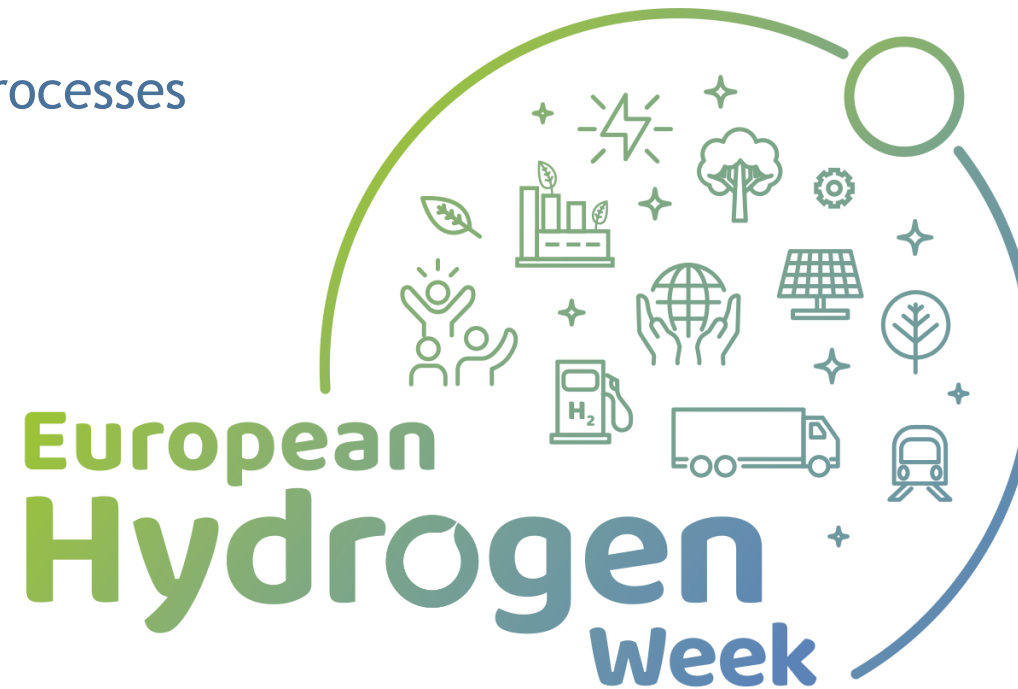
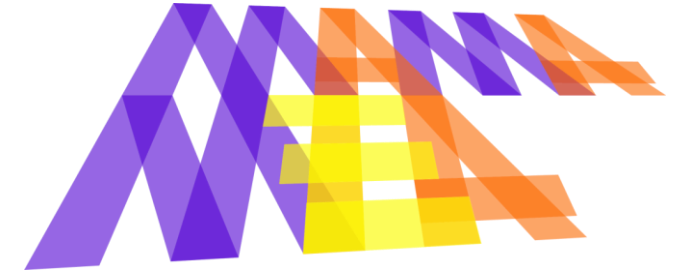


