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Pennsylvania

Cultivating World-Class Micro and Nanotechnology Companies

> ready > set > invest

Pennsylvania's numerous micro and nanotechnology companies are flourishing with help from the state's technology-based economic development organizations, world-renowned research institutions and robust workforce development pipeline.

In Pennsylvania, micro and nanotechnology are being advanced as enabling technologies that are bringing innovative projects to the next generation of development. Pennsylvania companies that have existing products on the market are also expertly applying nanotech. The economic development organizations and universities listed below have assisted nearly every company highlighted on the following pages by providing support such as business plan development, research and technology development, partnering, workforce development and capital for growth. In addition, the Commonwealth's Ben Franklin Technology Development Authority has been investing state dollars in nanotech for over five years.

Pennsylvania (PA), with its 2,000-plus life sciences establishments, world-class basic research, emerging companies, mature industry, global pharmaceuticals and strong infrastructure to support industry growth, is cultivating a nanotechnology environment that is showing significant promise. Dozens of micro and nanotech-focused companies have chosen to make PA their home because of these distinct advantages that will help propel them through the growth stages.

These investments and collaborations make up PA's statewide strategy, the Pennsylvania Initiative for Nanotechnology (PIN). PIN is the result of the combined efforts of the Commonwealth's six research universities, the PA State System of Higher Education, the PA Commission for Community Colleges, economic development organizations including the PA Department of Community and Economic Development, and dozens of companies. PIN leverages PA's clusters of research, corporate and economic development assets and builds upon substantial groundwork already in place.

PIN is winning PA national attention. Josh Wolfe, a renowned authority on nanotechnology, commented on PA's nanotechnology standing, stating:

> *"In all my travels, one thing's certain about nanotech: it's not a Silicon Valley phenomenon. Leadership is up for grabs, and so are the scientific breakthroughs, the jobs and investment profits. Pennsylvania's got the scientific star power, plus the political, industrial and financial support to own this space."*

Wolfe is a managing partner of Lux Capital, editor of the Forbes/Wolfe Nanotech Report, and a director of Lux Research.

If you are interested in becoming part of the Pennsylvania micro and nanotechnology community, please call 1-800-GO-newPA or email ra-pin@state.pa.us.

Pennsylvania Initiative for Nanotechnology (PIN)

NanoHorizons Inc. (www.nanohorizons.com) offers nanotechnology products/processes for near term biotech, pharmaceutical, chemical, and microelectronic applications. The company's initial products include technologies for monitoring respiration, drug screening through QuickMass® high-throughput mass spectrometry, molecular detection through nanoparticle synthesis in nanopores. This growing company has forged partnerships with Arrow International, Sarnoff Corp., Shimadzu Biotech, and the Defense Advanced Research Projects Agency (DARPA), among others.

NanoHorizons has developed silver nano-particles that can mesh with the cotton, plastic, or nylon material in shoes, pads, jerseys, helmets or other pieces of sports equipment to kill the bacteria and microbes that cause odors and bacteria. Other applications include plastic storage containers, food packaging materials, plastic gloves and bacteria-resistant mascara.

"NanoHorizons was founded on technology developed by a team headed by Dr. Stephen Fonash at the Nanofabrication Facility at Penn State University and now employs recent graduates of the University's Engineering program. With significant funding from the Life Sciences Greenhouse of Central and Northern PA and the Ben Franklin Technology Partners of Central and Northern PA, Nano-Horizons has found that Pennsylvania's competitive cost of doing business, government support, deep talent pool, and abundance of university and industry R&D are cultivating a very favorable environment for nanotech companies."

– Robert Burlinson, CEO, NanoHorizons

NanoHorizon's high-performance polycrystalline thin film transistors on a flexible polymer

