SCORED 2:0
Steel Coatings For Reducing Degradation

Robert Steinberger-Wilckens
University of Birmingham

www.scored-2-0.eu
r.steinbergerwilckens@bham.ac.uk

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PROJECT OVERVIEW

Project Information	
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
Grant agreement number	**325331**
Application area (FP7) or Pillar (Horizon 2020)	Stationary power and CHP
Start date	01/07/2013
End date	30/06/2017
Total budget (€)	**3.656.757** €
FCH JU contribution (€)	**2.183.023** €
Other contribution (€, source)	n/a

PROJECT OVERVIEW (2)

Project Information (2)

Stage of implementation	78% project months elapsed vs total project duration, at date of November 1, 2016
Partners	

PROJECT SUMMARY

MAWP / AWP background

- 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 objectives and status

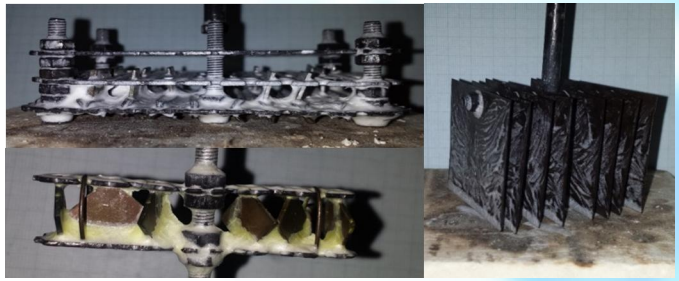
- addresses the production of coated steel components showing markedly improved properties with regard to chromium release, electrical resistivity and scale growth
- uses the currently best commercial product, Sanergy pre-coated steel, as a benchmark – several coatings developed and used by the project are at least just as good
- contributes to extending the operational lifetime of SOFC to >>40,000 hours

PROJECT APPROACH

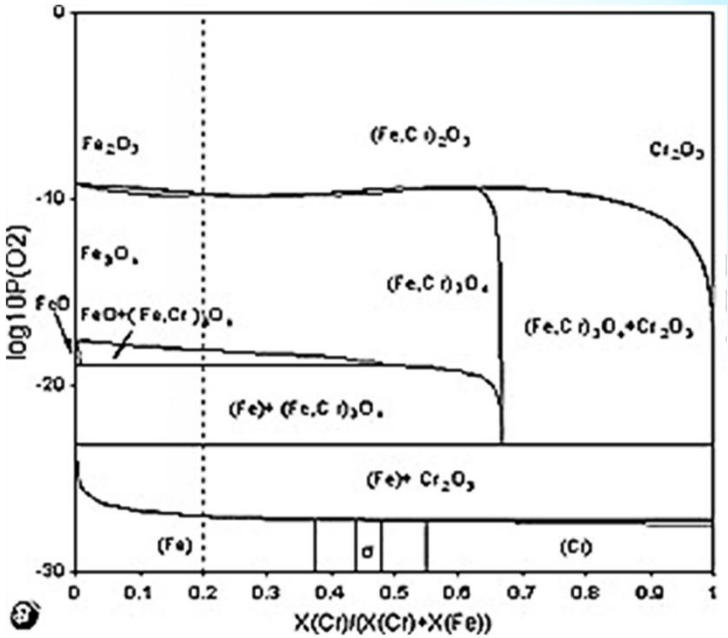
- Use of ‘standard’ SOFC steels:
  - CroFer22H, K 41 / 441, Sandvik Sanergy HT
- Benchmark with Sandvik pre-coated steel with CeCo coating
- Coating of samples with the same materials across different coating methods
  - wet powder spraying (as standard procedure) (WPS)
  - atmospheric plasma spraying (APS)
  - physical vapour deposition (PVD)
  - atomic layer deposition (ALD)
- To identify the best combination of processes and materials w.r.t. the defined performance indicators
  - low weight gain
  - high conductivity of scales
  - low cost of application

PROJECT APPROACH (2)

- novel coating aspects:
  - surface modification instead of coating
  ⟶ no additional layer, harder surface
  - ink jet printing of protective layers
  ⟶ arbitrary shapes and contours, no overspray



- thermodynamical modelling of scale growth
- development of accelerated testing regimes
- understanding of temperature influence on scale growth and protective properties



PROJECT APPROACH (3)

Generations of coatings / processes:

