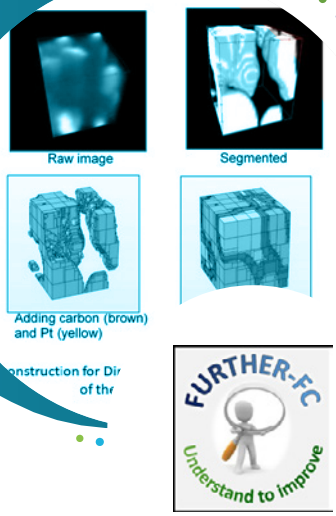
FURTHER-FC

FURTHER UNDERSTANDING RELATED TO TRANSPORT LIMITATIONS AT HIGH CURRENT DENSITY TOWARDS FUTURE ELECTRODES FOR FUEL CELLS



Project ID:	**875025**
PRD 2023:	**Panel 3 – H2 end uses – transport**
Call topic:	**FCH-01-4-2019: Towards a better understanding of charge, mass and heat transports in new generation PEMFC MEA for automotive applications**
Project total costs:	**EUR 3 122 598.75**
Clean H_2 JU max. contribution:	**EUR 2 199 567.35**
Project period:	**1.1.2020–29.2.2024**
Coordinator:	**Commissariat à l'énergie atomique et aux énergies alternatives, France**
Beneficiaries:	Centre national de la recherche scientifique, Chemours France SAS, Deutsches Zentrum für Luft- und Raumfahrt EV, École Nationale Supérieure de Chimie de Montpellier, Hochschule Esslingen, Imperial College of Science Technology and Medicine, Institut National Polytechnique de Toulouse, Paul Scherrer Institut, Chemours Company FC LLC, Toyota Motor Europe NV, Université de Montpellier, University of Calgary

https://further-fc.eu/

PROJECT AND OBJECTIVES

FURTHER-FC proposes complete experimental and modelling coupled platforms to better understand the performance limitations of the cathode catalyst layers (CCLs) of low-Pt-loaded proton-exchange membrane fuel cells. Based on this, CCL improvements will be discussed and tested. Up-to-date references and some customised membrane electrode assemblies (different ionomer-to-carbon ratio, thickness, etc.) have been produced, models of the CCLs are progressing based on their structural characterisation, and the first effective properties have been derived.

PROGRESS AND MAIN ACHIEVEMENTS

- Progress has been made on the characterisation of the CCLs (atomic force microscopy, Raman thermography, three-dimensional focused ion beam scanning electron microscopy, limiting current, etc.), including reference and first customised MEAs.
- Three-dimensional (3D) images of the GDL (with MPL) have been produced, and 3D images of CCLs are in progress.
- Modelling has been done on GDL, based on 3D images of fibrous substrate (X-ray) and of MPL (FIB-SEM), as has the evaluation of transport properties.
- Modelling of CCLs is ongoing (LBM, DNS). This is also based on 3D images.
- The definition and validation of test protocols allows for reliable comparison between the partners.
- Limiting-current analysis is ongoing (differential cells) to better understand the main contributors to the performance limitations.
- Progress has been made on the ultra-low loading catalyst layers, enabling a better understanding of the ORR kinetics.
- Bulk in-plane and through-plane electronic conductivities as a function of relative humidity and compression have been determined, as have through-plane proton conductivities as a function of relative humidity.
- The hydrophilicity and solvophilicity of the catalyst and catalyst layers have provided insights into the water sorption of these powders and layers during ink formulation and testing.
- The calibration of Raman thermography on the membrane has been achieved.

FUTURE STEPS AND PLANS

- The finalisation of the characterisations of customised membrane electrode assemblies is ongoing.
- The finalisation of the modelling of the CCLs at different scales is ongoing.
- The definition of the most performance-limiting mechanisms is ongoing.
- The upscaling of the models has started and will continue.
- Reproducibility of the fuel cell thermal behaviour is being checked.

QUANTITATIVE TARGETS AND STATUS

Target source	Parameter	Unit	Target	Target achieved?	SoA result achieved to date (by others)	Year for reported SoA result
MAWP (2014–2020)	Volumetric power density	kW/l	9.3		4.1	2017 (by Auto-Stack Core)
	Weight power density	kW/kg	4		3.4	
	Surface power density	W/cm^2	1.8		1.13	
	Cost	€/kW	20		36.8	
	Durability	hours	6 000		3 500	
	Total Pt loading	mg/cm^2	0.144		0.4	
	Total Pt loading	g/kW	0.08		0.35	
	Pt efficiency	A/mg	15		4.5	

Clean Hydrogen Partnership
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