Corrugated Membrane Fuel Cell Structures

2010 DOE Hydrogen Program Fuel Cell Project Kick-Off

Principle Investigator: Dr. Stephen Grot

Presenter: Dr. Walther Grot

Ion Power, Inc

September 28, 2010

Overview

Timeline

- Start Sept 1, 2010
- End August 31, 2013
- 0% Complete

Barriers

- B) Cost
- C) Performance

Budget

- Total project funding
  - DOE share $1,651,615
  - Contractor share $507,099
- Funding received in FY10: $253,340
- Funding for FY11 : $590,049

Partners

- Interactions/ collaborations
  - General Motors
    Testing and Modeling
  - GrafTech
    Graphite components
- Project lead
  - Ion Power

DOE 2015 Technical Targets Addressed by this Project

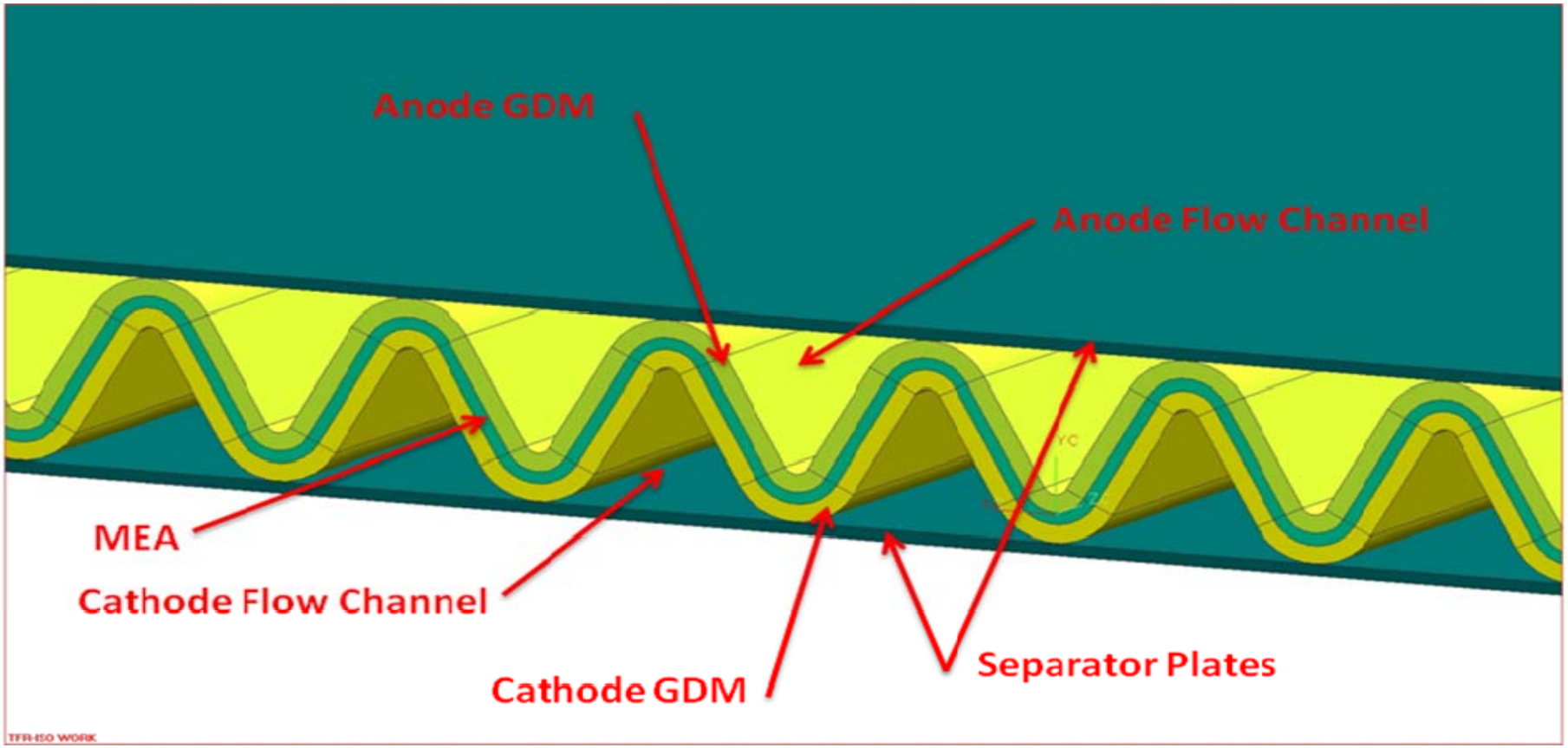
- PGM Loading: 0.2 mg PGM/cm^2
- PGM Total content: 0.2 g /kW
- Rated power performance: 1 W/cm^2
- ¼ power Performance: 250 mW/cm^2

