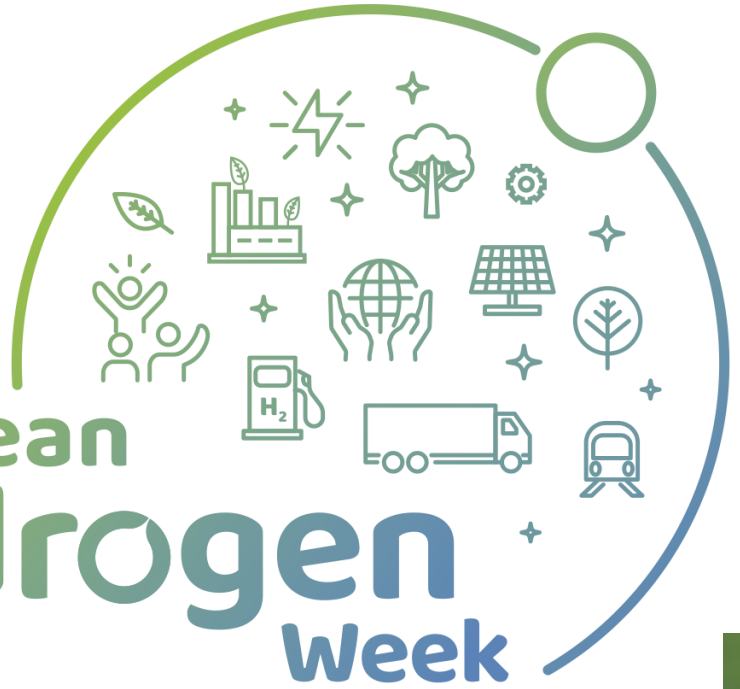
MAMA-MEA

Mass Manufacture of MEAs using high speed deposition processes



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Clean Hydrogen Partnership

EUROPEAN PARTNERSHIP

Co-funded by the European Union

#EUResearchDays
#PRD2022
#CleanHydrogen

Project Overview

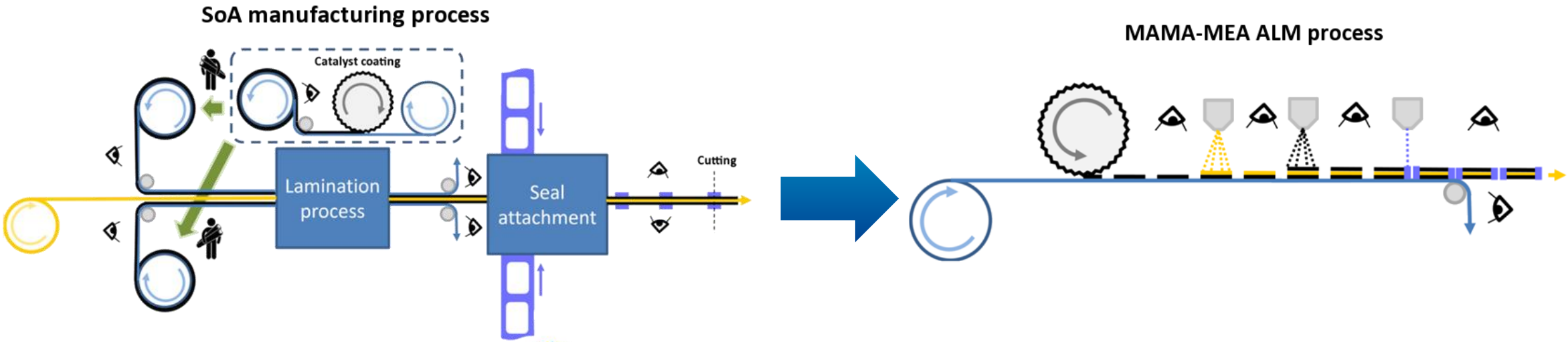
- Call year: 2017
- Call topic: FCH-02-8-2017: Step-change in Manufacturing of Fuel Cell Stack Components
- Project dates: 01.01.2018 – 30.06.2021
- % stage of implementation 01/11/2021: 100 %
- Total project budget: 3,189,816 €
- FCH JU max. contribution: 3,189,816 €
- Other financial contribution: 0 €
- Partners: Fraunhofer ENAS, INEA, Johnson Matthey, Nedstack, System Group, TU Chemnitz, UNIMORE

Co-funded by the European Union

Project Summary

MAMA-MEA - Mass Manufacture of MEAs using high speed deposition processes

Main objective: Development and design of a high-volume additive manufacturing process for CCMs suitable for 10 GW/year production



