Flow field plate modeling and simulation in Direct Methanol Fuel Cells

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Abstract

Direct methanol fuel cells (DMFCs) have emerged as an attractive solution to the present day energy crisis. It is a major challenge to transform a laboratory scale production of fuel cells to an industrial scale in terms of throughput, operating lifetime, cost, reliability, and efficiency. The performance of these fuel cells depends primarily on the design of the flow field bipolar plates which control the reactant distribution on the reaction surface, removal of water at the same pressure drop, maximization of cell voltage, uniformity of current density over the entire surface area, and stability of output. In this work, we investigate two different flow fields *viz.*, single and double serpentine to determine their optimum flow field using numerical models. The model accounts for the mass transfer relations inside the flow channel, the electrodes and the diffusion layers, and electrochemistry. COMSOL Multiphysics 5.3a is utilized to simulate the numerical model. Polarization curve, current density distribution, oxygen distribution and water mass distribution are introduced as the criterions to assist the optimization of proposed flow field. The study concludes that increasing the number of channels increases the water removal, reactant distribution and reduces the pressure drop however requires a relatively increased active area.