

Robust CCM DEVELOPMENT FOR AUTOMOTIVE APPLICATIONS

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Low temperature hydrogen fuel cells (H₂FCs) are one of the viable technologies that will help to decarbonise the transportation and energy sectors, in particular for the heavy-duty transport sector. Even a small uptake of Fuel Cell Hybrid Electric Vehicles (FCHEV) by the market will demand the manufacturing of over 250 million catalyst coated membranes (CCMs), the heart of a fuel cell, per year for just 1% of the automotive market. The industry is therefore facing an unprecedented challenge for high volume manufacturing to enable the introduction of electric vehicles using hydrogen as a fuel. This dramatic increase in demand provides both opportunities and challenges to current FC technologies, from materials and their supply chain, through manufacture, product characterisation, and recycling end-of-life products.

In order to enable mass production and global commercialization of automobiles and heavy duty trucks powered by hydrogen fuel cells it is imperative to design robust catalyst coated membranes (CCMs) capable of sustaining real life operation events such as start-up/shut-down cycles, cell reversal and exposure to impurities in hydrogen and air. At the same time, one of the greatest challenges for the fuel cell industry to unlock mass commercialization, is to thrift Pt to the loadings used in internal combustion engines (2-8 g Pt / Veh). A few viable paths have been identified to aid with the cost reduction of CCMs at volume, such as the design and integration of novel Pt and Pt alloy catalysts, advanced supports and innovative ionomers structures that allow higher oxygen permeability.

This presentation will document the latest efforts from the research and development group at Johnson Matthey Hydrogen Technologies with a particular emphasis on the development of novel CCMs able to produce record high power densities of 1.8 W/cm² at 0.60V. This leading accomplishment¹, which hits the FCH 2 JU Multi-Annual Work Plan target for light-duty vehicles for 2024, was achieved with high performance membrane electrode assemblies (MEAs) that integrates new materials and designs developed in the project in a full-size-cell (300 cm²) 4-cell stack, providing a Pt specific power density of 0.25 g Pt/kW. Advanced characterisation techniques will be documented which have helped to identify the properties that lead to catalyst activity and durability which will help to deploy hydrogen fuel cells at large volume.

1. GAIA, Grant Agreement Number 826097, <https://www.gaia-fuelcell.eu/index.php>

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