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Fluid Chain Mail

A team of researchers at Caltech have created a fluid-like chain mail that can go rigid on command.

The scifi material could give exoskeletons an unprecedented flexibility, while also being able to offer protection in its hardened state — think of it like Batman's cape, which can stiffen into a set of wings at will.

The team, working out of the Jet Propulsion Lab, managed by Caltech for NASA, suggests that the same material could also be used to provide structure while an injury heals or even be turned into a deployable bridge.

“We wanted to make materials that can change stiffness on command,” said Chiara Daraio, professor of mechanical engineering at Caltech and corresponding author of the study on the material published in *Nature* this week, in a statement. “We’d like to create a fabric that goes from soft and foldable to rigid and load-bearing in a controllable way.”

Armor Mill

The basic concept is a familiar one.

“Think about coffee in a vacuum-sealed bag,” Daraio added. “When still packed, it is solid, via a process we call ‘jamming.’ But as soon as you open the package, the coffee grounds are no longer jammed against each other and you can pour them as though they were a fluid.”

But rather than being made up of coffee grounds, the chain mail is made up of complex interlocking shapes, 3D-printed using polymers and metals.

“In this chain mail application, the ability to carry tensile loads at the grain scale is game changer,” Caltech mechanical engineering professor Jose Andrade said in the statement. “It’s like having a string that can carry compressive loads.”

In lab tests, the team found that its material can withstand more than 50 times its own weight when in its rigid state.

Now, the team is looking for ways to easily switch the material from its rigid to its fluid state and vice versa. For instance, Daraio suggested cables could be run through the material like “drawstrings on a hoodie.”

But it will likely take a while until the material will be able to help patients recover from an injury — or allow the Dark Knight to glide through the night sky, a strategy which, unfortunately, might be fatal.

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