# Animal footpads inspire a polymer that sticks to ice

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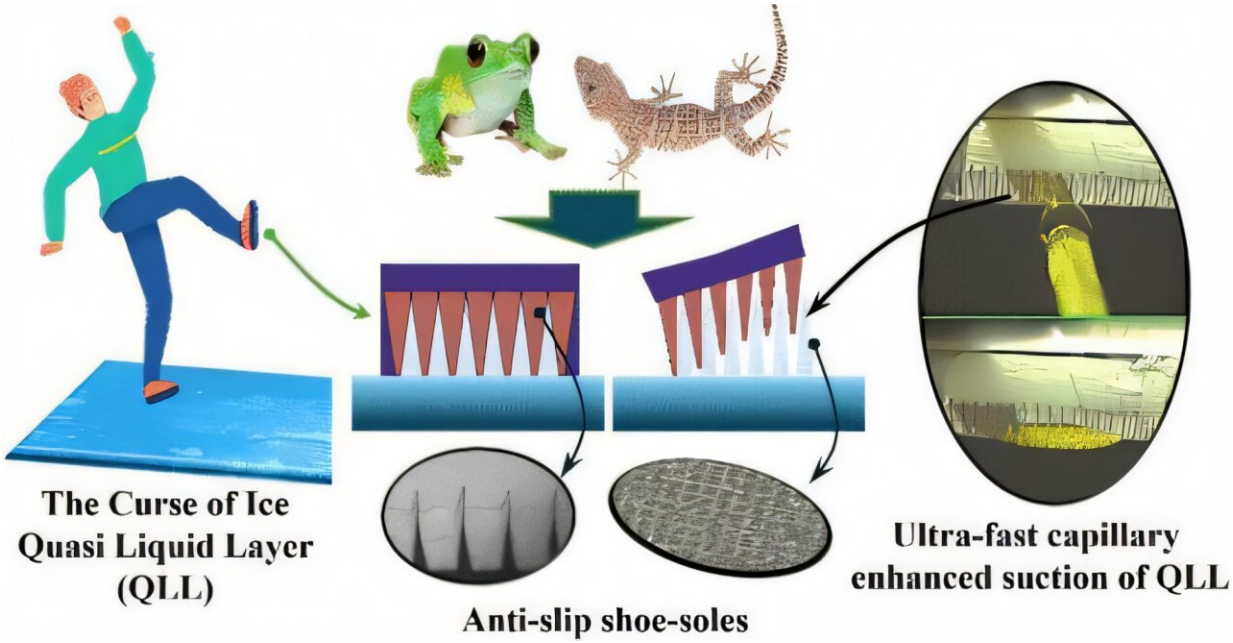


Credit: *ACS Applied Materials & Interfaces* (2024). DOI: 10.1021/acsami.4c14496

A solution to injuries from slips and falls may be found underfoot—literally. The footpads of geckos have hydrophilic (water-loving) mechanisms that allow the little animals to easily move over moist, slick surfaces.

Researchers have found that using silicone rubber enhanced with

zirconia nanoparticles creates a gecko-inspired slip-resistant polymer. They say the material, which sticks to ice, could be incorporated into shoe soles to reduce injuries in humans. Their study is published in *ACS Applied Materials & Interfaces*.

Slips and falls account for more than 38 million injuries and 684,000 deaths every year, according to the World Health Organization. And nearly half of these incidents happen on ice. Current anti-slip shoe soles rely on materials such as natural rubber that repel the layer of liquid water that sits atop the pavement on a rainy day.

On frozen walkways, however, shoe soles with these materials can cause ice to melt because of pressure from the wearer, creating the slippery surface the shoes are supposed to protect against.

Previous studies of gecko feet have led to new ideas for developing more effective anti-slip polymers. Those works found that their footpad's stickiness comes from hydrophilic capillary-enhanced adhesion: The force of water being drawn into narrow grooves in the footpad creates suction that helps the lizard navigate slippery surfaces.

Vipin Richhariya, Ashis Tripathy, Md Julker Nine and colleagues aimed to develop a polymer with capillary-enhanced adhesion that works on rainy sidewalks and frozen surfaces.

The researchers started with silicone rubber polymer and added zirconia nanoparticles to make the material attract water molecules. After they rolled the composite material into a thin film, they hardened it with heat and laser-etched a grooved pattern onto the film's surface that exposed the hydrophilic zirconia nanoparticles.

When the film encountered water molecules atop ice, it stuck to the slippery surface because the polymer mimicked the capillary action of

slip-resistant gecko footpads. They tested five versions of the patterned nanocomposite material with different proportions of zirconia nanoparticles by weight: 1%, 3%, 5%, 7%, and 9%.

Using infrared spectroscopy and simulated friction tests, the researchers found that the most slip-resistant nanocomposites contained 3% and 5% zirconia nanoparticles by weight. In addition to a nature-inspired anti-slip shoe sole, the team says this technology could be used in medical innovations, such as electronic skin and artificial skin, where polymers interact with a layer of fluid between two different surfaces.

**More information:** Vipin Richhariya et al, Capillary-Enhanced Biomimetic Adhesion on Icy Surfaces for High-Performance Antislip Shoe-Soles, *ACS Applied Materials & Interfaces* (2024). DOI: 10.1021/acsami.4c14496

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