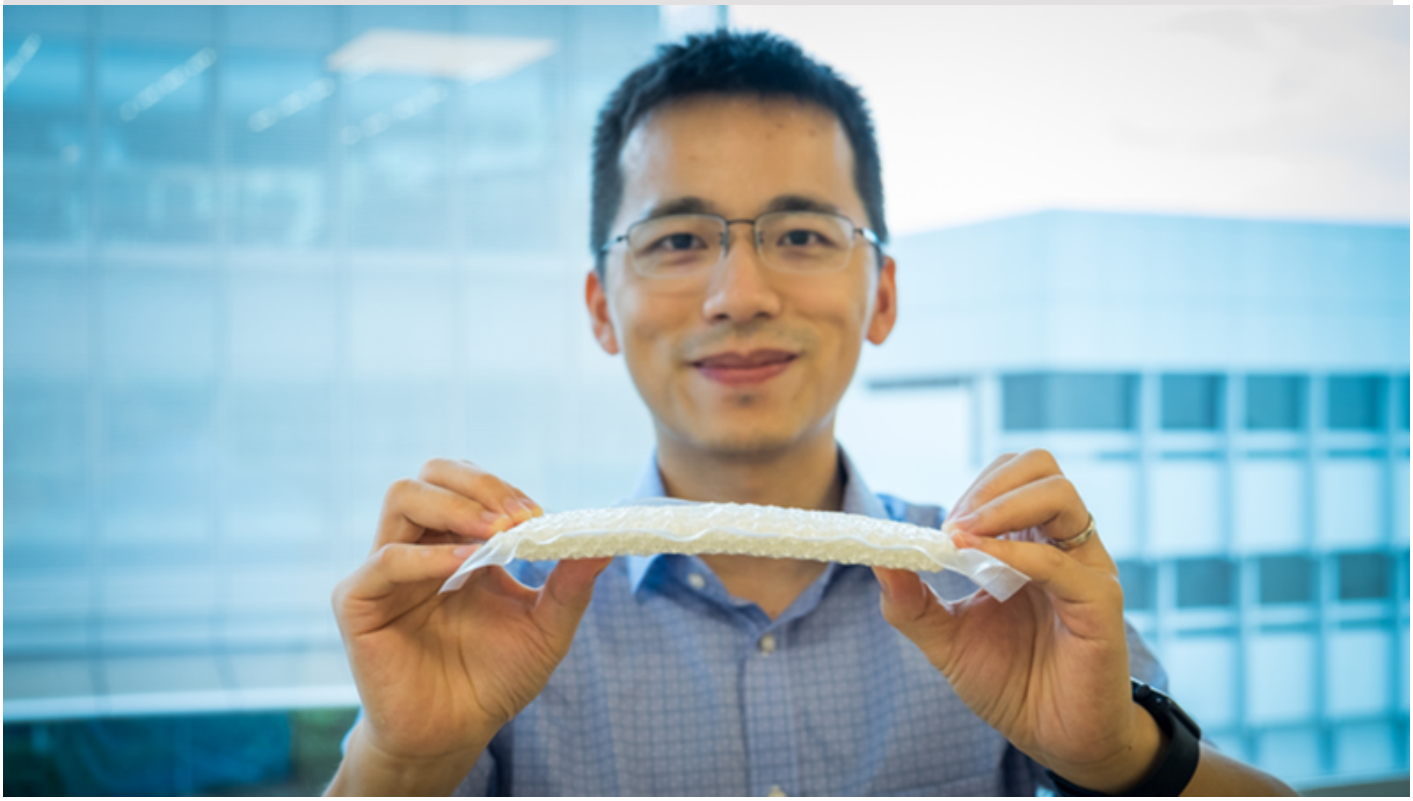
ENGINEERING NEWS

3D-printed ‘chain mail’ fabric can stiffen on demand

12 Aug 2021
Professional Engineering



NTU Singapore assistant professor Wang Yifan bends the 3D-printed nylon 'chain mail' (Credit: NTU Singapore)

A new type of chain mail-style fabric is flexible like cloth but can stiffen on demand, its developers have said.

The fabric was developed by researchers at Nanyang Technological University (NTU) in Singapore and the California Institute of Technology (Caltech).

The lightweight material is 3D-printed from nylon plastic polymers and comprises hollow octahedrons that interlock with each other. When the soft fabric is wrapped within a flexible plastic envelope and vacuum-packed, it turns into a rigid structure that is 25-times stiffer or harder to bend than when relaxed. The physical principle behind it is called ‘jamming transition’, similar to the stiffening behaviour in vacuum-packed bags of rice or beans.

The development could pave the way for next-generation smart fabrics that can harden to protect a user against impacts or when additional load-bearing capacity is needed, a research announcement said.

Potential applications include bulletproof or stab-proof vests, configurable medical support for elderly people, and protective exoskeletons for high-impact sports or workplaces such as construction sites.

Lead author of the new paper, NTU Singapore assistant professor Wang Yifan, said that the research has industrial relevance and could lead to a new ‘platform technology’ with applications in medical and robotic systems.

“With an engineered fabric that is lightweight and tuneable – easily changeable from soft to rigid – we can use it to address the needs of patients and the ageing population, for instance, to create exoskeletons that can help them stand, carry loads and assist them with their daily tasks,” said Yifan, who started the research when he was at Caltech.

“Inspired by ancient chain mail armour, we used plastic hollow particles that are interlocked to enhance our tuneable fabric’s stiffness. To further increase the material’s stiffness and strength, we are now working on fabrics made from various metals including aluminium, which could be used for larger-scale industrial applications requiring higher load capacity, such as bridges or buildings.”

The research was published in *Nature*.