

# HTPEMFC Components to Systems – An Overview of Activities at HySA Systems

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# HySA: Hydrogen South Africa

## Who we are/What we do

Department of  
Science & Technology



Key Programme 1: Combined Heat and Power



Key Programme 2: Portable Power Systems



Key Programme 3: Hydrogen Fuelled Vehicles



Key Programme 4: Hydrogen Filling Stations



Key Programme 5: Renewable H<sub>2</sub> Production



Value Chain



## HySA Systems

### Combined Heat & Power

HT-MEA

System Integration

System Validation

System/Stack Modelling



### Hydrogen Fuel Cell Vehicles

LT/HT -MEA

LT/HT-Stacks

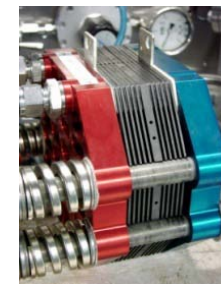
System Integration

System Validation

System/Stack Modelling

## Key technologies

- ✓ High Temperature PEM Fuel Cell Stacks
- ✓ HT-Catalyst & Catalyst Supports
- ✓ GDL & BPP
- ✓ MEAs for HT-PEMFCs
- ✓ Solid State Hydrogen Storage Materials & Systems
- ✓ Li-ion Batteries
- ✓ Pd-membranes



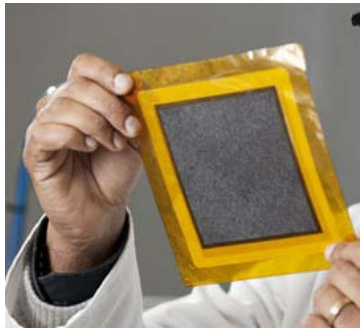
# Combined Heat and Power

- Enefarm – 20,000 installed units, target 50,000 units by 2015 (2011 funding USD 112.7M)
  - 1kW<sub>e</sub> and 1kW<sub>th</sub>
- Callux programme – 800 installed FC CHP units by 2012 (Euro 86M)
  - 1kW<sub>e</sub> and 2kW<sub>th</sub>
- ClearEdge Power signed a USD 500M deal to supply CHP systems to Austria, target 50 MW by 2020
  - Up to 5 kW

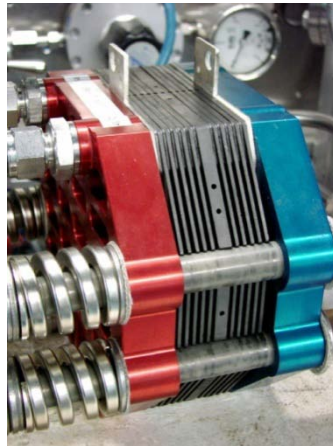


# Combined Heat and Power Focus

- Natural Gas based Systems (5-50 kW)
- High Temperature PEM Fuel Cells and MEAs (>120°)
- Near to Medium Term Markets
  - **Domestic CHPs (1-2kWe and 2kW<sub>th</sub> Units)**



