

Proton exchange membrane fuel cell model

Abstract: A Proton Exchange Membrane (PEM) fuel cell combines hydrogen and oxygen gas to produce electric current and water. The reactant gases flow in channels, diffuse to catalyst sites on either side of the membrane, which conducts protons and also transports water. The membrane will not conduct protons if it is dry. We begin with a simplified model of the electrochemistry and the role of membrane hydration in the current generated. A simple model of a single channel fuel cell will be developed as a system of ordinary differential equations (ODEs) that will be solved numerically with MATLAB. Solution techniques for the counterflow case (where oxidant and fuel flow in opposite directions in their channels on either side of the membrane) will be developed and compared. As time permits, the model will be extended to include effects of condensation in the channels; channel diffusion losses; coolant models; and electrode layers.