CHAPTER 5

CONSLUSIONS

5.1 Conclusions

In this study, a novel design of multi-sectional flow field for cathode side of small or micro DMFC is presented. An actual single DMFC integrated with the multi-sectional flow field is fabricated and tested. The multi-sectional flow field was fabricated successfully using MEMS and precision machining processes. It includes a parallel-channels section, buffer zone and recycling channels. From the preliminary tests of water wetting process in the flow field and the *in-situ* observations of actual single DMFC, we got conclusions as follows:

1. Water can be removed under medium air flow rate on hydrophobic surface due to the lower flow resistance, but may suffered from partial flooded problem, especially in lower air flow rate. Besides, water can be removed by the capillary force on hydrophilic surface even without air inlet. A flow field with hydrophilic surface can provide a favorable recycling ability compared with hydrophobic surface in this design.
2. The *in-situ* observation for hydrophilic parallel channels shows the different behaviors of water respectively associated with stainless steel mesh and carbon cloth. As the stainless steel mesh, is slightly hydrophilic, water tends to be trapped in the texture to result in water flooding.
3. The *in-situ* observation for hydrophilic parallel channels shows that the

liquid water can form thin films on both sides of the channels. Water transport can be observed by the slight regular motion of the film. With suddenly increasing of air flow rate, the water films clearly turn thinner. And, there is no clogging problem even at a low flow rate. This proved the feasibility of the flow field design in this study.

4. Gold-plated flow field is further fabricated to increase the electric conductivity and maintains the hydrophilic property. Test result shows that the flow field with gold-plated surface and deeper channel depth has increase rates in maximum current and power output for about 4.6 and 5.6 times, respectively, than flow field with SiO_2-induced surface.

5.2 Future Work

In this work, the power output of DMFC is still too low. Some of the possible reasons are high electronic resistance in the material or the contact resistance between materials. We therefore suggest that silicon is not suitable as the bipolar plate due to its low rigid strength. Other materials, such as gold-plated stainless steel, may be a better choice. Flow field with gold-plated stainless steel using electrical discharge machine (EDM) or micro-carving fabrication process is in progress in our laboratory.