DOE Hydrogen Program

2011 DOE Hydrogen Program Review

Corrugated Membrane Fuel Cell Structures

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Project ID # FC090

This presentation does not contain any proprietary or confidential information

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Overview

DOE Hydrogen Program

Timeline

- Start Sept 1, 2010
- End August 31, 2013
- 10% Complete

Barriers

B: Costs
- Lower cost metal GDL
- Lower plate and GDL manufacturing costs

C: Performance
- High power density with low Pt MEAs

Budget

- Total project funding
  - DOE share $1,651,616
  - Contractor share $507,096
- Funding received in FY10: $253,340
- Funding for FY11: $400,000

Partners

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

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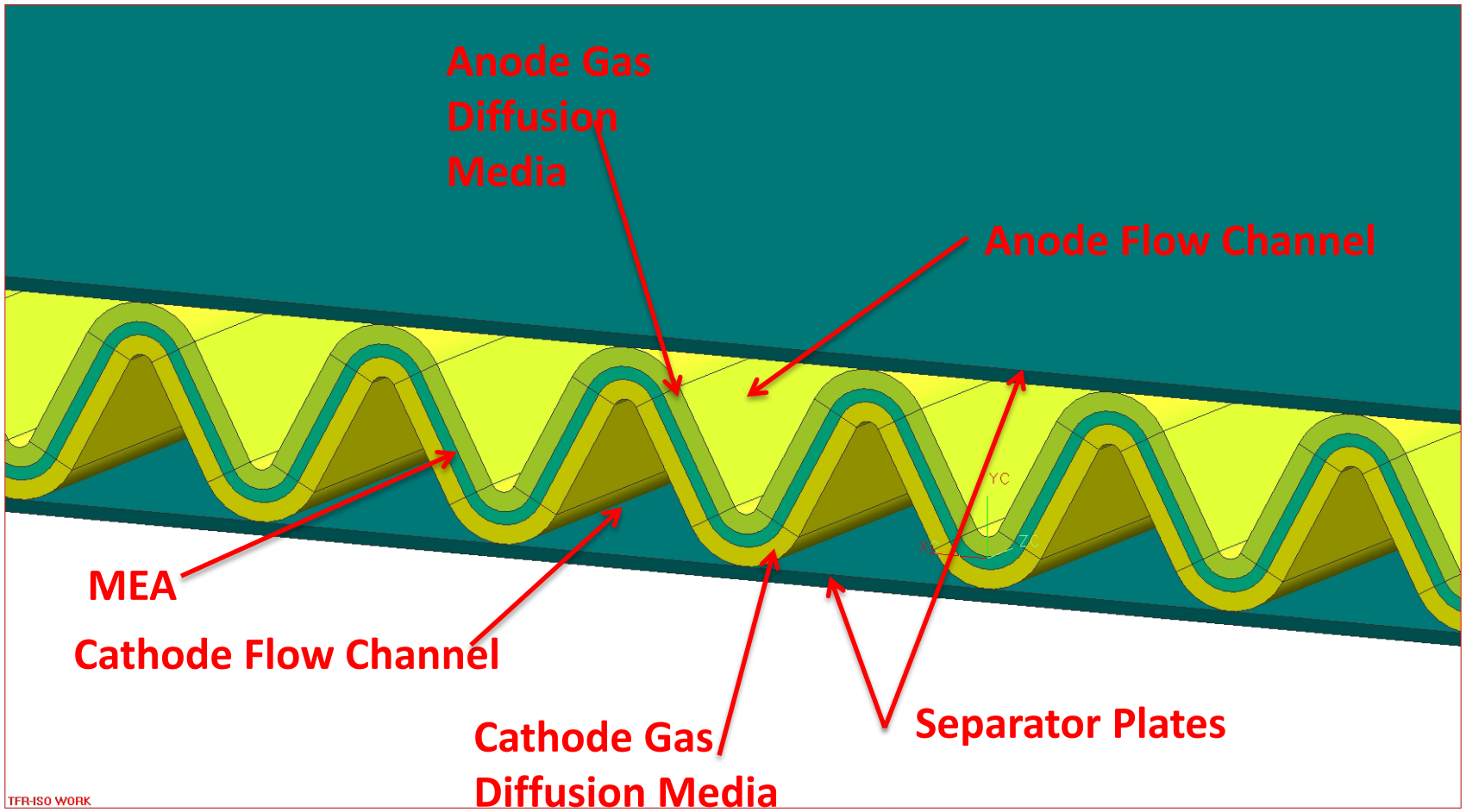
Objectives