HT MEAs



Stacks

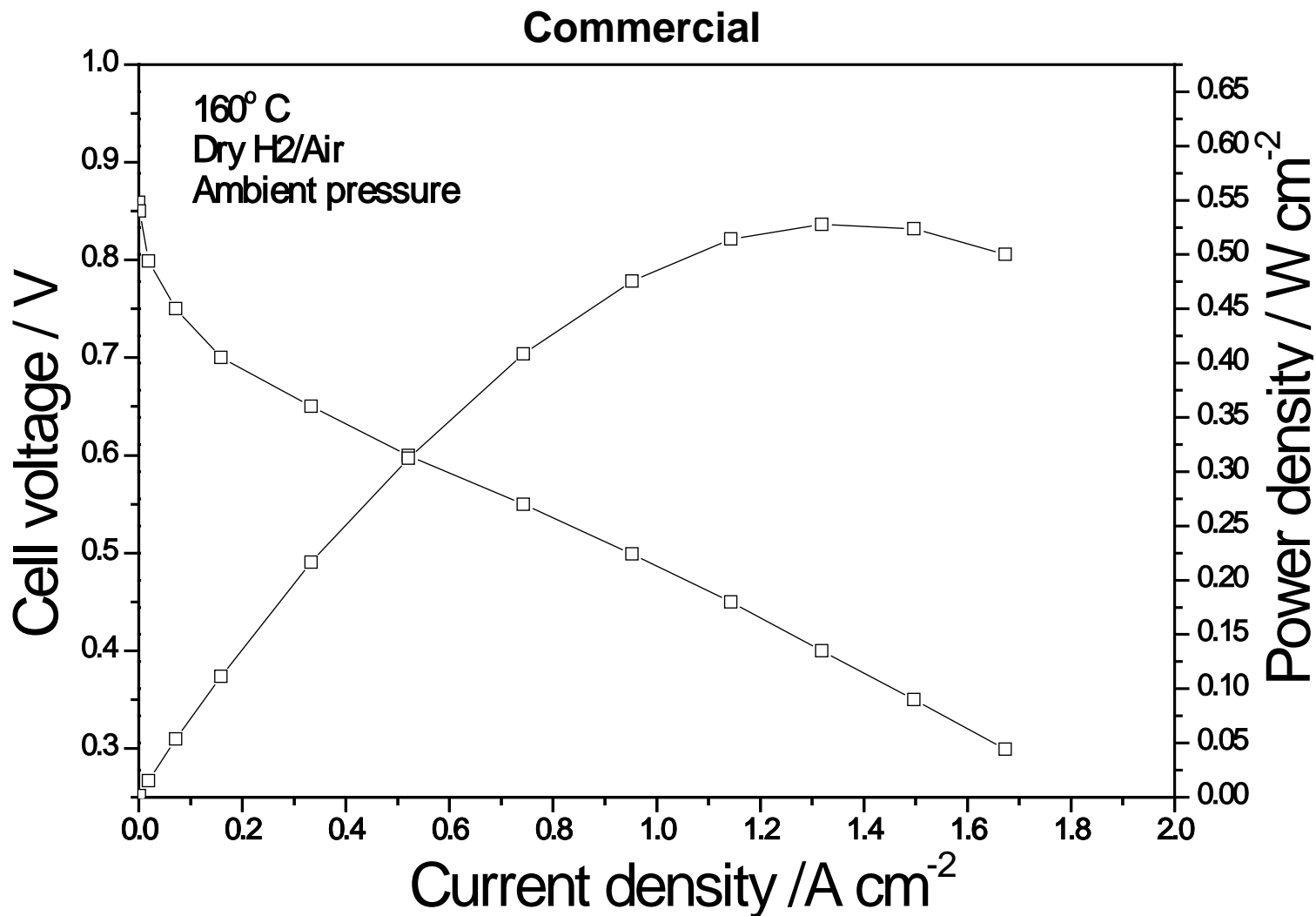


Systems

# HTPEM MEA

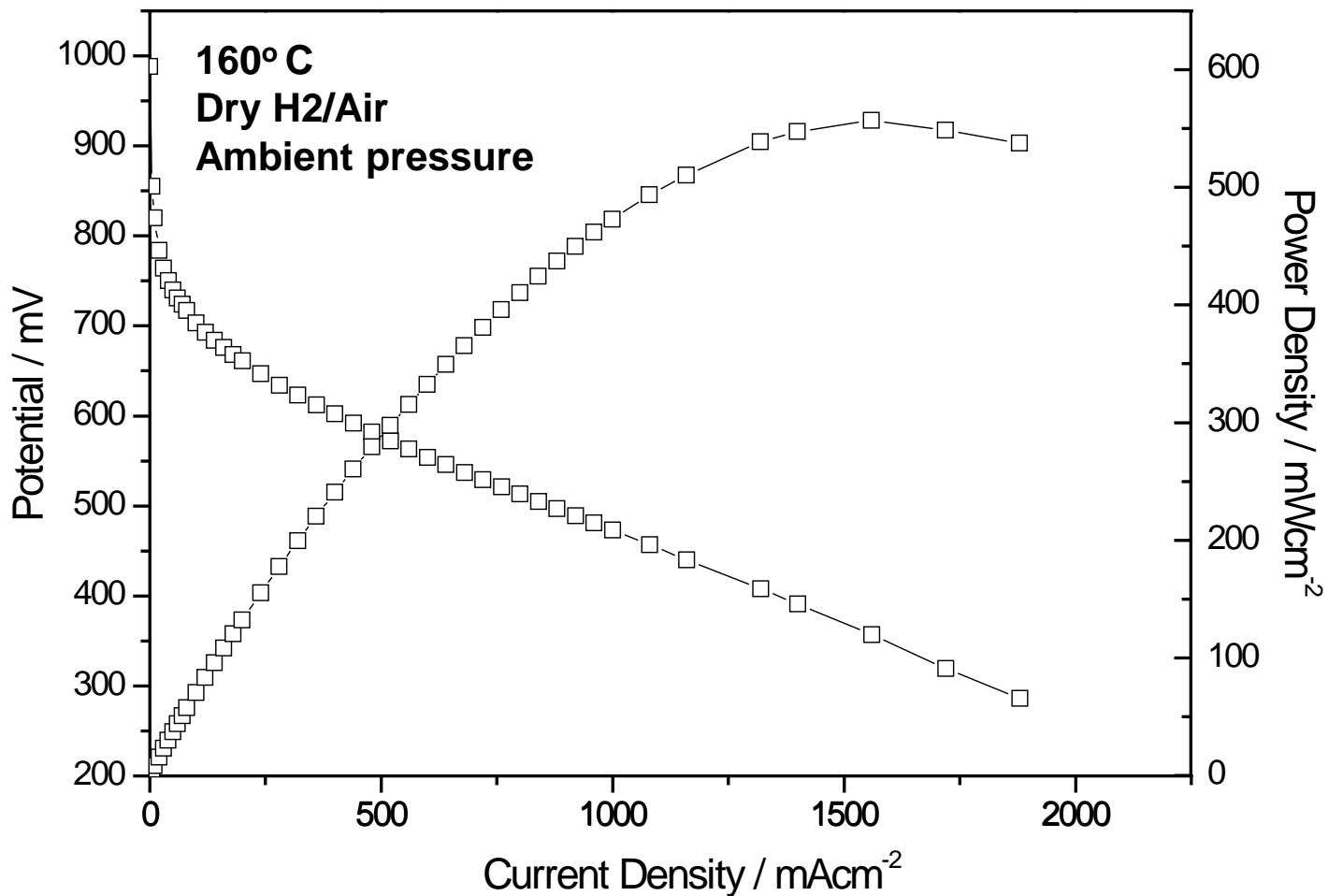


# HTPEM MEA



