Nanoassembly Technique Draws on Lessons from Cell Membranes

E. Zubarev and colleagues at Rice University have discovered how to assemble gold and silver nanoparticle building blocks into larger structures based on the self-assembly of lipid membranes that surround living cells. As reported in the November 29, 2006, issue of the *Journal of the American Chemical Society* (p. 15098; DOI: 10.1021/ja066708g), the method makes use of the hydrophobic effect, a biochemical phenomenon that all living creatures use to create membranes, ultrathin barriers of fatty acids that form a strong yet dynamic sack around the cell, sealing it from the outside world. Cell membranes are one example of a micelle, a strong bilayer covering that is made of two sheets of lipid-based amphiphiles, molecules that have a hydrophilic and a hydrophobic end. Like two pieces of cellophane tape being brought together, the hydrophobic sides of the amphiphilic sheets stick to one another, forming the bilayered micelle.

"When the micelle forms, the process drives the packing of all the junction points, which connect the hydrophobic and the hydrophilic part of an amphiphile, into a high-density array," said Zubarev, the Norman Hackerman-Welch Young Investigator and assistant professor of chemistry. "By attaching a nanoparticle to the junction point of an amphiphile, we can, in effect, use micellization as a means to assemble billions and billions of individual nanoparticles into well-defined one-dimensional superstructures that are soluble in water."

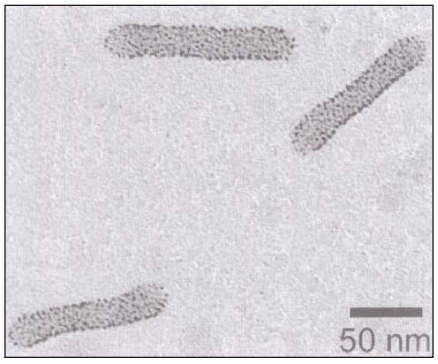

Figure 1. Electron microscope image shows tightly packed cylinders of gold nanoparticles. Note that the edges are darker than the centers, consistent with tubular structures. Credit: Eugene Zubarev/Rice University.

Zubarev and colleagues synthesized V-shaped amphiphiles of polystyrene-*b*-poly(ethylene oxide) and attached 2-nm-diameter gold particles at the focal point of the V. Upon adding water and inducing micelle formation, the team found it could create tightly packed cylinders of gold nanoparticles measuring just 18 nm in diameter.

All micelles form in three allowable shapes: spheres, cylinders, and sack-like vesicles (see Figure 1). By varying the length of the polystyrene arm, the solvents used, and the size of the gold particles, Zubarev and colleagues were able to form spheres and vesicles and vary the diameter of their cylinders, some of which grew to well over 1000 nm in length.

"We believe further manipulation of these parameters may provide an opportunity to control the optical and catalytic properties of these nanoassemblies," Zubarev said.

Complex Order Parameter in Ruthenate Superconductors Confirmed

Since it was discovered to be superconducting over a decade ago, the pairing symmetry of strontium ruthenium oxide has been widely explored and debated. Now, a team of researchers led by D. Van

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