Pitt researchers create non-toxic clean-up method for potentially toxic nano materials

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University of Pittsburgh researchers have developed the first natural, nontoxic method for biodegrading carbon nanotubes, a finding that could help diminish the environmental and health concerns that mar the otherwise bright prospects of the super-strong materials commonly used in products, from electronics to plastics.

A Pitt research team has found that carbon nanotubes deteriorate when exposed to the natural enzyme horseradish peroxidase (HRP), according to a report published recently in *Nano Letters* coauthored by Alexander Star, an assistant professor of chemistry in Pitt's School of Arts and Sciences, and Valerian Kagan, a professor and vice chair of the Department of Environmental and Occupational Health in Pitt's Graduate School of Public Health. These results open the door to further development of safe and natural methods—with HRP or other enzymes—of cleaning up carbon nanotube spills in the environment and the industrial or laboratory setting.

Carbon nanotubes are one-atom thick rolls of graphite 100,000 times smaller than a human hair yet stronger than steel and excellent conductors of electricity and heat. They reinforce plastics, ceramics, or concrete; conduct electricity in electronics or energy-conversion devices; and are sensitive chemical sensors, Star said. (Star created an early-detection device for asthma attacks wherein carbon nanotubes detect minute amounts of nitric oxide preceding an attack.)

"The many applications of nanotubes have resulted in greater production

of them, but their toxicity remains controversial," Star said. "Accidental spills of nanotubes are inevitable during their production, and the massive use of nanotube-based materials could lead to increased environmental pollution. We have demonstrated a nontoxic approach to successfully degrade carbon nanotubes in environmentally relevant conditions."

The team's work focused on nanotubes in their raw form as a fine, graphite-like powder, Kagan explained. In this form, nanotubes have caused severe lung inflammation in lab tests. Although small, nanotubes contain thousands of atoms on their surface that could react with the human body in unknown ways, Kagan said. Both he and Star are associated with a three-year-old Pitt initiative to investigate nanotoxicology.

"Nanomaterials aren't completely understood. Industries use nanotubes because they're unique—they are strong, they can be used as semiconductors. But do these features present unknown health risks? The field of nanotoxicology is developing to find out," Kagan said. "Studies have shown that they can be dangerous. We wanted to develop a method for safely neutralizing these very small materials should they contaminate the natural or working environment."

To break down the nanotubes, the team exposed them to a solution of HRP and a low concentration of hydrogen peroxide at 4 degrees Celcius (39 degrees Fahrenheit) for 12 weeks. Once fully developed, this method could be administered as easily as chemical clean-ups in today's labs, Kagan and Star said.

Source: University of Pittsburgh