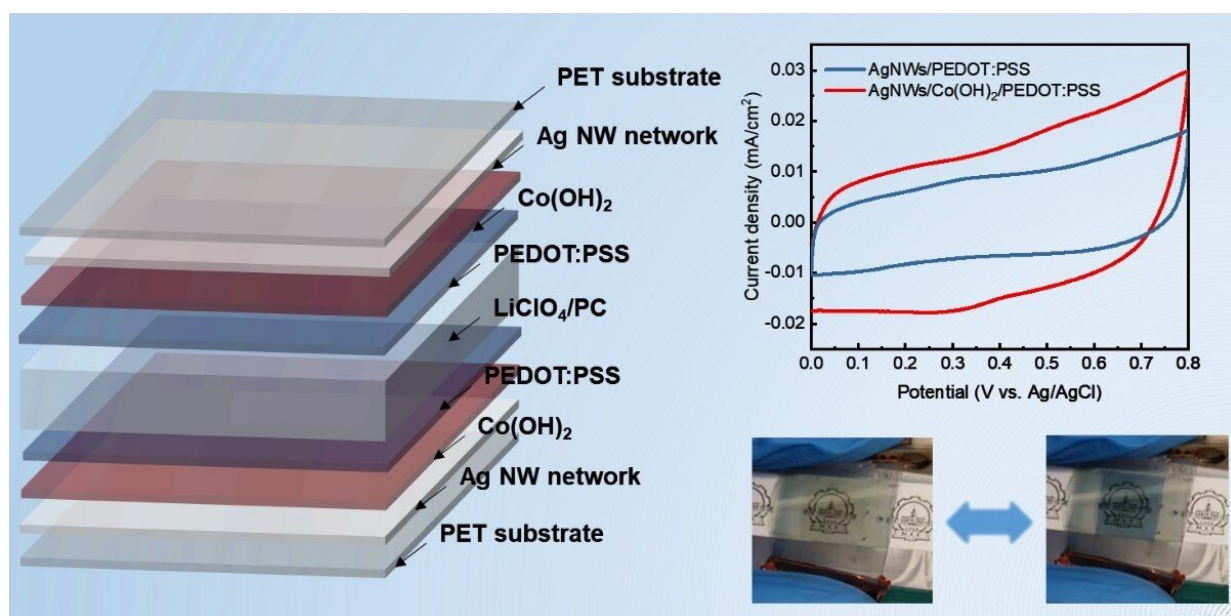


Bifunctional flexible electrochromic supercapacitors successfully fabricated

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An electrochromic supercapacitor was realized using silver nanowire electrodes as the current collector. PEDOT:PSS was used not only as the functional layer to achieve electrochromic and energy-storage properties at the same time, but also as a protective layer to prevent silver nanowires from electrochemical corrosion. Credit: *International Journal of Extreme Manufacturing* (2022). DOI: 10.1088/2631-7990/aca638

Researchers from the Harbin Institute of Technology and Southern University of Science and Technology have fabricated bifunctional flexible electrochromic energy-storage devices based on silver nanowire

flexible transparent electrodes.

Publishing in the *International Journal of Extreme Manufacturing*, the team used silver nanowire flexible transparent electrodes as the current collector for a bifunctional flexible electrochromic supercapacitor.

This bifunctional flexible device can exhibit its energy status through color changes, and can serve as an energy supplier for various wearable electronics, such as physiological sensors. The findings could have a widespread impact on the future development of smart windows for energy-efficient buildings.

In this research, a silver nanowire network flexible electrode with excellent opto-electrical performance and mechanical flexibility was used as the collector. To improve the electrochromic stability of the silver nanowire network, PEDOT:PSS (poly polystyrene sulfonate, a polymer mixture of two ionomers) was spin-coated. The PEDOT: PSS can concurrently serve as a [protective layer](#) and as an electrochromic energy-storage layer. To further increase the device's energy densities, $\text{Co}(\text{OH})_2$ nanosheets were electrodeposited onto the silver nanowire network.

One of the lead researchers, Professor Yanhong Tian from Harbin Institute of Technology, commented, "Given the increasing demands of flexible visual energy suppliers and smart windows, [there is a burning need] to develop new materials, new technologies to meet these requirements."

The electrochromic energy-storage device is one of only a few techniques that allows the presentation of energy status with the naked eye. However, the fabrication of the flexible device is still hindered by the slow development of flexible transparent electrodes. First author He Zhang explained, "In our work, we use silver nanowires to replace

conventional ITO material, and PEDOT:PSS can solve the electrochemical instability problem of silver nanowires."

The symmetrical electrochromic supercapacitor assembled based on AgNWs/Co(OH)₂/PEDOT:PSS in this work exhibited an areal capacitance of 0.8 mF/cm² and coloration efficiency 269.8 cm²/C of. Furthermore, the obtained devices exhibited excellent stability against mechanical deformation.

The areal capacitance remained stable during 1000 cycles of bending with a 25-mm curvature radius. These results demonstrate the broad application potential of the flexible electrochromic supercapacitor for emerging portable and multifunctional electronics.

The team studied a flexible [device](#) that is based on a [silver nanowire](#) electrode, which can also be generalized to other materials, such as copper nanowires and silver grids.

Prof. Yanhong Tian said, "This is an important advance and it is only the beginning—we are already looking to use this technique to support the development of flexible energy suppliers for next-generation wearable electronics."

More information: He Zhang et al, Bifunctional flexible electrochromic energy storage devices based on silver nanowire flexible transparent electrodes, *International Journal of Extreme Manufacturing* (2022). [DOI: 10.1088/2631-7990/aca638](https://doi.org/10.1088/2631-7990/aca638)

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