New MEA Materials for Improved DMFC Performance, Durability and Cost

Kick-Off Meeting

PolyFuel

Friday, August 21, 2009
Philip Cox
Vice President,

Product Development

BUILDING
FUEL CELL
SOLUTIONS

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Project Overview and Partners

- Two and half years
  - Target: November 2009 through May 2012
  - Project not yet started
- Budget
  - Total: $3,116,971; DOE: $2,493,577
  - Year 1 - $ 1,610,241 DOE: $ 322,048
  - Year 2 - $ 1,506,730 DOE $ 301,346
  - Cost Share: 20%
- Partners:
  - Northeastern University
    - Testing and catalyst development for improved performance and durability
  - Johnson Matthey
    - MEA fabrication scale up and MEA optimization

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Project Objectives

- Leverage the PolyFuel Passive water recovery MEA design to improve
  - Cost
    - Improved manufacturability
    - Lower catalyst loading
  - Durability
    - Improved durability at low catalyst loading
  - Performance
    - Improved performance

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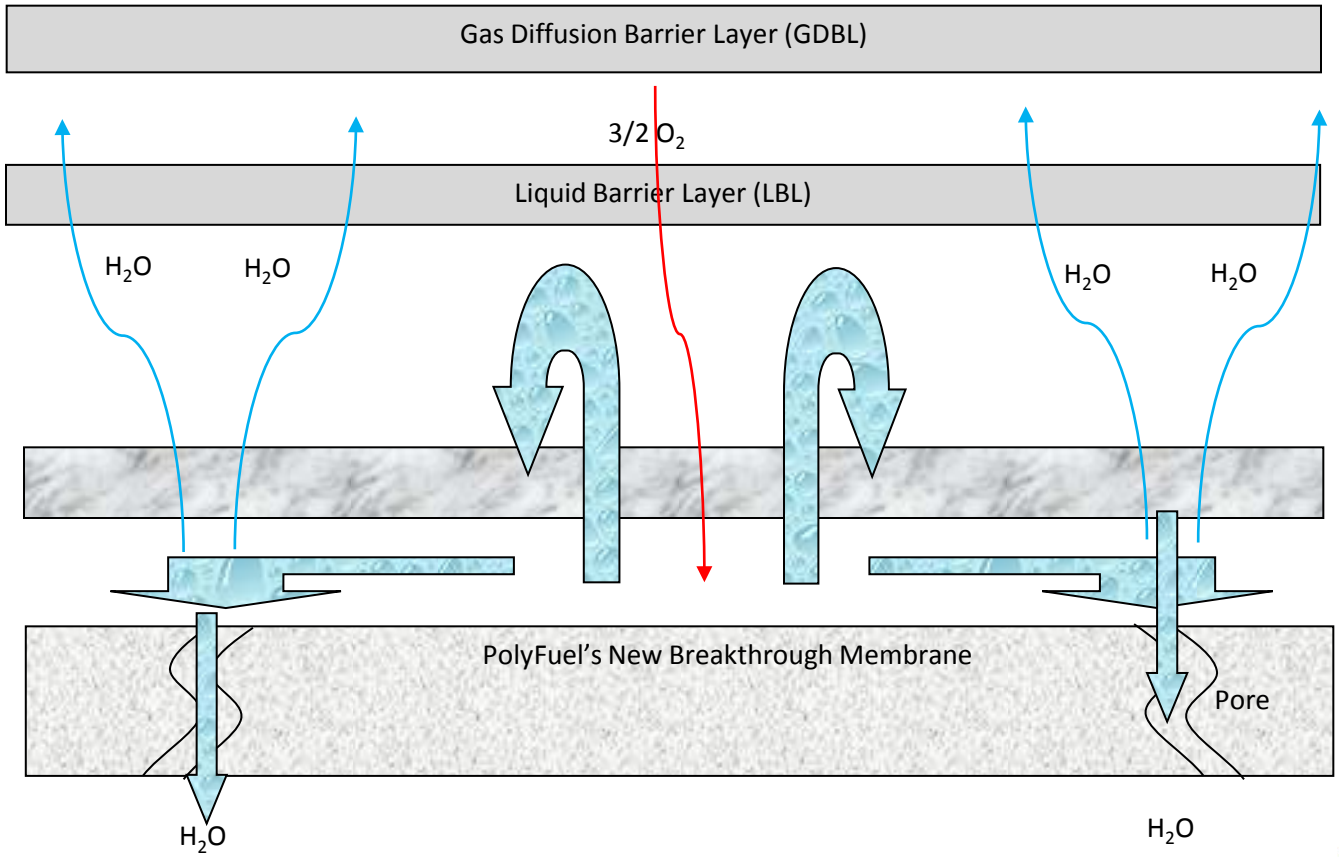
MEA Approach

