SUSTAINED POTENTIAL OSCILLATIONS IN PEM FUEL CELL WITH PtRu ANODE CATALYST

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The Proton Exchange Membrane (PEM) fuel cell is receiving a great deal of attention as a high efficiency, low polluting power generator. It is especially promising for transportation applications due to its high power density and low operating temperatures (about 80 °C). Improvements in the CO tolerance of the anode is key to the commercial viability for PEM fuel cell operated on reformate gas.

We are following a systematic approach in designing CO tolerant anode for the PEM fuel cells. Research efforts are first focused on the state-of-art anode electrocatalyst Pt and PtRu, in an attempt to understand the mechanism and kinetics of H_2/CO electrooxidation on these noble metal catalysts at practical fuel cell conditions. This will be followed by development of our own CO tolerant anode catalysts.

In the experimental study of PtRu anode catalyst, sustained potential oscillations are observed in a PEM fuel cell operating at constant current density with H_2/CO as anode feed. These oscillations appear when the fuel cell temperature is below around 70 °C. A threshold value exists for both the current density and the anode flow rate at a given fuel cell temperature for the onset of the potential oscillations. Temperature is found to be the most sensitive parameter. The oscillations are believed to be due to the coupling of anode electrooxidation of H_2 and CO on PtRu alloy surface, on which OH_{ad} can be formed more facile, preferably on top of Ru atoms at lower overpotentials.

Experimental conditions that lead to such potential oscillations is presented. Further, a realistic model is established based on the kinetic analysis of the reaction on PEM fuel cell anode in the presence of CO. The model can reproduce the observed oscillatory phenomenon both qualitatively and quantitatively. A comparison between experiment and simulation results is discussed.

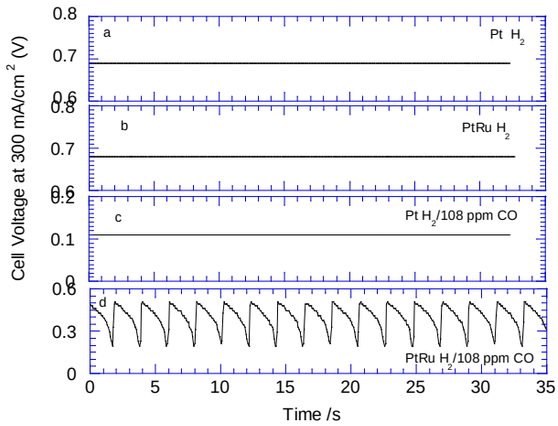

Figure 1. Fuel cell voltage pattern for (a) Pt in H_2 (b) PtRu in H_2 (c) Pt in H_2/108 ppm CO (d) PtRu in H_2/108 ppm CO. Other operation conditions are identical: cell temperature, 42 °C; current density, 300 mA/cm^2; anode flow rate, 36.4 scc/min.

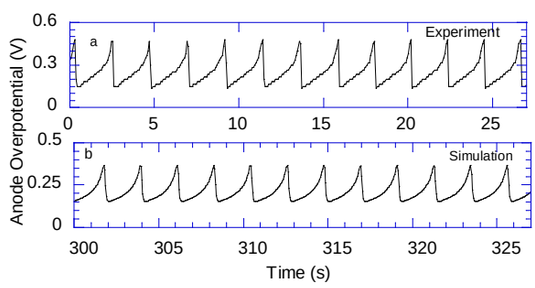

Figure 2. Comparison between experimental result and simulation. Fuel cell temperature, 42 °C; Current density, 300 mA/cm^2; Anode inlet flow rate, 48.1 scc/min.

References

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2. W. Wolf, K. Krischer, M. Lubke, M. Eiswirth and G. Ertl, *J. Electroanal. Chem*., **385**, 85 (1995).