Fuel cells and hydrogen
Joint undertaking

Programme Review Day 2011
Brussels, 22 November

New Energy World JU
fuel cells & hydrogen for sustainability

http://www.fch-ju.eu/

Development of an Internal Reforming Alcohol High Temperature PEM Fuel Cell Stack

IRAFC
245202 FCH-JU-2008-1

Stylianos G. Neophytides
Advent Technologies

Consortium

Advent Technologies (Coordinator) *Greece*

R&D and production of MEA

University of Maria Curie- Sklodowska, Department of Chemical Technology UMCS , *Poland*

Preparation, studying and characterization of catalysts

Nedstack Fuel Cell Technology BV, *The Netherlands*

Producer of PEM fuel cell stacks and systems

Centre National de la Recherche Scientifique, Laboratory of Materials, Surfaces and Catalytic Processes (LMSPC) *France*

Preparation of new catalytic materials, catalytic reactivity, kinetic studies and surface science, new energy sources,electrocatalysis and fuel cells

Foundation for Research and Technology Hellas-Institute of Chemical Engineering & High Temperature Chemical Processes, *Greece*

High and low temperature electrochemistry, heterogeneous catalysis, chemical and electrochemical kinetics and reactor design

Institut für Mikrotechnik Mainz GmbH, *Germany*

Research and development in microtechnology

The ultimate goal of the project is to deliver:

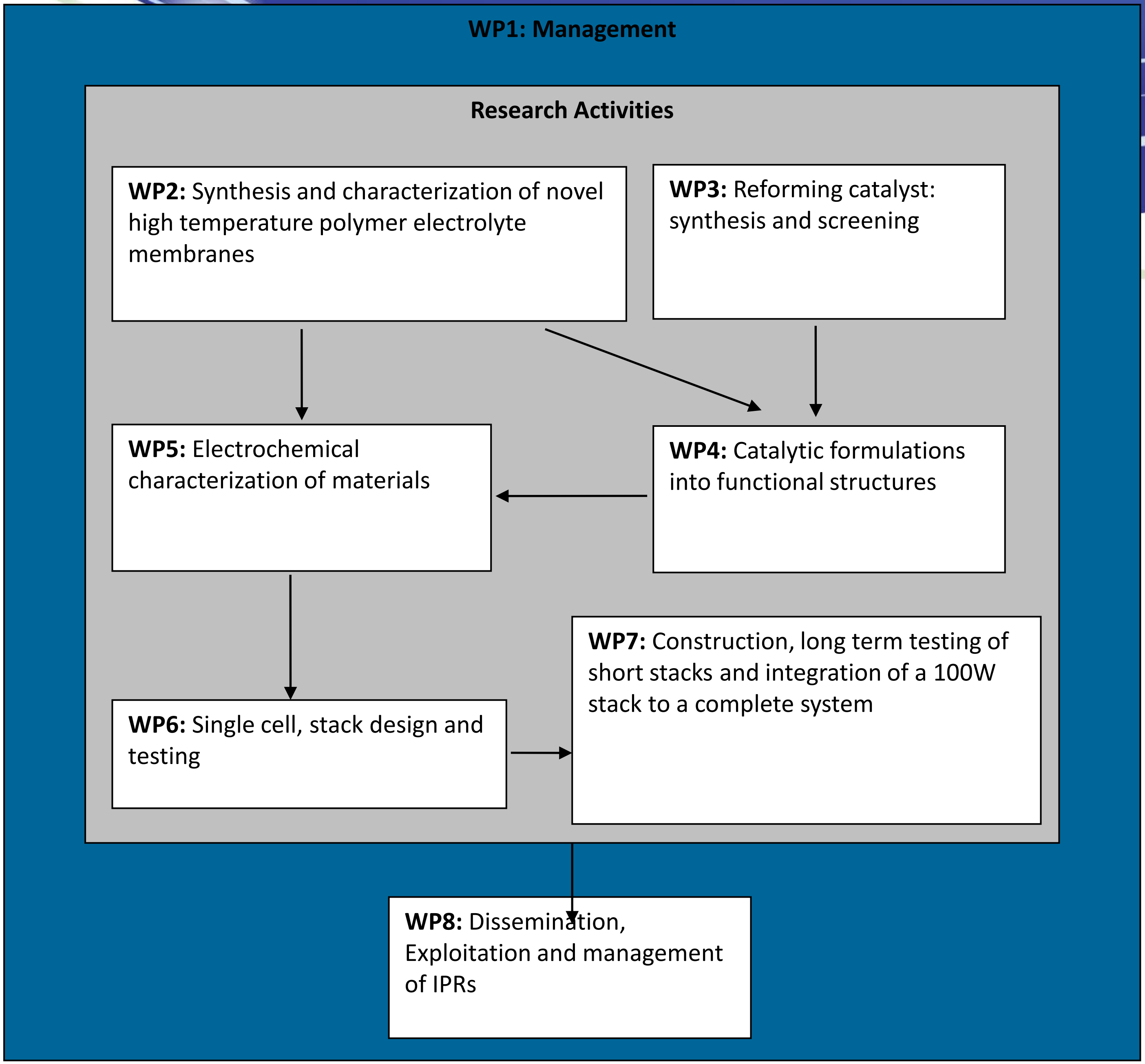
-***An Internal-Alcohol-Reforming High-Temperature PEM fuel cell*** (IRAFC) with the following characteristics:

(i) 0.15 W/cm^2 at 0.7V, operating at 220° C

(ii) Specific (W/kg) and volumetric (W/m^3) power density similar to current, state-of-the-art high-temperature PEM fuel cells operating on hydrogen.

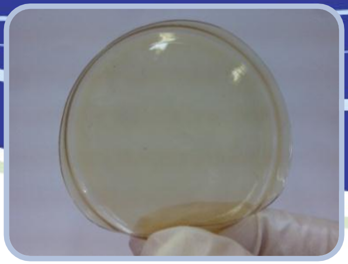
STRATEGY AND MILESTONES

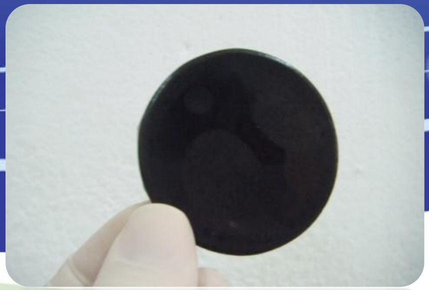
- MEA operating at temperatures 200-220° C
- Methanol reforming catalysts active at 200-240° C
- Optimum combined fuel cell and reformer stack design
- Reliable system performance at 200-220° C for 500hrs

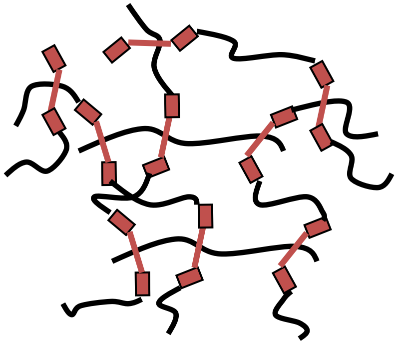

WP1: Management
Research Activities
WP2: Synthesis and characterization of novel high temperature polymer electrolyte membranes
WP3: Reforming catalyst: synthesis and screening
WP5: Electrochemical characterization of materials
WP4: Catalytic formulations into functional structures
WP7: Construction, long term testing of short stacks and integration of a 100W stack to a complete system
WP6: Single cell, stack design and testing
WP8: Dissemination, Exploitation and management of IPRs

Preparation of new crosslinked membranes

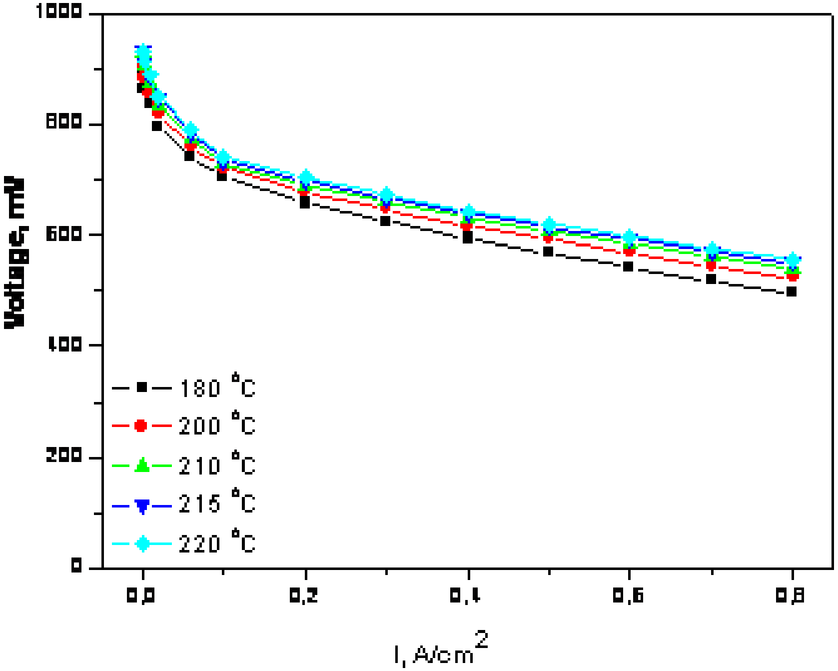
Crosslinking of the polymer electrolytes using three different methodologies has been selected and tested providing high quality crosslinked membranes that was the base of MEA construction that are able to operate at temperatures up to 230° C.