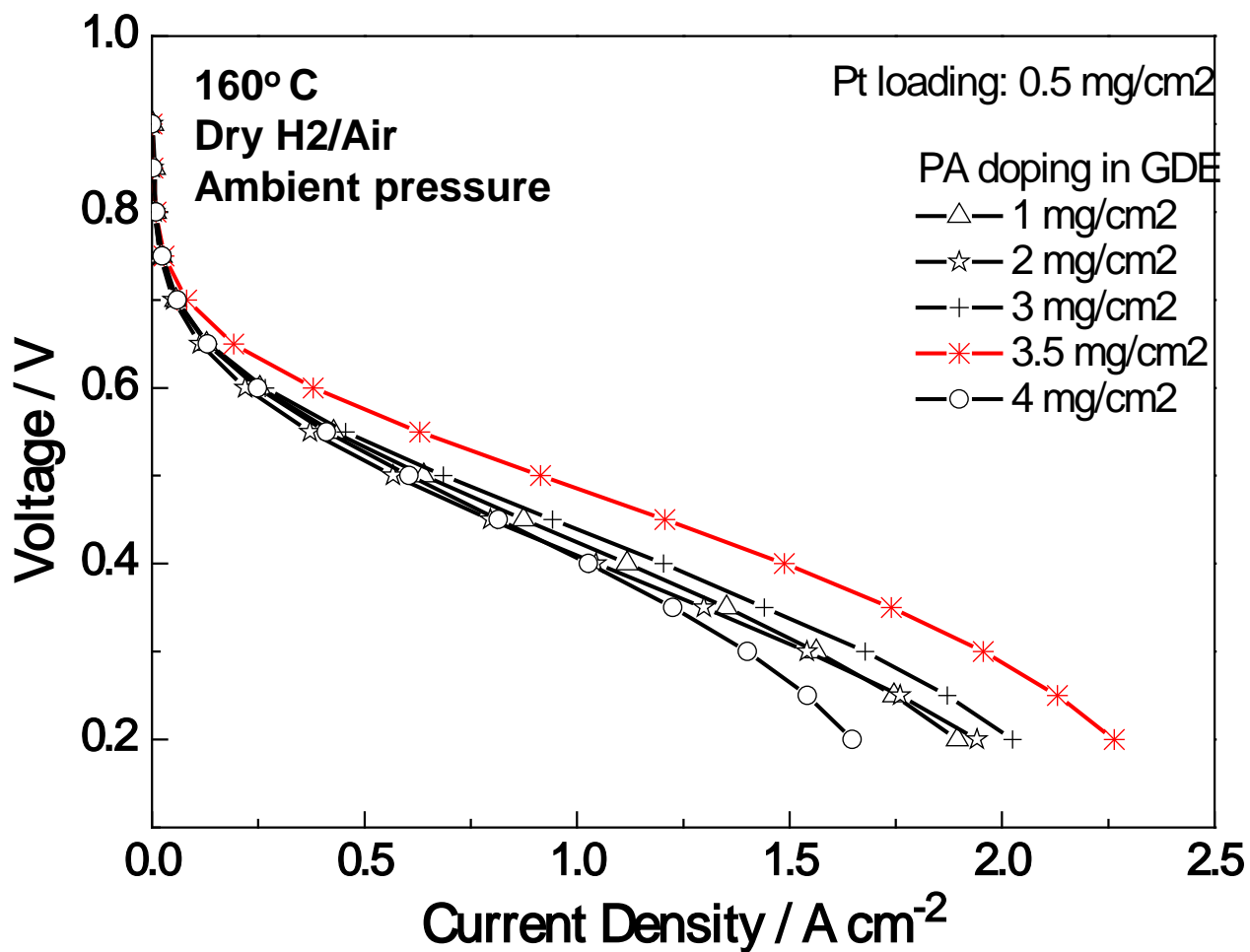
# HTPEM MEA

## In-house





# HTPEM MEA



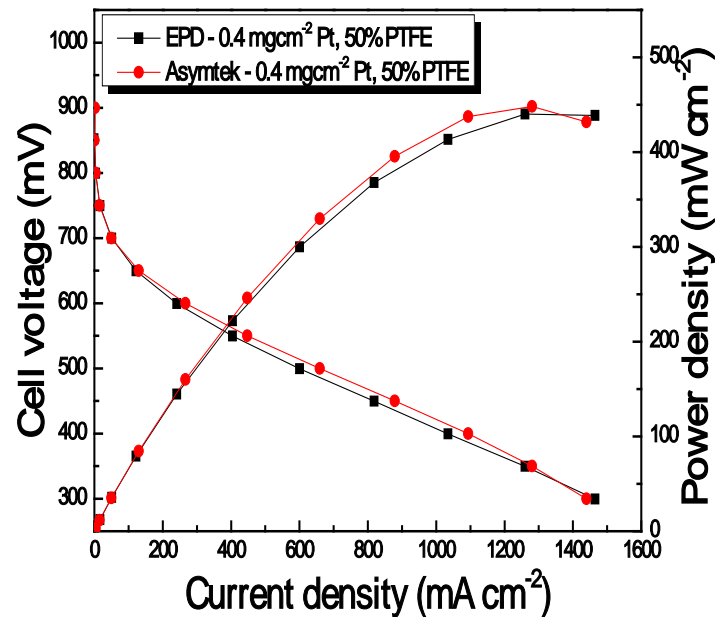
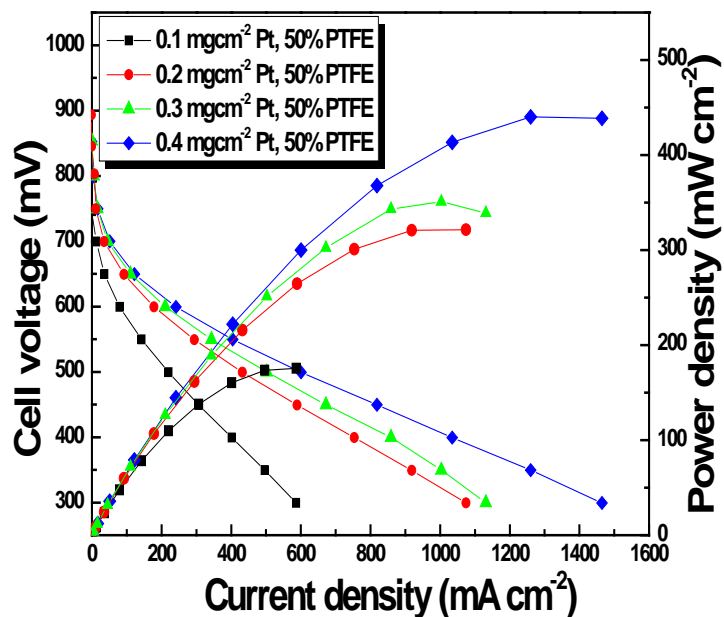