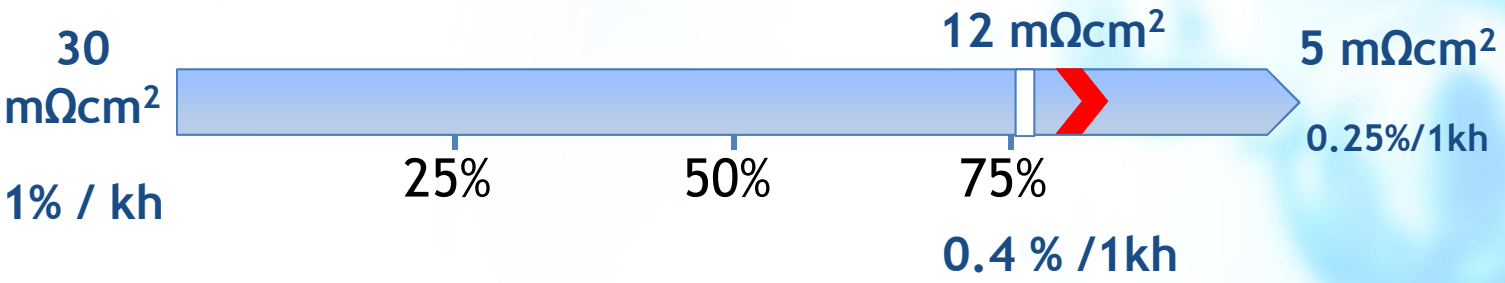
- Gen 1 = $MnCo_2$ standard coating (benchmark)
- Gen 2 = nitrided surfaces
- Gen 3 = MnCoFe
- Gen 4 = MnCoFe co-doped for higher density
- Gen 5 = nitrided surface with MCF
- Gen 6 = further combinations

not all processes (ALD, PVD) allow the admixing of several dopants

PROJECT PROGRESS – KPI

Achievement to-date

% stage of implement.



Aspect addressed	Parameter (KPI)	Unit	SoA 2016	FCH JU Targets		
				Call topic	2017	2020
performance	ASR	mΩ cm²	10	n/a	n/a	n/a
degradation	degradation rate	%/1kh	1	n/a	n/a	n/a

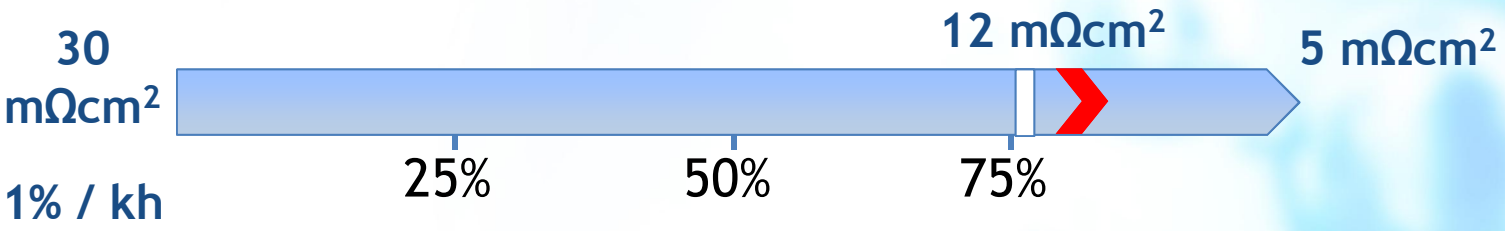
Future steps:

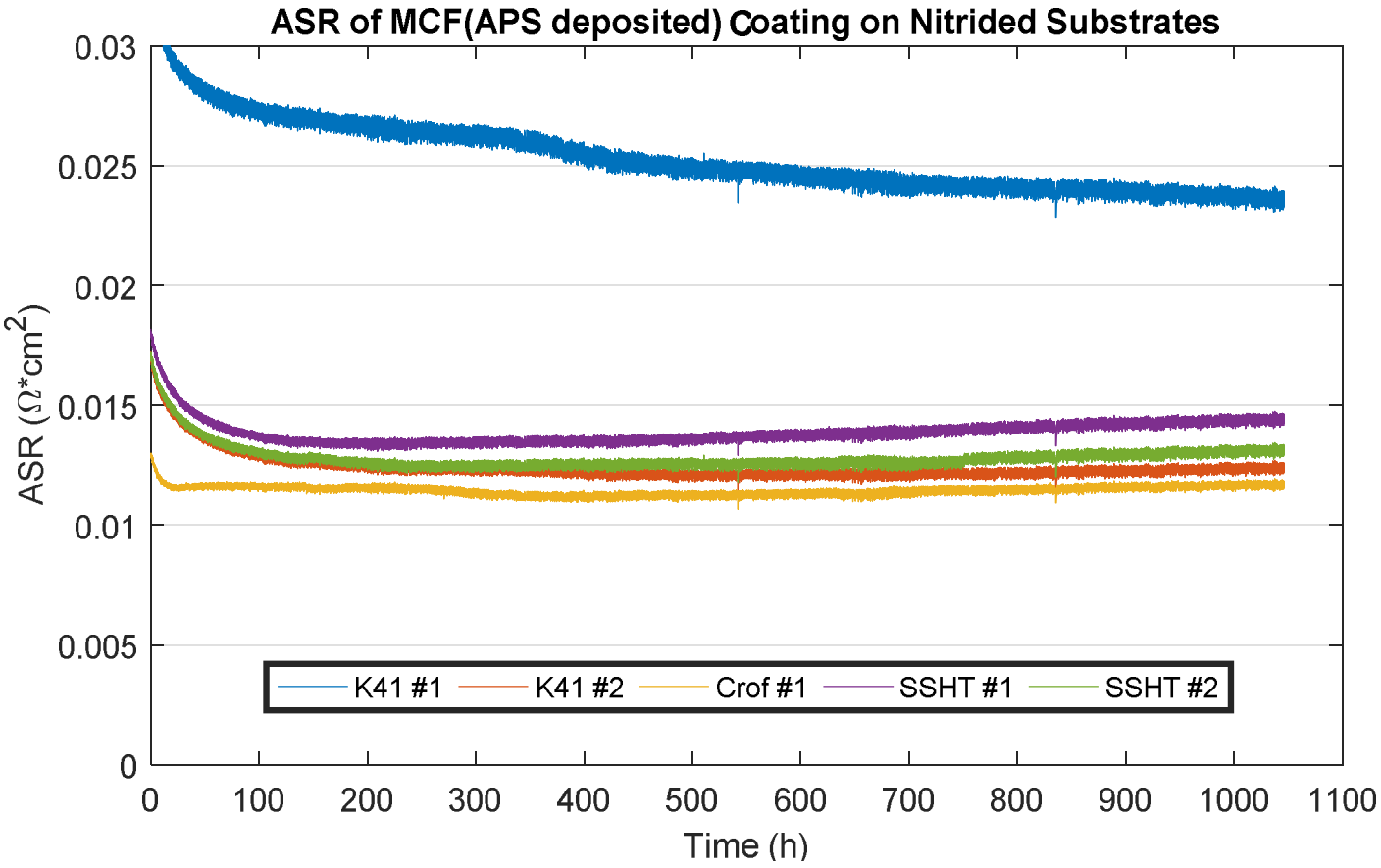
- *further optimisation of coatings and layer application techniques*
- *tests with Gen 5 coatings and processes*

PROJECT PROGRESS – ASR

Achievement to-date

% stage of implement.