MAMA-MEA

Mass Manufacture of MEAs using
high speed deposition processes



Dr. Silvain Buche

Johnson Matthey Hydrogen Technologies

www.mama-mea.eu

Silvain.buche@matthey.com



EUROPEAN PARTNERSHIP



#EUResearchDays
#PRD2022
#CleanHydrogen

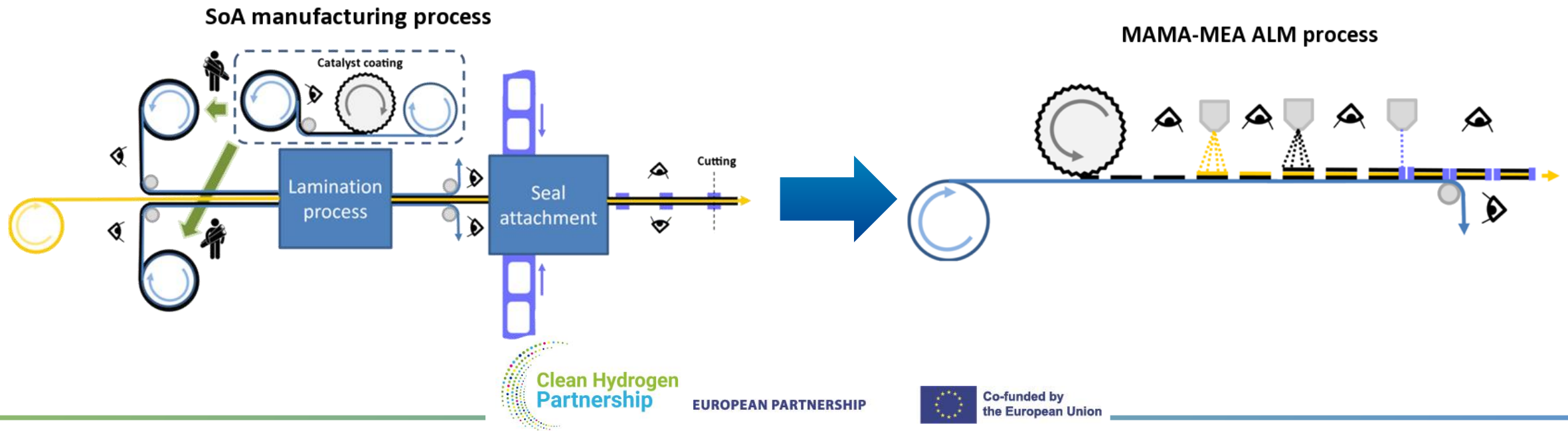
Project Overview

- 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

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

<i>KPI</i>	<i>MAMA-MEA and FCH targets</i>	<i>Status in the project</i>
Stack CAPEX	<350 €/kW	Assessment completed
Power density	>0.67 W/cm ²	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



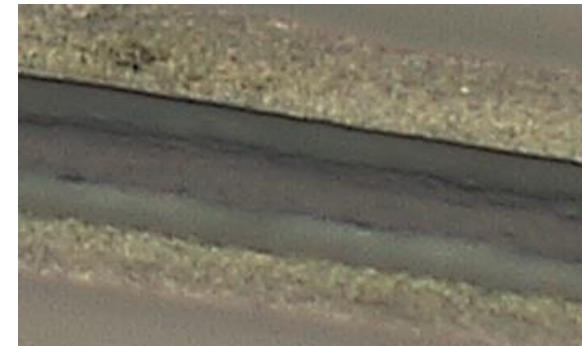
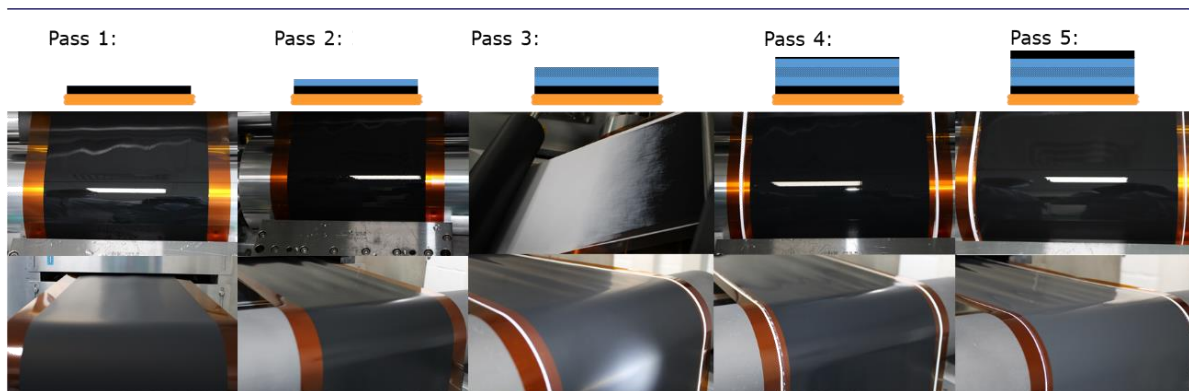
CCM roll
manufactured

