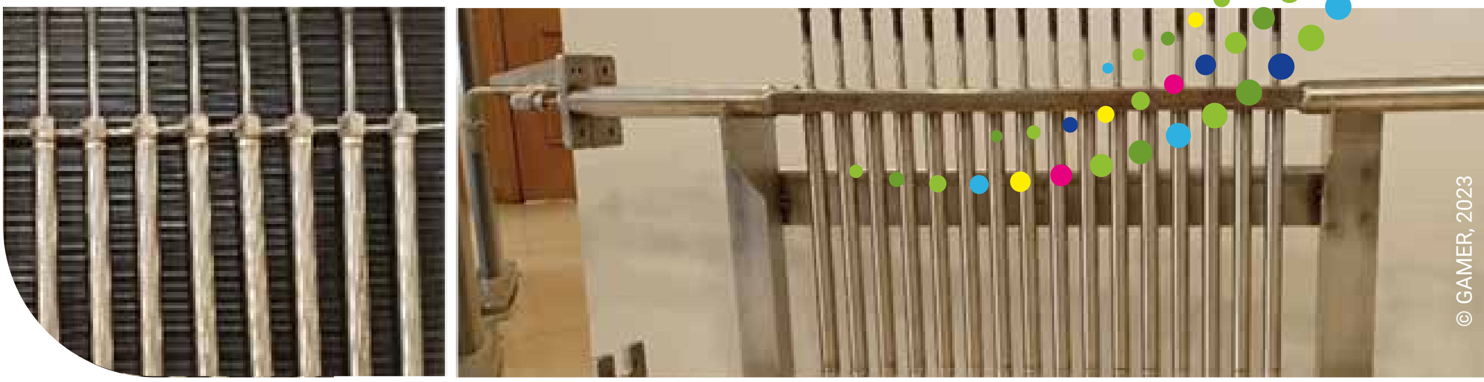
Clean Hydrogen Partnership

Hydrogen Production

Advances in proton ceramic electrolysers lower costs, increase output



Proton ceramic electrolysers (PCE) opened the way to producing, hot, pressurised dry hydrogen. The Clean Hydrogen Partnership is funding projects focusing on cost-effective PCEs that can play an even bigger role in decarbonising various sectors of industry, advancing Europe's leadership in hydrogen technology.

Game on for PCE development

PCEs offer several potential advantages for steam electrolysis. They are used to produce dry hydrogen directly, which can be used in various applications such as fuel cells for the transport sector and ammonia production. The CHP project GAMER has shown that integration of PCE within a renewable methanol plant using geothermal sources or waste heat or in a refinery environment has potential in terms of gains in efficiency and sustainability.

The electrolysis process operates at intermediate temperature, typically below 650°C, which is beneficial for thermal and material integration with a range of other processes and reduces energy and materials costs. Durability tests show PCEs maintain great stability at 600oC.

The GAMER project has developed an innovative PCE tubular technology for pressurised operation. The project has designed, built and tested tubular repeating cell units (RU) and their assemblies into racks (each made of 16 RU).

A demonstration facility with all balance of plant, rated for 10 kW operation, has also been designed, built and commissioned. PCE can exhibit inherent efficiency improvement when operating in pressurised conditions, as demonstrated on these RUs at up to up to 10 bar.

As the PCEs can operate at elevated temperatures (+600oC), both reaction kinetics and energy efficiency are enhanced during the electrolysis process compared to a low temperature electrolysis process.

Building a clean green future

Based on the GAMER results, the recently funded project PROTOSTACK project aims to develop new compact modular stacks designed to advance PCEs that can operate at a higher pressure of 30 bar. This will improve overall system efficiency with the advantages that are offered by pressurised operation, which were demonstrated during the GAMER project.

Other projects such as WINNER are forging ahead towards optimised electrochemical proton conducting ceramic cells for the production of green hydrogen by ammonia cracking and hydrocarbon dehydrogenation processes as well as reversible steam electrolysis, from small to medium scale.

