

# Soft, stretchy 'jelly batteries' inspired by electric eels

July 17 2024

---



Researchers have developed soft, stretchable 'jelly batteries' that could be used for wearable devices or soft robotics, or even implanted in the brain to deliver drugs or treat conditions such as epilepsy. Credit: University of Cambridge

Researchers have developed soft, stretchable 'jelly batteries' that could be used for wearable devices or soft robotics, or even implanted in the

brain to deliver drugs or treat conditions such as epilepsy.

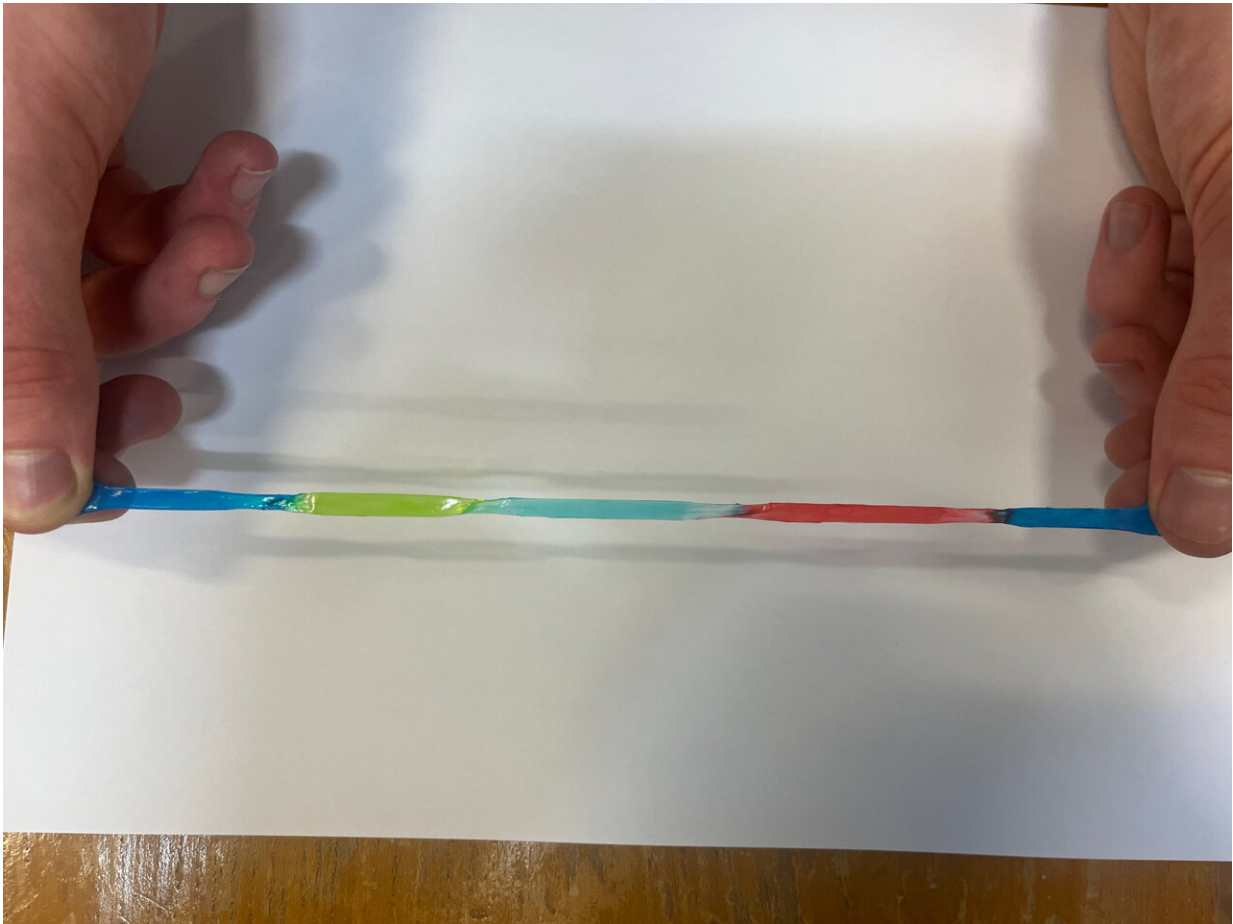
The researchers, from the University of Cambridge, took their inspiration from electric eels, which stun their prey with modified [muscle cells](#) called electrocytes.

Like electrocytes, the jelly-like materials developed by the Cambridge researchers have a layered structure, like sticky Lego, that makes them capable of delivering an electric current.

The self-healing jelly batteries can stretch to over ten times their original length without affecting their conductivity—the first time that such stretchability and conductivity has been combined in a single material. The [results are reported](#) in the journal *Science Advances*.

The jelly batteries are made from hydrogels: 3D networks of polymers that contain over 60% water. The polymers are held together by reversible on/off interactions that control the jelly's [mechanical properties](#).

The ability to precisely control mechanical properties and mimic the characteristics of human tissue makes hydrogels ideal candidates for [soft robotics](#) and bioelectronics; however, they need to be both conductive and stretchy for such applications.



Researchers have developed soft, stretchable 'jelly batteries' that could be used for wearable devices or soft robotics, or even implanted in the brain to deliver drugs or treat conditions such as epilepsy. Credit: University of Cambridge

"It's difficult to design a material that is both highly stretchable and highly conductive, since those two properties are normally at odds with one another," said first author Stephen O'Neill, from Cambridge's Yusuf Hamied Department of Chemistry. "Typically, conductivity decreases when a material is stretched."

"Normally, hydrogels are made of polymers that have a neutral charge, but if we charge them, they can become conductive," said co-author Dr.

Jade McCune, also from the Department of Chemistry. "And by changing the salt component of each gel, we can make them sticky and squish them together in multiple layers, so we can build up a larger energy potential."

Conventional electronics use rigid metallic materials with electrons as [charge carriers](#), while the jelly batteries use ions to carry charge, like electric eels.

The hydrogels stick strongly to each other because of reversible bonds that can form between the different layers, using barrel-shaped molecules called cucurbiturils that are like molecular handcuffs. The strong adhesion between layers provided by the molecular handcuffs allows for the jelly batteries to be stretched, without the layers coming apart and crucially, without any loss of conductivity.

The properties of the jelly batteries make them promising for future use in biomedical implants, since they are soft and mold to human tissue. "We can customize the mechanical properties of the hydrogels so they match [human tissue](#)," said Professor Oren Scherman, Director of the Melville Laboratory for Polymer Synthesis, who led the research in collaboration with Professor George Malliaras from the Department of Engineering.

"Since they contain no rigid components such as metal, a hydrogel implant would be much less likely to be rejected by the body or cause the build-up of scar tissue."

In addition to their softness, the hydrogels are also surprisingly tough. They can withstand being squashed without permanently losing their original shape, and can self-heal when damaged.

The researchers are planning future experiments to test the [hydrogels](#) in

living organisms to assess their suitability for a range of medical applications.

**More information:** Stephen O'Neill et al, Highly Stretchable Dynamic Hydrogels for Soft Multilayer Electronics, *Science Advances* (2024).

[DOI: 10.1126/sciadv.adn5142](https://doi.org/10.1126/sciadv.adn5142).

[www.science.org/doi/10.1126/sciadv.adn5142](https://www.science.org/doi/10.1126/sciadv.adn5142)

Provided by University of Cambridge

Citation: Soft, stretchy 'jelly batteries' inspired by electric eels (2024, July 17) retrieved 17 July 2024 from <https://techxplore.com/news/2024-07-soft-stretchy-jelly-batteries-electric.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.