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



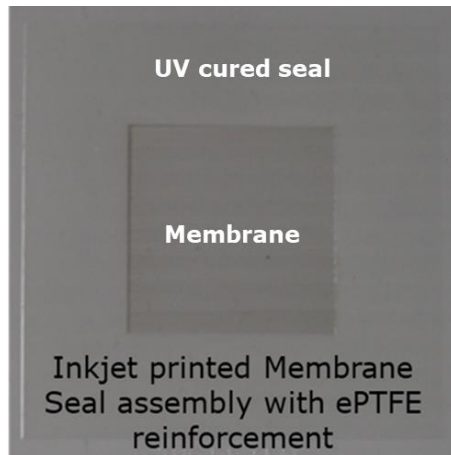
Achievement to-date

Not
demonstrated



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



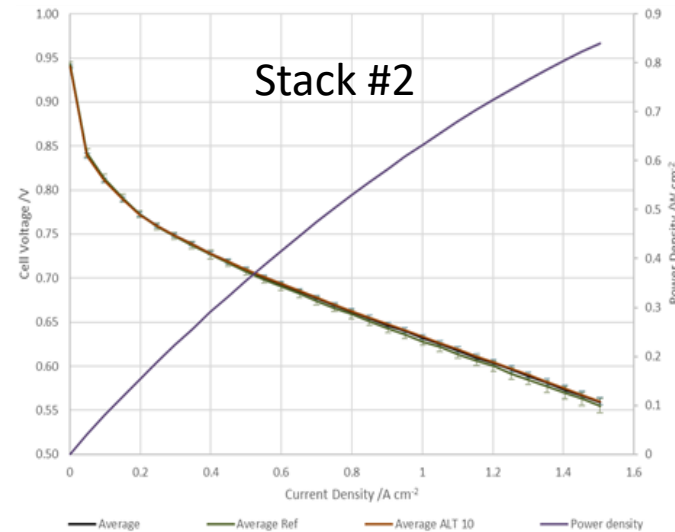
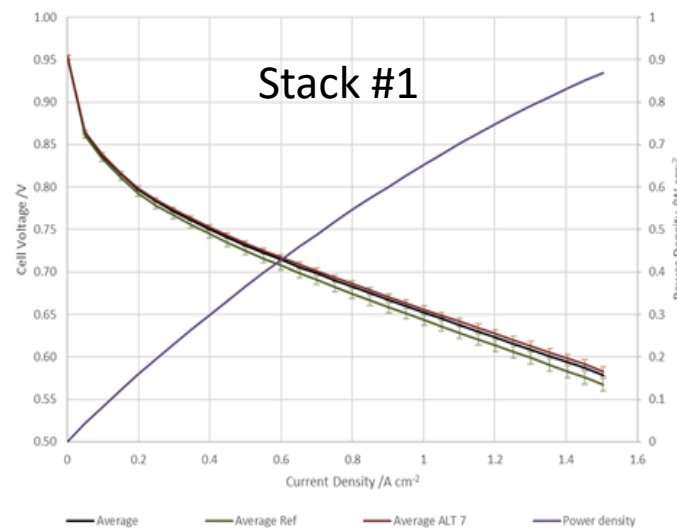
Short Stack
Testing

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 m² footprint for a €15M cost for over 3GW/year production



