MMLCR=SOFC
(278525)
SCORED 2:0
(325331)

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PROJECT OVERVIEW

- **MMLCR=SOFC - Working towards Mass Manufactured, Low Cost and Robust SOFC stacks**
- Call topic:
  SP1-JTI-FCH.2011.3.1 Next generation stack and cell design
- Start date / end date: 01.01.2012 – 30.06.2015
- Budget:
  total budget 4.494.396 €,
  FCH JU contribution 2.067.975 € (46%)

PROJECT OVERVIEW (2)

MMLCR=SOFC

- Consortium Partners

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- addresses the improvement of thermo-mechanical robustness of lightweight SOFC stack designs and their automated manufacturing
- 70% project duration passed – final testing of prototypes and validation of alternative technical solutions pending

PROJECT TARGETS AND ACHIEVEMENTS

MMLCR=SOFC

Status before project	MAIP target	Project Target	Current achievements	Expected final achievement
100 thermal cycles	must sustain repeated on/off cycling	1000 thermal cycles	evaluation in progress	1000 thermal cycles
20 000 hrs to 80% of BoL	lifetime > 20,000 hrs	40 000 hrs to 80% of BoL	evaluation in progress	40 000 hrs to 80% of BoL
> 10 000€/kW	2000 (2020) to 4000 (2015) €/kW	2000 €/kW	evaluation in progress	2000 €/kW (stack)

- The goal of this application area is to achieve the principal technical and economic specifications necessary for stationary fuel cell systems to compete with existing and future energy conversion technologies.

PROJECT TARGETS AND ACHIEVEMENTS

MMLCR=SOFC

Status before project	AIP target	Project Target	Current achievements	Expected final achievement
100 thermal cycles	several hundred	1000 thermal cycles	evaluation in progress	1000 thermal cycles
~60 minutes	start-up below 1 hour	20 minutes	40 minutes	20 minutes
~15 kg/kW	reduced materials	<5kg/kW	5kg/kW	<5kg/kW
n/a	evidence of realistic lifetimes	long-term testing	test on final design to start	5000 hours

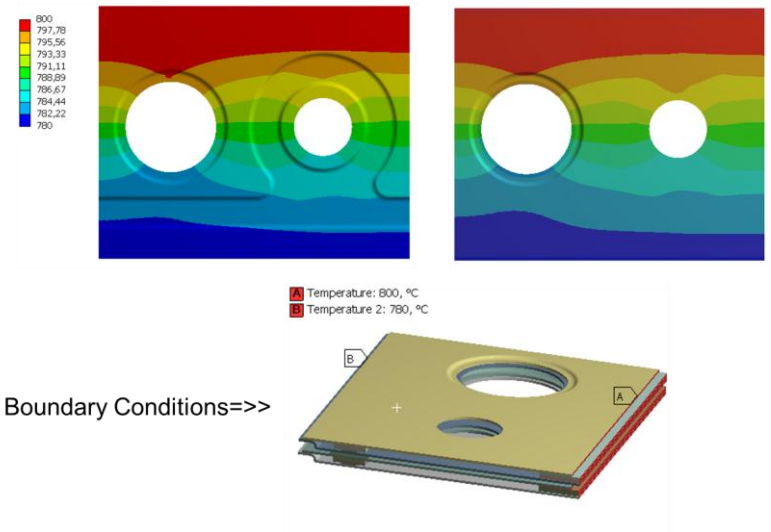
- Improved electrical efficiency over the state of the art (n/a)
- Considerable cost reductions consistent with market acceptance requirements for industrial or residential or other relevant applications (as MAIP)
- Improved tolerance to contaminants with respect to state of art FCs (n/a)

