# Nanotechnology: "Science of Small Things" Destined to be Big, $12.5-Trillion Industry

*By Krysta Venturella, Editorial Assistant*


This mPhase ultra sensitive magnetometer used in cell phones and security applications is so small,s it fits on the face of a penny.

Imagine materials that are 100 times stronger than steel, computers indistinguishable from the human brain, bulletproof vests the thickness of a single piece of paper, maps of each individual's genome to create solutions to individual diseases, or tiny robots that can travel through the human body combating disease and other ailments. These are not creations from a science-fiction novel, but innovations that will be made possible in the future with nanotechnology.

Today, nanotechnology applications are widespread, ranging from wrinkle-free, stain-resistant clothing and fabrics, anti-bacterial and self-healing bandages, paints, pigments and cosmetics, to bugs that eat chemical pollutants and pull them out of the environment.

Nanotechnology, commonly known as "the science of small things," involves research and technology developed at the atomic, molecular and macromolecular levels. A nanometer is a billionth of a meter or one 80,000th the thickness of a human hair. This science is critical to New Jersey and global economies.

In fact, nanotechnology is so crucial that President Bush during his 2006 State of the Union Address, he called for doubling the research and development (R&D) budget from about $1 billion annually in areas like nanotechnology for the United States, in order for the U.S. to remain globally competitive in this field.

The National Science Foundation predicts nanotechnology will be a $12.5 trillion industry by 2015, and the mid-Atlantic region, spanning Delaware, New Jersey and Eastern Pennsylvania, has the potential to draw in a piece of that economic growth.

The Mid-Atlantic Nanotechnology Alliance's (MANA) 2006 study found: "The Mid-Atlantic region is well positioned to become a global leader in prototyping and

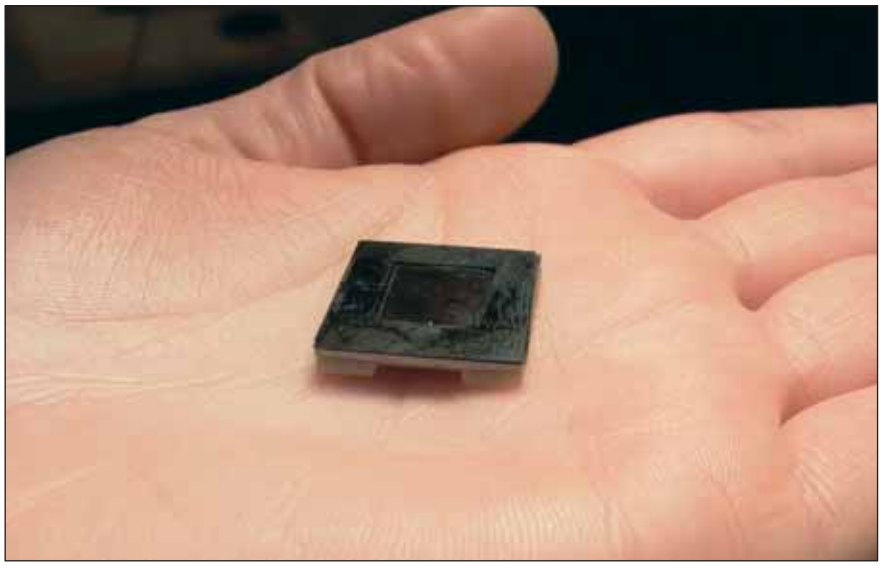
commercializing discoveries for applications in the multi-trillion-dollar nanotechno-logy-related energy, biomedical and opto-electronics markets." The study also found that nanotechno-logy is a key driver in the next industrial revolution and is critical to maintaining a competitive advantage in this region, which is already an industrial powerhouse and a hub for industrial and academic entities in nanotechnology.

Alice White, president of the NJ Nanotechnology Consortium, says nanotechnology is a buzz word that many people hear, "but most don't understand what it can do for them." She says it did not just spring up from nowhere, because technology is a continuum.

The Consortium, which combines the leading-edge fabrication capabilities of Bell Laboratories with regional academic research institutions and universities, is working on controlling fabrication on the nanometer scale to make increasingly sophisticated devices that are more sensitive, smaller and consume less power. Other projects include efforts in DNA separation and changing the topography of a surface to control whether or not a fluid can wet it.

Currently, more than 100 companies in the region are engaged in nanotechnology research, product development and business activities. David Bishop, CTO/COO of LGS, a subsidiary of Murray Hill-based Alcatel-Lucent, says, "I can't think of a single industry that can't benefit from nanotechnology. My sense is that nanotechnology's impact is going to be every bit as important as the invention of transistors, computers and information technology that we see today."

