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Analysis and design of PEM fuel cells

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Abstract

This paper presents a detailed numerical investigation of the transport and electrochemical phenomena involved during the operation of a single proton exchange membrane (PEM) fuel cell on reformate feed with a view to developing optimal design and operating conditions. A one-dimensional non-isothermal model, validated with experimental data, is utilized to evaluate the fuel cell performance over a wide range of design and operating parameters that affect the thermal response and water management. Based on a systematic parametric analysis on the various physical and electrochemical phenomena, feasible operating regimes and optimal design conditions are identified with the objective of maximizing the power density subject to constraints. Overall, this paper illustrates a methodology for using physics-based models for cell design and optimization.

Keywords: PEM fuel cell; Mathematical model; CO poisoning; Cell optimization