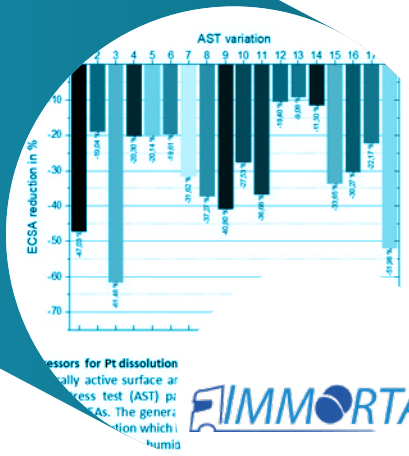
IMMORTAL

IMPROVED LIFETIME STACKS FOR HEAVY DUTY TRUCKS THROUGH ULTRA-DURABLE COMPONENTS



Project ID:	**101006641**
PRD 2023:	**Panel 3 – H2 end uses – transport**
Call topic:	**FCH-01-2-2020: Durability-lifetime of stacks for heavy duty trucks**
Project total costs:	**EUR 4 461 953.75**
Clean H_2 JU max. contribution:	**EUR 3 825 927.50**
Project period:	**1.1.2021–31.12.2023**
Coordinator:	**Centre national de la recherche scientifique, France**
Beneficiaries:	Albert-Ludwigs-Universität Freiburg, AVL List GmbH, FPT Industrial SpA, FPT Motorenforschung AG, Johnson Matthey Hydrogen Technologies Limited, Johnson Matthey plc, Pretexo, Robert Bosch GmbH, Université de Montpellier

https://immortal-fuelcell.eu

PROJECT AND OBJECTIVES

IMMORTAL aims to develop high-performance and high-durability membrane electrode assemblies (MEAs), and their components, specifically designed for heavy-duty truck application. By month 14, an initial set of accelerated and load profile cell and stack tests had been developed and applied to baseline MEAs. Selected actual truck missions were simulated to produce load profiles that will be used to produce updated load profile testing procedures. By month 18, new materials (support, catalyst, membrane), which were integrated into an initial heavy-duty MEA, had been developed. The performance of these MEAs comes within 93 % of the final power density target of 0.675 V in short-stack testing.

NON-QUANTITATIVE OBJECTIVES

IMMORTAL aims to contribute to activities on Mission Innovation's hydrogen innovation challenge through cooperation with the US Department of Energy's Million Mile Fuel Cell Truck Consortium. Several workshops have been held with the consortium, and with Japan's fuel cell platform, which included discussions on, inter alia, heavy-duty stressors, the second-generation Toyota Mirai and advanced characterisation techniques.

PROGRESS AND MAIN ACHIEVEMENTS

- IMMORTAL has developed highly stable catalyst layers at the target platinum loading (0.3 mg/cm^2) that achieve a decay rate due to irreversible losses ≥ 50 % lower than the reference catalyst-coated membrane (from the INSPIRE project) using a project accelerated stress test protocol (Milestone 5).
- IMMORTAL has developed and validated a highly durable reinforced membrane that has withstood > 100 000 wet/dry cycles in an MEA held at open circuit voltage at 90 °C.
- IMMORTAL has developed MEAs integrating these novel components that achieve 93 % of the final target power density in short-stack testing (target: 0.675 V).

FUTURE STEPS AND PLANS

- IMMORTAL will deliver further optimised materials for a second generation of heavy-duty-specific MEAs (expected spring 2023).
- It will deliver this second generation of heavy-duty-specific MEAs for single-cell and short-stack accelerated stress testing and load-profile testing as part of work package 2 (expected from June 2023).

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 SoA target
AWP 2020	Cell voltage at 1.77 A/cm^2	V	0.675	0.661	⚙	0.675	2021
	Durability	hours	30 000 with < 10 % degradation	Durability testing is planned in RP2; MEAs have been developed for heavy-duty trucks		8 500 with < 10 % degradation	2020
Project's own objectives	Catalyst surface area and mass activity	cm^2/g of Pt and A/mg of Pt	Exceeding values of reference Pt and better retention after accelerated degradation cycles than reference Pt/C	Two catalyst designs achieve this objective	✓	N/A	N/A
	Membrane durability in MEA AST cycles	cycles	50 000	110 000	✓	No public result comes close to this number of cycles	N/A

Clean Hydrogen Partnership
Co-funded by the European Union