# HTPEM MEA

160° C  
Dry H<sub>2</sub>/Air  
Ambient pressure

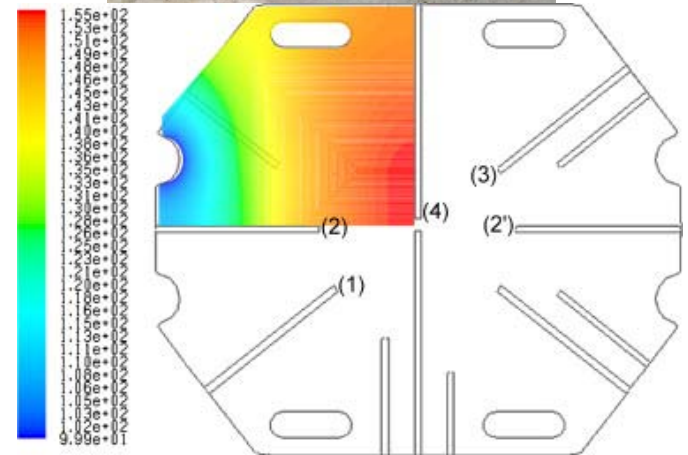
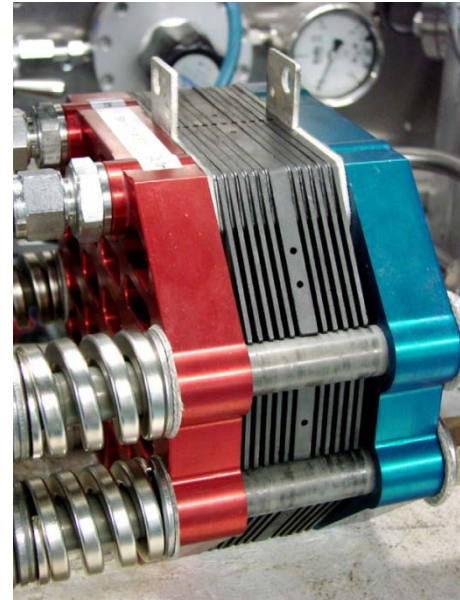
# HTPEM MEA

