Project uses nanotubes to sniff out heavy metals

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A team of researchers from Arizona State University and Motorola Labs has developed sensors based on carbon nanotubes, microscopically small structures that possess excellent electronic properties. In early tests, the new devices detected the presence of heavy-metal ions in water down to partsper-trillion levels.

Specifically, the researchers developed a method for applying peptides to singlewalled carbon nanotubes (SWNT) in field-effect transistors.

“This is a fairly general sensor platform for all kinds of applications,” says Nongjian Tao, an electrical engineering professor at ASU and one of the researchers on the project. “We tested heavy-metal ions in water, but the platform can be applied to many other areas to sense toxic chemicals in the air – or they can be used as biosensors when applied to medicine.”

“Integration of nanosensors into devices and sensor networks will enable the detection of biological and chemical agents at very low concentrations, which could be vital in the areas of public safety and homeland security,” adds Vida Ilderem, vice president of the Embedded Systems Research Labs at Motorola in Tempe.

The researchers report the advance in a paper, titled “Tuning the Chemical Selectivity of SWNT-FETs for Detection of Heavy-Metal Ions,” which will be published in the journal *Small*. An early view of the article is available at the journal's Web site

(www3.interscience.wiley.com/cg … bin/jissue/109627347).

“Our sensor is based on the novel properties of peptides and carbon nanotubes,” Tao says. “Peptides can be used to recognize and detect various chemical species with high sensitivity and selectivity, while carbon nanotubes are well-known for their electronic properties.”

The peptides are made of 20 or so amino acids, so changing the sequence of amino acids allows the researchers to “tune the peptides and recognize different compounds,”

Tao says, adding: “We developed a simple way to attach different peptides to different nanotubes.”

Erica Forzani, an ASU assistant research professor in electrical engineering, says the peptides are selective to specific compounds.

In the heavy-metal tests, the researchers developed one peptide to detect nickel and another to detect copper. If the nickel peptide were used, it would detect only the presence of nickel and be “blind” to any other heavy-metal ion (copper, lead or zinc) passing over the carbon nanotubes. Tao explains that it's the combination of the structure of the nanotubes and the selectivity of the peptides that makes the devices so powerful.

“The nanotubes basically are a sheet of interconnected atoms rolled into a tube,” Tao says. “Every single atom in the tube is exposed to the environment and can interact with chemicals and molecules. That is why it is so sensitive. But without the peptides, it would not recognize specific compounds.”

“The potential for the carbon nanotubes is extraordinary,” Forzani adds, “because with a very simple device that does not require sophisticated

electronic circuitry, you can detect very low concentrations of analytes."

The researchers will investigate the use of the sensors on biological molecules, such as RNA sequence detection, Tao and Forzani say.

Source: Arizona State University