PEMFC stack and MEA manufacturing workshop
Volume & quality challenges workshop

Challenges for upscaling of MEA production from an R&D perspective

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CNRS (Montpellier) – current FCH JU funded projects

- CNRS is involved in 4 projects involving scale-up and manufacturing

VOLUMETRIQ

2015-2019 – Coordinator

VOLUme **M**anufacturing of P**E**MFC Stacks for **TR**ansportation and **I**n-Line **Q**uality Assurance
CNRS, JMFC, Solvay, ElringKlinger, BMW, Pretexo

INSPIRE

2016-2019

*Integration of **N**ovel **S**tack Components for **P**erformance, **I**mproved Du**R**ability and Low**E**r Cost*
JMFC, BMW, DANA, SGL, CNRS, TUBerlin, TUMunich, VTT, IMTEK, Pretexo

CRESCENDO

2018-2021 - Coordinator

Critical Raw material ElectrocatalystS replacement ENabling Designed pOst-2020 PEMFC
CNRS, JMFC, BMW, TUBerlin, ICL, CEA, UPadova, Pretexo

GAIA

next Generation Automotive membrane electrode Assemblies
CNRS, BMW, JMFC, Freudenberg, 3M, ZSW, TUBerlin, TUMunich, Elmarco, Pretexo

2019-2022 - Coordinator

Challenges for upscaling of MEA production from an R&D perspective

- Transferability of lab-scale material/method/process
- Transfer from lab-scale to production scale equipment
- Research respecting the constraints of downstream high volume manufacture
- Cost, solvents, recycling

VOLUMETRIQ - VOLUme Manufacturing of PEMFC Stacks for TRansportation and In-Line Quality Assurance

- First FCH JU call to address manufacture ***"Cell and stack components, stack and system manufacturing technologies and quality assurance"***
- Recognising the short-fall in terms of manufacturability, production efficiency and production cost
- VOLUMETRIQ aimed to provide a European supply chain for an optimised stack design and key stack/cell components with volume manufacturing capability and embedded quality control to enable validation of performance, lifetime and manufacturability, with analysis of each process capability and efficiency, including costs, while developing the appropriate quality assurance methodologies for at-scale fuel cell manufacturing

VOLUMETRIQ Highlights

- Single cell provides 1.55 W/cm^2 at 0.6 V, exceeding target
- CCMs for 90 kW VOLUMETRIQ stack manufactured on high volume production line at JMFC
- Advanced handling technologies for CCM processing, with potential cycle time reduction of ca. 61 % and increased yield, and improvements on the MEA assembly process leading to a cycle time reduction of ca. 72 %
- Automated Stack Assembly Line at EK with capability to assemble 10,000 stacks annually
- Final expected stack power density >5.0 kW/L with 2.5 A/cm^2 at 0.6 V, (excluding housing)
- Step-change improvement in MEA durability enabled by a novel membrane reinforcement approach reducing gas crossover and increasing mechanical properties at high temperature

