

Journal

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Singapore's Artificial Leaf Turns Contaminated Seawater Into Clean Hydrogen

NTU researchers built a perovskite-powered device that generates hydrogen from seawater while degrading toxic hydrazine — published in Nature Communications.



Clean hydrogen from seawater sounds like alchemy. Researchers at Nanyang Technological University, Singapore, made it engineering — with a solar-powered "artificial leaf" that also detoxifies industrial wastewater in the same reaction.

Published September 17, 2026, in Nature.Communications, the device harvests sunlight through lead halide perovskite photoelectrodes, converts energy to drive electrochemical reactions, and produces hydrogen at rates comparable to other solar-powered hydrogen systems — without external electricity.

Dual function: energy and remediation

The cathode incorporates conductive epoxy with silver and copper nanoparticles, optimized for hydrogen evolution. Simultaneously, the system degrades hydrazine — a highly toxic contaminant common in industrial wastewater and rocket fuel processing — from concentrations of 0.5 M to 0.5 parts per billion within 30 hours, more than twenty times below the U.S. EPA permissible limit of 10 ppb.

That dual-use design matters for deployment economics. Facilities paying separately for hydrogen production and wastewater treatment could amortize capital costs across both problems. Islands, coastal industrial zones, and naval bases with seawater access and hydrazine exposure become natural pilot sites.

Performance and durability

Under illumination equivalent to clear-day sunlight at Earth's surface, the device maintained stable operation for more than 72 hours, generating hydrogen at $466 \mu\text{mol cm}^{-2} \text{ h}^{-1}$ — competitive with comparable solar hydrogen devices in recent literature.

Durability beyond 72 hours, scale-up to module arrays, and perovskite stability in harsh marine environments remain open engineering questions. Lab breakthroughs in photoelectrochemical hydrogen routinely face translation gaps; NTU's team will need partners for field trials.

Context in the clean energy landscape

The same week, geothermal startup Mazama Energy raised \$135 million for superhot rock drilling — another bet on 24/7 clean energy beyond intermittent solar and wind. Hydrogen from seawater addresses storage and industrial feedstock needs solar and wind alone cannot solve; enhanced geothermal addresses baseload grid demand. The climate tech portfolio diversifies as individual pathways mature.

Artificial photosynthesis research has produced decades of promising lab devices. NTU's contribution adds wastewater remediation to the value proposition — a differentiator if techno-economic analysis survives scale-up.

The bottom line

Singapore's artificial leaf is not yet a product you install on a rooftop. It is a Nature Communications proof that one integrated device can produce fuel-grade hydrogen and clean poisonous wastewater using only sunlight. For JSIPE readers tracking engineering innovation, that combination of energy and environmental remediation in a single photoelectrochemical platform is the story — incremental on either axis alone, compelling on both together.

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