DeMStack
Understanding the Degradation Mechanisms of a High Temperature PEMFC Stack & Optimization of the Individual Components

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Programme Review Days 2016
Brussels, 21-22 November

PROJECT OVERVIEW

DeMStack 325368	
Call topic	SP1-JTI-FCH.2012.3.1_Cell and stack degradation mechanisms and methods to achieve cost reduction and lifetime enhancement
Application area (FP7)	Stationary power and CHP
Start date	01/05/2013
End date	31/10/2016
Total budget (€)	2,576,615
FCH JU contribution (€)	1,495,680
Stage of implementation	100%

FORTH/ICE-HT

Advent

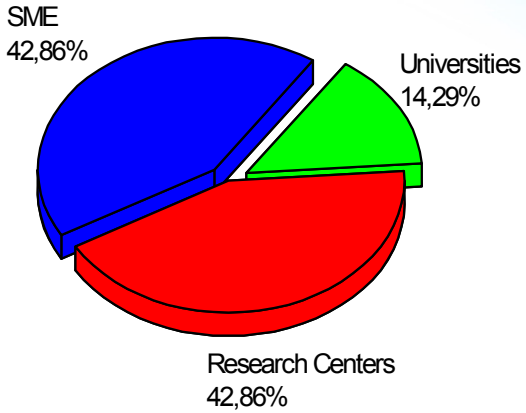
IK4 CIDETEC Research Alliance

JRC EUROPEAN COMMISSION

cmr Prototech

UNIVERSITY OF CHEMISTRY AND TECHNOLOGY PRAGUE

helbio



PROJECT SUMMARY

Objectives

➢ DeMStack activities are on the stack optimization and construction based on the high temperature MEA technology of ADVENT S.A..

➢The strategy aims at improvements based on degradation studies and materials development carried out in previous and ongoing projects.

➢ This is the first attempt to combine optimized components and methodologies into an integrated system; a low-cost HT PEMFC 1 kW stack will be integrated with a fuel processor specifically built to suit the demands of the FC stack.

➢ The robustness of the stack, the simplicity of BoP and the operational stability into a commercially reliable product will be demonstrated.

- Fuel Cell Stack Power output of 1 kW at 0.2 A/cm^2 at 180^{o}C
- Operation over a wide range of reformates: (H_2≥50%, CO = 0-4%, steam = 0-30%)
- Overall cost reduction by a factor of 2 (reduction of the MEA's cost)
- Integrated system with power output 0.9 kW.

PROJECT SUMMARY

Possible applications:

CHP units

Auxiliary power units (3-10kW),

Battery chargers with LPG (300 W),

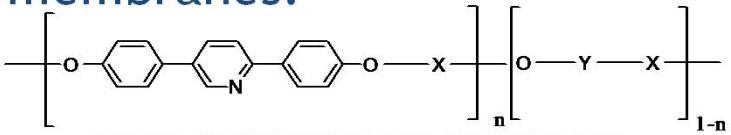
Power supply in remote/off grid areas (2kW),

Regenerative fuel cells for space (3kW satellites),

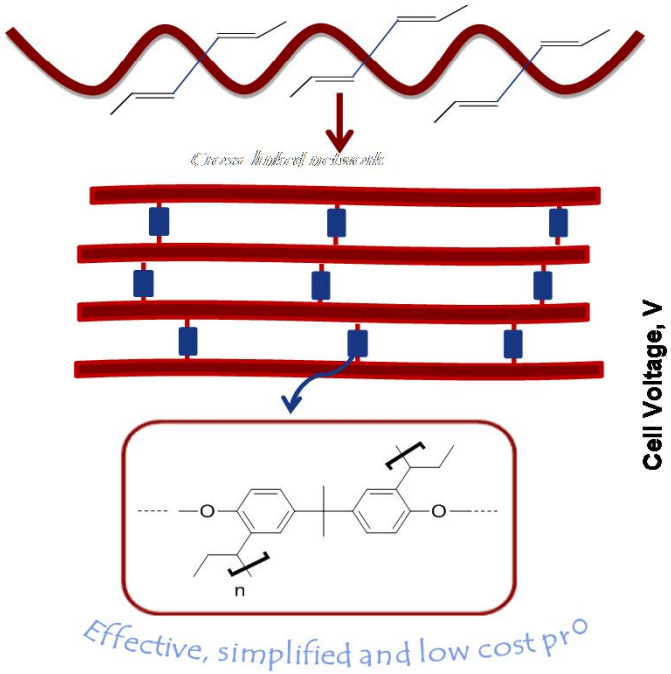
Stationary back up power systems.

