



STORAGE RESEARCH INFRASTRUCTURE ECO-SYSTEM

RI Information sheet 2022

AIT, _Hycenta and FCECH

Technology(ies) of Energy Storage (that can be assign to the facility, e.g. electrochemical, chemical, thermal, cross-cutting,)

Contact person 1:

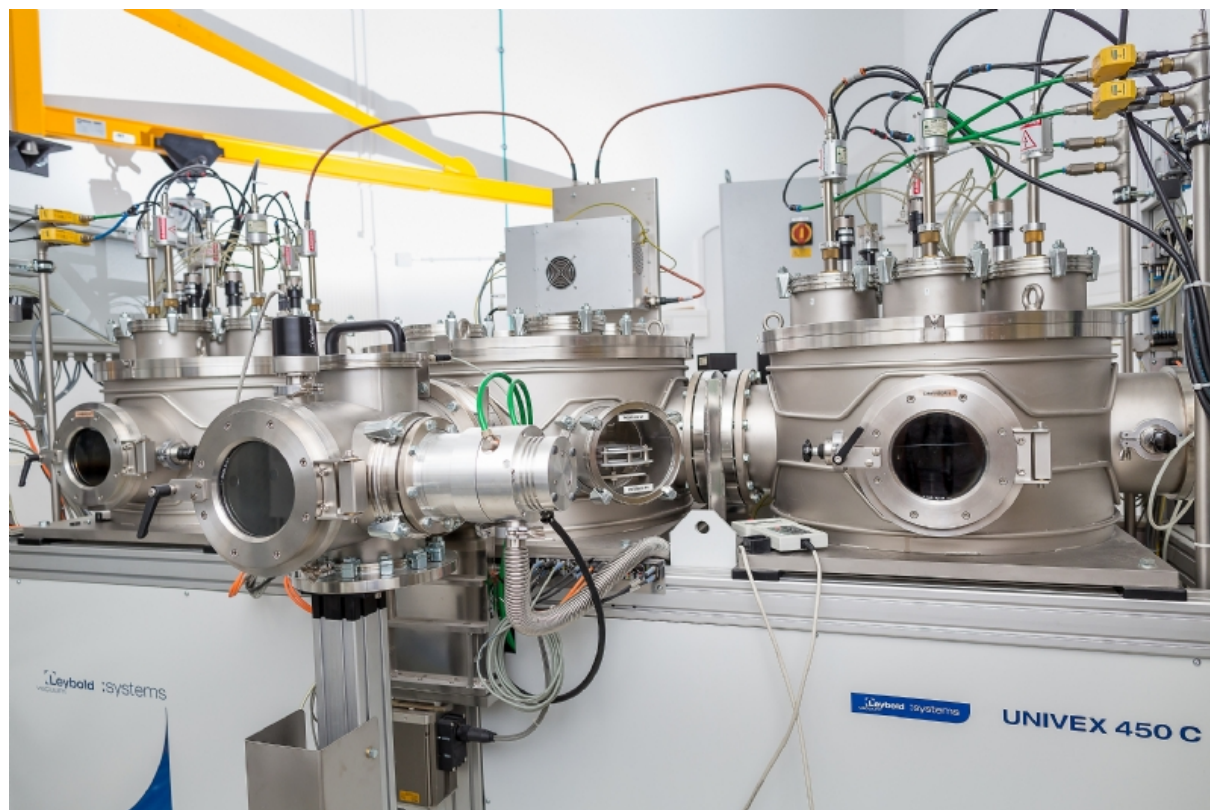
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Project Acronym	StoRIES
Call	H2020-LC-GD-2020
Grant Agreement No.	101036910
Project Start Date	01-11-2021
Project End Date	31-10-2025
Duration	48 months

1. Photo



2. Geographical coordinates (°, ′, ... N/S, E/W)

Coordinates location Vienna (Functional Coatings Lab ECH):
48.269299610795855, 16.4276179807003471

Coordinates location Graz (HyCentA): 47.05890730390111, 15.46413641906399

3. Description of the research infrastructure for the webpage

The **Functional Coatings Lab for Energy Conversion and Hydrogen at the AIT Center for Energy** disposes comprehensive materials synthesis and characterization infrastructure for material- and process development in the fields of Energy Conversion and Hydrogen, especially membrane-based electrolysis technologies (PEM, AEM) for water splitting or reduction of carbon dioxide, direct solar (photo-electrochemical) water splitting, and next generation solar cell technologies.

- Electrochemical setups including state-of-the-art gas chromatography for lab-size electrolysis experiments such as water splitting for hydrogen production or the reduction of carbon dioxide. Commercial electrolyser

stacks as well as individually fabricated cells or cell components can be tested, evaluated and optimized.

