Gecko inspired pads allow researchers to climb glass wall

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Credit: *Journal of the Royal Society Interface*

A team of researchers working at Stanford University has used prior research involving the means by which gecko's climb walls to create pads that allow a human to do very nearly the same thing. In their paper published in *Journal of the Royal Society Interface*, the team describes how they improved on the ideas used by gecko's to allow for the creation of pads capable of carrying the weight of a human while climbing a glass wall.

Geckos are able to climb vertical walls because they have very tiny hair-like strands on the bottom of their feet called setae. The setae provide a sticking force by causing a weak attraction between molecules on them and those on the climbing surface. The weak force is multiplied by thousands of setae covering a small area on the foot. Scientists trying to mimic such an ability have struggled as the approach hasn't worked as well when applied to larger or heavier objects. In this new effort, the researchers have discovered why mimicking the approach hasn't scaled well, and then found a work-around.

As it turns out, when geckos climb, they don't distribute their weight evenly across their feet or toes, thus only a small percentage of the setae are actually in use at any given time. When scaling up, this problem becomes multiplied. To overcome that problem, the researchers first created artificial setae they call microwedges—each was applied to a tile using very tiny springs to allow for using all of them at the same time—the springs were in turn connected to a pad roughly the size of a human hand. A strap was placed on the back of the pad to allow for attaching to a hand. The team also attached a tether to each pad that reaches down to the foot area, and has a step on it. To climb, a person reaches up, places a pad against the wall (causing the step on that side to rise an equal distance) places a foot on the step and pushes themselves higher using leg force. The process is repeated alternating between the left and right hands/feet as the person climbs higher.

Currently, the pads only work on clean smooth surfaces, but the team hopes to improve on that by making self cleaning pads, similar to the approach used by geckos. Applications range from window washing to satellite retrieval systems.

More information: Human climbing with efficiently scaled gecko-inspired dry adhesives, *Journal of the Royal Society Interface*, Published 19 November 2014. DOI: 10.1098/rsif.2014.0675

ABSTRACT
Since the discovery of the mechanism of adhesion in geckos, many synthetic dry adhesives have been developed with desirable gecko-like properties such as reusability, directionality, self-cleaning ability, rough surface adhesion and high adhesive stress. However, fully exploiting these adhesives in practical applications at different length scales requires efficient scaling (i.e. with little loss in adhesion as area grows). Just as natural gecko adhesives have been used as a benchmark for synthetic materials, so can gecko adhesion systems provide a baseline for scaling efficiency. In

the tokay gecko (Gekko gecko), a scaling power law has been reported relating the maximum shear stress ?max to the area A: ?max ? A?1/4. We present a mechanical concept which improves upon the gecko's non-uniform load-sharing and results in a nearly even load distribution over multiple patches of gecko-inspired adhesive. We created a synthetic adhesion system incorporating this concept which shows efficient scaling across four orders of magnitude of area, yielding an improved scaling power law: ?max ? A?1/50. Furthermore, we found that the synthetic adhesion system does not fail catastrophically when a simulated failure is induced on a portion of the adhesive. In a practical demonstration, the synthetic adhesion system enabled a 70 kg human to climb vertical glass with 140 cm2 of adhesive per hand.

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