Gecko Tech

The amazing lizard uses its hairy toes to defy gravity and its dynamic tail to always land on its feet if it falls. See how scientists are using the gecko's tricks to design better robots, spacesuits and—just maybe—Spiderman gloves

INSPIRED BY NATURE

By Dan Smith *Posted 04.04.2008 at 6:10 pm* 3 Comments

Popular Tags

SciTech

global warming | medicine | physics | bacteria | How it Works | biology | food | robots | NASA | deep brain stimulation | evolution | nanotech

Regular Features

- Future Human *with Laura Allen* | On our continued evolution as a species
- Inspired by Nature *with Dan Smith* | Developments in biomimicry
- Science Confirms the Obvious *with Laura Allen* | The research that makes us say "duh"

All Tags | All Photos | All Videos

Sticky Toes: The adhesive pads on the Tokay gecko's foot *Photo by* ***David Clements***

Most people's knowledge of geckos doesn't extend much beyond the Cockney-tongued lizard hawking car insurance on TV. I won't go into the implausibility of these ads, the least of which being that a gecko wouldn't have a chance to survive Britain's cold climate long enough to pick up an accent. They do, however, thrive abundantly in warm, tropical climates, and in total compose

Photo Galleries

PHOTO GALLERIES

SciTech

From Space to Shovel

Hyperspectral satellites can uncover ancient remains hiding in plain view

Beyond the Male "Pill"

From remote-control key fobs to ultrasound, male contraception

nearly 15% of all reptile species on Earth. If you're fortunate enough to live in gecko country, you've probably seen them climbing and crawling over just about every surface imaginable, including the ceiling.

Naturally, this impressive ability to "defy gravity" by quickly attaching and detaching themselves from surfaces without losing their balance led scientists to question how and why, and studies seeking to answer these fascinating questions have resulted in a variety of useful technologies for we humans to use in robots, spacecraft and Spiderman-like climbing gloves.

Originally, it was thought that a gecko's ability to cling to walls was due to a secretion of some sort of adhesive on the pads of their feet. But when scrutinized with modern high-power microscopes, the surface of a gecko's foot revealed hundreds of thousands of tiny hair-like projections, called setae, which can be as small as one tenth the diameter of a strand of human hair and are themselves covered in even smaller projections, called spatulae, which are sometimes so tiny as to be smaller than the wavelength of visible light. Each time one of these setae comes into contact with a surface, the tiny hairs form a temporary atomic bond called a van der Waals force. This molecular bonding is relatively weak, but when multiplied over thousands upon thousands of setae, it becomes quite potent—strong enough that if every single setae was bonded to a surface, a typical adult gecko could support nearly 300 pounds of weight.

Another interesting facet of this setae foot design is that the adhesion is directional. As the gecko attaches its foot to a wall, since the setae are not all the same length, only some will make a connection. The gecko's weight and direction of travel will bend some of the setae down allowing more connections with shorter stalks, increasing the bond. However, when the gecko moves its foot in the opposite direction the connections break and the foot detaches from the wall. This allows the gecko to walk

Related Articles

The Hidden Talents of the Lowly Sea Cucumber

The Gecko's Magic isn't all in the Toes

Tags

Inspired By Nature, SciTech, biology, biomimicry, Dan Smith, geckos, inspired by nature, lizards, Spiderman

goes high tech

Xerox PARC Lab Tour

See what the legendary Silicon Valley research facility is cooking up next

+ More Photo Galleries

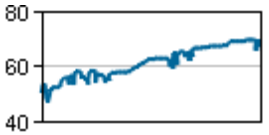
PPX The PopSci Predictions Exchange

SciTech

Deep-Brain Stim for Depression

Will the FDA clear deep-brain stimulation as a treatment for clinical depression by September 30, 2008?

Large Hadron Collider Functions



Will the LHC be fully functional and producing data by October 31, 2008?

Ready to bet on the future? Start here!

along the surface, attaching and detaching without getting stuck, secreting any adhesive, or expending any unnecessary energy.

The unique nature of this directional sticking has vast potential for use by humans. Unlike most strong adhesives currently used, a gecko-inspired system using van der Waals forces doesn't rely on tacky substances to stick, is reusable, self-cleaning and doesn't leave any residues. And since gecko-based adhesives would be directional and based on the physical bond between surfaces, these adhesives could be used (and reused) in space or even underwater.

