Trees are source for high-capacity, soft batteries

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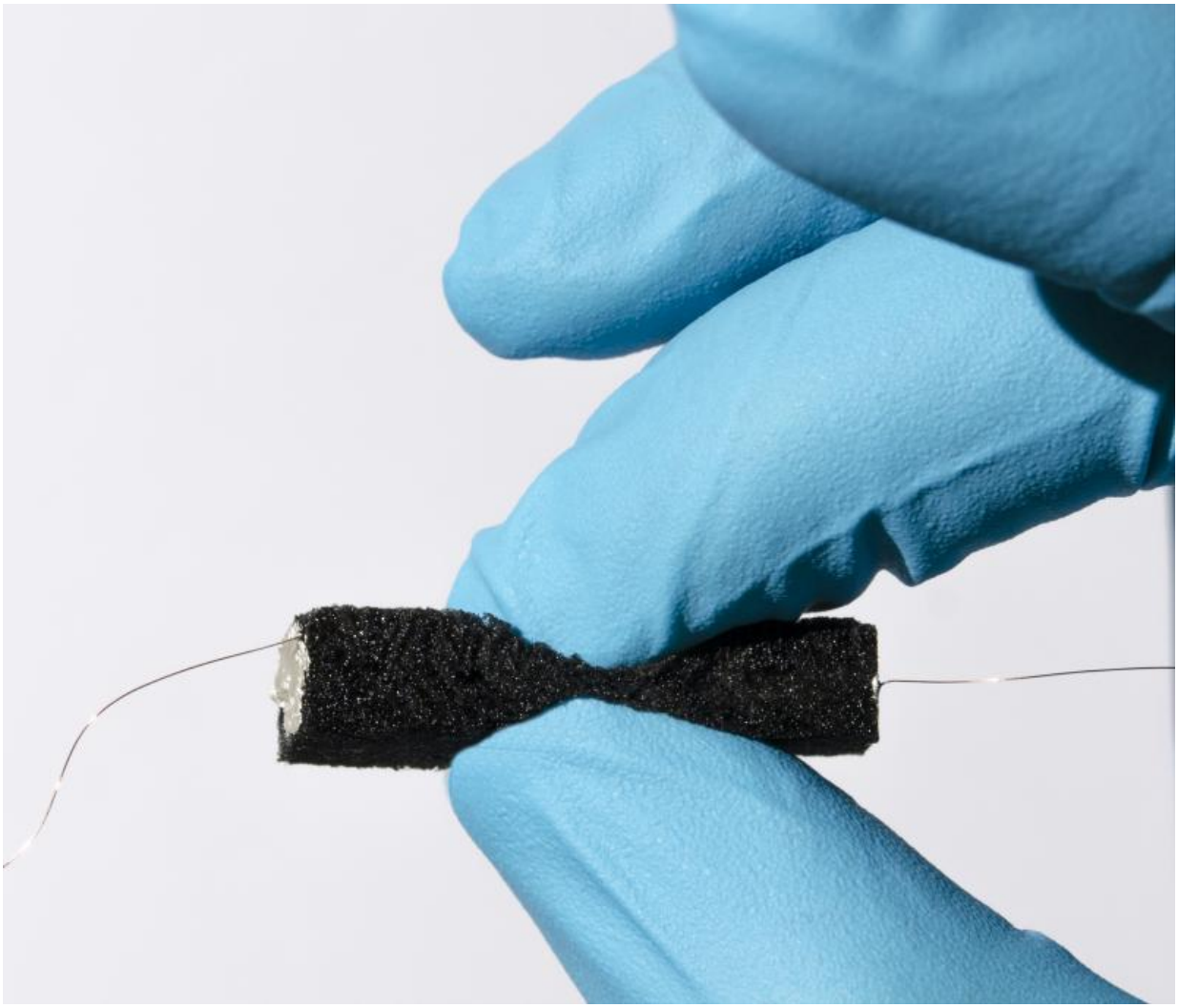

A closeup of the soft battery, created with wood pulp nanocellulose. Credit: Max Hamedi and Wallenberg Wood Science Center

A method for making elastic high-capacity batteries from wood pulp was unveiled by researchers in Sweden and the US. Using nanocellulose broken down from tree fibres, a team from KTH Royal Institute of Technology and Stanford University produced an elastic, foam-like battery material that can withstand shock and stress.

"It is possible to make incredible materials from trees and cellulose," says Max Hamedi, who is a researcher at KTH and Harvard University. One benefit of the new wood-based aerogel material is that it can be used for three-dimensional structures.

"There are limits to how thin a battery can be, but that becomes less relevant in 3D, " Hamedi says. "We are no longer restricted to two dimensions. We can build in three dimensions, enabling us to fit more electronics in a smaller space."

A 3D structure enables storage of significantly more power in less space than is possible with conventional batteries, he says.

"Three-dimensional, porous materials have been regarded as an obstacle to building electrodes. But we have proven that this is not a problem. In fact, this type of structure and material architecture allows flexibility and freedom in the design of batteries," Hamedi says.

The process for creating the material begins with breaking down tree fibres, making them roughly one million times thinner. The nanocellulose is dissolved, frozen and then freeze-dried so that the moisture evaporates without passing through a liquid state.

Then the material goes through a process in which the molecules are stabilised so that the material does not collapse.

"The result is a material that is both strong, light and soft," Hamedi says.

"The material resembles foam in a mattress, though it is a little harder, lighter and more porous. You can touch it without it breaking."

The finished aerogel can then be treated with electronic properties. "We use a very precise technique, verging on the atomic level, which adds ink that conducts electricity within the aerogel. You can coat the entire surface within."

In terms of surface area, Hamedi compares the material to a pair of human lungs, which if unfurled could be spread over a football field. Similarly, a single cubic decimeter of the battery material would cover most of a football pitch, he says.

"You can press it as much as you want. While flexible and stretchable electronics already exist, the insensitivity to shock and impact are somewhat new."

Hamedi says the aerogel batteries could be used in electric car bodies, as well as in clothing, providing the garment has a lining.

More information: "Self-Assembled Three-Dimensional And Compressible Interdigitated Thin Film Supercapacitors And Batteries" *Nature Communications*, May 29, 2015 DOI: 10.1038/ncomms8259

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