NTU Researchers Develop Sweat-Powered Batteries That Could Be Used in Wearables

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Wearable devices like digital watches and heart monitors could be powered by your own body and perspiration in the future.

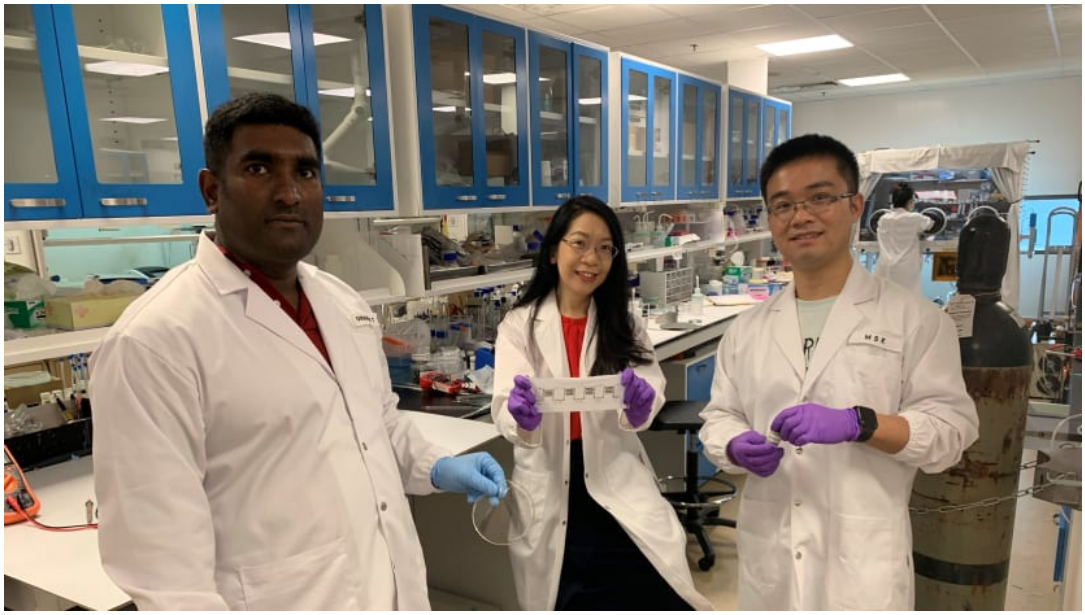
Credit: Nanyang Technological University

Researchers at the Nanyang Technological University in Singapore have recently developed a stretchable battery that is powered by your own sweat. The team behind the battery's development said that it could serve as a sustainable power alternative for wearable devices that could help cut down on electronic waste.

The battery, which is in its prototype stage, consists of 2cm by 2cm printed silver flake electrodes that can generate voltage as high as 4.2 V and an output power of 3.9 megawatts (mW) when enough sweat is added to it. This amount is sufficient to power a commercial temperature sensor device and send the data continuously to a smartphone via Bluetooth in a separate trial.

The battery is charged by the reaction of the silver flake electrodes with the salt from a person's perspiration, more specifically, the chloride ions making up the salt. As the flakes come into contact with sweat, the chloride ions cause the flakes to clump together, forming an electric flow between the electrodes and increasing their ability to conduct electricity.

Additionally, the more the battery is stretched, the less resistant it is to electricity, thus allowing the battery to still be operational even when exposed to strain. The absorbent material used is also able to retain a large amount of sweat, which means the battery will remain powered even if the rate of perspiration is inconsistent.

