

## Comparison of Oxygen Reduction Reaction Measurements on Platinum Electrocatalysts Utilising Rotating Disk and Floating Electrodes with those from Membrane Electrode Assemblies

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Comparison of electrochemical surface area and mass activity results for the oxygen reduction reaction, derived from experiments using the rotating disk electrode technique (RDE) between different laboratories, and between in situ and ex situ measurements is considered beset with pitfalls, and recent studies have attempted to identify sources of error and non-reproducibility<sup>1-4</sup>. That such comparison should be possible is nevertheless extremely important to new fuel cell catalyst development. Therefore, within the framework of project INSPIRE, we have developed a protocol for RDE testing and applied it to a reference Pt/C catalyst and to a developmental PtNi/C catalyst, and compared the results with those obtained using the floating electrode (FE) technique<sup>5</sup>, and with those obtained from complete membrane electrode assembly (MEA) testing within a full single fuel cell, both with regard to initial properties and those after accelerated ageing induced by voltage cycling.

For RDE measurements, a detailed testing protocol was developed to enhance the accuracy and comparability of the method, and was validated by experimental investigations. Comparable results for the activities of the Pt/C catalysts between the different laboratories were achieved. The kinetic activity of the PtNi/C catalyst was higher than that of the Pt/C catalyst, but the scatter of the data was larger in RDE measurements. Based on the results of MEA degradation studies, a modified procedure for accelerated aging in RDE measurements was developed, that was able to induce activity losses in the supported Pt catalyst without being unduly harsh for the Pt alloy catalysts. The floating electrode technique delivered similar kinetic current densities at 0.9 V as measured in the RDE, but did not require a mass transport correction, as the limiting currents were several orders of magnitude larger. In this case also mass activities at much lower potentials more representative of actual fuel cell applications were determined, namely at 0.65 V vs. RHE. Measurements of the same catalysts in small and large size MEAs provided further data. Overall, very good agreement was found for the Pt/C catalyst between data derived from RDE, FE and MEA.

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