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Medical & healthcare | Batteries

NTU Singapore team develops flexible battery for smart contact lenses

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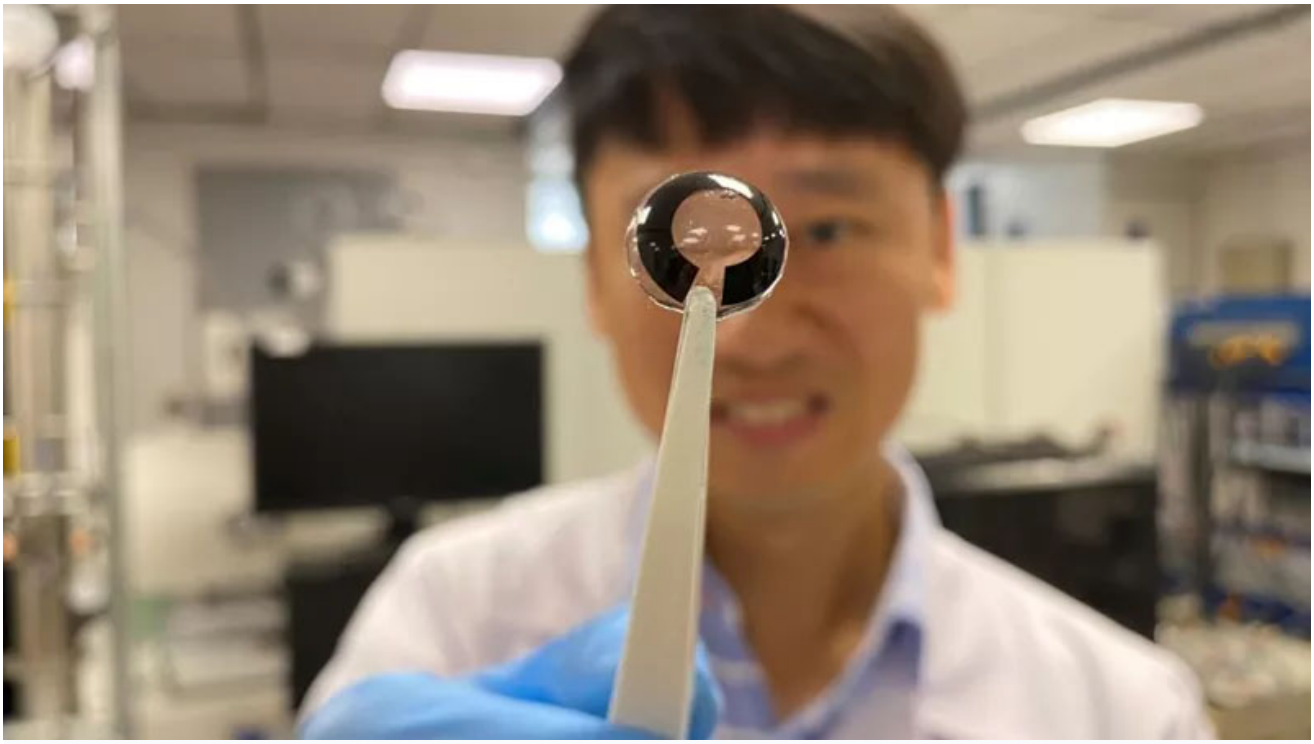
Smart contact lenses could be powered by a flexible battery as thin as a human cornea that stores electricity when immersed in saline solution.