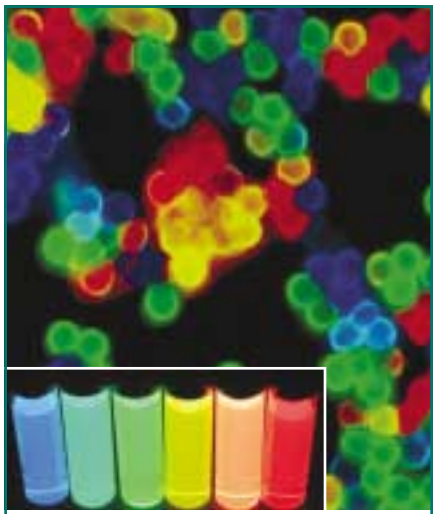
Pennsylvania Governor Edward G. Rendell recently presented checks totaling over $1.5 million to Omega Piezo Technologies (www.omegapiezo.com) and HyperNex Inc. (www.hypernexinc.com). Rendell commented "Nanotechnology is an engine that will drive industrial change in the coming years. The Pennsylvania Initiative for Nanotechnology is positioning the Commonwealth to be a national force in this building wave of development."

Air Products (www.airproducts.com; NYSE: APD), a Fortune 500 company headquartered in PA, serves customers in technology, energy, healthcare and industrial markets worldwide with a unique portfolio of products, services and solutions. The company has long supported research at Lehigh University with approximately 400 of Air Products' employees being Lehigh University graduates. Air Products has also funded nanotechnology research at Penn State University in the areas of nanoclay and inorganic nanoparticles.

"Pennsylvania has a very strong and diverse set of capabilities in nanotechnology" said Jeffrey T. DePinto, Business Development Manager for nanotechnology at Air Products. "Organizations such as Ben Franklin Technology Partners of Northeastern PA are providing an infrastructure that makes Pennsylvania very attractive to nanotech companies."

Crystalplex Corp. (www.crystalplex.com) is bringing nanotech to today's major challenges in drug discovery and clinical diagnostics. With their PlxBeads® technology, Crystalplex has created tiny beads encoded with semiconducting nanocrystals, which are easily excited to emit visible colors. Varying colors and chemistries produce nanosensors with unique optical signatures that enable researchers to study very rich molecule solutions, combining multiple assays or experiments into a single operation.

LaunchCyte LLC, a Pittsburgh-based early-stage venture capital firm that received funding in 2004 from the Commonwealth's Ben Franklin Technology Development Authority, founded Crystalplex. In addition, Crystalplex has been funded by Innovation Works (the Ben Franklin Technology Partner of Southwestern PA), the Pittsburgh Life Sciences Greenhouse, the University of Pittsburgh Medical Center as well as private investors.



Crystalplex nanocrystal encoded beads for biomedical testing, available in a full spectrum of colors

Seagate Technology (www.seagate.com; NYSE: STX) is the worldwide leader in the design, manufacturing and marketing of hard disc drives, providing products for a wide range of consumer electronics applications. Seagate was the first to implement nanotech in high volume disc drive manufacturing. Seagate recording heads and media have nano-scale dimensions and require additional materials with sub-nano-scale precision in thickness. This greater precision allows for more storage information density as well as improved performance and reliability in Seagate's products.

"Seagate Research is one of the premier facilities in the world for driving the development and technology of data storage that will be used in the future," said Dr. Mark Kryder, Seagate CTO and VP of Research. "Pittsburgh was chosen as the ideal setting largely because it enables us to work more closely with the research facilities at the Data Storage Systems Center and the Parallel Data Laboratory at Carnegie Mellon University."

NSF Awards $11.4 million to University of Pennsylvania to open Nanoscale Science and Engineering Center

The Penn center will receive $11.4 million during the next five years with the funding being renewable for a second term, for a total of approximately $23 million from the NSF program, along with several million dollars in additional grants from NSF and other government sources.

Photo by Felice Macera

Dean Eduardo Glandt with President Amy Gutmann and Professor Dawn Bonnell celebrating the new Nano-Bio Interface Center.

Technological innovation has made **PPG Industries** (www.ppg.com; NYSE:PPG) the world's leading maker of transportation coatings and a major global supplier of industrial and packaging coatings, flat and fabricated glass, continuous-strand fiber glass, and industrial and specialty chemicals. A flagship nano product of PPG, CeramiClear Clearcoat® uses nanoparticle technology in the final coating applied to car bodies, protecting the color coat while providing a durable, glossy appearance. The patented nanoparticle technology creates a highly cross-linked network at the surface of the coating for superior resistance to damage caused by day-to-day use, car washes and environmental hazards such as acid rain and tree sap.

