PEMTASTIC

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

PEMTASTIC

Project ID	101101433
PRR 2025	Pillar 3 - H_2 End Uses - Transport
Call Topic	HORIZON-JTI-CLEANH$_2$-2022-03-02
Project Total Costs	2 748 608.75
Clean H_2 JU Max. Contribution	2 998 608.50
Project Period	01-02-2023 - 31-01-2026
Coordinator Beneficiary	DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV, DE
Beneficiaries	SYMBIO FRANCE, IMERYS GRAPHITE and CARBON BELGIUM, CHEMOURS FRANCE SAS, CHEMOURS BELGIUM, THE CHEMOURS COMPANY FC, LLC, HERAEUS DEUTSCHLAND GMBH and CO KG, IMERYS GRAPHITE and CARBON SWITZERLAND SA, IRD FUEL CELLS A/S, ZURCHER HOCHSCHULE FUR ANGEWANDTE WISSENSCHAFTEN, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES

https://pemtastic-project.eu/

PROJECT AND GENERAL OBJECTIVES

PEMTASTIC aims to tackle the key technical challenges to increase durability of membrane electrode assemblies (MEAs) for heavy-duty applications. These challenges are approached with 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 high temperature (105 °C). The quantitative targets correspond to a durability of 20 000 hours maintaining a state-of-the art power density of 1.2 W/cm^2 at 0.65 V at a Pt loading of 0.30 g/kW.

NON-QUANTITATIVE OBJECTIVES

- Definition of fuel cell operation protocols and cycling tests for heavy-duty applications.
- Definition of operational strategy for high fuel efficiency.
- Parametrisation of degradation models to predict MEA lifetime and identify specific improvements of the CCM and its components.
- Development of robust catalyst (Pt/C) support deposition process for oxygen reduction reaction catalysts.
- Development of membrane and ionomer for operation at high temperature.
- Catalyst layers and CCM with increased durability and state-of-the-art performance tailored for heavy-duty operation.
- Dissemination and promotion of project results, through ad-hoc strategies through target groups and key stakeholders and definition of an exploitation strategy of the PEMTASTIC outcomes.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- Definition of protocols for testing of materials as well as single cells and stacks.
- Development of a multiscale modelling approach to predict cell performance and degradation processes from the mesoscale to the single-cell level, improving understanding of which characterisations are needed or available to parametrise the models.
- Implementation, validation and revision of new testing protocols into test benches ensuring reproducibility among testing partners.
- Durability tests up to 1 500 hours using PEMTATIC heavy-duty load cycle along with in-situ and ex-situ characterisation.
- Sensitivity study on Gen0 and Gen1 MEAs and ongoing stressor tests.
- Use of innovative materials from IMERYS, Herae-

PRR 2025 PILLAR
H2 End Uses - Transport

Clean Hydrogen Partnership

Co-funded by the European Union

us and Chemours to design the first generation PEMTASTIC MEA.

- Identification of promising materials the second generation PEMTASTIC MEA.
- Very good visibility of PEMTASTIC achieved (website, LinkedIn, workshops, fairs).

FUTURE STEPS AND PLANS

- Finalise tests on the first generation PEMTASTIC MEA.
- Assembly of the second generation PEMTASTIC MEA.
- Improvement of degradation model using experimental results of the first-generation MEA.
- Demonstration that model outcomes can guide the MEA development to improve MEA performance and durability.
- Disseminate project results in conferences and journals.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?	SoA result achieved to date (by others)	Year for reported SoA result
Project's own objectives	MEA Durability	hours	20 000	Performance models extended to degradation models. Gen2 Pt/C outperforms Gen1 without compromising durability. Stable prototype membrane used with 2.5-fold higher AST durability. HD-load profile to benchmark durability (500-1500 h) was developed.		15 000	2020
	PGM loading	mg cm-2	0.3	Pt loading of project MEA Gen1 was reduced to 0.3 mgcm-2.		0.4	2020
	Power density	W cm-2	1.2@0.65 V	Adjustment of I/C ratio to optimise performance. In differential conditions Gen1 exhibits power of 1.2 Wcm-2 at 650 mV and Pt loading of 0.3 mg cm-2.		1.0 @ 0.65 V	2020
	Operation temperature	°C	95-105	Gen1 MEA equipped with highly stable prototype membrane. HD-cycling and Stressor test will be carried out at 105°C to allow identification of degradation at targeted temperature.		N/A	N/A