To pack more membrane active area into a given geometric plate area. Thereby allowing both targets of power density and platinum utilization to be achieved

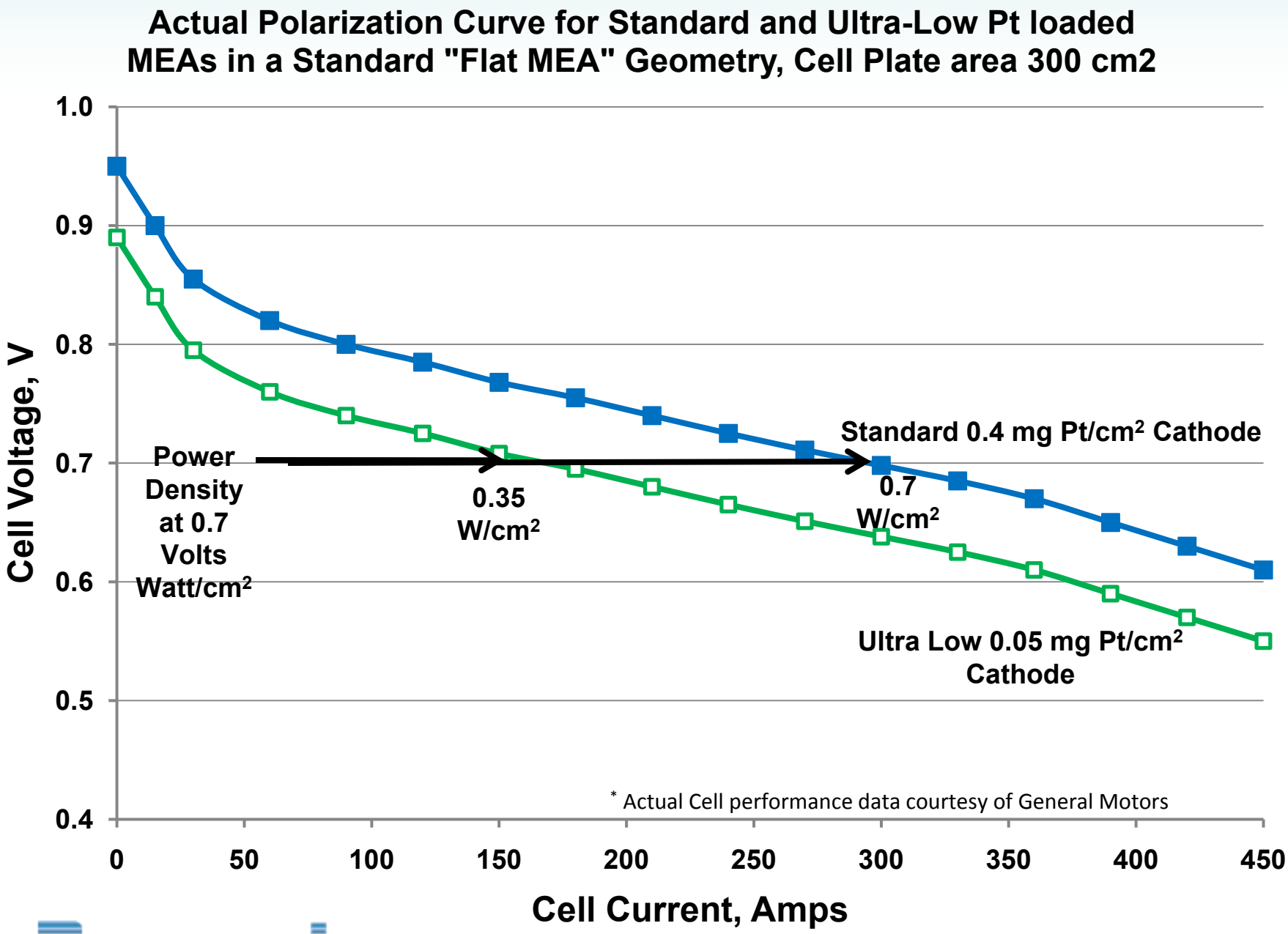
- To demonstrate a single fuel cell (50 cm^2) with a two-fold increase in the membrane active area over the geometric area of the cell by corrugating the MEA structure.
- Incorporation of an ultra-low Pt loaded corrugated MEA structure in a 50 cm^2 single cell that achieves the DOE 2015 target of 0.2 gram Pt/kW, while simultaneously reaching the power density targets:
  - 1 W/cm^2 at full power
  - 0.25 W/cm^2 at ¼ power

