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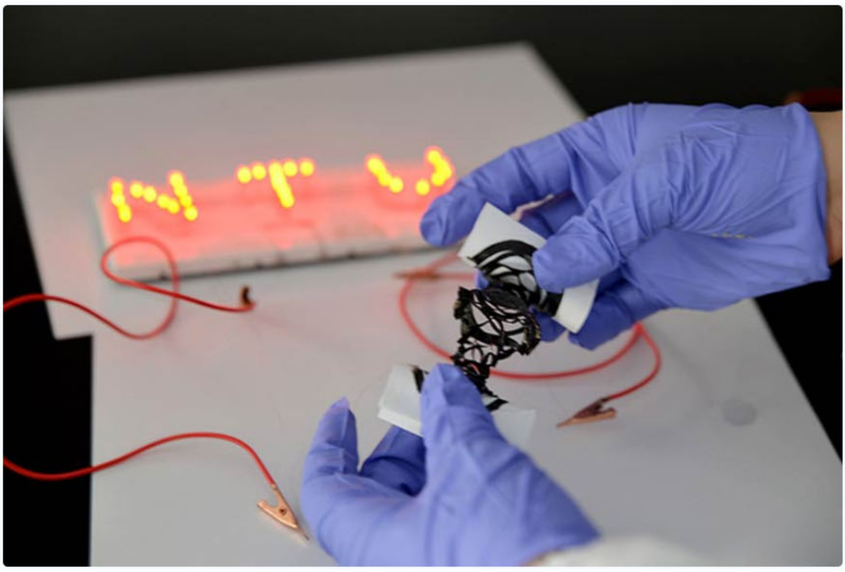

Credit: Nanyang Technological University

NTU scientists invent editable fabric-like power source for use in wearable electronic devices

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When the editable supercapacitor was paired with a sensor and placed on the human elbow, it performed better than existing stretchable supercapacitors, providing a stable stream of signals even when the arm was swinging.

Scientists at Nanyang Technological University, Singapore (NTU Singapore) have created a customisable, fabric-like power source that can be cut, folded or stretched without losing its function, and will be of use in wearable electronic devices.

The team led by Professor Chen Xiaodong, Associate Chair (Faculty) at the School of Materials Science & Engineering, reported in the journal Advanced Materials (print edition, January 8) how they have created the power source, a supercapacitor, which works like a fast-charging battery and can be recharged many times.

This supercapacitor is customisable or "editable", meaning that its structure and shape can be changed after it is manufactured, while retaining its function as a power source. Existing stretchable supercapacitors are made into predetermined designs and structures, but the new invention can be stretched multi-directionally, making it easier to match while combining it with other electrical components.

The supercapacitor is made of strengthened manganese dioxide nanowire composite material, a common material for supercapacitors. However, the ultralong nanowire structure, strengthened with a network of carbon nanotubes and nanocellulose fibres, allows the electrodes to withstand the associated strains during the customisation process.

When edited into a honeycomb-like structure, the new supercapacitor has the ability to store an electrical charge four times higher than most existing stretchable supercapacitors. In addition, when stretched to four times its original length, it maintains nearly 98 per cent of the initial ability to store electrical energy, even after 10,000 stretch-and-release cycles.

Experiments done by Prof. Chen and his team also demonstrated that when the editable supercapacitor was paired with a sensor and placed on the human elbow, it performed better than existing stretchable supercapacitors. The editable supercapacitor was able to provide a stable stream of signals even when the arm was swinging. These signals are then transmitted wirelessly to external devices, such as one that captures a patient's heart rate.

The team has filed a patent for the technology. They believe that the editable supercapacitor could be easily mass-produced as it would rely on existing manufacturing technologies. Production cost is estimated to be low at about SGD$0.13 (USD$0.10) to produce 1 sq cm of the material.

Professor Chen said, "A reliable and editable supercapacitor is important for development of the wearable electronics industry. It also opens up all sorts of possibilities in the realm of the 'Internet-of-Things' when wearable electronics can reliably power themselves and connect and communicate with appliances in the home and other environments."

"My own dream is to one day combine our flexible supercapacitors with wearable sensors for health and sports performance diagnostics. With the ability for wearable electronics to power themselves, you could imagine the day when we create a device that could be used to monitor a marathon runner during a race with great sensitivity, detecting signals from both under and over-exertion," he added.

The NTU team also collaborated with Dr. Loh Xian Jun, Senior Scientist and Head of the Soft Materials Department at the Institute of Materials Research and Engineering (IMRE), under the Agency for Science, Technology and Research (A*STAR).

Dr. Loh commented, "Customisable and versatile, these interconnected, fabric-like power sources are able to offer a plug-and-play functionality while maintaining good performance. Being highly stretchable, these flexible power sources are promising next-generation 'fabric' energy storage devices that could be integrated into wearable electronics."