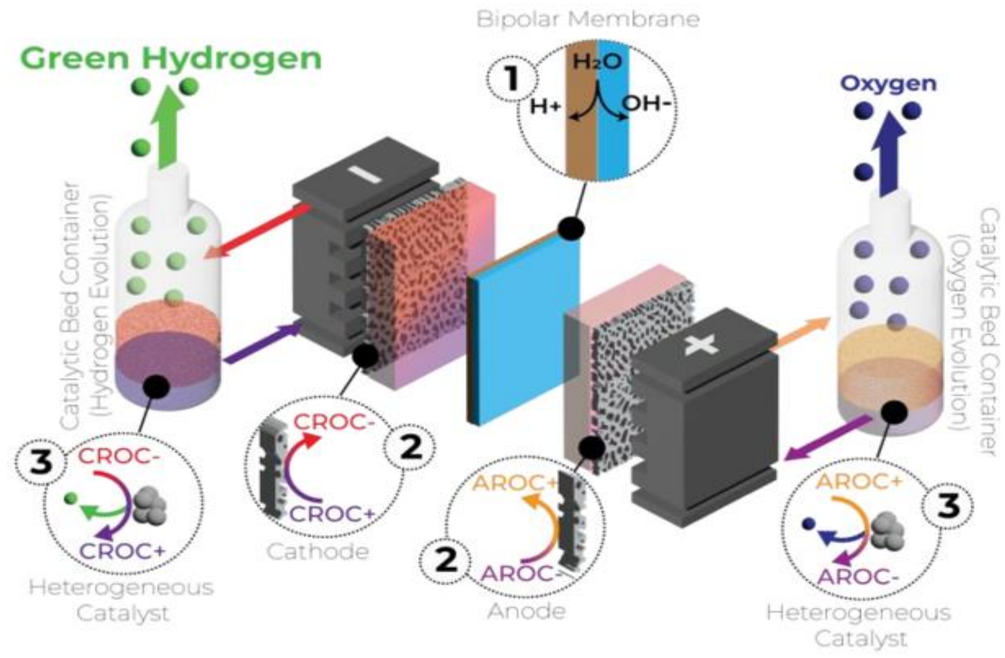
Redox-Mediated economic, critical raw material free, low capex and highly efficient green hydrogen production technology

www.redhy.eu

INTRODUCTION

REDHy is a 4-years project tackling the limitations of contemporary electrolyser technologies by reimagining water electrolysis, allowing it to surpass the drawbacks of state-of-the-art and become a pivotal technology in the hydrogen economy.

REDHy approach will play a crucial role in the upcoming hydrogen economy allowing secure subsequent investments, and showcasing the necessity for ground-breaking, innovative thinking to reach climate objectives in a timely fashion. The REDHy technology presents an alternative pathway for green hydrogen production, employing a series of cutting-edge innovations to create a more economically viable process.



OBJECTIVES

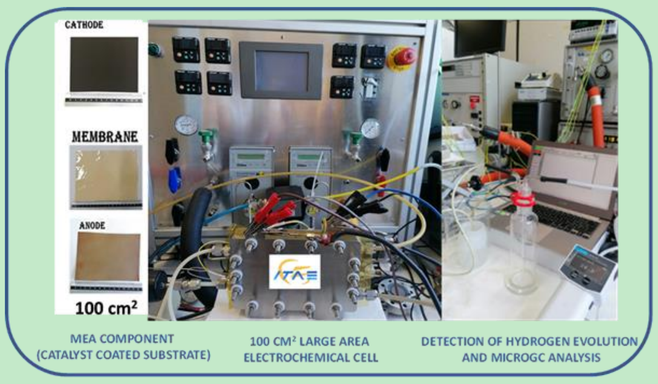
- Develop **highly efficient** and durable **materials free of critical raw** and **fluorine free materials** for the REDHy technology
- Validate the **stack's efficiency** and robustness to address dynamic situations frequently occurring when the electrical grid is fed by a large proportion of **renewable energy sources** or if the system is directly interfaced with RES.
- **Eliminate** the **use** of and the **need** for **critical raw materials** and **fluorinated membranes** and **ionomers** at stack level.
- Demonstrate **optimization** strategies for the **porous electrodes** to enhance their **mass transport characteristics** and enhance **energy efficiency**.
- Demonstrate a **reduced energy consumption** of at least 48 kWh*kg-1 H2 by implementing highly reversible, stable redox mediators with enhanced kinetics
- Demonstrate a drastic reduction in interface resistances across all cell components leading to energy efficiencies >82%.
- Demonstrate the decoupling of oxygen and hydrogen production and enabling the REDHy system to operate at minimum 5% of partial load operation (nominal load 1.5 A/cm2) without exceeding 0.4 % of H2concentration in O2.
- Demonstrate that the REDHy technology is capable to perform efficient and direct seawater electrolysis.
- Integrate the short stack in a prototype full system.
- Demonstrate the operation of the REDHy electrolyser at 1.5 A/cm2 with electricity consumption of 48 kWh*kg-1 over at least 1200 hours of operation with a degradation of 0.1 % /1000 hours.

CONCEPT

The principle of the REDHy technology is presented in the figure above, representing the explosion view of the electrochemical cell and the external catalytic bed reactors decoupling the green hydrogen and oxygen production: 1) Applied potential initiates water dissociation into protons and hydroxide ions traveling to the opposite charged electrodes, 2) at the electrodes cathodic redox couples (CROC) and the anodic redox couple (AROC) are fed and charged by the applied potential, 3) Charged CROC and AROC are transferred to the catalytic bed container reducing the protons to hydrogen and oxidizing the hydroxide to oxygen in contact with the heterogenous catalysts in the catalytic bed.

APPROACH

The developed redox mediators, materials and functional components will be assessed in a prototype consisting of a single cell and external catalytic reactors. This first base-prototype will be produced by extending the single cell electrolysis test rig allowing to make a screening of the components under practical operating conditions and to assess the achievement of relevant project targets at single cell level (TRL3). As presented in the figure.



CONCLUSION:

Free from critical raw materials Cell design without the need for a membrane electrode assembly reducing the interface-resistant values across the cell components, Lower energy consumption at nominal capacity due to enhanced kinetics and lower interface resistance Capable of operating safely and efficiently with intermittent renewable energy sources while simultaneously decoupling hydrogen and oxygen evolution, eliminating the risk of exceeding 0.4% of hydrogen concentration in O2 Capable of long-term operation under current densities up to 1.5 A*cm-2 due to the high cyclability of the redox mediators and no electrochemical degradation of catalysts and electrodes

Clean Hydrogen Partnership

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