NC State to Lead NSF Nanosystems Engineering Research Center on Self-Powered Health Monitoring

North Carolina State University

North Carolina State University will lead a national nanotechnology research effort to create self-powered devices to help people monitor their health and understand how the surrounding environment affects it, the National Science Foundation announced today.

The NSF [1] Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies [2](ASSIST), to be headquartered on NC State's Centennial Campus, is a joint effort between NC State and partner institutions Florida International University, Pennsylvania State University and the University of Virginia. The center, funded by an initial five-year $18.5 million grant from NSF, also includes five affiliated universities and about 30 industry partners in its global research consortium.

"Tackling the world's grand challenges is one of NC State's strategic imperatives," said NC State Chancellor Randy Woodson. "The ASSIST center holds the potential to transform health care, leading to advanced environmental health research and enhanced environmental policy."

With the addition of ASSIST, NC State is the only university in the country currently leading two active NSF Engineering Research Centers (ERCs), among the largest and most prestigious grants made by the engineering directorate of the federal agency. The FREEDM Systems Center, a smart grid ERC formed in 2008, is also headquartered at NC State.

ASSIST researchers will use the tiniest of materials to develop self-powered health monitoring sensors and devices. These devices could be worn on the chest like a patch, on the wrist like a watch, as a cap that fits over a tooth, or in other ways, depending on the biological system that's being monitored.

Wireless health monitoring is already a fast-growing industry, but the self-powered technology being developed by ASSIST means that changing and recharging batteries on current devices could soon be a thing of the past. By using nanomaterials and nanostructures — a nanowire is thousands of times thinner than a human hair — and thermoelectric and piezoelectric materials that use body heat and motion, respectively, as power sources, ASSIST researchers want to make devices that operate on the smallest amounts of energy.

"Currently there are many devices out there that monitor health in different ways," said Dr. Veena Misra, the center's director and professor of electrical and computer engineering at NC State. "What's unique about our technologies is the fact that they

are powered by the human body, so they don't require battery charging."

These devices could transform health care by improving the way doctors, patients and researchers gather and interpret important health data. Armed with uninterrupted streams of heart rate readings, respiration rates and other health indicators, as well as personalized exposure data for environmental pollutants such as ozone and carbon monoxide, sick people could better manage chronic diseases, and healthy people could make even better decisions to keep themselves fit.

On a larger scale, data gleaned from research studies employing these devices could prove invaluable to lawmakers crafting environmental policy. And if people using the devices make better decisions about where and how healthfully they live, national health care costs, which topped $2.5 trillion in 2010, could come down.

The center's headquarters will be housed in the Larry K. Monteith Engineering Research Center on NC State's Centennial Campus. There, ASSIST researchers will develop thermoelectric materials that harvest body heat and new nanosensors that gather health information from the body such as heart rates, oxygen levels and respiration data. In addition, the researchers will find ways to package the technology developed by the center into wearable devices.

The center's partner institutions will also play important research roles. At Penn State, researchers will create new piezoelectric materials and energy-efficient transistors. The team from the University of Virginia will develop ways to make the systems work on very small amounts of power, while the group from Florida International University will create sensors that gather biochemical signals from the body, such as stress levels.

The results of that work, coupled with low-power radios developed by the University of Michigan, will be used to process and transmit health data gathered by the sensors to computers and consumer devices, such as cell phones, so patients, doctors and researchers can easily digest it. The University of North Carolina at Chapel Hill will provide ASSIST with medical guidance and arrange testing of the center's technology.

"We have assembled a comprehensive team that works together closely under a systems-driven approach to tackle this challenging set of global health problems," Misra said.

ASSIST also has foreign partnerships with the University of Adelaide, the Korea Advanced Institute of Science and Technology, and the Tokyo Institute of Technology.

"The research conducted at ASSIST will help patients, doctors and scientists make direct correlations between a person's health and the surrounding environment, leading to better prediction and treatment of chronic diseases," said Dr. Louis A. Martin-Vega, dean of the College of Engineering at NC State. "The fact that NC State now leads two NSF Engineering Research Centers is a testament to our world-class engineering faculty, students and facilities."

ASSIST will also draw on the expertise of industry partners to help guide the center's work to the marketplace. These partners include companies and agencies involved in nanomaterials and nanodevices, integrated chip manufacturing, software development, bioengineering and health care.

The center will feature a nanotechnology education program, including an undergraduate concentration and a graduate master's certificate, as well as a personalized professional-development program for graduate students.

The center will also partner with 11 middle and high schools in North Carolina, Virginia, Florida and Pennsylvania to develop outreach activities that bring nanosystems engineering into K-12 classrooms. Students in partner high schools will have the chance to be involved in ASSIST research.

The five-year NSF grant for ASSIST is renewable for an additional five years and follows a two-year selection process by the federal agency. The grant is among a new group of Engineering Research Center awards that invest in nanosystems.

Dr. John Muth, professor of electrical and computer engineering at NC State, will serve as the center's deputy director. The ASSIST leadership team also includes Dr. Thomas Jackson, Kirby Professor of Electrical Engineering at Penn State, research director and partner campus director; Dr. David Peden, senior associate dean for translational research at the UNC School of Medicine, medical director; Dr. Benton Calhoun, associate professor of electrical and computer engineering at the University of Virginia, partner campus director; Dr. Shekhar Bhansali, Alcatel-Lucent Professor and head of electrical and computer engineering at Florida International University, partner campus director; Dr. Mehmet Ozturk, professor of electrical and computer engineering and director of the NC State Nanofabrication Facility, education and diversity director; Dr. Gail Jones, professor of science, technology, engineering and mathematics education in NC State's College of Education, pre-college education director; and Dr. Ted Baker, associate professor of management, innovation and entrepreneurship in NC State's Poole College of Management, industry collaboration and innovation director.

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