This project has received funding from the FCH JU and European Union's Horizon2020 research and innovation programme under Grant Agreement no. 779591.

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

MAMA-MEA

Mass Manufacture of MEAs using high speed deposition processes

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Programme Review Days 2019

Brussels, 19-20 November 2019

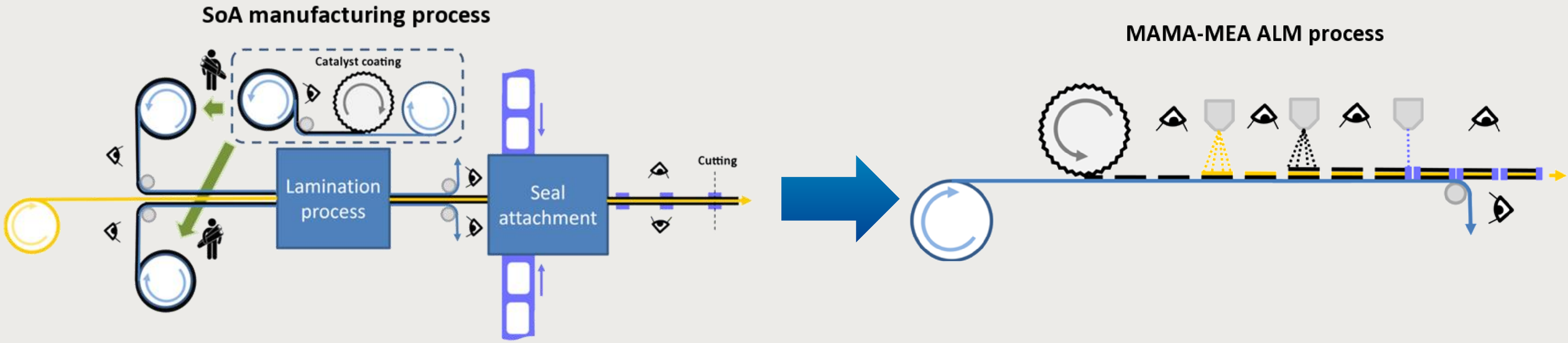
PROJECT OVERVIEW

- **Call year:** 2017
- **Call topic:** FCH-02-8-2017: Step-change in Manufacturing of Fuel Cell Stack Components
- **Project dates:** 01.01.2018 – 31.12.2020
- **% stage of implementation 01/11/2019:** 60 %
- **Total project budget:** 3,189,816 €
- **FCH JU max. contribution:** 3,189,816 €
- **Other financial contribution:** 0 €
- **Partners:** Fraunhofer ENAS, INEA, JMFC, Nedstack, System Group, TU Chemnitz, UNIMORE

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 – KPIs and Application and Market Area

KPIs of MAMA-MEA

KPI	*MAMA-MEA and FCH targets*	*Status in the project*
Stack CAPEX	<350 €/kW	Not validated yet
Power density	>0.67 W/cm²	Already reached on 50 cm² samples
Degradation	<0.25 % / 1000 h	Not validated yet
Lifetime expectation	20,000 h	First RH-cycling of ALMCCMs performed on par with the baseline material
Material utilisation	**>95%**	**Not validated yet**
Metal loading control	≤10 % at ≤0.1 mg_{Pt}/cm^2	Not validated yet
Production web speed	**~1 lm/s**	**Speed on the DCL for first ALMCCMs 50 lm/min**
Production capacity	**Potential of reaching 10 GW/a**	**Not validated yet**
Performance target	**Within 10 % of benchmark CCM**	**Reached for 50 cm² ALMCCMs**

Application and market area: fuel cell, electrolysers and CCM manufacturers; other similar multi-layer structures

PROJECT PROGRESS/ACTIONS – Deposition Technology Assessment

Selection, grading and categorisation of suitable techniques for high volume production

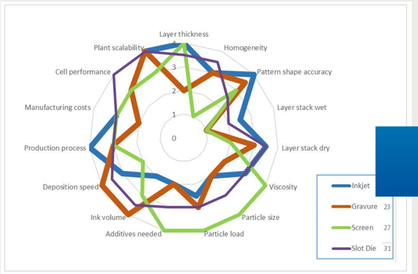
Achievement to-date

Deposition technologies

Selected deposition technologies

- Specification of deposited layers
- Review of scientific and technical literature about liquid deposition technologies
- Detailed deposition technology assessment
- Deposition techniques down-selected according to industrial MEA requirements

