NTU team beats challenges in race for smart contact lenses

Battery as thin as human cornea; new design overcomes hurdles such as weight and circuitry

Osmond Chia

High-tech contact lenses that film footage and display information to its wearer have long captured the imagination of many, as seen in movies such as Mission Impossible and Netflix series Black Mirror.

Now, scientists from the Nanyang Technological University (NTU) have developed a saline-powered battery small enough to fit under a lens, which could pave the way forward in the pursuit of smart contact lenses – the holy grail of augmented reality.

The team developed a flexible battery as thin as a human cornea, which stores electricity when it is immersed in a special saline solution, said Associate Professor Lee Seok Woo of NTU's School of Electrical and Electronic Engineering, who has worked on the project since 2019.

The battery cells are coated with glucose, which reacts with the sodium and chloride ions in the saline solution in the contact lens case to generate an electric charge that powers the battery.

A similar technology is used in batteries for wearables, powered by human perspiration, said Prof Lee.

The battery can also receive roughly an hour's worth of additional power while being worn, since such ions are also found on the liquid layer of a person's eyes, Prof Lee told The Sunday Times.

The contact lens battery is embedded along the sides of a soft lens to ensure that vision is not obstructed.

Early tests found that the battery is able to power a smart lens and send a signal continuously to a smartphone via Bluetooth for 12 hours.

The battery can also be charged up to 200 times, said Prof Lee, adding that work is being done to further improve its performance.

The battery's design overcomes key challenges in the race for smart lenses such as weight and circuitry, and makes it possible for daily wear in the future, he said.

There are no metals in the battery, and it relies on glucose and water to generate electricity, making the lens safe to wear, he added.

The team tested the lens on mammal cells, which showed no deterioration when in contact with the lens – a sign that the device is biocompatible and not harmful to humans.

However, it is years away from being tried on humans.

"We have not tried the lens on a human eye yet, because there are many levels of safety checks. That will be the final step," said Prof Lee.

The team, which published its research in June, has since filed a patent through NTU's innovation and enterprise arm NTUitive and is working towards commercialising the invention.

It will take many years before a smart lens that displays data to the cornea becomes a reality, but the industry could soon see high-tech lenses that are able to monitor its wearer's health through glucose readings on the surface of the eye, said Prof Lee.

NTU nanoscale optic specialist Murukeshan Vadakke Matham, who was not involved in the study, said: "The smart contact lenses industry has been looking for a thin, biocompatible battery that does not contain heavy metals, and this invention could help further the development to meet some unmet needs of the industry."

Others in the race to develop a smart contact lens include Dubai's Xpanceo, which is working on lenses capable of night vision, health monitoring and mixed-reality features.

The start-up's co-founder and nano-optics expert Valentyn Volkov told ST it has developed a prototype lens that can display images and is working on ways to allow the lens to operate without circuitry and wires. Like NTU's prototype, it is not ready for human use yet and some ways off mass production.

Mr Volkov said NTU's use of biocompatible materials offers new ways to make smart contact lenses a reality, but further steps need to be made to improve its battery life to be closer to lithium-ion batteries.

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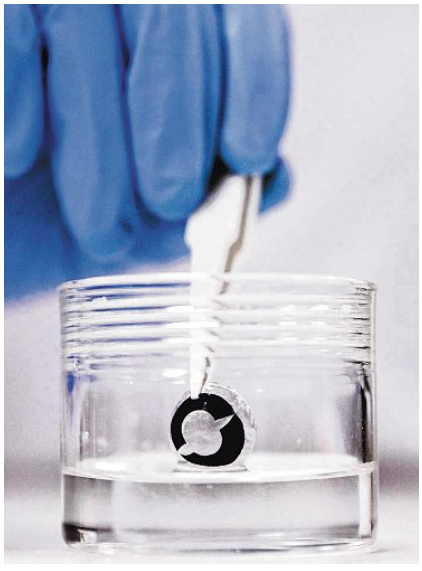

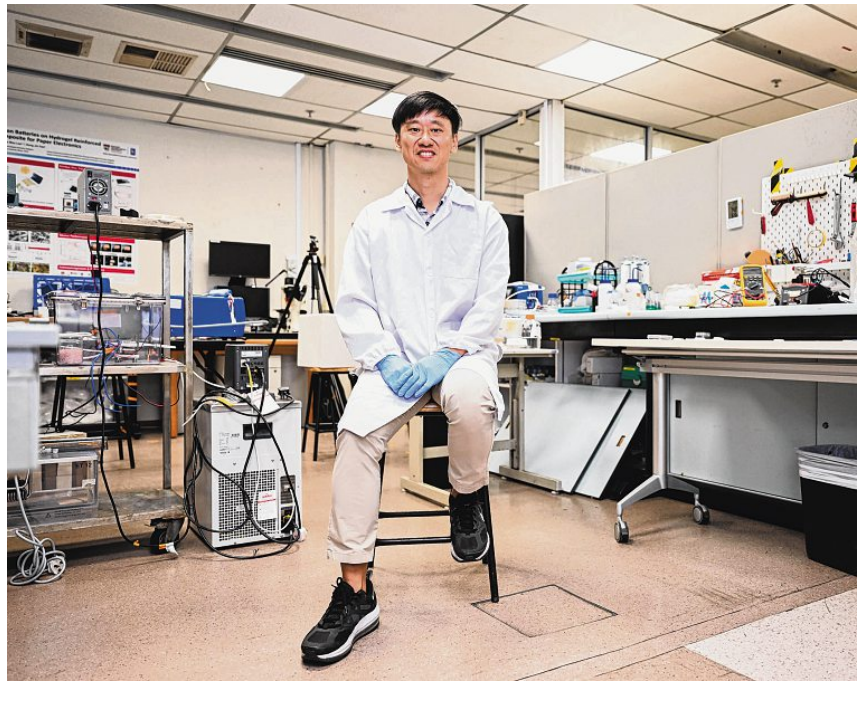

The team developed a flexible battery (above) as thin as a human cornea, which stores electricity when it is immersed in a special saline solution, said Associate Professor Lee Seok Woo (right) of NTU's School of Electrical and Electronic Engineering, who has worked on the project since 2019. ST PHOTOS: AZMI ATHNI