Measurement of the Performance of a 47-Cell PEM Stack with Impurities in the Anode Feed Stream

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A 47-cell Ballard® Nexa™ PEM stack was used to investigate the distribution of crossover gasses and feed impurities within the anode gas manifold of the stack. Separate voltage taps were applied to each MEA in the stack to measure the time-dependent potential. Safe operation of the PEM stack requires no more than .01% total inert gas under normal operating conditions; however, by leaving the exhaust valve partially open instead of allowing the system to periodically purge the exhaust line as it was designed, feeds of up to 10% inert gas were safely used in this study. By releasing exhaust gas at a constant rate while drawing a constant current from the stack, a steady-state voltage drop was observed after changing the anode feed from ultra-pure to one diluted with an inert gas such as helium or nitrogen. The results of one such experiment (Figure 1) demonstrate MEA potential decreasing in response to decreasing hydrogen concentration in the anode manifold. By analyzing MEA voltage with respect to time, the distribution of the impurity can be determined. Additionally, exhaust gas concentration was measured using gas chromatography. The aforementioned technique is shown to be useful for optimizing gas management, detecting cathode gas cross-over (internal leaks), assessing system aging, and performing other system and design diagnostics.

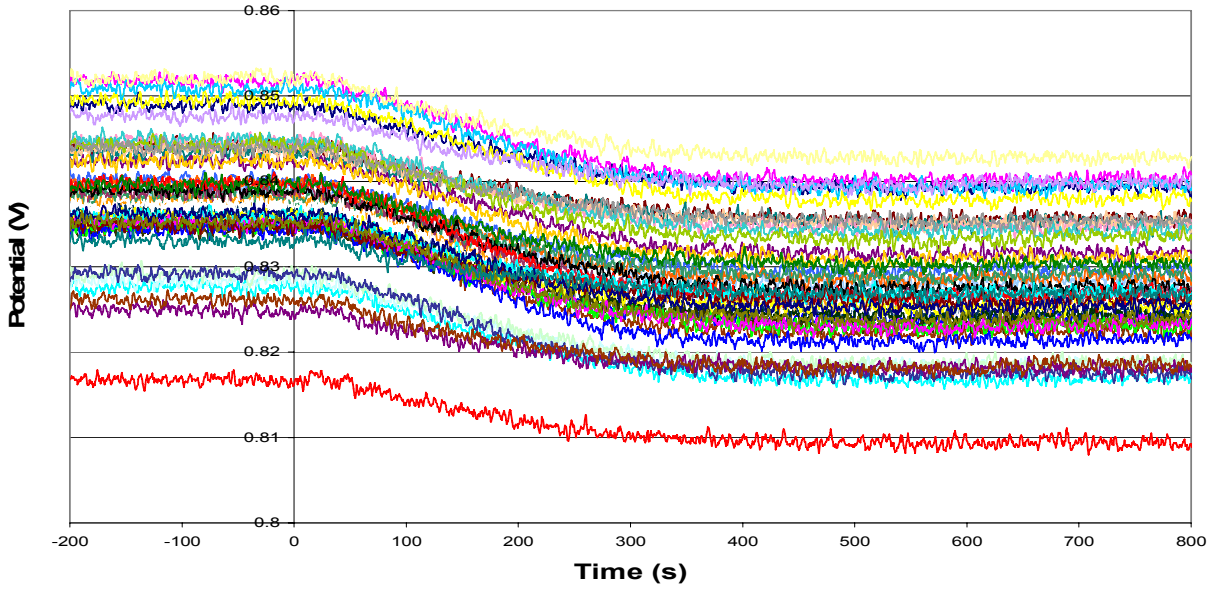

Figure 1: MEA voltage for each of the 47 in a Nexa™ stack at 75 W represented as a function of time. At t=0, the anode feed gas was switched from pure to an 8% nitrogen mixture.