## EPD based MEA

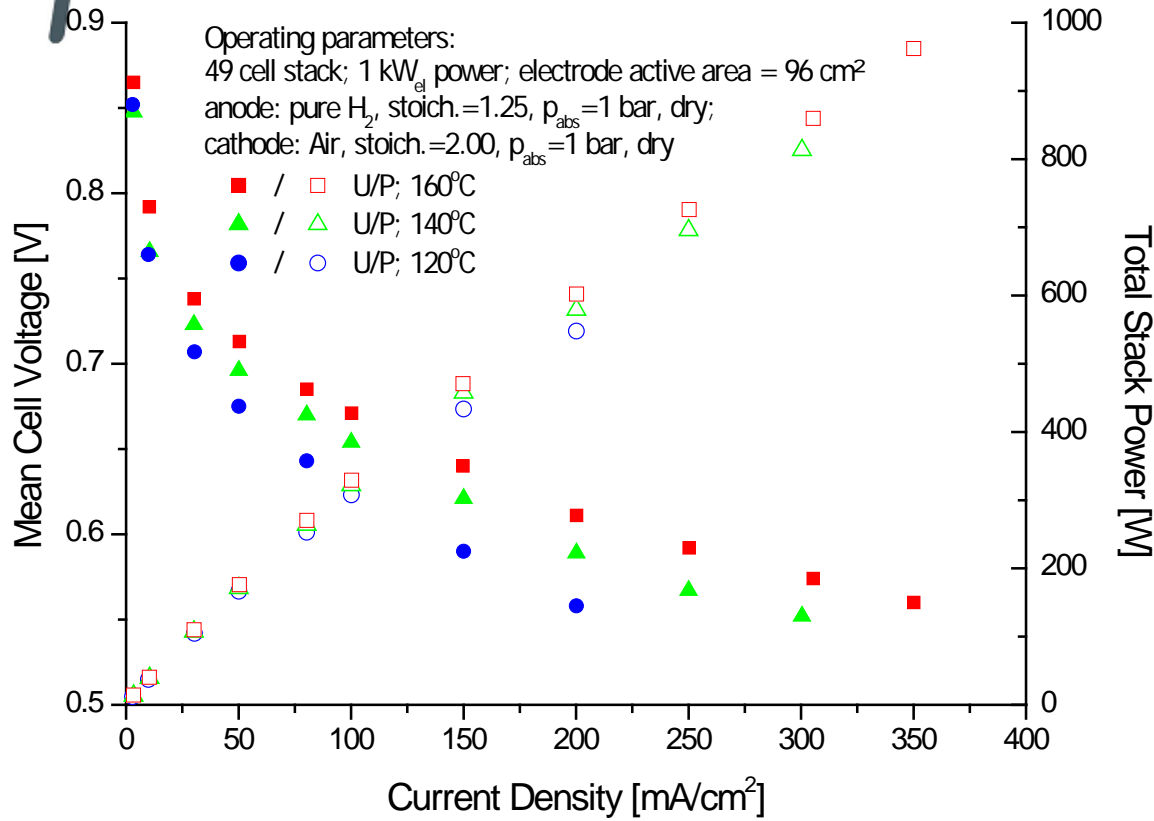


# HTPEMFC Stack

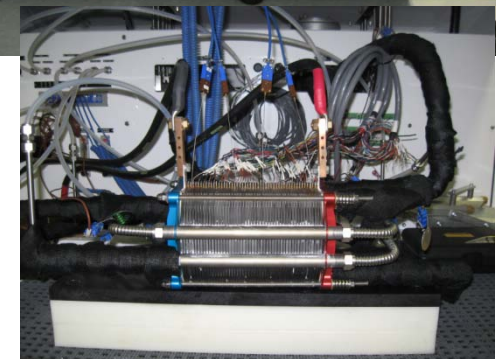
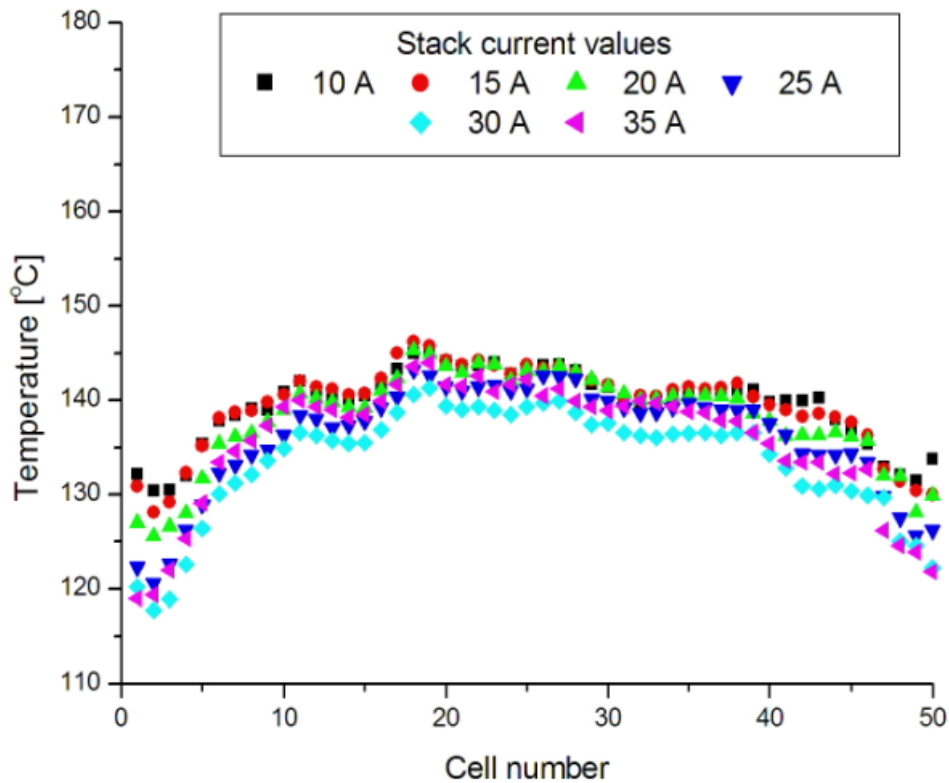
- External Cooling
  - Avoids sealing problems
  - Allows high temperature gradients between heat removal zone and active area
  - Compact cell design



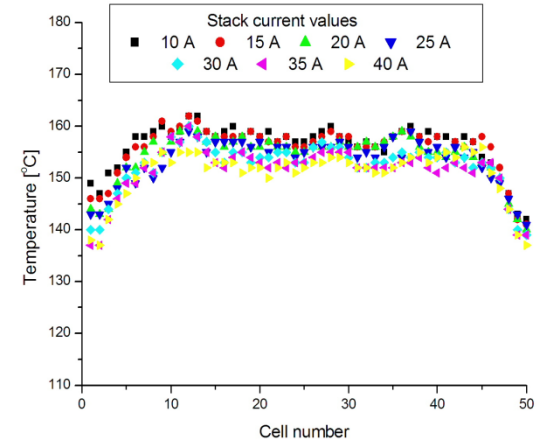
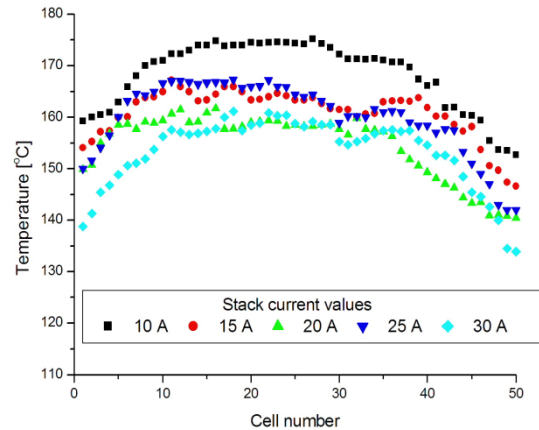
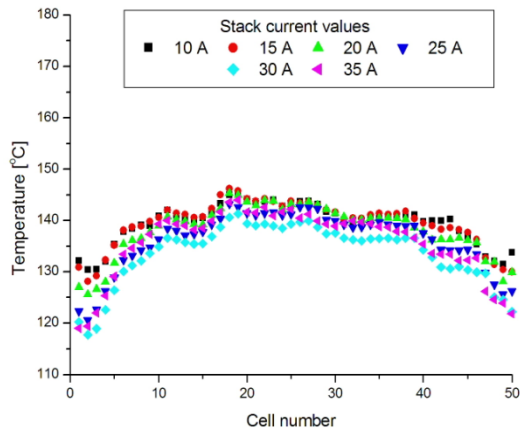
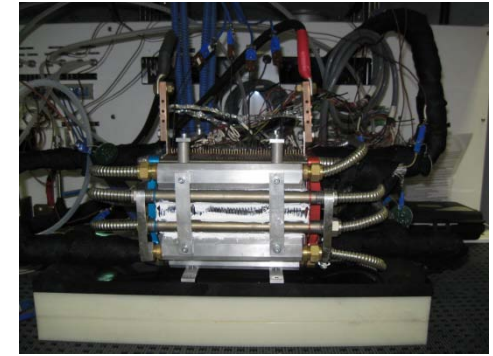
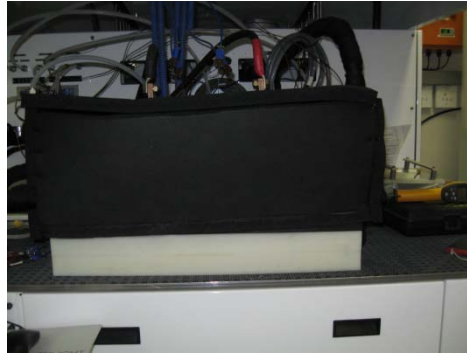
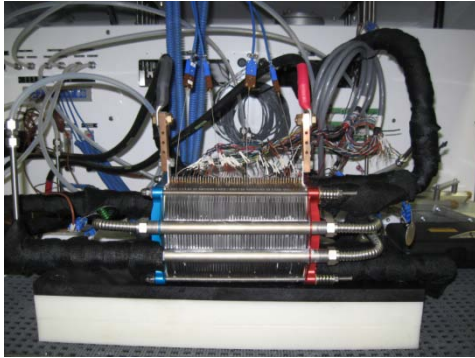
# HTPEMFC Stack