- Physical vapour deposition setups: cluster sputter tool with 11 sputter sources (DC and RF) with 4-inch diameter targets and substrates; several thermal and electron evaporators.
- Fully automated ultrasonic spray pyrolysis (USP) system: with 4 parallel pumping systems for the fabrication of binary, ternary or quaternary materials. Sample size up to 10x10 cm² for spray pyrolysis and 20x20 cm² for spray coating.
- Patterning: UV, NIL, e-beam and laser interference lithography
- Chemical laboratory: including chemical benches, electrochemical deposition setups (multiple potentiostats/galvanostats), chemical bath, automated SILAR, spin coating and blade-coating setups.
- Materials characterization setups: X-Ray diffraction (XRD), X-Ray Fluorescence, Atomic Force Microscopy, Scanning Electron Microscopy, Energy-dispersive electron spectroscopy, Fourier-transform infrared (FTIR)- and Raman spectroscopy, impedance spectroscopy, etc.
- Solar energy laboratory: for direct solar photo-electrochemical hydrogen production experiments, e.g. AAA+ steady state simulator, EQE and IQE setups, impedance spectroscopy, Photoluminescence (PL) and electroluminescence (EL) imaging, IR thermography, etc.
- Ageing: Climatic and UV chambers for accelerated ageing (UV ageing, damp heat, humidity-freeze, etc.)
- Digital material development: Fully automated material deposition (USP) and characterization (XRD, FTIR, SEM/EDS) setups for the fabrication and AI-supported evaluation of multi-parameter (e.g. composition, thickness) samples.

The **HyCentA Research GmbH** infrastructure facility, located at the campus of the Graz University of Technology, includes the following test beds and hydrogen refuelling stations:

- Fuel cell system test bench: Fuel cell systems are integrated as Hardware in the Loop (HiL) into a virtual overall system. This allows fuel cell systems to be operated, analysed and optimised dynamically under real load and ambient

conditions for stationary and mobile uses. The integrated climate chamber allows temperature variations between -40 to $+85^{\circ}\text{C}$. The power range for electrical power goes from $2.5 - 160$ kW.

- Multifunctional test bench 1 & 2: Applicable to the testing of hydrogen-carrying components and hydrogen systems in which compressed gaseous hydrogen up to 890 bar is used, maximal electrical power range goes up to 30 kW. Hydrogen is provided at both multifunction test benches at different pressure levels (high, medium and low pressure). The test benches can be heated up to 60°C .
- Test cell 3: Due to the possibility of media conditioning at different temperatures (-40°C to 85°C) and supply of H_2 and N_2 at different pressure levels, the test cell can be used for investigations of high-pressure infrastructure components (e.g.: used in refuelling stations).
- 350 bar dispenser: for cars, trucks and buses: Nominal refuelling pressure at 15°C is 350 bar with maximum refuelling pressure up to 430 bar. Refuelling couplings are WEH TK 16 for cars and WEH TK 16 High Flow for busses and heavy-duty trucks. The refuelling speed is manually adjustable and the maximum refuelling quantity is 30.5 kg. SAE refuelling is not possible, there is no cold-fill line adapted to the dispenser.
- 700 bar dispenser with cold filling system: Nominal refuelling pressure at 15°C is 700 bar with maximum refuelling pressure up to 875 bar. Refuelling coupling is the Walther HG-004 and an IR interface according to SAE J2799 is available. Pressure increase rates can be adapted according to SAE J2601 or variably adjusted.
- Gas analysis laboratory: Serves to determine hydrogen quality according to ISO 14687 2019:11. It consists of three sections: sample preparation, analysis section and material analysis section. The sample preparation area comprises two deductions: Deduction Area and Laminar Flow Area, which creates a clean room environment for particle analysis (ISO 5). The Analysis Area comprises an FTIR (Fourier Transform Infrared) spectrometer and an IMR (Ion Molecular Reaction) mass spectrometer. The material analysis area is intended for the maintenance of components such as filters, test bench equipment, fittings and for the evaluation of materials regarding hydrogen compatibility.

4. Availability of the research infrastructure

(Please indicate time periods in which infrastructure will not be available for StoRIES in the next 2 years – if already known)

None

5. Special considerations (confidentiality / NDA agreements, insurance requirement, special training, HSE training)

HSE training

Eventually NDA agreement

IPs according to GA/CA

6. Energy storage technology that can be analysed/studied by using the research infrastructure

- Electrochemical
- Chemical
- Thermal
- Mechanical
- Superconducting Magnetic
- Cross-cutting (Specifically: ...)

7. Key words for the webpage

Hydrogen, Electrolysis, water splitting; Photo-electrochemical water splitting; fuel cell; gas analysis; test bench

8. TRL level (if applicable):

- 1-3
- 4-6
- Above