Turbocharged Nanomotors

October 29 2008

(PhysOrg.com) -- Nanorobots that are introduced into the body to eradicate tumor cells or clean out clogged arteries are not just science fiction; they are a realistic vision of the technological possibilities of the not-so-distant future. Efficient nanomotors will be needed to drive these nanomachines.

A team of scientists from University of California, San Diego (USA) and Arizona State University (Tempe, USA) has now developed nanorods that swim extremely fast. “These nanorods travel about 75 times their own length in one second,” report Joseph Wang and his co-workers in the journal *Angewandte Chemie*. “We are approaching the speed of the most efficient biological nanomotors, including flagellated bacteria.”

The first simple applications for nanomotors could include rapid transportation of pharmaceutical agents to specific target areas, or the passage of specimen molecules through the tiny channels of diagnostic systems on a microchip. However, forward motion through a liquid is not as trivial as one would like to think. One method for the construction of nanomotors that can achieve this is the fuel-driven catalytic nanowire. These are tiny nanoscopic rods whose ends are made of two different metals. Unlike macroscopic motors, they do not have a fuel tank; instead they move through a medium that contains the fuel they need.

The “classic” example of such a system is a gold–platinum nanotube that can travel at speeds of 10 to 20 μm per second with hydrogen peroxide as its fuel. Wang and his team have now dramatically accelerated these

nanorod motors: they have achieved speeds of over 150 µm per second by replacing the gold portion with an alloy of silver and gold.

How does the nanomotor work? The platinum segment catalyzes the splitting of hydrogen peroxide (H_2O_2) into oxygen (O_2) and protons (H^+). It absorbs the excess electrons. These are transferred to the silver/gold segment, where they speed up the reduction reaction of H_2O_2 and protons to make water. The release of oxygen and water produces a small current, which drives the nanorod through the fluid, platinum side first. “The silver/gold alloy causes the electrons to be transferred more quickly,” explains Wang. “This increases the fuel decomposition rate and the nanorod is accelerated faster.” The speed of the nanorods can be tailored by changing the proportion of silver in the alloy. “Fuel additives or variations of the platinum segment will make these rods even faster,” predicts Wang.

Citation: Joseph Wang, Ultrafast Catalytic Alloy Nanomotors, *Angewandte Chemie International Edition*, doi: 10.1002/anie.200803841

Provided by Wiley