Making sure the wonder materials don't become the wonder pollutant

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Carbon nanotubes are 10,000 times thinner than a human hair, yet stronger than steel and more durable than diamonds. They conduct heat and electricity with efficiency that rivals copper wires and silicon chips, with possible uses in everything from concrete and clothes to bicycle parts and electronics. The have been hailed as the next “wonder material” for what could become a multi-billion dollar manufacturing industry in the 21st century.

But as useful as nanotubes may be, the process of making them may have unintentional and potentially harmful impacts on the environment. MIT/WHOI graduate student Desirée Plata and her mentors—chemists Phil Gschwend of the Massachusetts Institute of Technology and Chris Reddy of the Woods Hole Oceanographic Institution—recently analyzed ten commercially made carbon nanotubes to identify the chemical byproducts of the manufacturing process and to help track them in the environment.

Plata found that the ten different carbon nanotubes had vastly different compositions; most previous toxicity studies have generally assumed that all nanotubes are the same. This diversity of chemical signatures will make it harder to trace the impacts of carbon nanotubes in the environment

In previous work (first presented last fall), Plata and colleagues found that the process of nanotube manufacturing produced emissions of at least 15 aromatic hydrocarbons, including four different kinds of toxic

polycyclic aromatic hydrocarbons (PAHs) similar to those found in cigarette smoke and automobile tailpipe emissions. They also found that the process was largely inefficient: much of the raw carbon went unconsumed and was vented into the atmosphere.

The new research by Plata et al was published April 3 on the web site of the journal Nanotechnology. In the next phase of Plata's work, she will collect real-time data from a European nanotube manufacturing facility that is poised to let her set up the same monitors she used in the MIT lab.

"It is the indiscriminant use of poorly understood chemicals that causes environmental and public health costs," Plata said. "We want to work proactively with the carbon nanotube industry to avoid repeating environmental mistakes of the past. Instead of reacting to problems, we hope to preclude them altogether."

Plata was honored in February for her nanotube work by the Division of Environmental Chemistry of the American Chemical Society, which selected her as a winner of one of its 2008 Graduate Student Paper Awards.

Source: Woods Hole Oceanographic Institution