

## RESEARCH HIGHLIGHT

## Stretching the performance of wearable Li-ion batteries

Colm O'Dwyer

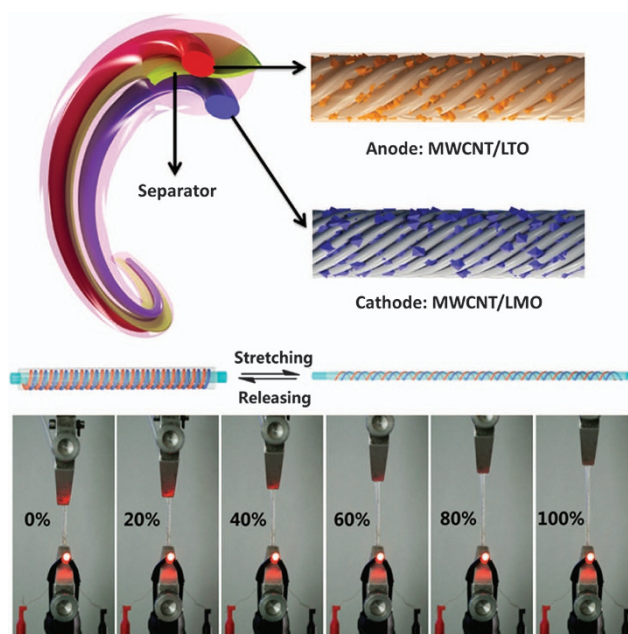
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As advancements are made in wearable technology, including the development of portable devices that can function when stretched or bent, so too must the ways by which these devices generate and store power.<sup>1</sup> For true portability of flexible smartphones, interactive bracelets and smart textiles for example, higher energy-density batteries need to be part of the 'fabric' of the device. Researchers from Fudan University in Shanghai demonstrated that a wire-shaped lithium-ion battery can be fabricated from a composite pairing of aligned yarns of active materials, sheathed in a heat-shrinkable tube.<sup>2</sup>

These stretchable wire-shaped batteries, depicted in Figure 1, deliver an energy density of 27 Wh kg<sup>-1</sup>, surpassing wire-shaped supercapacitors.<sup>3</sup> They are flexible and light, and retain 97% capacity after 1000 bending cycles. On using a modified spring-like structure to accommodate elastic stretching up to 100%, they maintain 84% capacity after 200 cycles. These stretchable batteries are safe and prevent dendrite formation in a close-packed woven pairing of intercalation-mode electrodes, since they are free of metallic lithium.

These batteries can also be woven into light-weight, flexible and stretchable textiles, and operate without damage. As a demonstration, the team showed that a fully charged 10-cm-long wire-shaped battery powered nine light-emitting diodes for ~60 s, and operated even when bent into different shapes.

The findings should motivate further research into the energy storage options for reliable, safe and high-performance wearable technology, and provide a basis for device-compatible Li-ion battery architectures<sup>4</sup> for powering flexible portable electronics. Seamless integration with the device shape and structure and improvement in energy density remain a challenge. In the future, shape-adaptable batteries could be integrated with power from piezoelectric, thermoelectric, photovoltaic and other power sources.



**Figure 1** (Top) Structure of the flexible wire-shaped lithium-ion battery composed of aligned woven yarns of active materials. (Bottom) The wire-shaped battery can power a LED when stretched to double its length.

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