellular- and molecular biology strategic focus area. SBES provides core leadership through growth of visionary research to advance human discovery in human tissue engineering. The ability to provide this leadership is supported through the production of students who are qualified engineers with strong life science knowledge, the introduction of engineering into traditional medical school subjects, specialty course work that relates engineering to regenerative medicine,



*Students developing techniques for tracing particles in fluid flow through the heart. Laser light and optical tracking are being utilized to characterize the nature of fluid flow around artificial heart valves.*

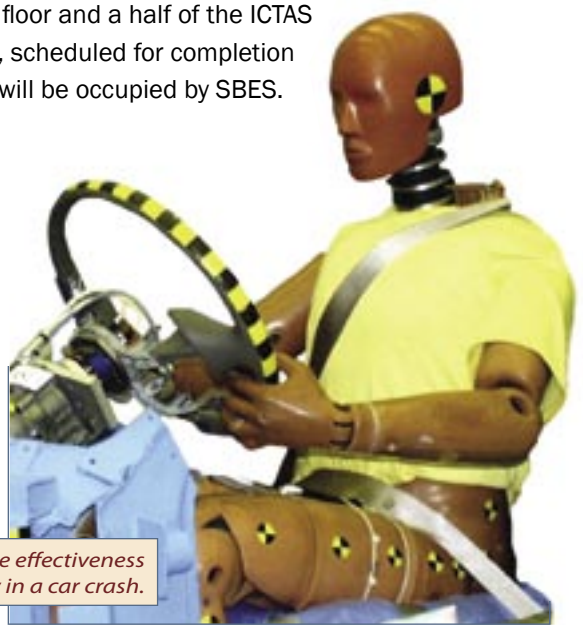
*Tissue engineering student characterizing cell suspensions that will be utilized for implantation on scaffolding and for tissue growth. This approach is expected to be used in tissue typed matched organ and connective replacements in the future.*

partnerships to interact directly with the medical profession, and student design projects that may be commercialized through strategic partnerships.

SBES also has strong areas of research in musculoskeletal biomechanics, injury biomechanics, imaging, and medical physics. In each of these areas SBES has outstanding faculty, unique facilities for testing and research, and is carrying out some of the leading research in the country. SBES has been successful in garnering a high rate of research funding which has been growing at the rate of $1 million a year in recent years, one of the best research growth rates in the College of Engineering. At present it has over $5 million in research awards for the current year.

This flourishing partnership is producing visionary research objectives and results while fostering an intellectual environment that is attractive and stimulating to outstanding researchers worldwide. ICTAS is committed to the pursuit of these critical technology research needs and provides ongoing support to SBES.

An entire floor and a half of the ICTAS I building, scheduled for completion in 2008, will be occupied by SBES.



*Crash test dummy instrumented to evaluate the effectiveness of seat belt mechanisms in reducing injury in a car crash.*

## *ICTAS sponsors Doctoral Scholars Program*

The **ICTAS Doctoral Scholars Program**, established in 2007, is intended as a complement to Virginia Tech's mission and strategic plan and as an investment in the university's intellectual talent and creativity.

The program honors exceptional Ph.D. applicants through award of full financial support for the Ph.D. qualifying period.

ICTAS Doctoral Scholars will be selected from the Colleges of Engineering, Science, Natural Resources, Agriculture and Life Sciences, and Veterinary Medicine. Nominations will be accepted each year during November. Nominators are encouraged to nominate the "best of the best" in terms of academic and other credentials, in addition to acknowledged creativity and dedication to the chosen field of interest.

As part of the university's continuing pursuit of excellence in research, this opportunity leads the way in offering a challenge to others to establish and support programs that inspire our most creative resources to reach for the stars — or create new ones.

Applications should be directed to the college of choice. General inquiries related to program administration may be directed to **Ann Craig**, *annc@vt.edu* or 231-2059.

