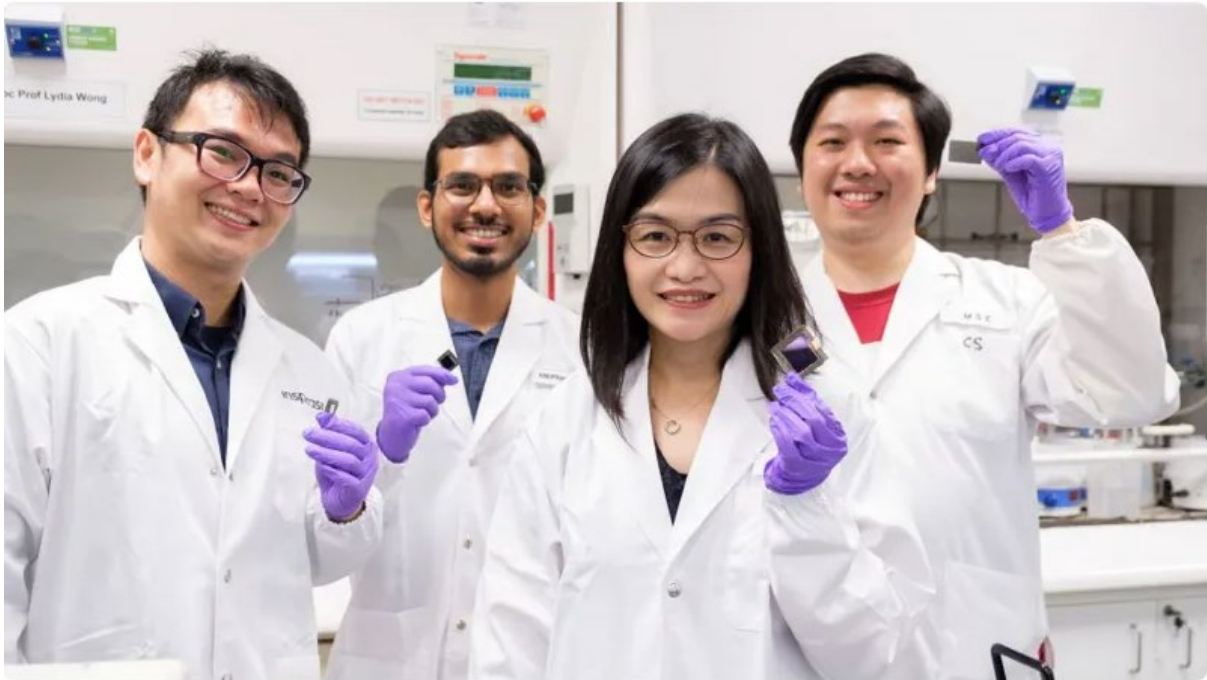


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NTU solar device produces hydrogen while treating wastewater



L-R: Dr Stener Lie, Dr Anupam Sadhu, Prof Lydia H. Wong and Dr Hao Zhe Chun of NTU's School of Materials Science and Engineering - NTU Singapore

Scientists at Nanyang Technological University (NTU) have developed a solar-powered device that produces hydrogen from seawater while removing toxic hydrazine from wastewater.

The device uses sunlight to generate the electricity required for both processes, avoiding an external power source. The research, led by Prof Lydia Wong at NTU's School of Materials Science and Engineering, is detailed in Nature Communications.

Conventional water electrolysis uses an electrical current to split water into hydrogen and oxygen. However, using seawater can reduce efficiency because chloride ions interfere with the reactions and can lead to the formation of corrosive chlorine compounds.

The NTU researchers instead designed the anode to use hydrazine as part of the electrochemical reaction. A catalyst breaks the compound down into hydrogen and nitrogen, a process that requires less energy than the oxygen-producing reaction normally used in electrolysis.

This allows the device to produce hydrogen more efficiently while simultaneously treating hydrazine-contaminated water. The approach also suppresses the formation of chlorine compounds.

The catalyst contains iron, cobalt and chromium and was designed to resist corrosion. The researchers said its electrical, physical and chemical properties can be tailored for different applications.

The solar-powered cathode was fabricated using lead halide-based perovskites and protected against degradation using a conductive epoxy resin containing silver and copper particles, together with titanium foil.

Tests in simulated and real seawater produced a stable photocurrent, with the device achieving a photocurrent density of 25mA cm^{-2} , which the researchers said was among the highest reported for lead-based perovskite cathodes.

Under illumination equivalent to sunlight reaching the Earth's surface on a clear day, the system operated for over 72 hours and produced hydrogen at a rate of $466\mu\text{mol cm}^{-2}\text{ h}^{-1}$.

The device also removed hydrazine without requiring the contaminant to be separated from the water first. Within 30 hours, it reduced the hydrazine concentration from 0.5M, equivalent to about 1.6 per cent by weight, to 0.5 parts per billion (ppb), which is more than 20 times below the US Environmental Protection Agency's permissible limit of 10ppb.

“This dual-function device represents a major leap forward for environmental technology. By efficiently harvesting solar energy to break down a toxic industrial pollutant while simultaneously harvesting clean fuel, we are solving both an energy problem and a pollution problem,” Prof Wong said in a statement.

The researchers are now developing catalysts that could extend the system to other pollutants and enable waste materials to be converted into fuels and industrial chemicals.

<https://www.theengineer.co.uk/content/news/solar-device-produces-hydrogen-while-treating-wastewater>