Possibly applications include gecko-foot materials that NASA could use on the boots of spacesuits or in multi-purpose adhesive tapes. These tapes could also be tailored to medical procedures to bind tissue together and might replace the need for sutures altogether, as recent research at MIT indicates. Since they can work in a fluid environment, the medical tape could be used inside the body, made biodegradable, or possibly deliver drugs. Then, of course, there's the more far-out potential for the development of gloves that could give the wearer Spiderman-like climbing powers.

Aside from their amazing feet, more recent studies have shown scientists taking design cues from the function of the gecko's tail. It seems that the gecko uses its tail as a sort of fifth limb that acts much like a bike's kickstand to push itself back up against a wall if it begins to slip. This happens even if the gecko falls back up to an angle of 60 degrees from the wall.

Like cats, geckos always seem able to land on four feet if they fall. If its tail kickstand isn't enough to regain its footing, the gecko also instinctively uses its tail as a sort of pendulum to rotate it back into a feet-down position in the blink of an eye. This discovery could serve as design inspiration for more efficient gliders or spacecraft with more precise control surfaces.

Data from these studies of the gecko's amazing climbing abilities is currently being applied in several projects hoping to develop autonomous climbing robots. DARPA (no surprise there) has

been funding many of these robots including the RiSE project or the Waalbot. Their hope is to to create search-and-rescue or reconnaissance 'bots that can use gecko-inspired tech to climb treacherous surfaces and regain their balance if they fall.

The majority of this research is based on just the Tokay gecko, a larger variety found in southeast Asia. But further research into the 1,100 additional species of gecko could lead to a diversification and refinement of the potential uses of gecko-based technologies. And if it leads to gloves that allow us to climb walls, geckos may be selling us insurance for more than just our cars.

3 Comments

Einstein007 Article

Shin Rating: 1 2 3 4 5

04/04/08 at 9:48 pm

Wow thats really cool. I would love to be able to climb walls. I just hope that no geckos are killed in the use and study of their "technology," because I would hate for them to go extinct. I'm not saying that they do kill geckos, just that I hope they never will.

0 out of 0 people found this comment helpful

5. The Zero-Emissions One-Wheeled Motorcycle
6. Cosmic Explosions
7. Video: The XOS Exoskeleton in Action
8. Your Sewer on Drugs
9. Electricity in the Air
10. Evolution's Most Effective Killer: Snake Venom

Most Commented

SciTech

1. Bill Nye vs. Intelligent Design
2. Post Your Questions for Lawrence Lessig
3. One in Eight U.S. Biology Teachers Teaches Creationism
4. The Older Brother Effect
5. What Would You Do With Your Mountain Fortress?
6. Can the Sun Keep You Cool?
7. Aqua Teen Hunger Force = Terrorism?!
8. When Lions, Buffaloes and Crocodiles Attack—At the Same Time
9. Aviation Adventurer Steve Fossett Reported Missing
10. Images of Villages Adjusting to Climate Change

Most Emailed

SciTech

1. This Germ Could Save Your Life
2. Building the Real Iron Man
3. Ten Times the Turbine
4. Electricity in the Air

empjag

Article Rating: 1 2 3 4 5

04/04/08 at 10:23 pm

Come on, PopSci.

"Spider-man."

0 out of 1 people found this comment helpful

To comment, please login.

Article Rating: 1 2 3 4 5

04/06/08 at 4:45 pm

Oh no! They didn't insert a hyphen in "Spiderman"! Who the freak cares?!

Great story by the way.

0 out of 0 people found this comment helpful

5. For Treating Blindness, Scientists Look to Algae
6. Man Regenerates Finger
7. A Brief History of Exoskeletons
8. Your Sewer on Drugs
9. Money Minded: How to Psychoanalyze the Stock Market
10. The Space Archaeologists

INSIDE POPSCI

The Zero-Emissions One-Wheeled Motorcycle

Ten Times the Turbine

A Lifesaving Beacon for Miners

A Sewage-Proof Suit

The Natural Artificial Foot

A Living Air Filter

A Rocket Engine for the Masses

A Homebuilt Tumor-Killer

The Indestructable Bridge

Steam Under the Hood