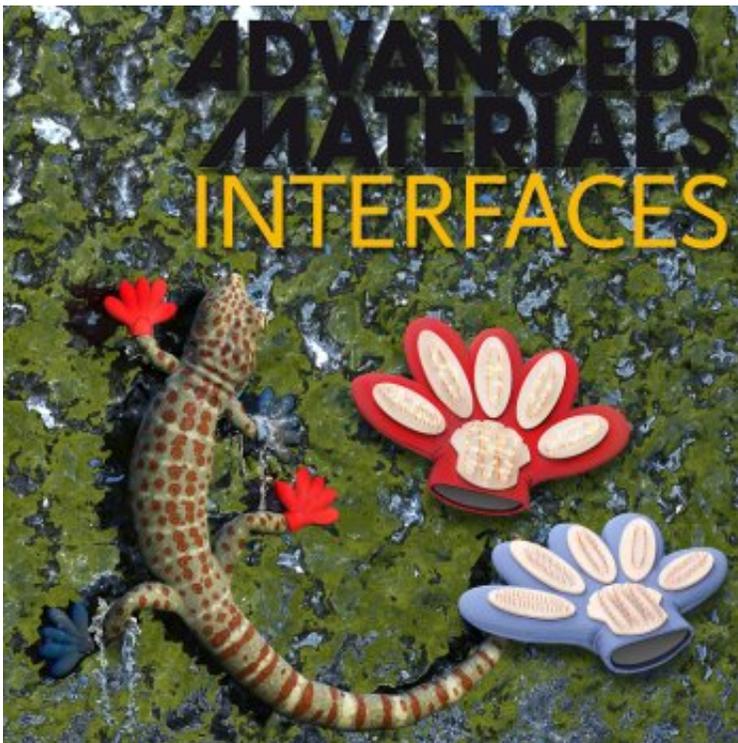


Groundbreaking new reusable adhesive works underwater

January 28 2019, by Taylor Tucker



Illinois researchers study on shape memory polymers (SMPs) is featured in the latest edition of *Advance Materials Interface*. Credit: *Advance Materials Interface*

Illinois researchers have introduced a new cutting-edge reusable adhesive that activates in seconds, works underwater, and is strong enough to deadlift 11 pounds: shape memory polymers (SMPs).

The team—associate professor in mechanical science and engineering

Seok Kim, graduate student Jun Kyu Park, and former graduate student Jeffrey D. Eisenhaure (Ph.D. ME '17, now with Northrop Grumman)—has proved that SMPs can retain dry adhesion properties while submerged. Their study, "Reversible underwater dry adhesion of a shape memory polymer," was recently published by the scientific journal *Advanced Materials Interfaces*.

Classified as a smart material, SMPs have the ability to manually transition between their original state and a deformed state. By manipulating the state of their SMPs, Kim and his team achieved successful adhesion to surfaces submerged in water as well as other liquid media such as oil.

"Dry adhesives, such as those inspired by gecko feet, are believed to be inadequate to achieve high adhesion to a wet or submerged surface," Kim said. "However, this belief has been nullified because of our SMP reversible dry adhesives."

By applying pressure to the submerged SMP in its original rubbery state, liquid can be squeezed out from the contact interface. Under sufficient pressure, the SMP then transitions to a glassy state, essentially creating a hermetic contact condition that maintains highly strong dry adhesion. However, this state is not permanent; the SMP's shape recovery properties allow for reversal of the adhesion. Furthermore, because the SMP can transition fluently between both states, its adhesion is reusable.

The researchers found that the maximum adhesion strength of the SMP while submerged in a freshwater condition was 18 atm, which is at least 18 times larger than that of vacuum suction cups. Similar results were achieved for submersion in saltwater and oil. They performed various experiments to explore the applications of their SMPs—for example, they used the adhesive to attach a hook to a wet wall. Once the SMP had adhered, they were able to hang a loaded backpack on the hook without

experiencing any weakness in the [adhesion](#).

"These findings will result in reusable high-strength adhesive fasteners for wet or submerged wall mounting," said Kim, who plans to commercialize his results through a start-up.

"The next step for this technology will be to further explore SMP adhesive systems to enable reversible adhesive grippers."

More information: Jun Kyu Park et al, Reversible Underwater Dry Adhesion of a Shape Memory Polymer, *Advanced Materials Interfaces* (2018). [DOI: 10.1002/admi.201801542](https://doi.org/10.1002/admi.201801542)

Provided by University of Illinois at Urbana-Champaign

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