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Three-Dimensional Numerical Simulation of a Straight Channel Proton Exchange Membrane Fuel Cell

Hu, G. L. [1] ***and Chen, S.*** [1]

1) Clean Energy and Environment Engineering, Key Laboratory of MOE of China, Zhejiang University, Hangzhou310027, China.

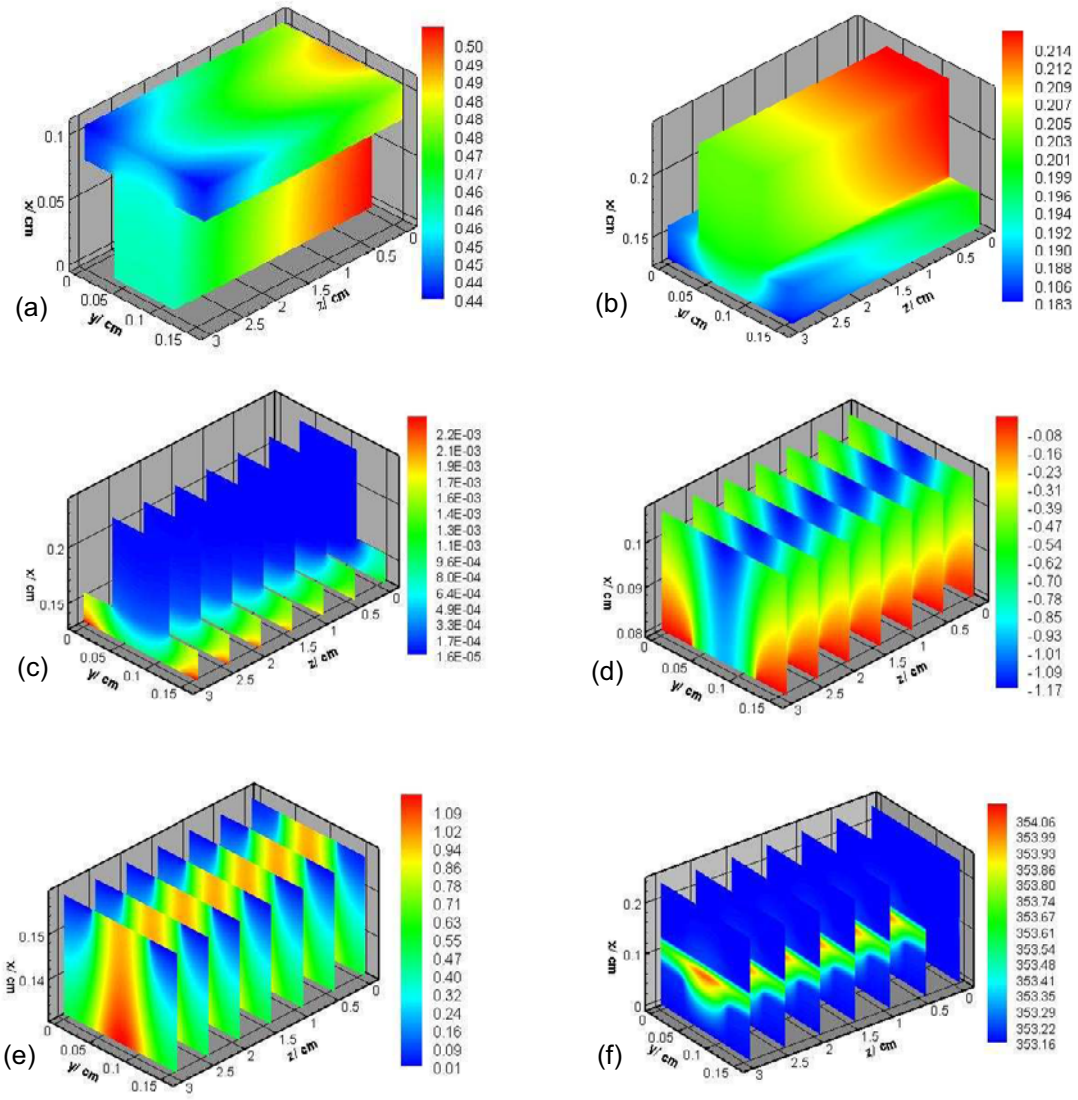

Fig. 1. Computed results of characteristic parameters. (a) Hydrogen mass fraction; (b) Oxygen mass fraction in the cathode; (c) Liquid saturation of water in the cathode; (d) Carbon phase potential in the anode(mV); (e) Carbon phase potential in the cathode(mV); (f) Temperature.

A comprehensive gas-liquid two-phase mathematical model is developed to better study transport phenomena in the whole proton exchange membrane fuel cell (PEMFC). Almost all important transport phenomena such as fluid flows, heat transfer, mass transfer, electrochemical kinetics, and charge transfer, as well as the effect of phase change on mass transfer and temperature field are accounted for in this model. As a result of electrochemical reaction, hydrogen and oxygen are consumed, which cause the mass fraction decreasing along the flow direction, illustrated as (a) and (b). As a product of the electrochemical reaction, water is generated in the cathode, which makes liquid saturation of water increases along the flow direction, as shown in (c). Carbon phase potential loss is very small with the order of 1 mV because the electron conductivity is very high, as shown in (d) and (e). In (f), the peak value of temperature lies in the middle of membrane for the ohm heating of proton current.

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