Artificial Muscles Power Nanobots

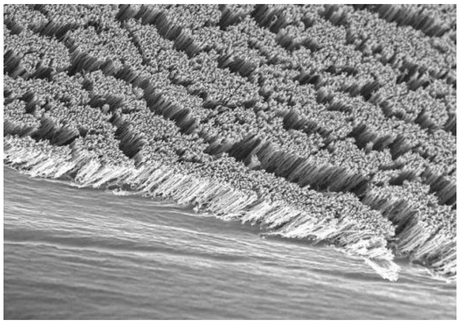
BY CAITILIN E. DEVOR

7 November 2011—Tiny robots, called nanobots, may one day be able to propel themselves through the human body during the diagnosis and treatment of disease, thanks to the development of carbon nanotubes recently reported in an October issue of *Science*. Researchers from the Intelligent Polymer Research Institute at University of Wollongong in Australia have developed an artificial muscle that gives the nanobots their own power source and greater mobility during their journey throughout the body.

The inability to give nanobots mobility has limited their potential use because they cannot be controlled once inside the body. Traditional motors are impractical on the nanoscale necessary for use within areas such as the human bloodstream, so instead of a motor, researchers developed an artificial muscle.

"We stumbled upon a type of material that produces a rotating action when we apply voltage to it," said Geoff Spinks, author of the study and Chief Investigator and materials scientist at the Australian Research Council Centre of Excellence for Electromaterials Science.

Muscles like those in the bicep and hamstring function through the sliding action of linear fibers, but the artificial muscle created by the carbon nanotubes works by twisting the fibers so they coil like the strands of a rope and then uncoil, repeatedly. The coiling motion is modeled after the cylindrical muscles of octopus arms and elephant trunks, which contract against an incompressible core. Rather than contracting against such a core, the hollow nanotubes are filled with an electrolyte solution and a voltage source induces increases and decreases in the volume of electrolyte solution within the hollow nanotubes. The fluctuations in volume cause the twisting and untwisting of the fibers.



Powering solutions. Scientists use carbon nanotubes like these to faciliate voltage-dependent muscle action. Image obtained by Creative Commons license and is available at http://www.flickr.com/photos/argonne/3974996774/.

At 38 microns in diameter, the individual carbon nanotubes are thinner than human hair and researchers refer to the carbon nanotube fibers as yarns. The yarn rotates 590 revolutions per minute and can twist 15,000 degrees before untwisting.

Researchers imagine the nanobots powered with the nanotubes will resemble bacterium cells with a single flagellum, or spinning tail-like structure, that pushes the device forward in short bursts. Currently, such nanobots remain too difficult to actually physically build, but the nanotubes are already powering paddles 200 times their weight in the laboratory.

The nanotubes can be developed in lengths from the micrometers used in the yarns to multiple centimeters, and thus may also be applied in other conditions where traditional motors are impractical. Proposed uses include zoom lenses of cameras and movement assistant devices for individuals with mobility limitations. ■

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