PROJECT ACTIONS

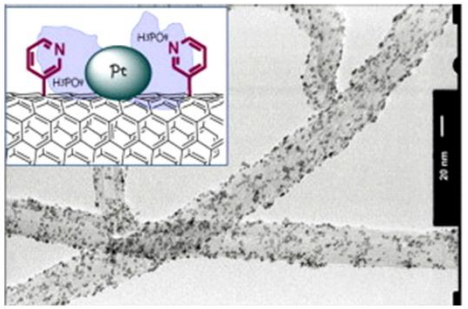
- Low cost stable HT Membrane Electrode Assemblies.
- Catalytic layers of alternative architectures and low Pt loadings.
- Overall cost reduction by a factor of 2 resulting by the significant reduction of the MEA's cost due to the lower Pt loading and the cheaper membranes.



Cross-linking through side double bonds



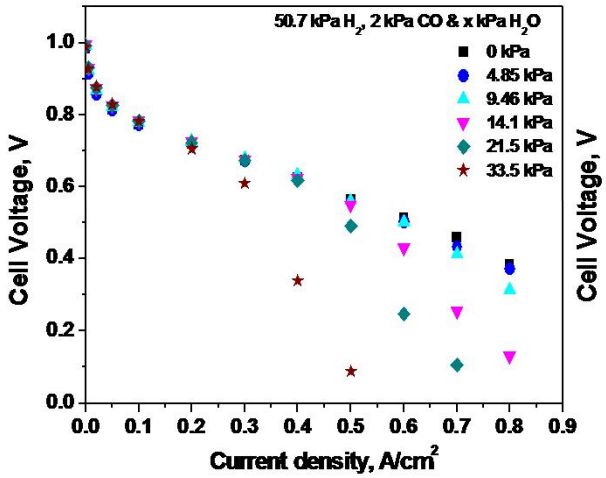
Effective, simplified and low cost pro



