MOST-H2

Novel metal organic framework adsorbents for efficient storage of hydrogen

MOST-H2 @H2Most most-h2.eu

Abstract

The EU-funded project MOST-H2 unites 16 partners from Greece, Austria, France, Germany, Italy, Morocco, Spain and the UK, working on a multi-scale, lab-to-tank approach to develop and validate an innovative, low cost cryo-adsorptive hydrogen storage system.

The main focus is on developing monolithic Metal-Organic Framework (MOF) adsorbents with an optimal combination of volumetric and gravimetric H_2 storage capacity and a small environmental footprint; the optimal materials will be combined with a specially designed high pressure cryogenic tank. The outcomes will contribute to establishing hydrogen as widespread energy carrier – a key priority for the EU in becoming climate-neutral.

MOST-H2 Approach

The project's strategy comprises machine-learning assisted MOF synthesis, development and scaling of optimal MOF monoliths, design, construction and testing of a H2 storage tank, techno-economic studies and a cradle-to-grave assessment of the life cycle of the new materials and processes.

Expected Impacts

- Successful and scalable MOF-based system for short-term H_2 storage with superior gravimetric and volumetric capacity performance, well suited for enabling efficient and economic H_2 use in demanding applications
- Enhanced research and production of MOFs in the EU
- Accelerated deployment of competitive hydrogen mobility
- Contribution to strengthening Europe's autonomy in the strategic value chain of hydrogen

MOST-H2 Objectives

New materials

- High performance, sustainable, monolithic MOF-based H_2 adsorbents
- Industrial manufacturing processes for monoltihic MOFs production

H2 storage process

- Cryoadsorption tank design optimised for integrating high-density monolithic MOFs
- MOST-H2 storage system with a capacity of 0.5 kg H_2, operating between 100 bar/80 K and 5 bar/160 K

Application

- Sustainable MOST-H2 storage concept for hydrogen mobility
- Feasibility study for railways
- Road transport scenarios

MOFs structure design and selection of best-performing MOFs

MOST-H2 will focus on specific MOF platforms that have revealed strong potential for efficient H_2 storage. These families are based on low-cost and low-hazard metals and linkers.

Since the number of structural variants is vast, machine learning algorithms will be adapted, trained and used to guide synthesis towards the most promising MOF structures.

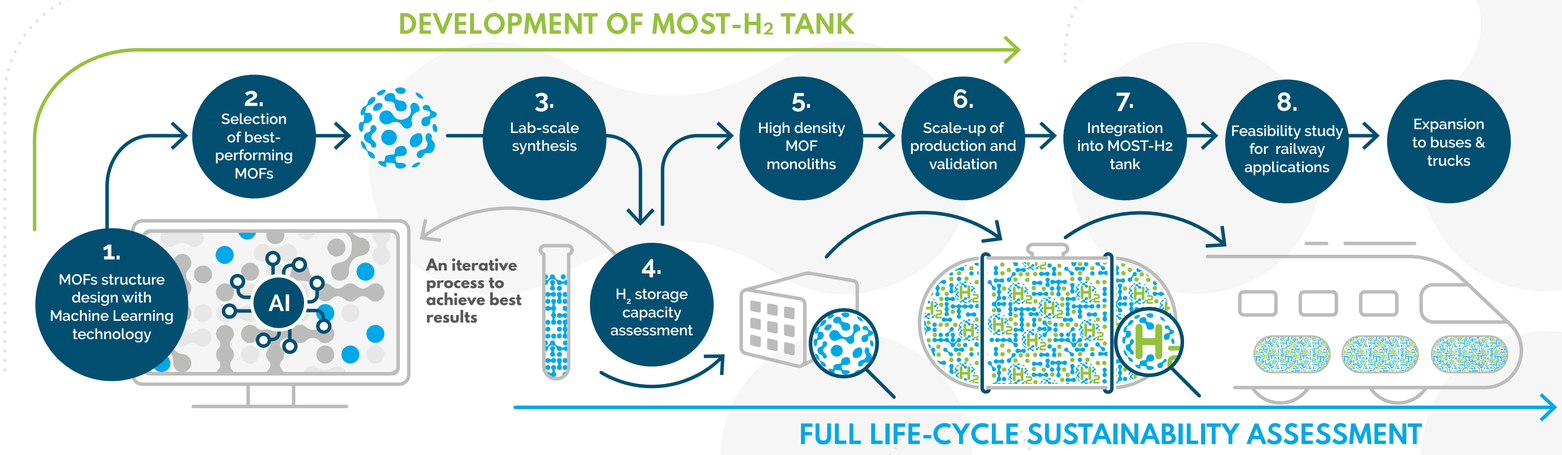
Material characterization and H_2 storage capacity assessment

The lab scale developed materials will be characterized by state-of-the-art methods, while their H_2 adsorption properties will be assessed thoroughly by a broad range of techniques and highly specialized instrumentation.

Feasibility study for railway applications and exploitation strategies

The techno-economic viability and versatility of the MOST-H2 solution will be assessed with main focus on the railway sector (on-board and stationary use).

This will provide a good basis for assessing the potential of the MOST-H2 storage concept in other applications, contributing to further decarbonising the transport system and the definition of potential business cases.



An iterative process to achieve best results

The iterative materials discovery cycle (screening- synthesis-characterization-machine learning training) coupled with Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) analysis will be an integral part of the selection process that will lead to optimal MOF monolithic structures.

High density MOF monoliths

The most promising structures will be formed as high-density monoliths and assessed for their H_2 storage capacity.

Production will be scaled up to meet the volumes required for demonstration (approx. 10 kg of monolithic MOFs).

Integration into MOST-H2 tank

The project will also focus on designing, constructing and testing a cryo-adsorption H_2 storage tank (MOST-tank) filled with monolithic MOFs and able to deliver 500 g of H_2.

Project Partners

- Contribution to accelerated deployment of hydrogen mobility
- Support Europe's autonomy in the strategic value chain of hydrogen

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