Light-sensitive particles change chemistry at the flick of a switch

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A light-sensitive, self-assembled monolayer that provides unique control over particle interactions has been developed by scientists at the University of Illinois at Urbana-Champaign. Particles coated with the monolayer change their surface charge and chemistry upon exposure to ultraviolet light.

"Tailoring interactions between particles allows us to design colloidal fluids, gels and crystals for use as ceramic, photonic and pharmaceutical materials," said Jeffrey Moore, a William H. and Janet Lycan Professor of Chemistry and a researcher at the Frederick Seitz Materials Research Laboratory and at the Beckman Institute for Advanced Science and Technology. "We are assembling a toolkit of molecules that can be incorporated as monolayers on particles to achieve desired effects."

Light-induced modification of colloidal interactions provides an 'extra handle' for tailoring system behavior, said Jennifer Lewis, the Thurnauer Professor of Materials Science and Engineering and interim director of the Frederick Seitz Materials Research Laboratory.

"The monolayer is designed so that light triggers the cleavage of a specific chemical bond, thereby exposing an underlying functional group of interest," said Lewis, who also is a professor of chemical and biomolecular engineering and a researcher at the Beckman Institute.

Moore and Lewis first demonstrated the technique in a paper published in the Sept. 30, 2005, issue of the *Journal of the American Chemical*

Society. In that work, the surface charge and, thus, the electrostatic interactions between photosensitive silica microspheres, were modified by exposure to ultraviolet light.

In recent work, the researchers documented the gel-to-fluid transition in binary mixtures that initially were oppositely charged. "Exposure to ultraviolet light rendered all of the particles negative and converted the system into a colloidal fluid that settled to form a dense sediment," said Moore, who will present the team's findings at the national meeting of the American Chemical Society, to be held in Atlanta, March 26-30.

"These light-responsive systems will enable novel assembly routes for creating colloidal structures in a variety of materials," Lewis said. "We are currently investigating the ability to locally photo-pattern such assemblies in three dimensions without requiring multiple processing steps."

Light-sensitive colloidal particles could also be used to "tune" the elastic properties, viscous response and microstructure of gel-based inks used in the direct-write assembly of complex, three-dimensional structures formed by robotic deposition.

The Moore group is developing multiple wavelength-specific triggers that would allow different wavelengths of light to induce changes sequentially.

Source: University of Illinois at Urbana-Champaign