PROJECT PROFILE NO PP231

An Automotive Class MEA

OBJECTIVES

- Fabricate and test MEA components and complete MEA’s that demonstrate significant progress towards the long-term goal of an automotive MEA with a cost per unit power of $8/kW.
- Accomplish this in two stages with an interim target of $150/kW and a final target of $50/kW.
- Create a world leading MEA manufacturing capability within the UK consisting of a network of SME and large companies.
- Develop an automotive MEA with new low-cost substrate, membrane, catalyst layers and seals, achieving 0.7W/cm^2 and 2000 hrs durability, under practical automotive operating conditions.

SUMMARY

If fuel cells become competitive for powering cars they can make a major impact on environmental issues as well as easing national energy security concerns. Despite the many advantages of fuel cells it is still not clear that they can meet the cost and reliability benchmark set by the internal combustion engine. The membrane electrode assembly (MEA) is the most expensive component of a PEM fuel cell and in many ways determines the fuel cell performance, lifetime and cost. This project addresses a key priority in the DTI New and Renewable Energy Programme – to develop advanced membrane electrode assemblies for PEM Fuel Cells which would be capable of meeting the $8/kW target required for fuel cell cars.

Small-scale dynamic nonwoven line for low cost substrate fabrications (courtesy of Technical Fibre Products Ltd)

A recent US DOE study shows that the current MEA cost is around $150/kW – assuming the fuel cells are manufactured in high volumes of several hundred thousand stacks per annum. In reality, the Contractor’s assessment is that the overall MEA costs today are around $300/kW.

The MEA is defined as comprising membrane, catalyst and substrate layers with seals, which allow it to be directly assembled into a stack. Many

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MEA development strategies are based on economies of scale overcoming the cost problem for fuel cells, which, while necessary, are far from sufficient. If an idealised MEA generating 0.5 Wcm^{-2} at 0.7V, using a total 0.4 $mgPtcm^{-2}$, is considered and the lowest future price proposed for Nafion type membranes, even at very high volumes, is $\$50/m^2$ and Pt continues to trade in the $400-$600 (troy oz.) range, it can easily be seen that the cost of even this idealised MEA is some $25-30/ kW for these starting materials alone. Carbon based substrates and seals add in further costs to this figure. The route to a low cost MEA is thus lower cost materials throughout the MEA and less material per kW (ie increased performance or power density) combined with durability and manufacturability. The current situation is also that none of the critical components of today's MEAs are manufactured in the UK.

This project targets MEA cost reductions by employing innovative materials design to improve performance as well as using lower cost materials. The new materials and designs will be manufacturable and reliable when tested under realistic conditions. In fact many materials cannot readily be made at lab scale and it is the manufacturing processes themselves that determine the material properties, particularly at the interfaces. The project establishes a group of UK based companies to address the issues. The partners are assigned to different aspects of the problem in a common framework under the guidance of the Contractor, Johnson Matthey Fuel Cells. The project will thus establish a UK supply chain capable of supplying the automotive MEA.

Technical Fibre Products will focus on applying its wet-laid nonwoven technology to the development of the substrate (gas diffusion layer) with the desired properties of electrical conductivity, mechanical strength and fluid permeability. Intelicoat Technologies will address the development of processes to produce multi-layer membranes using lower cost ionomers and reinforcement materials. Primasil Silicones will bring its expertise to bear in the design and development of moulded elastomeric gaskets and seals for the MEA, that are critical to the correct functioning and mechanical robustness of the MEA. MAST Carbons will develop new carbon materials and binders to be employed in the substrate and catalyst layers. JMFC will be responsible for the development of advanced catalyst layers, offering improved performance, but at significantly reduced platinum loadings of $0.3mg/cm^2$.

The project comprises an 18 month Phase 1 development period, with a major review at this point, and a further 15 month Phase 2 activity. The project comprises 36 distinct milestone activities, which are largely component based, each with clear and quantified targets.

CONTRACTOR

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COST

The total cost of this project is £5,979,000 with the Department of Trade and Industry (DTI) contributing £3,273,000 and JMFC, TFP, Intelicoat, Primasil and MAST the balance.

DURATION

33 months – April 2004 to December 2006.

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