Breakthrough: Scientists used nanotubes to send signals to nerve cells

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Texas scientists have added one more trick to the amazing repertoire of carbon nanotubes -- the ability to carry electrical signals to nerve cells.

Nanotubes, tiny hollow carbon filaments about one ten-thousandth the diameter of a human hair, are already famed as one of the most versatile materials ever discovered. A hundred times as strong as steel and one-sixth as dense, able to conduct electricity better than copper or to substitute for silicon in semiconductor chips, carbon nanotubes have been proposed as the basis for everything from elevator cables that could lift payloads into Earth orbit to computers smaller than human cells.

Thin films of carbon nanotubes deposited on transparent plastic can also serve as a surface on which cells can grow. And as researchers at the University of Texas Medical Branch at Galveston (UTMB) and Rice University suggest in a paper published in the May issue of the *Journal of Nanoscience and Nanotechnology*, these nanotube films could potentially serve as an electrical interface between living tissue and prosthetic devices or biomedical instruments.

"As far as I know, we're the first group to show that you can have some kind of electrical communication between these two things, by stimulating cells through our transparent conductive layer," said Todd Pappas, director of sensory and molecular neuroengineering at UTMB's Center for Biomedical Engineering and one of the study's senior authors. Pappas and UTMB research associate Anton Liopo collaborated on the work with James Tour, director of the Carbon Nanotechnology

Laboratory at Rice's Richard E. Smalley Institute for Nanoscale Science and Technology, Rice postdoctoral fellow Michael Stewart and Rice graduate student Jared Hudson.

The group employed two different types of cells in their experiments, neuroblastoma cells commonly used in test-tube experiments and neurons cultured from experimental rats. Both cell types were placed on ten-layer-thick "mats" of single-walled carbon nanotubes (SWNTs) deposited on transparent plastic. This enabled the researchers to use a microscope to position a tiny electrode next to individual cells and record their responses to electrical pulses transmitted through the SWNTs.

In addition to their electrical stimulation experiments, the scientists also studied how different kinds of SWNTs affected the growth and development of neuroblastoma cells. They compared cells placed on mats made of "functionalized" SWNTs, carbon nanotubes with additional molecules attached to their surfaces that may be used to guide cell growth or customize nanotube electrical properties, to cells cultured on unmodified "native" carbon nanotubes and conventional tissue culture plastic.

"Native carbon nanotubes support neuron attachment and growth well -- as we expected, better than the two types of functionalized nanotubes we tested," Pappas said. "Next we want to find a way to functionalize the nanotubes to make neuron attachment and communication better and make these surfaces more biocompatible."

Another avenue Pappas wants to explore is finding out whether nanotubes are sensitive enough to record ongoing electrical activity in cells. "Where we want to get to is a device that can both sense and deliver stimuli to cells for things like prosthetic control," Pappas said. "I think it's definitely doable, and we're pursuing that with Jim Tour and his group. It's great to be able to work with a guy who's on the cutting edge of nanoelectronics technology -- he seems to develop something new every week, and it's really become a great interaction."

Source: University of Texas Medical Branch