Breakthrough opens door to low-cost green hydrogen

16 March 2022

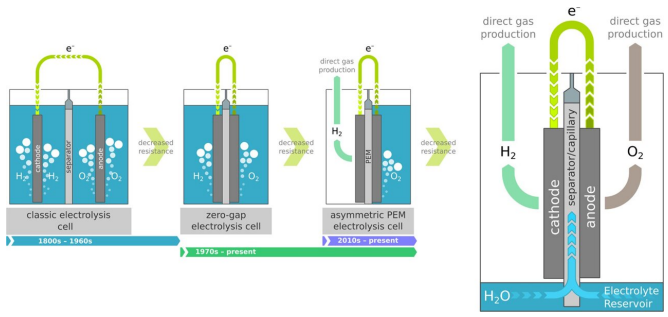


Fig. 1: Conceptualization of the Capillary-Fed Electrolysis (CFE) cell. Inspired by the historic evolution of water electrolysis cell architectures culminating in the direct production of one of the gases, the Capillary-Fed Electrolysis cell directly produces both gases. Liquid electrolyte is continuously drawn up the separator by a capillary effect, from a reservoir at the bottom of the cell. The porous, hydrophilic separator sustains the flow rate required for water electrolysis. Credit: *Nature Communications* (2022). DOI: 10.1038/s41467-022-28953-x

In a clean energy breakthrough, researchers from the University of Wollongong (UOW) and ARC Centre of Excellence for Electromaterials Science (ACES) have developed new electrolyzer technology that brings cost-competitive renewable, or green, hydrogen closer to reality.

The research findings are published today (16 March 2022) in *Nature Communications* and report on the research team's "capillary-fed electrolysis cell" and its production of green hydrogen from water at 98% cell energy efficiency.

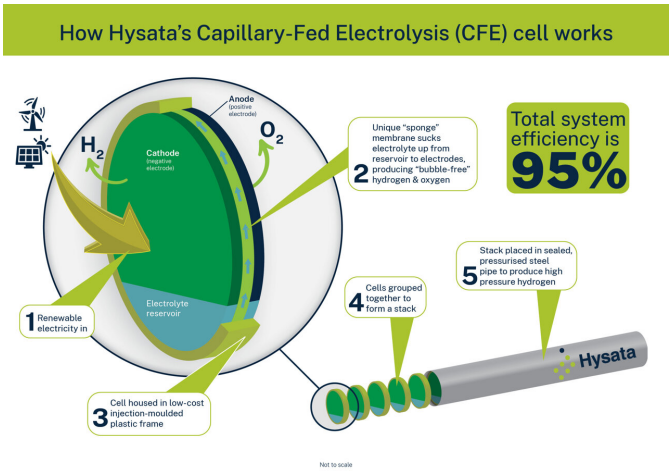
This productivity is superior to other existing electrolyzer technologies, and is well above the International Renewable Energy Agency's (IRENA) 2050 target, enabling an affordable hydrogen production cost that can match the production costs of fossil fuels.

Professor Gerry Swiegers from ACES and UOW's Intelligent Polymer Research Institute (IPRI) led the research team, with critical input from other UOW researchers including ACES Director Distinguished Professor Gordon Wallace.

A UOW spin-out company, Hysata, was formed last year to commercialize the breakthrough hydrogen electrolyzer technology.

Hysata is based at UOW's Australian Institute for Innovative Materials (AIIM)—the headquarters for both IPRI and ACES—and is commercializing the technology with backing from IP Group and the Clean Energy Finance Corporation (CEFC).

"Electrolyzers have been around for 200 years, however the large amounts of renewable electricity required to produce green hydrogen and the overall cost of electrolyzers today has prevented large-scale uptake of green hydrogen," said Professor Swiegers, who is the Chief Technology Officer at Hysata.



Infographic of the Hysata capillary-fed electrolysis cell. Credit: Hysata

"Hysata's overall electrolyzer system has been designed for ease of manufacturing, scaling and installation, delivering 95% overall system efficiency, equivalent to 41.5 kWh/kg, compared to 75% or less for existing electrolyzer technologies. For hydrogen producers, this will significantly reduce both the capital and operational costs to produce green hydrogen.

"Hysata is proud to be at the forefront of this technology innovation and introducing an entirely new category of electrolyzer that is as monumental as the shift from the internal combustion engine to electric motors."

Professor Wallace described his excitement on the discoveries and how it is a testament to work built upon over a long time. "Exciting new technological opportunities are based on many years of thorough fundamental scientific explorations. The Hysata development is no exception and we are proud to be associated with this."

Paul Barrett, Head of Physical Sciences at IP Group Australia and Hysata CEO, explained that these new findings provide a pathway to commercialize the world's most efficient electrolyzer.

"The global momentum towards net zero is creating a massive opportunity for green hydrogen and electrolyzers," Mr. Barrett said.

"Economics will ultimately determine which technologies win, and with our world-beating efficiency, Hysata is well placed to lead in this major new global market. Our electrolyzer will deliver the world's lowest hydrogen cost, save hydrogen producers billions of dollars in electricity costs, and enable green hydrogen to outcompete fossil fuel-derived hydrogen.

"Our technology will enable hydrogen production of below US$1.50/kg per kilogram by the mid-2020s, meeting Australian and global cost targets much earlier than generally expected. This is critical to making green hydrogen commercially viable and decarbonizing hard-to-abate sectors.

"Hysata has some of Australia's brightest minds working together to position Australia as a leading manufacturer and exporter of electrolyzers, with plans underway to build a pilot electrolyzer manufacturing plant and employ dozens of new highly skilled specialists in 2022.

"Green hydrogen is forecast to be a trillion-dollar industry with the backbone of this industry being the electrolyzer. Given the urgency to reach net zero, we are gearing up to scale up as quickly as possible. The elegant design of our electrolyzer is perfectly suited to mass production."

"This is indeed an exciting breakthrough with Hysata," Professor Wallace added. "We are also aware that our next exciting breakthroughs depend on continued investment in fundamental research."

"A high-performance capillary-fed electrolysis cell promises more cost-competitive renewable hydrogen," by Aaron Hodges, Anh Linh Hoang, George Tsekouras, Klaudia Wagner, Chong-Yong Lee, Gerhard F. Swiegers and Gordon G. Wallace, is published in *Nature Communications*.

More information: Aaron Hodges et al, A high-performance capillary-fed electrolysis cell promises more cost-competitive renewable hydrogen, *Nature Communications* (2022). DOI: 10.1038/s41467-022-28953-x

Provided by University of Wollongong