INNOVATION

Chain Mail-Inspired Fabric Supports 50 Times Its Own Weight

The material can easily shift from a fluid to sturdy state and could be used for smart exoskeletons or temporary bridges.

By Chris Young
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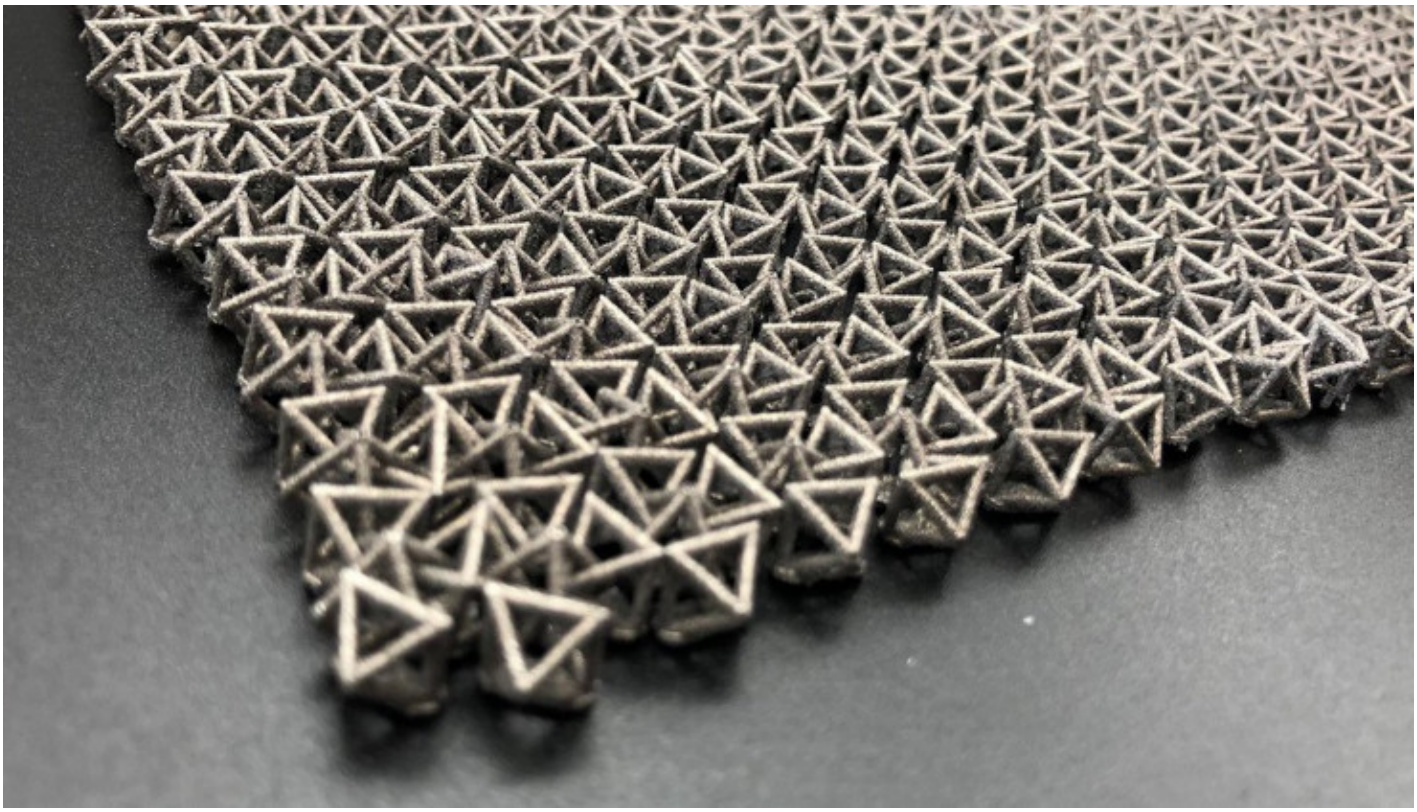