Project Summary

MAMA-MEA KPIs

KPI	MAMA-MEA and FCH targets	Status in the project
Stack CAPEX	<350 €/kW	Assessment completed
Power density	>0.67 W/cm²	Reached on short stacks
Degradation	<0.25 % / 1000 h	Validated
Lifetime expectation	20,000 h	Based on AST similar durability to baseline validated
Material utilisation	>95%	Assessment completed
Metal loading control	≤10 % at ≤0.1 mg_{Pt}/cm^2	Completed
Production web speed	~1 lm/s	Speed on the DCL for ALMCCMs 50 lm/min
Production capacity	Potential of reaching 10 GW/a	Assessment completed
Performance target	Within 10 % of benchmark CCM	Validated

Multi-Layer Deposition Processing

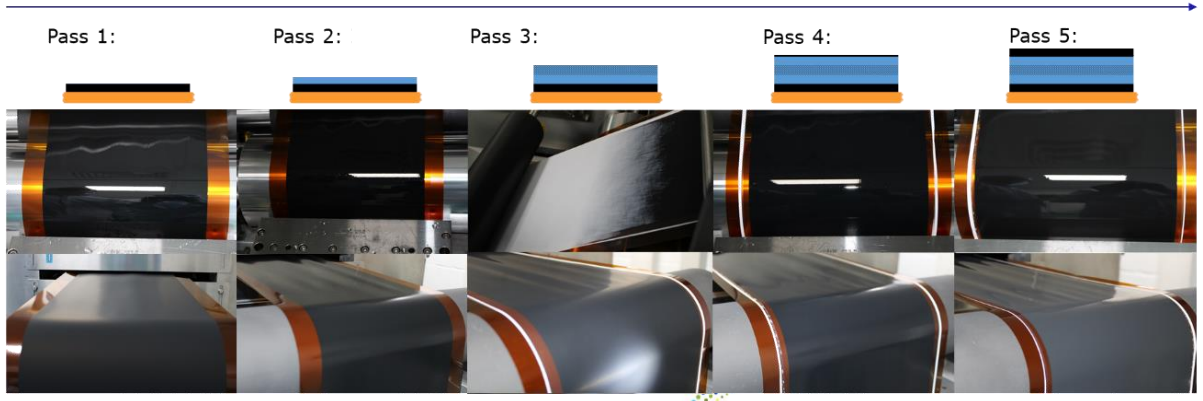
Demonstrate roll-to-roll Additive Layer Manufacture (ALM)

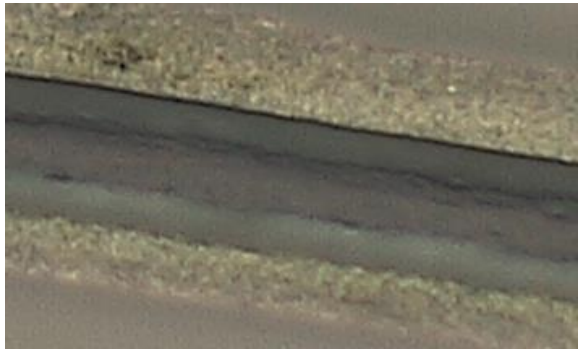
Achievement to-date

Small scale concept → CCM roll manufactured

25% 50% 75%

- Specification and technology assessment completed
- 14 trials carried out successfully on the roll-to-roll development coating line with various configurations and formulations. Layer quality on par with current high volume process line.





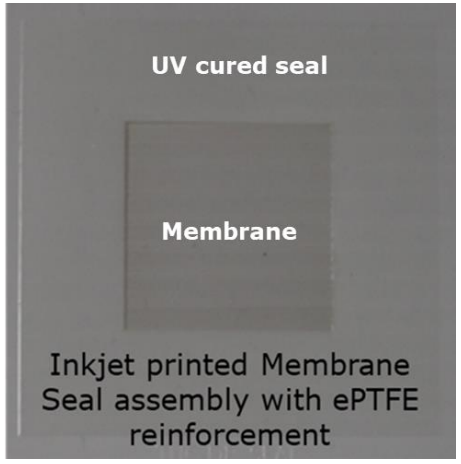
Edge Protection Seal Deposition

Demonstrate concept of process seal deposition integration

Achievement to-date

Not demonstrated → 25% → 50% → 75% → Process Concept Demonstrated

- Inkjet seal printing concept fully demonstrated
- Roll-to-roll patch coating also demonstrated



