Segmentation of polymer electrolyte fuel cell (PEFC) with sub–millimeter resolution in the land-channel direction.

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Abstract:

Water management in the PEFC has been subjected to immense research. Flooding of the water in a catalyst layer and a gas diffusion layer lowers the concentration of reactants at the reaction sites thus the voltage decreases. The geometry of a PEFC bipolar plate is consisting of the flow channels and the lands to transport reactants and electrons to the reaction sites, respectively. Generally, under the land areas the transport distance for the reactants and the products is longer than in the channel areas hence the current generation becomes uneven. At high current density operation, the current distribution could be significantly uneven which is related to the effect of mass transport and the thermal transport properties on the water removal.

Along the flow channel current distribution in the PEFC is a widely used diagnostic technique. However, this technique doesn't provide any information on the current distribution in the land-channel direction. Few experimental studies [1] and many computational studies have predicted the current distribution under the land and the flow channel. Therefore, to improve the performance and the durability of the PEFC, this study is important.

In this work a novel experimental technique was developed to measure the unevenness in current at sub-millimeter scale, due to the land-channel geometry. In a cross flow arrangement, the sub-millimeter segmentation was applied in a direction perpendicular to the active area of 3mm x 3mm. At cathode side, a graphite plate with single flow channel and two adjacent lands was used, whereas anode flow field was segmented into the nine segments which are porous carbon papers to transport hydrogen and electrons; each segment is 300 microns wide to obtain high spatial resolution.

Reference

[1] I. A. Schneider, S. von Dahlen, A. Wokaun, and G.G. Scherer. *J. Electrochem. Soc.*, **157** B338 (2010)