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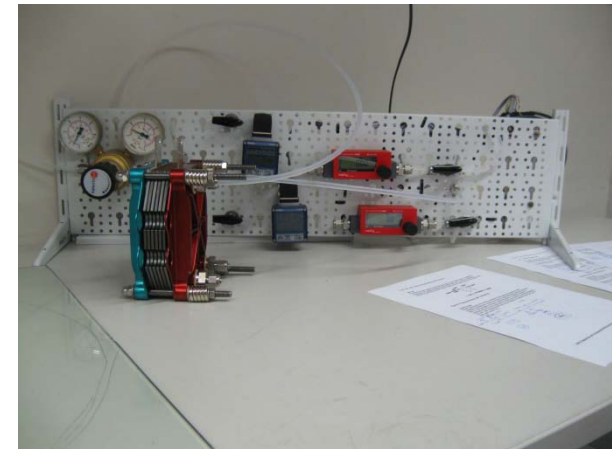
# HTPEMFC Stack



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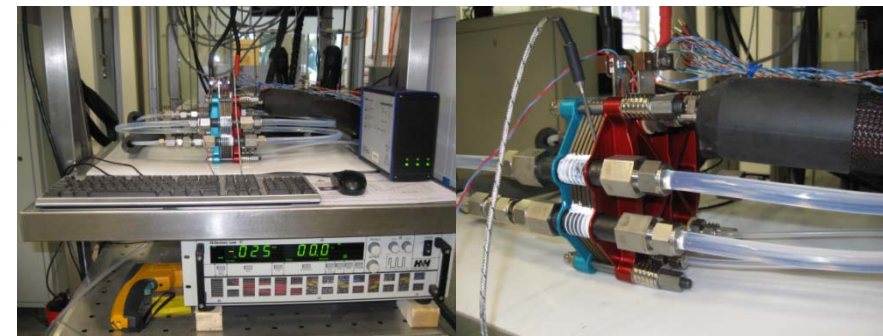
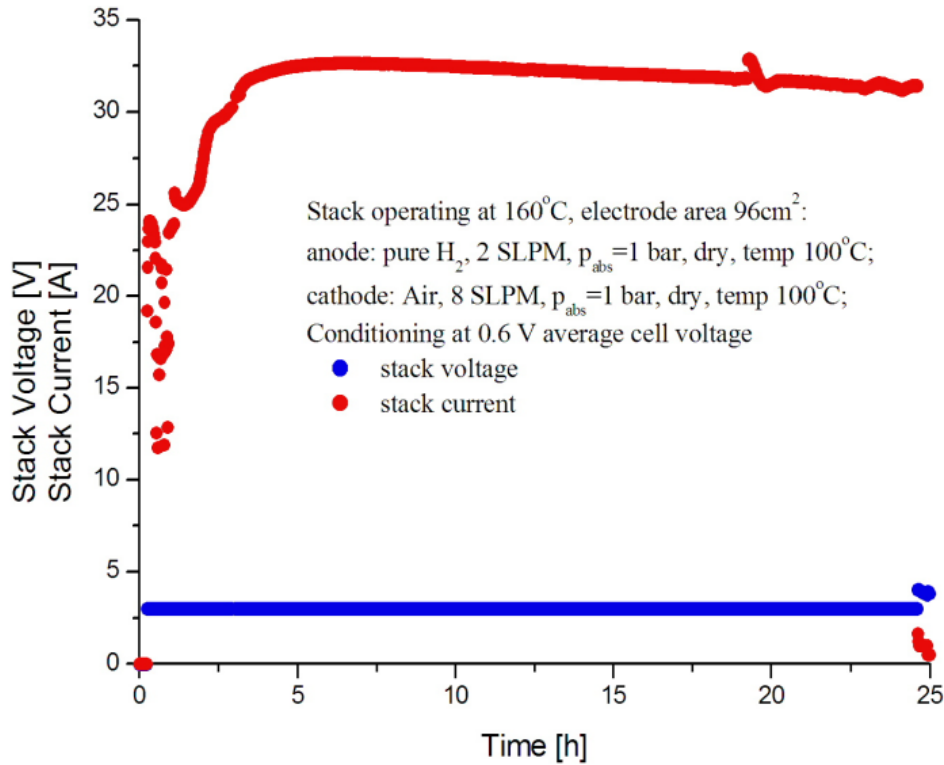
## HT PEM fuel cell stack manufacturing