- Bipolar plate cost: $3/kW
- Bipolar plate weight: < 0.4 k g/kW

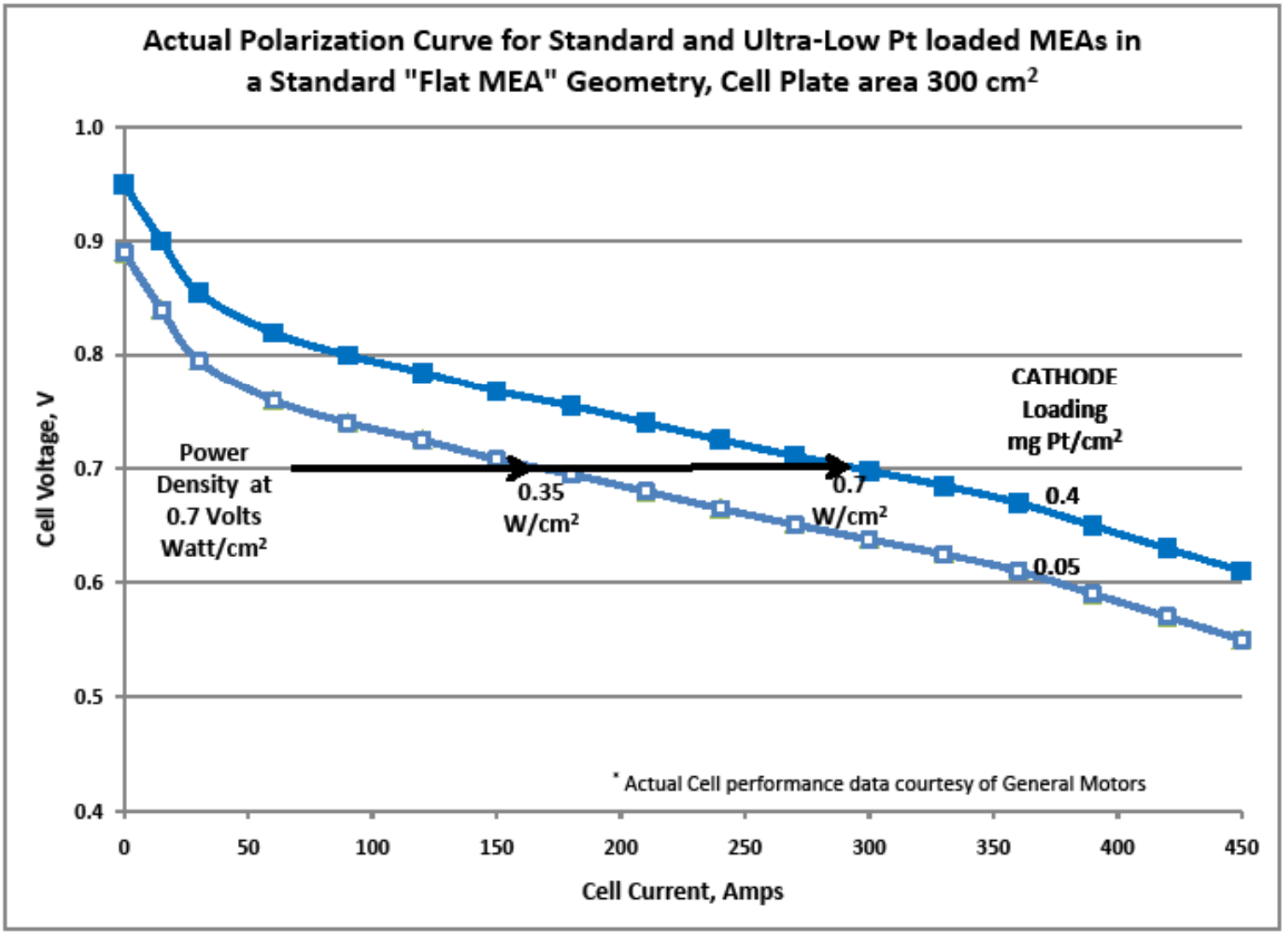
Relevance

Objectives:

- To demonstrate a single fuel cell (50 cm^2) with a 2-fold increase in the membrane active area over the geometric area of the cell by corrugating the MEA structure.
- Incorporation of an ultra-low Pt loaded corrugated MEA structure in a 50 cm^2 single cell that achieves the DOE 2015 target of 0.2 g PGM/kW