With four principal technical centers in the Pittsburgh area, PPG is the largest employer of scientific personnel in a region that has earned a reputation as one of the most desirable in the United States for science, technology, higher education and health care.

SaRonix (www.saronix.com), a subsidiary of Pericom Semiconductor, manufactures industry-standard and custom frequency control products including Crystal and SAW Oscillators, Quartz Crystals, and Timing Modules. With assistance from the Pittsburgh Digital Greenhouse (PDG), SaRonix moved its design center to the Innovation Park at Penn State (PSU) from the Silicon Valley to take advantage of PSU's labs at the College of Engineering, Department of Engineering and Department of Computer Science and Engineering, as well as their micro and nanofab capabilities. The collaborative efforts with PSU and the PDG have helped SaRonix stay at the leading edge of product design and development.

Hanson Technologies, Inc. (www.hanson-technologies.com) is developing a sensor platform applicable to both biological and chemical detection. The company has recently focused on developing a way to test blood or urine of cattle for mad cow disease. Hanson Technologies received significant funding from the Ben Franklin Technology Partners of Central and Northern PA as well as from the Life Sciences Greenhouse of Central PA. The company has also entered into technology development partnerships with the Army Research Center, the Naval Research Labs, and the Penn State Nanotechnology Center.

Plextronics, Inc. (www.plextronics.com) recently received funding from Innovation Works and the Department of Community and Economic Development to help commercialize a new generation of polymer technology, based on research at Carnegie Mellon University. Plextronics' core technology, Plexcore,™ enables printed electronic devices to reach broad market applications. Plexcore is superior because it self-assembles into conductive "nanowires" that permeate a matrix of a structural plastic. These nanowires are distributed throughout the bulk of the plastic as shown below and therefore enable increased conductivity as well as stability.

Plexcore™ has been used with strong results as an additive in seamless flooring systems, which are designed for application in sensitive manufacturing environments, resulting in a static dissipative system. Static electricity is blamed for 40% of electronic device failure (a $40 billion per year global problem) and also causes fires and explosions in manufacturing environments that use volatile materials (e.g., pharmaceuticals and cosmetics). Plexcore™ materials could be an effective means of fighting this problem by creating static-safe flooring.

OraSure Technologies (www.orasure.com) has developed a technology being used by millions of people around the globe that uses oral fluid rather than blood or urine to simplify and speed the testing for HIV/AIDS. The test utilizes nanometer sized colloidal gold particles as the detection labels which enable the visual detection of assay results without the need for sophisticated laboratory equipment. FDA approval in 2004 has allowed the OraQuick® *ADVANCE* HIV-1/2 test to be used at more than 180,000 sites in the United States.

OraSure's OraQuick® ADVANCE Rapid HIV-1/2 Antibody Test with results in as little as 20 minutes

The company's breakthrough oral fluid testing technology has been lauded by the president and the U.S. Department of Health and Human Services (HSS). Claude Allen, Deputy Secretary of HHS, said, "The introduction of . . . the OraQuick® Rapid HIV-1 Antibody Test has enabled us to reduce barriers to testing and help increase the number of people who know their HIV status, helping to stop the spread of AIDS."

Between 1989 and 2003, OraSure revenues soared from $77,000 to $40 million, an average compound growth of 56% per year. The Ben Franklin Technology Partners of Northeastern PA provided vital resources and funding. In addition, the company has collaborated with Lehigh University's Center for Advanced Materials and Nanotechnology, and Center for Optical Technology.

From its humble beginnings in the Ben Franklin Business Incubator to national recognition for its HIV testing advances, OraSure has created nearly 200 jobs, renovated abandoned building space, attracted significant outside investment, and provided research and development work for Lehigh University.

NanoSelect, Inc. (www.nanoselect-inc.com), founded on University of Pennsylvania research, produces isolated and sorted nanotubes in aqueous suspensions important in creating the next wave of enhanced materials, electronics, catalysts, and biomedical applications. To aide its continued growth, the company is tapping into a full array of resources provided by the Nanotechnology Institute (NTI).

The NTI, an alliance of business, academic and government founded by Ben Franklin Technology Partners of Southeastern PA, Drexel University and the University of Pennsylvania is a one-stop shop for its member companies for licensing IP, reducing barriers and eliminating obstacles that have traditionally impeded technology transfer and commercialization. This process has been integral in attracting and retaining NTI members including large pharmaceutical companies such as Cephalon, GlaxoSmithKline, Merck and Elan; emerging life science companies such as LifeSensors, NanoSelect, and NanoBlox, and an international trading company Itochu.

