Researchers identify cost-effective method for eliminating contaminants from carbon nanotubes

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Semiconductor Research Corporation (SRC), SEMATECH and The University of Texas at Dallas researchers are the first to demonstrate that specific potentially hazardous organic contaminants present in a type of single-walled carbon nanotubes (SWNTs) can be easily removed.

This discovery should enable the continued consideration of SWNTs for advanced nanoelectronics manufacturing, as this material shows promise for continuing the benefits of scaling with significantly reduced risk to the environment. In addition to semiconductor manufacturers, several other industries also could gain greater product effectiveness from this research.

The research team analyzed the potential risk of a variety of functionalized SWNTs, and found that one family of nanotubes, carboxylated single-walled carbon nanotubes (CSWNTs), reduced the ability of mammalian cells to grow in culture. This is considered to be evidence of toxicity. However, researchers also found that standard separation techniques could remove the contaminating material, indicating that the purified nanotubes themselves were not responsible for the observed toxicity. The data suggests that specific organic impurities present in the CSWNTs may be responsible for much of the concern associated with this material, and further work is in progress to test this idea.

"The process for removing the toxic material from the CSWNTs is relatively easy, and could be applied to this type of common SWNT if it's to be used in a semiconductor manufacturing facility," said Rockford Draper, Professor, Departments of Molecular & Biology and Chemistry at the University of Texas at Dallas. "These insights could affect the way companies purchase and use certain SWNTs."

SRC's Center for Environmentally Benign Semiconductor Manufacturing supports a major effort to understand, assess and screen emerging materials for their potential impact on human health, safety and the environment—well before they are considered for the manufacturing of integrated circuits.

"In the International Technology Roadmap for Semiconductors, SWNTs are positioned as emerging research materials with several potential application opportunities. As this technology continues to evolve, SWNTs may help to enable the extensible manufacturability of scaled integrated circuits into the deep nanometer regime," said Dan Herr, SRC Director of Nanomanufacturing Sciences. "Our Center for Environmentally Benign Semiconductor Manufacturing focuses on developing high performance green materials and processes, with minimal environmental safety and health impact. It is developing tools for rapidly screening new candidate materials for their hazard and manufacturing potential, early in their research life cycle."

In the UT Dallas research, the data suggests that small carbon fragments generated during the CSWNT production process may be the cause of observed toxicity, which is distinct from SWNTs. The presence of small oxidized carbon fragments in CSWNTs has been previously reported by industry researchers, but this is the first data to suggest it could be toxic.

More information: For more information and details about the research, see the forthcoming manuscript entitled "Cytotoxicity

Screening of Single-Walled Carbon Nanotubes: Detection and Removal of Cytotoxic Contaminants from Carboxylated Carbon Nanotubes" by Wang et al, that has been recommended for publication in *Molecular Pharmaceutics*.

Provided by Semiconductor Research Corporation