→ Deposition technologies selected for proof of concept



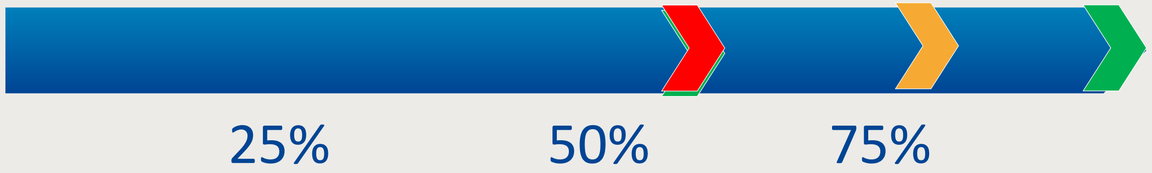
Component layer	Coating or printing technique			
	Inkjet printing	Gravure printing	Screen printing	Slot-die coating
Foundation catalyst				
Foundation ionomer				
Membrane				
Capping catalyst				
Seal				

PROJECT PROGRESS/ACTIONS – Deposition of Multi-layers

Deposition process optimisation and multi-layer printing

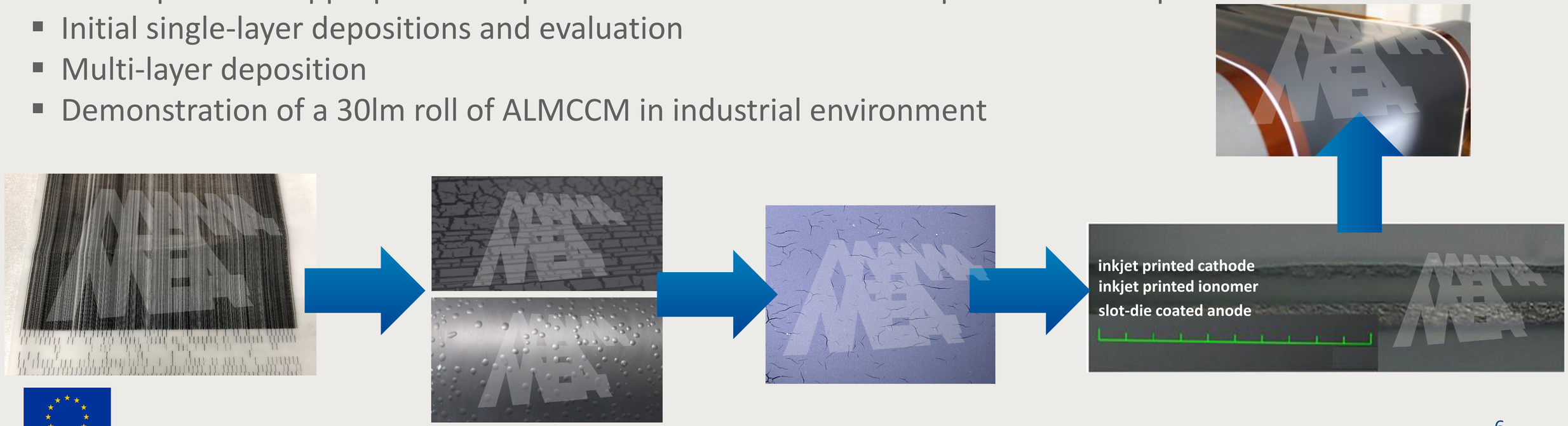
Achievement to-date

Deposition technologies



Inks
Single-layers
Multi-layers

- Development of appropriate compatible ink formulations for deposition techniques
- Initial single-layer depositions and evaluation
- Multi-layer deposition
- Demonstration of a 30lm roll of ALMCCM in industrial environment