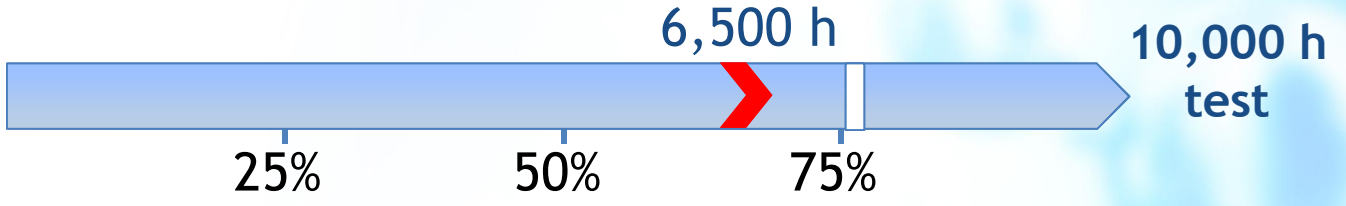


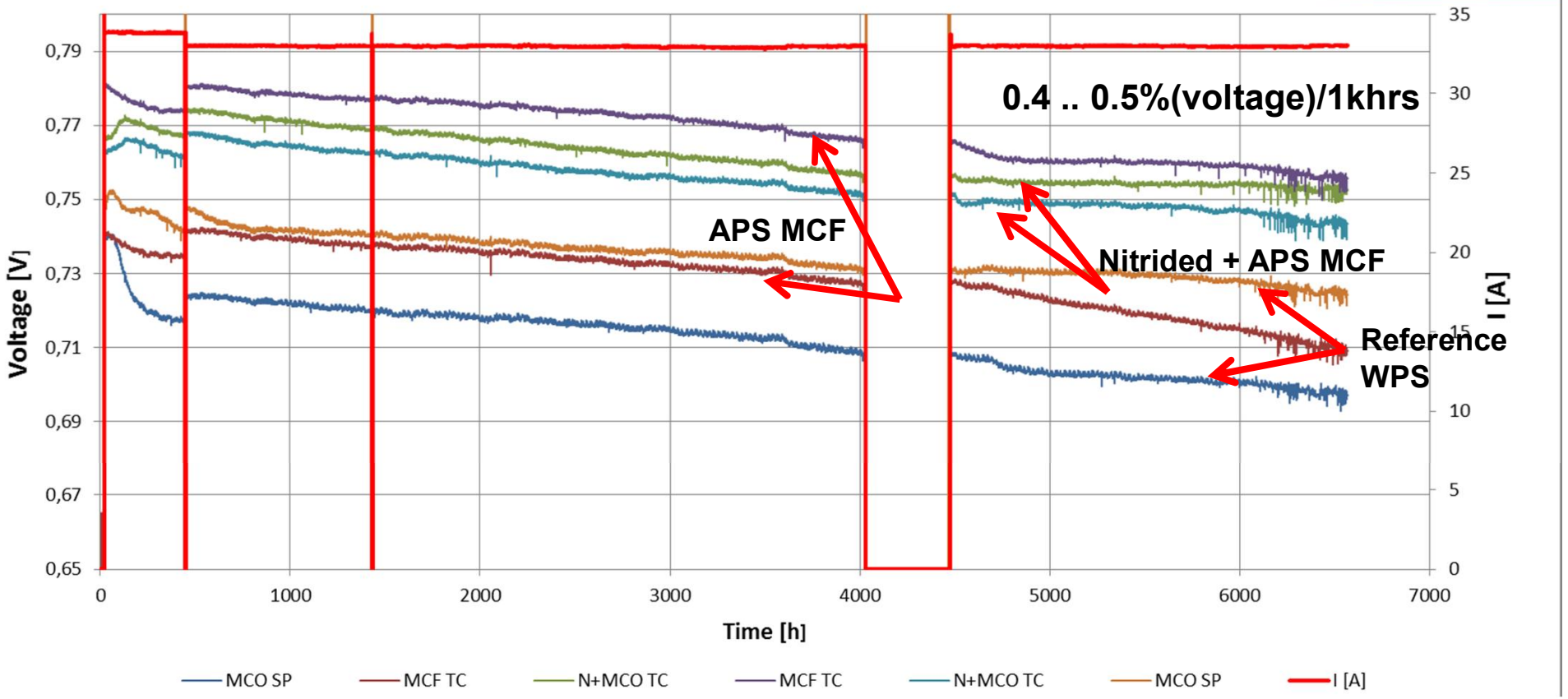


PROJECT PROGRESS - Lifetime

Achievement to-date

% stage of implement.





- 750 C, 410 mA/cm^2 and U_f 80%, active area 80 cm^2

SYNERGIES WITH OTHER PROJECTS AND PROGRAMMES

Interactions with projects funded under EU programmes	
MMLCR=SOFC	using MMLCR=SOFC stamped metal sheets as test objects for coating; Gen 3 coatings also used in MMLCR=SOFC; 3 common partners
STAMPEM	not really … but similar project idea, just PEFC
Interactions with national and international-level projects and initiatives	
CDT Fuel Cells and their Fuels	Joint funding of PhD students

DISSEMINATION ACTIVITIES

Public deliverables

- n/a

Conferences/Workshops

- 1 workshop organised by the project
- 2 conferences attended

Social media n/a

Publications: 12

- Simple Fabrication and Properties of Spinel Protective Coatings Using Wet Power Spraying for SOFC Interconnects – SOFC XIV, July 2015
- Cu-Mn-Co oxides as Protective Materials in SOFC Technology: the Effect of Chemical Composition on Mechanochemical Synthesis, Sintering Behaviour, Thermal Expansion and Electrical Conductivity – JECS, in print

Patents: n/a

- might be looking at patenting two developments

EXPLOITATION PLAN/EXPECTED IMPACT

Exploitation

use of results in commercial activities with partners SOLIDpower, Turbocoating, MIBA

scientific publishing

patenting (if applicable)

Impact

extension of lifetime of SOFC stacks, qualification as commercial products, effective cost reduction

Thank You!

r.steinbergerwilckens@bham.ac.uk