PEMTASTIC

ROBUST PEMFC MEA DERIVED FROM MODEL-BASED UNDERSTANDING OF DURABILITY LIMITATIONS FOR HEAVY DUTY APPLICATIONS

PEMTASTIC

Project ID	101101433
PRR 2024	Pillar 3 – H_2 end uses: transport
Call topic	HORIZON-JTI-CLEANH2-2022-03-02: Innovative and optimised MEA components towards next generation of improved PEMFC stacks for heavy duty vehicles
Project total costs	EUR 2 748 608.75
FCH JU max. contribution	EUR 2 748 608.50
Project start - end	1. 2. 2023 - 31. 1. 2026
Coordinator	Deutsches Zentrum für Luft- und Raumfahrt EV, Germany
Beneficiaries	Chemours Belgium; Chemours France SAS; Commissariat à l'Énergie Atomique et aux Énergies Alternatives; Heraeus Deutschland GmbH & Co. KG; Imerys Graphite & Carbon Belgium; Imerys Graphite & Carbon Switzerland SA; IRD Fuel Cells AS; Symbio France; The Chemours Company FC, LLC; Zürcher Hochschule für Angewandte Wissenschaften

https://pemtastic-project.eu/

PROJECT AND GENERAL OBJECTIVES

The research and development project Pemtastic aims to tackle the key technical challenges to increasing the durability of membrane electrode assemblies (MEAs) for heavy-duty applications. These challenges are approached using a combination of model-based design and the development of a durable catalyst-coated membrane (CCM) using innovative materials tailored for heavy-duty operation at a high temperature (105 °C). The quantitative targets correspond to a durability of 20 000 hours, maintaining a state-of-the-art (SOA) power density of 1.2 W/cm^2 at 0.65 V at a Pt load of 0.30 g/kW.

NON-QUANTITATIVE OBJECTIVES

- Define fuel cell operation protocols and cycling tests for heavy-duty applications and propose an operational strategy for high fuel efficiency.
- Parameterise degradation models to predict MEA lifetime and identify specific improvements in the CCM and its components.
- Develop a robust catalyst (Pt/C) support deposition process for oxygen reduction reaction catalysts.
- Develop membranes and ionomers that operate at high temperatures.
- Create catalyst layers and CCM with increased durability and state-of-the-art performance tailored for heavy-duty operation.

PROGRESS AND MAIN ACHIEVEMENTS

- The partners developed operation protocols for testing materials, single cells, and short stacks. These protocols are available as a public report and have been shared with other Clean H2 projects related to MEA or stack development.
- Specific in situ and ex situ tests were discussed among modellers and experimentalists.
- In the context of the modelling task, performance models were set up to extend to degradation based on the results for the Gen1 MEA.
- Significant effort was dedicated to implementing and debugging testing conditions for single cells into partner test benches to achieve sufficient reproducibility. Initial testing was conducted using a commercial MEA from IRD Fuel Cells, and durability tests were conducted using Pemtastic heavy-duty load cycling and characterisation protocols. The reproducibility of durability tests at different facilities will be assessed.
- The Gen1 MEA was designed using materials from Imerys, Heraeus, and Chemours. A Gen2 MEA will be designed in the second year, considering inputs from degradation models.
- The project was presented at three fairs, contributed to nine workshops or conferences, and was advertised on social media.

FUTURE STEPS AND PLANS

Next steps for the second year of project implementation are:

- Demonstrate reproducible durability among partners;
- Carry out specific accelerated stress tests for the parametrisation of degradation models;
- Identify the most important degradation mechanisms using the first-generation project MEA;
- Provide input for MEA improvement from degradation models;
- Identify specific improvements to be implemented in second-generation materials and components;
- start analysing second-generation MEAs and improve/extend degradation models.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?	SOA result achieved to date (by others)
SRIA (2021–2027)	Power density	W/cm^2 at 0.65 V	1.2		1.00
	PGM loading	g/kW	0.3		0.4
	Durability	hours	20		15
Project's own objectives	Operational temperature	°C	95–105 at low RH		80–85 °C

Clean Hydrogen Partnership
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