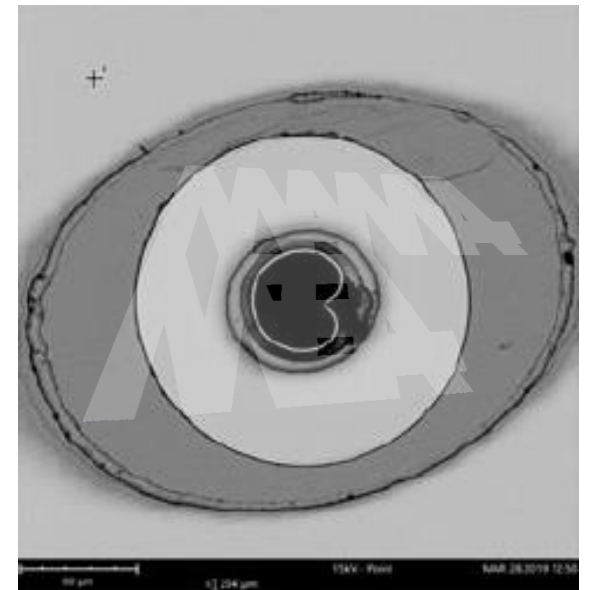
Risks, Challenges and Lessons Learned

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



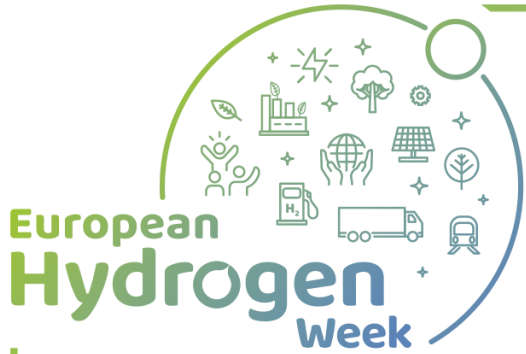
Exploitation Plan/Expected Impact

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

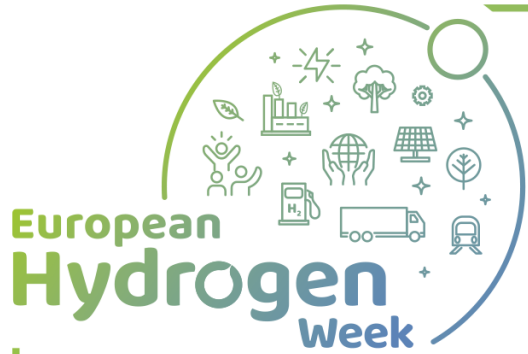
- **FIT-4-AMANDA:** Exchange of ideas, characterisation of FIT-4-AMANDA functional layers
- **INSPIRE & GAIA:** Exchange of materials
- **VOLUMETRIQ:** Exchange of R2R concepts and ideas
- **CAMELOT:** Digital printing concepts and experience shared



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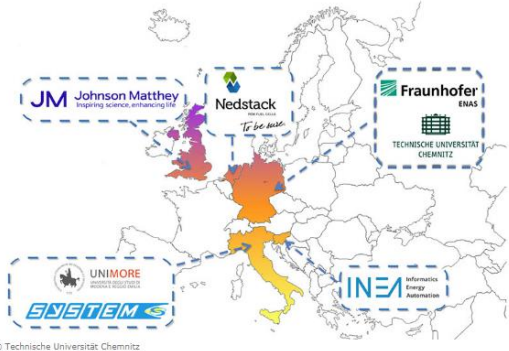
Dissemination Activities

www.mama-mea.eu



Home Project Partners News Dissemination Deliverables Internal workspace Impressum

MAMA-MEA brings together world-leading and highly experienced industrial, institutional and academic partners with expertise in coating technologies and process design, from both within and outside the fuel cell industry.



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Flyer

Facts and Figures

Full name: Mass Manufacture of MEAs Using High Speed Deposition Processes
Acronym: MAMA-MEA
Start date: 1 January 2018
Duration: 36 months
Total budget: 3.1 M€
EC funding: 3.1 M€

Contacts

Project Coordinator:
Vladimir Buday (TU Chemnitz)
email: vladimir.buday@tu-chemnitz.de
phone: +49 (0)371 531 30562

Technical Coordinator:
Dr Silvan Bucher (Johnson Matthey Fuel Cells Ltd)
email: silvan.bucher@johnsonmatthey.com
phone: +44 (0)118 924 2033

Day-to-day Manager:
Mandy Pöhlert (TU Chemnitz)
email: mandy.pohlert@tu-chemnitz.de
phone: +49 (0)371 531 31001