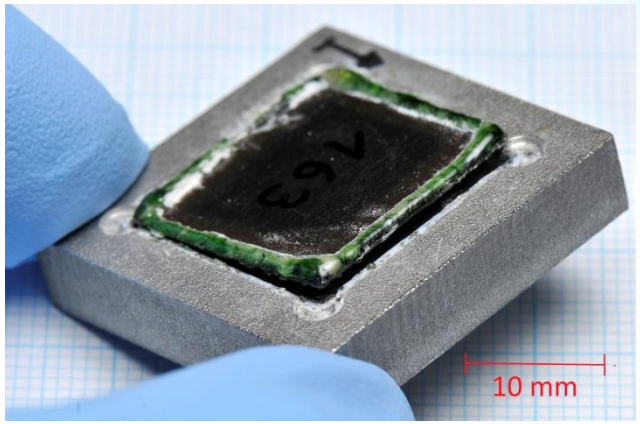
PROJECT TARGETS AND ACHIEVEMENTS

MMLCR=SOFC

Stack Design

- extensive thermo-mechanical modelling and manufacturing tests have guided the transition from design D1.0 to 2.0
- Design 2.0 has been successfully implemented
- two-cell stacks have been assembled

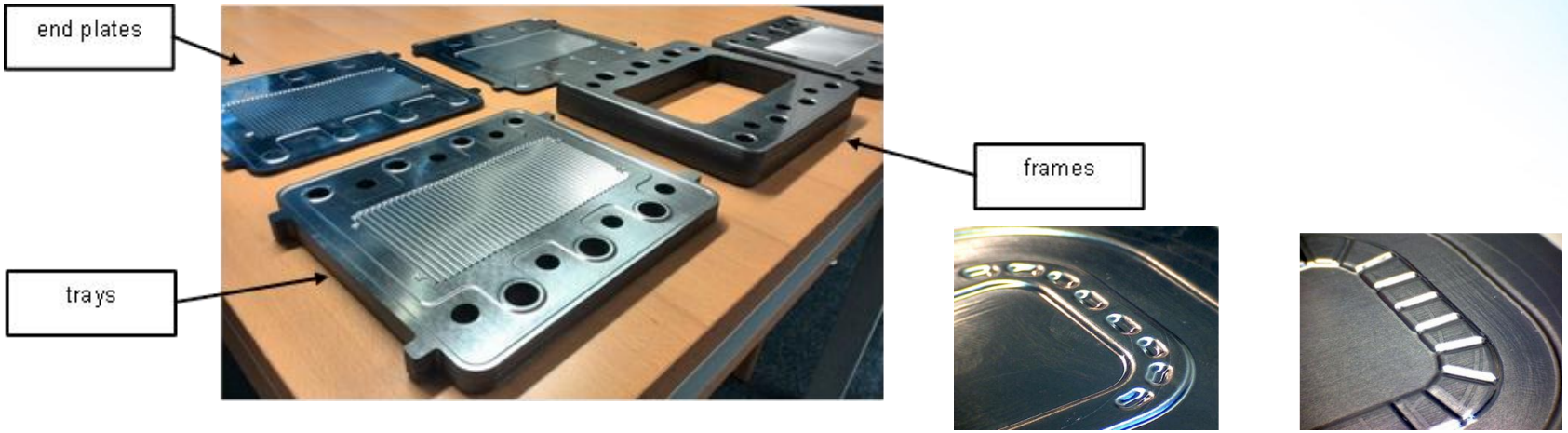




PROJECT TARGETS AND ACHIEVEMENTS

Stack Design (2)

- stacks for long-term tests are in production
- further improvements in design details (2.x) are being prepared for dedicated testing procedures
- depending on progress these might or might not still be integrated into a full stack by the end of the project

