Direct Methanol Fuel Cell Operating With Concentrated Methanol

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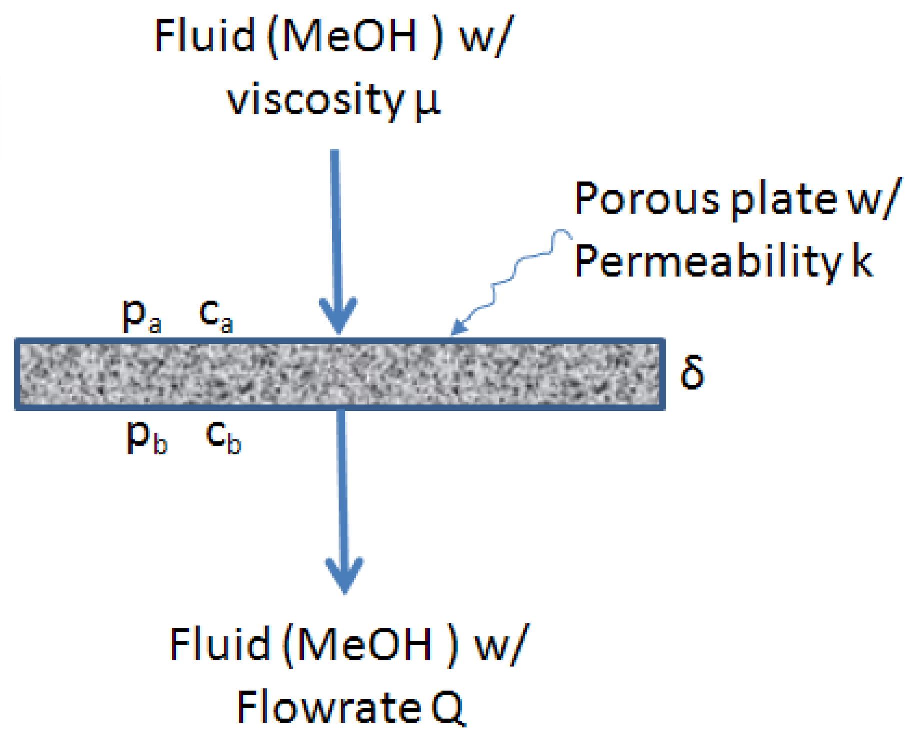
Mass Transport Through Porous Media

Transport in** the **porous layer

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

Q = volumetric flowrate (m^3/sec)
k = permeability (m^2)
A = cross-sectional area (m^2)
Δp = pressure difference (Pa)
μ = dynamic viscosity (Pa*sec)
δ = length over which the pressure drop takes place (m)
D_{eff} = effective diffusivity (m^2/sec)
M = molecular weight of fuel (gm/mole)
ρ = fuel density (gm/mL)
Δc = concentration difference (mole/L)