## RESEARCH CORNER

### PROJECTS FUNDED TO DATE

*In addition to investments in the strategic research focus areas of Nanotechnology, Cellular and Molecular Biology, Cognitive Systems and Communication, and Sustainable Development, ICTAS is invested in other ongoing efforts in the School of Biomedical Engineering and Sciences (SBES), Virginia Center for Autonomous Systems (VaCAS), Wireless at Virginia Tech (W@VTech), Virginia Tech Transportation Institute (VTTI), Center for Innovation in Construction Safety and Health (CICSH), Materials Center of Excellence (MCOE), and Next Navy Composites (N2C).*

### OPPORTUNITIES

*A call for proposals targeted to the ICTAS strategic focus areas was issued during summer 2006. In response, twenty-two creative and high-quality proposals were submitted for funding consideration. Out of those submissions, more than two-thirds were successful and are currently funded as ICTAS projects. In total, including ongoing and 2006 awardees, twenty-seven projects are underway under ICTAS support.*

*An open call for new proposals is planned for spring 2007 as funding for new initiatives is identified.*

# *Proposal Development Team makes changes*

The Proposal Development Team (PDT) works closely with faculty principal investigators to prepare proposals that reflect the expertise and capabilities of the university with special emphasis on interdisciplinary initiatives, talented faculty, and state-of-the-art facilities. The PDT efforts are complementary to the university's goal of increasing research while blending traditional disciplinary boundaries to meet the greater societal needs.

Recently, the Office of the Vice President for Research made a decision to merge the faculty development program led by **Robert Porter** with the Proposal Development Team led by **Roger Burnett**. The two functions have been collaborating on an increasing basis. It is anticipated that combination of the two functions will provide depth to both proposal development and faculty training. The new Interdisciplinary Research Team Internship (IRTI) program provides an example of how the two functions interrelate and contribute to the natural evolution of the research growth functions.

Porter will assume team leadership, while Burnett will transition to part-time status as special projects coordinator, including an ongoing liaison role to the National Capital Region Research Development Team.

For more information about the PDT, see *www.research.vt.edu/pdt*.

*Chemistry professor Tim Long with Melissa Wade of the PDT. Long credits the PDT with helping him construct a proposal that resulted in his winning a multi-million-dollar award.*

## SPOTLIGHT ON NEW FACULTY: GE WANG

# New Molecular Imaging Approach Promises to be Extremely Sensitive and Specific

Using a new highly sensitive imaging process, researchers have identified two adrenalin tumors in a live mouse. The process, called bioluminescence tomography (BLT), was invented by Ge Wang and his colleagues.

Wang, the Samuel Reynolds Pritchard Professor of Engineering, is a member of Virginia Tech's School of Biomedical Engineering and Science (SBES), part of ICTAS.

BLT imaging uses luciferase enzymes for the *in vivo* mapping of specifically tagged cells in living, small animals, especially mice. After luciferin is injected into an animal, the tagged cells emit photons in a spectral range around the infrared region, "quite like fireflies we see in the summer," Wang explains.

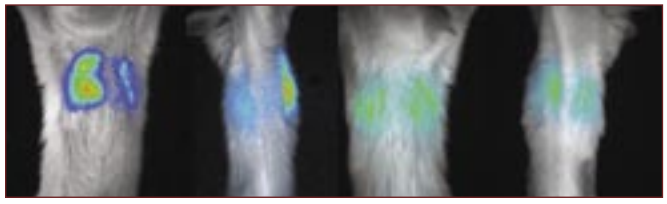
*Ge Wang*

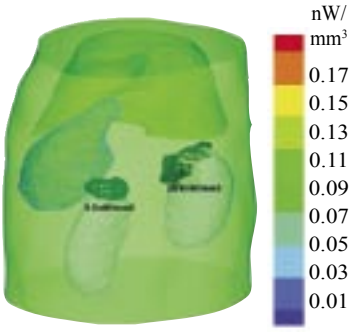
These types of photons can penetrate biological tissues by a few centimeters and be detected by a cooled charge-coupled device (CCD) based camera. BLT imaging represents an emerging concept for molecular imaging, and it has several unique advantages. For example, it produces much more sensitive, specific images of gene expressions than conventional methods do, which include x-ray computed tomography and magnetic resonance.

Wang and his research group invented BLT in 2002. In 2004 he and his collaborators wrote the first paper on BLT and today more than 10 groups worldwide are actively working in this new area. Wang relocated last year from the University of Iowa to Virginia Tech to lead the university's Biomedical Imaging Division.

