Nanotube-Tipped Probe Developed at Drexel Considered Vital to Cell Treatment

Drexel University College of Engineering researchers have successfully developed carbon nanotube-tipped pipettes that could become key to cell biology in-situ DNA sequencing and organelle-targeted drug delivery.

According to the researchers, this development makes it possible to perform injections or probe the fluid, not just inside a cell, but in specific regions inside the cell, maybe even specific organelles. The probe has the possibility of transferring fluids through the carbon nanotube (CNT) into and out of the pipette, thereby bridging the gap between existing microscale technologies and nanoscale interactions.

The carbon nanotube-tipped probe was developed Drs. Adam Fontecchio and Gennady Friedman, both of Drexel's Department of Electrical and Computer Engineering, Dr. Yury Gogotsi, Department of Materials Science and Engineering and three Ph.D. students.

Fontecchio described how the pipettes can enhance in-situ DNA sequencing. "The pipettes enable DNA to be examined inside a living cell without removing the cell from the living tissue," he said. "This avoids culturing and/or damaging the tissue." And the probes can aid in identifying separate drug reactions in cells. "Instead of flooding an entire cell with a drug under investigation, the drug interaction and effects with specific regions of the cell can be investigated," he said. "Since the CNT tips have diameters smaller than some cells, small amounts of drugs can be injected to specific regions organelles within a cell."

In their March 2007 paper, "Magnetically assembled carbon nanotube-tipped pipettes," published in *Applied Physics Letters*, (Appl. Phys. Lett. 90, 103108 2007), the Drexel researchers describe nanotube probes strong enough to pierce the wall of canine kidney cell membranes. They observed negligible cell deformation, even after removing the probe from the cell 20 minutes later. With this capability, carbon nanotube-tipped pipettes could become vital to in-situ DNA sequencing and organelle-targeted drug delivery.

The team's method uses magnetic CNTs and an external magnetic field to align the nanotubes and assemble the probes. Joshua Freedman, a NSF IGERT Fellow working with Drs. Fontecchio and Friedman, injected a solution of magnetic CNTs and optical glue into a glass pipette and used magnet CNT by polymerizing the optical glue with UV light. They demonstrated that the resulting carbon nanotube-tipped pipette was mechanically robust to perform cell injection and could transfer fluid into the pipette. Graduate students Davide Mattia and Guzeliya Korneva produced the CNTs by chemical vapor deposition into alumina templates and coated their inner walls with magnetic nanoparticles.

"The next step is to improve the pipette fabrication process to increase yield, demonstrate magnetic deflection of the CNTs and use the carbon nanotube- tipped pipettes in said cell biology and drug delivery research," said Fontecchio, who helped to develop the pipettes.

Source: Drexel University