Fuel Consumption rate

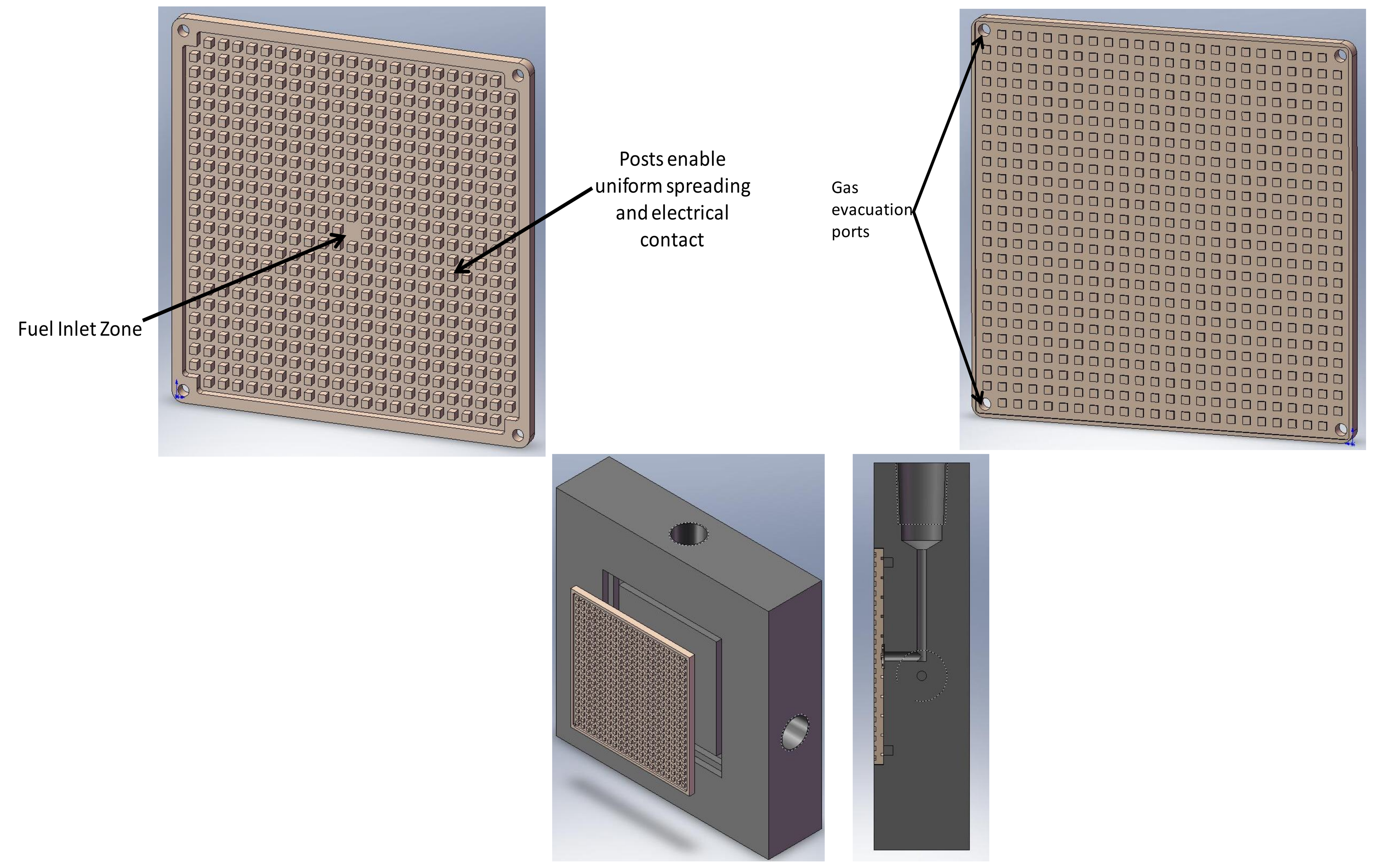
$$Q = \frac{I}{n \cdot F} \cdot \frac{M}{\rho}$$

Q = volumetric flowrate (m^3/sec)
I = operating current (Amps)
n = nr. of electrons exchanged (eq/mole)
F = Faraday's number (C/eq)
M = molecular weight of fuel (gm/mole)
ρ = fuel density (gm/mL)

