

Daniel J. Watts, Panasonic Endowed Chair of Sustainability and executive director of the Otto H. York Center for Environmental Engineering and Science, leads the NJIT Active Coatings Technologies team.

## SUPPORTING THE TROOPS IN 2003, NJIT

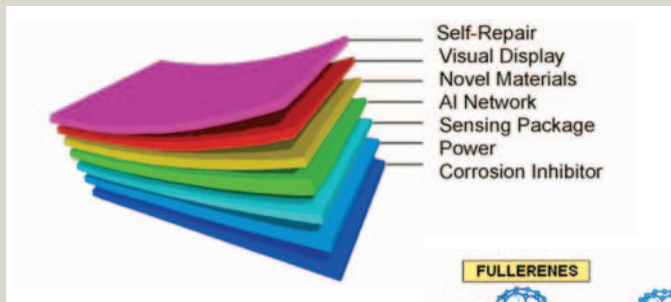
### *Active Coatings Technologies Research*

**“W**hile we have virtually every type of vulnerability packed into the boundaries of this state, we can also bring the most resources to bear in confronting these vulnerabilities. With technology and progress on our side, I am confident that we will succeed.”

— Donald H. Sebastian, senior vice president for research and development

BEGAN A PARTNERSHIP WITH PICATINNY ARSENAL TO CREATE A PAGE OUT OF SCIENCE FICTION — A “SMART” COATING ENRICHED WITH NANOMACHINES THAT COULD DETECT CORROSION OR SCRATCHES ON A SURFACE AND POSSIBLY EVEN HEAL THEM. BUT, ACCORDING TO DAN WATTS, PANASONIC ENDOWED CHAIR OF SUSTAINABILITY AND EXECUTIVE DIRECTOR OF THE OTTO H. YORK CENTER FOR ENVIRONMENTAL ENGINEERING AND SCIENCE, NO ONE GUESSED THAT THE FIRST PRACTICAL APPLICATION OF THE NEW TECHNOLOGIES WOULD BE IN COMBAT.

“The program was started as an environmental initiative, conceived in large part by Joseph Argento of the Industrial Ecology Center at Picatinny,” Watts explained. “The idea was to get Army vehicles and materiel off schedule-based maintenance, which is wasteful both in terms of cost and of environmental impact, and on to condition-based maintenance. We



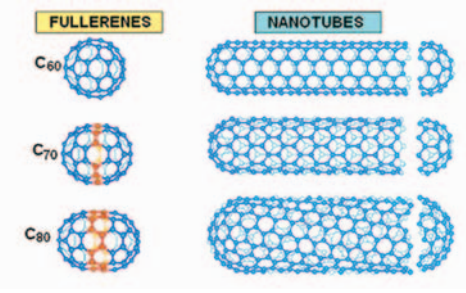
Above: The active coatings prototype offers a suite of technologies that can be combined as needed to create a customized active coating system.

aimed to develop technology that would tell us when a vehicle needed maintenance or when ammunition was exposed to unsafe temperatures.”

Then came the Iraq war and end users in the armed forces began to see that the “active coatings technologies,” as they are now called, could be extremely helpful in helicopters under fire, allowing both the pilot and the base to determine immediately where the chopper has been hit and how badly, and whether or not the pilot needed to return to base. So when the project’s first application rolled out this summer, it went to Apache helicopters in active combat.

Watts directs NJIT’s project team in cooperation with NJIT alumnus James Zunino, overall project officer for the Army Research, Development and Engineering Center (ARDEC) at Picatinny. Funded by the Department of Defense, the initiative is a partnership among NJIT, ARDEC’s U.S. Army Corrosion Office, Clemson University, the University of New Hampshire and the University of Massachusetts, coordinated by South Carolina Research Authority. The Picatinny group includes two additional university alumni, Laura Battista and Nelson Colon, and the NJIT research team draws expertise from physics, chemistry, electrical engineering and chemistry. Zunino says that 75 percent of the research effort is based at NJIT.

“What we’ve developed is a suite of multi-layered, modular active coatings with numerous functionalities such as self-repair, visual display, artificial intelligence, self-management, sensing package, and corrosion inhibitors that can be customized as needed,” Zunino said. “We started out thinking we’d make a single coating that did everything, but that turned out not to be practical or cost effective for most purposes. With the modular system, we can tailor coatings for specific applications.”



Fullerenes or “buckyballs” and single-walled carbon nanotubes are key components of the active coatings project. These carbon molecules can be used to add functionality such as sensing and monitoring, resistance to wear or corrosion, or improved electrical or thermal conductivity.

### Key NJIT researchers on the ACT project include:

**John Federici**, associate chair and professor of physics, and **Gordon Thomas**, professor of physics, and **Hee Lim**, research professor, have been studying flexible electronic circuits with



capabilities for sensing temperature, damage, scratch, flow, pressure, strain, impact, shock, pH, humidity and acoustics and have developed a wireless sensor system as part of the active coatings technologies project.

**Marino Xanthos**, professor of chemical engineering and director of research of the Polymer Processing Institute (PPI) at NJIT and **Ming-Wan Young**, president of PPI, are working with nanoclays and smart polymer coatings that can be incorporated into a coating system to add additional capabilities. These smart materials can respond to physical, chemical or mechanical stimuli by developing readable signals such as color changes, and can even initiate self-repair.



**Som Mitra**, professor and interim chair of chemistry and environmental science, has developed numerous innovations with implications for the active coatings program. Most recently, he developed an inexpensive solar cell that can be painted or printed on flexible plastic sheets and can be used to provide power for active coatings capabilities. He also developed a technique for producing a plentiful supply of carbon nanotubes by growing them in 10-foot hollow steel tubing. He worked with Research Professor **Zafar Iqbal** to develop a new technique that uses microwaves to change the chemical characteristics of carbon nanotubes.



**Haim Grebel**, professor of electrical and computer engineering and director of the Electronic Imaging Center at NJIT, leads a team that has been growing carbon nanotubes and testing them to establish their optical, thermal and mechanical properties for potential use in communications and sensor systems. He worked with Federici to study optical and electronic characteristics of carbon nanotubes using terahertz spectroscopy.

