



## High Temperature Polymer Electrolyte Membrane Fuel Cells - Performance and degradation -

High Temperature Polymer Electrolyte Membrane Fuel Cells (HTEPM) are based on phosphoric acid doped polybenzimidazole (PBI) membranes using platinum catalysts on carbon electrode support at operating temperatures in the range 140-180 °C. The membrane electrode assemblies (MEA) are under development. Pilot scale production is in progress at Danish Power Systems. Here is presented the latest results on performance and durability.

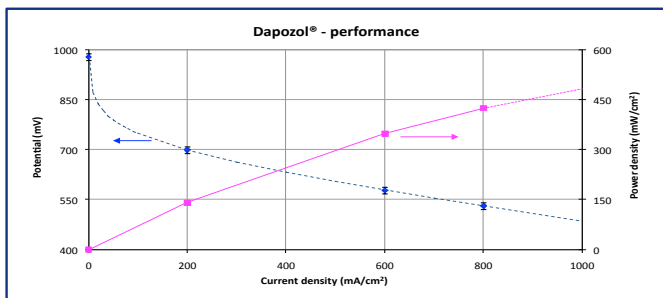


Fig. 1. Polarization and a power curve for MEAs tested with hydrogen at 160 °C. Based on 90 identical 50 cm<sup>2</sup> MEAs. Error bars on the polarization curve indicates standard deviation below 2 %.

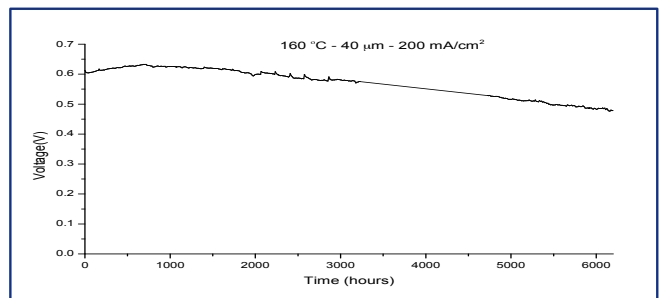


Fig. 4. Durability testing at 200 mA/cm<sup>2</sup> and 160 °C. The test is on-going.

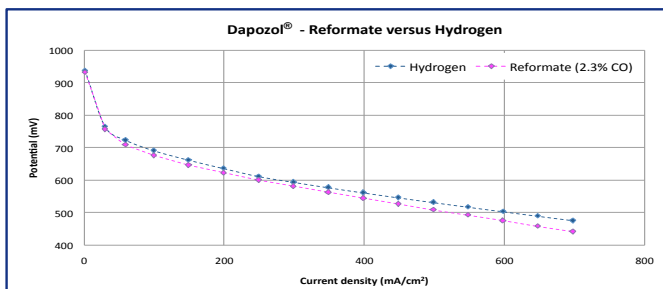


Fig. 2. Polarization curve for MEAs tested with hydrogen and reformat at 160 °C.

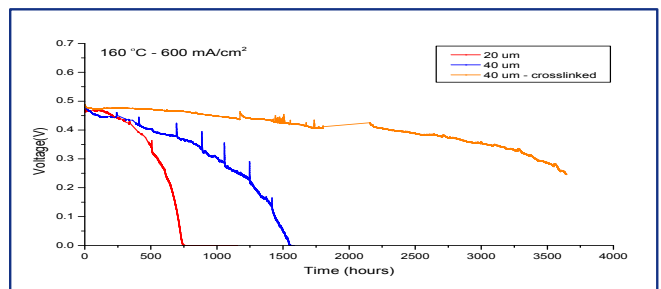


Fig. 5. Durability testing at 600 mA/cm<sup>2</sup> and 160 °C - comparing standard and improved crosslinked membranes. The test is on-going.

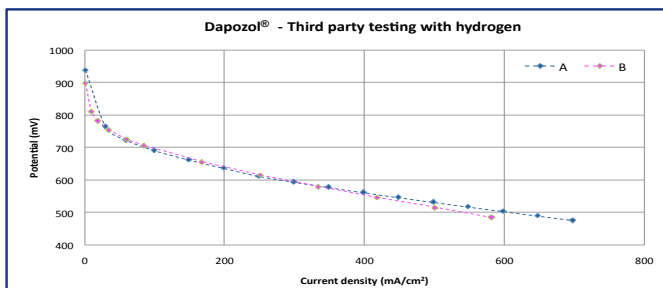
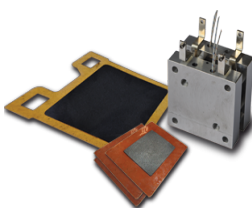
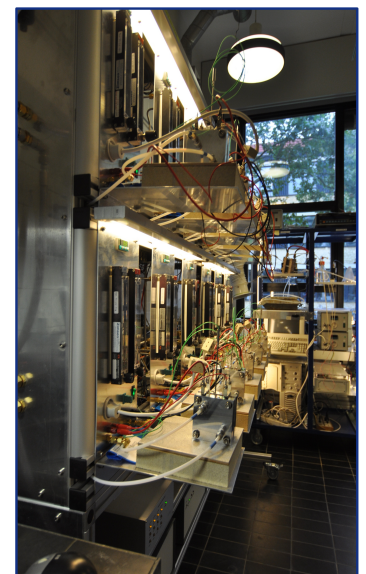


Fig. 3. Polarization curve for MEAs tested with hydrogen at 160 °C by third parties. This shows performance data similar to those achieved by DPS.

- Testing procedure:**
- Standardized test protocols
  - Test parameters:
    - ✓ Hydrogen and air
    - ✓ Ambient pressure
    - ✓ Temperature 160°C
  - Polarization and power curves
  - Degradation (µV/h)
  - Post mortem analysis
  - Clear benchmarking necessities

Fig. 6A and 6B. Durability laboratory at the Technical University of Denmark.



**HTEPM Energy technology:**

- Low weight - Easy to operate
- No noise - No smell - No vibration - No down-time
- No particles - No NOx
- High energy efficiency - Low carbon dioxide
- Multiple fuels: Hydrogen - Bio fuels - Methanol - Ethanol - LPG - Natural gas - Diesel - DME - SNG
- High CO tolerance - No humidifier - Low pressure
- High temperature - Heat utilisation - Good kinetics

DPS: Hans Aage Hjuler, Thomas Steenberg, Carina Terkelsen and Hèctor Rodrigo Garcia  
DTU – Department of Chemistry: Maria Teresa Romero Sánchez, Lars Nilausen Cleemann and Jens Oluf Jensen