Researchers Discover Nanoparticles Can Break On Through

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(PhysOrg.com) -- In a finding that could speed the use of sensors or barcodes at the nanoscale, North Carolina State University engineers have shown that certain types of tiny organic particles, when heated to the proper temperature, bob to the surface of a layer of a thin polymer film and then can reversibly recede below the surface when heated a second time.

Selectively bringing a number of particles to a surface and then sinking them back below it results in controllable surface patterns. According to NC State researchers involved in the project, patterning surfaces is one of the holy grails of current nanotechnology research, and is difficult to do with certain particles. They add that the finding could result in tiny reusable bar codes, or in small fluorescent features that turn off when they sense too much heat or the presence of a certain chemical.

Dr. Jan Genzer, professor of chemical and biomolecular engineering, and Dr. Richard Spontak, professor of chemical and biomolecular engineering and materials science and engineering, published their finding along with graduate students Arif Gozen and Bin Wei in the journal *Nano Letters*. They worked with engineers who designed the unique particles at the University of Melbourne in Australia.

The researchers used a special type of organic nanoparticle called a core-shell microgel in which the core of a cross-linked, or networked, polymer is surrounded by a shell of a different polymer.

"Most polymers are chain-like macromolecules that are like very long, cooked spaghetti noodles, but these special core-shell particles are shaped more like squash balls of one polymer with a fuzzy surface of a different polymer," Spontak says.

Heating these approximately 30-nanometer particles – which are hundreds of times smaller than a human hair – allows them to break through a polymer/polymer interface like a submarine coming to the surface of water. Reheating the particles at a polymer surface sinks them back below the surface.

"This technique allows us to place the particles right where we want them – on the surface of a thin film," Genzer says. "It can be used to create a reusable bar code, for instance, or other functional polymer surfaces."

Citation: Autophobicity-Driven Surface Segregation and Patterning of Core-Shell Microgel Nanoparticles. Online Aug. 8, 2008, in *Nano Letters*

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