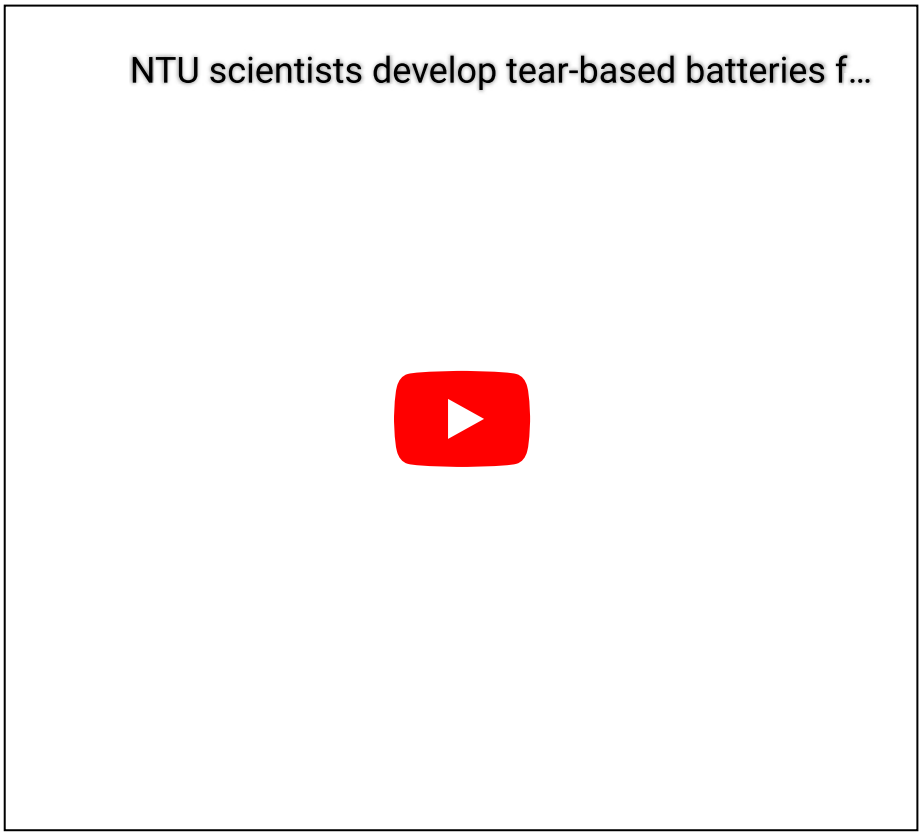


Associate Professor Lee Seok Woo, from NTU's School of Electrical and Electronic Engineering (EEE) holding up the flexible battery that is as thin as a human cornea - *NTU Singapore*

This is the claim of a team from Nanyang Technological University, Singapore (NTU Singapore), whose work is detailed in *Nano Energy*.

Smart contact lenses display information on corneas and can be used to access augmented reality. Current uses include helping to correct vision, monitoring wearers' health, and flagging and treating diseases for people with chronic health conditions including diabetes and glaucoma.

Smart contact lenses could be further developed to record and transmit everything a wearer sees and hears to cloud-based data storage, but reaching this scenario will require a safe and suitable battery. Existing rechargeable batteries rely on wires or induction coils that contain metal and are unsuitable for use in the human eye as they are uncomfortable and present risks to the user.



Co-first author Dr Yun Jeonghun, a research fellow from NTU's School of Electrical and Electronic Engineering said: "The most common battery charging system for smart contact lenses requires metal electrodes in the lens, which are harmful if they are exposed to the naked human eye.

"Meanwhile, another mode of powering lenses, induction charging, requires a coil to be in the lens to transmit power, much like wireless charging pad for a smartphone. Our tear-based battery eliminates the two potential concerns that these two methods pose, while also freeing up space for further innovation in the development smart contact lenses."

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The battery, which is about 0.5mm-thin, generates electrical power by reacting with the basal tears, which are the constant tears that create a thin film over the eyeballs.

The flexible and flat battery discharges electricity through reduction, when its glucose oxidase coating reacts with the sodium and chloride ions in the tears, generating a current within the contact lenses.

Using a simulated human eye, the team demonstrated that the battery could produce a current of 45μA and a maximum power of 201μW, which would be sufficient to power a smart contact lens. Laboratory tests showed that the battery could be charged and discharged up to 200 times.

The team recommends that the battery should be placed for at least eight hours in a suitable solution that contains a high quantity of glucose, sodium and potassium ions, to be charged while the user is asleep.

Research lead Associate Professor Lee Seok Woo, from NTU's EEE, said: "This research began with a simple question: could contact lens batteries be recharged with our tears? There were similar examples for self-charging batteries, such as those for wearable technology that are powered by human perspiration.

"However, previous techniques for lens batteries were not perfect as one side of the battery electrode was charged and the other was not. Our approach can charge both electrodes of a battery through a unique combination of enzymatic reaction and self-reduction reaction.

"Besides the charging mechanism, it relies on just glucose and water to generate electricity, both of which are safe to humans and would be less harmful to the environment when disposed, compared to conventional batteries."

The research team has filed for a patent through NTUitive, NTU's innovation and enterprise company, and is working towards commercialising their invention. The NTU team will be conducting further research to improve the amount of electrical current their battery can discharge. They will also be working with contact lens companies to implement their technology.