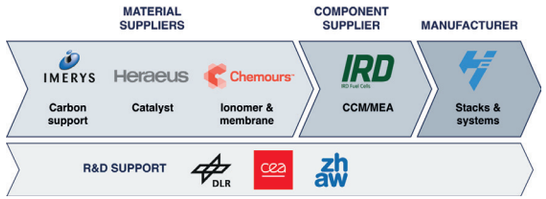
Project description

The R&D project PEMTASTIC aims to meet the key technical challenges to increase durability of membrane-electrode assembly (MEA) for heavy-duty applications. These challenges are approached with a combination of model-based design and the development of a durable catalyst coated membrane 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/cm²@0.65 V at a Pt loading of 0.30 g/kW.



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Contact

Dr. rer. nat. Pawel Gazdzicki
Team Leader Low Temperature Fuel Cell & Electrolysis

Deutsches Zentrum für Luft- und Raumfahrt (DLR)
German Aerospace Center
Institute of Engineering Thermodynamics
Electrochemical Energy Technology
Pfaffenwaldring 38-40
70569 Stuttgart

Phone: +49 711 6862-8094
Mail: Pawel.Gazdzicki@dlr.de

About Clean Hydrogen Partnerhship

The Clean Hydrogen Partnership is supporting research and innovation (R&I) activities in hydrogen technologies in Europe. It aims to accelerate the development of advanced clean hydrogen applications ready for market, across end-use sectors such as energy, transport, building and industry, while strengthening the competitiveness of the clean hydrogen value chain. The members of the partnership are the European Commission, fuel cell and hydrogen industries represented by Hydrogen Europe and the research community represented by Hydrogen Europe Research.

Clean Hydrogen Partnership

Co-funded by the European Union

The project is supported by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research.

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German Aerospace Center (DLR)
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Address:
Pfaffenwaldring 38-40, 70569 Stuttgart, Germany
Telefon +49 711 6862-359, E-Mail tt-info@dlr.de

DLR.de/TT/pemtastic

Project website:
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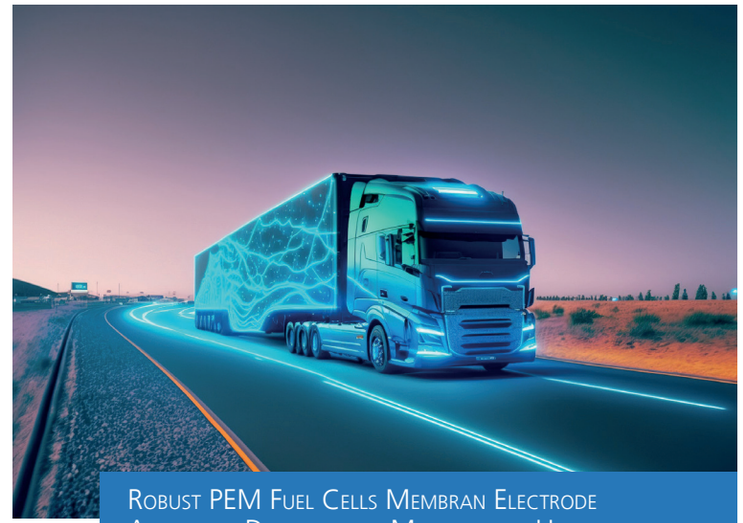
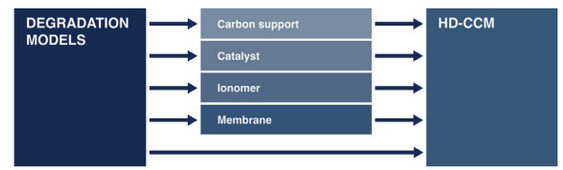
PEMTASTIC



ROBUST PEM FUEL CELLS MEMBRAN ELECTRODE ASSEMBLIES DERIVED FROM MODEL-BASED UNDERSTANDING OF DURABILITY LIMITATIONS FOR HEAVY DUTY APPLICATIONS



MODEL-BASED CCM DEVELOPMENT

Objectives

To overcome durability hurdle of polymer electrolyte membrane fuel cells (PEMFC) and in line with the Strategic Research and Innovation Agenda (SRIA) of the Clean Hydrogen Joint Undertaking, new application-tailored component materials, cell designs and operating strategies must be developed.

