Nanotechnology Fabrication Takes Massive Leap

New Inking Technique Uses a Variety of Materials that Promise to Change Electronics

By **W Thomas Payne**

Nanotube fabrication took another leap forward with the announcement in the journal *Advanced Materials* of a method for creating the ultra-small structures in virtually any length desired. A research team in the Department of Mechanical Science and Engineering at the University of Illinois have created a system akin to a fountain pen for the process.

The project, led by Professor Min-Feng Yu, fabricated a micropipette with an aperture just 100 nanometers wide, and connected it to a reservoir filled with the special ink to create freestanding nanoblocks, wires, and tubes as long as 16 millimeters.

"The process is like drawing with a fountain pen - the ink comes out and quickly dries or 'solidifies,' " said Yu in a press release from the University of Illinois. "But, unlike drawing with a fountain pen, we can draw objects in three dimensions."

The technique is similar to one developed by a colleague at Illinois revealed earlier this year, but her process used a pipette roughly ten times larger than that used in this process, and also required the creation of a new type of ink.

The breakthrough process shows promise in a variety of fields, ranging from electronics to power transmission, and could revolutionize microchip technology. And perhaps, beyond. As a proof the versatility of the technology, the team created a variety of nanostructures from materials as diverse as sugar, potassium hydroxide (a commonly used chemical in manufacturing), and densely packed quantum dots.

Current manufacture of electronic circuits requires careful etching and deposition of ceramo-metallic substances within the etches to build microcircuits, and that technology is rapidly approaching its limits in scaling. The possibility with the sol-gel process is to directly write the circuits onto the substrate, eliminating the painstaking etching and templating process. The etching and templating process creates impurities that can cause up to one in ten of the manufactured microcircuits to be unusable and end up as trash.

"Our procedure offers an economically viable alternative for the direct-write manufacture of nanofibers made from many materials," Yu said. "In addition, the process can be used to integrate nanoscale and microscale components."

Principal authors of the paper were graduate students Abhijit Suryavanshi and Jie Hu, working under Yu's supervision. Work was funded in part by the Grainger Foundation, the National Science Foundation, the Office of Naval Research, and the U.S. Department of Energy.

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