Project LASER-CELL

(Contract number: 278674**)**

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AFC Energy plc

Project LASER-CELL
OVERVIEW

KEY PROJECT FACTS

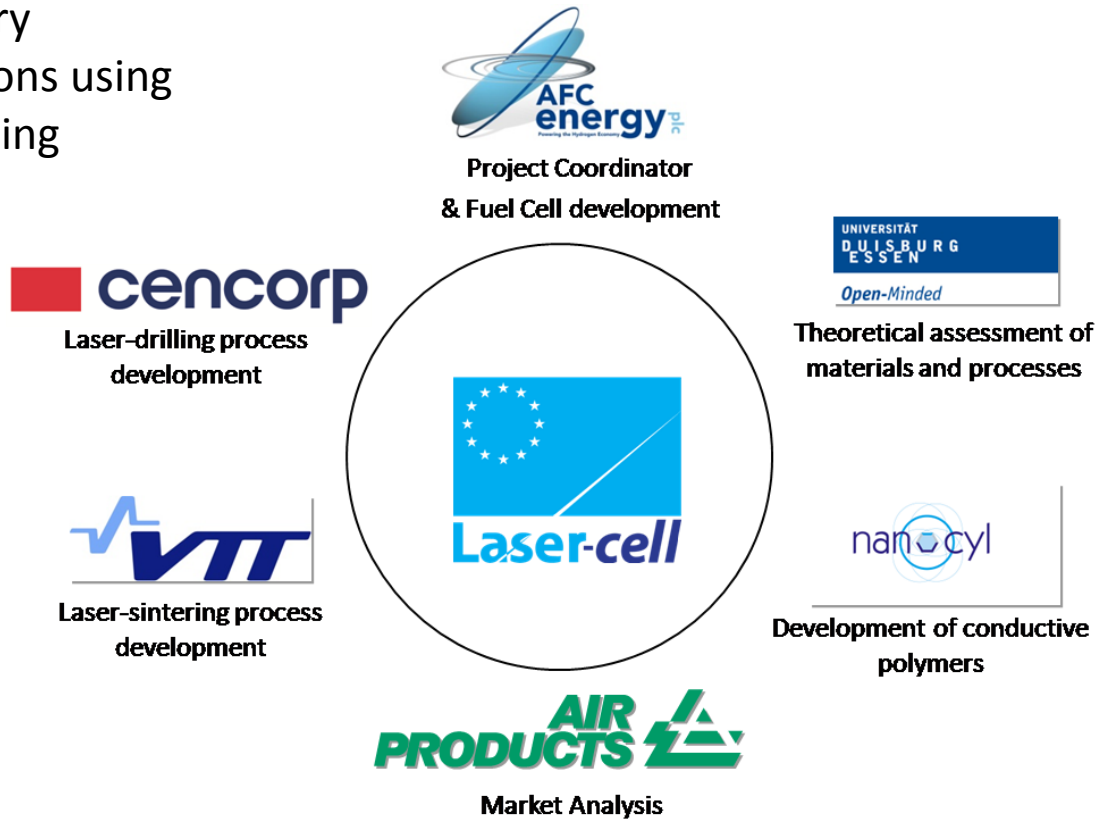
Project title: Innovative cell and stack design for stationary industrial applications using novel laser processing techniques