"The introduction of BLT relative to planar bioluminescent imaging can be compared to the development of x-ray computed tomography based on radiography. Without BLT, bioluminescent imaging is basically qualitative. With BLT, quantitative and three-dimensional analyses on bioluminescent molecular probes become feasible inside a living mouse," Wang explains.

*Four bioluminescent views of a living mouse as input for 3-D reconstruction of a gene expression distribution inside the mouse using the bioluminescence tomography approach that Dr. Wang's group pioneered.*






*At left, a BLT image rendering; at right, a histological verification. BLT was used to identify two adrenalin tumors in a living mouse.*

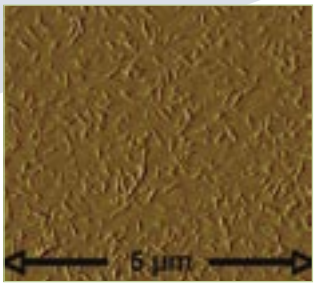
BLT is a high-tech procedure. In contrast to the straight-ray imaging modalities like x-ray computed tomography, bioluminescence imaging is typically diffusion dominated. The system involves complex hardware design, *in vivo* mouse modeling, and sophisticated reconstruction methodology.

Wang's group is currently developing a second-generation BLT system that can simultaneously collect diffused photons of different colors on the body surface of a mouse through customized optical paths. Also, the system may use the mechanism of temperature modulation to improve the BLT reconstruction.

According to the National Institutes of Health (NIH) Roadmap (*http://nihroadmap.nih.gov/*), optical molecular imaging plays an instrumental role in the development of medicine. Great efforts, including those with bioluminescence imaging techniques, are being made to understand the link between genes and phenotypic expressions under normal and disease conditions. Bioluminescence imaging of genetic signatures, specific proteins, and biological pathways may contribute to the development of predictive, preventive, and personalized medicine by facilitating disease diagnosis, therapy monitoring, and drug development in small animal models of human diseases.

# Targeted Delivery of Therapeutic and Diagnostic Agents

Four innovative interdisciplinary programs connecting nanotechnology and health care are receiving initial seed funding from Virginia Tech's Institute for Critical Technology and Applied Science (ICTAS). The four areas will come under one of the designated primary research thrusts within ICTAS, "Nano-Biomaterials for the Delivery of Therapeutic and Diagnostic Agents."




*Cellulose nanocrystals functionalized with antibodies on their surfaces can help to ameliorate vascular inflammation.*

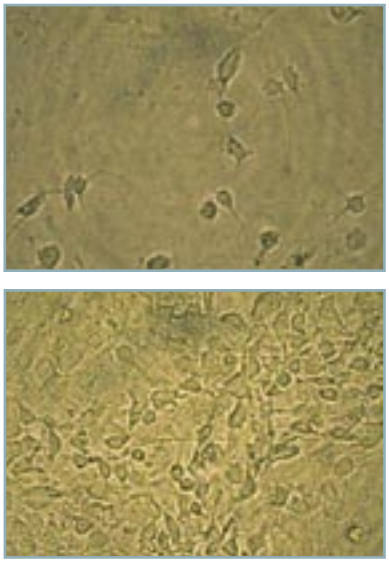
As scientists and engineers unfold the understanding of materials at the nanoscale level, a "tremendous potential for major discoveries in healthcare exists," says **Judy Riffle**, professor of chemistry and leader of the effort.

"In response to the potential for discovery and creativity in nano-medicine, and the need for educating graduate students with the interdisciplinary skills to improve the manner in which devastating diseases are treated and monitored, Virginia Tech is well positioned to build a world-class program in nano-biomaterials as an interface to nanotechnologies in the medical field," Riffle adds.

Consequently, ICTAS is funding efforts in four related areas in the interdisciplinary field of nano-biomaterials. The first is targeted drug delivery to treat diseases due to intracellular bacterial pathogens and cancer. The second relates to using specific nanocrystals, labeled bioconjugated cellulose, for immuno-targeting. In the third area, researchers will perform micro-injection of nanoparticles and use real-time spectroscopy in biological systems. The last focus area is engineered nanoconstructs for targeted regulation of intracellular free radical concentration.