Challenges and development steps

Lab-scale

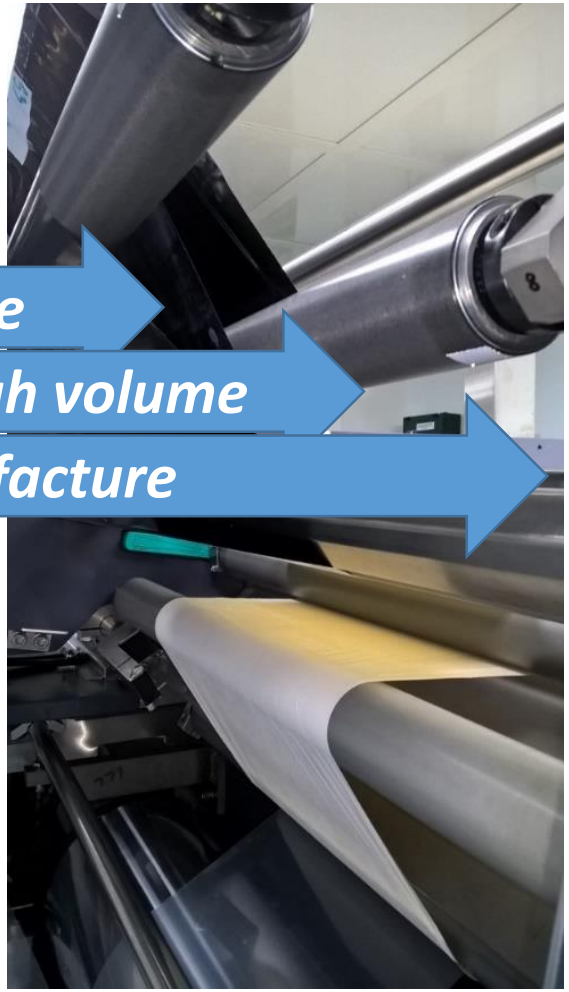
Reinforcement scale-up

Tune reinforcement composition

Compatibility with volume production line

Adapt lab-scale solvent mix for high volume

Membrane manufacture



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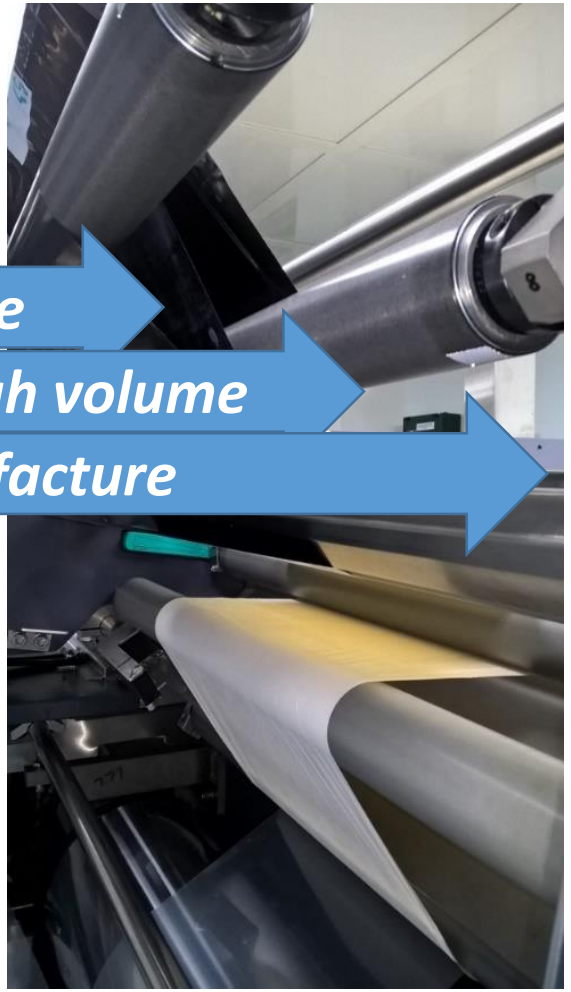
- *Compatibility with volume production line*
- *Adapt lab-scale solvent mix for high volume*
- *Membrane manufacture*

