STAMPEM
(GA #303449)

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SINTEF

www.stampem.eu

PROJECT OVERVIEW

- STAble and low cost Manufactured bipolar plates for PEM Fuel Cells - **STAMPEM**
- Call topic: SP1-JTI-FCH.2011.1.7
- July 1st 2012 to June 30th 2015
- Total Budget € 5 223 807
  FCH JU contribution € 2 576 505
  Research Council of Norway ~€ 400 000 (SINTEF)
- Project objective:
  "**Develop durable coating materials for PEMFC metal based bipolar plates**"
- Month 29 of 36 (80 % project duration passed)

SINTEF Innovation in Motion Miba elringklinger Fraunhofer ISE UNIVERSITY OF BIRMINGHAM Fronius

PROJECT TARGETS AND ACHIEVEMENTS

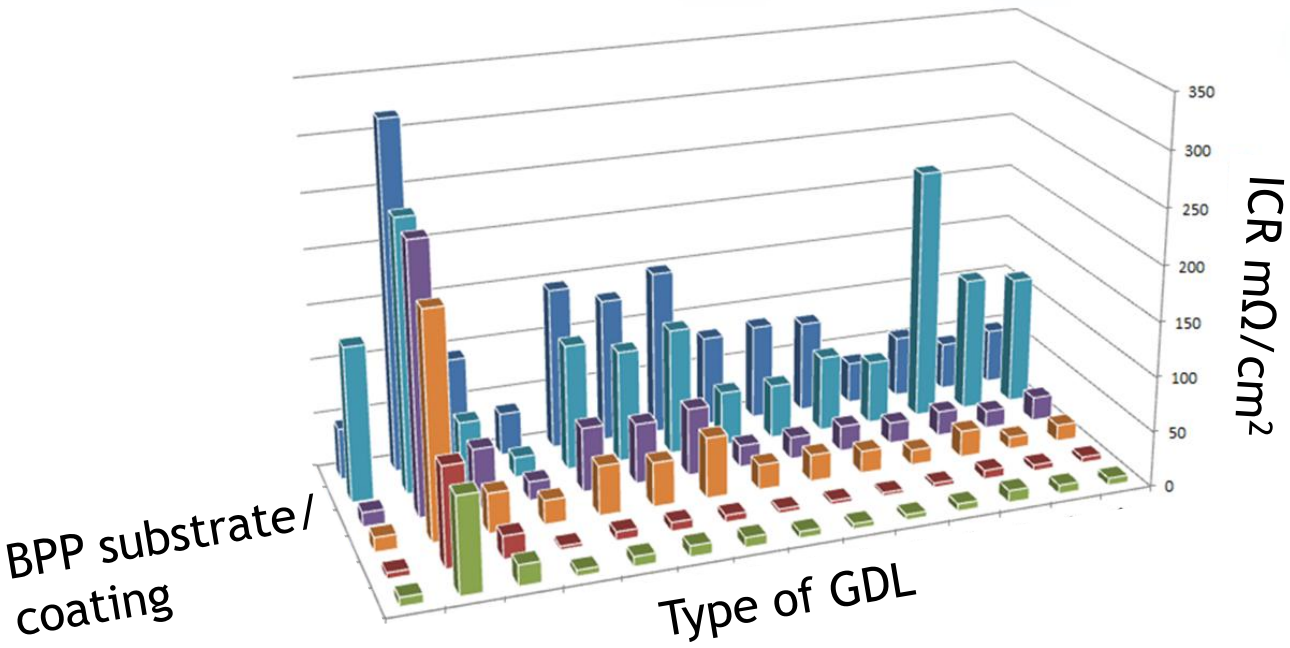
Status before project	AIP target	Project Target	Current status/ achievements	Expected final achievement
OK with carbon composite or gold coated SS	ICR < 25 mΩ cm^2 at relevant clamping pressures	< 25 mΩ cm^2 after 10 000 hours extrapolated from AST	< 10 mΩ cm^2 at BoL & and after 100 hours in-situ AST. Operated ~1000 hours in full size single cells	< 25 mΩ cm^2 after 10 000 hours extrapolated from AST
OK with carbon composite or gold coated SS	Corrosion resistance < 10 µA/cm^2	< 10 µA/cm^2 after 10 000 hours extrapolated from AST	< 1 µA/cm^2 in 1 mM H_2SO_4 at 0.8 V_{SHE} and 80 °C at BoL. No visible corrosion after ASTs or tests of full size single cells	< 10 µA/cm^2 after 10 000 hours extrapolated from AST

PROJECT TARGETS AND ACHIEVEMENTS II

Status before project	AIP target, linked to MAIP targets	Project Target	Current status/achievements	Expected final achievement
OK with carbon composite or gold coated SS	Corrosion stability > 5,000 h	10 000 hours extrapolated from AST	~1000 hours in full size single cell,	10 000 hours extrapolated from AST
Above target	Costs (excluding taxes and levies) < 2.5 € /kW at 500,000 pieces annually	< 2.5 € /kW	> € 6-12 /kW	Probably still higher than 2.5 € /kW