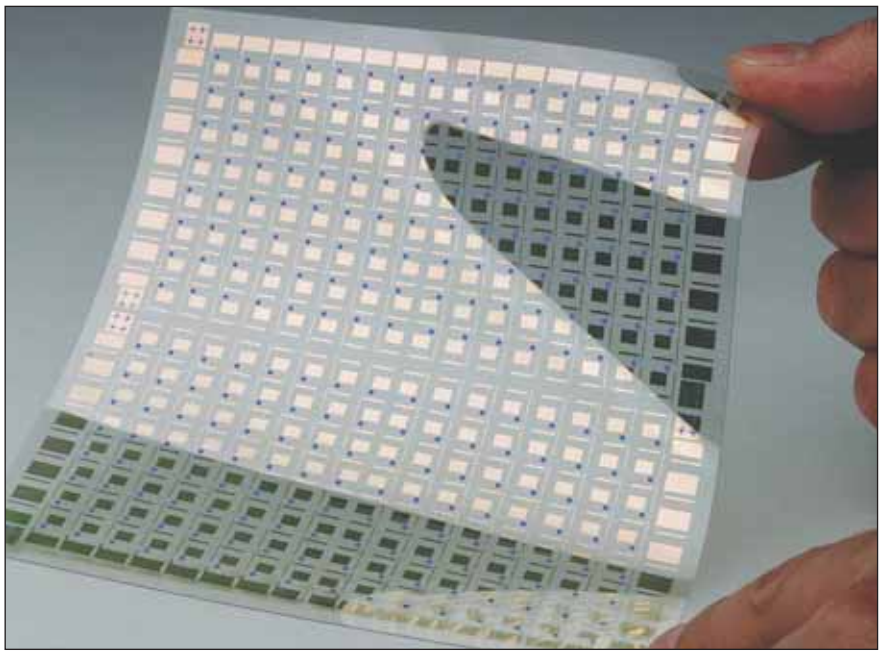
New Jersey has a strong position in key industries such as pharmaceuticals, telecommunications, materials, electronics and energy. "If I look at traditional areas of economic strength in the state, they are all likely to be revolutionized by nanotechnology," Bishop says. It is also integral for these industries to integrate nanotechnology into their products to remain globally competitive.



The mPhase Smart Nanobattery that lasts longer and has a longer shelf-life than regular batteries, fits in the palm of your hand, with room to spare.

In explaining the usefulness of nanotechnology in the medical field, Bishop says, in the future, instead of undergoing chemo-therapy and having both healthy and cancerous cells affected by radiation, nanotechnology will make it possible to go directly to the site of a tumor and rectify the problem.

Little Falls-based mPhase Technologies, which recently created a 100 percent wholly-owned subsidiary called Always-Ready, Inc., is revolutionizing the



A printed plastic display circuit in which small blue regions correspond to organic semiconducting material. Bell Labs scientists recently created prototypes of a similar dielectric material that can be "stretched" to any size or shape and used for next-generation telecoms and other applications.

traditional design of the battery with nanotechnology. Steve Simon, executive vice president of engineering, research and development for the company, says mPhase has created the Smart Nanobattery that lasts longer and has a longer shelf-life than regular batteries. mPhase is currently looking to build a battery that has no energy leakage (which inevitably happens over time) by separating the chemicals in batteries so nothing mixes until the consumer wants the battery activated. mPhase also manufactures ultra-sensitive magnetometers, which are devices used in cell phones (for direction finding) and security applications (for detecting if weapons are present, by recognizing changes in magnetic fields).

Through the NJ Nanotechnology Consortium at Alcatel-Lucent Bell Labs, Murray Hill, mPhase has access to the world's leading nanotechnology laboratory clean room. Ronald A. Durando, president, CEO and director of mPhase, notes that the capital cost to put this facility equipment together (without the building costs taken into consideration) would exceed $200 million.

Simon explains that nanotechnology is a collaborative effort between large and small businesses and universities, which must share intellectual property and resources.

Fred Allen, owner of RADii Consulting, LLC, Princeton Junction, chairman of the Nanotechnology Industry Network of the NJ Technology Council, and director of the Greater Garden State Nanotechnology Alliance, says the Alliance is a coalition of universities, companies and organizations in the region that have expressed interest in nanotechnology commerciali-zation. It is called "Greater Garden State" because "technology doesn't recognize state borders," he says. This regional initiative is in collaboration with area universities Princeton, Rutgers, Rowan and New Jersey Institute of Technology.

Commenting on the Nanotechnology Industry Network, he says, "It wants to help retain, grow and add jobs in the region. We want to make sure the talented workforce that has been here for decades stays here because there is opportunity. The more nanotechnology is kept at the forefront and recognized as something that enables other industries to thrive, the more this is going to help our region."

The 2006 New Jersey Commission on Science and Technology study, "Nanotechnology: Assets and Opportunities for New Jersey," reported that investments in the state's universities and emerging technology businesses are essential to prepare the workforce and thus create economic growth.

Bishop feels nanotechnology is New Jersey's chance to become the nano-equivalent of the Route 128 corridor around Boston for computers, or Silicon Valley for semi-conductors, in this new economic era. "New Jersey can't afford not to win," he says.

"The real impact in nanotechnology will be things we aren't smart enough to imagine yet, because we are still thinking in the conventional, non-nano space," Bishop says. "Nanotechnology is, to me, like we have knocked a wall down and have wandered into some new magic place, picking up the gold nuggets and diamonds. We don't know exactly what we're going to find, but there is a lot of good stuff in there."

Simon agrees. "It is like the tip of the iceberg. I don't think you can even envision what nanotechnology will bring in the future."