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University of Arkansas, Fayetteville. Technology Development Foundation

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Quarterly Newsletter

September 2007 Issue

the university of arkansas technology development foundation

UofA Commercializing TiO_2-Based Long Nanowires

ATLANTA, Georgia, Intellectual Property Partners LLC (IP2) announced today the availability of titanium dioxide-based long nanowires, a breakthrough multifunctional material created at the University of Arkansas.

The titanium dioxide-based nanowires are extremely light, long and thin fibers. When assembled into free-standing membranes, they provide an exceptional new solution to a suite of important applications, including filtration. "TiO_2-based nanowires can withstand extreme temperatures of up to 700 °C and can be used in the strongest chemical acids and bases," says IP2 president James Throckmorton. "Their high thermal stability and chemical inertness provide solutions not possible until now to applications in high temperature or other harsh environments."

TiO_2 nanowires have a diameter of 60 nanometers (1 nanometer equals one billionth of meter) and a length of 30 to 40 millimeters, with an aspect ratio (i.e. length versus diameter) of 500,000 to 1. "It's unprecedented to have a pure fiber with such a huge aspect ratio," Throckmorton continues. "We're excited to bring this patent-pending technology to a company that can bring it to market."

IP2 holds the global license for the Titanium Dioxide (also known as TiO_2, titania and titanium white) technology, which was developed at the University of Arkansas by Assistant Professor Z. Ryan Tian, formerly with Sandia National Laboratories. The technology was made available through the University of Arkansas Technology Development Foundation (UATDF), an organization that helps transfer early stage inventions

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Breakthrough in Nanomachining and Organic Molecular Breakdown

FAYETTEVILLE, Ark. - Engineering researchers at the University of Arkansas and the University of Nebraska-Lincoln have discovered a novel nanomachining process that will help manufacturers produce superior nanoscale devices to perform important functions such as detecting DNA and precisely controlling drug release.

The research, to be published in the *Physical Review Letters*, focuses on the dielectric breakdown of liquid organic molecules introduced during the nanomachining process. Dielectric materials do not conduct electric current. The collaborative research was funded by the National Science Foundation's division of Civil, Mechanical and Manufacturing Innovation.

"Understanding dielectric properties of very thin layers plays a critical role in next-generation electronic devices," said Ajay Malshe, professor of mechanical engineering at the University of Arkansas. "In the past 10 years, the machining process in conductive materials for these devices has been scaled down to the micro level - between 3 and 10 micrometers. With this project, we demonstrated dielectric breakdown for the first time at the nanolevel."

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ARTP to Launche New Website

The U of A Technology Development Foundation, in conjunction with the Graduate School, is in the process of making final adjustments on a new research & technology park website. The new site has over 50 pages of park related information, photos, maps and news articles.

Highlights of the new site will include over 30 individual affiliate pages including company bios and contact information, a secure log in page for company owners/presidents to view information, resumes, etc., and comprehensive facilities information pages including photos, directions, maps, transportation options and the park's master plan. You may direct your questions and comments regarding the site to cmileham@uark.edu.

City of Fayetteville Hosts Lt. Governor's Day

Lt. Governor, Bill Halter was in town August 3rd, as part of a membership luncheon with the Fayetteville Chamber of Commerce. While in Fayetteville, Lt. Governor Halter visited with the Arkansas Higher Education Coordinating Board, was given a welcome ceremony and a tour of the Blair Library and visited Washington Regional Medical Center before his luncheon with the chamber. After the luncheon, Halter and his team came to the ARTP's Innovation Center, where they met with Tom Muccio and his team from BioBased Systems.

Bio Based began operations in 2003, specializing in the research and development of Agro-based polyols for the Polyurethane industry. Agrol® was the first of a family of soybean-based polyols to be commercialized by BioBased Technologies™. It has found use in a wide range of applications including but not limited to spray insulating foams, rigid foams, flexible foams and CASE (coatings, adhesives, sealants, and elastomers).