- Internal Water Recycling & Water Balance 1 of the 3 water molecules created on the cathode must be recycled



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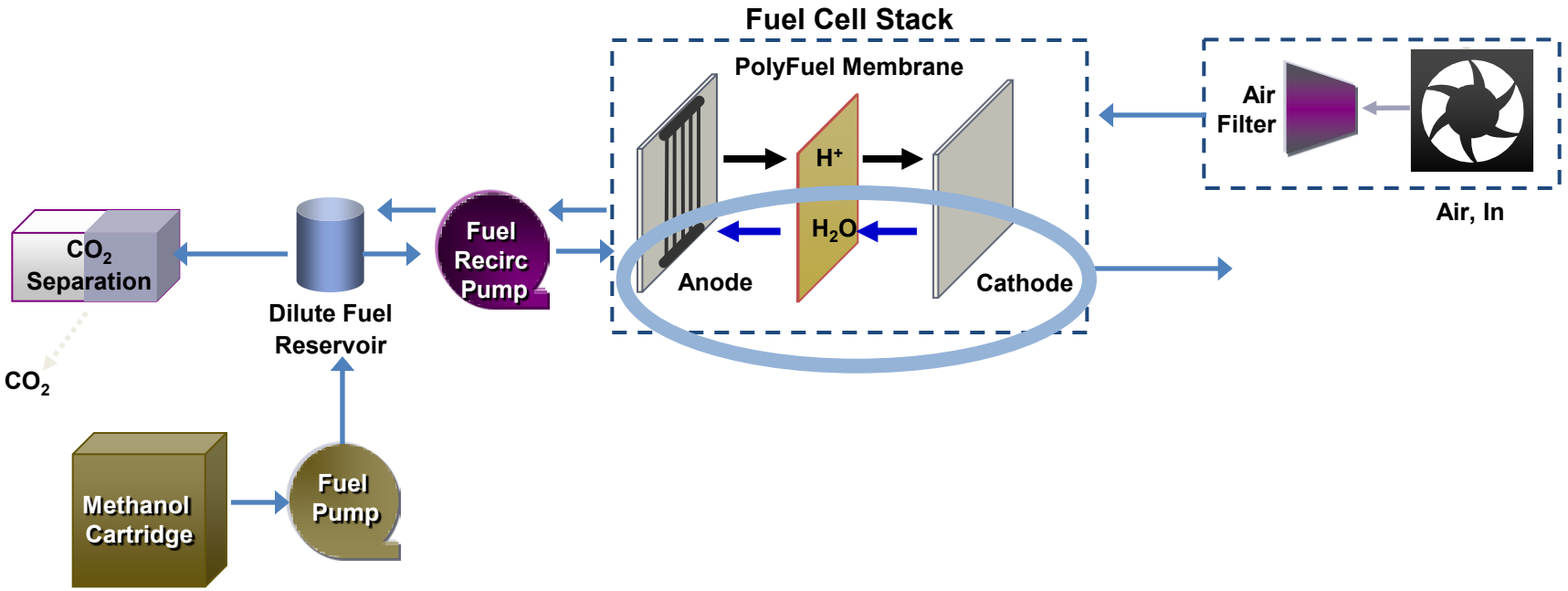
Integration into Simplified System Architecture



