POSTER ABSTRACT

Second Generation PEM Fuel Cells and the Indirect Reduction of Oxygen

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2015 is a breakthrough year for fuel cell technology, with the launch of the Toyota Mirai, a hydrogen fuelled proton exchange membrane (PEM) fuel cell vehicle. The European market release is scheduled for September 2015 with an expected vehicle price around £50,000 (+VAT).[1] Although this is a major step for the global uptake of PEM fuel cells, the vehicle price is too high to generate "significant" vehicle sales. A vehicle price of around £20,000 needs to be achievable for fuel cells to make a global impact. Indeed, it is widely accepted that system cost and durability are the primary challenges facing PEM fuel cell commercialization.[2] These challenges are a result of the direct reduction of oxygen at the cathode, which requires a high Pt loading and is the main cause of durability issues experienced by fuel cell developers.

An alternative approach is to construct fuel cells with chemically regenerative redox cathodes, utilising the indirect reduction of oxygen.[3] In these fuel cells a liquid catalyst is reduced at the cathode and is subsequently re-oxidised via bubbling with air (where oxygen is reduced to water). The electrochemical reduction is relatively facile and can often be conducted at carbon, reducing the Pt requirement and eliminating the major mechanism for fuel cell degradation.

In the early 1980s, Ford Motor Company studied promising regenerative systems but could not achieve the current densities required for commercialization.[4] Over the last 10 years ACAL Energy Ltd has developed a regenerative system to a level where the performance is now competitive with conventional PEM fuel cells, suggesting this technology could have a major role in the mid-long term future.[5,6]

This presentation will discuss the advantages of regenerative fuel cell technology and the technical hurdles that remain for commercialisation.

References

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