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Polymer Electrolyte Membrane (PEM) Fuel Cells Modeling and Optimization ZHUQIAN ZHANG, XIA WANG, ZHONGYING SHI, Oakland University, XINXIN ZHANG, FAN YU, University of Science and Techology Beijing —
Performance of polymer electrolyte membrane (PEM) fuel cells is dependent on operating parameters and designing parameters. Operating parameters mainly include temperature, pressure, humidity and the flow rate of the inlet reactants. Designing parameters include reactants distributor patterns and dimensions, electrodes dimensions, and electrodes properties such as porosity, permeability and so on. This work aims to investigate the effects of various designing parameters on the performance of PEM fuel cells, and the optimum values will be determined under a given operating condition.A three-dimensional steady-state electrochemical mathematical model was established where the mass, fluid and thermal transport processes are considered as well as the electrochemical reaction. A Powell multivariable optimization algorithm will be applied to investigate the optimum values of designing parameters. The objective function is defined as the maximum potential of the electrolyte fluid phase at the membrane/cathode interface at a typical value of the cell voltage. The robustness of the optimum design of the fuel cell under different cell potentials will be investigated using a statistical sensitivity analysis. By comparing with the reference case, the results obtained here provide useful tools for a better design of fuel cells.

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