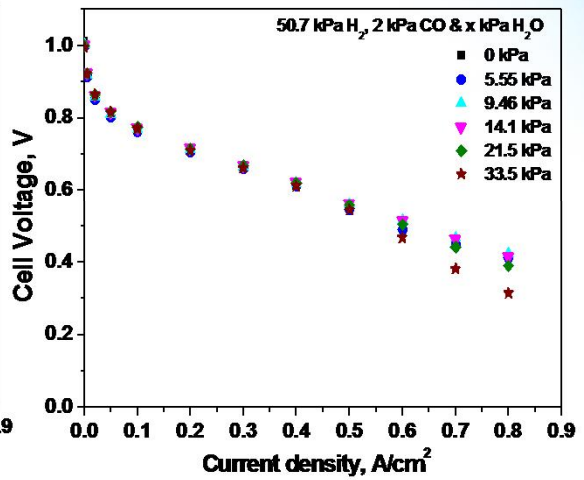
Pt loading≈ 0.7 mgPt/cm²

0.5gPA/gPt

30wt% Pt/C

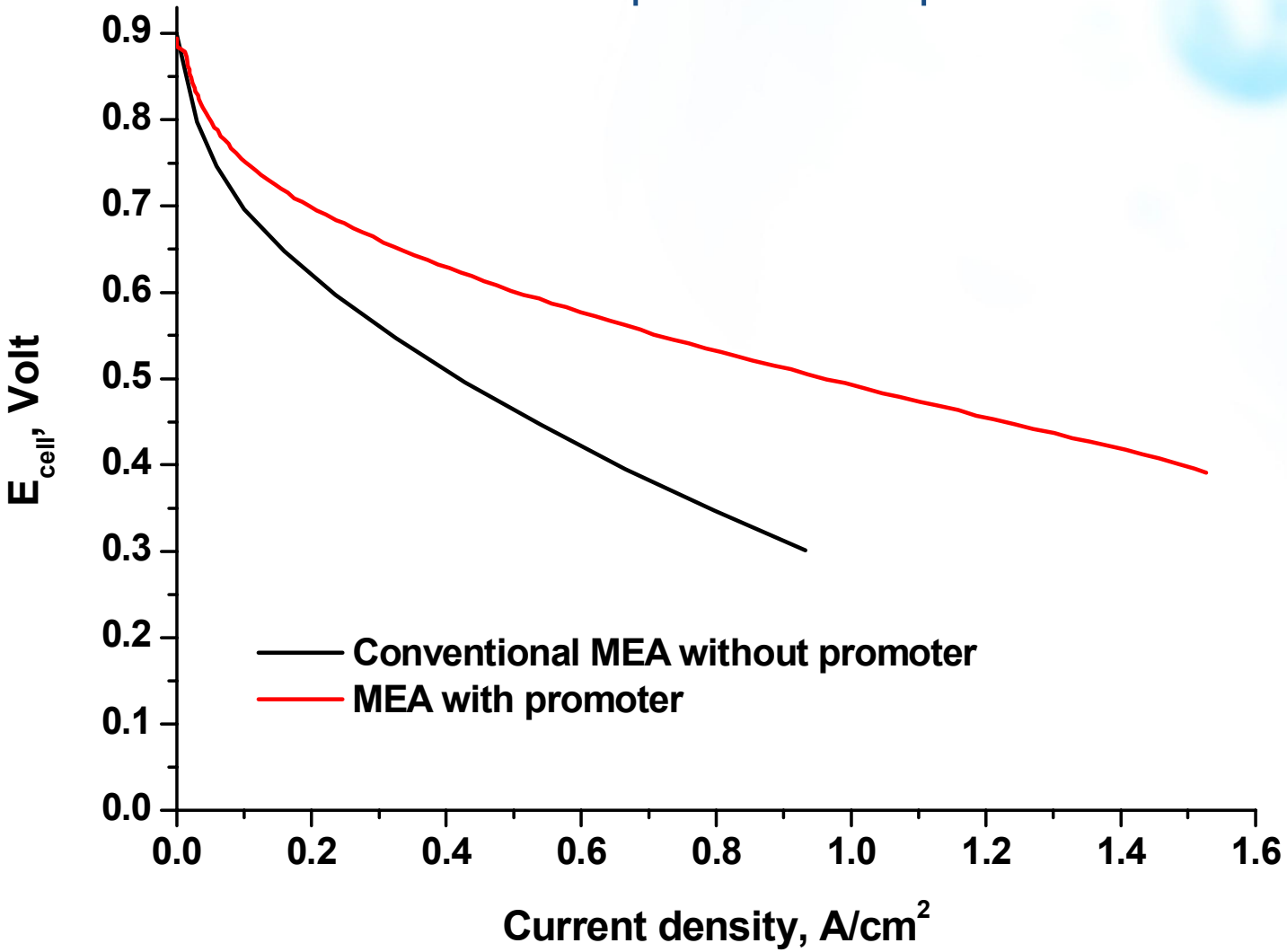


30wt% Pt/ox.MWCNT-Py

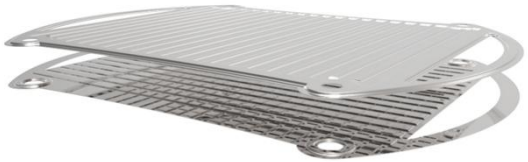


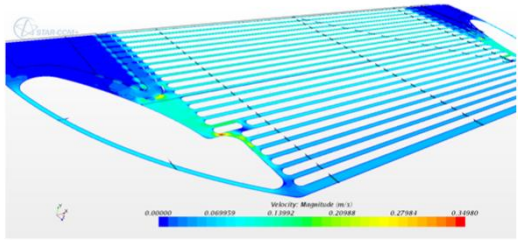
PROJECT ACHIEVEMENTS

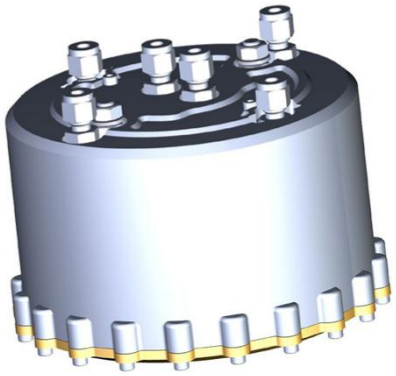
Addition of a performance promoter



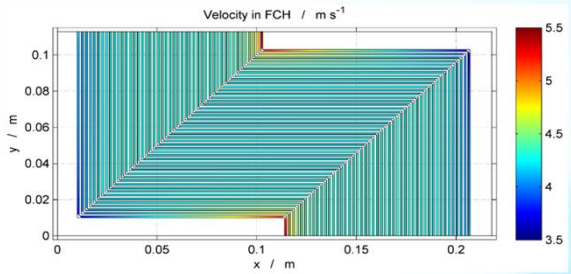
PROJECT ACTIONS

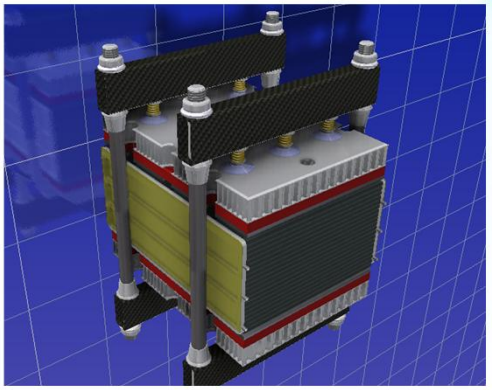


