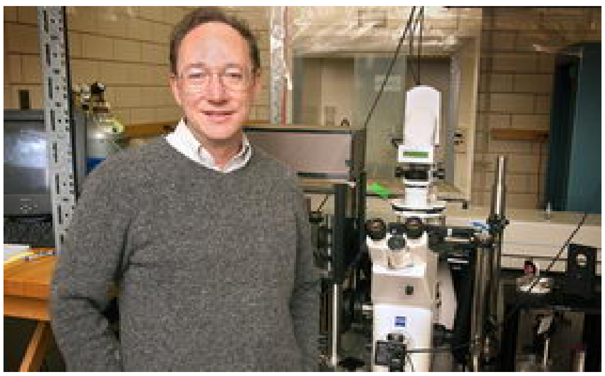
Polarized particles join toolbox for building unique structures

October 12 2006



Steve Granick, a professor of materials science and engineering, of chemistry and of physics, and his colleagues have created polarized, spherical particles that spontaneously self-assemble into clusters with specific shapes and distributions of electric charge. University of Illinois Photo

Researchers at the University of Illinois at Urbana-Champaign have created polarized, spherical particles that spontaneously self-assemble into clusters with specific shapes and distributions of electric charge. The polarized particles can be used in the directional self-assembly of intricate shapes and unique structures.

"The world abounds with particles that have traditionally been treated as geometrically symmetric, chemically isotropic and electrically uniform," said Steve Granick, a professor of materials science and engineering, chemistry and physics. "We have muddied the waters a bit by asking:

'What happens when we build clusters from particles that have an uneven distribution of electric charge?' "

The polarized spheres are called Janus particles; Janus was the Roman god of change, often portrayed with two faces gazing in opposite directions. The spheres offer new opportunities in particle engineering for building particular structures. The clusters may also prove useful as simple systems in which to explore the role of charge interactions in determining how proteins aggregate.

Granick and his collaborators describe their work in a paper accepted for publication in the journal *Nano Letters*, and posted on its Web site.

To make their Janus particles, the researchers begin with negatively charged beads one micron in diameter. Using electron beam deposition, they coat one hemisphere of the beads with a gold film, which is then made positively charged.

When placed in solution, the particles spontaneously self-assemble into specific geometrical shapes depending on the number of particles. For example, clusters of seven particles resemble a flywheel, which can revolve around a polar axle.

The compact shapes differ fundamentally from the strings and rings formed by magnetic particles, said Granick, who also is a researcher at the Frederick Seitz Materials Research Laboratory and at the Beckman Institute for Advanced Science and Technology.

"The observed shapes are in excellent agreement with computer simulations," said Erik Luijten, a professor of materials science and engineering, and a corresponding author of the paper. "The simulations not only show you the shapes, they also show you how the particles are oriented in the cluster."

Surprisingly, the charge distribution of the initial Janus particles is preserved in the clusters. One half of each cluster tends to be positively charged; the other half negatively charged. This uneven distribution of surface charge could be utilized, perhaps, in the directional self-assembly of particles into more elaborate and intricate shapes.

"Future work could consider particles whose shape is not just spherical, but also rod-like or oblate," Granick said. "This is just the beginning of something that will catch a lot of people's imaginations."

Source: University of Illinois at Urbana-Champaign

Citation: Polarized particles join toolbox for building unique structures (2006, October 12) retrieved 23 April 2024 from
https://phys.org/news/2006-10-polarized-particles-toolbox-unique.html