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Assistant Professor Tan Swee Ching (right) from NUS' Department of Materials Science and Engineering, who led the team of researchers, with research fellow Zhang Yaoxin (left) and laboratory technologist Qu Hao, discussing their innovation, which provides a higher electrical output than a conventional AA-size battery. ST PHOTO: SYAMIL SAPARI

NUS team invents battery that generates power using humid air

Ang Qing

What if you could wear a health-monitoring device that powers itself using the humid weather?

This futuristic-sounding scenario might soon become a reality with a battery invented by researchers from the National University of Singapore (NUS) that harvests water in the air for electricity.

Apart from having a higher voltage than conventional chemical batteries, the novel device is made from non-toxic and eco-friendly materials, said Assistant Professor Tan Swee Ching from NUS' Department of Materials Science and Engineering, who led the team of researchers.

The origins of the moisture-electricity generation device (MEG) can be traced to a chance experimentation in 2020, said research team member Zhang Yaoxin, who is a research fellow at NUS' Department of Materials Science and Engineering.

While tinkering with materials in the lab, the team discovered that electricity could be generated from an interaction between a wet surface and dry one, he said.

Using this principle, the team crafted its MEG comprising a layer of fabric – about 0.3mm in thickness – sea salt, carbon ink and a water-absorbing gel.

When three pieces of fabric were placed together, the voltage of the assembled device was tested to reach as high as 1.96V – more than a commercial AA-size battery of about 1.5V – which is sufficient to power small electronic devices.

So far, the team has trialled the fabric-based battery on small electronic devices including a watch and an alarm clock, said Prof Tan.

The breakthrough was first published in the scientific journal Advanced Materials on March 25.

This comes as research in recent years has highlighted the potential of MEGs, which harness the ability of different materials to generate electricity from the interaction with moisture in the air.

MEGs produce voltage through the difference in electrical potential between a negatively charged dry surface and a positively charged wet surface.

In the NUS innovation, this asymmetry is created by coating one end of the battery with the hydrogel that constantly absorbs water from the air, rendering it perpetually wet while the opposite end stays dry.

The battery's design allows for high water content in the wet region and zero water content in the dry region to be maintained, sustaining electrical output for as long as 30 days in a humid environment, said Prof Tan.

This is unlike previous MEGs that are unable to maintain this asymmetry after being saturated with water, he added.

In the battery designed by the NUS team researchers, the hydrogel locks in the absorbed water, such that the asymmetry can be maintained for a longer period.

The low fabrication cost of about 15 cents per sq m and use of readily available raw materials make the MEG suitable for mass production, said Prof Tan.

Having filed the technology's patent, the team is looking for investors to further its research and hopes to increase the battery's power input by experimenting with new materials.

Lauding the battery as a novel invention, Professor Xu Zhichuan from Nanyang Technological University's School of Materials Science and Engineering said the technique provides a possible new way to power small electronics.

"The next challenges could be the scale-up and reliability engineering in the product development phase," he noted.

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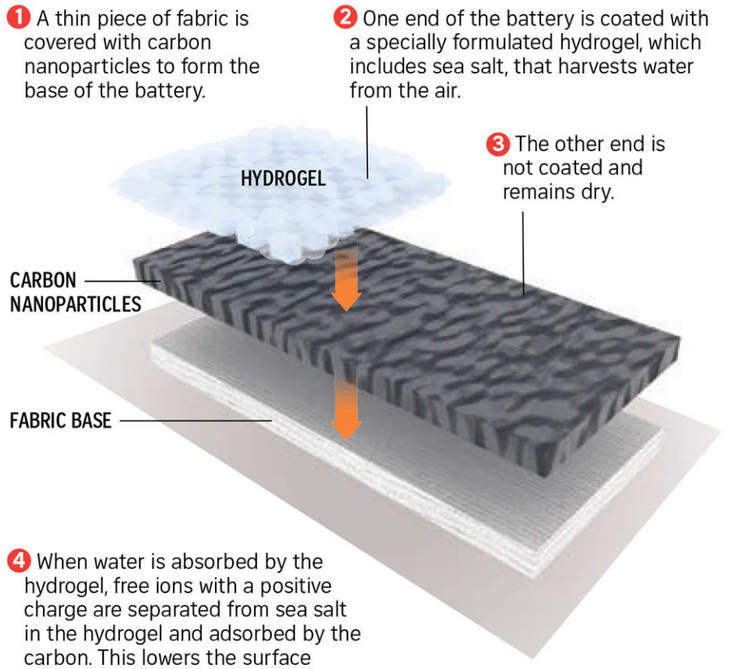
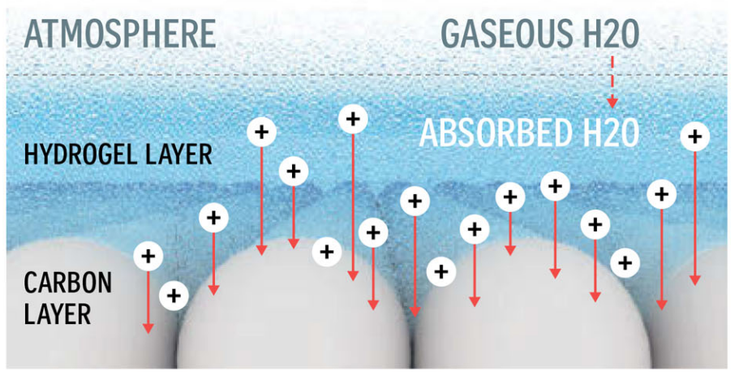
Energy from air

How the new NUS battery harvests water from the air to make electricity.





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