Short Stack and Cell Testing

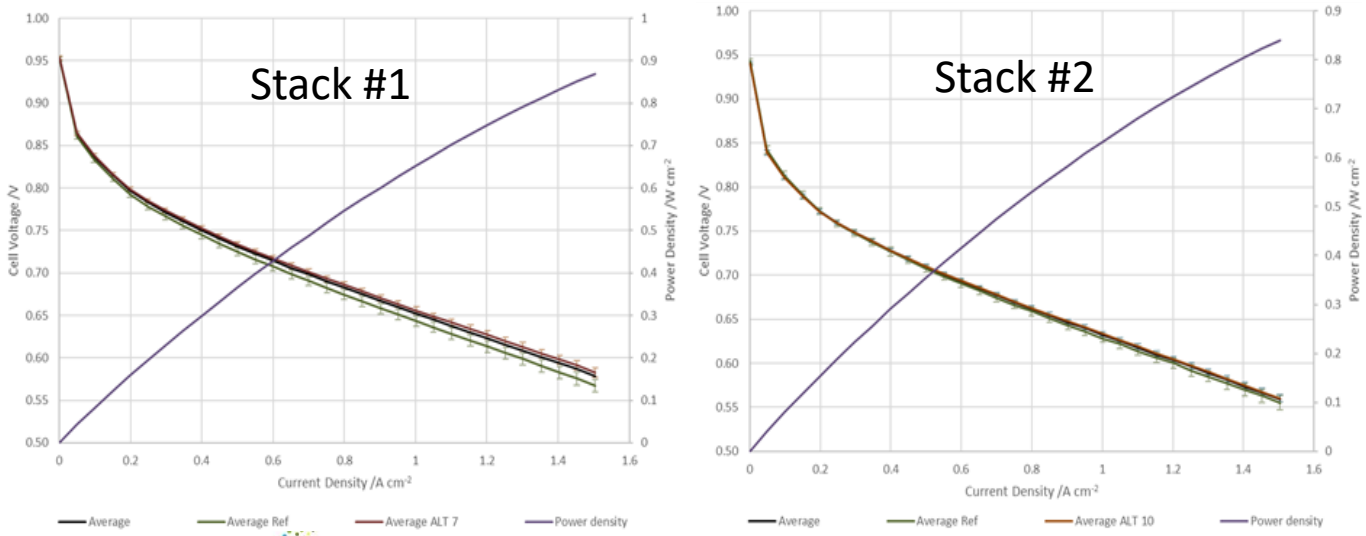
Fully printed CCM demonstrating equivalent performance and durability

Achievement to-date

Single cell → Short Stack Testing

25% 50% 75%

- Two short rainbow stacks (baseline + ALM MEAs) tested at Nedstack successfully, accelerated stress test equivalence confirmed



Process Line Concept Development

Achievement to-date

Concept → Full process line concept developed

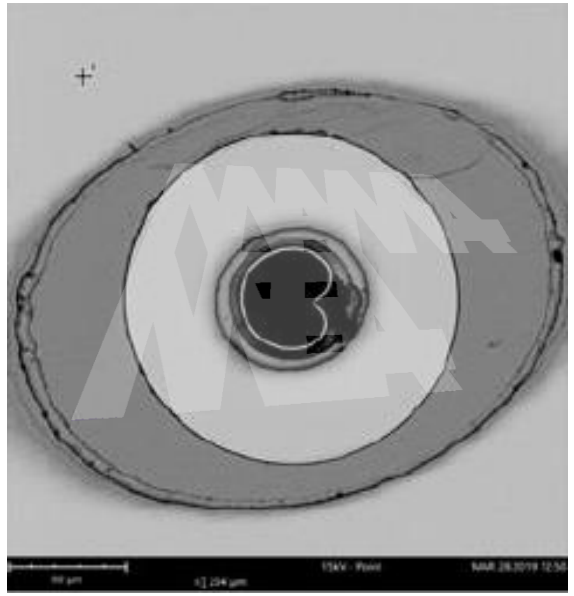
25% 50% 75%

- The MAMA-MEA project has developed and costed a fully printed CCM manufacturing process line. This includes mechanical design, sensors and actuators, control system design and SCADA system design
- Design is modular roll-to-roll manufacturing with a 120 m^2 footprint for a €15M cost for over 3GW/year production

Risks, Challenges and Lessons Learned

Digital printing presents significant opportunities for the fuel cell industry.
Inkjet in particular has a role to play but the technology, while it has demonstrated equivalent performance, is still not yet ready at high volume (assessed during MAMA-MEA project)

- Corrosion of industrial printheads by catalyst inks means lifetime is extremely limited
- Off-the-shelf inks are not readily printable and require significant modifications



MAMA-MEA has enabled the conversation to start with inkjet printhead manufacturers and System Group have gained valuable experience. Printhead development needs to continue.

