

# A Major Catalyst for Prosperity

As New Jersey's public technological research university, NJIT works to create new industries by developing commercially promising new technologies.

The country's fastest growing university R&D program is right here in the Garden State. Over the past decade, the New Jersey Institute of Technology has more than doubled its research expenditures to a total of \$75 million in 2003, ranking NJIT among the top 10 technological universities nationally. Robert A. Altenkirch, president of NJIT, believes that expanding research at the state's technological university is vital to New Jersey's economic future.

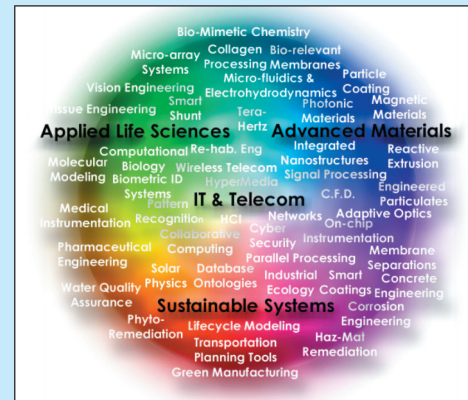
"Technology and science are the engines that drive our nation's economy," he said. "And the technological research university has an important role in priming those engines. A strong program of applied research leads to new knowledge and applications that improve processes and products for industry."

Donald H. Sebastian, vice president for



**Dr. Leonid Tsybeskov's team works with Hewlett-Packard and IBM to explore the properties of silicon nanostructures.**

research and development, said that research at NJIT has a distinctive character. "Our research is both 'hands-on' and 'brains on,'" he said. "We address the needs and shortcomings of existing products, processes and services, and yet our approach is serious science, rooted in fundamentals and furthers the body of fundamental knowledge."



**NJIT's research program focuses on four cross-cutting areas critical to economic growth.**

Sebastian said that NJIT is an agile university with a strong entrepreneurial character that allows it to respond quickly and efficiently to changing marketplace trends and emerging societal needs. He said that the university's efforts for homeland security is a good illustration of NJIT's flexibility.

## Developing Technologies for Homeland Security

Recognizing that technology is the best way to defend against bioterrorism, secure state borders and protect critical infrastructure, NJIT established a Homeland Security Technology Center. The center coordinates defense-related projects in the university and forges partnerships with state and federal agencies for homeland security initiatives. Projects include:

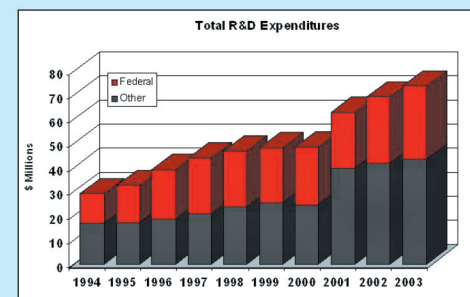
**Detecting Concealed Explosives:** With funding from the National Science Foundation and the Army Research Office, Drs. John Federici, Dale Gary and Robert Barat explore the use of terahertz (THz) electromagnetic radiation to detect and identify explosives and biological agents by means of a spectroscope. THz technology can detect explosives and biological agents concealed in clothing, sealed packages and suitcases, since it readily transmits through plastics, clothing and other non-metals. Picometrix, Inc., of Ann Arbor, Mich., is collaborating on the project.

**Security through Grip Detection:** A system known as "dynamic grip recognition" patented by Dr. Michael Recce is well on the way to producing a safer handgun. Recce's invention embeds multiple small electronic sensors in both sides of a gun's handle to identify the user. Dr. Timothy Chang is integrating the electronics and computerized parts of the gun.

Australian-based research and development company Metal Storm Ltd., Taurus International Manufacturing, Inc., Florida, and Forjas Taurus, Brazil, are partners in commercializing the "smart gun." Recce projects that grip recognition could also be effective in preventing sky-jackers from taking control of an aircraft.

**Improving Face Recognition:** Dr. Chengjun Liu has developed a face recognition system that takes into account such factors as lighting and facial expressions. The technology can be used as a security system with facial identification replacing a physical key or a password. Such a system could also assist law enforcement officials in locating fugitives by means of video cameras strategically placed in public places. Liu has grant support from the Department of Defense as part of the government's effort for combating terrorism using face recognition technologies.

**Keeping the Internet Secure:** Data watermarking, intrusion alarm systems and distortionless data hiding are some of the tech-



**NJIT has the fastest-growing research program in the nation over the last decade.**

niques under study at the Center for Wireless Networking and Internet Security, directed by Dr. Atam Dhawan. One project focuses on methods to predict and intercept on-line intruders. Another study looks at mobility modeling and trajectory prediction techniques for wireless networks with the goal of reducing vulnerability to hostile threats.

## Advancing Nanotechnology

NJIT partnered with Lucent Technologies and the State of New Jersey to create the New Jersey Nanotechnology Consortium, an initiative designed to bring the state into the forefront of the burgeoning "small tech" (MEMS and nanotechnology) industries. The center's goals are to conduct research, develop and prototype devices and systems, stimulate new business and growth, commercialize nanotechnology

concepts and train more nanotech scientists and specialists. In addition, NJIT researchers have launched a number of projects that utilize nanotechnology, including:

**Investigating Nanostructures:** New techniques for processing nanostructured powders are the goal of Dr. Robert Pfeffer's research team at NJIT's New Jersey Center for Engineered Particulates. Although the unique properties of nanostructured materials can greatly benefit many industries, such as food, pharmaceutical, chemical, and ceramics, little attention has been paid to flow around nanoparticles and flow in nanodomains. With funding from the National Science Foundation, Pfeffer's team, together with researchers from the Illinois Institute of Technology, studies the physics of fluidization and transport of nanoparticles. The goal is to be able to process nanoparticles to produce nanomixtures and nanocomposites with tailored properties.