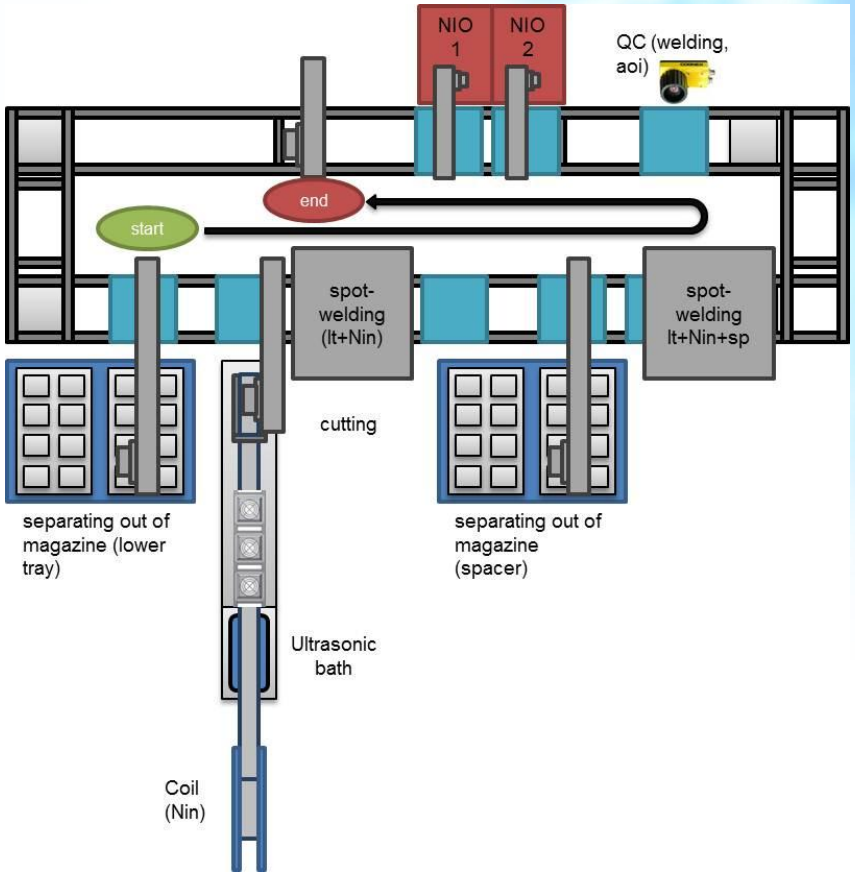


PROJECT TARGETS AND ACHIEVEMENTS

MMLCR=SOFC

Automated assembly sub-unit

- design finalised
- waiting for design freeze to further proceed with design and manufacturing of unit
- due to budget constraints only the most labour intensive and quality-assurance sensitive manufacturing step will be implemented



RISKS AND MITIGATION

- Integration of design variants (D2.x) into final design
  - several design detail variants have been developed but are not yet progressed enough to be included in final long-term verification testing
  - this refers to
    * laser welding
    * new glass material(s)
    * new contact elements
  - validation experiments will be performed; follow-up work can build on results
- Prototype of assembly plant cannot be built for cost reasons
  - most critical sub-unit will be built

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

MMLCR=SOFC

- Project builds on
  FP 6 IP Real-SOFC
  German nationally funded ZeuS II & ZeuS III
- In the way of component coating possible input is expected from the SCORED 2:0 project

PROJECT OVERVIEW

- **SCORED 2:0 - Steel Coatings For Reducing Degradation**
- Call topic:
  SP1-JTI-FCH.2012.3.4 - Component and sub-system cost and reliability improvement for critical path items in stationary power and CHP fuel cell systems
- Start date / end date: 01.07.2013 – 30.06.2016
- Budget:
  total budget **3.656.757** €,
  FCH JU contribution **2.183.023** € (46%)

PROJECT OVERVIEW (2)

SCORED 2:0

- Consortium Partners

UNIVERSITY OF BIRMINGHAM

- addresses the production of coated steel components showing markedly improved properties with regard to chromium release, electrical resistivity and scale growth.
- 45% project duration passed – first round of optimised coatings expected after first evaluation phase

PROJECT TARGETS AND ACHIEVEMENTS

SCORED 2:0

Status before project	MAIP target	Project Target	Current status/ achievements	Expected final achievement
20 000 hrs to 80% BoL	lifetime > 20,000 hrs	40 000 hrs	long-term tests still to start	40 000 hrs
> 10 000€/kW	2000 (2020) to 4000 (2015) €/kW	not specified	evaluation in progress	some contribution

- The goal of this application area is to achieve the principal technical and economic specifications necessary for stationary fuel cell systems to compete with existing and future energy conversion technologies.