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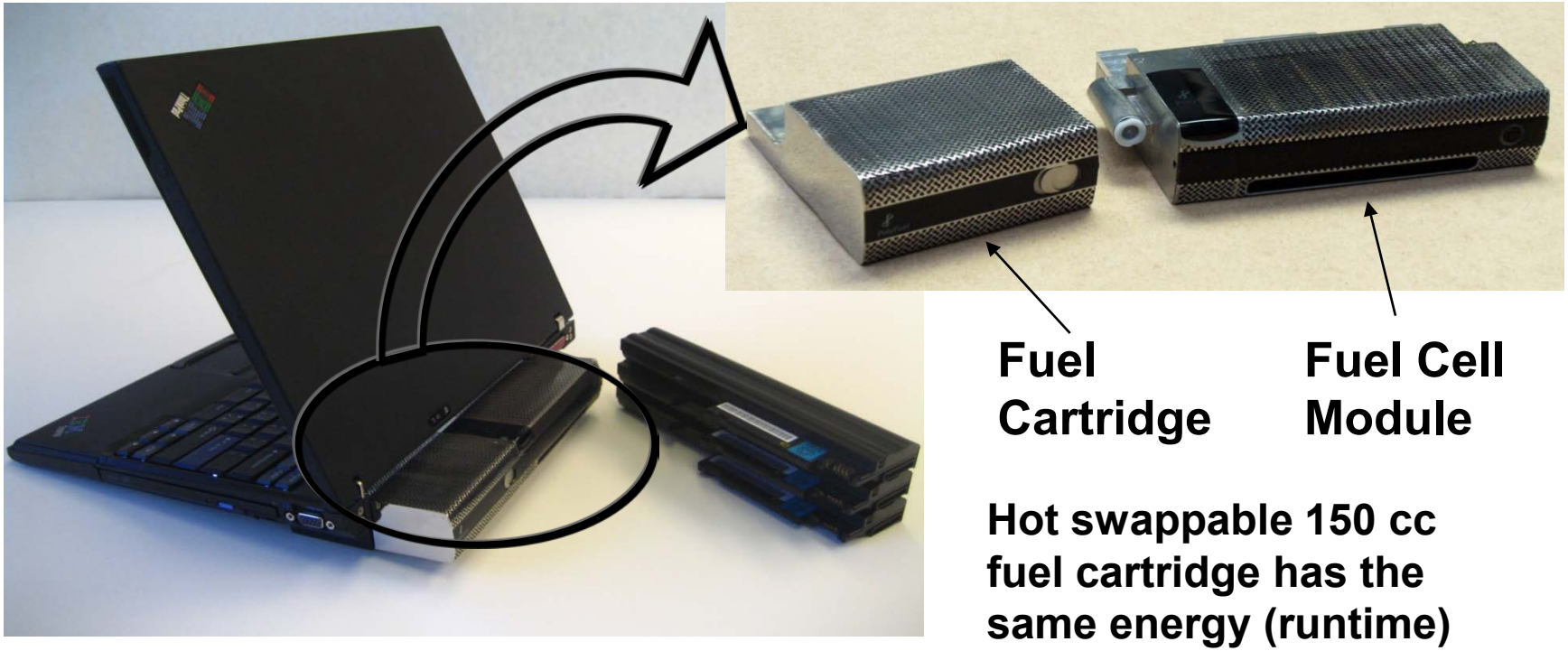
PolyFuel's *Non-Stop Power* Supply Prototype DP3



Fuel Cartridge

Fuel Cell Module

Hot swappable 150 cc fuel cartridge has the same energy (runtime) as 3 six-cell LIBs

