

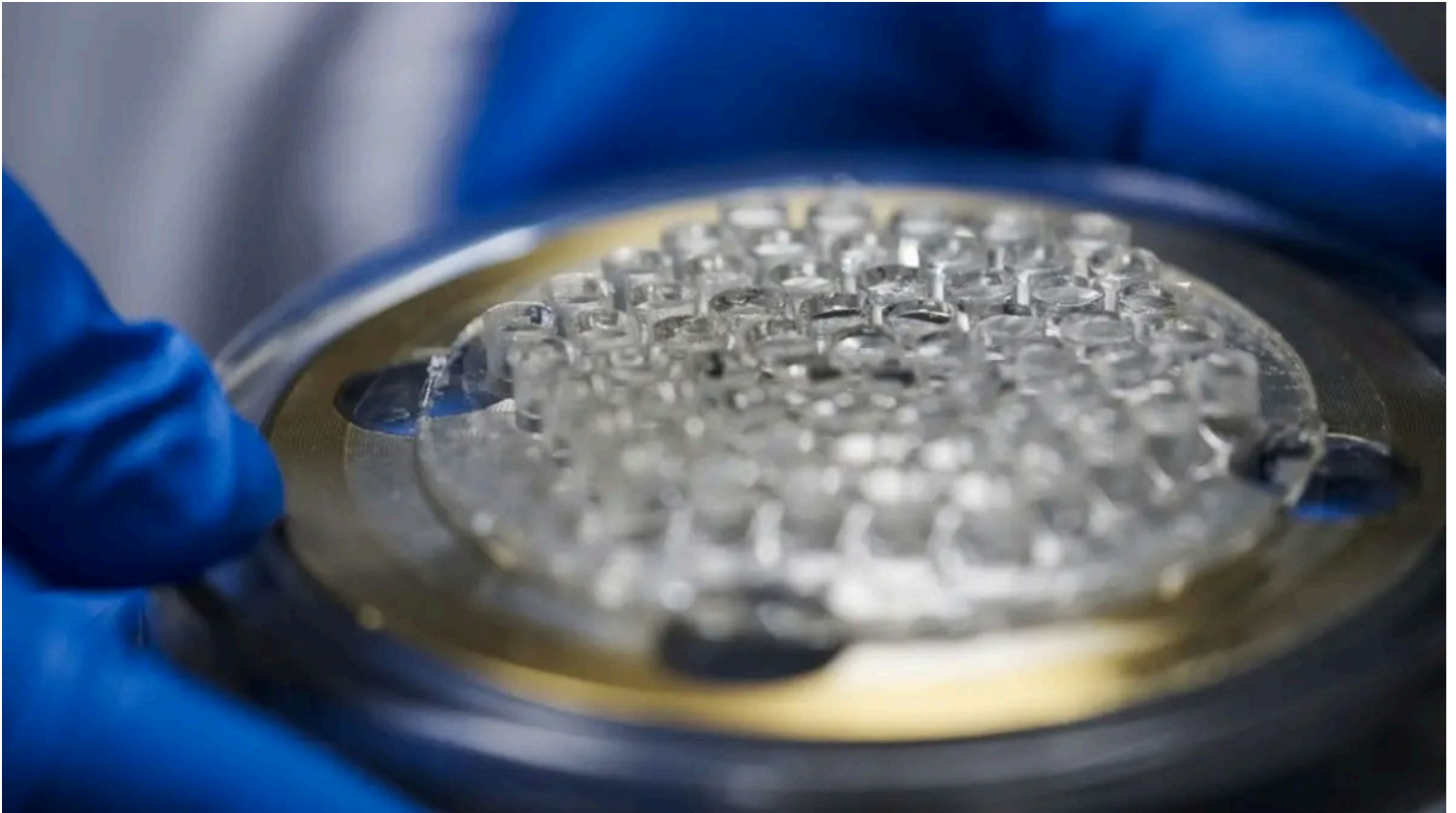
Stick it like Spiderman! 1 ounce of this reusable glue holds 132 pounds

The shape of the reusable adhesive made from an epoxy polymer can be altered using external stimulus like heat or light.



[Ameya Paleja](#) Published: Apr 30, 2024 07:31 AM EST

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Representational stock image of a reusable adhesive.

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Researchers at the Nanyang Technological University (NTU) Singapore have devised an epoxy-based adhesive ten times stronger than the adhesion at a gecko's feet.