Approach


Anode Gas Diffusion Media
Anode Flow Channel
MEA
Cathode Flow Channel
Cathode Gas Diffusion Media
Separator Plates
TFR-ISO WORK

Approach

DOE Hydrogen Program



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Take Away: Low Pt loaded MEAs currently suffer from Low Power Density

Approach

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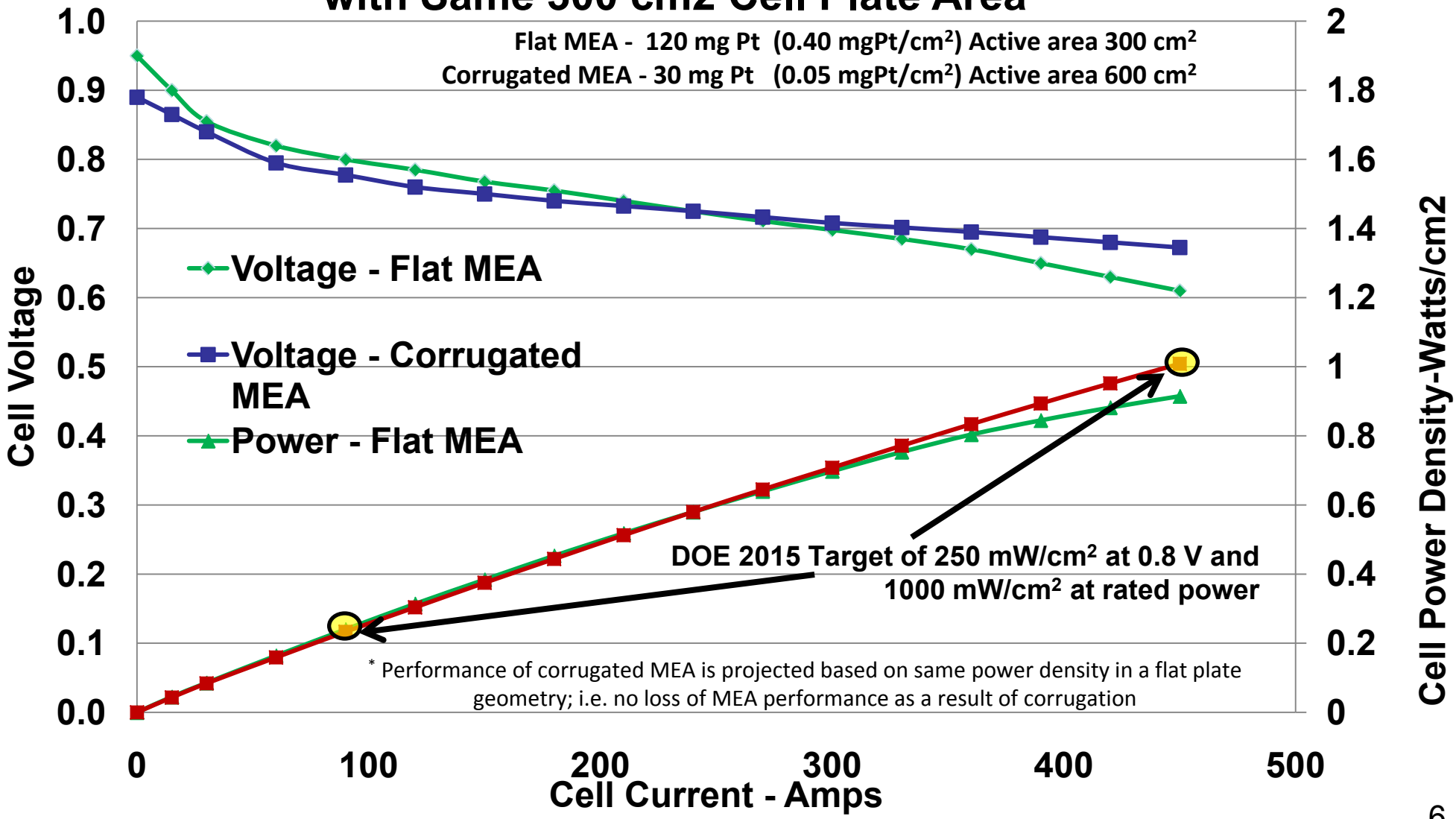
Projected Comparison of Cell Voltage and Power Density for "Flat MEA" vs "Low Pt loaded Corrugated MEA" with Same 300 cm2 Cell Plate Area



