SEAL-HYDROGEN

STABLE AND EFFICIENT ALKALINE WATER ELECTROLYZERS WITH ZERO CRITICAL RAW MATERIALS FOR PURE HYDROGEN PRODUCTION

Project ID	101137915
PRR 2024	Pillar 1 – Renewable hydrogen production
Call topic	HORIZON-JTI-CLEANH2-2023-01-01: Innovative electrolysis cells for hydrogen production
Project total costs	EUR 3 000 048.75
Clean H_2 JU max. contribution	EUR 3 000 000.00
Project period	1.1.2024–31.12.2026
Coordinator	Universitat de València, Spain
Beneficiaries	Forschungszentrum Jülich GmbH, HORIBA France SAS, Matteco Team SL, Siemens Energy Global GmbH & Co. KG

https://seal-hydrogen.eu/

PROJECT AND GENERAL OBJECTIVES

SEAL-Hydrogen is an ambitious 36-month project aiming to develop laboratory-validated and scalable technology to boost the next generation of efficient cost-effective and durable electrolysers. The project proposes a multidisciplinary approach to develop an efficient and highly durable alkaline water electrolysis stack (six cells) able to compete at the highest level with classic anion-exchange membrane and polymer electrolyte membrane electrolysers. A reliable method based on Raman spectroscopy will be developed for the precise determination of electrode stability, offering an appropriate quality control of great interest to both research and industry.

NON-QUANTITATIVE OBJECTIVES

The novelty of our technology lies in the:

- large-scale development of affordable formulations of layered double hydroxide (LDH) catalytic materials that have outstanding oxygen evolution reaction values, are made of non-toxic low-cost elements, are free of critical raw materials and can be mass-produced, while maintaining a circular economy approach thanks to a patented, environmentally sustainable synthetic route;
- development of triple-phase boundary electrodes (catalyst-support-ionomer) structures with improved thermomechanical stability;
- development of novel separator electrode assemblies with integrated components (porous transport electrodes);
- demonstration of the use of cutting-edge *in operando* Raman-spectroscopic techniques to characterise the intrinsic chemical activity and stability of catalysts.

The best-performing lab-scale cell components developed will be merged into an inexpensive, innovative electrolysis single cell (technology readiness level 4). A six-cell stack will be assembled to test and validate the potential of SEAL-Hydrogen's innovative approaches to overcome the main challenges of modern water electrolysis technologies. The involvement of manufacturing companies will ensure that manufacturability requirements are followed from the very beginning to prepare for further scale-up of the validated solution.

PROGRESS AND MAIN ACHIEVEMENTS

UVEG achieved the synthesis of various binary and ternary LDHs with different transition metal. Chemical and morphological characterisation is ongoing; electrochemical tests will follow. Matteco is focusing on scaling up NiFe LDHs to the kg scale, with plans to scale up other LDHs based on results from partners. Matteco achieved growth of a large-surface-area electrode for testing. HI ERN undertook a study of the dissolution of NiFe LDHs through a scanning flow cell coupled to an inductively coupled plasma mass spectrometer, showing promising preliminary results on Matteco LDH stability. Construction of the stack test station was initiated. The design is finalised, including specifications on Ni substrate properties for the constructed stack.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?
SRIA (2021–2027)	Electricity consumption in stacks	kWh/kg	48 (1.9 V at 0.8 A/cm^2)	N/A	
	CRM	mg/W	< 0.3	0.3 mg/W	
Project's own objectives	Interface resistance	-	1.9 V at 0.8 A/cm^2, 48 kWh/kg	N/A	
	Partial-load operation	%	0.05	N/A	
Project's own objectives and SRIA (2021–2027)	Stability (in terms of current)	A/cm^2	1	N/A	

Clean Hydrogen Partnership
Co-funded by the European Union