LASER-CELL

(Contract number: 278674)

Vivien CHAPMAN – presenting

(Gene LEWIS – Coordinator)

AFC Energy

www.laser-cell.eu

PROJECT OVERVIEW

- Project title: LASER-CELL – *Innovative Cell and Stack Design for Stationary Industrial Applications Using Novel Laser Processing Techniques*
- Call: FCH-JU-2010-1
- Start and end date: 1 December 2011 – 30 November 2014
- Total budget: €2,877,089.60; FCH JU contribution: €1,421,757; self-funded costs: €1,455,332.60
- Consortium:

AFC energy cencorp VTT AIR PRODUCTS nanocyl UNIVERSITÄT DUISBURG ESSEN Open-Minded

- Overall purpose of project: Within project LASER-CELL, a novel alkaline fuel cell (AFC) and stack will be designed that will deliver competitive performance and that can be economically produced in volume for large scale stationary applications.
- Stage of implementation: 99% of project duration passed

PROJECT TARGETS AND ACHIEVEMENTS

Status before project	AIP target	Project Target	Current status/ achievements	Expected final achievement
high costs	simplification of design and manufacturing	investigate 'drip-feed' design; unique and integrated stack parts	cost-modelling has shown benefits of mass-manufacture	modified gas-flow; improved fuel utilisation; material reduction
handmade, individually produced components	new architectures	modular concept design	modular stack design; plug'n'play properties	handling multiple cartridges without making BOP changes

PROJECT TARGETS AND ACHIEVEMENTS

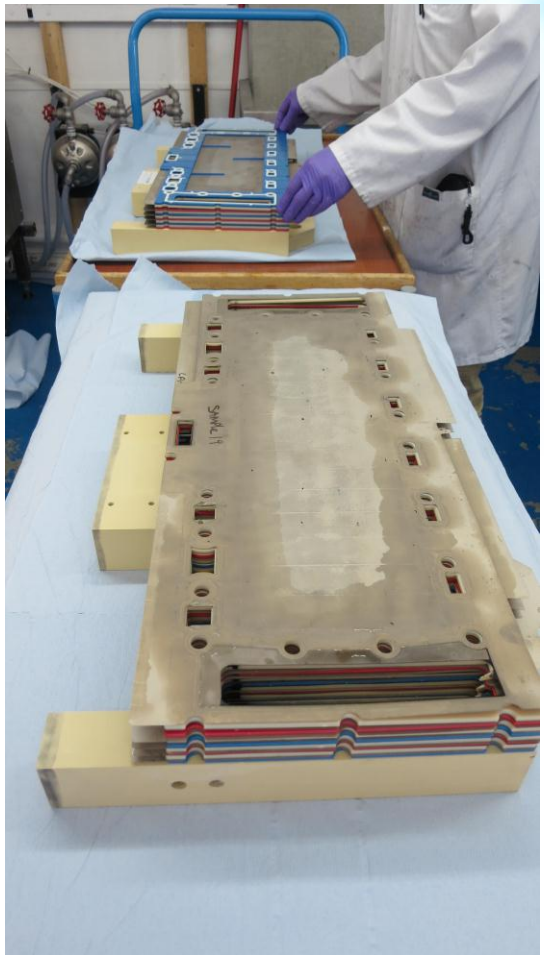
Status before project	AIP target	Project Target	Current status/ achievements	Expected final achievement
expensive materials	design to cost	low cost per kW	reducing part count; low-cost catalyst system	use of low-cost plastics; standard rubber gaskets
inadequate power output	increase in performance	reduced component thickness	more plates per stack	higher power density
uneven temperature distribution	robustness	thermal expansion management	selection of adequate materials	evenly distributed flow

PROJECT TARGETS AND ACHIEVEMENTS

→ Performance of laser sintered substrates is almost as good as current standard substrate of AFC

next steps:

- various studies and scientific papers published and available to the public
- continuation of partnership cooperation in H2020 foreseen
- final workshop „Lab to manufacturing – an iterative process“ as part of Programme Review days



RISKS AND MITIGATION

Objective No.	6
Bottlenecks and risks:	- extended trials requested - Coordinator agreed as work in other areas progressed ahead of schedule - delay did not have significant knock-on effects and did not put the final objectives at risk
Revision of targets:	No
Suggested nature of revision:	- extension of some trials - approved by the Coordinator and EU project officer - presented in the mid-term review

