Numerical Investigation of Cathode Water Management in Direct Methanol Fuel Cell with Micro-porous Layer

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Abstract: Water flooding in the cathode is considered as one of the most important factors that impede the performance of direct methanol fuel cells (DMFCs) during the operation of high current density. Therefore, it is essential to study water management of cathode in DMFC. In this work, a two-dimensional, steady-state, two-phase, mass-transport model of DMFC with micro-porous layer (MPL) was developed considering methanol crossover and water crossover processes. Emphasis is placed on investigating parameter design of cathode to relieve flooding in DMFC, further to improve cell performance. The effects of MPL parameters, including porosity and thickness, on water distribution in cathode porous region were studied. The results show that the relationship between porosity and water content is nonlinear. It is found that there exists an optimal MPL porosity value, 0.4, to make water content in MPL reach the lowest level. Additionally, the thickness of MPL is also closely related to water content of cathode. MPL thickness is positively correlated with water content in MPL. On the other hand, the porosity of backing layer has vital effect on cell performance. It is also found that when the backing layer porosity increases to 0.6, the peak power density can be as high as 60.2 m W/cm2.

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