PROJECT PROGRESS/ACTIONS – Process validation

Benchmark against reference state-of-the-art (SoA) CCMs

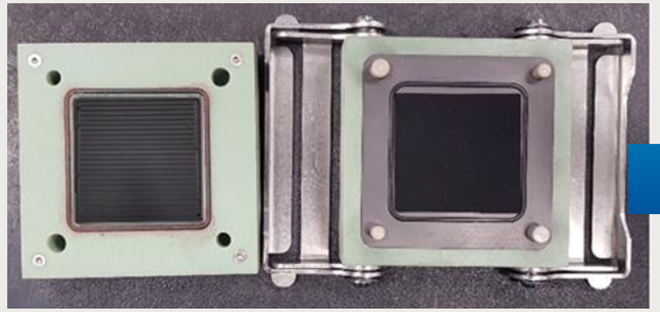
Achievement to-date

SoA CCMs

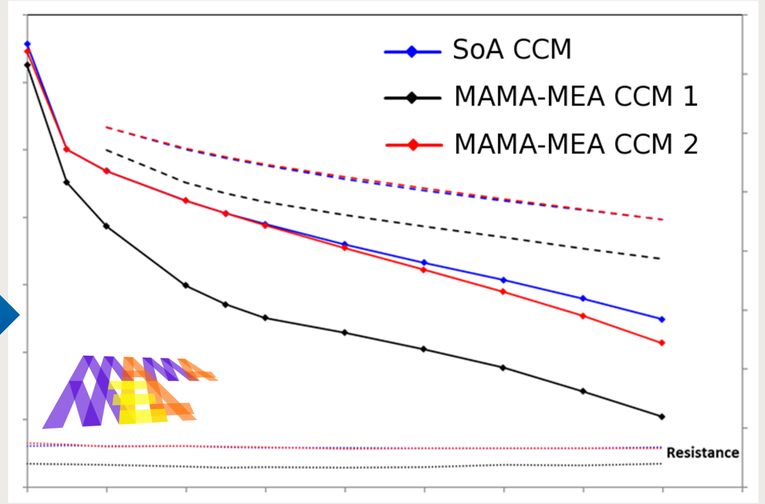
25% 50% 75%

Performance parity of MAMA-MEA CCMs

- Protocol definition and SoA component baselining
- Tests to confirm MEA functionality and reproducibility with stack relevant active area
- Durability testing in single cell and stack configuration
- Demonstration on two stacks with MAMA-MEA CCMs



cellFixture from balticFuelCells GmbH

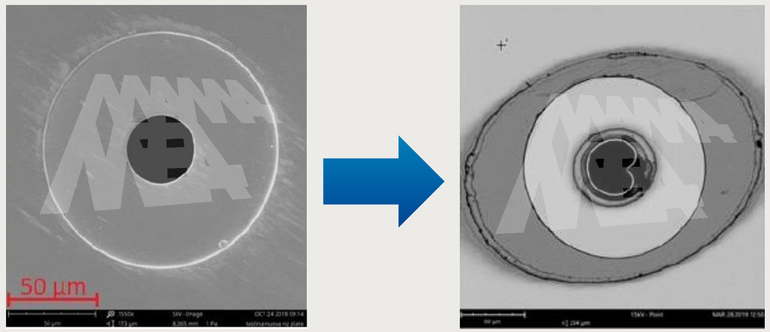


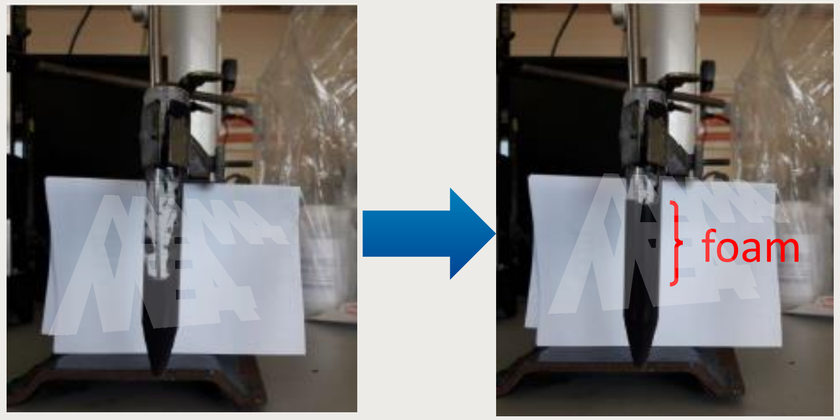
Risks and Challenges

Combination of mature manufacturing technologies from different industries poses challenges

Examples of mitigation strategies:

- Major challenge with one deposition technique encountered → modification/replacement by other technique
- Corrosion of industrial printheads by catalyst inks → compilation of material compatibility catalogue, collaboration with industrial printhead manufacturers
- Off-the-shelf inks are not printable → addition of non-contaminating agents / replacement of solvents