"[The] NTI's activity has played a unique role in bringing together research providers and research users in Pennsylvania and neighboring states. We need more partnerships of this kind, since the roles of industry and local state government will increase as we move from fundamental discoveries to technological innovation."

– Mihail C. Roco, Ph.D. Senior Advisor, National Science Foundation and Chair, National Science and Technology Council's Subcommittee on Nanoscale Science, Engineering and Technology

NanoBlox, Inc. (www.nanobloxinc.com), also a member of the NTI, manufactures patented nanoparticles, called NanoBlox™, and develops processes and applications to improve critical physical properties in materials. The company's patented nanodiamond dispersions have applications in automotive, metal plating, semiconductor manufacturing, memory disk production, optical, and pharmaceutical applications.

In 2004, recognizing the unique imaging and analysis capabilities in Lehigh University's Center for Advanced Materials and Nanotechnology (CAMN), NanoBlox joined the CAMN Industrial Liaison Program and the Lehigh Nanotech Network to study the structure and bonding of their novel particles. Nearby, the University of Pennsylvania is using infrared spectroscopy for analysis of NanoBlox™, surfaces, which can be tailored for specific applications.

Glucose Sensing Technologies, LLC (www.glucosesensingtechnologies.com), founded on University of Pittsburgh technology, is combining nanoscale and mesoscale quantum dots, colloids, macromolecules, and molecular recognition molecules to develop new photonic crystal materials for optical switching, optical memories, and chemical detection services. The company's flagship device is a noninvasive glucose measurement sensor that is applied via a contact lens that changes color according to the level of glucose found in a diabetic patient's body. The technology also offers such testing applications as measuring the levels of certain metals or chemicals in water.

Glucose Sensing noninvasive glucose measurement sensor

PA's Robust Nanotech Workforce Development Pipeline

Pennsylvania is a national leader in nanotech workforce development and education. Since 2000, the Commonwealth of PA has awarded over $4.1 million in Customized Job Training grants to PA companies performing nanofabrication work. Last year, $1.7 million in Workforce Leadership Grants was awarded to PA education groups.

In addition, the **Nanofabrication Manufacturing Technology (NMT) Partnership**, led by PSU, involves 30 colleges and universities across the state and is dedicated to meeting the needs of PA industry for skilled nanofabrication workers. The NMT Partnership is the nation's leading nanofab education and workforce development program. More than 150 associate degrees in nanofabrication have been awarded by PA community colleges through the NMT Partnership, and more than 30 PA companies using nanotech are employing these graduates.

Anthony Langzettlel, who participated in the NMT Partnership, recently became a process/test technician at Seagate Technology. Langzettel said,

"The NMT Partnership doesn't just teach theory, it incorporates theory into hands-on device fabrication. The program is providing students with world-class nano education and companies with state-of-the-art employees."

Save the Date

The Business of Nanotechnology
Pittsburgh, PA
April 18-20, 2005
Westin Convention Center Hotel
Look for future announcements
and program details
www.pananoconference.org

For more information on PIN and the companies that it supports, please visit:

Department of Community and Economic Development, Commonwealth of PA
www.newPA.com
Ben Franklin Technology Partners
www.benfranklin.org
Carnegie Mellon University
www.cmu.edu
Drexel University
www.drexel.edu
Lehigh University
www.lehigh.edu/nano
Life Sciences Greenhouses
www.bioadvance.org
www.pittsburghlifesciences.com
www.lsgpa.com
Nanotechnology Institute
www.nanotechinstitute.org
Penn State University
www.psu.edu
University of Pennsylvania
www.upenn.edu
University of Pittsburgh
www.pitt.edu
Pittsburgh Digital Greenhouse
www.digitalgreenhouse.com

For additional information, please contact:

- Richard Overmoyer, Deputy Secretary for Technology Investment, PA DCED
  rovermoyer@state.pa.us
- Kelly S. Wylam, Nanotech Program Manager
  kwylam@state.pa.us
- 1-800-GO-newPA