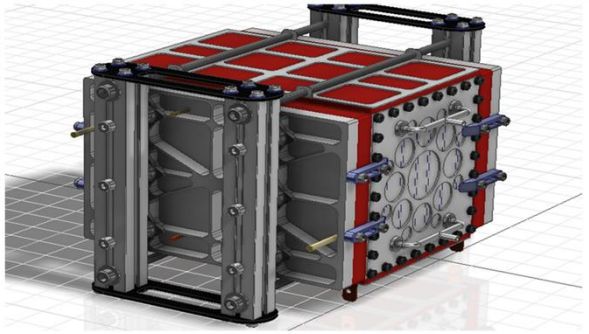




Hydroformed thin metal plates. New challenging concept
CFD calculations, completion of designs.
Selection and testing of materials.

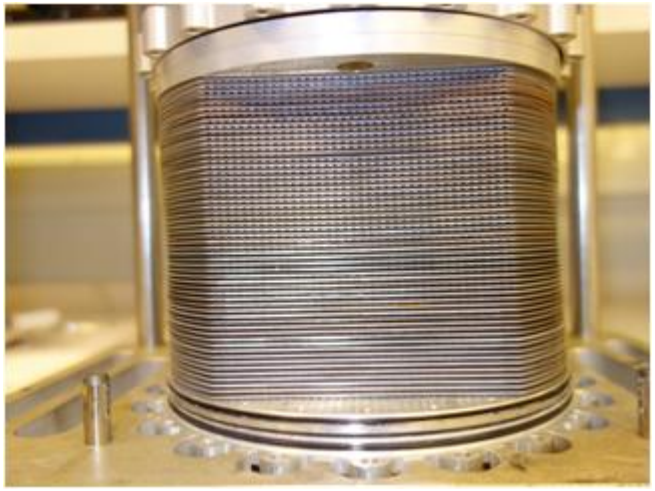


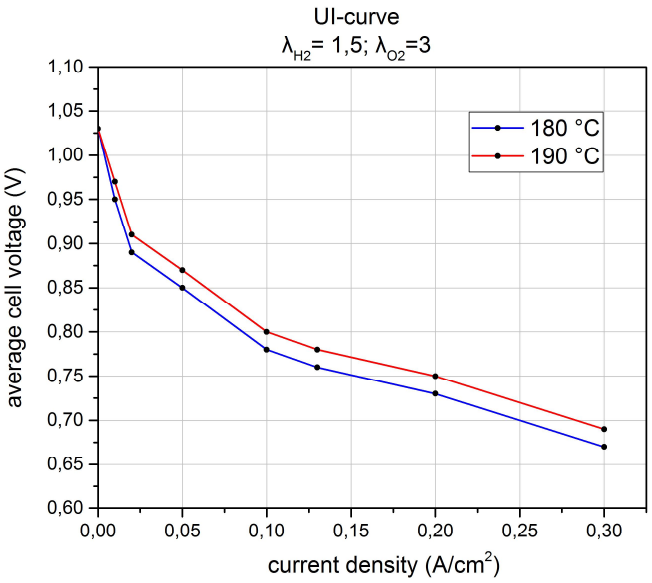




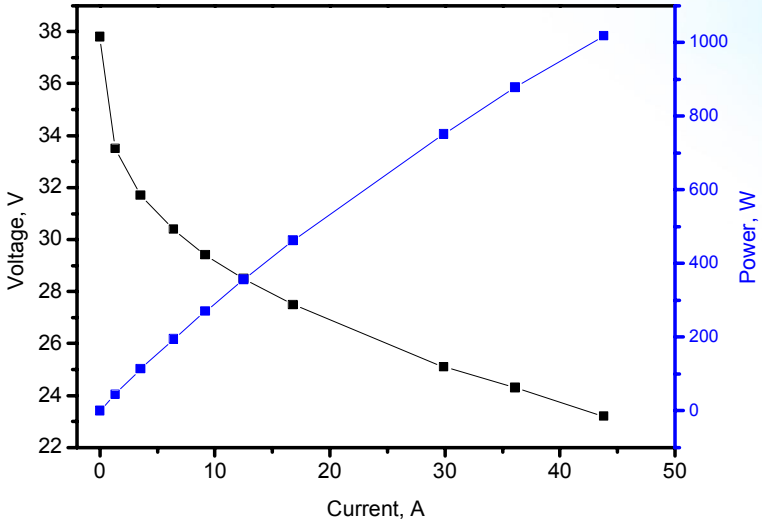
Graphitic Bipolar Plates. Already validated concept.
Increase of bending stiffness of the end plates
Decrease of the weight of the peripheral structure.

