

# **Cathode catalyst degradation in PEM fuel cells – a differential electrochemical mass spectrometry study**

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The most popular electrocatalyst used in commercial proton exchange membrane fuel cells (PEMFC) consists of platinum nanoparticles on carbon black (Pt/C) at both the anode and cathode. A serious barrier to commercialization of PEMFC is durability. Among the reasons for the performance degradation, Pt electrochemical surface area loss at the cathode due to carbon corrosion and Pt dissolution/aggregation is a major factor. The cathode is generally operated in a potential window (0.6 -1.0 V) that is thermodynamically susceptible to carbon corrosion and platinum oxidation. To make situation worse, start-stop or fuel starvation of the fuel cell can result in local cathode potentials as high as 1.4 - 1.5 V.

Cyclic voltammetry is commonly used to investigate cathode degradation mechanisms. However, the current signals from the two main reactions, carbon support corrosion and platinum dissolution caused by platinum oxidation, overlap and are impossible to resolve. Differential electrochemical mass spectrometry uses an on-line mass spectrometer to sample the working electrode in the electrochemical cell while an electrochemical potentiostat controls potential cycling. In this study, the MS was coupled to the cathode outlet of a 5 cm<sup>2</sup> single PEMFC and the potential was cycled from 100 to 1400 mV with a 10 mV/s scan rate. 50 sccm of pure hydrogen was fed to the anode and 30 sccm pure helium was fed to the cathode. Carbon corrosion products CO and CO<sub>2</sub> along with platinum oxidation related gases H<sub>2</sub> and O<sub>2</sub> exiting together from the cathode during potential cycling were detected by the MS. The mechanistic implications for PEMFC degradation will be discussed.