'Few-walled' carbon nanotubes said cheap and efficient option for certain applications

March 16 2005

North Carolina scientists have found that "thinnest" is not necessarily "best" in rating structure and function of carbon nanotubes, the molecule-sized cylinders that show promise for futuristic technology scaled at a billionths of a meter.
During an American Chemical Society national meeting, researchers at Duke University and Xintek, Inc. of Research Triangle Park, N.C., will report on the synthesis and testing of a new class of nanotubes made up of two to five layers of carbon atoms.

The scientists find these "few-walled" carbon nanotubes are structurally nearly as perfect as one carbon atom thick "single-walled" carbon nanotubes, while being cheaper to make than their single-walled cousins, said Duke assistant chemistry professor Jie Liu Liu and his colleagues discovered how to create the tubes within heated streams of alcohol and hydrogen.

Moreover, tests by Liu's collaborators at Xintek found that few-walled nanotubes can be made to spew out electrons with better performance than current commercial carbon nanotubes, Liu added.

Xintek is already commercializing varieties of carbon nanotubes as "field emitters" that generate electrons to empower portable and miniaturized X-ray sources. Other possible uses for electron field emitters would include-flat panel displays and new kinds of light sources.

Liu will report on the synthesis and evaluation of few-walled nanotubes during a scientific session on polymer nanocomposites beginning at 8 a.m. Pacific Standard Time on Wednesday, March 16, 2005, at the Torrey Room 1 and 2 of the San Diego Marriott Hotel.

Since carbon nanotubes were first discovered in 1991, chemists such as Liu and material scientists such as Xintek co-founder Otto Zhou have been attracted by the potential of these graphite-like nanocylinders to become 21st century wonder materials.

Carbon nanotubes of both single-walled and multi-walled varieties combine ultra miniaturization with exceptionally high structural strength. Their electronic properties can range between metal-like and semiconductor-like, depending on their structural alignments.

Liu's own laboratory, which is also linked to the University of North Carolina at Chapel Hill-based North Carolina Center for Nanoscale Materials directed by Zhou, who is a UNC-Chapel Hill professor, has evaluated various methods for making nanotubes.

Liu's teams of researchers have also developed techniques to make exceptionally long single-walled carbon nanotubes for potential use in nanoscale electronic circuitry.

The fact that single-walled carbon nanotubes are composed of just one layer makes them more predictable and reliable for use as precision electronic components. However, Liu said, "The problem is that single-walled nanotubes are very hard to make, and very hard to make in large quantities."

By contrast, "multi-walled nanotubes can be made very easily and in very large quantities, although in most cases they have a lot of structural defects," he added. Because of their ease of manufacture, multi-walled

carbon nanotubes are becoming commercially available for uses that can accommodate structural flaws, Liu said.

As an example, he described how using small portions of multi-walled nanotubes in manufacturing plastic auto parts alters the plastic's electrical charges in a way that makes automotive paint stick more uniformly.

Multi-walled nanotubes are normally encased by 10 to 30 consecutive layers of carbon atoms. But few-walled carbon nanotubes are different, Liu said. "The fact that they are smaller in diameter makes them uniquely suitable for certain applications. They are also more rigid than single-walled nanotubes. And they can be made much, much cheaper than single walled nanotubes."

His Duke laboratory stumbled onto few-walled nanotubes during a failed attempt to make single-walled carbon nanotubes. When the researchers tried growing the single-walled variety in a heated glass tube within a stream of alcohol and hydrogen under the influence of metal catalysts, they grew few-walled nanotubes instead.

Duke and Xintek have applied for a patent on the application of few-walled carbon nanotubes for electron field emission.

Source: Duke University