After meeting with BioBased, Halter spent an hour with the UATDF and representatives from Arkansas Power Electronics International, SFC Fluidics, Virtual Incubation Company, Lynguent, NCREPT, Axpet and Power Electronic Leveling Solutions. During the meeting representatives give Lt. Governer Halter a brief overview of their companies' history and explained the technology platforms being developed. It is hoped that Lt. Governor Halter can assist in helping get these companies to the next level

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Nanowire Coating for Bone Implants, Stents

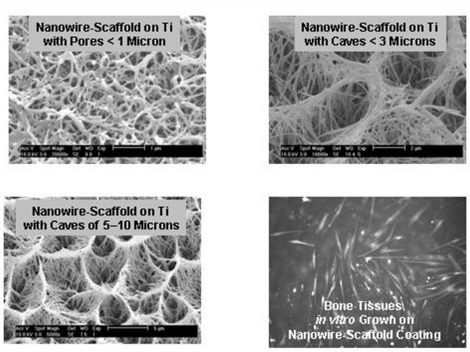
FAYETTEVILLE, Ark. - University of Arkansas researchers have found a simple, inexpensive way to create a nanowire coating on the surface of biocompatible titanium that can be used to create more effective surfaces for hip replacement, dental reconstruction and vascular stenting. Further, the material can easily be sterilized using ultraviolet light and water or using ethanol, making it useful in hospital settings and meat-processing plants

Wenjun Dong, Tierui Zhang, Lisa Cooney, Hong Wang, Yanbin Li, Andrew Cogbill, Vijay Varadan and Z. Ryan Tian of the University of Arkansas, Ying-Bing Jiang of the University of New Mexico, and Joshua Epstein of the University of Arkansas for Medical Sciences report their findings in an upcoming issue of the journal *Chemistry of Materials*.

The researchers used an alkali and heat to create titanium oxide-based ceramic nanowires that coat the surface of a titanium medical device.

"We can control the length, the height, the pore openings and the pore volumes within the nanowire scaffolds" by varying the time, temperature and alkali concentration in the reaction, said Z. Ryan Tian, assistant professor of chemistry and biochemistry in the J. William Fulbright College of Arts and Sciences. "This process is also extremely sustainable," requiring only that the device be rinsed in reusable water after the heating process.

Reconstructive bone surgeries, such as hip replacements, use titanium implants. However, muscle tissue may not adhere well to titanium's smooth surface, causing the implant to fail after a decade or so and requiring the patient to undergo a second surgery.



Tian and his colleagues created a nanowire-coated joint and placed it in mice. After four weeks, the researchers found that tissue had adhered to the joint.

"We saw beautiful tissue growth - lots of muscle fibers," Tian said. "We've added one more function to the currently-in-use titanium implant."

Because the researchers can control the size and shape of the pores in the nanowire scaffold, the material also could be

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Biosensor Center to Receive Part of Large NSF Grant

FAYETTEVILLE, Ark. - The Center for Nano-, Bio-, and Info-Technology Sensors and Systems at the University of Arkansas will benefit from a recent $9 million National Science Foundation grant to the Arkansas Science & Technology Authority. The university portion of the grant will allow researchers to create collaborative infrastructure for the design of arrays of nanosensors that can be integrated with wireless systems and fabricated with a specialized, yet low-cost, nanofabrication technology.

"This grant will enable our center to develop wireless sensors and networking technologies that will have a major impact on people and the way they live," said Vijay Varadan, Distinguished Professor of electrical engineering. "For example, we will develop wearable chemical and biological hazard sensors for firefighters, police and security personnel. In addition, we will develop biosensors for human physiological and ambulatory monitoring, and the detection of pathogens in clinical, food, agricultural and environmental samples. These are only a few examples of the kind of devices our center will create."

Researchers at the University of Arkansas center have already developed and tested two similar but slightly different biosensors that can measure important physiological signs. Integrated into "smart" fabrics - garments with wireless technology - these sensors will monitor a patient's respiration rate and body temperature in real time and thus provide point-of-care diagnostics to health-care professionals and greater freedom for patients.

The $9 million grant, made through the NSF Experimental Program to Stimulate Competitive Research, will establish the Arkansas ASSET Initiative (Advancing and Supporting Science, Engineering and Technology), which is designed to boost progress in two scientific research areas developing in Arkansas: plant-based bioproduction and wireless nano-, bio- and info-technology sensors. Both projects have potential for major economic development as well as regional and national commercial significance.

Each project has significant and integrated research on the campuses of Arkansas State University and the University of Arkansas at Little Rock, in addition to the University of Arkansas. As a co-principal investigator, Varadan will direct the wireless sensors project. Gail McClure, vice president of the Arkansas Science & Technology Authority, said that ASSET is the first strongly integrated, multi-university collaboration of three of the four graduate research institutions in Arkansas.

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Biosensor Center to Receive Part of Large NSF Grant

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The Arkansas Science & Technology Authority was created by statute in 1983 with the mission to bring the benefits of science and advanced technology to the people and state of Arkansas. This mission is addressed by strategies to promote scientific research, technology development, business innovation, and math, science and engineering education.

