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High Performance PEM Electrolyser for Cost-effective Grid Balancing Applications

HPEM2GAS - Deliverable report

D4.1 MEA Development with high catalyst utilisation

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Publishable summary

HPEM2Gas targets to develop advanced membrane-electrode assemblies for PEM water electrolysis with ultra low PGM loading ($\leq$0.5 mg_{PGM}/cm^2 MEA), a high performance (1.8 V/cell @ 3 A/cm^2) and low degradation (<5 µV/h/cell). The present report outlines the MEA optimisation results obtained within the first phase of the project (apr-16 to sep-17).

The work was initiated with a screening analysis carried out at the CNR-ITAE of different MEAs based on various precursors and combinations. The MEAs were judged based on polarisation and EIS; long-term test was performed on selected MEAs with encouraging performance. The project performance targets, with respect to catalyst loading and performance, were obtained for MEAs based on the Solvay membrane Aquivion® E98-09S, stabilised Solvay ionomer (D98-06ASX), and optimised catalysts developed by CNR-ITAE (cathode 40% Pt on C and anode: $Ir_{0.7}Ru_{0.3}O_x$). Information derived from the screening analysis was transferred to EWII in order to scale-up the selected formulations for large scale CCM coating. The activity was thus expanded to cover the ink formulation and processing for the novel ionomers and catalysts. Preparation of catalyst inks using wet electrode fabrication routes and involving high-surface catalyst powders was addressed to improve electrochemical characteristics and provide optimal rheology. Small and medium sized MEAs (130 cm^2 active area) have been spray coated by EWII utilising the optimised inks. The preliminary results are well in line with the results reported by CNR-ITAE.

The long-term test has illustrated that the decay rate declines with time. The lowest performance decay recorded for an optimised HPEM2Gas MEA is 8 µV/h @ 3 A/cm^2 after 4,000 h operation. Current and thermal cycling of single cells proved to have limited impact on degradation. Furthermore, pronounced reversible degradation has been observed at low temperature (55ºC) and too a much lower degree at high temperature (80ºC).