SherLOHCk Consortium Meeting in Erlangen

The SherLOHCk consortium recently held its fourth meeting in Erlangen, May 22-23. As the project approaches its conclusion, this meeting was crucial for drawing key insights and guiding the remaining tasks.

We extend our sincere thanks to FAU and Hydrogenious, particularly to Andreas Bosmann and Michael Lepper, for organizing these two productive days. The visits to both FAU and Hydrogenious facilities were highly informative, offering valuable perspectives on the project's progress.

Additionally, attendees had the opportunity to experience the Bergkirchweih festival, which not only provided a cultural exchange but also strengthened the social bonds within the consortium. These interactions are vital for fostering a collaborative spirit as we work towards our common goals.

SherLOHCk Project Overview and Key Findings

The SherLOHCk project has been focused on advancing LOHC (Liquid Organic Hydrogen Carriers) technology from a materials perspective to a system approach, aiming for innovative, cost-efficient, and sustainable catalytic solutions. This project is particularly geared towards enhancing energy efficiency in LOHC systems.

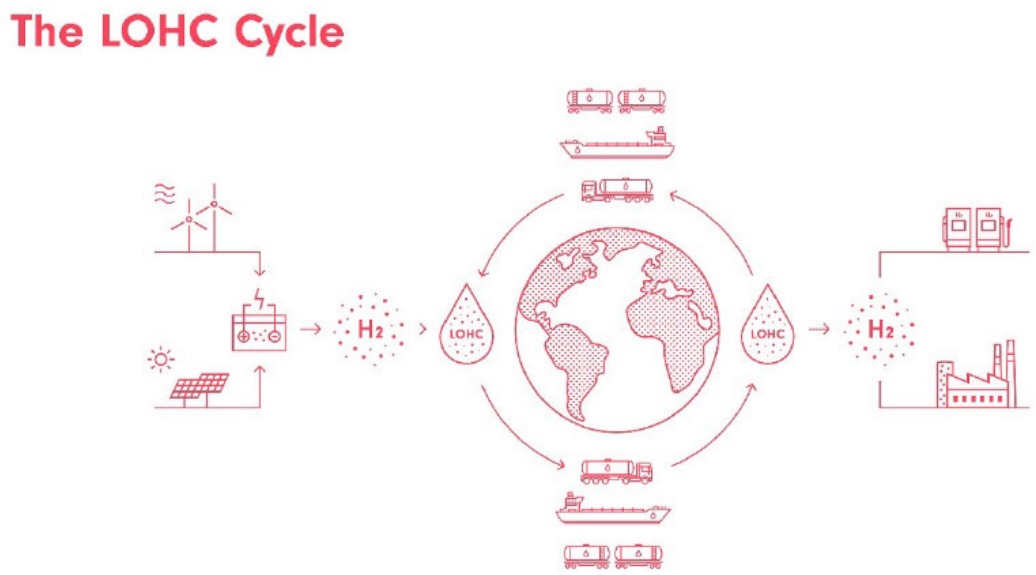
Context and Need: Hydrogen is emerging as a leading energy source in the fight against greenhouse gas emissions, with a significant push towards green hydrogen produced via water electrolysis using renewable energy like solar or wind. However, storing and transporting hydrogen from renewable production sites to application points remains a challenge. Despite hydrogen's high gravimetric energy density, its low volumetric density poses storage and transport issues due to the high pressures and low temperatures required.

Promising Solution: LOHC technology presents a promising solution for safe, high-density hydrogen transport and storage at ambient conditions. It is compatible with existing liquid fuel infrastructure and can significantly impact hydrogen markets by replacing compressed gas transport for both long and short distances. LOHCs support the development of a hydrogen mobility market, especially in remote locations without a gas grid, and are capable of handling the high share of renewable electricity produced by intermittent energy sources like wind and solar.

Advantages vs Drawbacks:

LOHC technology presents significant advantages over traditional hydrogen storage methods. It leverages existing oil infrastructure, reducing both investment and operational costs and facilitating large-scale hydrogen transport. LOHCs enable the safe handling and storage of hydrogen at ambient conditions, enhancing public acceptance and safety due to the non-flammable and non-explosive nature of the carrier compounds. Despite these benefits, challenges such as the energy-intensive dehydrogenation process

and the initial costs of developing new catalysts need to be addressed. Overcoming these hurdles will optimize the efficiency and cost-effectiveness of LOHC systems, further establishing them as a superior option for hydrogen storage and transport.