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

	DESCRIPTION OF COMPLEMENTARITY AND JOINT ACTIVITIES
ALKAMMONIA	• Project ALKAMMONIA (325343) • May 2013 – April 2016 • development of advanced simulation models for the cell and stack design • simulation models can be adapted for the development tasks in project ALKAMMONIA • experiments with the aim of eliminating or significantly reducing the ionic leakage within the stack will be incorporated • the final design of the substrate developed in LASER-CELL will be used in the ALKAMMONIA prototype

ALKAMMONIA

(Contract number: 325343)

Steven SCOWCROFT - Presenting

(James AUSTIN – Coordinator)

AFC Energy

www.alkammonia.eu

PROJECT OVERVIEW

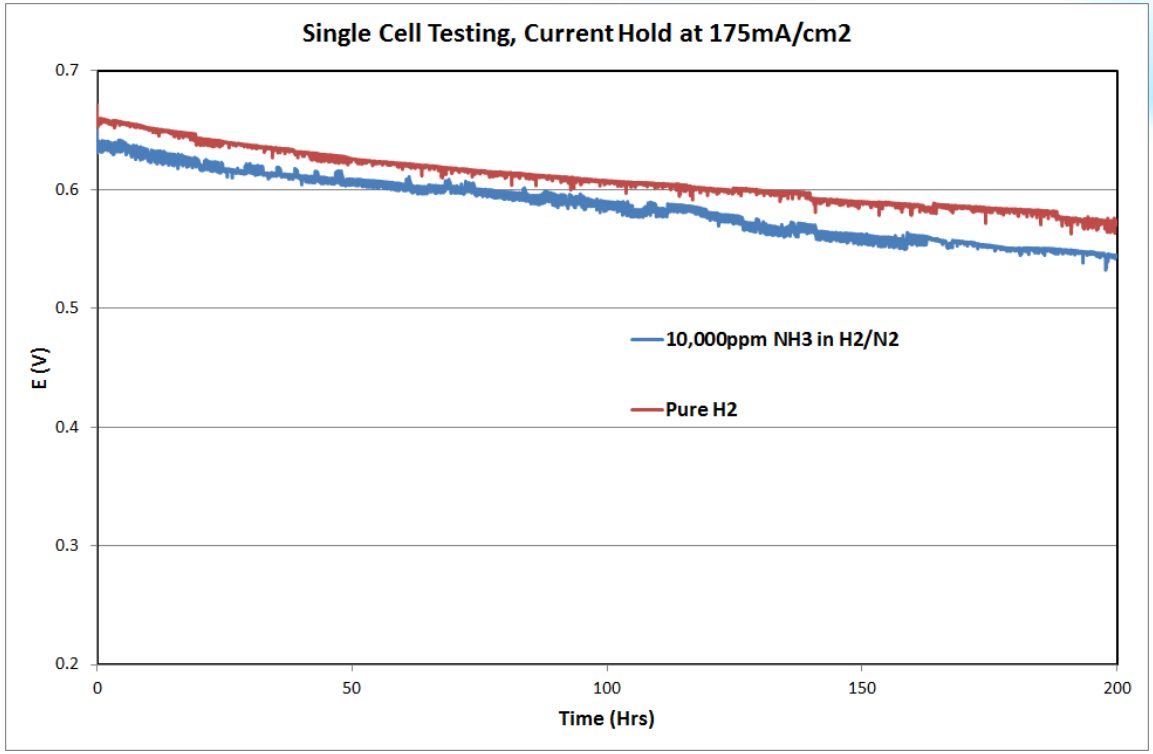
- Project title: *ALKAMMONIA – Ammonia fuelled alkaline fuel cells for remote power applications*
- Call: SP1-JTI-FCH.2012.3.5
- Start and end date: 1 May 2013 – 31 April 2016
- Total budget: €2,870,896; FCH JU contribution: €1,962,548; self-funded costs: €908,348
- Consortium:

- Overall purpose of project: to develop and test a proof-of-concept system to provide power in remote applications
- Stage of implementation: 53% of project duration passed

