NEW ATLAS

ENVIRONMENT

Flexible paper-based battery is designed to biodegrade once discarded

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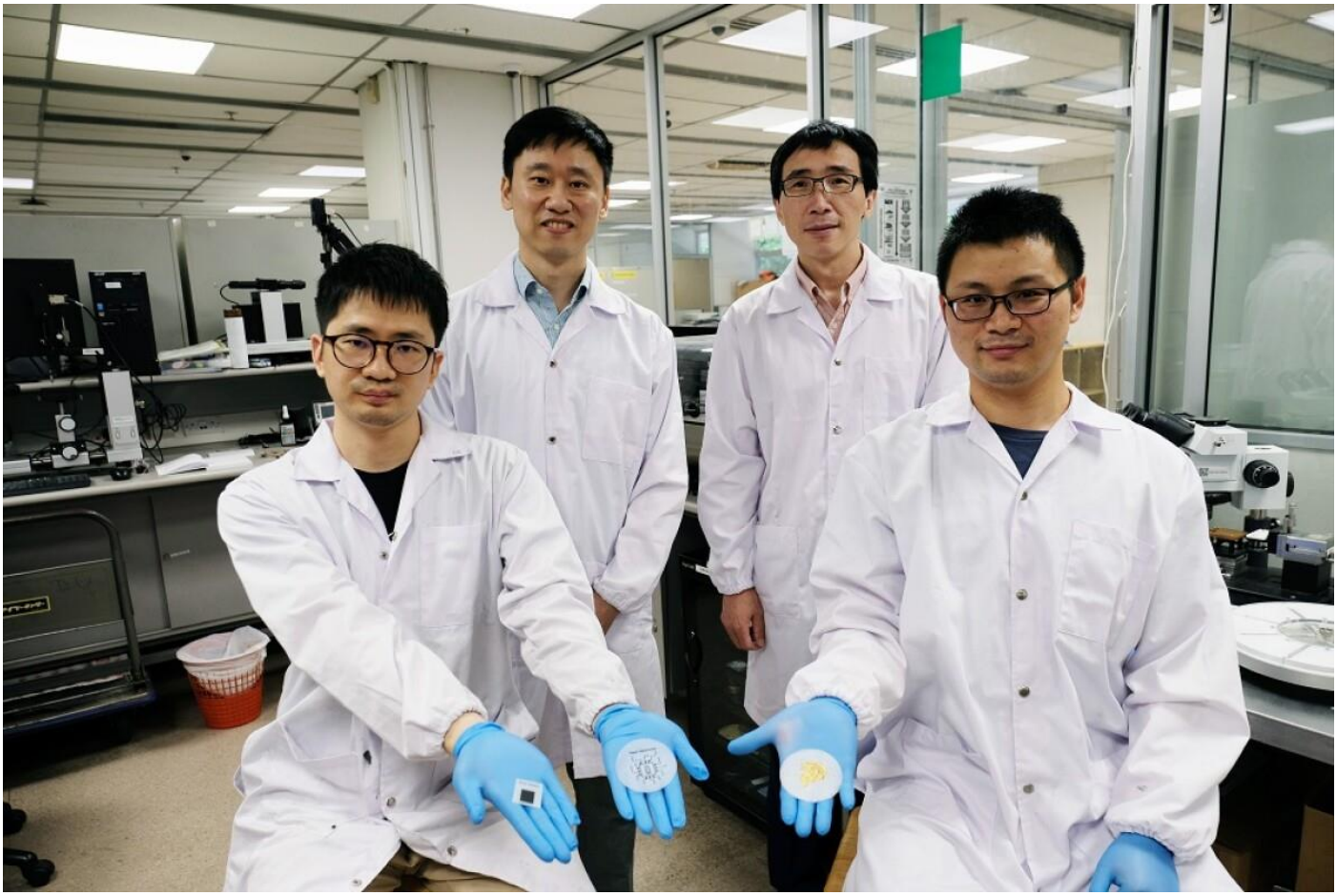

Although there are now biodegradable single-use electronic devices such as environmental sensors, the batteries which power those devices can still pose an ecological problem. That's why scientists have now created a fully biodegradable paper-based battery.

Developed by a team at Singapore's Nanyang Technological University, the battery measures just 4 by 4 cm (1.6 in) – at least, one version of it does – and it's reportedly capable of powering a small electric fan for 45 minutes. Its power output isn't interrupted if it's bent or twisted, or even if pieces of it are cut off.

At the heart of the battery is a sheet of cellulose paper, which has been reinforced with a hydrogel to fill the gaps between the cellulose fibers.

That paper serves as the separator between two electrodes – the anode and the cathode – which are screen-printed on opposite sides of the paper. The conductive ink used to print the anode consists mainly of zinc and carbon black, while both manganese and nickel have separately been used for the cathode ink.

After the electrode-printing process is complete, the whole battery is immersed in an electrolyte solution, after which a thin layer of gold is applied to both electrodes to increase their conductivity. The finished product is approximately 0.4-mm thick, and it gets thoroughly broken down by microorganisms within a month after being placed in the soil.

"When decomposition happens, the electrode materials are released into the environment," says Prof. Fan Hongjin, who is leading the study along with Asst. Prof. Lee Seok Woo. "The nickel or manganese used in the cathodes will remain in their oxide or hydroxide forms, which are close to the form of natural minerals. The zinc found in the anode will be naturally oxidized to form a non-toxic hydroxide. This points to the battery's potential as a more sustainable alternative to current batteries."

Along with its utilization in disposable electronics, the battery may ultimately also find use in non-disposable flexible electronic devices and "smart" fabrics.

The research is described in a paper that was recently published in the journal *Advanced Science*.