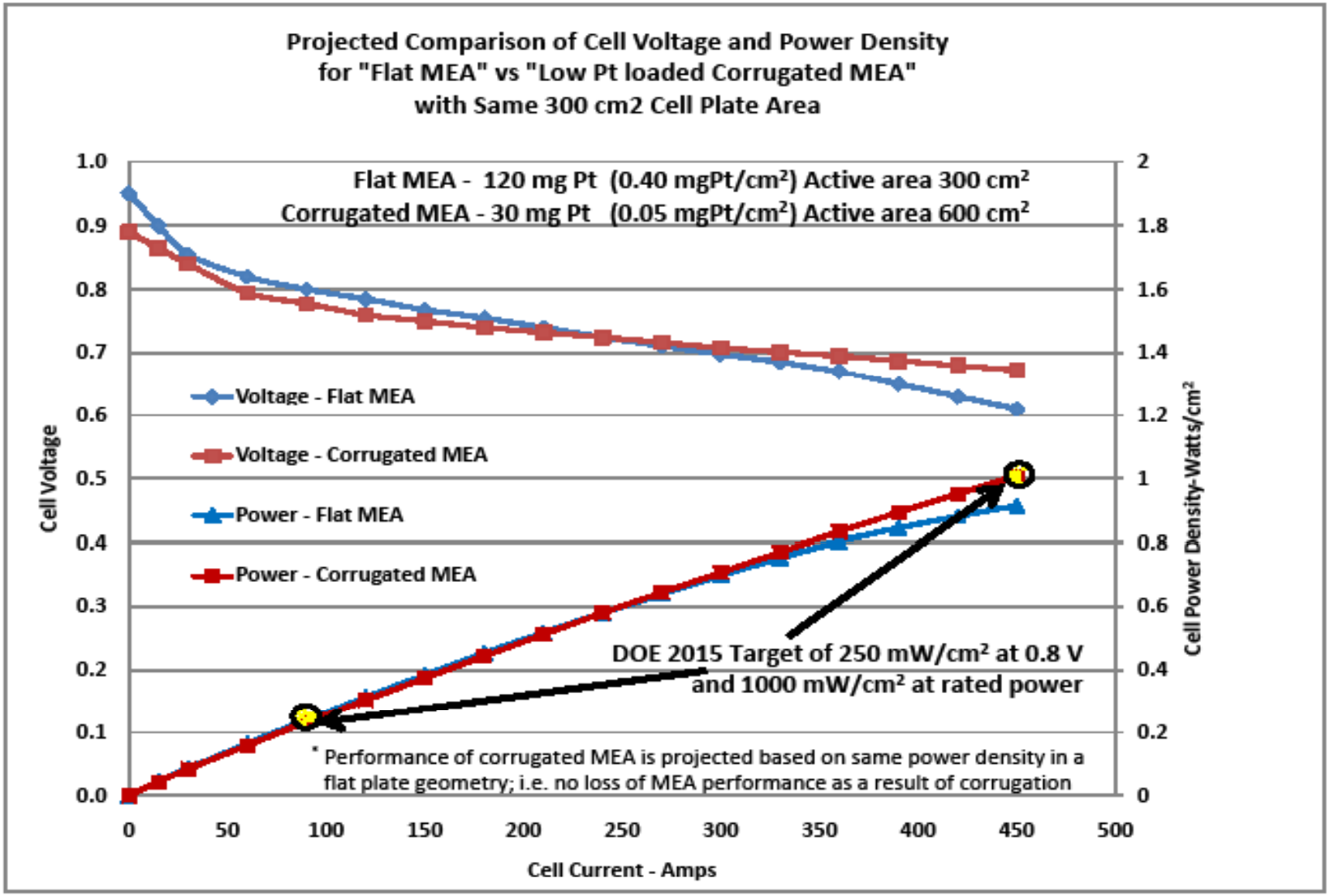


Approach



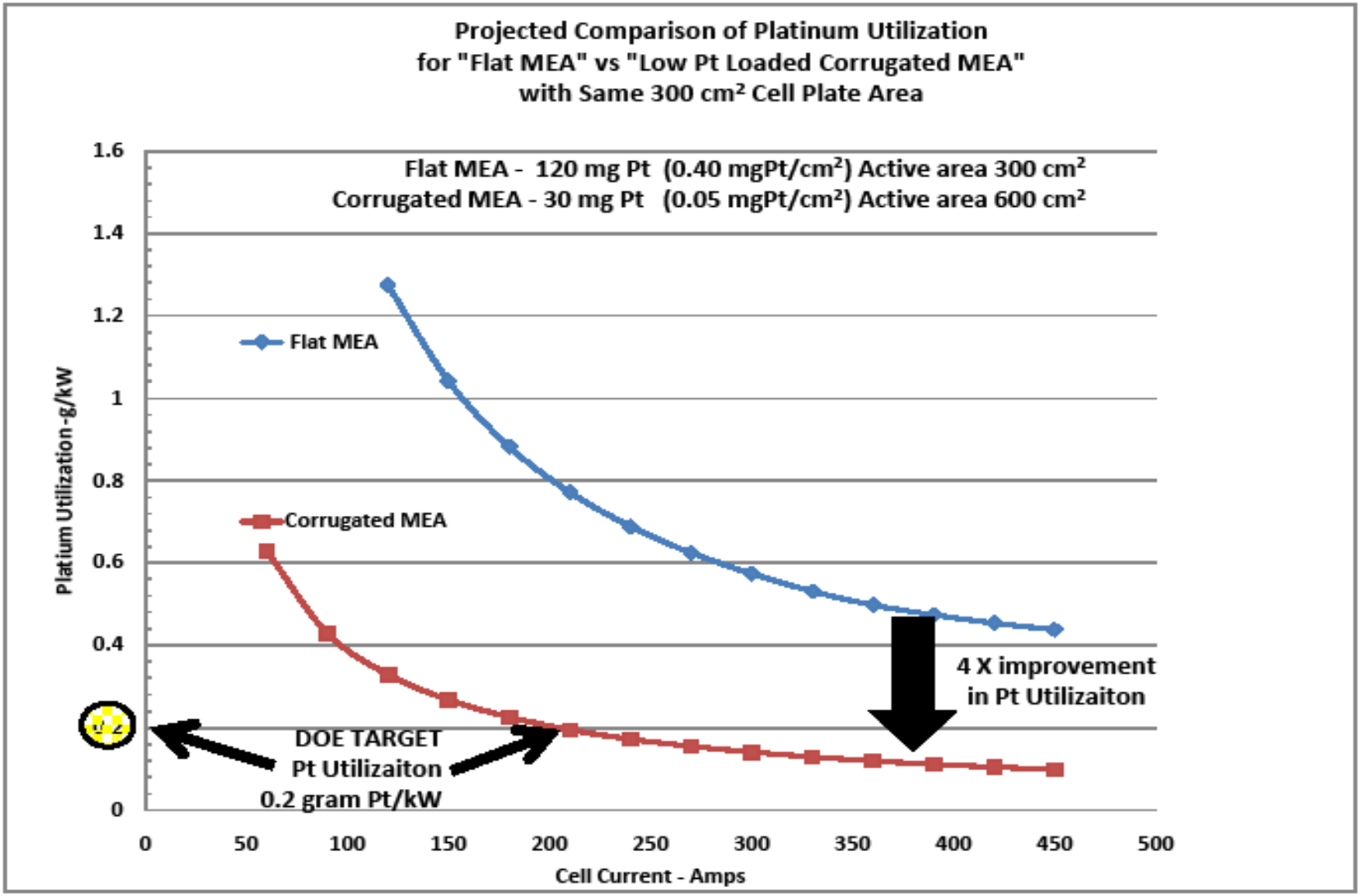
Take-Away: Low Pt loaded MEAs have good Pt Utilization (kW/g Pt)
but suffer from low power density (W/cm^2) thus don't reduce stack costs
(Read current state of the art)

