The Center for Integrated Nanotechnologies (CINT) is a Department of Energy Office of Science Nanoscale Science Research Center (NSRC) operating as a national user facility devoted to establishing the scientific principles that govern the design, performance, and integration of nanoscale materials. CINT provides open access to tools and expertise needed to explore the continuum from scientific discovery to the integration of nanostructures into the micro- and macro world.

Scientific Accomplishments

Nanotube “Glow Sticks” Transform Surface Science
Many physical and chemical processes necessary for biology and chemistry occur at the interface of water and solid surfaces. Using high-speed microscopic imaging, a team of CINT Users and Staff has found that semiconducting carbon nanotubes—light-emitting cylinders of pure carbon—could both detect and track the motion of individual molecules as they bombarded the surface at the water interface. The team is hopeful that their work will lead to practical, nanotube-based, single-molecule detectors in aqueous biological and chemical environments.

Quantum Dot Blinking
Research done in part by CINT Scientists and Users shows that quantum-dot blinking can be controlled and even completely suppressed electrochemically. The group developed a novel spectro-electrochemical experiment that allowed them to controllably charge and discharge a single quantum dot while monitoring its blinking behavior. Their findings should enhance the ability of biologists to track single particles, enable technologists to create novel light-emitting diodes and single-photon sources, and boost efforts of energy researchers to develop new types of highly efficient solar cells.

Hope for Cancer Detection
Inspired by his wife’s breast cancer diagnosis, CINT Industrial User Ed Flynn has developed a less invasive and more precise method for detection of breast cancer as compared to a mammogram. Instead of producing an image of a large mass of cancer cells, Flynn’s technology produces a magnetic signal when the nanoparticles attach to cancer cells. This allows physicians to see not only where the cancer is, but also how many cells there are. Mammograms can only detect a cancer mass of at least 100 million cancer cells. Flynn’s nanoparticle technology can detect cancer at a mass of 100,000 cells. By the time it is ready for commercial use, it could detect cancer before stage one.

Solar Photovoltaic Nanowires
An industrial collaboration between CINT and Sharp Labs of America is exploring new solar photovoltaic device architectures based on silicon nanowires with the aim of achieving conversion efficiencies comparable to those found in high-quality bulk single crystal silicon, but at thin-film costs. Nanowire devices afford greater control over import performance criteria including light absorption and electrical energy harvesting. This project is providing new insight into the growth of radially structured nanowires and fabrication of large area nanowire arrays.

Nanoscience Integration
The distinguishing characteristic of CINT is its emphasis on exploring the path from scientific discovery to the integration of nanostructures into the micro and macro worlds. This pathway involves the experimental and theoretical exploration of behavior, the development of a wide variety of synthesis and processing approaches, and an understanding of new performance regimes, testing design, and integration of nanoscale materials and structures. Integration itself is key to the exploitation of nanomaterials, and the scientific challenges that it poses are at the heart of CINT’s mission.

Societal Impact

Scientists from 23 countries, including the U.S., use CINT to conduct their research.

- Argentina
- India
- Singapore
- Australia
- Indonesia
- Slovenia
- Belgium
- Italy
- South Korea
- Canada
- Japan
- Sweden
- China
- Germany
- Switzerland
- France
- Mexico
- United Kingdom
- Greece
- New Zealand

Scientists from 41 states, the District of Columbia, and Puerto Rico use CINT to conduct their research.