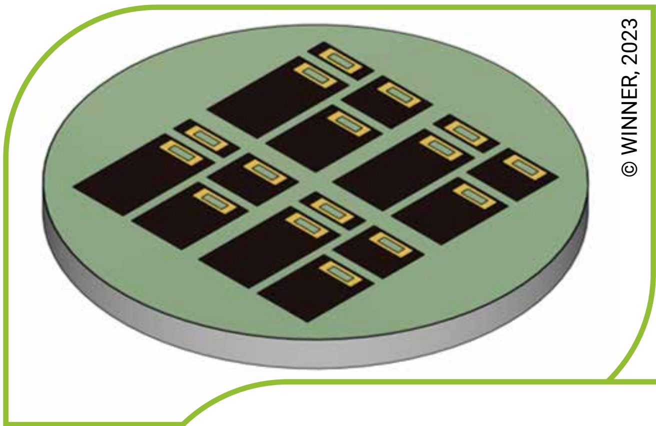
DESIGN CHALLENGES

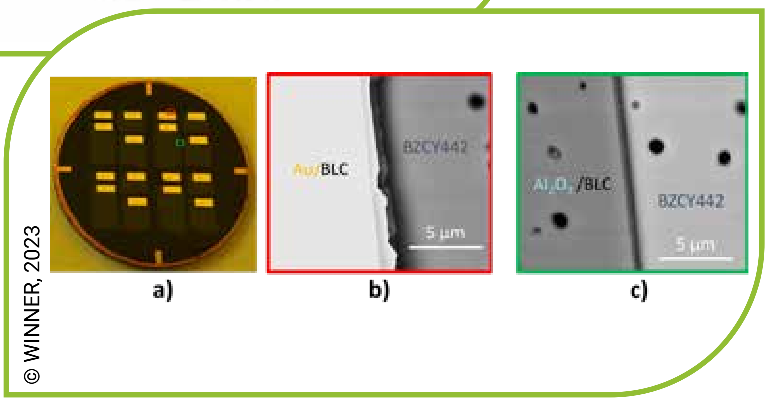
The overall aim of PCE technology development is to prove and upscale hydrogen production efficiently and safely to be commercially viable in the most sustainable way. However, up-scaling remains a challenging task. The durability of components, reducing manufacturing costs and optimising system integration with renewable energy sources, requires radical design and testing.

THE FUTURE OF PCE TECHNOLOGY

The Clean Hydrogen Partnership is funding projects to advance PCE development and scaling up to meet environmental, social, economic and commercial goals.

The goal? Development of efficient, cost effective, green PCE technology scaled to match market needs, with high sustainability and safety, is on the horizon as an important contributor to reaching climate goals.
Key results? Promising lab-scale results are approaching the proof-of-concept demonstration stage, paving the way to the scaling up and commercialisation of PCE technology.





KEY ACHIEVEMENTS

NOVEL DESIGN FOR PCE STACKS
based on a tube-in-shell design capable of stable operation at 600oC up to 10 bar for over 500 hours.

NO NI ELECTRODE OXIDATION
unlike cathode oxidation in high temperature electrolysers

HOT PRESSURISED HYDROGEN
produced for direct use:

• Improved efficiency of SEU by increasing pressure up to 10 bar

• Reversible PCE demonstrated at tubular cell level for more than 3000 hours at 4 bar

EFFICIENT THERMO COUPLING
with renewable sources

SUCCESSFUL PROGRESSIVE PROJECTS
encouraging further development of PCE technology

IMPACT

PCE TECHNOLOGY
using efficient large scale hydrogen production

INTEGRATION WITH RENEWABLE ENERGY SOURCES
including waste to energy sources

HIGH TEMPERATURE ELECTROLYSIS
splitting steam into hydrogen and water to produce dry hydrogen

INNOVATIVE ENGINEERING DESIGN
striving for durability, effectiveness and safety

FURTHER RESEARCH OF PCE TECHNOLOGY
with progressive upscaling and diverse resources

COLLABORATION AND AWARENESS
of clean green hydrogen production moving towards climate goals.

FIND OUT MORE

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