**Creating Functional Nanostructures:** Functional nanostructures for novel electron devices are the focus of NJIT's Integrated Nanostructures Laboratory, headed by Dr. Leonid Tsybeskov. In one project supported by the National Science Foundation, the team investi-



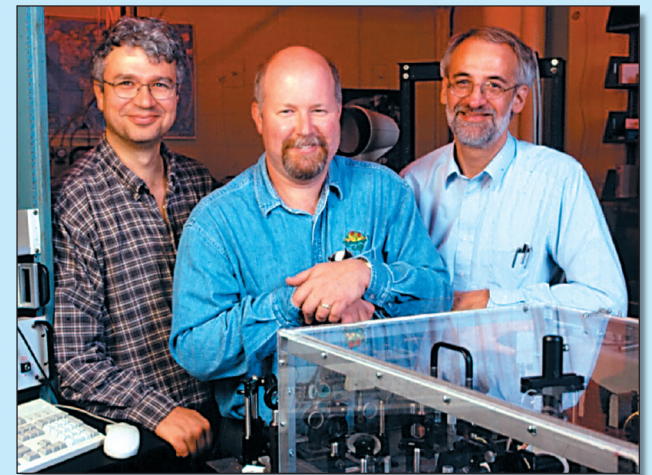
**Dr. Chengjun Liu has Defense Department funding for face recognition technologies designed to combat terrorism.**

gates links between structural and optical properties in three-dimensional nanostructures made of silicon and germanium. In partnership with Hewlett-Packard and IBM the team explores the feasibility of novel devices that make use of efficient light emission in these nanostructures.

## Information Technology and Wireless Telecommunications

NJIT has been a leader in information technology for more than two decades. Through the pioneering research efforts of Drs. Murray Turoff and Roxanne Hiltz, the university launched the Electronic Information Exchange System (EIES), the first computer-mediated communications in 1976, and began offering fully digital courses through the Virtual Classroom® in

**Drs. John Federici, Robert Barat and Dale Gary study uses of terahertz radiation.**



1986. Today, NJIT researchers work not only to improve and enhance computing hardware and software, but to adapt and use computing applications in every discipline, and to measure the impact of information technology on business and industry. Some ongoing projects include:

**Toward Pervasive Information Technology:** How people react to pervasive computing – small computing devices that are located on one's person or in one's environment – is the focus of research by Dr. Starr Roxanne Hiltz. The study is NJIT's contribution to the New Jersey Center for Pervasive Information Technology, a collaborative effort among Princeton University, NJIT and Rutgers, charged with developing the next generation of information appliances. One of the initial studies is exploring the attitudes of New Jersey residents toward potential uses of EZPass data.

**Next-Generation Wireless Communications:** Technologies to enable the next generation of wireless digital communications are the focus of research at the Center for Communications and Signal Processing. Dr. Yeheskel Bar-Ness leads a team of researchers working to develop the infrastructure needed to support the burgeoning demand for wireless communication. The group addresses issues such as privacy and security, interference and jamming, ever heavier user traffic, and rapid transmission of data through wireless networks.

**Taming Space Weather:** A better understanding of the solar flares that can interfere with wireless communication and damage satellites in Earth's orbit is the focus of research by Dr. Dale Gary, director of the Owens Valley Solar Array component of NJIT's Center for Solar-Terrestrial Research. He is leading a design study for the Frequency Agile Solar Radiotelescope (FASR). The project, supported by the National Science Foundation, will construct a new radio telescope capable of making high-resolution images of the solar corona. The high-energy particles that characterize these ejections have the potential to destroy satellites, affecting television viewing, pagers, cellular phones and other wireless devices. With the ability to observe these phenomena, especially those on the near face of the sun that most affect earth, researchers will be able to provide better information on the space environment to airlines, power companies and satellite operators.

## Advanced Materials

Materials science and engineering is the source

of many commercially promising technologies that are helping to create new jobs and businesses in New Jersey. One example is micro-electromechanical systems (MEMS) devices – the microscopic motors and sensors used for everything from airbag deployment to DNA analysis. NJIT researchers work with private partners on projects involving micro-mirrors for optical communications, chemical and environmental sensors, and sensors to warn of potential failures in the power grid. Other emerging technologies under study at NJIT include membrane separations, polymer processing, microflow engineering, particle processing and optoelectronics. Some interesting projects include:

**Evaluating Polymer Coatings:** Dr. Marino Xanthos leads a study to compare various types of polymer powder coatings for effectiveness as well as environmental impact during manufacturing and application. The project will look at novel "green" manufacturing methods of polymer powder coatings, as well as cost comparison and overall engineering effectiveness. Polymeric powder coatings provide environmental and corrosion protection in a variety of commercial and military applications. The investigation is sponsored by the Polymer Processing Institute at NJIT, which partners with companies to develop high performance materials and products.

**Membrane Separations:** Innovative techniques for separating liquid and gas molecules using synthetic membranes are the focus of Dr. Kamalesh Sirkar at NJIT's Center for Membrane Technologies. The technology has the potential for a wide variety of applications in chemical, petro-chemical, food, pharmaceutical, biomedical and biotechnology industries. A current project funded by the National Science Foundation involves innovative techniques for separating liquid and gas molecules using nanoporous polymeric filtration membranes. ●

**For more information about research at NJIT, visit [www.njit.edu/research](http://www.njit.edu/research)**