Further information: www.mama-mea.eu



Consortium



Activities

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

Poster

IAF Institut für Automotive Research
Department of Advanced Powertrains
Prof. Dipl.-Ing. Thomas von Unwerth

MAMA-MEA
Mass Manufacture of MEAs Using High Speed Deposition Processes

H2020 RIA project

- Submitted within the call H2020-JU-FCR-2017-1
- Duration: 36 months
- Start date: 1 January 2018
- EC Funding: 3.1 M€

Motivation

- Research in fuel cell technology will increase to 10% by 2020, per annum from 2015
- For catalyst coated membranes, continuous membrane forming processes are currently being implemented by manufacturers worldwide
- Growing requirement for increased numbers of COBs, necessitated by a manufacturing process change in terms of cost and capacity
- Current COB manufacturing and manufacturing costs will be reduced by up to 50% in the new COBs

Objectives

- Development of an innovative additive layer deposition process that integrates all the main COB components (membrane, catalyst layers, sealing) in a single continuous process for high manufacturing volumes for the fuel cell industry
- Building up a network of volume manufacturing sites of over 10 km² compared to state of the art processes
- Increasing the material utilization and reducing material and manufacturing costs
- Improvement of advanced deposition techniques from the coating and printing industry

Project partners

- Technische Universität Chemnitz (TUC)
- Johnson Matthey Fuel Cells Ltd (JMFC)
- Fraunhofer Institute for Electrochemical Nanotechnology (ENAS)
- Johnson Matthey Fuel Cells Ltd (JMFC)
- System Group (SG)
- NEA s.p.a. (NEA)
- Nedstack Fuel Cell Technology B.V. (NFTC)

Project progress so far

1.1.2018: Project start

1.1.2018: Kick-off meeting

1.1.2018: Deposition technologies selected for project start

1.1.2018: Down selection of most promising technology for each additive layer

1.1.2018: Equipment added to test COB performance and functionality achieved in prototypes

