

Team develops novel eco high performance energy storage device

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Professor Daniel Lau (right), Dr. Yuan Jikang (left) and Qian Jiansheng (middle) have developed a simple approach to synthesize novel environmentally-friendly manganese dioxide (MnO_2) ink by using glucose. The MnO_2 ink can be coated on various substrates, such as conductive paper, plastic and glass via ordinary printing. Credit: The Hong Kong Polytechnic University

The Department of Applied Physics of The Hong Kong Polytechnic

University (PolyU) has developed a simple approach to synthesize novel environmentally friendly manganese dioxide ink by using glucose.

The MnO₂ ink could be used for the production of light, thin, flexible and high performance [energy storage](#) devices via ordinary printing or even home-used printers. The capacity of the MnO₂ ink supercapacitor is more than 30 times higher than that of a commercial capacitor of the same weight of active material (e.g. carbon powder), demonstrating the great potential of MnO₂ ink in significantly enhancing the performances of energy storage devices, whereas its production cost amounts to less than HK\$1.

MnO₂ is a kind of environmentally-friendly material and it is degradable. Given the environmental compatibility and high potential capacity of MnO₂, it has always been regarded as an ideal candidate for the electrode materials of energy storage devices. The conventional MnO₂ electrode preparation methods suffer from high cost, complicated processes and could result in agglomeration of the MnO₂ ink during the coating process, leading to the reduction of electrical conductivity. The PolyU research team has developed a simple approach to synthesize aqueous MnO₂ ink. Firstly, highly crystalline carbon particles were prepared by microwave hydrothermal method, followed by a morphology transmission mechanism at room temperature. The MnO₂ ink can be coated on various substrates, such as conductive paper, plastic and glass. Its thickness and weight can also be controlled for the production of light, thin, transparent and flexible energy storage devices. Substrates coated by MnO₂ ink can easily be erased if required, facilitating the fabrication of electronic devices.

PolyU researchers coated the MnO₂ ink on conductive A4 paper and fabricated a capacitive energy storage device with maximum energy density and power density amounting to 4 mWh* cm⁻³ and 13 W* cm⁻³ respectively. The capacity of the MnO₂ ink capacitor is more than 30

times higher than that of a commercial capacitor of the same weight of active material (e.g. carbon powder), demonstrating the great potential of MnO₂ ink in significantly enhancing the performances of energy [storage devices](#). Given the small size, light, thin, flexible and high energy capacity properties of the MnO₂ ink energy storage device, it shows a potential in wide applications. For instance, in wearable devices and radio-frequency identification systems, the MnO₂ ink supercapacitor could be used as the power sources for the flexible and "bendable" display panels, smart textile, smart checkout tags, sensors, luggage tracking tags, etc., thereby contributing to the further development of these two areas.

The related paper has been recently published on *Angewandte Chemie International Edition*, a leading journal in Chemistry. The research team will work to further improve the performance of the MnO₂ ink energy storage device in the coming two years, with special focus on increasing the voltage, optimizing the structure and synthesis process of the device. In addition, further tests will be conducted to integrate the MnO₂ [ink energy storage device](#) with other energy collection systems.

Provided by Hong Kong Polytechnic University

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