- Manufacturing of major stack components, bipolar plates and end plates

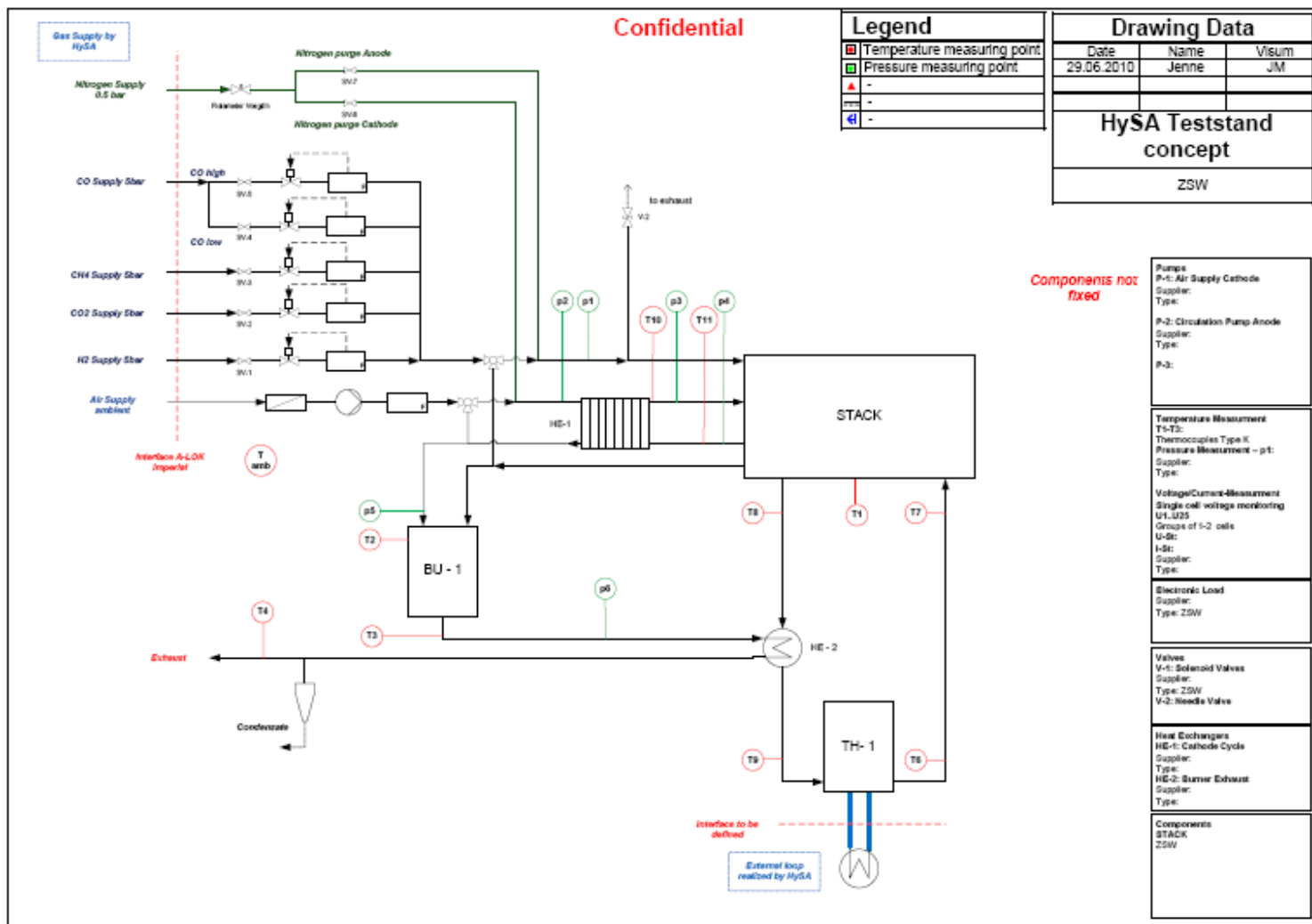




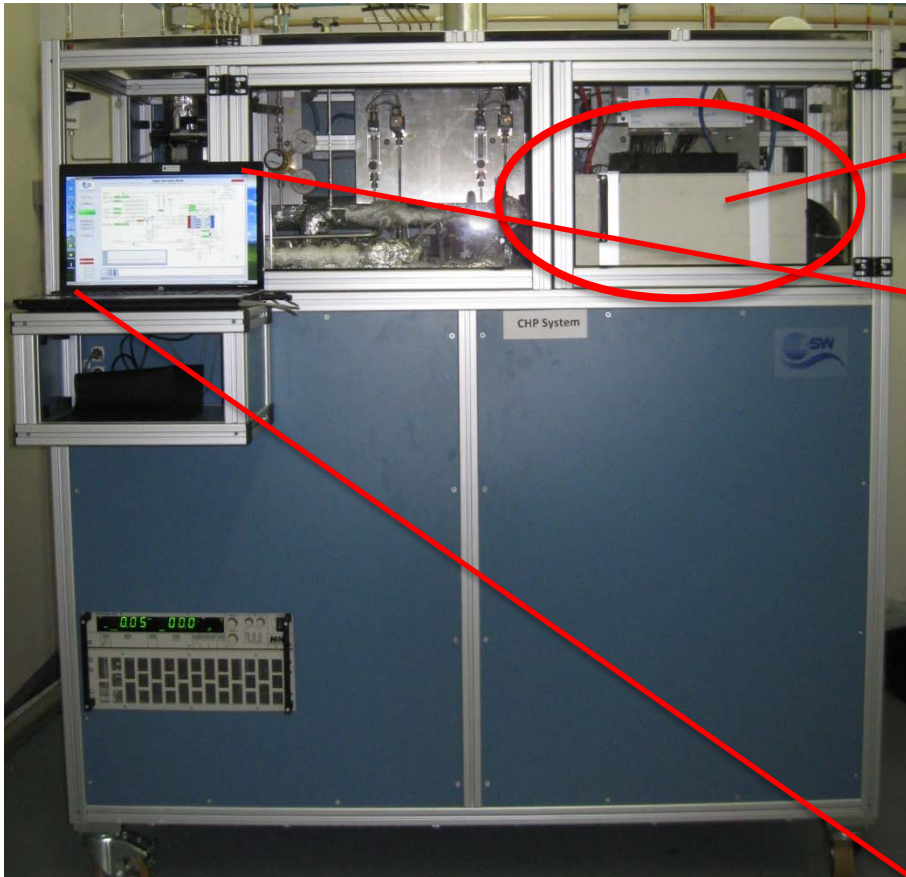
# HTPEMFC Stack



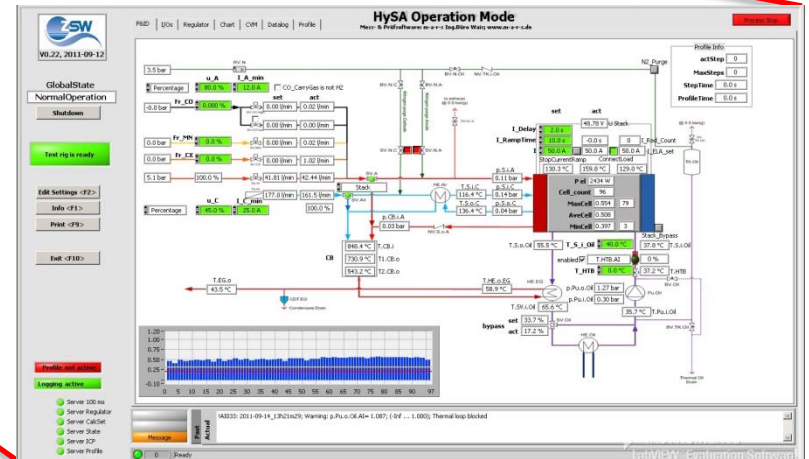
# 2 kW CHP Breadboard System



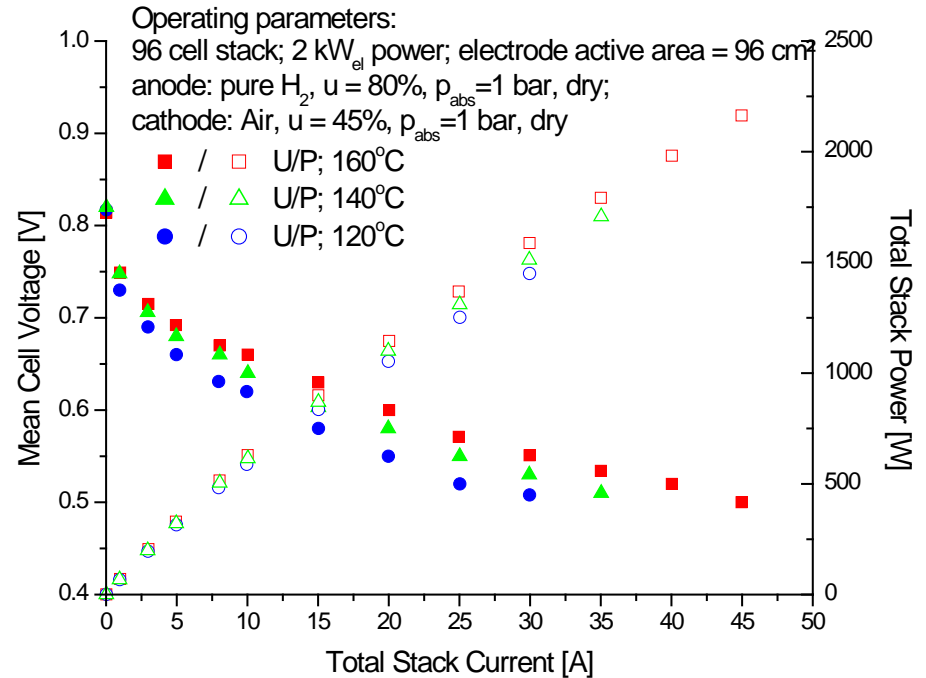
# 2 kW CHP Breadboard System



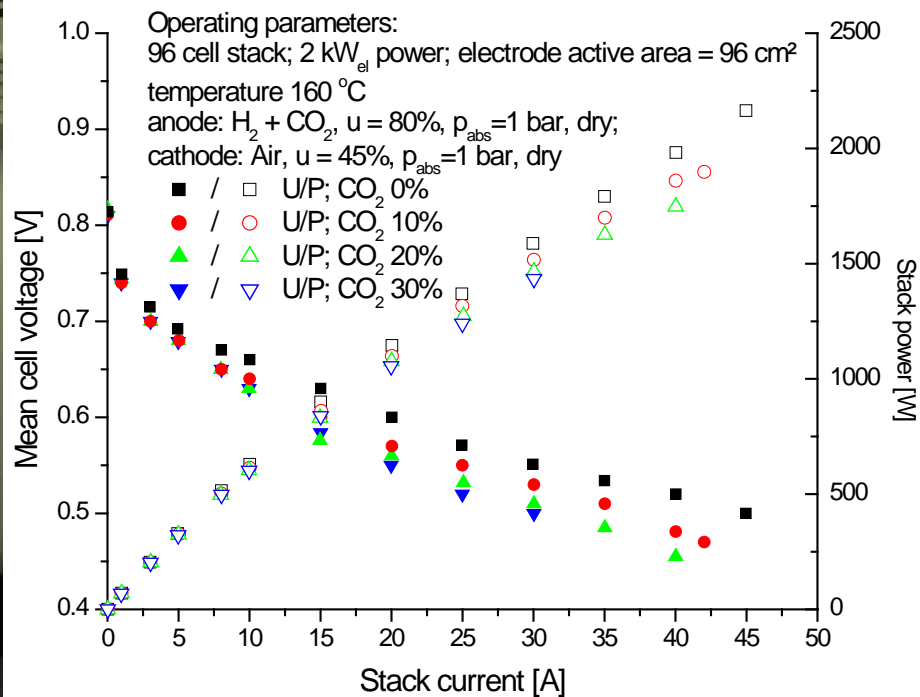
2 kW Stack,  
thermally insulated



# 2 kW CHP Breadboard System



# 2 kW CHP Breadboard System



# Ongoing Activities

- **MEA development**
  - MEA optimization to prevent acid poisoning
  - Minimise phosphoric acid adsorption by using selected additives in the MPL and CL
  - Electrophoretic deposition based MEAs
  - Catalyst ink optimization
- **Stack development**
  - Validation of the two 1 kW and one 2kW stack
  - Machining of stack components
  - Modelling of the stack – cost, thermofluid and mathematical
  - Assemble and validate a 2kW stack with locally machined components
- **System**
  - Analysis of a 2 kW breadboard system
  - Integrate with a Gen-II 2 kW stack and validate for performance and durability with reformat (simulated)
  - Process modelling of the 2 kW system

# Thank you for listening!





# ZiNG

## CONFERENCES

# **2<sup>nd</sup> ZiNG INTERNATIONAL HYDROGEN AND FUEL CELLS CONFERENCE NAPA VALLEY, CALIFORNIA 12<sup>th</sup> – 15<sup>th</sup> JULY 2013**

Chaired by:

Prof. Bruno G. Pollet FRSC (University of the Western Cape, HySA Systems)

Prof. Brant A. Peppley (Queen's University, Fuel Cell Research Centre)

[www.ZingHydrogen.info](http://www.ZingHydrogen.info)