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Translated from Dutch

Hydrogen directly from the sea and cleaner water as a bonus: this is how this new solar cell works

Researchers at Nanyang Technological University (NTU) in Singapore have developed a solar cell-like 'artificial leaf' that produces hydrogen directly from seawater using sunlight. At the same time, the system breaks down hydrazine, a highly toxic substance found in industrial wastewater, among other sources. The results have been published in Nature Communications.

Hydrogen production from seawater is attractive because it does not require scarce fresh water or prior desalination. However, chloride in seawater can form undesirable, corrosive chlorine compounds during conventional electrolysis. Therefore, the NTU team, led by materials scientist Lydia Wong, allows hydrazine to react at the anode. This produces nitrogen and hydrogen, while requiring less energy than conventional oxygen formation. A catalyst made of iron, cobalt, and chromium helps limit corrosion and chlorine formation.

The photosensitive cathode consists of lead halide perovskite and is protected against corrosion by a conductive layer containing silver, copper, and titanium, among other materials. In tests with artificial and real seawater, the system achieved a photocurrent density of 25 mA/cm². Under light comparable to bright sunlight, it remained stable for more than 72 hours and produced 466 micromoles of hydrogen per square centimeter per hour. The hydrazine concentration dropped from 0.5 molar to 0.5 parts per billion within thirty hours.

The researchers view the concept as a combination of hydrogen production and wastewater treatment. They aim to develop new catalysts that can also break down other pollutants and potentially convert them into fuels or usable chemicals. The system is still in the research phase but could evolve into a solar-powered reactor that simultaneously processes and utilizes waste.

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