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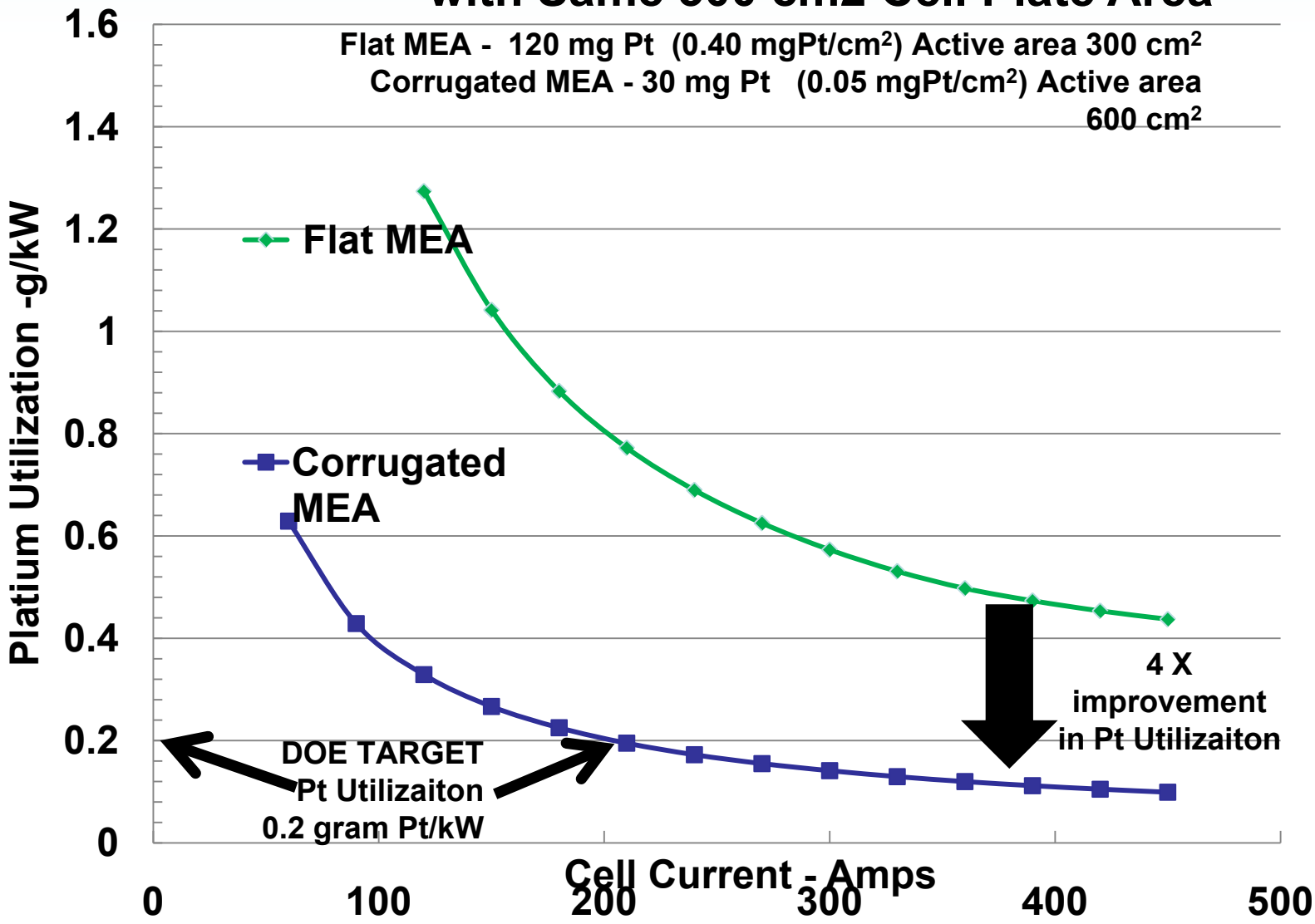
Take Away: When corrugated ,the MEA shows good power density (over plate area)