Project duration: 36 months

Total budget: December 2011

Total budget: 2.87M€

EC Contribution: 1.42M€



Consortium partners' key responsibilities

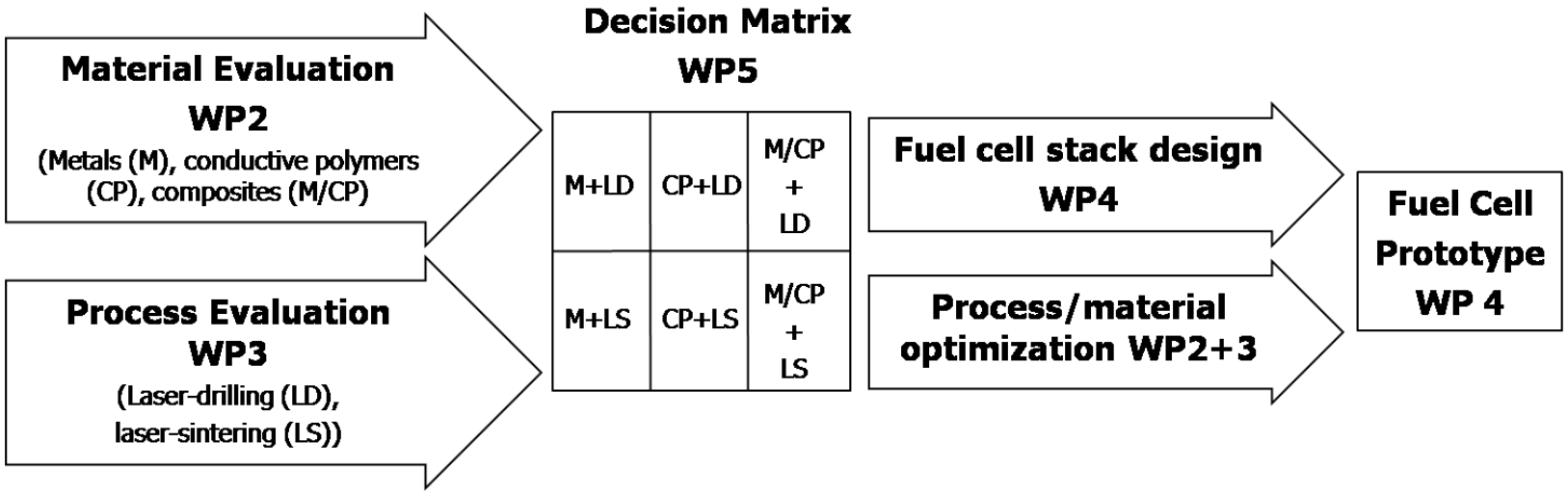
Project LASER-CELL
WORK PLAN OVERVIEW

PROJECT SUMMARY

Main fuel cell component considered: porous electrode substrate

Component materials considered: metals, conductive polymers, metal/polymer composites

Manufacturing processes considered: laser-drilling, laser-sintering



LASER-CELL OBJECTIVES

- DESIGNING A NOVEL Alkaline Fuel Cell (AFC) BASED ON LASER-PROCESSED SUBSTRATES that provide optimised technical and commercial characteristics.
- ASSESSING AND ADAPTING STATE-OF-THE-ART LASER MANUFACTURING TECHNIQUES and incorporating their benefits (while taking account of their restrictions) in the fuel-cell design.
- DESIGNING AN INNOVATIVE FUEL-CELL STACK to operate in industrial stationary settings, which delivers safety, mass manufacture, ease of assembly, recyclability, serviceability and optimal performance.
- Combining the above objectives in order to ESTABLISH THE COST-COMPETITIVENESS OF THE AFC TECHNOLOGY in comparison with all competing technologies – confirming for the first time the commercial viability of AFCs in large-scale stationary applications.

Project LASER-CELL
MILESTONES FOR YEAR ONE

FOCUS IN YEAR ONE:

- Initiation of project
- Evaluation of different substrate materials
- Evaluation of laser processes
- Theoretical analysis of substrate geometries

MILESTONES IN YEAR ONE:

- MS1: Approval of project initiation documents
- MS2: Identify most suitable conductive polymer
- MS3: Project awareness achieved
- MS4: Completion of prototype machines

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CENCORP: LASER-DRILLING OF METALS

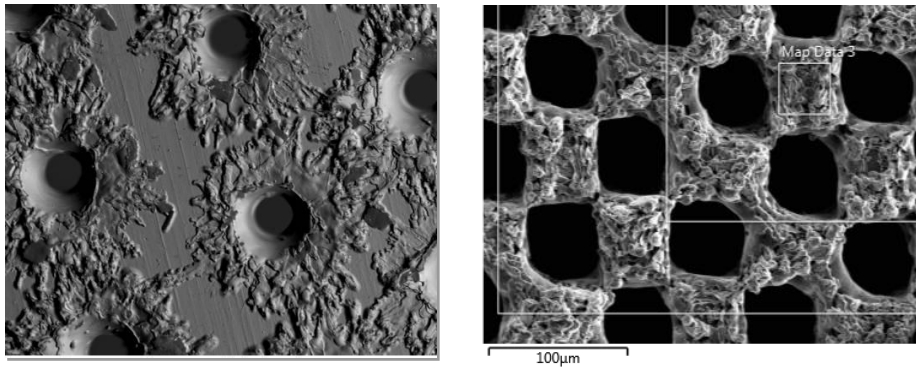
AIM

- Reduce processing cost of existing process

APPROACH:

Investigate the process sensitivity in terms of:

- Different laser sources
- Different metals
- Different substrate thicknesses
- Different laser parameters



SEM of laser entry side in nickel of standard process (left) and the optimised process (right).

RESULTS:

- Drilling speed can be increased six-fold, surpassing target of 4000 holes per second
- Distance between the holes could be significantly reduced, allowing more porous substrates with better functionality

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NANOCYL: CONDUCTIVE POLYMERS

AIM:

Determine a conductive polymer suitable for alkaline environments and laser-processing:

- Conductive polymer powders for laser-sintering
- Conductive polymer sheet for laser-drilling

RESULTS:

- Suitable polymers identified
- Powders for sintering trials supplied to VTT
- Polymer sheet production processes developed
- Sheet material supplied to AFC Energy & Cencorp

