Title:

Experimental methodology for modeling water diffusion transport in a PEMFC stack with respect to membrane temperature and resistance

Authors & affiliations:

A. P. Husar, M. Serra, J. Riera*
Institut de Robòtica Informàtica Industrial (UPC/CSIC), Spain
ahusar@iri.upc.edu

Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

This work proposes an experimental methodology for modeling water diffusion transport in a PEMFC, which is applied to a commercially available fuel cell stack. The effective water vapor diffusion coefficient and its dynamical variation for the stack under no load conditions are determined for the purpose of isolating the transfer of water across the 5 layer MEA (which include the two gas diffusion layers the two catalysts and the membrane) in relation to temperature and membrane resistance. This coefficient is dependent on the material properties of the components in the fuel cell, as well as on the membrane temperature and water content [1][2]. The dynamics of the membrane temperature and water content are established experimentally.

The controlled variables in this experiment are the water vapor partial pressures at the inlets and the temperature of the fuel cell. Experimental procedure is to independently vary the water vapor partial pressures and fuel cell temperature to obtain the water transport across the membrane, membrane resistance, and total resistance.

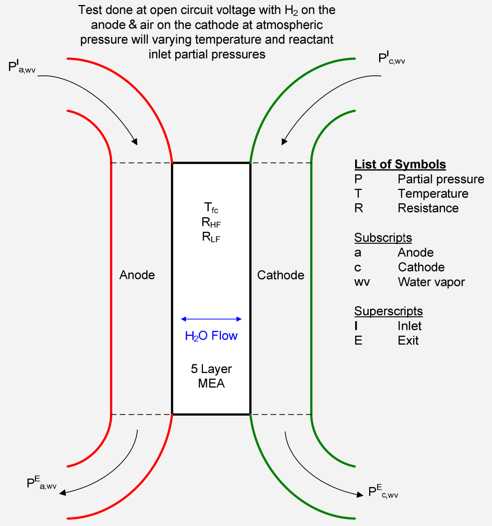

Fig. 1. Schematic diagram of fuel cell water transport model

The experimental setup for this study is based on a 21 cell PEMFC stack with an open cathode. An environmental chamber controls the fuel cell temperature and the inlet dew point temperature of the cathode reactant. The anode reactant inlet water vapor partial pressure is maintained by a membrane based humidifier which is controlled with a dew point sensor. The measured variables are the outlet dew point temperatures, membrane resistance through continual high frequency electrochemical impedance spectroscopy (EIS), and total resistance through full frequency spectrum EIS at steady state conditions.

The study determines the effective diffusion coefficient and membrane resistance from 10ºC to 70ºC and 10% to 100% relative humidity. The dynamics of the membrane temperature and water content is used to determine the distribution of water in the 5 layer MEA.

References:

1. T.E. Springer, T.A. Zawodzinski, S. Gottesfeld, J. Electrochem. Soc.138 (8) (1991)
2. T.V. Nguyen, R.E. White. J. Electrochem. Soc. 140 (8) 1993