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The next big things will be coming in nano packages

By Cindy Kibbe

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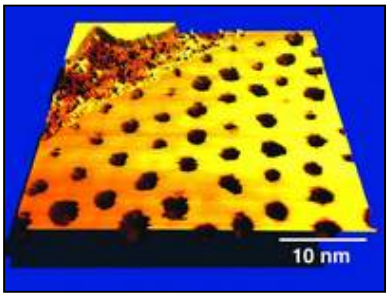
University of New Hampshire nantoechology researchers Glen Miller and Ph.D. candidate Drew Athans - shown here in one of UNH's Nuclear Magnetic Resonance labs - are among those who hope to use nanoscale features like this self-assembled array of holes in a one-atom thick layer of silver (below), created by UNH Professor Karsten Pohl, as the basis for nanotemplates capable of manufacturing thousands of nano devices.

Nanotechnology has been called the "next big thing," touted as being capable of helping to create everything from superconductive wires to ultra-strong, ultra-lightweight materials to cancer drugs and treatment modalities. Some even have gone so far as to predict nanomachines will be capable of replicating themselves – and pushing humans toward extinction.

"The technology in and of itself doesn't do much," said Shea, who's also a member of the university's nanotechnology research team, Nanogroup. "But it can be applied in many fields and areas and then revolutionize applications and industries."

But before microrobots worthy of Isaac Asimov fill our lives, practical and incremental applications must be found to ensure this nascent science delivers all it promises without creating another bubble to burst.

Christine Shea, associate professor of technology and operations management at the University of New Hampshire, defines nanotechnology as the manipulation of structures that are a billionth of a meter long, or a thousand times smaller than the width of a human hair.



She said the advent of the electron microscope helped to usher in this new science. "Once we could see things at that level, we started to manipulate things at that level."

Unlike Massachusetts, New Hampshire seems to be providing much more support for research and development at the university level than at the commercial level. But school think tanks are working overtime. Both Dartmouth College and UNH have well-established nanotechnology research teams. UNH, along with Northeastern University and UMass-Lowell, also has submitted a $40 million, 10-year proposal to the National Science

Foundation to create a joint engineering research center on nanomanufacturing.

Recently, the research center, called the Center for High Rate Nanomanufacturing, received a $12.4 million grant from the NSF — $4 million of that money going over the next five years directly to UNH.

The center is focusing on developing nanomanufacturing tools for biosensors that can be implanted in the body for early detection of disease and for nanotube memory chips that can store much more information than conventional silicon chips.

“It’s still very much at the research and development level,” said Shea. “The big stuff isn’t ready yet.”

That big stuff might come in the form of gold-plated nanoshells — beyond-tiny “ball bearings” that can deliver chemotherapy right to specific cancer cells. Researchers at Rice University discovered that when injected into a tumor and subjected to a specific wavelength of light, heat is created, and only the cancer cells are destroyed. Healthy tissue remains intact, and the nanoshells are harmlessly excreted a few weeks later.

A project currently in development at Nanogroup and financed by Exeter-based Bentley Pharmaceuticals is the encapsulation of insulin in nanoparticles that are designed to cross the intestines and release insulin in the bloodstream.

Nanogroup also is attempting to modify fullerenes and nanotubes for use with space radiation shielding of microelectronics in future satellites.

At Dartmouth, the Center for Nanomaterials Research is focusing on nanoparticles, nanocrystals and nanocomposite materials, especially with regards to their magnetic properties. Such information will directly apply to the next generation of circuits and semiconductors, say researchers.

Ian Baker, professor of engineering at Dartmouth and director for the center, said his group is working on making electronic materials that are stronger and work better at higher temperatures. These materials could be used for computer memory devices and mechanical devices.

“We are making new materials and trying to understand new phenomena,” said Baker.

The NSF has said the world’s nanotechnology market could reach $1 trillion and create 2 million new jobs within the next decade. This has investors licking their chops over the prospects.

Others are cautioning against creating another tech bubble – and burst — before practical commercial use of nanotechnology has been developed.

“Lots of money is being spent, but nobody’s got anything rolled out,” said Shea. “That’s exactly what we have to watch out for.”

Nanosys, a California nanotech start-up with roots in Cambridge, Mass., planned an initial public offering of stock earlier this year even though it had no revenue, no profit and no commercially available product. With investor hysteria closely approximating the recent Google IPO, Nanosys withdrew its offer Aug. 4, simply citing “adverse market conditions.”

What’s a nanostructure?

Among the nanostructures being researched are:
• Fullerenes – cagelike, hollow structures composed of hexagonal and pentagonal groups of carbon atoms. Named after Buckminster Fuller, the visionary architect, designer and inventor. One of the most common is the “buckyball,” a nano-sized “soccer ball” of carbon atoms.
• Nanotubes – tubes made of carbon atoms (also called “buckytubes”) looking much like microscopic tubes of chicken wire. Nanotubes are typically a few nanometers in diameter and up to a millimeter long.
• Nanoarrays – nano-sized grid-like membranes. They are currently being used to separate nucleic proteins.
• Nanowires – nano-sized wire that could be used

to create extremely small electronic devices. nhbr

Baker said that despite the Nanosys withdrawal, “a lot of stuff was going on before and is going on after the hype. Some of the new things will be revolutionary and will provide explosive growth.”