10 Hour Runtime Notebook PC Comparison

PolyFuel *Non-Stop Power* Reference Design Prototype 725 g

Conventional lithium-ion (3) six-cell batteries 950 g

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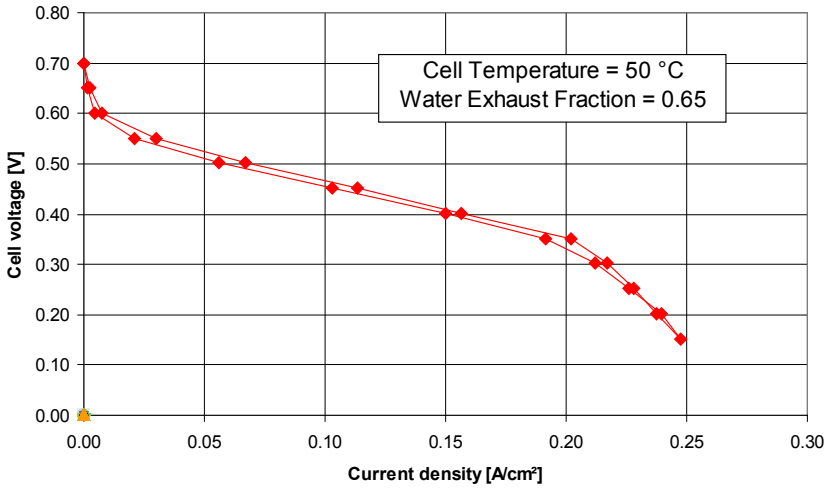
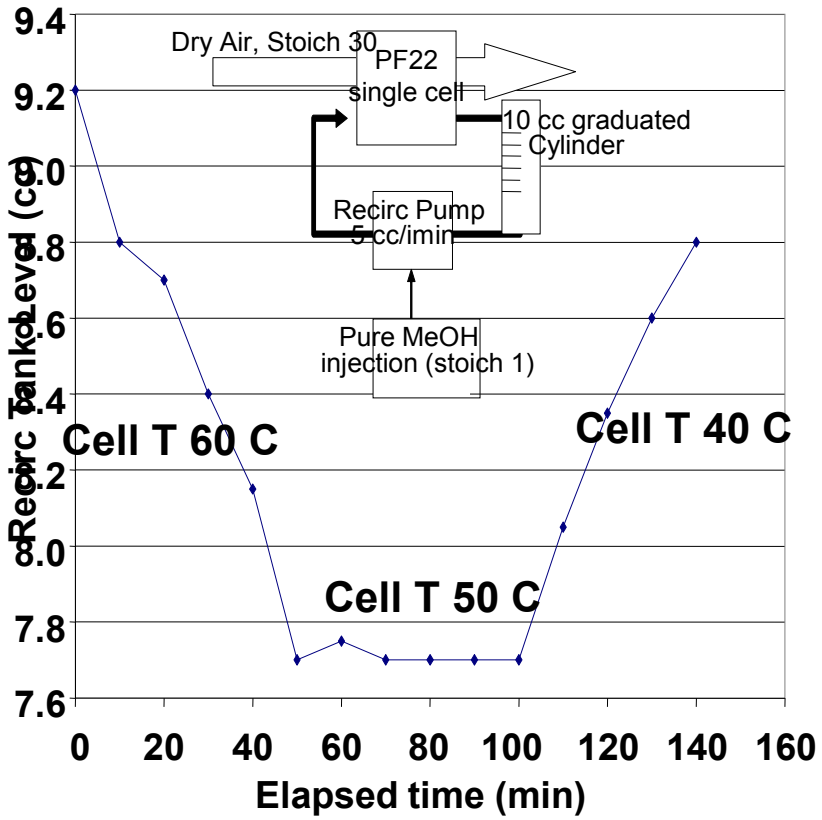
Cell Performance and operational stability