Approach

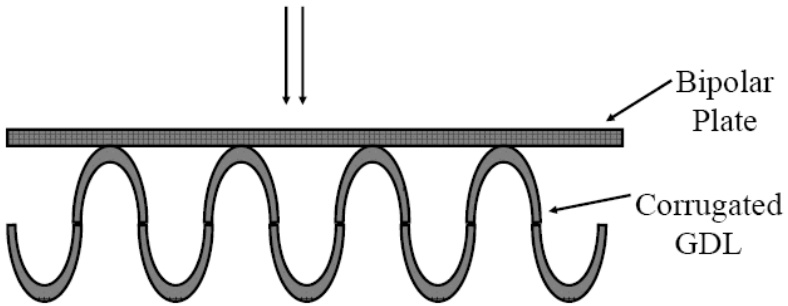
Projected Comparison of Platinum Utilization for "Flat MEA" vs "Low Pt Loaded Corrugated MEA" with Same 300 cm2 Cell Plate Area



Take Away: The real potential of this approach is to hit the Pt Utilization target at the same time as the power density target

Approach

- Work in 50 cm^2 single cell hardware
- Prototype corrugated structures out of metal and Graphite
- Fabricate a single integrated part the “Corrugated GDL-Plate” structure for mechanical compression strength



- Perform mechanical FEA modeling to predict forces and flexing of the structures

Technical Accomplishments

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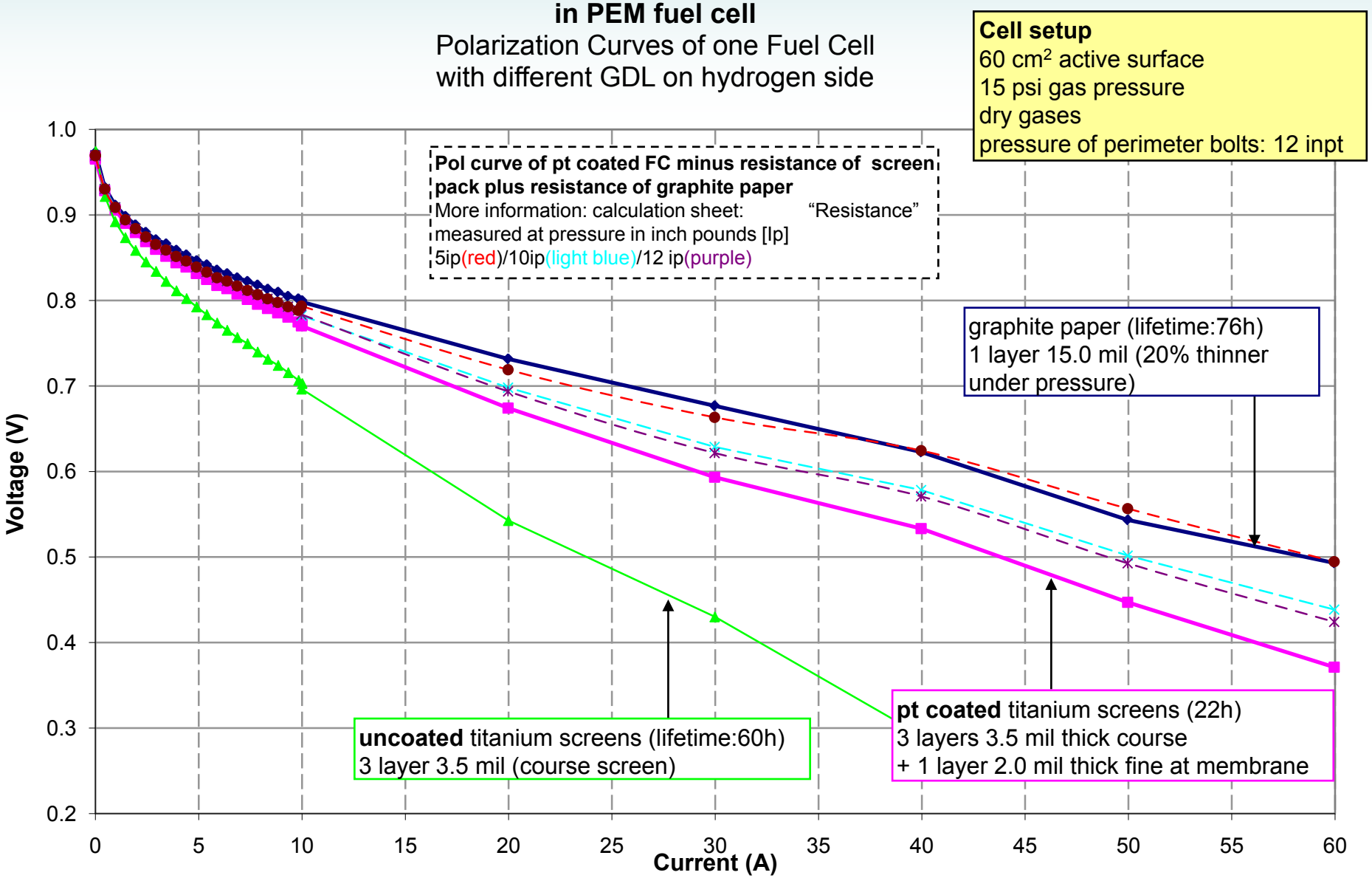
Titanium Screen as Gas Diffusion Layer (GDL) in PEM fuel cell

