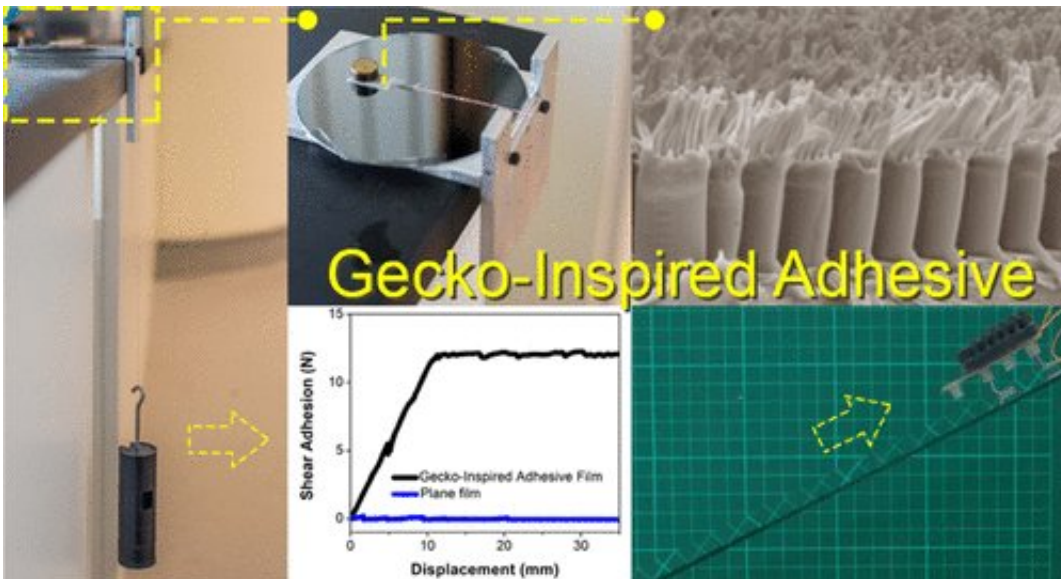


# Scaling to new heights with gecko-inspired adhesive

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Credit: American Chemical Society

Some animals, such as geckos, can easily climb up walls and across ceilings. But currently, no material exists that allows everyday people to scale walls or transverse ceilings as effortlessly. Now, scientists report in *ACS Applied Materials and Interfaces* a dry adhesive that could someday make it easier to defy gravity.

Geckos can scale walls because of their unique toe pads that help them quickly attach and detach from surfaces. Interestingly, gecko toe pads are covered with bristle-like layers of a stiff material called keratin. The

bristle-like structure of the keratin in a toe pad helps it to stick—each pad is covered with microscopic pillars, which then branch out at the tips into even smaller structures. Scientists have manufactured dry adhesives with similar properties, but they haven't been as sticky as gecko toes. And some methods involve the use of layers, but the first [layer](#) is usually damaged as successive ones are applied. Other methods are not easily scaled up. Hemant Kumar Raut, Hong Yee Low and colleagues wanted create a dry adhesive that was ultra-sticky but also simple to fabricate in large batches.

The researchers made a dry adhesive with stiff polycarbonate using a nanoimprinting technique to build web-like layers. This [method](#) is cost-effective, easy to perform and is scalable. To prevent damage to the first layer, the team used a [sacrificial layer](#), which was dissolved away after the second layer was applied. In repetitive attachment and detachment tests, only a 20 percent decline in stickiness occurred after 50 cycles. This level of adhesion lasted for up to 200 cycles. The researchers say that their film's adhesion was comparable to that of a gecko. The team also placed the adhesive film on the feet of a miniature robot, which moved with ease up a 30-degree incline.

**More information:** Hemant Kumar Raut et al. Gecko-Inspired Dry Adhesive Based on Micro–Nanoscale Hierarchical Arrays for Application in Climbing Devices, *ACS Applied Materials & Interfaces* (2017). [DOI: 10.1021/acsami.7b09526](https://doi.org/10.1021/acsami.7b09526)

### **Abstract**

The unusual ability of geckos to climb vertical walls underlies a unique combination of a hierarchical structural design and a stiffer material composition. While a dense array of microscopic hierarchical structures enables the gecko toe pads to adhere to various surfaces, a stiffer material ( $\beta$ -keratin) composition enables them to maintain reliable adhesion over innumerable cycles. This unique strategy has been seldom

implemented in engineered dry adhesives because fabrication of high-aspect-ratio hierarchical structures using a stiffer polymer is challenging. Herein, we report the fabrication of high-aspect-ratio hierarchical arrays on flexible polycarbonate sheets (stiffness comparable to that of  $\beta$ -keratin) by a sacrificial-layer-mediated nanoimprinting technique. Dry-adhesive films comprising the hierarchical arrays showed a formidable shear adhesion of  $11.91 \pm 0.43$  N/cm<sup>2</sup>. Cyclic adhesion tests also showed that the shear adhesion of the adhesive films reduced by only about 20% after 50 cycles and remained nearly constant until about 200 cycles. Most importantly, the high-aspect-ratio hierarchical arrays were integrated onto the feet of a miniature robot and the locomotion on a 30° inclined surface was demonstrated.

Provided by American Chemical Society

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