Micro-fabricated methanol/water reformers for small PEM fuel cells

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Introduction

The reforming reaction between methanol and water is a practical method for storing and delivering hydrogen on demand to a PEM fuel cell. While the basic reaction is straightforward, careful attention to catalyst and reactor bed design is essential to avoid unwanted competing reactions, such as cracking, which leads to carbon monoxide generation that can quickly poison the anode of a PEM fuel cell.

In this contribution, we demonstrate the performance of a novel micro-fabricated reformer unit, capable of providing up to 20sccm of reformate feed to a PEM fuel cell. This unit was made of etched silicon and glass, and had integral, resistive heaters. A monolithic flow channel is packed with copper/zinc oxide catalyst material (Figure 1). Silicon micro-fabrication techniques allow more efficient use of space for such small devices, rather than simply scaling down larger reactor designs.

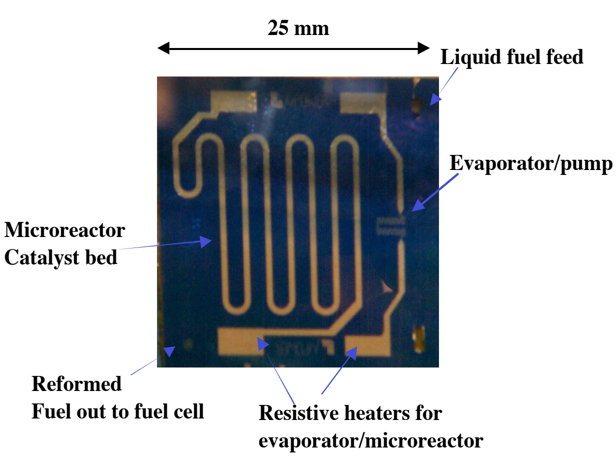

Figure 1: Methanol/water micro-reformer

A commercial 5 cm^2 MEA with a Pt/Ru catalyst was used to test the reformer unit. It utilized a serpentine flow field for the anode and a passive, air breathing cathode, in order to better model a realistic system.

Results and Discussion

The reactor was fed by a syringe pump containing 1.0:1.1 mole ratio methanol:water. Reactor operating temperature was *ca.* 200°C. The reactor was found to be selective enough for the reforming reaction that any residual CO was managed by using an air bleed of a few percent to the anode. The fuel cell was run at ambient temperature, 22°C, from the direct reformer feed and air bleed.

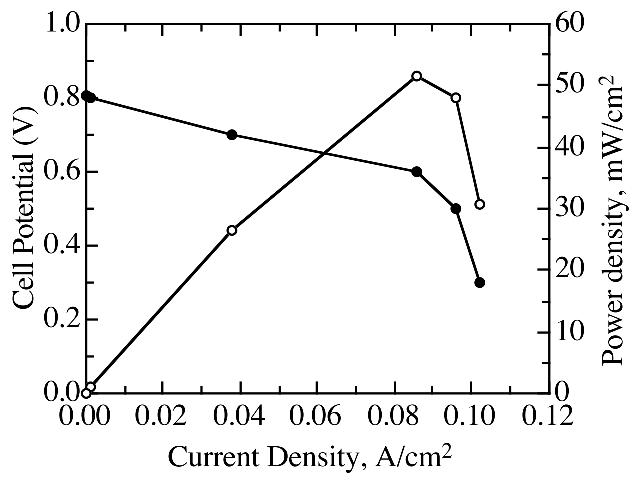

Figure 2: Fuel cell performance. Solid circles: cell potential. Hollow circles: power density. Anode gas composition: 5 sccm reformate, 0.25 sccm air bleed.

Fuel cell performance was in excess of 50mW/cm^2 at a cell potential of 0.6V (Figure 2). Performance was stable over a period of several hours.

Future work will involve lifetime testing. The micro-reactor structure and insulation will undergo further development centered on higher performance, higher gas delivery rates and minimal parasitic heating loss.

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