STORAGE RESEARCH INFRASTRUCTURE ECO-SYSTEM

RI Information sheet 2022

Sotacarbo, Photoelectrochemistry (PEC) lab

Chemical energy storage by means of electrochemical processes

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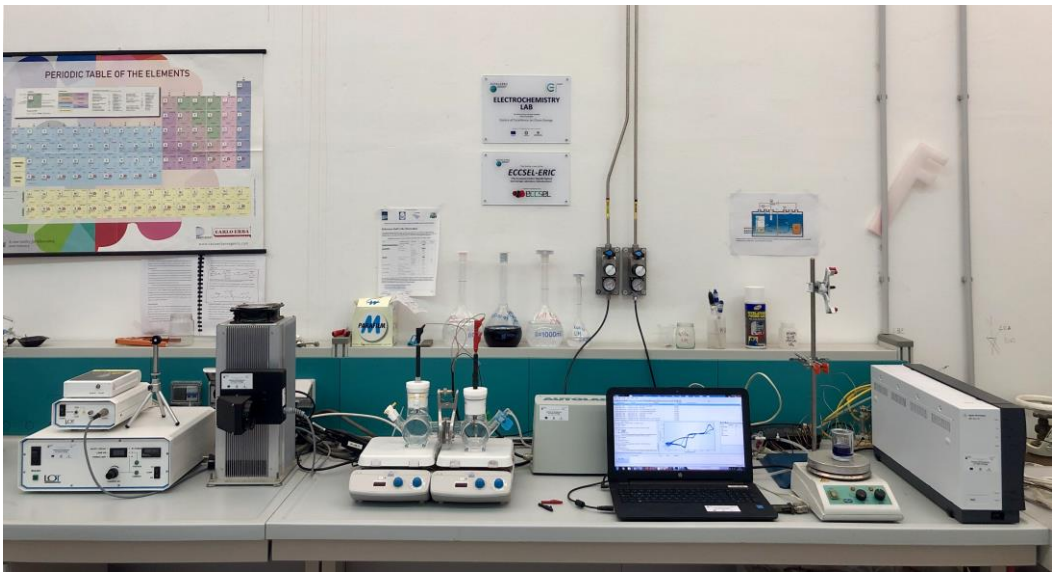
Project Acronym	StoRIES
Call	H2020-LC-GD-2020
Grant Agreement No.	101036910
Project Start Date	01-11-2021
Project End Date	31-10-2025
Duration	48 months

1. Photo



2. Geographical coordinates (˚, “, … N/S, E/W)

Sotacarbo Research Centre, Grande Miniera di Serbariu, Carbonia, Italy

39°9’32” N, 8°30’40” E

39.16006860186053, 8.51211346024538

3. Description of the research infrastructure for the webpage

The main objective of the PEC laboratory is to convert CO_2 - through photoelectrochemical (PEC) reduction - into value-added chemicals and fuels, such as syngas, hydrocarbons, and oxygenates compounds using energy that is not produced from fossil fuels, as well as the production of hydrogen by photoelectrochemical water-splitting. Moreover, the integration of renewable energy could make this PEC process a potential candidate for an environmentally sustainable use of CO_2 that can support storage, both to reduce total costs and the distance between emission sources and storage sites.

The PEC Lab facility has been conceived in different sections:

- a photoanode-driven PEC reactor that consists of a photo-anode half-cell (such as WO_3-TiO_2 nanotubular structures), a cathode half-cell (such as

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copper-based electrodes with BDD or TiO_2 nanotubes substrates) and a protonic membrane (Nafion®);

- a solar simulator (LOT Quantum Design), a potentiostat/galvanostat (Autolab PGSTAT204 with FRA32M electrochemical impedance spectroscopy (EIS) module), a micro-gas chromatograph (Agilent 490) for the analysis of the gas phase and a gas chromatograph (Agilent GC7890A) coupled with a mass spectrometer (Agilent 5977A MSD) to analyze the liquid phase.
- two EL-Bronkhorst flow meters to set the gas feeding (CO_2 and N_2).

The simplified process can be summarized as follows: 1) the light crosses the quartz window and reaches the photoanode, where photo-generated electrons and hole pairs are generated and O_2 evolves; 2) the protons pass through the protonic membrane, while electrons are collected and reach the cathode through an external wire; 3) the protons react with CO_2 in presence of electrons on the electrocatalyst to produce chemicals or fuels, and each other in order to produce hydrogen. The physical separation of the two reactions in a photoanode and electrocathode respectively is necessary to increase the efficiency of the process and limit charge recombination.

The activities involve the synthesis and electrochemical characterization of Cu-based photoelectrodes as well as Cu/Zn-based p-n heterojunctions, and WO_3-TiO_2 nanotubular structures.

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)

N.a.

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

N.a.

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

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- Electrochemical ☒
- Chemical ☒
- Thermal ☐
- Mechanical ☐
- Superconducting Magnetic ☐
- Cross-cutting ☐ (Specifically: …)

7. Key words for the webpage

Chemical energy storage; photoelectrochemical conversion; CO_2 conversion; H_2 production; electrochemistry

8. TRL level (if applicable):

- 1-3 ☒
- 4-6 ☐
- Above ☐

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