Nano World: Water harvesting surfaces

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Beetles that harvest water from desert air have inspired the creation of printable surfaces that improve on nature with the aid of glass nanoparticles. These surfaces could also help control the flow of microscopic amounts of fluid in labs on microchips, experts tell UPI's Nano World.

Currently, methods to collect water from the air using nets "are very inefficient, with most of the water in fog-laden winds passing right through the holes in the nets," said Oxford University zoologist Andrew Parker in England. These new surfaces "are far more efficient," he said.

Scientists at the Massachusetts Institute of Technology in Cambridge investigated the Stenocara beetle, which lives in the Namib Desert in Africa, "the hottest terrestrial environment on Earth," Parker explained. In the foggy dawn, the beetle tilts itself forward into the wind to capture water droplets on its back. These roll down into the beetle's mouth, providing it a fresh morning drink.

Earlier, Parker and his colleagues discovered the back of the beetle is made of surface bumps decorated with spots about 100 millionths of a meter wide that are hydrophilic, or water loving. Between these bumps is a surface that is superhydrophobic, or extremely water repellant. Small water droplets accumulate on the bumps until they coalesce into larger drops that overcome the binding forces of the hydrophilic spots due to sheer weight and get funneled down the water-repellant grooves.

To mimic the beetle's technique for harvesting water, the MIT

researchers developed printable surfaces that are both superhydrophilic and superhydrophobic.

"We've gone beyond what nature has come up with. These aren't just hydrophilic patterns, but superhydrophilic patterns," said researcher Michael Rubner, a materials scientist.

First the researchers decorated a crinkled microporous polymer surface with glass-polymer nanoparticles coated with water-repellant Teflon-like molecules. Next they created superhydrophilic canals on top of this surface made of glass nanoparticles that do not possess water-repellant coatings. The nanoparticles in these canals possess many spaces in between them, making them act somewhat like sponges, "with water droplets immediately sucked into these voids," Rubner explained. Materials chemist Lei Zhai and chemical engineer Robert Cohen, along with Rubner and their colleagues, will report their findings in the June 14 issue of the journal Nano Letters.

Parker noted 22 countries with negligible rainfalls experience desert fogs "and could really benefit if you could make such a water harvesting material cheaply, to for instance put on roofs."

Improved water-harvesting surfaces could help outside the desert as well. "China has a huge problem with water shortages. You could imagine putting these up on mountainsides that would get run into by fast-moving clouds," Parker said.

Rubner noted the researchers are pursuing uses for their surfaces in microfluidic devices, which shuffle around microscopic amounts of fluid. These increasingly find use as miniaturized labs.

The most important question now, Parker said, is whether these surfaces can be manufactured reliably and cost effectively at large scales.

Research might also want to explore incorporating heat reflectivity into these surfaces just as the desert beetles do, to minimize water evaporation, he added.