Researchers Fabricate Complex SWNT Architectures Using Newly Developed Assembly Process

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(PhysOrg.com) -- Given the sheer number of potential applications for carbon nanotubes, experts in the field of nanotechnology are developing effective ways to mass produce intricate nanoscale structures for electronics, sensing, energy and biomedical applications in a timely, cost-effective manner with a high level of accuracy.

Using a new assembly process, a team of researchers at Northeastern University's National Science Foundation (NSF) Nanoscale Science and Engineering Center for High-rate Nanomanufacturing (CHN) manufactured large-scale patterned single walled carbon nanotube (SWNT) networks in complex patterns. Led by Ahmed Busnaina, Ph.D., the William Lincoln Smith professor and director of Northeastern's CHN, and professor Yung-Joon Jung, the researchers built intricate SWNT architectures with a high degree of accuracy, laying the foundation for the nanomanufacturing industry to overcome a major obstacle – precise and accurate placement of SWNTs.

These findings were published online in the *Journal of the American Chemical Society*. The research was funded by the National Science Foundation.

The researchers used a nanotemplate guided fluidic assembly process for optimum accuracy and control over the placement of the SWNTs on a silicon wafer. Using this fluidic assembly process for the SWNTs

assembly enabled a highly controlled environment at the nanoscale. A surface treatment on the substrate, or wafer, made SWNTs highly attracted to the surface. As a result, the team was able to build highly organized SWNT architectures in various dimensions and geometries.

This assembly method can be extended to scales as small as a few nanometers while the length of the architecture is scalable up to 12" wafers.

"This novel process helps us better understand the fundamental mechanism governing the assembly of SWNTs and it finally makes building large-scale (wafer-level) nanoscale structures and networks of single-walled nanotubes possible," said Busnaina.

The potential applications of these complex structures include transistors, horizontal interconnect systems, complex SWNT-based materials and various types of sensors, batteries, photovoltices, medical and biotechnology applications.

Other Northeastern researchers involved in this study include Dr. Sivasubramanian Somu, Dr. Yoland Echegoyen Sanz and graduate students Laila Jaber-Ansari and Myung Gwan Hahm.

About the NSF Nanoscale Science and Engineering Center for High-rate Nanomanufacturing

In the fall of 2004, the National Science Foundation awarded Northeastern University and its partners, the University of Massachusetts Lowell, the University of New Hampshire, Michigan State University and the Museum of Science, a Nanoscale Science and Engineering Center for high-rate Nanomanufacturing with funding of $12.4 million over five years. The Center for high-rate nanomanufacturing is focused on developing tools and processes that will enable high-rate/high-volume

bottom-up, precise, parallel assembly of nanoelements (such as carbon nanotubes, nanoparticles, etc.) and polymer nanostructures. The center nanotemplates are utilized to conduct fast massive directed assembly of nanoscale elements by controlling the forces required to assemble, detach, and transfer nanoelements at high rates and over large areas. The developed nanotemplates and tools will accelerate the creation of highly anticipated commercial products and will enable the creation of an entirely new generation of applications.

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Provided by Northeastern University