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

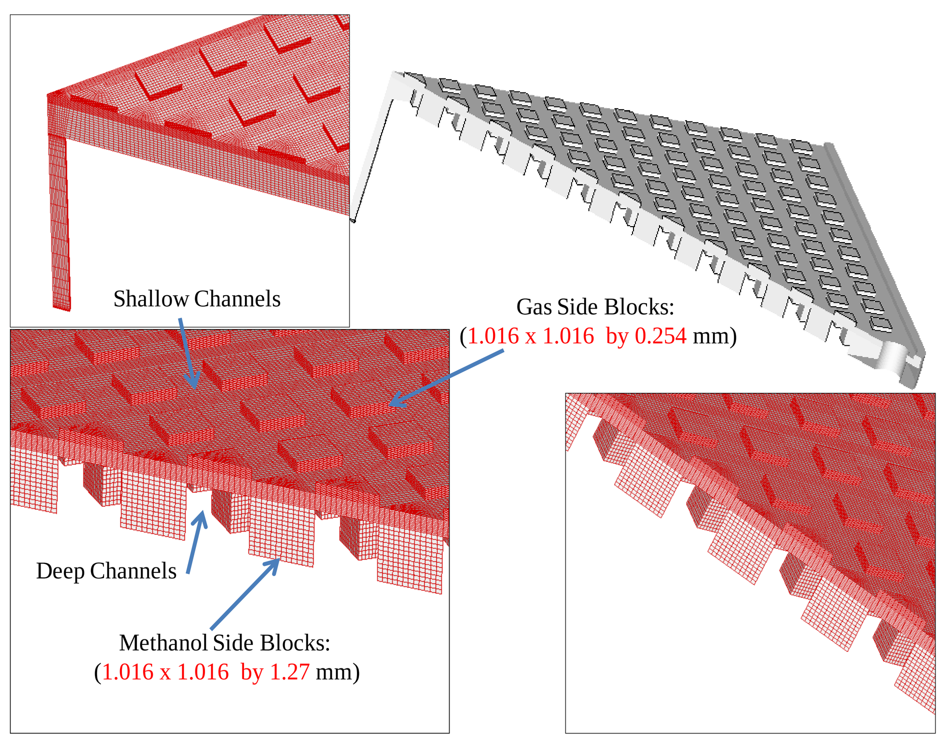
Diffuser Construction

Integrated flow field – diffusion layer (IFDL)