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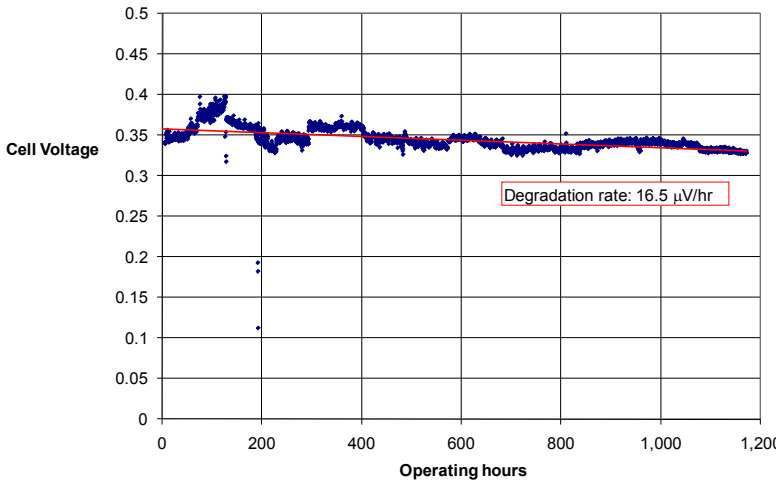
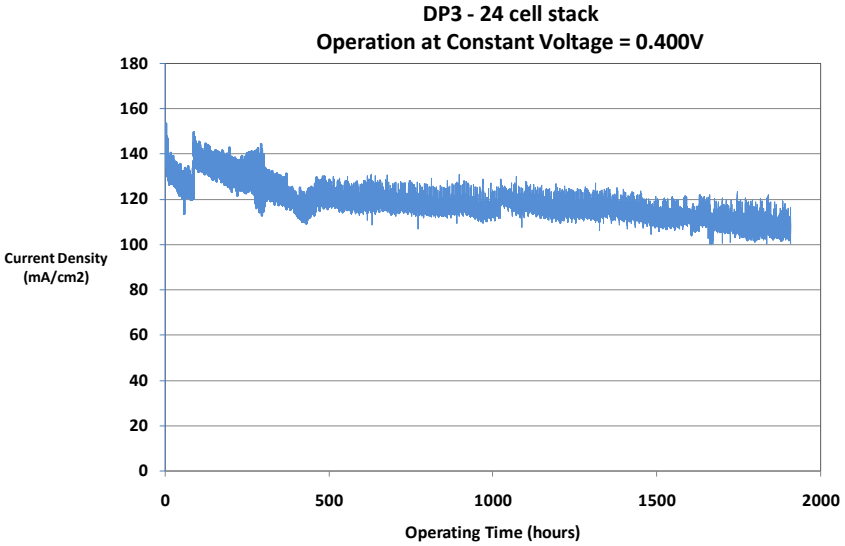
Initial Durability and performance stability

Single cell Durability with Passive water Recovery



Stack Durability with Passive water Recovery



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Technical Barriers and Targets

Two important challenges

- Lowering MEA costs while maintaining performance
  - < 3 mg/cm2 and > 0.4 V at 150 mA/cm2
- Improved durability both in storage and operation
  - > 1000 hours with lower catalyst loading with acceptable water transport properties

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Project Timeline

		Y1Q1	Y1Q2	Y1Q3	Y1Q4	Y2Q1	Y2Q2	Y2Q3	Y2Q4	Y3Q1	Y3Q2
Task 1 - Membrane Optimization											
1.1	Membrane Post-Processing										
1.2	PolyFuel Commercial and Experimental Membranes										
1.3	Reversible Wet-Dry Cycling										
Task 2 - Cathode Gas Diffusion Layer Development											
2.1	Cathode Gas Diffusion Layer Ink Production										
2.2	Deposition of Cathode Gas Diffusion Layers										
2.3	Cathode Gas Diffusion Layer Optimization										
2.4	Quality Control Techniques										
Task 3 - Catalyst Development, Performance, Durability and Ethanol											
3.1	Commercial Catalyst Screening										
3.2	Ultrastable Anode Catalyst										
3.3	Ethanol Catalyst Development										
Task 4 - MEA Development											
4.1	Cathode Catalyst Layer Composition										
4.2	Cathode Catalyst Layer Deposition										
4.3	Anode Structure										
4.4	Catalyst Loading Optimization										
4.5	Delamination Mitigation										
Task 5 - MEA & Short Stack Performance and Durability Testing MEA Development											
5.1	Regular Fuel Cell Testing										
5.2	Small Volume Recirculated Fuel Loop Test										
Task 6 - Program Management and Reporting											
	GO-NO-GO - MINIMUM PERFORMANCE AND DURABILITY >0.4V, 500hr, 1 wk off stability										
	Final Target - MINIMUM PERFORMANCE AND DURABILITY >0.4V, 1000 hr, <3mg/cm2 Pt, 1 wk off stability										

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