Varadan holds the College of Engineering's Twenty-First Century Endowed Chair in Nano- and Bio-Technologies and Medicine and the college's Chair in Microelectronics and High Density Electronics. In addition to his position as director of the above center, he directs the university's High Density Electronics Center. Varadan is also a professor of neurosurgery in the College of Medicine at the University of Arkansas for Medical Sciences.

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Breakthrough in Nanomachining and Organic Molecular Breakdown

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A micrometer is a millionth of a meter, and a nanometer is a billionth of a meter. A human hair typically has a diameter of 70,000 nanometers.

"This understanding is an important step toward achieving reproducibility, reliability and repeatability when machining at sub-20 nanometer scales, which is vital for the realization of nanoscale active systems," said Kamlakar Rajurkar, professor of industrial engineering and management systems at the University of Nebraska-Lincoln.

Using a scanning-probe microscope with additional features, Malshe, Rajurkar and Kumar Virwani, a recent engineering doctoral graduate and co-author of the study, devised an electric-discharge machining and manufacturing platform and discovered the breakdown of dielectric molecules across a gap less than 20 nanometers in length. The nano-electric machining platform allowed the researchers to position a cathode tip - a negatively charged electrode acting as a point - against an anode plane - a positively charged plane - and sandwich the organic molecules between them.

The voltage applied in the gap generated an intense electric field. After making the cut and ceasing voltage, the researchers observed the behavior of the organic molecules, which were confined in the gap. Rajurkar identified the above process as nanoscale electric discharge machining, or nanoEDM.

Organic molecular medium is an integral part of the machining set up, Malshe said. Understanding its dielectric and breakdown properties is critical to determining how the process of machining works and will lead to improving machining performance and speed.

Understanding the molecular behavior and breakdown of dielectric media during the machining of extremely resistant materials is also critical to developing commercial products with features such as nanopores for detecting DNA, nanojets for controlled drug release and nozzles for nanofluidic devices. There is great demand for such features in difficult-to-machine metals such as gold, titanium and platinum, silicon and ceramics such as silicon nitride, silicon dioxide and conductive polymers. The research also expands knowledge of organic and molecular electronics.

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from the University to corporations and start-up organizations. Phil Stafford, president of the UATDF says, "This new nanotechnology has such exciting potential. We're very pleased to be working with IP2 to help us find the best commercial fit for it."

IP2 is offering the exclusive rights to this technology to only one corporation. Applications include high temperature filtration, difficult chemical filtration, and water filtration. Other potential brand new applications include oil refinery catalyst, foundry applications, solar cells, high temperature non-woven textiles, drug delivery and tissue growth.

University of Arkansas Technology Development Foundation:

In cooperation with public and private business development entities, the University of Arkansas Technology Development Foundation (UATDF) bolsters the University's efforts to catalyze a technology-based economy in Arkansas. Created in May, 2003, the Foundation validates, develops and transfers inventions made at the University to Arkansas companies and start-up ventures. For more information, please visit www.uark.edu/ua/artp.

About Intellectual Property Partners LLC:

Based in Atlanta, Georgia, IP2 turns promising technologies into profitable realities for the business world through a unique process that reduces risks, saves time and lowers costs. IP2 unearths promising intellectual property within universities, assesses market potential, and validates the technology. IP2 then provides early-stage investment capital and forms a proof-of-commercialization entity to "prove and package" the technology for full-scale commercialization. The final step in IP2's proprietary process is the sale of a technology license to a corporate buyer. For more information, please visit www.ip2.biz.

Nanowire Coating for Bone Implants, Stents

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coated onto stents used in patients with coronary artery disease and in potential stroke victims. Conventional stents sometimes become reclogged with fat after implantation. The most recent stent used to address this problem, called the drug-eluting stent, consists of a polymer coating mixed with the drugs, but the coating may be vulnerable to biodegradation, and may not function for long. The nanowire coating without the degradation problem could be used to carry drugs that would help keep the arteries clear over a period of time.

"This drug release could be applied to the angioplasty catheter's surface," Tian said.

In addition to these biomedical applications, the nanofiber scaffold has a property that may make it useful in both hospitals and food processing plants: The material, when rinsed in water and exposed to ultraviolet light, kills more than 99 percent of bacteria on its surface. This effect occurs because photons from the light cause a charge separation on the material, splitting water molecules into free radicals that destroy the bacteria. Alternatively, immersion in 70 percent ethanol completely sterilizes the material, allowing growth of cells/tissues in the laboratory prior to implantation.

This property could prove extremely useful in bacteria-prone environments, performing such functions as sterilizing on-site surgery hospitals used during military actions or cleaning surfaces in meat-processing plants. The researchers have applied for a provisional patent for the multifunctional nanowire bioscaffolds on titanium or titanium-containing alloys such as Nitinol.

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