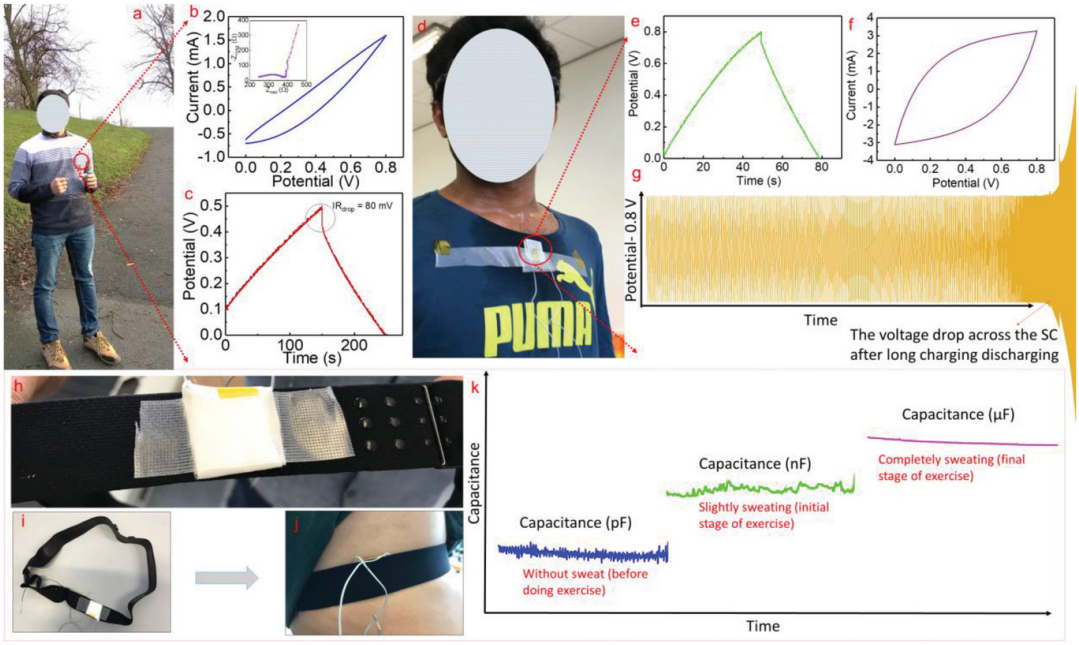


Professor Lee Pooi See (middle) holding the stretchable sweat-powered battery beside senior research fellow Dr Gurunathan Thangavel (left) and research fellow Dr Lyu Jian (right).
Credit: Nanyang Technological University

Unlike conventional batteries currently used in wearable devices, the sweat-powered battery contains no heavy metals or toxic chemicals that can harm both the person wearing it and the environment. Materials scientist Professor and Dean of NTU Graduate College Lee Pooi See voiced her support for the battery's sustainable nature, stating: "We can be looking at a more environmentally friendly way of powering wearable devices that do not rely on conventional batteries."

Associate Professor Irene Goldthorpe from the Department of Electrical and Computer Engineering Department of the University of Waterloo, Canada spoke well of the sweat-powered battery as it turns something harmful to wearable devices into an asset. "This may open a new paradigm in the design of wearable electronics," Professor Goldthorpe added.

A similar idea was previously tested in 2014 when Dr Wenzhao Jia of the University of California, San Diego, created a tattoo-like biobattery that could power wearable devices and even smartphones with just sweat. Unlike NTU Singapore's stretchable battery, the biobattery Dr Jia developed uses lactate commonly found in a person's sweat after vigorous exercise. However, Dr Jia's biobattery could only give an output of four microwatts (μW) at the time due to the biobattery's small electrodes (2x3mm). Even so, she and her team will be working on enhancing it with help from a start-up company so it can power small electronic devices.



Readings of the electrical output of the Glasgow Research Team's sweat-powered superconductor in a real application.
Credit: Libu Manjakkal, Abhilash Pullanchiyodan, Nivasan Yogeswaran, Ensieh S. Hosseini, Ravinder Dahiya

Another sweat-powered device, this time in the form of a wearable supercapacitor, was designed in May 2020 by a team of researchers from the University of Glasgow. Much like NTU Singapore's stretchable battery, this device is also powered by the salt from a person sweat.

The Glasgow Research Team used a piece of cloth with a dried-up solution containing an electrically conductive polymer, which is taped to a part of clothing where sweat tends to accumulate. This piece of cloth is then attached to a wearable superconductor that measured the saltiness of a person's sweat absorbed by the cloth and stores electricity generated from the cloth, which was able to light up a few LEDs.

It's important to note, however, that while this device can be stretched and bent like NTU Singapore's battery, the Glasgow Research Team's device can't be washed as the dried up electrically conductive polymer will be washed away.

These developments in sweat-based technology could very well start a paradigm shift once enough progress has been made, just as Professor Lee Pooi See predicts.

Written by John Paul Joaquin