***Look for a new technology profile section highlighting specific scientific aspects of the reearch areas in future editions of this newsletter.***

The Virginia Tech team of researchers will include chemists and physicists who have traditionally studied materials at the atomic (angstrom) level, and who now are striving to synthesize supramolecular constructs to impact cellular and biological interactions that depend on the larger nanoscale. The team includes biologists and engineers who have studied macroscopic properties, and are now working to understand the fundamental underlying aspects of structures and disease at a smaller scale.



*Nanoparticles of cerium oxide are being used to preserve neuronal lifespan and function and protect neurons and other mammalian cells from free radical mediated injury, which occurs with aging and many other diseases. This work holds great promise for future treatment of neurodegenerative and inflammatory disorders. The micrograph above shows the decline in cultured neurons with age. Below, neurons of the same age treated with cerium oxide nanoparticles show robust growth with preserved neuronal function. Current collaborative work between Drs. Rzigalinski, Meehan, and Davis is directed toward dissection of the mechanism of action of these nanoparticles to design nanoparticles with controlled free radical scavenging activity.*

Virginia Tech's nationally ranked macromolecular program (5th nationally), the Virginia-Maryland Regional College of Veterinary Medicine, the Wake Forest – Virginia Tech School of Biomedical Engineering and Science (SBES), the biomedical research

### *Initial Faculty Participants in the Targeted Delivery and Diagnostics in Nanomedicine research thrust:*

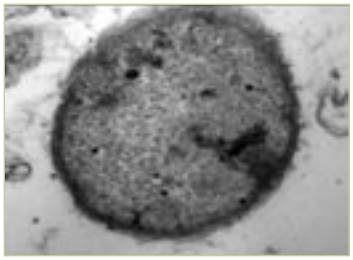
**David Cox**, Chemical Engineering; **Richey Davis**, Chemical Engineering; **Kevin Edgar**, Wood Science; **Marion Ehrich**, DBSP; **Randy Heflin**, Physics; **Ramanathan Kasimanickam**, Veterinary Medicine; **Giti Khodaparest**, Physics; **Yong Woo Lee**, Department of Biomedical Sciences and Pathology; **Tim Long**, Chemistry; **Kathleen Meehan**, Electrical and Computer Engineering; **Gary Pickrell**, Materials Science and Engineering; **Padma Rajagopalan**, Chemical Engineering; **Judy Riffle**, Chemistry; **Maren Roman**, Wood Science; **Bev Rzigalinski**, Virginia College of Osteopathic Medicine; **Nathan Sriranganathan**, Veterinary Medicine

programs at the Virginia College of Osteopathic Medicine, and others on campus will combine their efforts under the ICTAS umbrella to collaborate in this interdisciplinary thrust.

"It is clear that a melding of expertise among the physical scientists/engineers, and biologists/MDs/veterinarians/ biomedical engineers could exploit nanomedicine in a far more efficient manner than any of these professionals can do alone," Riffle says.

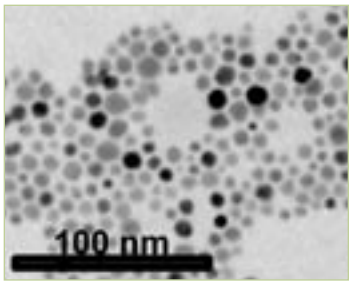
The U.S. government invested approximately $4 billion in nanotechnology between 2001-2005. Notably, the first President's Council of Advisors on Science and Technology (PCAST) review of the U.S. nanotechnology initiative in 2005 concluded that the U.S. leads globally in nanotechnology, but it feared that the U.S. was not producing enough scientists and engineers to carry the field forward.

Approximately 7000 square feet of interdisciplinary space housing three laboratories (nanobiomaterials synthesis, nanobiomaterials characterization of morphology and structure, and nanomedical research) will be dedicated to this effort in the ICTAS I building currently under construction on campus. It is envisioned that the effort will be expanded into the full Virginia Tech Nano-Biomaterials effort in the ICTAS II facility planned for 2010.



*A cell containing bacteria. The cell has uptaken carbon nanotubes that can deliver drugs to intracellular bacteria.*

A "working group" of Virginia Tech faculty has formed for the purpose of identifying outside funding sources and developing productive collaborations to augment and grow the initiative. Faculty who may be interested in participating should contact **Judy Riffle** (working group contact, *judyriffle@aol.com*), her assistant **Angie Flynn** (*anflynn@vt.edu*), or **Roop Mahajan** (ICTAS Director, *mahajanr@vt.edu*).