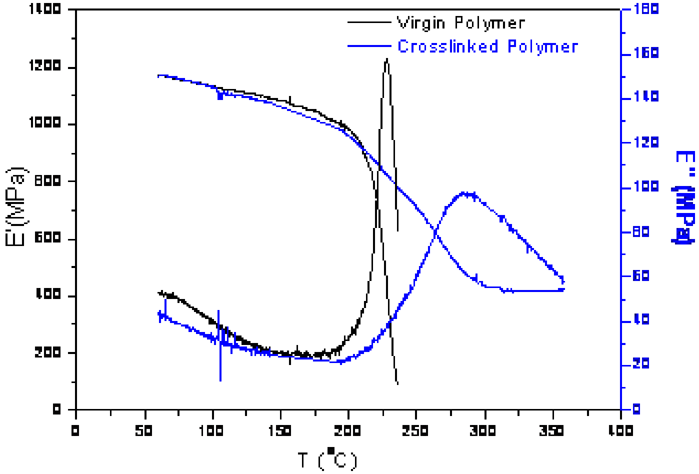




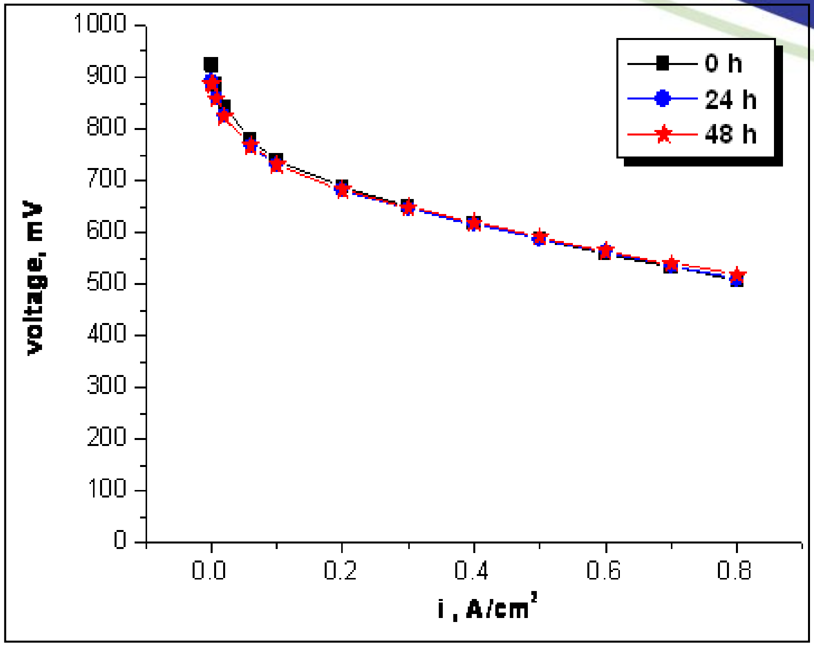


MEA testing at 180-220° C

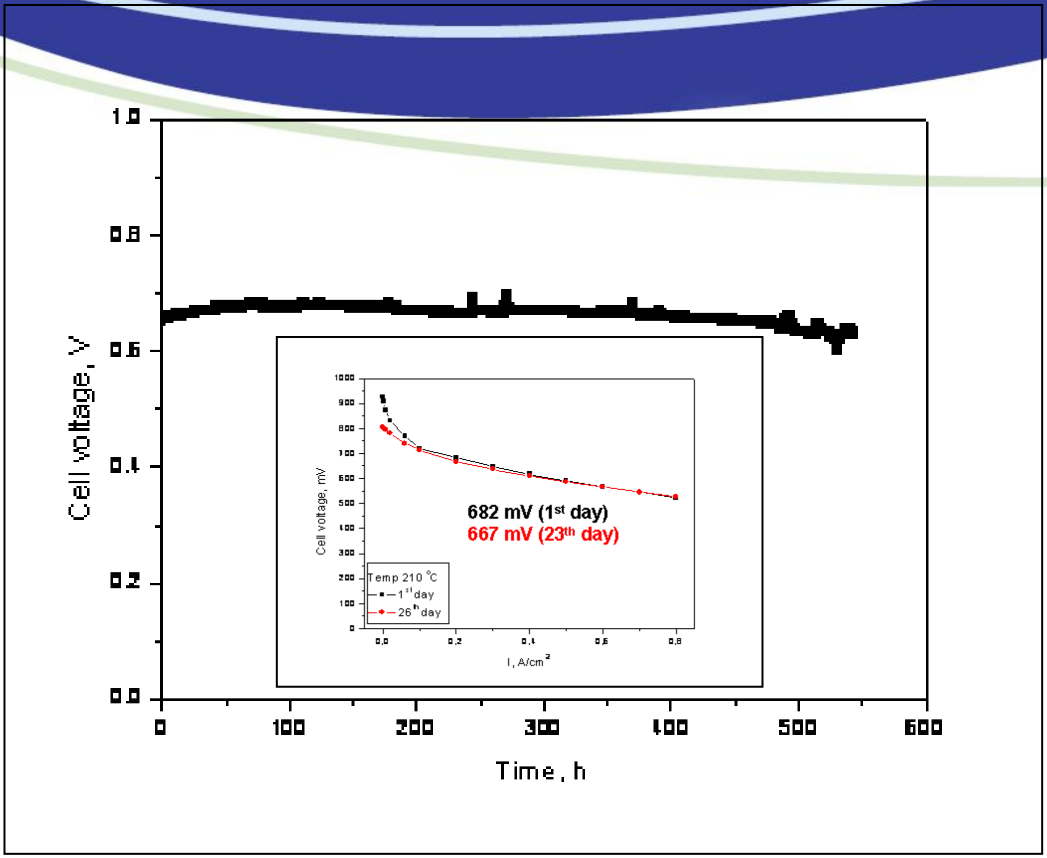