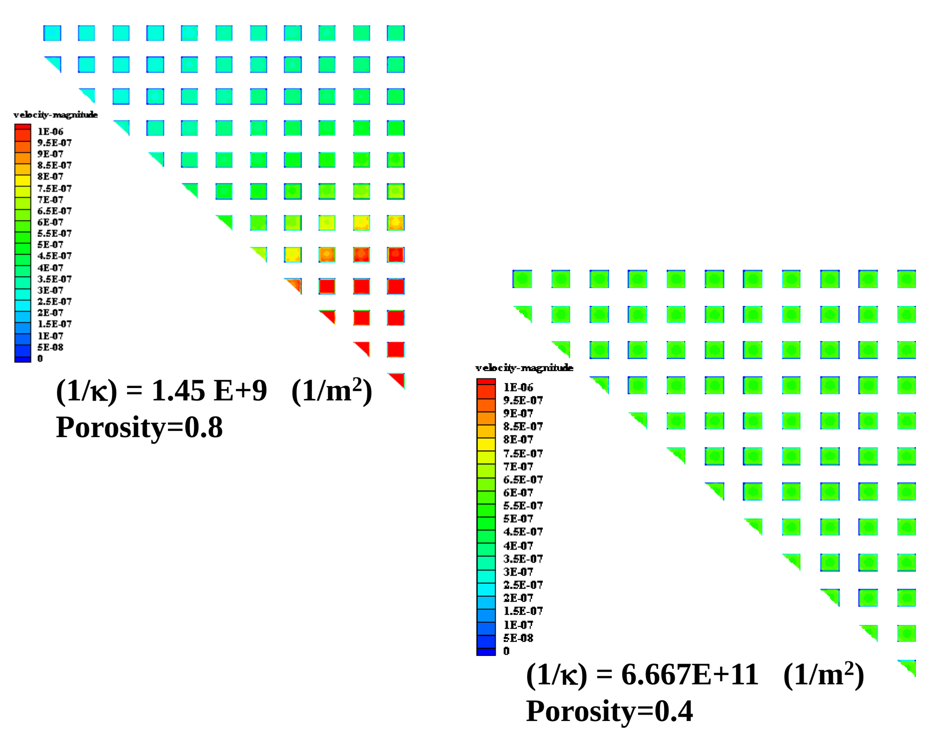


Modeling

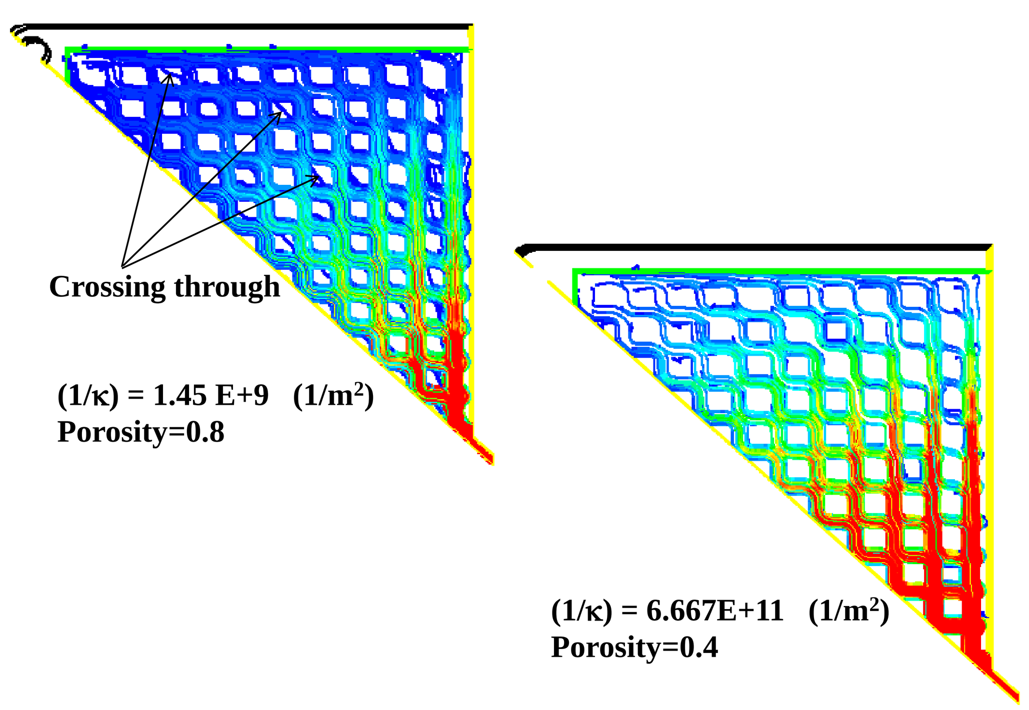
Meshing the structure



Methanol Velocity on the Lands

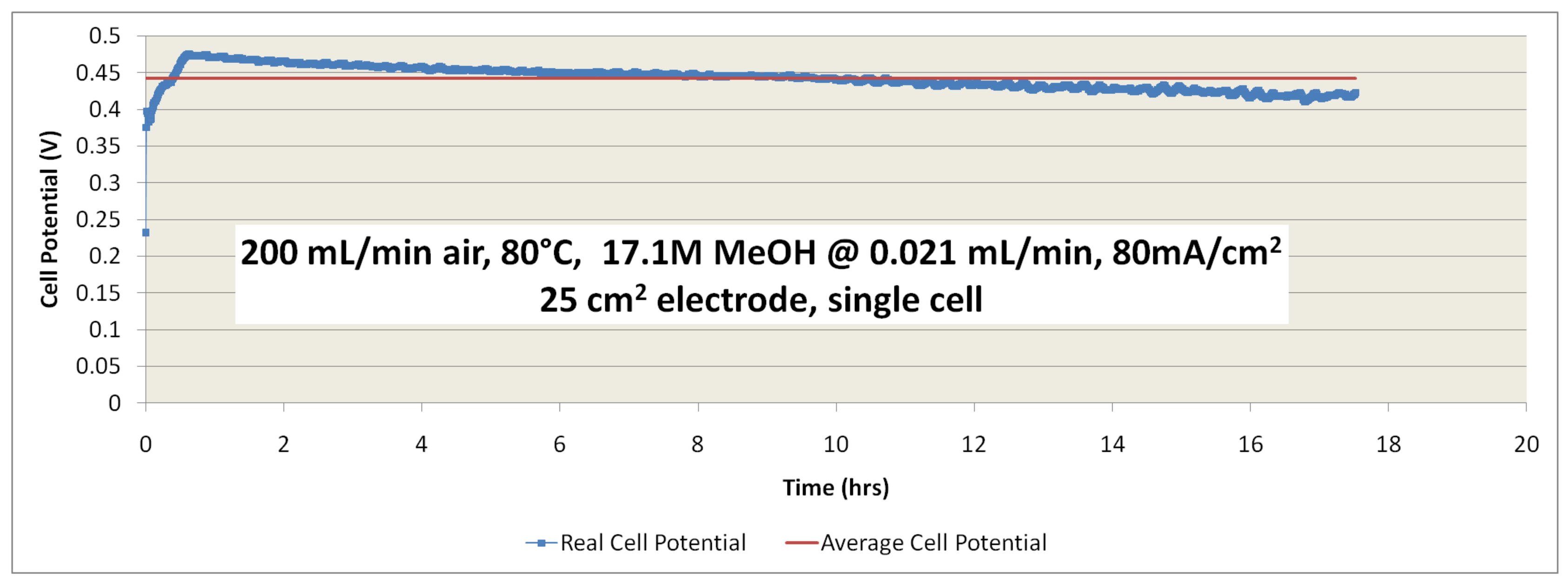


Methanol Stream Pathlines



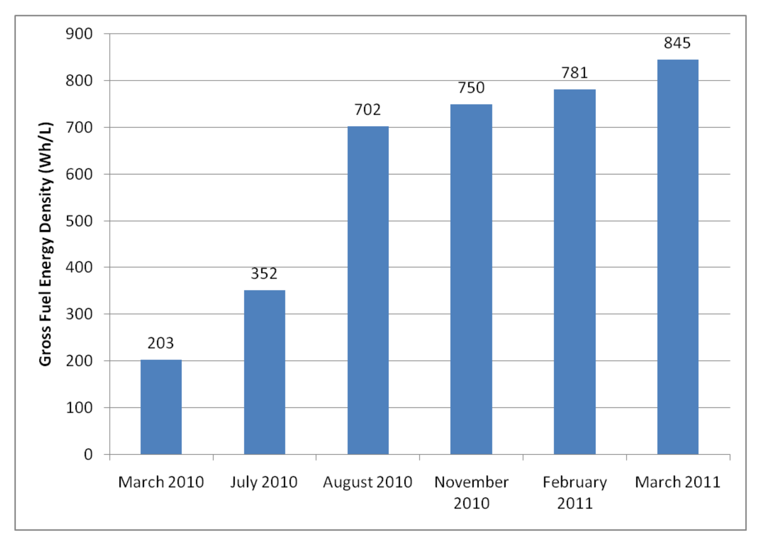
Experimental

Cells are operated with continuous anode flow

