Gravity-Defying Geckos Teach Scientists a Lesson

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The scientific quest to make artificial gecko feet has taken a leap forward.

Geckos, lizards that are notorious for their sticky feet, can run up walls and across ceilings, and hang tauntingly by one toe. They have no suction cups, hooks or glue on their feet, so how do they do it?

Five years ago, researchers at the University of California, Berkeley; Stanford; and Lewis and Clark College found the secret: 500,000 minute hairs cover the sole of each foot, and the tip of each hair splits into hundreds more. The hairs are so elastic that they can bend or squish to conform to microscopic nooks and crannies under the creature's feet, even on the glass walls of an aquarium.

As a result, the tiny hairs touch so much surface area so closely that weak forces of attraction between molecules in the hairs and in whatever surface the animal is walking on add up and become sufficient to let the gecko hang on. The
and the tip of each hair splits into hundreds more. Top, a lizard's hairs are magnified 595 times. connection breaks when the gecko shifts its foot enough to change the angle between the hairs and the surface.

The discovery intrigued scientists, who immediately realized that if synthetic gecko-foot hairs could be made, they might be a great adhesive - strong, glue-free, dry, reusable and, unlike suction cups, capable of working in a vacuum like outer space. Engineers envisioned robotic instruments that could climb walls or grab objects without dropping them, and rovers that could maneuver rugged terrain on distant planets. Such adhesives could also be used to stick components together in electronic devices.

The National Science Foundation takes these ideas so seriously that it gave a $400,000 grant to scientists at the University of Akron and Rensselaer Polytechnic Institute to try making imitation gecko feet.

In a recent issue of the journal Chemical Communications, the team reported that it had indeed produced synthetic hairs, with 200 times the sticking power of the ones made by nature.

Although the scientists have tested only minute amounts of the material, they estimate that if its properties hold up on a larger scale, a dime-size patch of it could support 2 to 22 pounds, depending on how densely the hairs were packed.

"Think of it almost like nano-Velcro," said Ali Dhinojwala, an associate professor of polymer science at the University of Akron.

The synthetic hairs - one ten-thousandth the width of a human hair - are made of highly flexible carbon cylinders, or nanotubes, embedded in a plastic base like bristles in a hairbrush.

The tubes are strong and practically unbreakable, Professor Dhinojwala said, adding that other groups had tried making the tubes of plastic, but it turned out to be too weak.

He said people had asked him whether the new material could be fashioned into gloves and shoes for rock climbers.

"I'm a little hesitant on going too fast," Professor Dhinojwala said. "Nature has had more time than we have..."
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had. I would hesitate to extrapolate. But the imagination is there.

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