MEA stability test 200° C

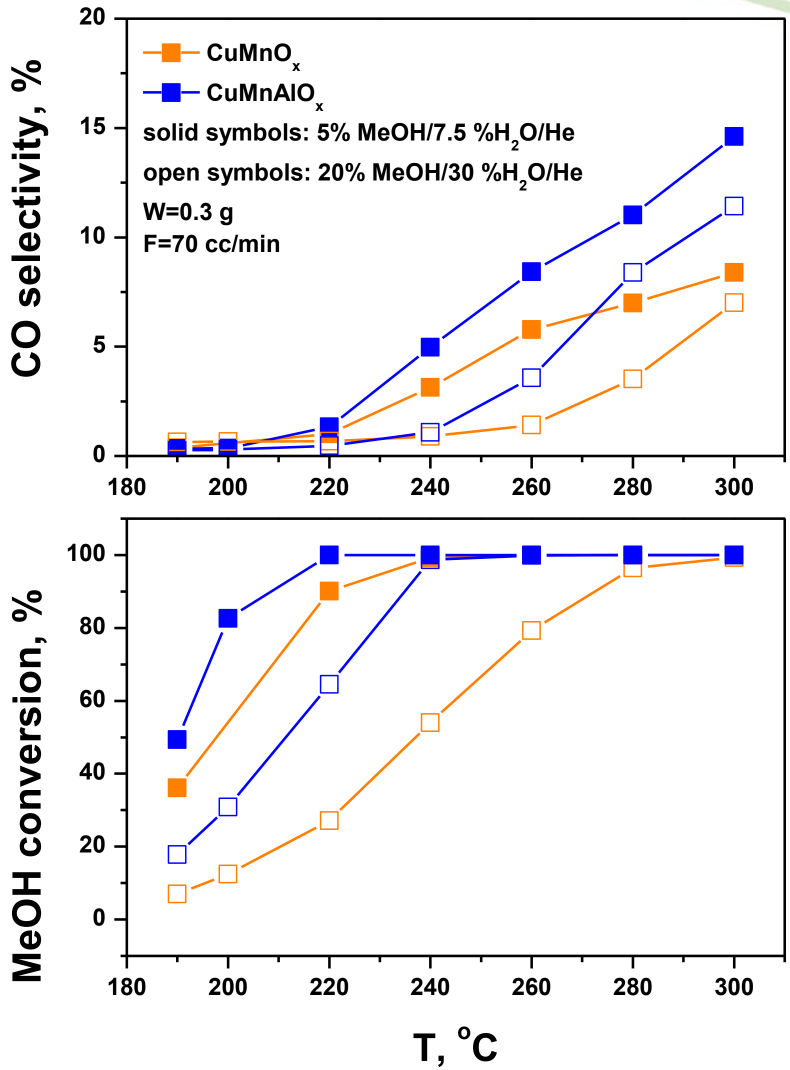


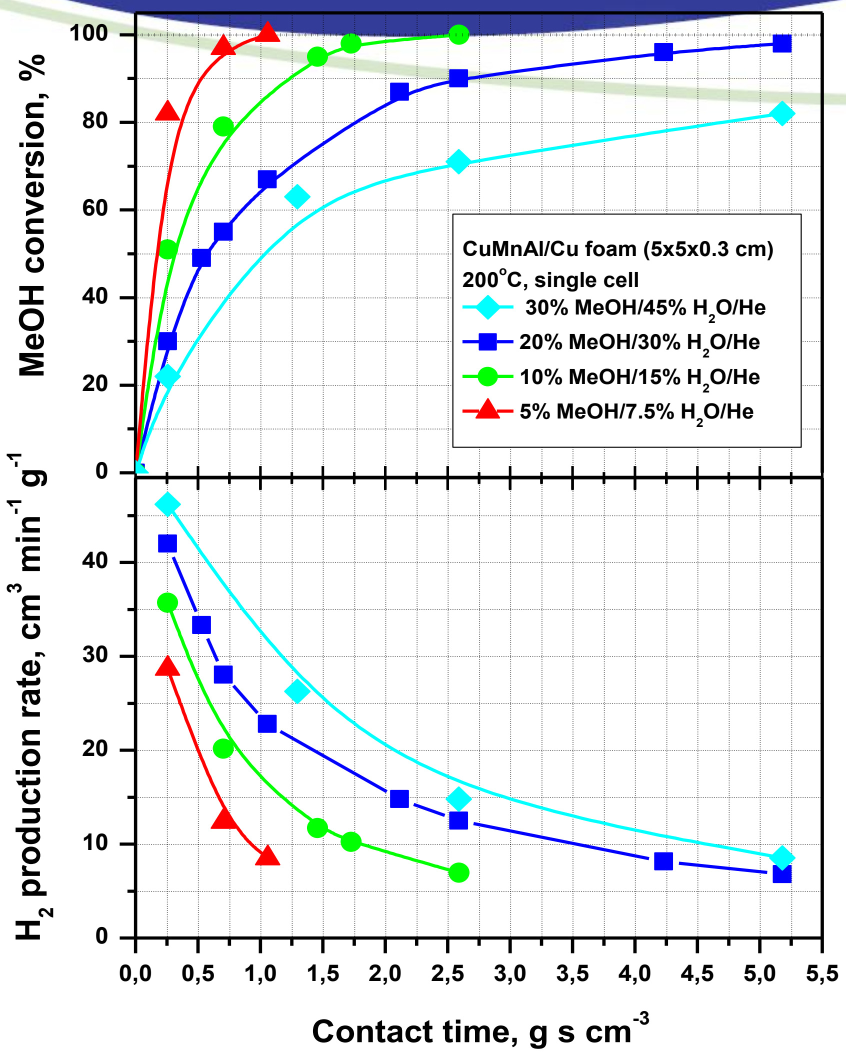
MEA stability test 210° C



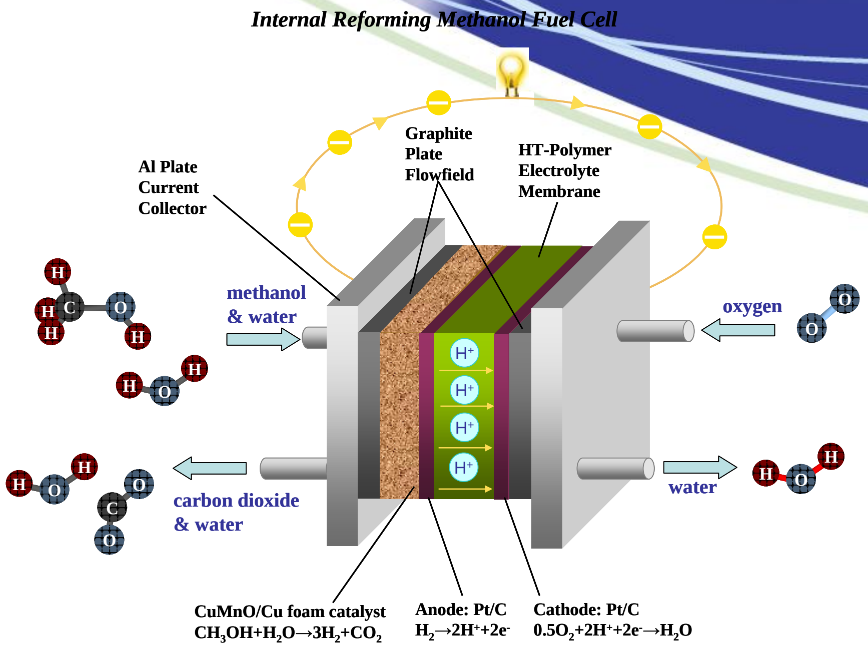
- No degradation observed at 200° C for 48hrs
- Stable performance at 210° C for 550hrs

CuMnAlO results in More than threefold increase in catalytic rate than $_x$ CuMnO$_x$