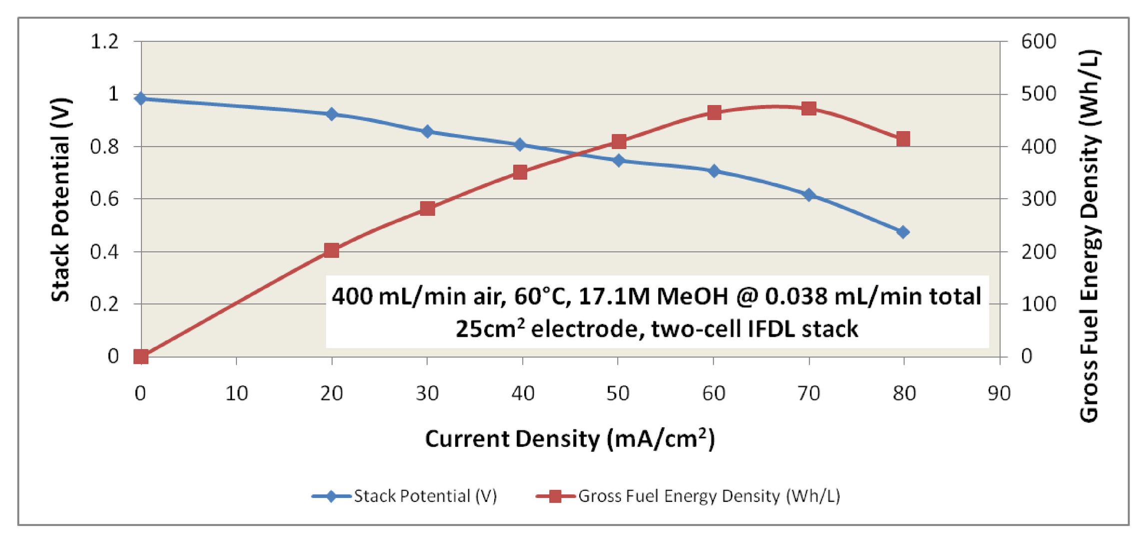


Energy	15.478	W*hr
GFED	702	W*hr/L
%U	58%	
Eavg	0.44	V
Pavg	35	mW/cm2
Pmax	38	mW/cm2
Ravg	5	mOhm

Single Cell Performance Improvement
Target Goal: 1000 Wh/L



Two-Cell Stack Initial Demonstration



NuVant Systems Inc.
Advanced Fuel Cell Technology