- In-line quality control will be key for ALM, further work is needed

Exploitation Plan/Expected Impact

Exploitation

- Additive Layer Manufacturing is on **JM**'s technology roadmap for both fuel cell and electrolysis components
- **SG** is planning inkjet manufacturing machines for "CCM-like" products
- **INEA** is offering upgrades to existing manufacturing lines (e.g. new QC)
- **TUC, ENAS** and **UNIMORE** use the non-sensitive project outputs for academic and consultancy purposes

Impact

- **MAMA-MEA**'s high volume Additive Layer deposition manufacturing process addresses the growing demand for CCMs
- Higher utilisation of material – depositing only on the designated area -> cost/scrap reduction

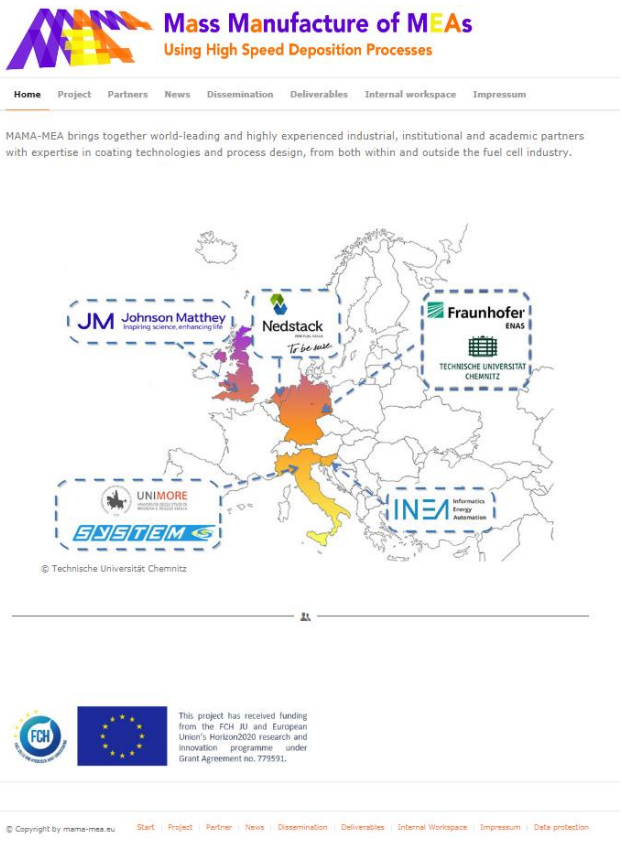
Synergies With Other Projects And Programmes

Interactions with projects funded under EU programmes

- **FIT-4-AMANDA**: Exchange of ideas, characterisation of FIT-4-AMANDA functional layers
- **INSPIRE & GAIA**: Exchange of materials
- **VOLUMETRIQ**: Exchange of R2R concepts and ideas
- **CAMELOT:** Digital printing concepts and experience shared