Approach



Take-Away: If low Pt loaded MEA is built in the “Corrugated MEA” configuration, it achieves the DOE Power Density targets of 250 mW/cm^2 and 1000 mW/cm^2 at low and rated power.
(Read Project Goal)

Approach



Take-Away: And Corrugated geometry allows to meet DOE Target Pt utilization of 0.2 g Pt/kW
(Read Project Goal)

Detailed Milestones

No.	Reference Task #	Deliverable	Due (Month/Yr)
1	1.1	50 cm^2 jig designed and built	411
2	1.2	Both flat and corrugated seals for 50 cm^2 jig	7/11
3	1.3	**MILESTONE Year 1:** Test jig baseline equal or exceeding GM standard cell performance	10/11
4	2	Grafoil corrugated GDL plate subassembly, with resistance <10 mOhm-cm^2 and >20 psi compressive force	5/12
5	3	Provide method for making metal corrugated GDL plate subassemblies, with resistance < 10 mOhm-cm^2 and >20 psi compressive force	5/12
6	3	Down-select most promising metal corrugated GDL plate subassembly	5/13
	2 & 3 & 5	**Go/No-Go:** Can corrugated GDL materials give target properties of <10 mOhm-cm^2 and > 20 psi compressive	11/12
7	5.1	Material property data for candidate GDL materials received from tasks 2 and 3	10/11
8	5.2	FEA analysis of corrugated MEA design	9/12
9	6.1	**MILESTONE Year 2:** First fuel cell performance data on a corrugated MEA	5/12
10	6.2	Optimized fuel cell performance with down-selected corrugation material	5/13
11	6.3	**MILESTONE Year 3:** Fuel cell performance with ultra-low loaded MEA in corrugated architecture exceeding full power density and Pt utilization DOE 2015 targets	7/13
12	7.0	Monthly progress reports summarizing project work	Monthly
13	7.0	Final report providing overall analysis and recommendations	9/13

