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Demonstration of Enhanced Sensitivity to CO in H_2 of an Electrochemical Analyzer

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Carbon monoxide in the anode feed stream is detrimental to polymer electrolyte fuel cell (PEMFC) performance. Carbon monoxide is an impurity in hydrogen reformed from fossil fuels, or bio gas. While steam reformation of natural gas will make hydrogen affordable and available, it may produce trace amounts of CO. The ISO has set a fuel standard of 99.97% H_2 as applicable to PEMFC vehicles with a maximum allowance of 0.2 ppm for CO [1]. The standard is based on actual fuel cell poisoning data and in addition to the hydrogen grade being certified, it would be prudent to have in-line analyzers to protect expensive fuel cell components from these contaminants. Low cost in-line analyzers can also be deployed at various points in the hydrogen production and distribution system. Previous publications have demonstrated that Nafion® based sensors using platinum electrodes respond to CO [2]. This response can be used to quantitatively analyze the amount of CO present in the hydrogen fuel stream.

Carbon monoxide chemisorbs on platinum surfaces preventing hydrogen dissociation from occurring, and inherently reducing the current output that can be measured as increasing resistance of the system. The fuel quality analyzer is a 5 cm^2 membrane electrode assembly (MEA) with platinum electrodes. One electrode is low surface area Pt sputtered on carbon cloth with 0.1 mg Pt/cm^2 loading. The opposing electrode is a BASF Pt-Vulcan higher surface area 0.2 mg Pt/cm^2. Both were hot pressed on to Nafion® 117 membrane. The higher surface area electrode is positioned as the counter/reference electrode and exposed to UHP hydrogen only, while CO/H_2 is introduced at the sputtered electrode. Stripping voltammetry is used to verify the presence of CO, its amount, and to oxidize CO off the electrode's surface, which inherently regenerates the analyzer for subsequent uses.

The analyzer is designed to be operated as a hydrogen pump, with H_2 flowing on both sides. A potentiostat is used to probe the electrode with a voltage, measuring the current response, from hydrogen oxidizing on one side and reducing on the other. The inverse of the slope of the resulting line gives the resistance of the cell. Figure 1 demonstrates resistance increases over time in the presence of 1ppm CO.

The focus of this study is to investigate results obtained utilizing various CO concentrations while maintaining constant CO dosage. The operating conditions tested were 30°C and 60°C and an applied voltage bias of 0.0 V and 0.2 V. Operating conditions were varied in an effort to find optimal conditions for increased sensitivity of CO and will be presented

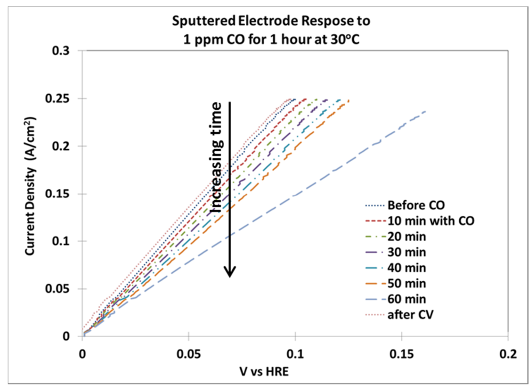

Figure 1. Resistance increases in the presence of 1ppm CO over 1 hour.

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