CHANNEL

DEVELOPMENT OF THE MOST COST-EFFICIENT HYDROGENPRODUCTIONUNITBASEDONANION EXCHANGE MEMBRANE ELECTROLYSIS

Project ID:	875088
PRD 2023:	Panel 1 – H2 production
Call topic:	FCH-02-4-2019: New anion exchange membrane electrolysers
Project total costs:	EUR 1 999 906.25
Clean H_2 JU max. contribution:	EUR 1 999 906.25
Project period:	1.1.2020–30.6.2023
Coordinator:	SINTEF AS, Norway
Beneficiaries:	Enapter SRL, Evonik Creavis GmbH, Shell Global Solutions International BV, Evonik Operations GmbH, Norwegian University of Science and Technology

https://www.sintef.no/projectweb/channel-fch/

PROJECT AND OBJECTIVES

CHANNEL aims to build a cost-efficient 2 kW anion-exchange membrane (AEM) water electrolyser able to operate at differential pressure and under dynamic operation, optimal for producing high-quality, low-cost green hydrogen from renewable energy sources. CHANNEL will conduct a techno-economic analysis and determine detailed future size and cost targets for AEM electrolysers. It will identify markets and their requirements, establishing the production quantities essential to meet market needs, accounting for the expected cost decrease.

NON-QUANTITATIVE OBJECTIVES

- The project aims to contribute to science and technology through the submission of journal articles for publication and through conference contributions.
- The CHANNEL promotional video was released in early 2021.
- Two students from the University of St Andrews were trained and have been working on the project.
- CHANNEL aims to contribute to the AEM test protocol harmonisation workshop alongside NEWELY and ANIONE.
- The transient AEM model code is to be released on a public platform (GitHub).
- Education: two PhD students (Forschungszentrum Jülich) and one postdoctoral researcher (Norwegian University of Science and Technology) were hired as part of the project.

PROGRESS AND MAIN ACHIEVEMENTS

- Highly active and durable hydrogen and oxygen evolution reaction electrocatalysts were developed and production was scaled up.
- The single-cell electrolyser performance target of 1.85 V at 1 A/cm^2 using a non-PGM electrocatalyst was achieved.
- High-performance AEMs were developed.
- Stack design has been finalised and the deliverable was due to be submitted by the end of March 2023.

FUTURE STEPS AND PLANS

- A journal article based on the modelling of the transient pseudo-two-dimensional (P2D) AEM model and simulation of electrode catalyst loading and composition as a function of KOH concentration, temperature and cell current density is in the process of being published, offering additional insight into the drivers of AEM cell performance and assisting optimisation activities.
- The model will be shared through an open-source modelling system to allow others in the research community to utilise it to make informed decisions on how best to optimise AEM electrolyser technologies.
- A demonstration of the preliminary AEM stack prototype will take place, as will the assembly of the preliminary stack and validation. This is in addition to finalising the stack design.

QUANTITATIVE TARGETS AND STATUS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?	SoA result achieved to date (by others)	Year of reported SoA result
Project's own objectives	OER catalyst performance	mV	< 300 (at 10 mA/cm^2 1 M KOH)	237 (1 M KOH) 270 (0.1 M KOH)	✓	250 at 10 mA/cm^2 (Ir-based catalyst)	2023
	HER catalyst performance	mV	< 150 (at – 0.2 V versus RHE)	60 in 1 M KOH 120 in 0.1 M KOH	✓	30 at – 10 mA/cm^2 (Pt-based catalyst) in 1 M KOH	2023
	OER catalyst stability	mV	< 25 degradation over 1 000 hours in RDE	33	⚙	N/A	N/A
	HER catalyst stability	mV	< 25 degradation over 1 000 hours in RDE	26	⚙		
	Single-cell performance (at 1 A/cm^2)	V	1.85	1.85	✓	1.85	2023
AWP 2019	Membrane OH^- conductivity (T = RT)	mS/cm	50	< 50	⚙	Approximately 120 (50-micron membrane from Sustainion) 40–45 FAA-3 (Fumatech)	2023
	Ionomer OH conductivity (60 °C)	mS/cm	Not specified	> 60	✓	N/A	N/A

Clean Hydrogen Partnership
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