PROJECT TARGETS AND ACHIEVEMENTS

SCORED 2:0

Status before project	AIP target	Project Target	Current status/achievementS	Expected final achievement
	n/a	40 000 hrs lifetime	long-term tests still to start	40 000 hrs

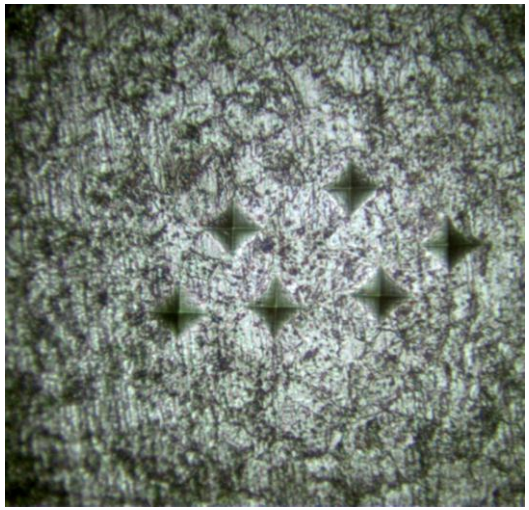
- Manufacturing processes for high performance and cost effective components
- Protection of fuel cell stack from chromium release
- Validation of corrosion rates in application specific environments
- Cost assessment vs. target cost and demonstration of considerable cost reduction

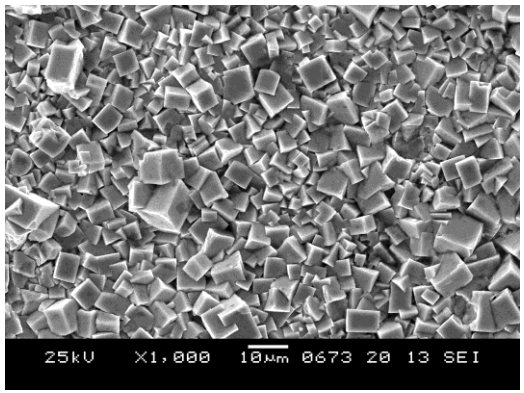
PROJECT TARGETS AND ACHIEVEMENTS

SCORED 2:0

Materials testing

- testing equipment has been sourced and set up
- all materials and procedures have been applied and samples are being exposed to SOFC cathode conditions for scale growth, contact resistance and chromium evaporation testing





RISKS AND MITIGATION

SCORED 2:0

- Lack of final testing time for long-term tests
  - interaction between ‘materials/process freeze’ and remaining project duration for long-term testing
  - validation experiments can be performed at enhanced stress conditions (‘accelerated testing’)
- New coatings and procedures do not improve level of corrosion and contact resistance as compared to benchmark, or fail to reduce cost
  - project is designed as a ‘scoping’ project
  - failure to improve status quo also confirms this status

DISSEMINATION ACTIVITIES

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- 23rd International congress on Glass, 30 June-7July 2013, Prague: “Long-term stability of glass-ceramic sealants in the SiO2-B2O3-BaO/SrO-MgO-ZnO system for SOFC”.
- 53rd Congress SECV, 23 - 25 Oct. 2013, Alcora: “Glass-ceramics sealants for SOFC from laser heating”.
- DKG 3rd International Symposium on Materials Processing Science with Lasers as Energy Sources, 22.&23. April 2014, Berlin: “Glass Solder Sealing of Solid Oxide Fuel Cells via Laser Heating”.
- 1st Joint meeting of the DGG and ACers GOMD 2014: International Congress on Glass, 25 -30 May 2014, Aachen: “Laser cladding of glass-ceramic sealants for SOFC”.

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

MMLCR=SOFC + SCORED 2:0

- Projects build on
  FP 6 IP Real-SOFC
  German nationally funded ZeuS II & ZeuS III
  SOFC-Life
- In the way of component coating possible input is expected from SCORED 2:0 to MMLCR=SOFC
- In the way of sample components for coating input is expected from MMLCR=SOFC to SCORED 2:0

EXPLOITATION PLAN/EXPECTED IMPACT

- What has your project changed in the panorama of FCH technology development and/or commericalisation?
- How will the project's results be exploited? When? By whom?
- RTD projects:
  - What are the main results that go beyond international state-of-the art?
  - What are the achievements that will allow progressing one step further to cost reductions and enhanced performance (efficiency, durability)?
  - How can the results from your project be taken on-board by industry?
- Demonstration projects:
  - What are the next stages, after project ends to make commercial impact or achieve MAIP targets?
- Cross-cutting:
  - What are the main achievements going with TRL increase? (test standardisation, safety assessment etc.)

ACKNOWLEDGMENTS

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Thanks for your attention!

Acknowledgments go to the FCH JU for the much appreciated organisational and financial support of our projects.