Direct Methanol Fuel Cell Operating With Concentrated Methanol
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Mass Transport Through Porous Media

Transport in the porous layer

\[ Q = \left( -\frac{k \cdot A}{\mu} \cdot \frac{\Delta p}{\delta} \right) + \left( -D_{\text{eff}} \cdot A \cdot \frac{M}{\rho} \cdot \frac{\Delta c}{\delta} \right) \]

Fuel Consumption rate

\[ Q = \frac{I \cdot M}{n \cdot F \cdot \rho} \]

- \( Q \) = volumetric flowrate (m³/sec)
- \( k \) = permeability (m²)
- \( A \) = cross-sectional area (m²)
- \( \mu \) = dynamic viscosity (Pa·sec)
- \( \delta \) = length over which the pressure drop takes place (m)
- \( D_{\text{eff}} \) = effective diffusivity (m²/sec)
- \( M \) = molecular weight of fuel (gm/mole)
- \( \rho \) = fuel density (gm/mL)
- \( \Delta c \) = concentration difference (mole/L)

Matching the rate of discharge of fuel through the porous structure with the fuel consumption at the DMFC anode reduces the methanol crossover

Experimental

Cells are operated with continuous anode flow

Single Cell Performance Improvement
Target Goal: 1000 Wh/L

Experimental

Two-Cell Stack Initial Demonstration

Energy 15.478 W*hr
GFED 702 W*hr/L
%U 58%
Eavg 0.44 V
Pavg 35 mW/cm²
Pmax 38 mW/cm²
Ravg 5 mOhm

Modeling

Meshing the structure

Methanol Stream Pathlines

Methanol Velocity on the Lands

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