The chain mail-inspired material. Caltech

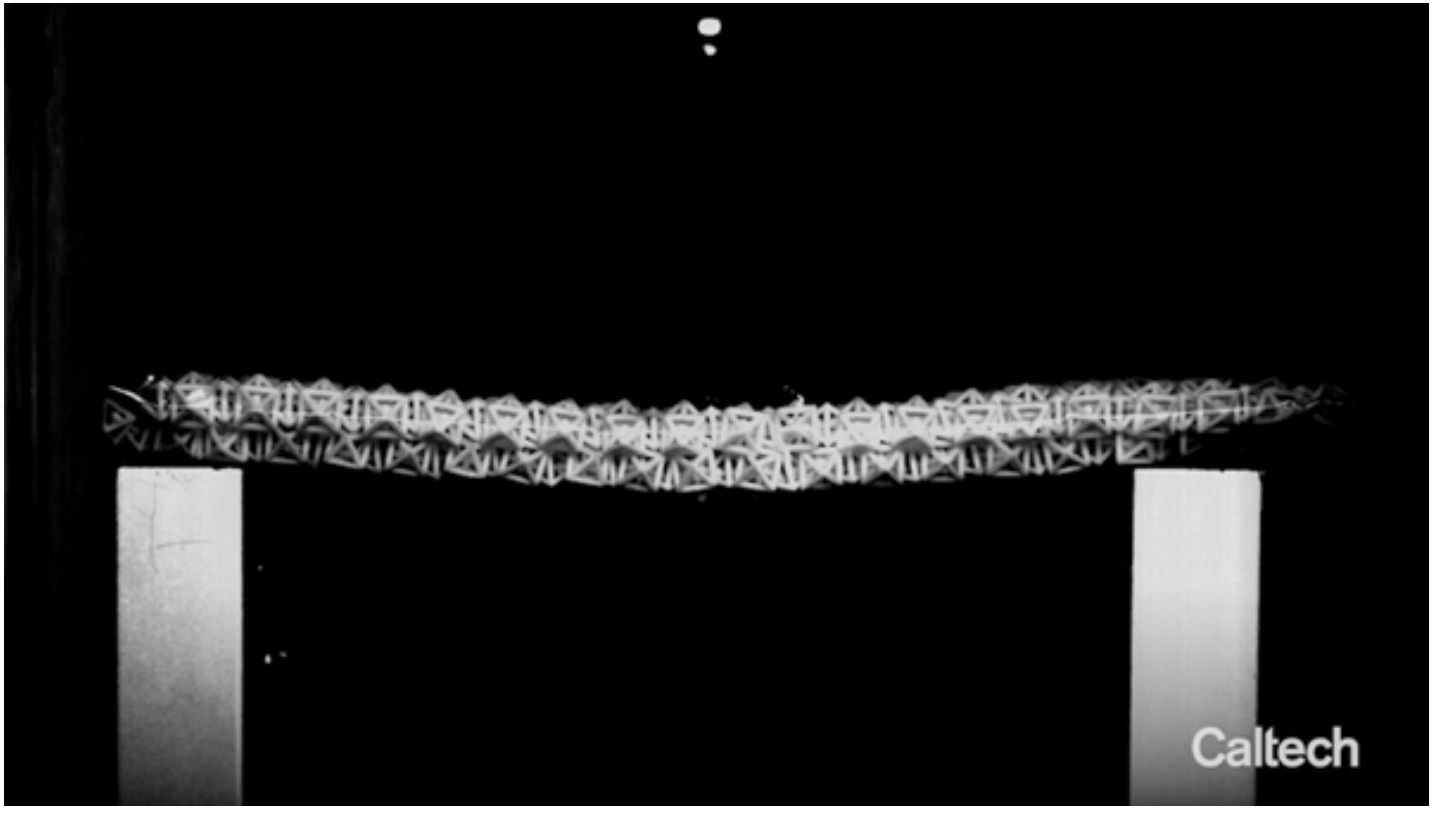
Engineers at California Institute of Technology (Caltech) and the Nanyang Technological University (NTU) in Singapore teamed up to develop a chain mail-inspired fabric that transforms from a fluid malleable material into a solid protective material when under pressure, a press statement reveals.

The material could be used for a host of potentially lifechanging applications, including as smart fabric for exoskeletons, for a cast that becomes more or less rigid when needed to facilitate the healing of an injury, and as a deployable bridge that could be thrown over an obstacle and stiffened so that people can walk across with ease.

