European Fuel Cell Car Workshop
March, 1st - 3rd 2017, Orléans, France

Toward a New PEMFC Stack Design for Controlled Water Management

G. Maranzana, J. Dillet, A. Thomas, S. Abbou, S. Didierjean, O. Lottin

Laboratoire d'Energétique et de Mécanique Théorique et Appliquée,
LEMTA UMR 7563 CNRS-Université de Lorraine, 2, avenue de la Forêt de Haye
54518 Vandoeuvre-Lès-Nancy, France
Sophie.didierjean@univ-lorraine.fr

Water management remains one of the most important issues for optimal performances and lifetime of PEMFC. In this context, an experimental approach was developed in order to study the influence of the temperature field on water transport in a single cell. The experiments consisted in creating various thermal configurations by imposing a temperature difference between the two bipolar plates and in measuring, at the anode and at the cathode, the average temperature of the electrodes and water fluxes by means of water balance. The results obtained for three thermal configurations put forward a strong influence of the temperature profile on the water transport. On the whole, water fluxes were directed as the heat fluxes which depend on the temperature difference between the MEA and the plates [1]. These results show that water transport in the cell can be managed by a control of the temperature difference between the anode plate and the cathode plate, which is possible for a single cell but not for all the cells in a stack with standard configuration. Therefore a new stack design (prototype presented in figure 1) was proposed in order to make possible a differentiate thermal control of the anode plate and of the cathode plate [2]. Internal water management through thermal control also allows reducing hydrogen starvation when the fuel cell operates in dead end mode at the anode. Indeed, if the temperature at the anode is higher than at the cathode, the water produced by the electrochemical reaction mainly flows through the cathode side: the water content in the hydrogen channel is then reduced and the channel can remain closed during a longer period. As a consequence, hydrogen consumption decreases as well as the occurrence of the conditions giving rise to electrodes materials degradations [3].

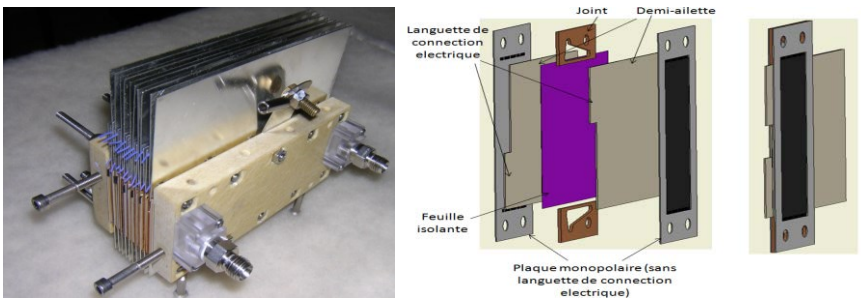

Figure 1. New stack design prototype

References

[1] A. Thomas, G.Maranzana, S. Didierjean, J. Dillet, O. Lottin, Measurements of Electrode Temperatures, Heat and Water Fluxes in PEMFC: Conclusions about Transfer Mechanisms, Journal of the Electrochemical Society, Vol. 160, N°2, pp. F191-F204, 2013.
[2] G. Maranzana, O. Lottin, J. Dillet, A. Thomas, S. Didierjean, Patent. Architecture fluidique, thermique et électrique d'un stack de pile à combustible, n° PCT/EP2013/070043. 2013.
[3] S. Abbou, J. Dillet, G. Maranzana, S. Didierjean, O. Lottin, Impact of Water Management on Local Potential Evolutions during PEM Fuel Cell Operation with Dead-Ended Anode, ECS Transactions; Vol. 69, N°17, pp. 1267-1276, 2015.