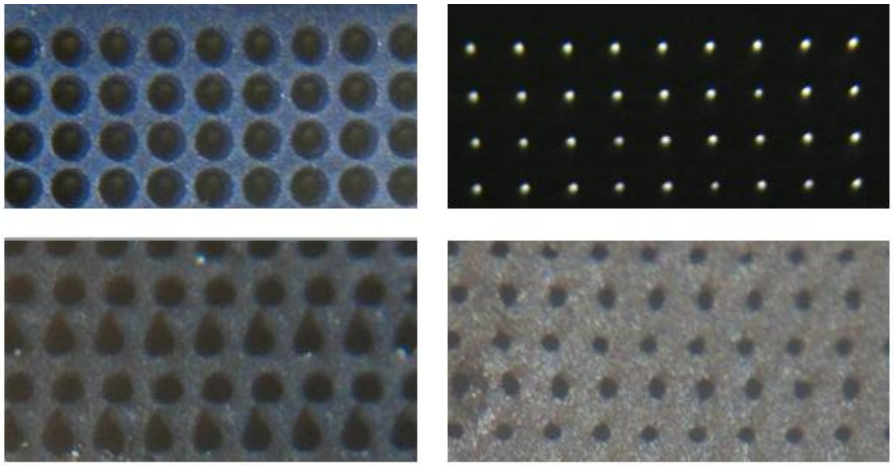
Process→ ↓ Polymer	Master-Batch	Compression molding	Injection molding	Sheet extrusion
HDPE	*Done*	*Done*	*Waiting for new mold to start trials*	*Done*
PEEK	*Done*	***Not possible (temperature limitation)***	*Waiting for new mold to start trials*	*Sourcing 3rd party extruding company*
PPE (Noryl)	*Done*	*Done*	*Waiting for new mold to start trials*	

Status of the process development for the polymers selected for the project.

Project LASER-CELL
CENCORP: *LASER-DRILLING POLYMERS*

RESULTS:

- Conductive polymer sheets laser-drilled successfully for the first time
- Established that drilling is possible for a wide range of thicknesses



HDPE: laser-entry (left) and exit (right)
holed at 0.5mm (top) and 1mm (bottom)

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VTT: LASER-SINTERING

AIM

- Develop novel production process that allows rapid production of laser-sintered substrates from metals and conductive polymers.

RESULTS:

- Laser-sintering prototype completed
- Prototype includes pre-heating chamber for polymer powders
- First successful trials with metal powders

Laser-sintering prototype at VTT in Finnland (left and middle) and porous metal sample produced (right).

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UDE: THEORETICAL ANALYSIS

AIM

- Develop and apply methods to efficiently analyse different substrate geometries with regards to performance and cost

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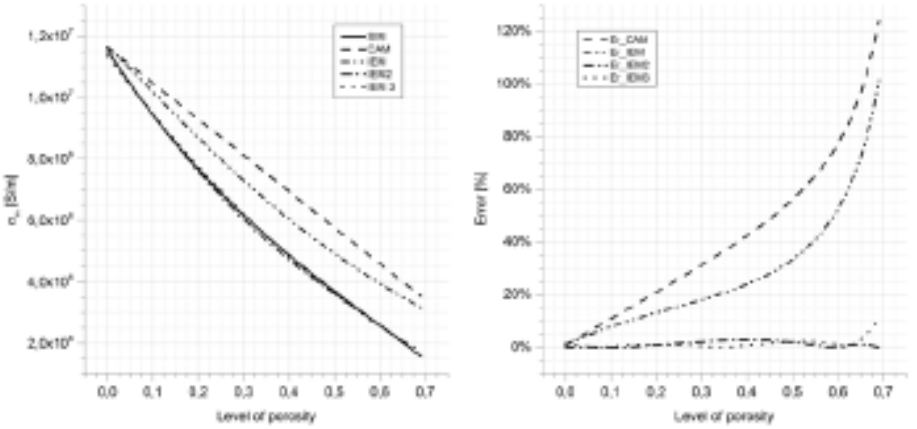
Open-Minded

RESULTS:

- Detailed investigation regarding the effect of porosity on substrate conductivity completed
- Cost model for the evaluation of different process/material combinations completed



Approximation functions for the effective in-plane-resistivity of a porous nickel-substrate and errors compared to the conductivities directly calculated from the simulation

Project LASER-CELL

AFC ENERGY: FUEL CELL TESTING

AIM

- Validate novel substrates under real, alkaline fuel cell operating conditions

RESULTS:

- Comprehensive base-line document approved by all partners that describes testing standards
- Fuel cell test stands upgraded with humidification
- Alkaline leaching tank for evaluation of conductive polymers in operation

Upgraded fuel cell test stands at AFC Energy's laboratory

YEAR TWO

MILESTONES AND DELIVERABLES :

- Continued development of laser processes
- Evaluation of novel fuel cell stack concepts
- Development of complex alkaline fuel cell model
- Selection of optimal substrate material and manufacturing process
- Produce a prototype of the final substrate design

Thank you very much for your kind attention!

For further information visit our website:

www.laser-cell.eu