PROJECT TARGETS AND ACHIEVEMENTS

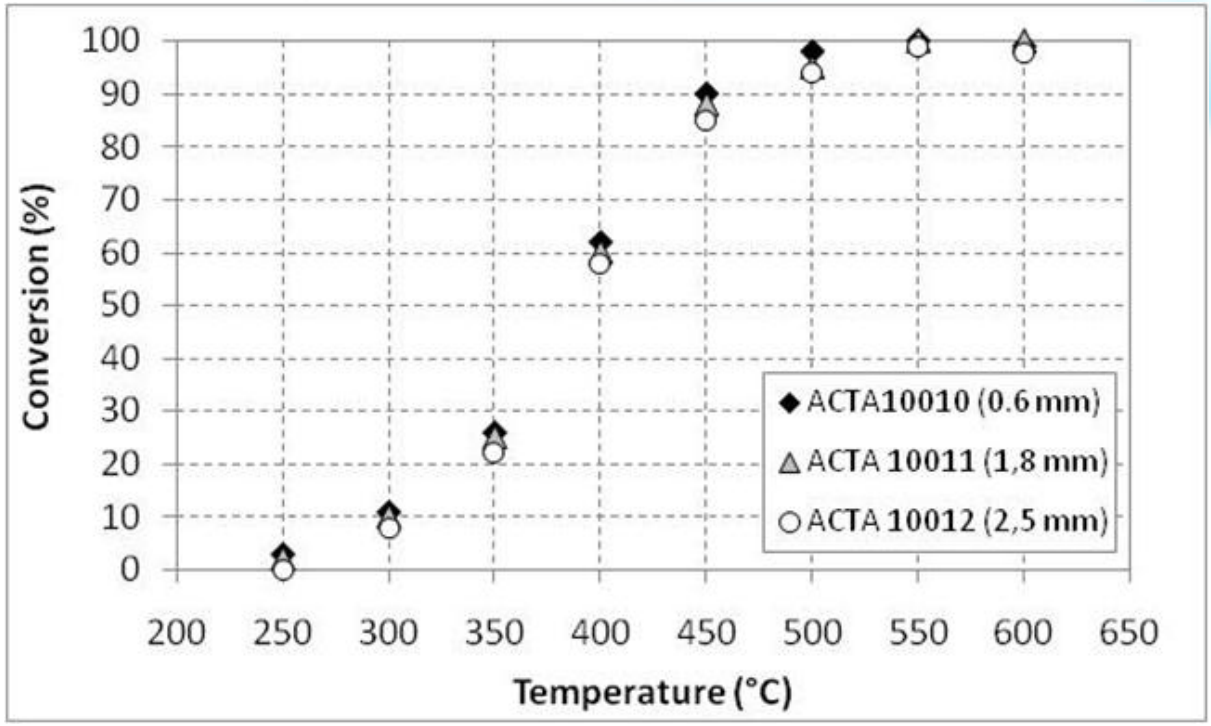
Status before project	MAIP / AIP target	Project Target	Current status/ achievements	Expected final achievement
High costs	Cost of system €/kW: mid-term 4,000 €/kW (2015); long-term 2,000€/kW (2020)	€2,500 (2012) €1,500 (2016)	Tasks needed to achieve target, including revisions to substrate design, are on schedule	Cost above long-term target achievable with design revision and discounts for bulk purchasing
Focus purely on research and development	Market acceptance requirements such as cost, lifetime, reliability	Set up Special Advisory Board (SAB)	First SAB meeting in cooperation with POWER-UP scheduled	Regular SAB meetings; established contacts with clients

PROJECT TARGETS AND ACHIEVEMENTS



- Single-cell testing to examine the effects of using cracked ammonia as a fuel
- A range of ammonia levels were tested; up to 10,000ppm (1%), in 75% hydrogen and 25% nitrogen
- Rate of voltage degradation not affected by nitrogen or ammonia