Chain mail-inspired fabric supports 50 times its own weight

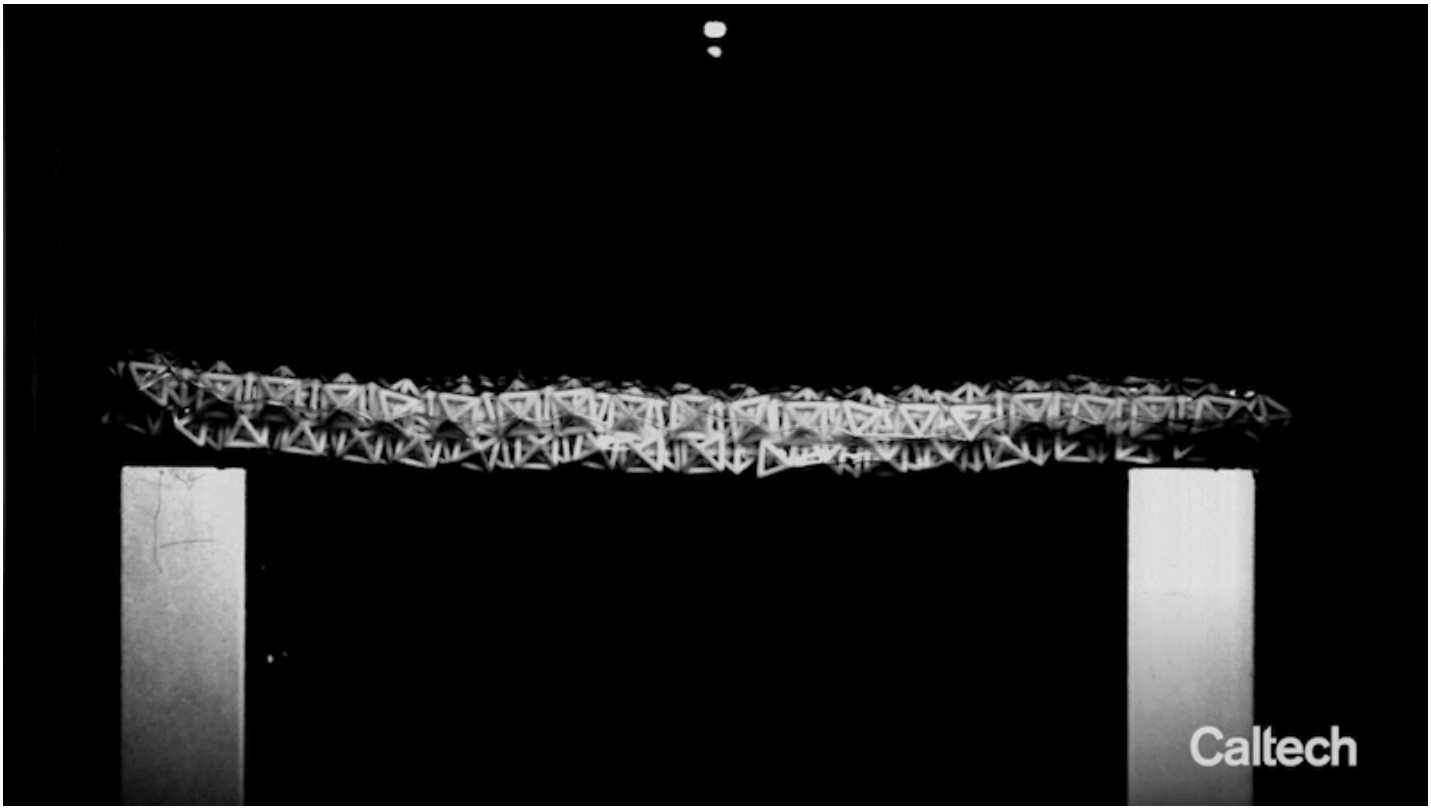
The team set out "to create a fabric that goes from soft and foldable to rigid and load-bearing in a controllable way," said Chiara Daraio, a corresponding author on the team's study, which is published in the journal *Nature*. The researchers developed the material via a combination of trial and error with different material types and computer simulations of the different patterns and their properties.

They compare the tough state of their material to the way a pack of rice can be extremely hard when vacuum sealed — once opened, however, it flows out of the bag like a fluid. The key to the team's material was controlling this process. Below is a demonstration of the soft, unjammed material being struck by a metal ball.



Source: Caltech

And here's the same material, struck by the same ball but in its jammed state — it is clearly more impact-resistant and much sturdier.



Source: Caltech

The material developed by the group of international researchers is composed of hundreds of 3D-printed hollow, 8-sided triangular shapes that can be made out of plastic or aluminum. By jamming these triangular shapes together using a plastic vacuum casing, the team was able to demonstrate that their material could support a load more than 50 times the fabrics' own weight.

The smart wearable equipment of the future

"These fabrics have potential applications in smart wearable equipment: when unjammed, they are lightweight, compliant, and comfortable to wear; after the jamming transition, they become a supportive and protective layer on the wearer's body," said Caltech postdoctoral researcher Yifan Wang, who is now an assistant professor at NTU.

The researchers also say they could run a cable through a lightweight roll of the material that's been suspended over a river or gorge, and then tighten the cables to jam the pieces together and make them tough. "Think of these cables like the drawstrings on a hoodie," Wang said. Small strips of the chain mail-like material could also be used as a form of back support or as a load-bearing strip for exoskeleton users, or to improve haptic feedback technologies for virtual reality sets. The material, therefore, could play a large role in military, medical, and even home electronics innovations of the future.