Polarization Curves of one Fuel Cell with different GDL on hydrogen side



Take Away: Expanded Ti GDL is close to working, need to test on Cathode, and improve contact resistance

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Technical Accomplishments

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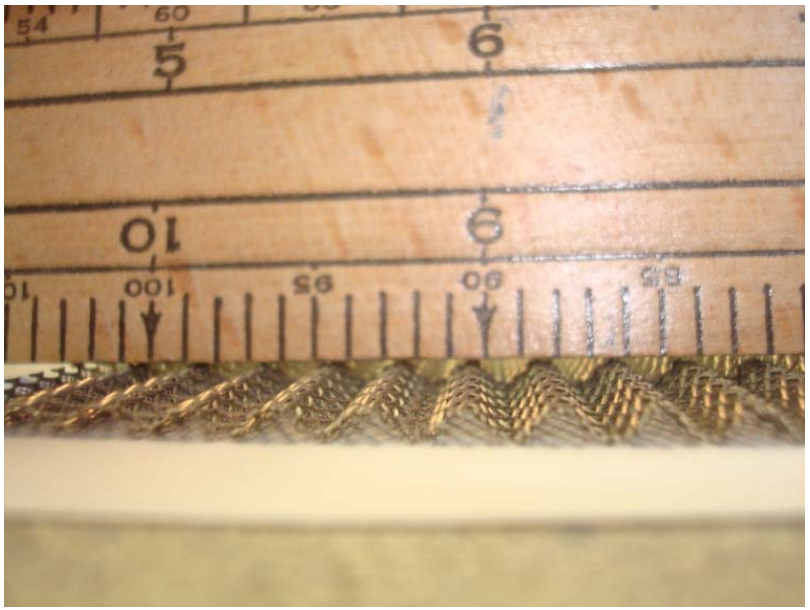
Corrugated GDL structure formed with expanded Ti Metal screen. Fine 2 mil screen for good diffusion and contact, with course 10 mil thick screen for strength.

(Supplier: Dexmet)



Collaborations

DOE Hydrogen Program

Subcontractor	• **General Motors**: Modeling, Testing, and Jig Design
Subcontractor	• **GrafTech**: Graphite based GDL–Plate Subassembly Development
Supplier	• **Dexmet**: Expanded Ti metal screens and plates, in different shapes

Project Summary

Success has been made in expanded metal screen structures both in cell performance and in structures

Proposed Future Work

- Get single cell test fixture working
- Get corrugated Ti expanded screen GDL attached to Ti plate
- Demonstrate low contact resistance and good mass transport in flat Ti screen Structures
- Get mechanical strength modeling effort underway