Modeling Proton Transport in Hydrophobic Polymeric Electrolytes

Miguel Andrews[1]

[1]University of the West Indies, St. Augustine, Trinidad and Tobago

Abstract

The Polymer Electrolyte Membrane fuel cell is one of the most promising green technologies for addressing portable, as well as transportation power needs. However, the science behind the fuel cell, in many regards, is still an enigma, and even more so, with the vast numbers of novel materials created annually; designed to offset issues related to durability, conductivity, cost-effectiveness and manufacturability of fuel cell components.
This research presents a computational model in COMSOL that shows the rate of proton transport in a novel hydrophobic polymer electrolyte and is based on a two phase hydraulic model. The model provides its user with a visual approach for assessing a polyelectrolyte based on its microstructure and also provides insight into potential mechanisms of species transport within the material.

Reference

1.Spiegel, C. PEM Fuel Cell Modeling and Simulation Using Matlab 2008.
2.Springer, T. E. Modeling and Experimental Diagnostics in Polymer Electrolyte Fuel Cells Journal of The Electrochemical Society, ECS, 1993, 140, 3513.
3.Bykolu, A. Review of proton exchange membrane fuel cell models International Journal of Hydrogen Energy, 2005, 30, 1181-1212.
4.Eikerling, M.; Kornyshev et al. Electrophysical Properties of Polymer Electrolyte Membranes: A Random Network Model The Journal of Physical Chemistry B, American Chemical Society, 1997, 101, 10807-10820.
5.Gurau, V. et al. Two-dimensional model for proton exchange membrane fuel cells AIChE Journal, 1998, 44, 2410-2422.
6.Kreuer, K. On the development of proton conducting polymer membranes for hydrogen and methanol fuel cells Journal of Membrane Science, 2001, 185, 29-39.
7.Li, Q. et al. Approaches and Recent Development of Polymer Electrolyte Membranes for Fuel Cells Operating above 100 C Chemistry of Materials, American Chemical Society,2003, 15, 4896-4915.
8.Thiam, H. S. et al. Overview on nanostructured membrane in fuel cell applications International Journal of Hydrogen Energy, 2011, 36, 3187-3205.
9.Motupally, S. et al. Diffusion of Water in Nafion 115 Membrane Journal of the Electrochemical Society, 2000, 3171-3177.
10.Fuel cell fundamentals / Ryan P. O'Hayre ... [et al.]. Hoboken, N.J. : John Wiley & Sons, c2009.
11.Bruce, Peter G.. Solid State Electrochemistry. Cambridge University Press, 1994.

Figures used in the abstract

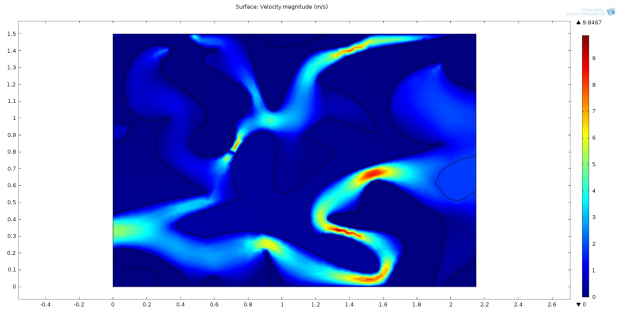

Figure 1: Velocity profile of steam-like amorphous phase

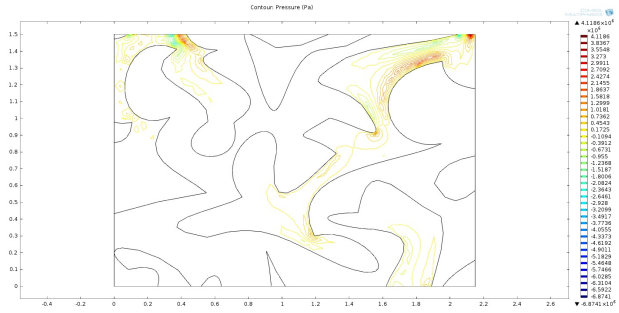

Figure 2: Pressure profile of steam-like amorphous phase

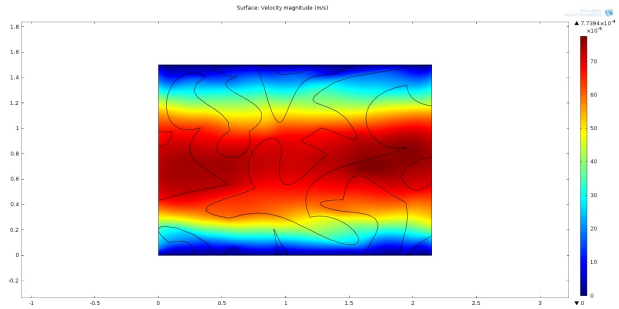

Figure 3: Velocity profile of polymer-like amorphous phase

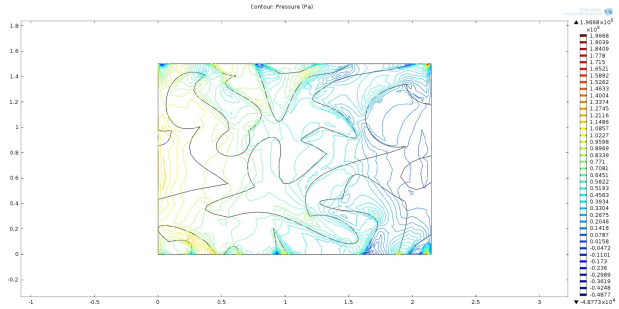

Figure 4: Pressure profile of polymer-like amorphous phase