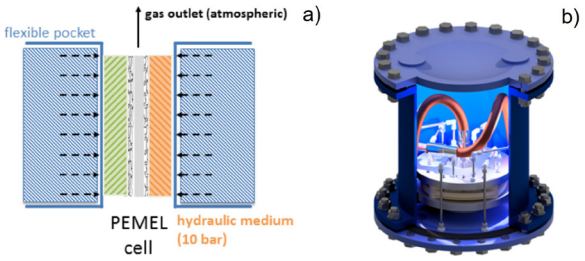
NOVEL MODULAR STACK DESIGN FOR HIGH PRESSURE PEM WATER ELECTROLYZER TECHNOLOGY WITH WIDE OPERATION RANGE AND REDUCED COST (PRETZEL)

Goal of the project

Green hydrogen produced by electrolysis might become a key energy carrier for the implementation of renewable energy as a cross-sectional connection between the energy sector, industry and mobility. Proton exchange membrane electrolyzer (PEMEL) is the preferred technology for this purpose, still costs, efficiency, lifetime and operability need to be optimized. The aim of PRETZEL project is to develop a new PEMEL that provides significant improvements in efficiency and operability to satisfy emerging market requirements.

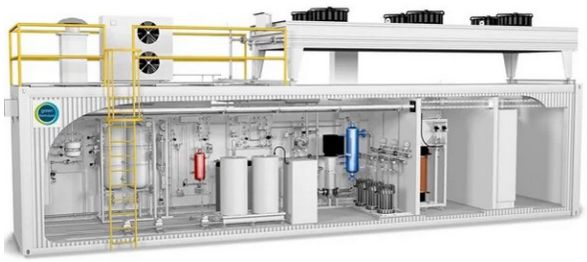
Short description of the project

The central objective of PRETZEL is to develop a new PEMEL for hydrogen production, upscaling a patented design approach based on hydraulic cell compression.



Principle of homogeneous hydraulic cell compression (a) and stack design for hydraulic compression (b).

The system will operate with a maximum energy consumption of 25 kWh, with a production capacity of 4.5 m^3 H_2 / h at rated power, at a pressure of 100 bar and water temperature of 90°C.
All subsystems needed to properly operate a PEMEL stack will be integrated in a housing, equipped with a hydrogen detection and ventilation system.



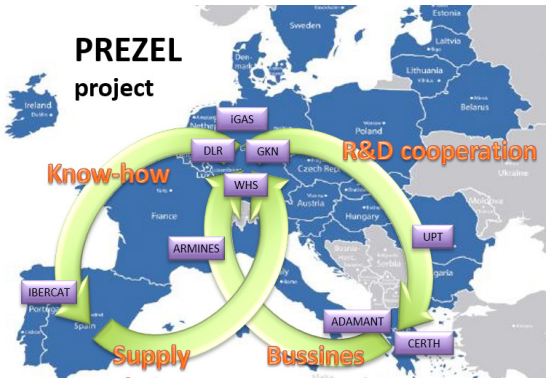
Schematic drawing of a PEMEL system as container solution by iGas energy.

Project implemented by:

Project Coordinator:
German Aerospace Center, Stuttgart, Germany (DLR)

EU Partners:

- Westphalian University of Applied Sciences, Germany (WHS)
- Association for Research and Development of Industrial Methods and Processes, France (ARMINES)
- Politehnica University Timişoara, Romania (UPT)
- Adamant Composites Ltd., Greece
- GKN Sinter Metals Engineering GmbH, Germany (GKN)
- Centre for Research and Technology Hellas, Greece (CERTH)
- Soluciones Catalíticas IBERCAT, Spain
- iGas energy GmbH, Germany



"PRETZEL"-like shape passing over the geographical location of all PRETZEL partners representing the long-term collaboration in know-how, supply chain, business partnership and R&D.

Implementation period

01.01.2018 – 31.12.2020

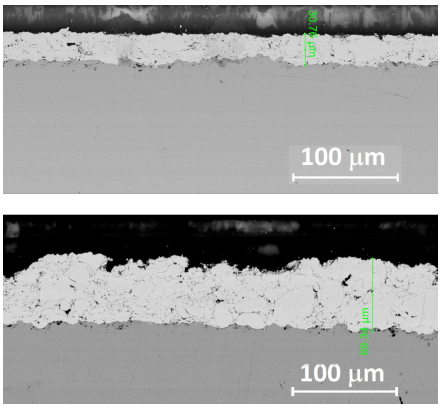
Main activities

UPT's main activities in PRETZEL are the investigation of newly developed bipolar plates (BPP), as cost-efficient alternative for the classical titanium BPP, consisting of highly corrosion resistant Nb-coatings deposited by vacuum plasma spraying (VPS) on copper pole plates in regard of:

- **Corrosion resistance** evaluation in simulated PEMEL environment, at 90°C and O_2 saturated solution, including accelerated stress tests at constant potential of 2 V applied for 6 hours
- **Interfacial contact resistance** (ICR) versus compaction force measurement
- **Structure and morphology** of BPP before and after accelerated stress tests

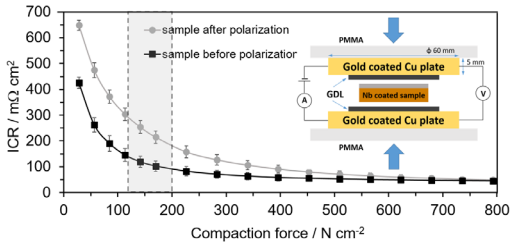
Results

- A 30 µm thick Nb coating fully protects the copper substrate against corrosion in simulated PEMEL environment, showing excellent corrosion resistance properties, with i_{corr} lower than 0.1 µA cm^{-2}.
- Cross-section images show no signs of corrosion, nor the formation of pinholes beneath the coating.



Cross section FE-SEM images of Nb-coatings after accelerated stress test.

• ICR decreases with compaction force up to 45 mΩ cm^2. In the range of 120 to 200 N cm^{-2}, which is the common pressure applied for assembling commercial PEM electrolyzer stacks, ICR decreases from 130 to 90 mΩ cm^2.



Interfacial contact resistance at different compaction forces.

Applicability and transferability of the results:

- **System:** Development and validation of a 25 kW PEM electrolyzer system with hydrogen output pressure of 100 bars or higher.
- **Cell components:** Reduction of Ir catalyst loading compared to the state-of-the-art, by the use of new aerogel supports.
- **Protocols:** development of complete protocols for BPP testing, including stress test, corrosion resistance and ICR.

Financed through/by

Fuel Cell and Hydrogen 2 Joint Undertaking under the European Union´s Horizon 2020 research and innovation programme under grant agreement No 779478.

Research Centre

Research Institute for Renewable Energy (ICER-TM), UPT

Research team

Assoc. Prof. Andrea KELLENBERGER, PhD
Prof. Nicolae VASZILCSIN, PhD
Assoc. Prof. Narcis DUTEANU, PhD
Assist. Prof. Mircea Laurentiu DAN, PhD
Prof. Adina NEGREA, PhD
M.Sc.Eng. Delia DUCA,
Eng. Anuta SERAC

Contact information

Prof. Andrea KELLENBERGER, PhD
Faculty of Industrial Chemistry and Environmental Engineering
Department of Applied Chemistry and Engineering of Inorganic Compounds and Environment
Bd. V. Parvan, No. 6, 300223, Timisoara
Phone: (+40) 256 404 178
Mobile: (+40) 726 448 966
E-mail: andrea.kellenberger@upt.ro
Web: http://pretzel-electrolyzer.eu/