PROJECT TARGETS AND ACHIEVEMENTS

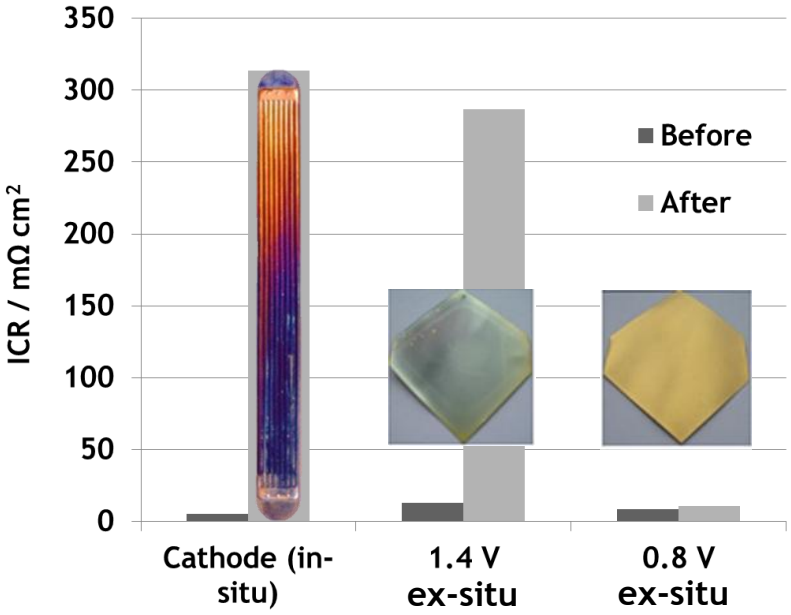
- Effect of GDL properties on ICR
  - Optimize combination of BPP surface and type of GDL to get the best performance

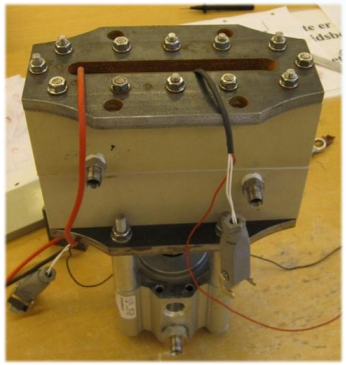


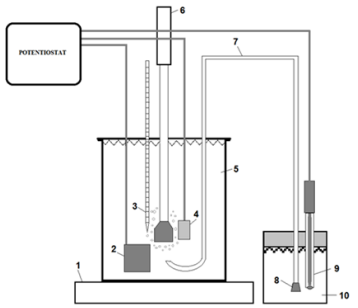
PROJECT TARGETS AND ACHIEVEMENTS

- Comparing in-situ and ex-situ results
  - OCV-0.4 V cycling in-situ AST 100 hours
  - 0.8 V or 1.4 V for 1 hour ex-situ