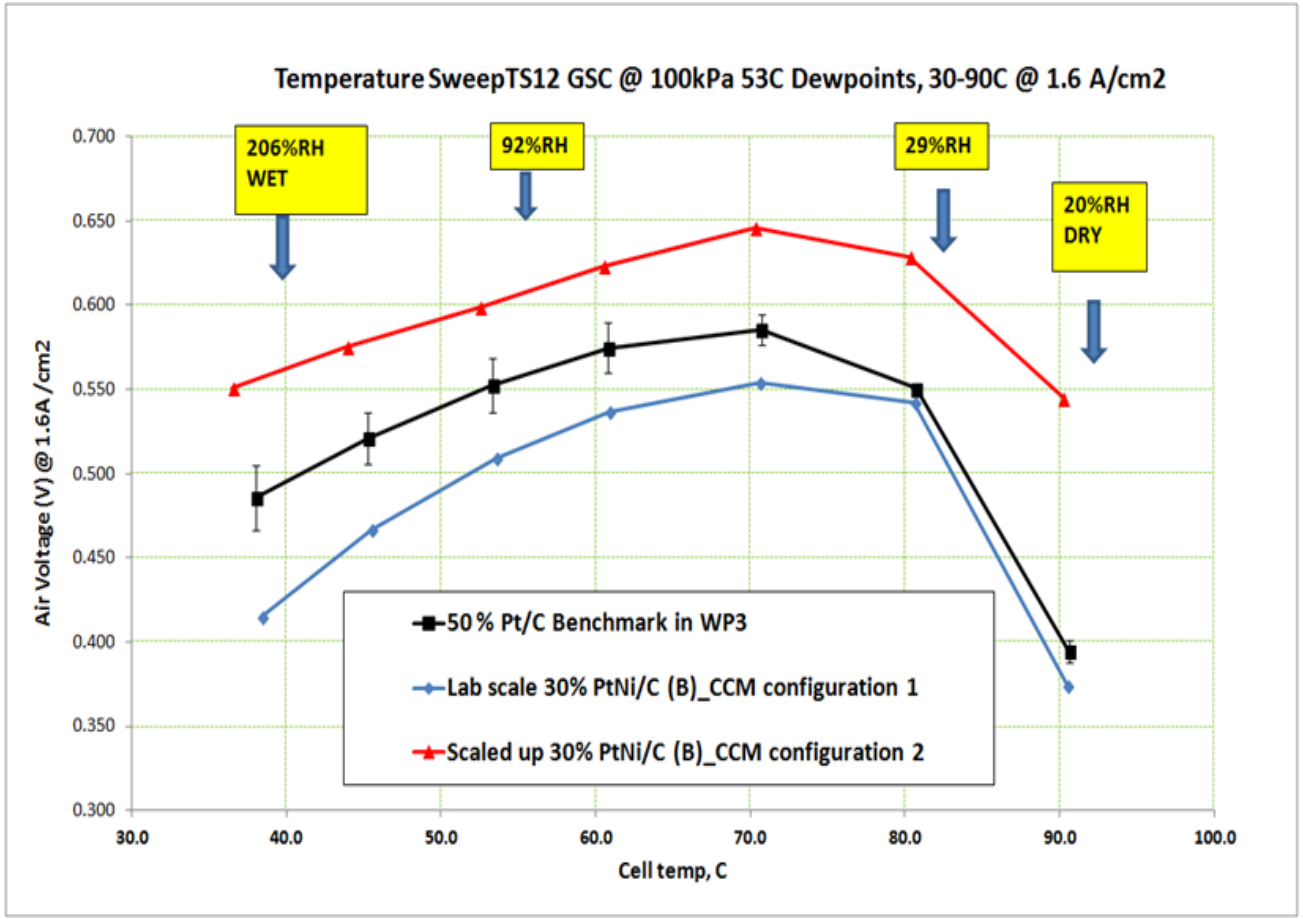


Novel membrane reinforcement approach brings about a factor 4 increase in MEA lifetime on accelerated stress testing at 90 °C, OCV and rapid RH (wet/dry) cycle, H_2/air

Catalyst

- New catalyst formulations scaled-up by JMFC in INSPIRE and CRESCENDO

Catalyst key		Pt wt %	Carbon type	Surface area m^2/g Pt	Status towards GEN 2	
A	Pt/C Benchmark	50%	C1	53 ± 3	Completed, >200g	
B	PtNi /C	30%	C1	45	Completed, >200g	✓
H	PtNi (x)	50%	C2	46	Completed, >200g	X
I	PtNi	30%	C2	65	Completed, >200g	✓



- 50 cm^2 cell testing, RH sweep, showing cell voltage at 1.6 A/cm^2
- Scaled-up catalyst B with layer configuration 2, gives higher cell voltage at all RH conditions than Pt/C benchmark

How can research organisations/academia support the European supply chain in taking the lead ?

- By aligning innovation in research effort with industrial needs
- By contributing the incremental adjustments that can enable implementation of step change products/processes – research is needed throughout the value chain
- By proposing solutions to satisfy evolving industrial requirements and technical specifications coming from new knowledge

Opportunities

- Challenge of lab to production scale given the multiple constraints (time, access, financial) – opportunity for funded pilot level scale-up of project successes and advanced qualification
- Advantage of European FCH JU consortia comprising the requisite spectrum of competences advancing together towards a common goal to improve cell and stack components, adapt and optimise their interfaces