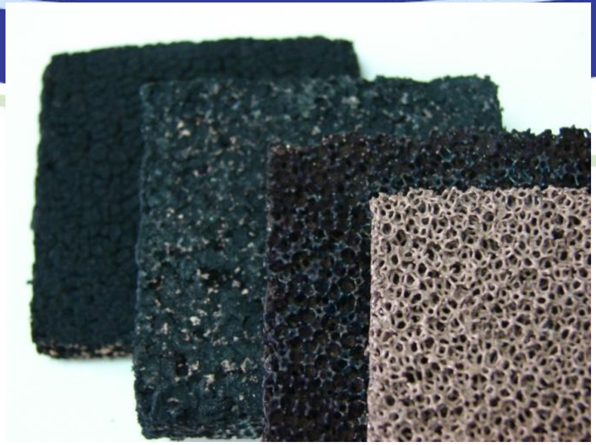




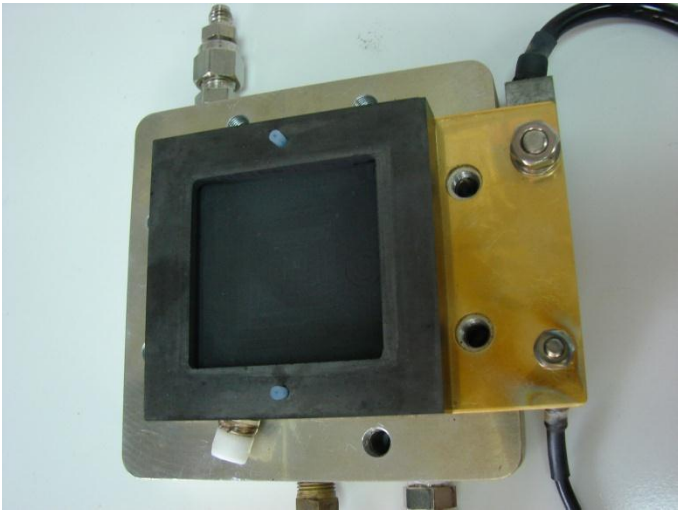
Internal reforming alcohol single cell



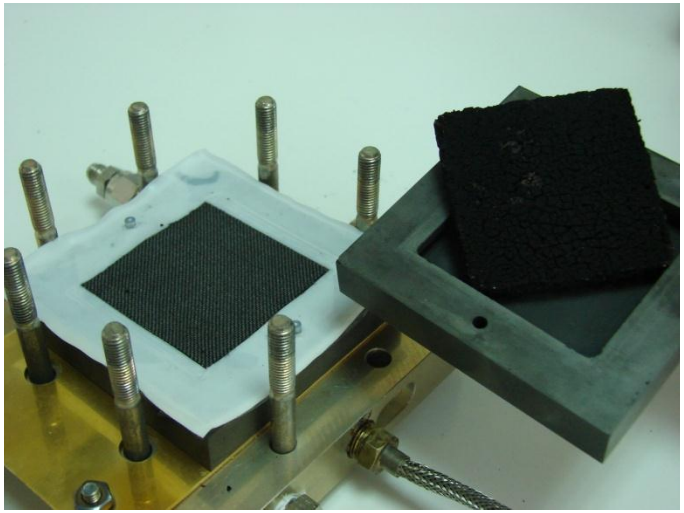
Different combined single cell architectu
Been tested



CuMnOx/Cu foam

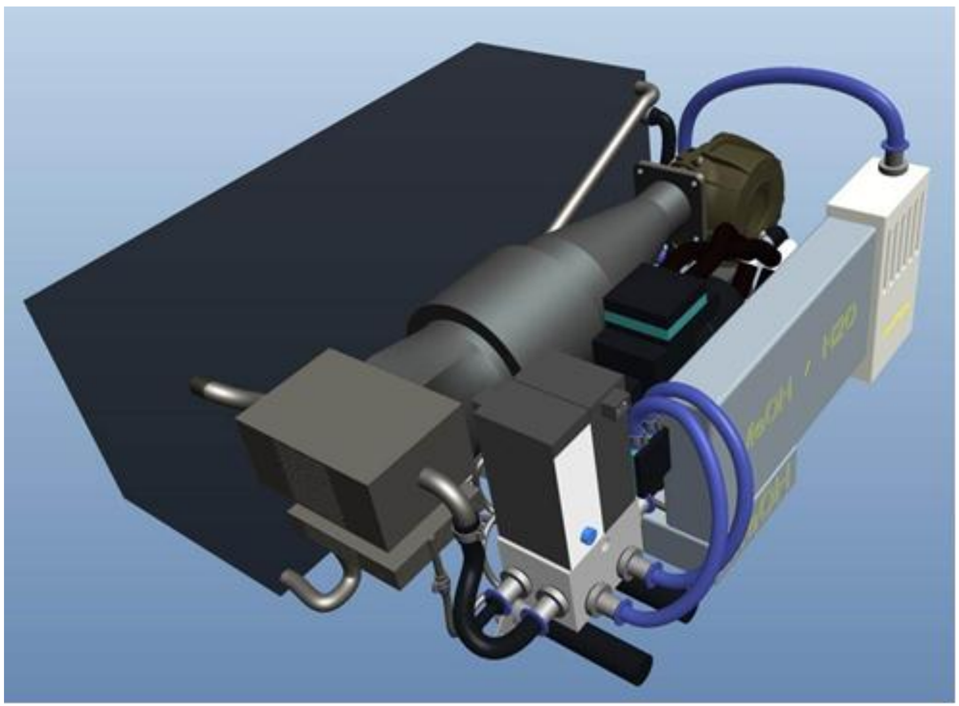


Modified Graphite Plate (Anode)



MEA and $CuMnO_x$/Cu foam catalyst

CAD model of the final system



Dimensions:

L	320 mm
W	290 mm
H	125 mm
Volume	11.6 L (w/o Insulation + DC/DC converter + control board)

Comparison:

On market system (250 W)

L	600 mm
W	400 mm
H	250 mm
Volume	60 L

IRAFC System advantages:

- Easy fueling
- Use of liquid fuel
- Compact design
- Combination of reformer/fuel cell
- Multi application

Application areas:

- Portable fuel cells
- Stationary Back up and UPS systems
- Remote and off grid areas

In agreement with early markets application areas goals

Technology transfer:

✓Highly interdisciplinary approach since the consortium consists of companies and academic institutes whose expertise cover a broad range of activities

✓Interface with international and national research projects, e.g.:

- DEMMEA -245156
- 09-ΣΥΝ-51-453
- Eurostars E!5094

Future perspectives:

✓Exploitation of the system application in:

- Refrigerators in remote and off grid areas
- Stationary back up power systems

Dissemination & public awareness:

- 6 publications in peer reviewed journals
- Participation in 16 conferences and events
- 1 patent application
- Website dedicated to IRAFC project (http://irafc.iceht.forth.gr/index.php)