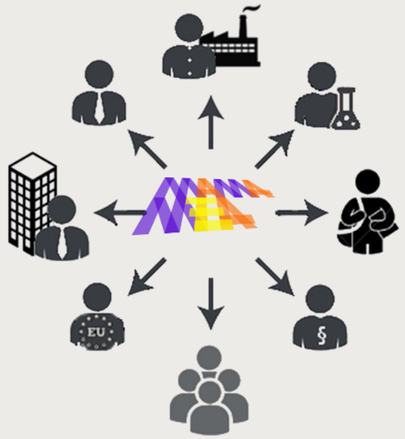




EXPLOITATION PLAN/EXPECTED IMPACT

Exploitation

- Additive layer manufacturing is on the **JMFC**'s technology roadmap
- **SG** is planning inkjet manufacturing machines for "CCM-like" products
- **INEA** is offering upgrades to existing manufacturing lines (e.g. new QC)
- **TUC** and **UNIMORE** use the non-sensitive project outputs for academic and consultancy purposes



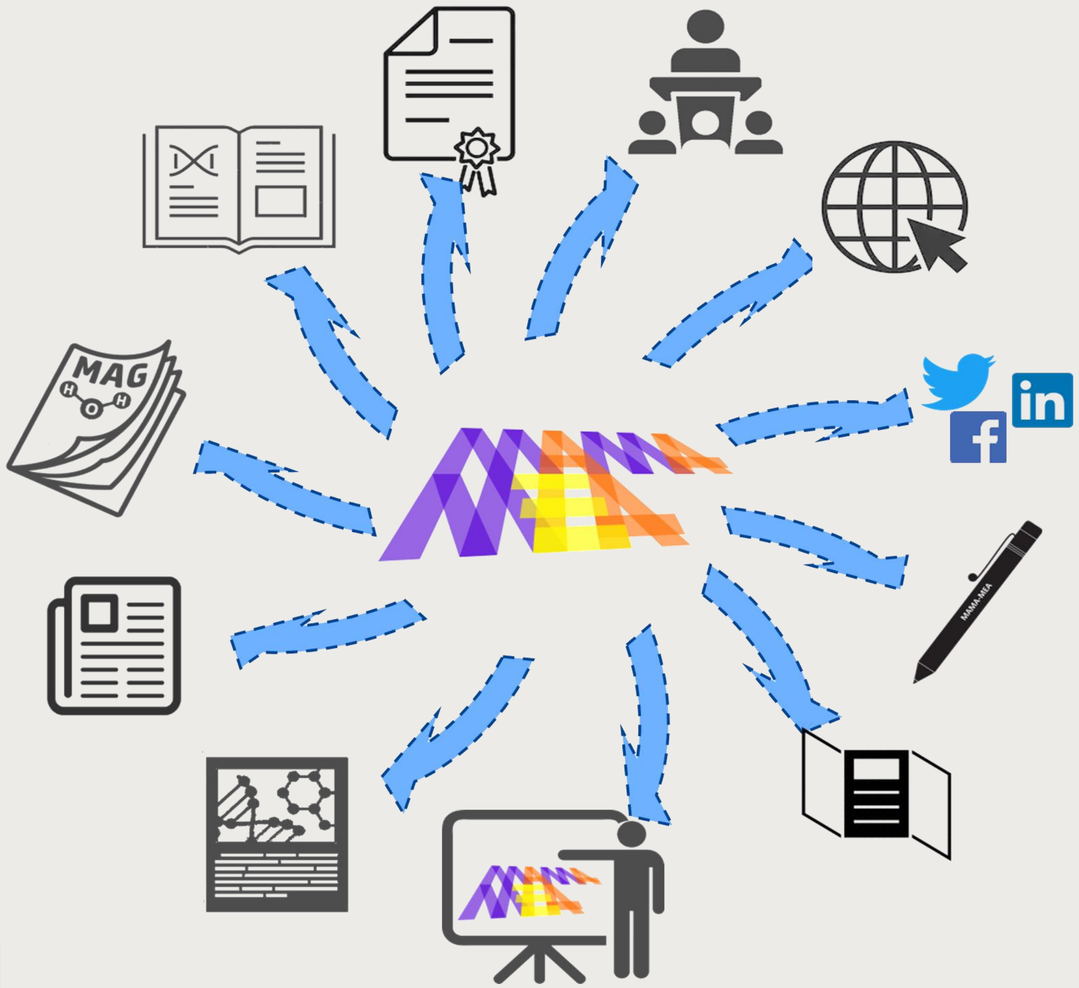
Impact

- MAMA-MEA's high volume additive layer deposition manufacturing addresses the growing demand for CCMs

- Higher utilisation of material – depositing only on the designated area → cost/scrap reduction

