Abstract Low²HigH₂

Low pressure reactive distillation to high pressure H_2 from a sustainable LOHC system, full cSBO with a proposed starting date on 1 January 2022 and a proposed duration of 48 months, with partners UAntwerpen, KU Leuven and FAU (Germany).

The main impediment to the commercial deployment of liquid organic hydrogen carriers (LOHC) is the significant heat requirements at high temperature for H_2 release. In Low²HigH₂, Patrice Perreault and Tom Breugelmans from the University of Antwerp (UA), Bert Sels from KUL, and Peter Wasserscheid from Friedrich-Alexander-Universität Erlangen (FAU, Germany) and co-founder of Hydrogenious LOHC Technologies, propose to circumvent this issue by combining a low pressure/low temperature LOHC dehydrogenation step using reactive distillation (RD) combined with electrochemical compression (EHC) for producing pressurized, ultrapure hydrogen in full heat integration with industrial waste heat streams. The proposed new technology promises a step-change in energy efficiency for H_2 delivery using infrastructure-compatible sustainable hydrogen storage systems. The proposed low temperature (below 200 °C) dehydrogenation of a sustainable LOHC system facilitates heat integration with low temperature industrial waste heat sources.

H_2 release from a hetero-atom free, sustainable LOHC is possible at temperatures as low as 200 °C by working at a reduced pressure, here by coupling dehydrogenation at RD conditions to the suction side of an EHC. The reduced pressure shifts the thermodynamic equilibrium towards dehydrogenation, and increases its rate. The EHC produces ultra-pure, compressed H_2, due to its very high selectivity for proton transport. The key achievement of the Low²HigH₂ project is the **design of a 5kW (based on LHV of released H_2) RD dehydrogenation EHC compression unit**. The unit developed in this project will represent the first of its kind on the kW scale. The ground-breaking combination of RD LOHC dehydrogenation and EHC will enable low temperature (< 200 °C) hydrogen release and provision of ultra-pure H_2 at 30 bar at minimal energy requirements, thus making it competitive with state-of-the-art compressed H_2.

For substantive questions about this project proposal, please contact MOT4 representative Jeroen van Walsem (jvanwalsem@catalisti.be; +32 497 731 175).