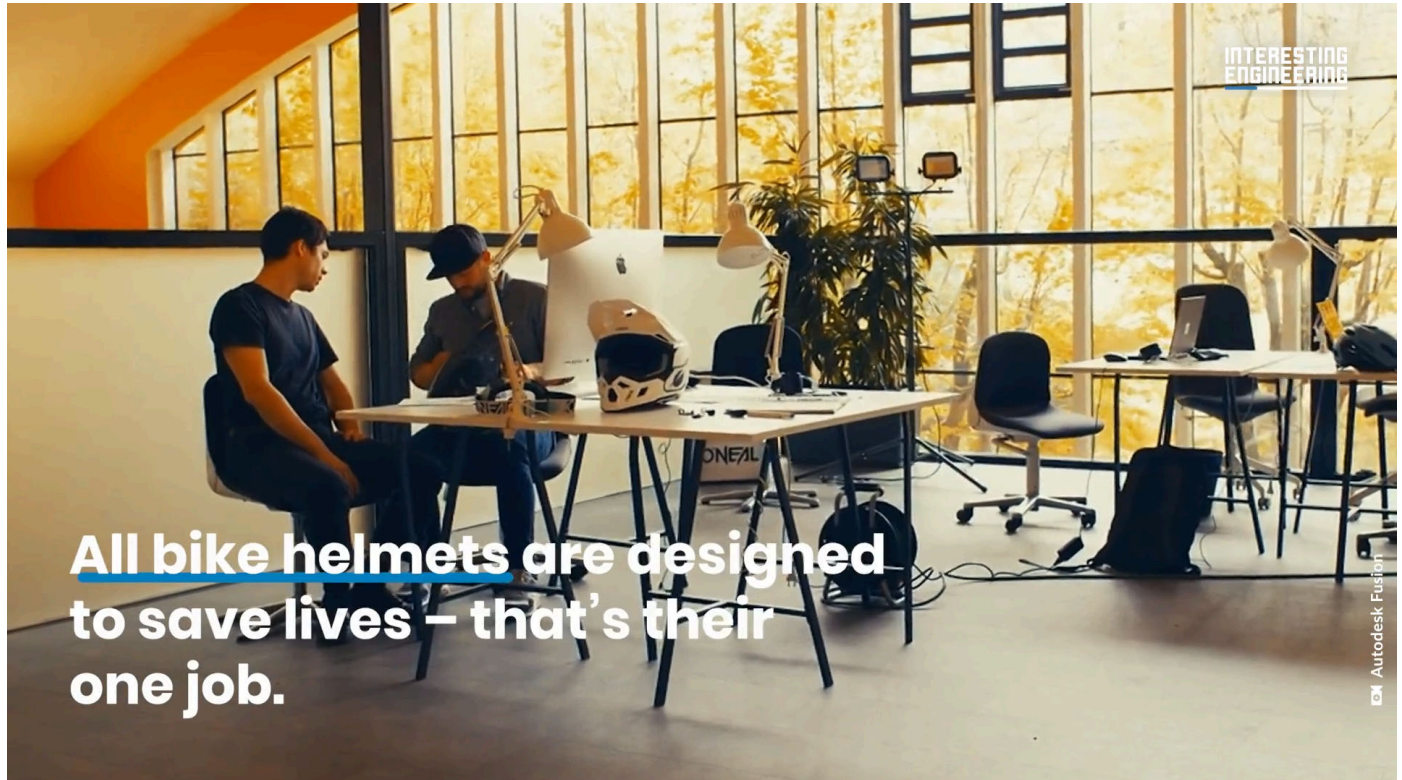


The fictional character of Spider-Man had to be bitten by a genetically modified spider to acquire the spidey sense and ability to swing from building to building in New York.

Humans of the future would not need to take such risks since the adhesive developed by the NTU researchers can carry a fully grown human's weight, even though its weight is just a fraction of its carrying ability.

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"This research is based on a fundamental understanding of the mechanisms of adhesion forces on rough surfaces," said Jimmy Hsia, a professor of Mechanical Engineering at NTU. It can help us develop strong yet [easily detachable adhesives](#) adaptable to rough surfaces." The secret ingredient that makes this possible is shape-

What are shape-memory polymers?

Shape-memory polymers retain the memory of a previous form and can return to their original shape in the presence of an external stimulus such as heat, light, or electric current.

NTU researchers used an epoxy polymer dubbed E44, which is stiff and glass-like at room temperature. When heated, the polymer turns into a soft rubber-like material that can take any shape and lock into small crevices and nooks that are invisible to the naked eye. As it cools, the polymer turns stiff again and creates a strong adhesive-like bond with the material it interacts with.

The researchers found that the polymer is most adhesive when arranged in hair-like fibrils. The team experimented with long and short fibrils but found that those with radii between 0.5 mm and three mm showed the highest adhesion while maintaining their structure.

One such fibril with a cross-section of 19.6 square millimeters can carry a weight of over three pounds (1.56 kg). An array no larger than the palm of a human hand consisting of 37 such fibrils weighs just over an ounce (30 grams) but can carry a weight of around 132 pounds (60 kg), the press release added.

NTU Singapore scientists develop a smart, reusable adhesive that sticks on various surfaces



How well does it work?

While the concept of using the shape-memory polymer is straightforward, in their research, the NTU team has found that the polymer takes less than a minute to deform and lose its attachment when a hair dryer is used to increase its temperature to 140 Fahrenheit (60 degrees Celsius). On the other hand, it takes about three minutes for the material to cool, lock in its adhesion to a new material, and stay clung to it.

“At this current stage, the heating and cooling times, as well as switching temperature, restrict the number of real-world use cases,” said Linghu Changhong, a research fellow at NTU, who was involved in the research.

“However, our findings show that reducing the wait times to mere seconds is possible, and the switching temperatures can be lowered to near body temperature, dramatically opening up application possibilities.”

The researchers have figured out that adjusting the ratios of its components can control the temperature at which the polymer changes its state. The [press release](#) added that this will also enable its use in extreme weather conditions.

The research findings were published in the journal [National Science Review](#).

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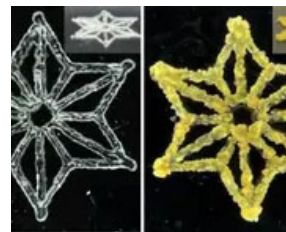
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