Dissemination Activities

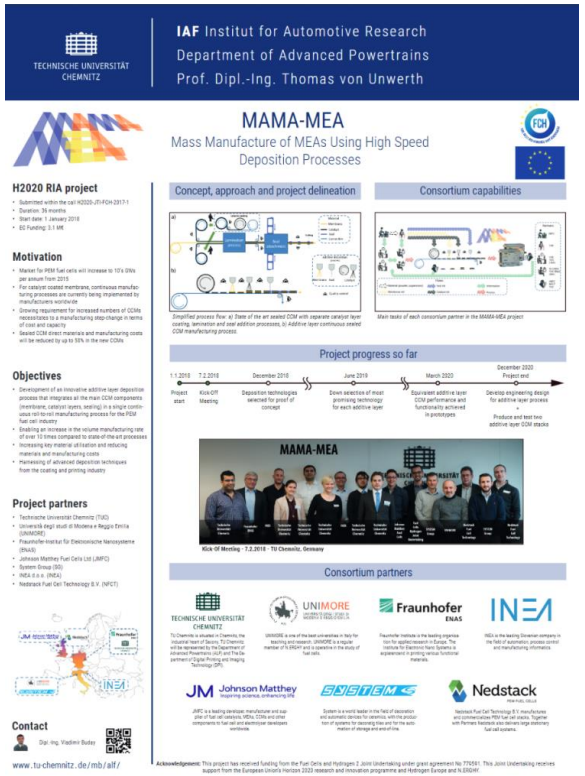
www.mama-mea.eu



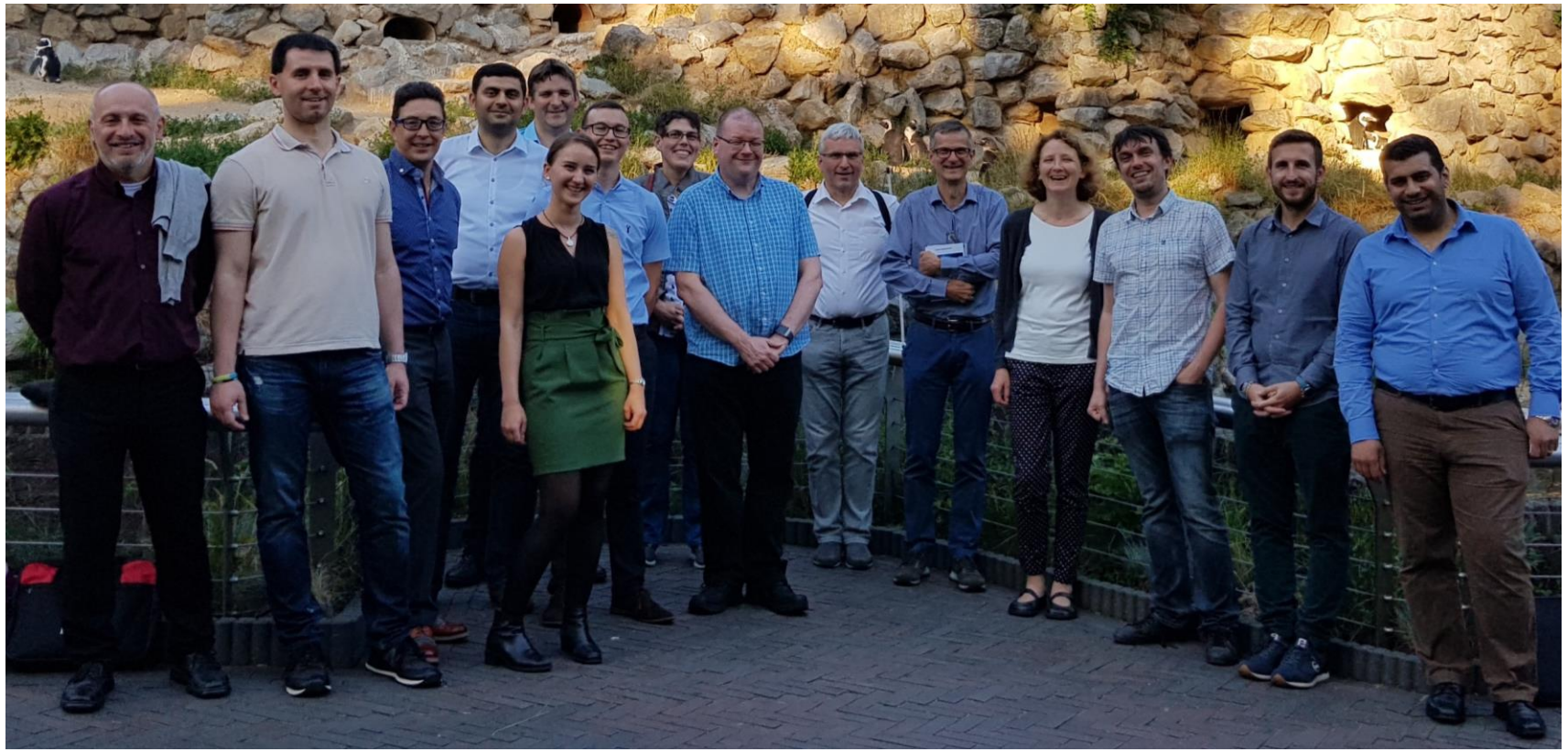
Flyer

Activities	#
Conferences	9
Workshops	6
Scientific publications	4
Communication with other projects	5
Education and training	3

Poster



MAMA-MEA team thanks you for your attention



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European Hydrogen Week

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