Communications Activities

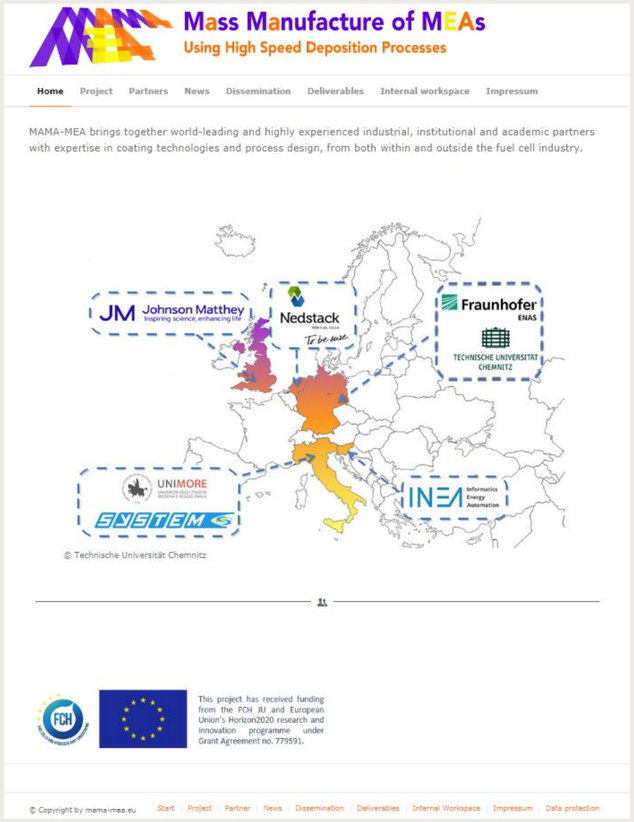
(public, students, scientists, companies, stakeholders, politicians)



- Name ✓
- Project web-site ✓
- Social media ✓
- Flyers ✓
- Giveaways ✓
- Poster ✓
- Presentation ✓
- Articles ✓
- Chapters in books ✗
- Scientific papers ✓
- Patents ○
- Image video ○
- Lectures ✓
- Workshop ○

Dissemination Activities
Tools (examples)

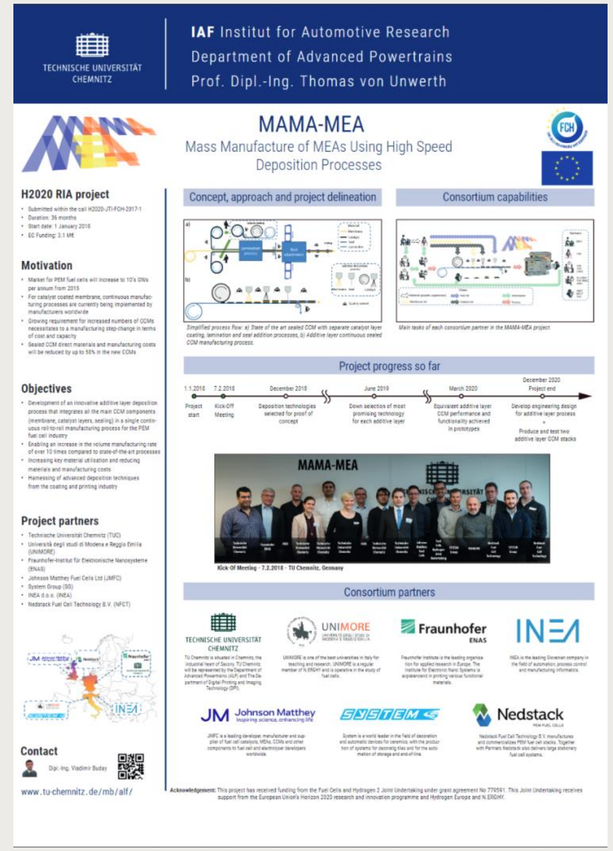
www.mama-mea.eu



Flyer

Activities	*Amount*
Conferences	6
Workshops	5
Scientific publications	1
Communication with other projects	6

Poster



SYNERGIES WITH OTHER PROJECTS AND PROGRAMMES

Interactions with projects funded under EU programmes

- FIT-4-AMANDA: Exchange of ideas regarding QC techniques; characterisation of FIT-4-AMANDA functional layers during demonstrations of QC hardware
- INSPIRE: Exchange of ideas during INSPIRE's FCH JU PEMFC development workshop
- GRASSHOPPER: Exchange of materials
- GAIA: Exchange of materials
- VOLUMETRIQ: Exchange ideas

MAMA-MEA team thanks you for your attention!

Brussels, 19-20 November 2019

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