



What Smart Hazmat Suits and Sonora Cactus Skins Have in Common

Arizona State University researchers find that prickly pear cactuses go through complex microscale, seasonal and age-related wettability changes.

EMBARGOED FOR RELEASE until Monday, Nov. 19, 2018, 9:30 a.m. ET

AIP Media Line
301-209-3090
media@aip.org

WASHINGTON, D.C., November 19, 2018 -- When Konrad Rykaczewski moved to Arizona's Sonora Desert region six years ago he took a water bottle and sprayed the plants in his front yard, not to water them, but to see how they interacted with water droplets.

"It was the first time I'd lived in a desert, and I was fascinated by the flora and fauna," Rykaczewski said, a professor of engineering at Arizona State University in Tempe, Arizona. "What I noticed about prickly pear cacti is that the new pads are superhydrophobic, but the ones a season older right below them are superhydrophilic. I wondered why."

Rykaczewski began to look at desert animals, including rattlesnakes that change shape to drink water from their skin. Motivated by his front yard observations, Rykaczewski recruited students and with a seed grant from ASU's Biomimicry Center began experimenting in the laboratory to characterize the cactuses' microscopic 3D epidermal structure at dry and wet times of the year. Rykaczewski applies the lessons in wettability -- the study of how droplets interact with solids -- to engineering surfaces for industrial applications.

Kenneth (Chad) Manning, a doctoral student on the project who led the experimental work, will present the team's discoveries from this Sonoran wettability research at the American Physical Society's Division of Fluid Dynamics 71st Annual Meeting, which will take place Nov. 18-20 at the Georgia World Congress Center in Atlanta, Georgia.

They discovered that while new cactus pads (cladodes) have a continuous waxy, hydrophobic surface, older ones are covered with a network of microcracks "that go down all the way through the wax to the cell wall," which is hydrophilic, explained Manning.

Using high-speed video, the researchers documented that water droplets bounce off young, waxy pads, but with older pads the microcracks exposing the inner hydrophilic surface cause

water droplets to hit and stick. "The skin is acting as a smart membrane," said Manning. "As cacti dry out the cracks close, helping to preserve water."

The results are now informing Manning's research to develop a smart material for hazmat suits. The pores of the material will close in the presence of dangerous chemicals but will otherwise remain open allowing for vapor and heat transfer out of the hazmat suit, a factor which currently limits their use.

It's a smart-skin trick prickly pear cactuses have already finessed. "It's the same sort of change in the surface morphology," Manning said.

###

Presentation F13.8, "Droplet Interactions with the Prickly Pear Cactus and Western Diamondback Rattlesnake of the Sonoran Desert" by Kenneth C. Manning, Praveen Kotagama, Akshay Phadnis, Gordon W. Schuett and Konrad Rykaczewski, will be Monday, Nov. 19, 9:31 a.m. in Room B218 of the Georgia World Congress Center in Atlanta. Abstract:

<http://meetings.aps.org/Meeting/DFD18/Session/F13.8>

###

----- **MORE MEETING INFORMATION** -----

USEFUL LINKS

Main meeting website: <https://www.apsdfd2018.org/>

Meeting technical program: <http://meetings.aps.org/Meeting/DFD18/SessionIndex2>

Invited talks: http://meetings.aps.org/Meeting/DFD18/APS_Invited

Hotel information: <https://www.apsdfd2018.org/hotels/>

GALLERY OF FLUID DYNAMICS

At the Annual Meeting, The Gallery of Fluid Motion will consist of posters and videos submitted by attendees illustrating the science and beauty of fluid motion. More information can be found here: <https://gfm.aps.org/>.

PRESS REGISTRATION

We will grant free registration to credentialed journalists and professional freelance journalists. If you are a reporter and would like to attend, contact Rhys Leahy or the AIP Media Line (media@aip.org, 301-209-3090). We can also help with setting up interviews and obtaining images, sound clips or background information.

LIVE MEDIA WEBCAST

A press briefing featuring a selection of newsworthy research will be webcast live from the conference Monday, Nov. 19. Times and topics to be announced. Members of the media should register in advance at <http://apswebcasting.com/webcast/registration/aps1118.php>.

ABOUT DFD

The Division of Fluid Dynamics of the American Physical Society, established in 1947, exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure. For more information about DFD, visit <https://www.aps.org/units/dfd/>.

ABOUT APS

The American Physical Society (APS) is a nonprofit membership organization working to advance and diffuse the knowledge of physics through its outstanding research journals, scientific meetings, and education, outreach, advocacy, and international activities. APS represents over 55,000 members, including physicists in academia, national laboratories, and industry in the United States and throughout the world. For more information about APS, visit <https://www.aps.org/>.