Major Go/No-Go Milestone

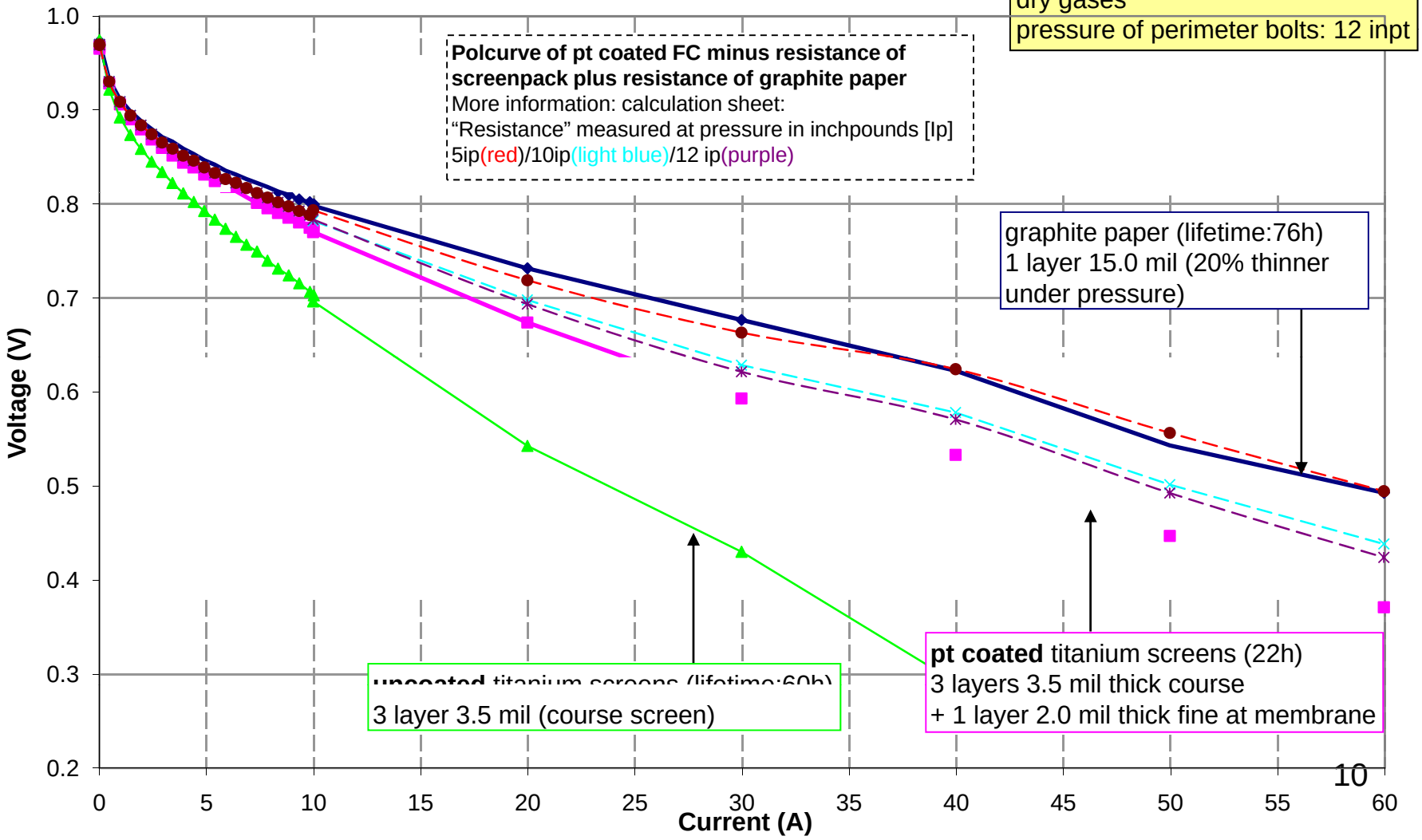
The corrugated GDL-Plate structure target properties:

< 10 mOhm-cm^2 electrical resistance
at > 20 psi compressive strength,

at least 80% of power density
Compared to MEA in a flat plate structure

Technical Accomplishments

Titanium Screen as Gas Diffusion Layer (GDL)
in PEM fuel cell
Polarization Curves of one Fuel Cell
with different GDL on hydrogen side



Collaborations

Subcontractor:	• **General Motors**: Modeling, Testing, and Jig design
Subcontractor:	• **GrafTech** : Graphite based GDL – Plate subassembly development

Proposed Future Work FY 11

Task 1: 50 cm^2 fuel cell test jig design and construction. Gas connections to corrugated structures will be a challenge.

Task 2 and 3: Develop some preliminary corrugated GDL-plate structures. Look at strength capabilities

Task 5: Develop Finite Element Analysis model capabilities for mechanical properties of GDL-Plate structures