1.1.2018: Developing engineering design for additive layer process

1.1.2018: Production of first additive layer COB matrix

Consortium partners

Kick-off Meeting: 1.1.2018 - TU Chemnitz, Germany

Consortium partners

Technische Universität Chemnitz

UNIMORE

Fraunhofer ENAS

INEA

Johnson Matthey

SYSTEM

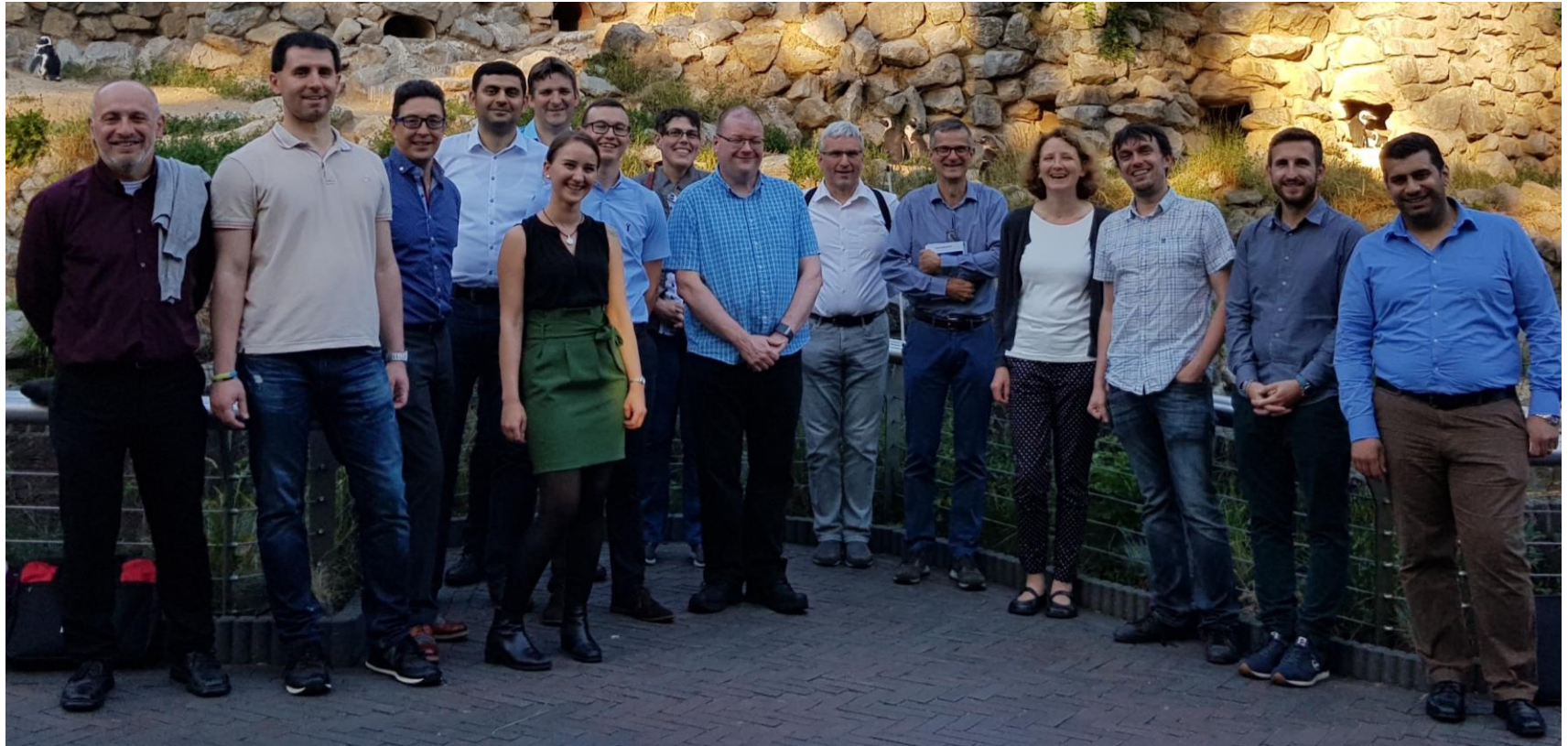
Nedstack

Contact

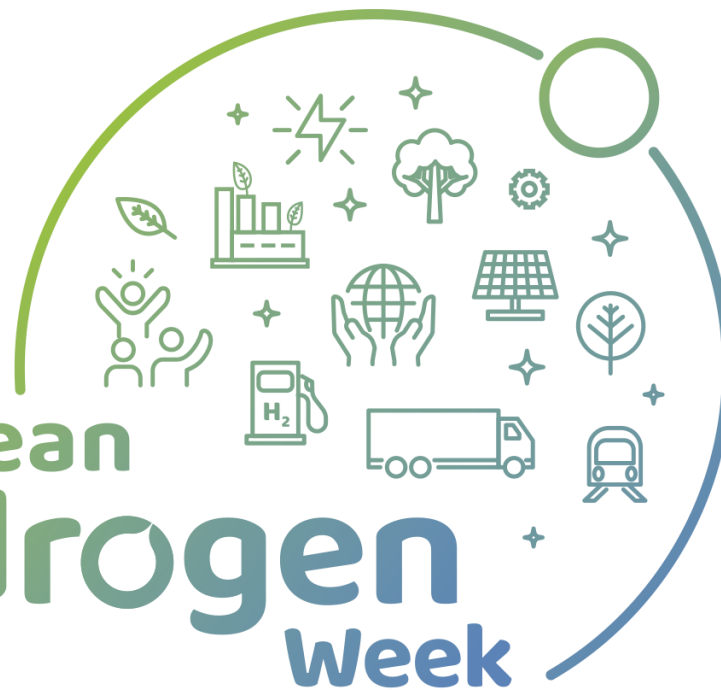
Dipl.-Ing. Vladimir Buday

v.buday@tu-chemnitz.de

MAMA-MEA team thanks you for your attention



“This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 779591. This Joint Undertaking receives support from the European Union’s Horizon 2020 Research and Innovation Programme, Hydrogen Europe and Hydrogen Europe Research”



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