This is the purpose of the PEMSTATIC project which aims at bringing to technology readiness level (TRL) 4 the highly innovative concept of durable heavy duty membrane electrode assembly (MEA) derived from enhanced degradation models and addressing the different sub-components of the catalyst coated membrane (CCM) and their interactions.

Clean Hydrogen JU SRIA KPIs				
	SOA 2020	Targets 2024	Targets 2030	PEMTASTIC targets
Durability / h	15,000	20,000	30,000	20,000
PGM loading / gkW^{-2}	0.4	<0.3	<0.25	0.3
Power density / Wcm^{-2}	1.0 @ 0.65V	>1.2 @ 0.65V	>1.2 @ 0.65V	1.2 @ 0.65V
Additional Project KPIs				
Operation temperature / C°	80-85			95-105 at low RH

Objective 1: Define fuel cell operation protocols and cycling tests for heavy duty application and propose operation strategy for high fuel efficiency.

Objective 2: Parameterisation of degradation models to predict MEA lifetime and identify specific improvements of the CCM and its components.

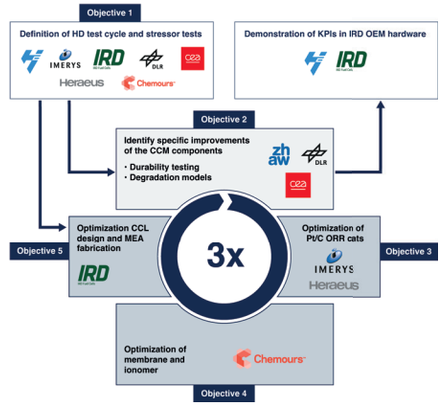
Objective 3: Development of robust catalyst support and deposition process for catalysts.

Objective 4: Development of membrane and ionomer for operation at increased temperature

Objective 5: Catalyst layers and CCM with increased durability and state-of-the art performance tailored for heavy duty operation

Objective 6: Ensure the dissemination of the project results and the promotion of the project, through ad-hoc strategies through target groups and key stakeholders and define the exploitation strategy of the PEMTASTIC outcome.

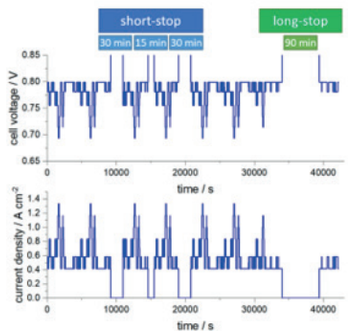
Methodology & results



PEMTASTIC fuel cell testing protocols for HD application

	PEMTASTIC HD condtions	
	At air **inlet**	At air **outlet** (calc by CEA)
Differential Cell		
Cell temperature [°C]	90	105
Gas composition	H2/air	H2/(N2+9%O2)
Outlet pressure anode / cathode [bar_{abs}]	2.5/2.5	2.6/2.2
Gas inlet temperature anode/cathode [°C]	Cell temperature + 5 °C	
RH anode / cathode [%]	80/50	35/60
H2 and O2 stoichiometry for 4 cm channel length [-]	10/10	
Fixed gas flow according to current density [A/cm^2]	3,0	
Stack / Technical Single Cell		
Coolant inlet temperature [°C]	90	
Gas composition	H2/air	
Inlet pressure anode / cathode [bar_{abs}]	2.6/2.5	
Gas inlet temperature anode/cathode [°C]	95	
RH anode / cathode [%]	50/35	
Stoichiometry integral cell / stack [-]	1.2/1.8	
Fixed gas flow according to current density [A/cm^2]	0,2	

HD load profile for PEMFC derived from truck driving cycle



Consortium

DLR: coordination, MEA characterization, degradation modelling

ZHAW: multi-scale degradation modelling

CEA: MEA characterization, ex-situ analytics

Chemours: improved ionomers and membranes

Imerys: innovative catalyst support

Heraeus: advanced catalyst deposition

IRD: CCM development

Symbio: operation strategy, stack testing