

NIH awards Emory and Georgia Tech \$10 million for partnerships in cancer nanotechnology

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The National Institutes of Health (NIH) has awarded scientists from Emory University and the Georgia Institute of Technology two new collaborative research grants, totaling nearly \$10 million, to establish a multidisciplinary research program in cancer [nanotechnology](#) and to develop a new class of nanoparticles for molecular and cellular imaging. Working at the sub-atomic level, these scientists are seeking **data that will link molecular signatures, (underlying molecular features), to patients' clinical outcomes**, so that cancers can be predicted, detected earlier and treated more effectively. Although the primary focus of the new programs will be prostate cancer, the research will have broad applications to many types of tumors, including breast and colorectal cancer and lymphoma.

Dr. Shuming Nie, PhD, principal investigator of the project, is one of the first scientists in the world to utilize nanotechnology in the biomedical field. Used in manufacturing for many years, nanotechnology enables scientists to build devices and materials one atom or molecule at a time, creating tightly packed structures that take on new properties by virtue of their miniature size. A nanometer is one-billionth of a meter, or about 100,000 times smaller than the width of a human hair. Most animal cells are 10,000- 20,000 nanometers in diameter, so nanoscale devices are tiny enough to enter cells and analyze DNA and proteins, potentially identifying and treating cancerous cells at much earlier stages than currently possible.

The National Cancer Institute has awarded a five-year grant of \$7.1 million to establish a multidisciplinary Bioengineering Research Partnership (BRP) in cancer nanotechnology. This partnership will integrate the bioengineering strengths of Georgia Tech and the cancer biology and clinical oncology expertise of Emory University

School of Medicine and the Winship Cancer Institute. The new program is part of the joint Coulter Department of Biomedical Engineering at Georgia Tech and Emory, established in 1997, and ranked second in the nation by U.S. News & World Report.

"This Bioengineering Research Partnership (BRP) will incorporate expertise in bioengineering, bioinformatics, tumor biology, bioanalytical chemistry, systems biology, as well as hematology, oncology, pathology and urology," said Shuming Nie, PhD, principal investigator of the project. "The goal of the program is to develop nanotechnology tools for linking molecular signatures to cancer behavior and clinical outcome." Dr. Nie is a Georgia Cancer Coalition Distinguished Scholar, an associate professor in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University and director of cancer nanotechnology at Emory's Winship Cancer Institute. In addition, the National Institute of General Medical Sciences has awarded Emory and Georgia Tech a four-year, \$2.7 million exploratory center grant to develop nanoparticle probes for molecular and cellular imaging of cancer. This funding is part of the new NIH Roadmap Initiative.

Bill Todd, president of the Georgia Cancer Coalition said, "Dr. Nie's accomplishments are a great source of pride for both the Georgia Cancer Coalition and the state of Georgia. These two research grants, totaling \$10 million, will help move us closer to developing new treatment techniques and possible cures for cancer. We are very enthusiastic about being part of the process to move this technology from the laboratory to the bedside in the fight against cancer."

"The State of Georgia is breaking new ground," said Governor Sonny Perdue. "As we foster greater

collaboration among our fine universities and growing biotech sector, we will see tremendous innovation, resulting in greater economic growth for the state and better, more effective prevention, treatment and care for cancer patients everywhere." Governor Perdue also said, "The Georgia Cancer Coalition's continued success in recruiting the nation's top researchers and clinicians to Georgia has proven an invaluable tool in the fight against cancer."

Prostate cancer is the most common cancer and second leading cause of death in American men. Approximately 180,000 new cases are diagnosed yearly, and 40,000 men will die from the disease this year. As they age, most men will develop either benign (non-cancerous) prostate enlargement or prostate cancer. Currently, the most commonly used diagnostic techniques often do not find tumors until after they are large enough to metastasize to a different location in the body and are much more difficult to treat. Researchers in the new research partnership will develop advanced nanoparticle technologies for extremely sensitive profiling of biomarkers on cancer cells and tissue specimens. The use of nanotechnology enables researchers to combine traditional pathology and cancer biology with highly sensitive molecular analysis.

In addition to basic knowledge on cancer biology and biomarkers, the Bioengineering Research Partnership is expected to produce a database linking molecular signatures with clinical outcome; a new class of nanoparticles for molecular profiling of cancer; and imaging microscopes and software that are integrated with the new discoveries in nanotechnology.

The exploratory center grant will be used to develop advanced nanoparticle quantum dot probes for molecular and cellular imaging. A nanoparticle is the basic building block of nanotechnology. Quantum dots are nanometer-sized luminescent semiconductor crystals that have unique electronic and optical properties due to their size and their highly compact structure.

"The goal of this exploratory program is to develop a new class of bioconjugated quantum dots that can both image and target single-molecule

processes in single living cells," said Dr. Nie. "Quantum dots have novel properties, including improved brightness, resistance against photobleaching, and multicolor light emission. The larger size of the quantum dots also provides enough surface area for linking to other diagnostic and therapeutic agents."

Dr. Nie and his colleagues recently used bioconjugated quantum dots for the first time to simultaneously target and image prostate tumors in living mice. Bioconjugated dots are chemically linked to molecules such as antibodies, peptides, proteins or DNA and engineered to detect other molecules, such as those present on the surface of cancer cells.

Dr. Nie and his team will collaborate with cell biologists to study a variety of molecules involved in the development and progression of cancer, including those involved in programmed cell death; genes such as the p53 gene, which is implicated in many kinds of cancer; and microtubules and molecular motors, which are involved in transporting the proteins in cells that regulate cell growth.

"These grants serve to highlight the importance of the partnership between Emory University, Georgia Tech and the Georgia Cancer Coalition," said Jonathan Simons, MD, director of Emory's Winship Cancer Institute. "This partnership, which has been energized by the GCC Scholars program, has produced one of the premier cancer nanotechnology and bioengineering programs in the country."

"The NIH Roadmap Initiatives are designed to transform the nation's medical research capabilities," said Larry McIntire, PhD, chair of the Coulter Department of Biomedical Engineering. "Our well-established Emory/Georgia Tech partnerships in biomedical engineering will serve as an ideal research environment to transform nanotechnology from the laboratory into promising diagnostics and therapies for cancer patients." The Bioengineering Research Partnership includes faculty from the Coulter Department of Biomedical Engineering at Georgia Tech and Emory; Emory's Winship Cancer Institute; and the Departments of

Urology, Radiation Oncology, and Pathology and Laboratory Medicine in Emory University School of Medicine.

Also included are scientists at the Cambridge Research Institute (CRI) in Woburn, Massachusetts. In addition to Dr. Nie, collaborators include investigators Leland Chung, Fray Marshall, John Petros, Peter Johnstone, Mahul Amin, Gang Bao, May Wang, Haiyen Zhau, and Richard Levenson, (CRI). Drs. Nie, Chung, Wang and Johnstone are Georgia Cancer Coalition Distinguished Scholars. The new exploratory center integrates the biomedical expertise of Emory University, the engineering strength of Georgia Tech, the organic chemistry capabilities of Scripps Research Institute in La Jolla, California; and the biophysical expertise of Harvard University. The research team includes Dr. Nie as principal investigator along with Dr. Chung, Dr. Wang, and Dr. Paraskevi Giannakakou from the Winship Cancer Institute. All are Georgia Cancer Coalition Distinguished Scholars.

Source: Emory University Health Sciences Center

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