Nano World: Two-faced Janus nanoparticles

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Janus particles -- two-faced particles named after the Roman god of doorways -- could find use in everything from novel anti-cancer therapies and solar cells to paper-thin flexible video displays, experts told UPI's Nano World.

A Janus particle is composed of two fused hemispheres, each made from a different substance than the other. This means Janus particles could, for instance, carry two different and complementary medicines.

"Janus particles may be useful for directed drug delivery," said researcher Joerg Lahann, a chemist and materials scientist at the University of Michigan at Ann Arbor.

For instance, one side could hold compounds that bind to molecules specific to a certain tissue or disease, while the opposite side would carry the appropriate drug.

"You could use this to target tumor cells," said chemical engineer Robert Langer of the Massachusetts Institute of Technology in Cambridge.

Janus particles could also lead to more efficient solar-power systems. Solar cells require paired materials called electron donors and electron acceptors that work together to help convert solar energy into electrical current.

"One of the big challenges that limit theoretical yields from solar cells right now is that the interfaces between electron donors and acceptors are not really as developed as we'd like," Lahann said. "With Janus particles made of electron donors and acceptors, you could have huge surface areas connecting them."

Janus particles could also help lead to electronic paper: flexible, paper-thin video displays. Imagine Janus particles colored black on one side and white on the other, suspended inside transparent capsules and laminated under a layer of clear plastic onto a sheet of paper. If these particles are made of materials that allow an electric field to flip them, then electronics under each particle can turn that sheet of paper into a black-and-white display.

Lahann and his team created the Janus particles by taking pairs of polymer fluids and squeezing them out side by side from a needle together. "This looks very much like toothpaste," he said.

As droplets made of both fluids form at the needle's tip, "a high electrical field, several thousand volts, is applied," Lahann said, causing the droplet to break up to form nanoparticles.

"These may be some of the smallest Janus particles made of polymers yet," Lahann said. Their findings were published Sept. 25 in the online version of the journal Nature Materials.

The smallest Janus particles the researchers created are 170 nanometers wide.

"We could maybe make them 100 nanometers," he said, "but the optimum range for applications we're seeing right now are 200 to 500 nanometers."

Future research could lead to particles made of three or more materials, Lahann said. This could lead to particles colored red, green and blue for color electronic paper.

"This is a wonderful proof-of-concept for a platform technology for Lahann and others to build on," said Samir Mitragotri, a chemical engineer at the University of California, Santa Barbara.