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Reactant consumption analysis in microchannel based fuel cells
JOSEPH D'ALESSANDRO, PETRU FODOR, Cleveland State University, Department of Physics — In this work a miniaturized fuel cell design based on microchannels using liquid fuel and oxidizer streams is optimized for improved fuel usage. This particular design exploits the laminar nature of the fluid flow at small Reynolds numbers to keep the fuel and oxidizer confined in the vicinity of the corresponding electrodes without the need of a proton exchange membrane. Thus typical issues associated with the proton exchange membrane, such as reactant crossover, membrane dry-out and fouling are avoided. While the long term functional degradation effects associated with a physical membrane are eliminated, for an arbitrarily chosen geometry the slow thermal diffusion limits the efficiency of the cell due to the formation of depletion layers close to the electrodes. The performance of the cell is sensitive to geometry and rate of fluid flow with high aspect ratio cells operated at high Peclet number regimes being the most efficient.

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