*Magnetic nanoparticles approximately 10 nm in diameter show potential for intracellular delivery of drugs. The nanoparticles can penetrate cell membranes to interact with sub-cellular components.*

# FACILITIES CORNER

## ICTAS A

*This building is located in the Virginia Tech Corporate Research Center and boasts approximately 32,000 square feet. The Nanoscale Chacterization and Fabrication Laboratory (NCFL) will occupy one floor of the building while the other floor will accommodate research-related offices and workspace. ICTAS A's grand opening is scheduled for September 21, 2007.*

## ICTAS I

*This building is currently under construction in the engineering quadrangle on the main campus in Blacksburg and is expected to open during summer 2008. ICTAS I includes approximately 100,000 gross square feet of additional space. Research related labs, offices and workspaces will occupy the majority of the space. ICTAS headquarters, which is temporarily housed in the Corporate Research Center, will move to this building upon completion.*

## ICTAS II

*This building is in the design stages and will encompass approximately 77,000 square feet of research space.*

VirginiaTech
Invent the Future



ICTAS News is published by the **Institute for Critical Technology and Applied Science** at Virginia Tech

**Roop L. Mahajan**, Director

Please send comments and address corrections to **Ann Craig**, *annc@vt.edu*

# *Meet Roop Mahajan, Virginia Tech's Research Institute Director*

**Roop L. Mahajan**, an internationally known researcher with expertise ranging from nanotechnology to bio- micro-electro-mechanical systems (Bio-MEMS), became the director of ICTAS in July 2006.

Mahajan came to Virginia Tech from the University of Colorado at Boulder where he was the founder and director of the Center for Advanced Manufacturing and Packaging for Microwave, Optical, and Digital Electronics (CAMPmode). Since 1992, CAMPmode has functioned as an industry/consortium sponsored center. In 1995, the center became a National Science Foundation Industry/University Cooperative Research Center. CAMPmode currently focuses on nanotechnology and on MEMS.

Mahajan was also the founder and co-director of MicroElectronic Devices in Cardiovascular Applications (MEDICA). This interdisciplinary center draws on faculty at Colorado University's Health Sciences Center and its College of Engineering and Applied Sciences. It fosters scientific advancement in the study and application of MEMS in cardiovascular applications.

Mahajan also has expertise in cellular engineering microsystems (CEMS), artificial neural networks, humanistic engineering, thermal sciences, and solar energy.

Mahajan, who held the Roubos Chaired Professorship of ME at Colorado, is the **James S. Tucker Professor of Engineering at Virginia Tech**.

He has received numerous awards including the American Society of Mechanical Engineers (ASME) 2003 Charles Russ Richards Memorial Award for outstanding achievement in ME. He also received the 2002 ASME Heat Transfer Memorial Award, and the Subaru Educator of the Year Award in 2002. He is an ASME Fellow. He holds three patents and has five invention disclosures.

He was employed by AT&T Bell Labs from 1976 until 1991, first as a member of technical staff for three years; later as a research leader/supervisor in thermal and computational engineering. He received the Bell Labs Fellow Award in 1989, an honor bestowed to only about one percent of the entire technical community of Bell Labs.

Mahajan received his Ph.D. in mechanical engineering from Cornell University in 1977 and his bachelor's and master's degrees, also in ME, from Punjab Engineering College, Chandigarh, India.

## *ICTAS Team:*

**Roop Mahajan**, Director; **Shelley Johnson**, Administrative Assistant; **Christie Thompson**, Associate Director for Administration; **Linda Collier**, Fiscal Technician Senior; **Lois Hall**, Fiscal Technician; **Bill Reynolds**, Director - NCFL; **Steve McCartney**, NCFL Technician; **Joerg Jinschek**, Research Assistant Professor - TEM; **Eliffe Bagci**, Post Doc; **Ann Craig**, Director - Communications; **Kathy Acosta**, Graphic Designer; **Jeff Beeby**, Project Manager; **Dawn Maxey**, Facilities Manager; **Josh Nay**, Facilities Assistant; **James Lane**, Computer Network Support Technician.

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