  => improved test protocols

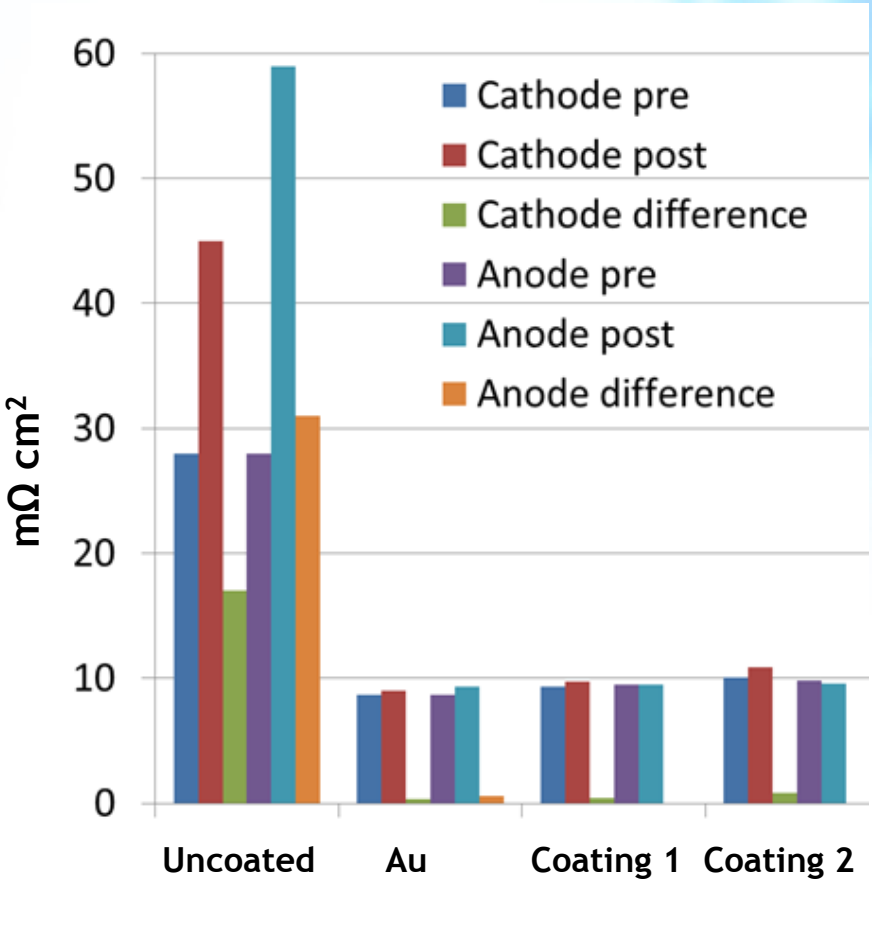






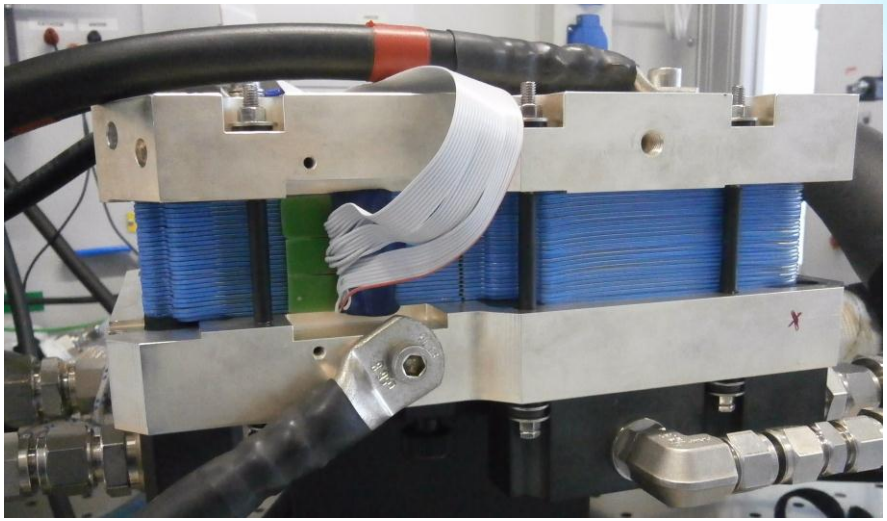
PROJECT TARGETS AND ACHIEVEMENTS

- Status best coatings after small scale in-situ testing, AST 100 hours
  - 75°C and 100%rH humidity
  - Cycling OCV-0.4 V
  - Performance is similar to gold coated BPPs



PROJECT TARGETS AND ACHIEVEMENTS

- Next steps
  - Further coating and process optimization
  - Validation of performance in system operation
  - Post-mortem analysis of BPPs, MEAs and GDLs
  - Verification of ex-situ and in-situ AST protocols
  - Dissemination activities
  - Techno-economical assessment



RISKS AND MITIGATION

- **Cost target: < € 2.5/kW at 500,000 pieces annually**
- **Substrate costs of about € 2-4/kW** leaves < € 0.5/kW for stamping/forming/joining and coating
- **Best performing PVD-coatings**, incl. manufacturing, have projected costs of around **€ 6-10/kW**, depending on material composition, design of the BPP, surface finish and other end user requirements

=> **Total € 8-14/kW so far in the STAMPEM case**

- Multiple coating approaches, with low cost alternatives
  - E.g. metal nitrides, C-based, multilayer coatings by PVD
  - Conductive polymer by electrochemical deposition
  - Carbon composite by spraying, painting or dip-coating
- Conductive polymer and carbon composite low cost coatings are promising in ex-situ and small scale, but not verified in stack operation and still require development of large scale manufacturing

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

- The Research Council of Norway is funding SINTEF so that its total funding is the same as in FP7 projects

- Sharing experience and joint workshops with COBRA (other FCH JU PEM BPP project)
- Discussions with e.g. LANL (US) on metal BPPs in general and planned international workshop in May 2015

HORIZONTAL ACTIVITIES

- Master-, PhD students and Post docs involved in the project, both at R&D and industry partners
- Contributing to further development of test protocols by applying, investigating and improving existing test protocols for BPP (ex-situ and AST)
- Dissemination activities, next slide

DISSEMINATION ACTIVITIES

- Conferences, workshops organised/attended by project
  - 6 presentations at conferences/workshops
  - Open, international PEM BPP workshop to be organized at the end of the project (May 2015)
- Publications, patents arising out of project and its results
  - One article published, four more in writing
  - Project web site
  - Annual project flyers

EXPLOITATION PLAN/EXPECTED IMPACT

- New knowledge gained within metal based BPP
  - Improved ex-situ/AST test conditions/more relevant test parameters
  - Possibilities and limitations of ex-situ and small-scale in-situ testing of coating materials
  - Importance of the surface condition of the plate prior to coating
  - New pre-cleaning approaches, e.g. Fronius' plasma treatment
- Exploitation/further work
  - Optimization and cost reduction strategies of PVD-coatings and manufacturing
  - Investigation of automation (e.g. handling, cleaning, pre- and post inspection, etc.)
  - Further development and in-situ verification of polymer and composite coatings by UoB and SINTEF
  - Verification of PVD-coatings performance in full scale stacks (incl BOP)
  - Implementation of process improvements/materials in BPP business by EK and TCL