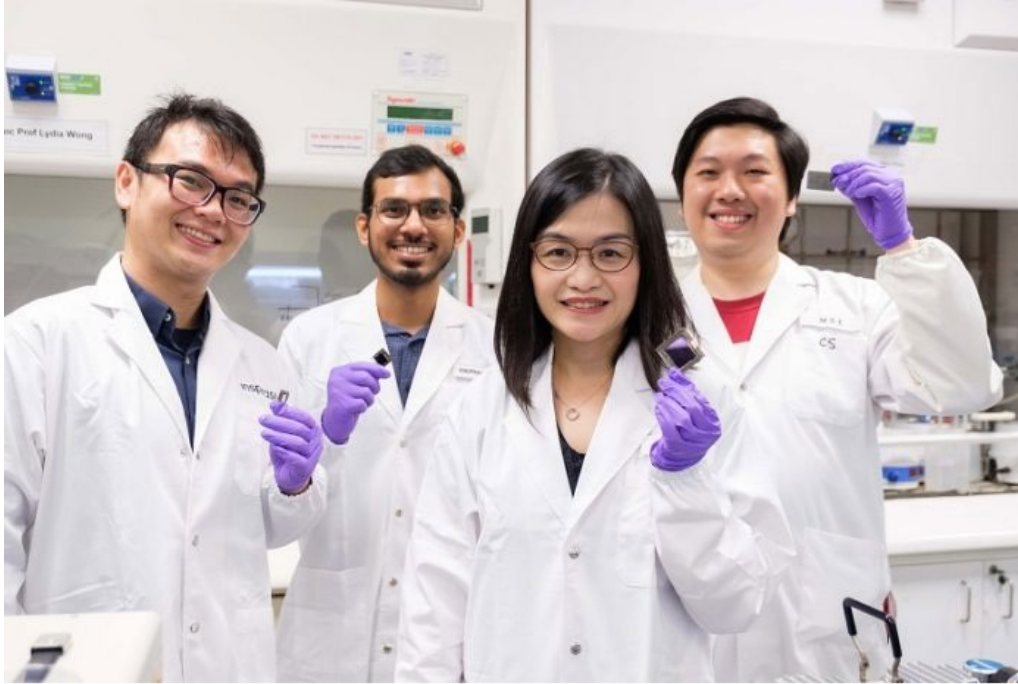


18 September 2026

Artificial Leaf Could Turn Polluted Seawater into Clean Hydrogen Fuel



The researchers behind the innovation. From left: Dr. Stener Lie, Dr. Anupam Sadhu, Prof Lydia H. Wong and Dr. Hao Zhe Chun of NTU's School of Materials Science and Engineering. Credit: NTU Singapore.

Scientists have developed an “artificial leaf” that uses sunlight to produce clean hydrogen from seawater while also removing a highly toxic industrial pollutant.

The device was created by researchers at Nanyang Technological University in Singapore. Inspired by natural leaves, it captures sunlight and converts it into electricity.

This electricity powers chemical reactions without requiring an outside energy source.

The technology, described in the *journal Nature Communications*, could provide a greener way to produce fuel and clean polluted water at the same time.

Hydrogen is considered a promising clean fuel because it produces water rather than carbon dioxide when used. However, producing hydrogen can require large amounts of energy.

One common method is electrolysis, which uses an electric current to split water molecules into hydrogen and oxygen. Electrons travel to a negative electrode, called the cathode, where they react with water to produce hydrogen gas.

Using seawater instead of freshwater could make this process more sustainable because it would protect limited freshwater supplies and avoid the need to remove salt before hydrogen production. However, seawater contains chloride ions that can interfere with the process. It can also produce toxic and corrosive chlorine compounds that damage the equipment.

To overcome these problems, the researchers created a positive electrode, or anode, containing a catalyst made with iron, cobalt and chromium. The catalyst breaks down hydrazine, a toxic chemical found in some industrial wastewater, into harmless nitrogen and useful hydrogen.

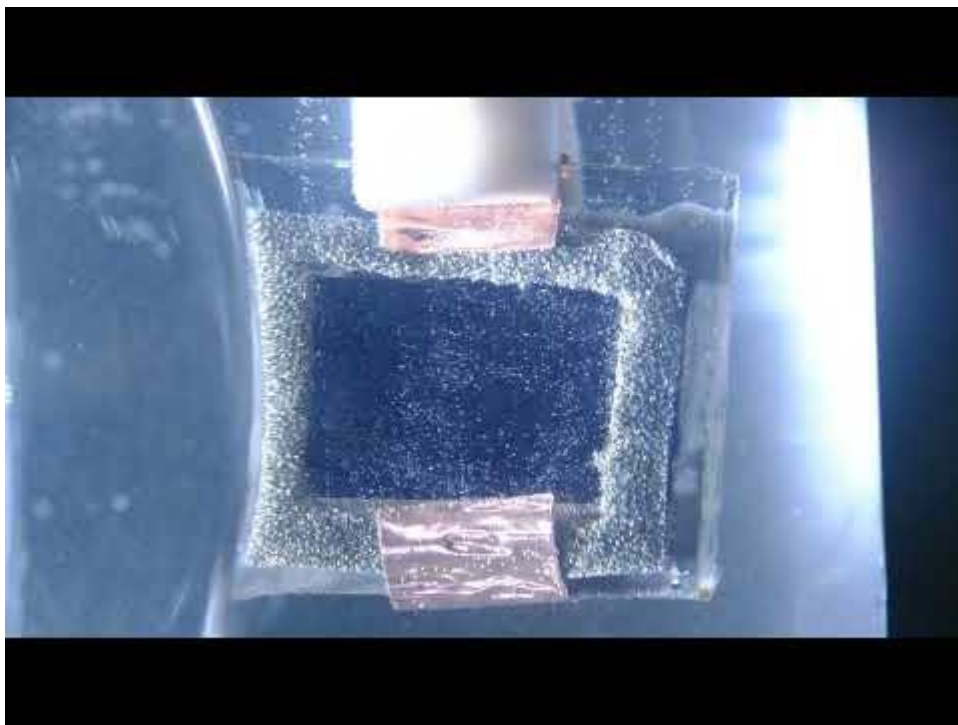
This reaction requires less energy than the oxygen-producing reaction normally used during electrolysis. As a result, the device can make hydrogen more efficiently. It produces hydrogen at both electrodes while also removing hydrazine from the water.

The catalyst is resistant to corrosion, and the researchers can adjust its electrical, physical and chemical properties. The design also greatly reduces the production of harmful chlorine compounds.

The cathode is made from lead halide perovskite, a material that absorbs light and converts it into electricity. Because seawater could damage this material, the researchers protected it with titanium foil and a conductive epoxy coating containing silver and copper particles.

Tests using both simulated and real seawater showed that the device could generate a strong and stable electric current under light. Its photocurrent density, which measures how much current is produced across the illuminated surface, was among the highest reported for this type of perovskite-based cathode.

The artificial leaf continued operating steadily for more than 72 hours under light similar to sunshine on a clear day. It also produced hydrogen at a rate comparable to other solar-powered systems.



Importantly, the device reduced hydrazine from a high concentration to just 0.5 parts per billion within 30 hours. This was more than 20 times below the maximum level permitted by the US Environmental Protection Agency.

The researchers now hope to develop new catalysts that can remove other pollutants. Future versions may also turn waste materials into useful products, including fuels and industrial chemicals.

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