PROJECT ACHIEVEMENTS





Hydroformed thin metal plates.
Internal liquid cooling



Graphitic Bipolar Plates.
External liquid cooling.

PROJECT ACHIEVEMENTS

Achievement to-date

% stage of implement.

Efficiency

≥40%

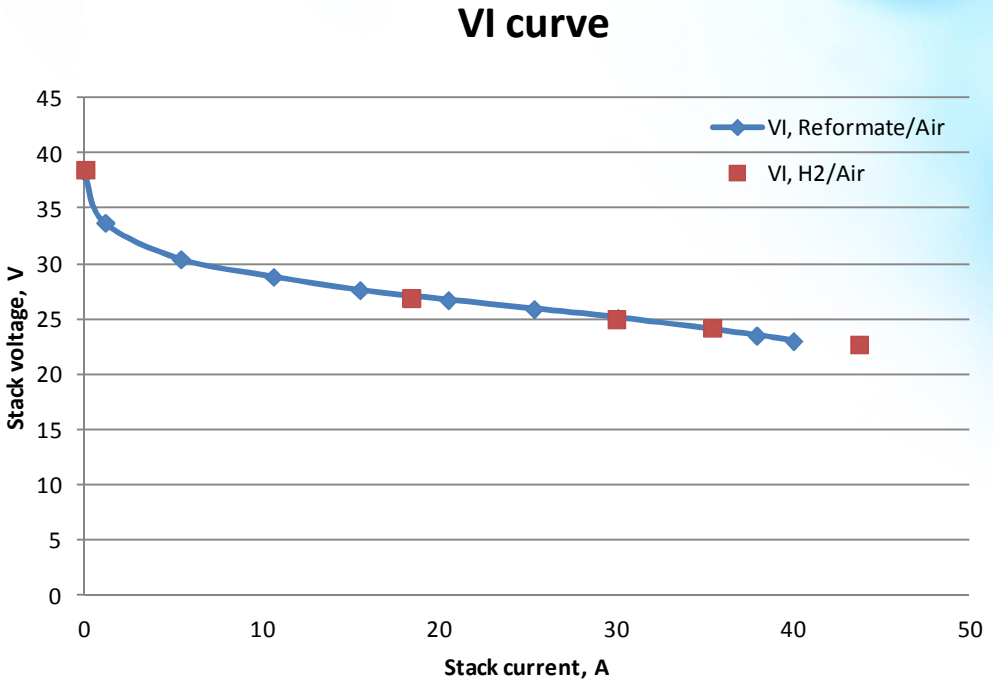
40%

Cost

< 3000 €/kW

25% 50% 75%

< 2000 €/kW



SYNERGIES WITH OTHER PROJECTS AND PROGRAMMES

Interactions with projects funded under EU programmes	
DEMMEA_245156	The present project was built on technology, techniques and methodologies from the DEMMEA project.
IRAFC_245202	DeMStack used knowledge gained under the IRAFC on polymer electrolytes.
IRMFC_325358	There is interface-exchange of knowledge with IRMFC. Moreover, DeMStack exploited polymer electrolytes optimized under IRMFC.
CathCat_303492	Interaction in terms of knowledge exchange.
Interactions with national and international-level projects and initiatives	
European Space Agency	Development of a Closed Loop Regenerative HT PEM Fuel Cell System
European Space Agency	Demonstration of a closed loop H2/O2 fuel cell system

DISSEMINATION ACTIVITIES

Conferences/Workshops/Schools

- 20 events in which the project has participated.
- 26 papers presented.

Organization of the 3degis conference:

3rd International Workshop on Degradation Issues of Fuel Cells and Electrolysers, Santorini, Creece, 29/9-1/10/2015

Website: demstack.iceht.forth.gr

Publications: 7

- "The structure and stability of the anodic electrochemical interface in a high temperature Polymer Electrolyte Membrane Fuel Cell under reformate feed" M. Geormezi, F. Paloukis, A. Orfanidi, M.K. Daletou, S.G. Neophytides, Journal of Power Sources 285 (2015) 499-509.
- "H_3PO_3 electrochemical behaviour on a bulk Pt electrode: adsorption and oxidation kinetics" M. Prokop, T. Bystron, M. Paidar, K. Bouzek, Electrochimica Acta 212 (2016) 465–472.

Thank You!

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