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Experimental Program to Stimulate Competitive Research

LA Tech's Institute for Micromanufacturing World Leader in Nanotechnology

This is the third of a three-part series of articles on the three university teams that headed the Consortium of nine universities collaborating on micro- and nano-scale science and technology research under a grant funded by a $9 million National Science Foundation EPSCoR grant in 2001. The largest award received by the Board of Regents' Louisiana EPSCoR program as of that date, it was matched with another $3 million from the Board of Regents Support Fund and $3.8 million pledged by the participating universities and private industry.

A challenge with "smart drugs" developed to target specific areas in the body is their delivery: if any part of their structure is changed, they either won't work or, worse, they could produce negative side effects.

Addressing that problem are researchers at Louisiana Tech University's Institute for Micromanufacturing (I*f*M). They are employing two unique technologies they pioneered for the controlled release of drugs via nanocapsules with special release properties. They are:

- The Layer-by-Layer nanoassembly of macro-molecules, a new nanotechnology method, and
- a unique polyion Layer-by-Layer nanocapsule fabrication technology.

"The first four papers on Layer-by-Layer nanoassembly were published in 1992-1993, two of them with Institute for Micromanufacturing co-authorship," says I*f*M Director Kody Varahramyan.

"And I*f*M is one of only two centers in the world developing and advancing the Layer-by-Layer nanocapsule fabrication technology. The other is Germany's Max Planck Institute for Colloids."

The attractive feature of Layer-by-Layer nanoassembly is its distinctive self-assembly method enabling us to design materials with a desired set of characteristics and a wide range of applications, such as unique materials for coating applications and nanosensors and detectors for biomedical and environmental applications.

Louisiana Tech's Institute for Micromanufacturing has three components: the research and development facility on the university campus (above); the X-ray beam lines and lithography processing facility at the Center for Advanced Microstructures and Devices in Baton Rouge; and the Technology Transfer Center in the Shreve Industrial Park in Shreveport.

Dr. Kody Varahramyan, Director of Louisiana Tech University's Institute for Micromanufacturing showing Governor Kathleen Blanco some microdevices during her recent tour of the Institute's facilities. During her visit Governor Blanco emphasized the pivotal role of universities in building technologies for commercialization and the economic development of Louisiana.

"This method doesn't require expensive equipment and tools for its implementation, a definite advantage," adds Dr. Varahramyan, who heads one of the three teams comprising the NSF EPSCoR-funded consortium. The other two lead universities are the University of New Orleans and LSU Health Sciences Center in New Orleans.

"I*f*M is the only center in the U.S. that has reported and published results on Layer-by-Layer nanocapsules. We have a contract with a company that is beginning to develop this technique for its products and are preparing a contract with another. Our foreign competitors in this area consist of scientific groups in Germany, Japan, China, and Australia," says Dr. Varahramyan.

"With this technology we are able to make a coating the thickness of a few nanometers on any surface and with any needed composition. Our architectural approach to this nanocoating allows us to create thin films of materials monolayer by monolayer that can be engineered to display desirable properties and characteristics - layer-by-layer

continued on page 2

Micromanufacturing Institute *continued from page 2*

coated substrates such as glass, paper, and plastics with desirable optical, mechanical, and thermal characteristics, for example."

IfM, the only institute of its kind in the U.S., was established in 1991 to meet the research and development needs of industry in the area of miniaturization technologies. From its original micromanufacturing emphasis, the Institute's research and educational efforts have greatly grown and expanded to its current five thrust areas: nanotechnology, biotechnology, biomedical nanotechnology, environmental technology, and information technology. The activities carried out through these thrust areas, coupled with the Institute's integrated nanomanufacturing and micromanufacturing resources, have led to the realization of a broad range of research, educational and commercialization efforts.

The funding IfM received through the $9 million NSF EPSCoR Consortium grant supported researchers in their development of the Layer-by-Layer nanoassembly method for micro/nano capsule engineering for drug delivery, sensing, and other applications, says Dr. Varahramyan.

Investigations performed under the NSF EPSCoR Consortium grant also resulted in the development of a microfluidic technology platform for chemical, biomedical, and environmental applications. Some general uses are microreactors for chemical process development by the chemical industry, micromixers for high throughput screening for drug discovery, and microscale fuel cells for low power portable electronics applications.

Additionally, IfM researchers developed a polymer-based low-cost sensor technology platform. The platform is based on the tunneling transduction mechanism to detect the deflection of a membrane caused by the variation of the sensed quantity. Due to the high sensitivity of the tunneling transduction mechanism, high-performance low-cost sensors can be conveniently realized for chemical sensing and other applications.

Participation in the NSF-funded Consortium has proven a catalyst for IfM in terms of both new funding and collaborative opportunities.

Planning Grants Requests for Applications

An RFA for Planning Grants for Major Initiatives through May 31, 2006 has been issued. This program provides assistance to teams of researchers who are developing proposals for large-scale, federally funded programs, such as an NSF Science and Technology Center or an Engineering Research Center. Two levels of support are offered, based on the minimum federal funding level for the resulting federal initiative. The RFA is available at www.laregents.org.

Noting that 2004 was an exceptional year, Dr. Varahramyan says that 2005 may become IfM's best year yet. "Last year, besides our research and educational outreach programs for students, we hosted a two-day workshop to help Louisiana researchers identify biotechnology research areas of interest and possible collaborative efforts, and prepare grant proposals.

"We also hosted a workshop co-sponsored by the U.S. Department of Energy (DOE), which awarded IfM a $200,000 grant to research to carry out a reseach project on nanotechnology for nuclear nonproliferation applications. Over 35 researchers from IfM and DOE's national laboratories discussed a roadmap to mitigate nuclear proliferation threats."

The new technologies will enable economical mass-production of easily concealed micro/nanosystems for a wide range of nuclear detection applications in battlefields, airports, residential and office complexes, subways, and more.

IfM initiated 2005 with over $10 million in active and recently completed grants and its largest number of faculty, staff, students and projects. The grants were received from the National Institutes of Health, NSF, NASA, the Department of Defense Army Research Office (DARPA), Whitaker Foundation, and the Governor's Biotechnology Initiative.

Dr. Varahramyan, Louisiana Tech's Entergy Distinguished Professor, was appointed IfM director in 2000. He joined the faculty in 1992, following 10 years as a member of the IBM microelectronics research and development technical staff.

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