PROJECT TARGETS AND ACHIEVEMENTS

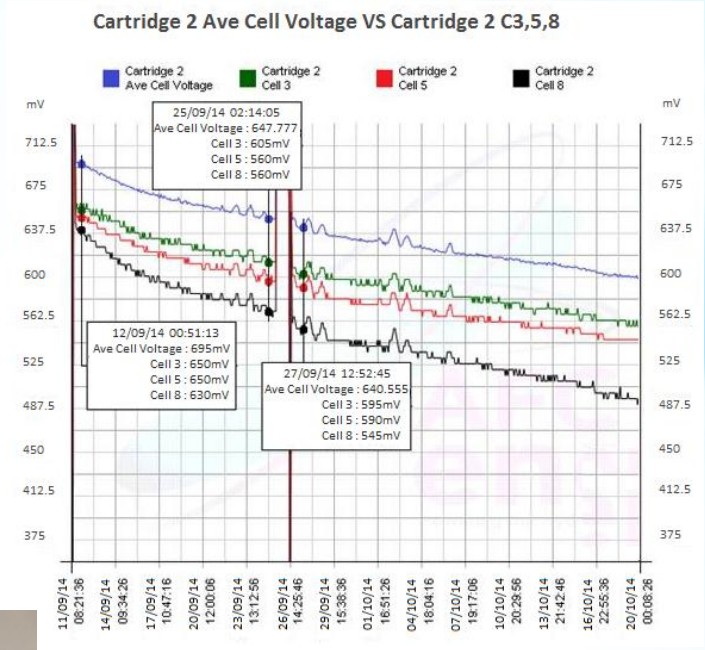


- Cracker catalyst durability: 1000 hours surpassed
- Catalyst developed by Acta based on Ru – Cs on alumina support
- Operational temperature defined at 550˚C – relatively low for a cracker

System and Cartridge testing

Progress:

- Stack testing using pre-prototype AFC system underway
- Improved system design work complete
- Controller development work nearing completion



next steps:

- 2 prototype AFC systems to build and test
- Integration work with cracker assembly

RISKS AND MITIGATION

Target	Proof of feasibility of integrated fuel cell units by demonstrating sufficient duration.
Bottlenecks and risks:	• Cracker catalyst and fuel cell stack must achieve desired lifetime targets • Integrated system design has not been completed • Testing is yet to confirm durability targets are achievable
Revision of targets:	No
Suggested nature of revision:	• testing with a 'mock' cracked ammonia feed stock has shown slight reduction in performance • reductions will be counteracted by the expected increase in performance from the new design with reduced ionic leakage

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

	DESCRIPTION OF COMPLEMENTARITY AND JOINT ACTIVITIES
LASER-CELL	• Project LASER-CELL (278674); November 11 – October 2014 • work completed will enable the ALKAMMONIA system to exploit the advances of project LASER-CELL • including: novel plate design, development of substrate material and the manufacturing process used to make the substrates
POWER-UP	• Project POWER-UP (325356); April 2013 – June 2017 • benefited from ALKAMMONIA's tests about the suitability of low-cost materials as a mass produced substrate material • potential of these processes has been examined and assessed in depth for POWER-UP • prototype manufacturing line has been built using the best performing process

HORIZONTAL ACTIVITIES

Training and education (LASER-CELL / ALKAMMONIA)

- face-to-face interactions with the research community at events
- project partners host several Masters and PhD students over the duration of the projects
- students examine specific parts of the Life Cycle Analysis, the costs and the risks analysis of the materials and systems
- **event in cooperation with ALKAMMONIA and POWER-UP presenting fuel cell science to high-school students taken place to explain employment opportunities in the industry**

DISSEMINATION ACTIVITIES

LASER-CELL / ALKAMMONIA

Telco Energy & INFRASTRUCTURE EFFICIENCY

London,
11/12 Nov 2014

ICALEO
INTERNATIONAL CONGRESS ON APPLICATIONS OF LASERS & ELECTRO-OPTICS

San Diego,
19-23 October 2014

euro chlor 17.

Madrid,
1-3 April 2014

Laser-cell

„*Lab to manufacturing – an iterative process*“:
12 Nov, 11:30am
FCH JU office

Programme Review Days Brussels, 10-12 Nov 2014

EXPLOITATION PLAN/EXPECTED IMPACT

ALKAMMONIA

- Coordinator received funding from the British government to complete a detailed study of the market for ammonia-fuelled systems; it will form the basis of the Coordinator's plans to exploit the technology in the post-funding period
- companies have the intention to jointly exploit the achievements of this project
- introduce an ammonia-fuelled, alkaline fuel cell system into the remote power market after the successful completion of the project

LASER-CELL

- the refinements to substrate and stack design will be implemented immediately
- first deployment will take place in project POWER-UP, in which a 500 kWe system will be demonstrated in Germany