Challenges abound in the world of the ultra-small

July 3, 2006

By Dale Mason

YADKINVILLE, NC - NanoTechLabs opened its doors in late 2004 and already sells an exclusive product, millimeter length nanotubes that a researcher at the University of Texas, Dallas, weaves into fibers. The military, which has provided much of the company's financial support, is interested in replacing Kevlar in body armor with nanofibers of much greater strength.

Based in Yadkinville, N.C., NanoTechLabs recently received a $100,000 grant from the Air Force and a matching grant from North Carolina for another $50,000. Founder and CEO Richard Czerw says would-be vendors are already calling. Czerw notes that the company doesn't actually end up with a lot of extra money from the grants it receives. "You don't make money. You basically spend it all. The extra money from the state allows us to buy equipment we couldn't otherwise."

Czerw started the four-employee company with two $100,000 federal small business grants, and won a $200,000 grant from the Department of Defense last year. The company is not seeking venture backing at this point, but may in the future, says Czerw.

"We have no outside investment and work on a cash basis," he notes. The company moved from start-up offices in Winston-Salem to 8,000-square-foot offices and labs in a Yadkinville industrial park, where space was less expensive. The company expects to add six more employees by the end of the year.

The DOD grant backed the company's research in incorporating nanotechnology into lubricants for use in satellites, space shuttles and high performance jets. NanoTechLabs is also working on extremely sensitive nanotech sensors. Looking much further into the future, the company is researching the use of nanotech neural probes implanted in humans to systematically study brain chemistry.

No Simple Matter

But working on the nanotech scale, where quantum physics rule, rather than the more familiar Newtonian physics of the macro world, is not a simple, easy matter.

Educational materials on the company Web site (www.nanotechlabs.com) explain some of the ramifications of working in the world of the ultra-small. Light, traveling at 186,000 miles an hour could whip around the world 11 times a second. In a nanosecond, light travels 11 inches. Then, of course, there is electron tunneling. In the everyday macro world, the idea of anything going from one place to another without crossing the intervening distance is impossible to imagine. But electrons do just that.

Yet nano materials such as nanotubes, nanowires, and nano particles show great promise for advanced communications, military equipment, and medicine. Ultra-tiny nano particles in lubricants conduct heat well and don't wear down like normal materials. Nanotubes are 400 times stronger than steel by weight. Nano materials are also highly conductive and their combined properties appeal to the military and the medical establishment.

A major problem, Czerw notes, is transferring nanotech properties to macroworld products. "Nano materials are very strong and very conductive," he says, "but you have to couple them to a macro system. When you make a composite, the resin or primer ruptures first, so you have to chemically bond it to the nano material. The fibers we're working on are only a tenth as strong as the base material. The problem is, how to get those nano properties at the macro level."

Collaboration Necessary

Those problems have proved daunting, he admits. "It's a lot harder, slower and more expensive than people expected. It's been 15 years since nanotech was introduced and you can name the products out there counting on one hand."

The difficulties require close collaboration with the company's business and research partners, Czerw explains. Those include Dr. Anthony Atala's Institute for Regenerative Medicine in the Piedmont Triad Research Park and the Wake Forest Baptist University Medical System in addition to the military and military contractors. "We work closely with them because if we don't, we won't go anywhere. They would not be able to deal with the nanotech materials. You can't just make a commodity and sell it. You can't just mix this stuff up with a spoon."

Each area presents its own set of problems, he says.

"We learned in the medical field that they think cells are small. To us, cells are enormous. There's a big cultural difference." Also in the medical field, he notes, the company has to learn to deal with problems such as "how do we do animal testing? What does the Federal Food and Drug Administration (FDA) require?"

Another problem is, “How do we characterize our material?” The techniques for examining nanotech materials are still cumbersome, time-consuming and expensive. “You can’t look at every gram, it would cost millions. So that’s a big issue. It’s hard to develop anything if someone orders materials and doesn’t get the same thing twice. There’s no easy answer.”

Nevertheless, on its Web site, the company says, “We envision a world where the health, safety, security and everyday lives of people around the world are continually improved through nanotechnology.”

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