Development of a micro PEM fuel cell using glass bipolar plates

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INTRODUCTION

In this project, a novel micro PEM fuel cell is developed using glass (Foturan) as the substrate material for bipolar plates. Typical macro scale fuel cells with power levels higher than 100W use graphite as their bipolar plate material due to graphite's high electrical conductivity, low cost, and low density. But due to limitations in fabrication methods, graphite cannot be used in micro manufacturing applications. Silicon has been the most widely used substrate material to fabricate the bipolar plates for micro fuel cells owning to its well-defined MEMS process in the electronic field. However, MEMS processing of silicon can be limiting due to high fabrication cost. Foturan is a patented material which is photosensitive and thus can be chemically etched via lithographical means. It is highly chemically resistant, has a comparably low fabrication cost compared to silicon, and is also suitable for mass production. A fully compact single cell has been fabricated and tested (below) successfully using Foturan and has proven the viability of stacking micro fuel cells for portable electronic applications.

EXPERIMENTAL

Bipolar plates were fabricated by first a lithography step, a following heat treatment step, chemical etching step, and then a thermal bonding step. To enhance electrical conductivity, silver was deposited onto the top of bipolar plates by sputtering. Al-electrodes were then inserted and UV-bonded. The MEA used was cut from typical MEA standards sold off-the shelf. Testing of the single cell was done using 99.9% pure hydrogen and Air to enhance forced-flow inside the cell.

RESULTS & CONCLUSION

Below shows the fabricated micro fuel cell fully packed (left) with the performance evaluation curve of it (right, I-V-W curve). It has been shown that the power density obtained (154mW/cm^2) was comparable to the state of the art performance of ongoing micro fuel cell research.

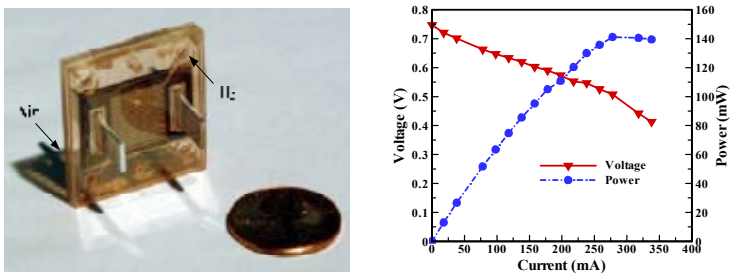

Fig. 1 Fully integrated micro PEM fuel cell (left) and the corresponding I-V-W curve (right)