Source: LOHC-BT Cycle © Hydrogenious LOHC Technologies

The hydrogen molecules are chemically bound to the LOHC via a catalytic reaction in a continuous process. The hydrogenation is an exothermic process generating approx. 10 kWhth/kgH2, heat at approx. 250 °C.	Hydrogen transportation in the LOHC offers easy and cost-efficient logistics utilising the existing infrastructure for fossil fuels via ship, train, truck at ambient temperature. Same applies to the storage facilities.	The hydrogen molecules are chemically released from the LOHC via a catalytic reaction in a continuous process. The hydrogen can be released on demand, assuring hydrogen purity according to ISO-14687.

SherLOHCk Goals and Achievements: SherLOHCk has made significant strides in improving LOHC technology to boost its competitiveness. Key achievements include:

- **Development of Sustainable Catalytic Solutions:** The project has focused on creating cost-effective and environmentally friendly catalysts that enhance the efficiency of both hydrogenation and dehydrogenation processes. Hence, multiple catalyst formulations have been prepared and tested achieving a low Pt content bimetallic catalyst as the most promising ones.
- **System Efficiency Enhancements:** Innovative approaches to reactor design and thermal management have been developed to reduce the overall energy consumption of the LOHC system. Novel catalytic system architecture considering 3D printed structures and internal heating system proved a stable behavior in continuous mode.

On-going activities:

- **Scale-Up Demonstration:** Ongoing activities are focused on scaling up the LOHC technology, with a demo-scale system (>200 h) currently being tested. Initial results are very promising, demonstrating the technology's practical applicability and scalability in continuous mode.
- Life Cycle Assessment (LCA): Comprehensive environmental impact assessments are currently underway. These studies are comparing the LOHC system with other hydrogen storage and transportation methods, such as compressed and liquefied hydrogen. Preliminary findings indicate that LOHC is promising not only from a techno-economic perspective but also environmentally.

Conclusions

By pushing the boundaries of LOHC technology, SherLOHCk is paving the way for more efficient and sustainable hydrogen storage and transport solutions. These advancements are crucial for the future of green energy, addressing both the practical and economic challenges of hydrogen logistics and contributing significantly to the development of a hydrogen-based economy.

The SherLOHCk consortium expresses gratitude to **Clean Hydrogen Partnership** and the European Union for the financial support. Special thanks to all project partners for their dedication and collaborative efforts throughout the project duration.

Publications

Throughout the SherLOHCk project, several significant articles have been published. Below the list of these publications can been found:

1. Alconada, K., & Barrio, L. Evaluation of bimetallic Pt–Co and Pt–Ni catalysts in LOHC dehydrogenation. Int. J. Hydrogen Energy 2024, 51(part D), 243-255. DOI
2. D'Ambra, F., Levy, J., Hajiyev, P., Cantat, T., Gébel, G., Faucheux, V., & Nicolas, E. Evaluation of acetophenone as a novel alcohol-cycloalkane bifunctional liquid organic hydrogen carrier (LOHC). Int. J. Hydrogen Energy 2023, 48(85), 33207-33222. DOI
3. Gemechu, D.N., Mohammed, A.M., Redi, M., Bessarabov, D., Mekonnen, Y.S., & Obodo, K.O. First principles-based approaches for catalytic activity on the dehydrogenation of liquid organic hydrogen carriers: A review. Int. J. Hydrogen Energy 2023, 48(85), 33186-33206. DOI
4. Obodo, K.O., Ouma, C.N.M., & Bessarabov, D. Low-Pt-Based Sn Alloy for the Dehydrogenation of Methylcyclohexane to Toluene: A Density Functional Theory Study. Catalysts 2022, 12(10), 1221. DOI
5. Obodo, K.O., Ouma, C.N.M., & Bessarabov, D. Modified Pt (211) and (311) surfaces towards the dehydrogenation of methylcyclohexane to toluene: A density functional theory study. Applied Surface Science 2022, 584, 152590. DOI

Advisory board Meeting

We are pleased to announce that last June 28 the "Advisory Board Meetingtook place. This crucial meeting explored additional steps towards both research advancements and market readiness. Esteemed companies participating include ARKEMA, AXELERA, ENAGAS & FUKUSHIMA Energy Agency. This gathering provided valuable insights and guidance to propel our project forward.

Coming soon

Upcoming Video Release

We are excited to announce that a comprehensive video summarizing the entire SherLOHCk project will be released soon. Stay tuned to our social media channels, especially LinkedIn, for this upcoming release.

Public Workshop in November

within the frame of the next EU Hydrogen Week (euhydrogenweek.eu) that will take place next November 2024 in Brussels, we will organize a public workshop. It will give the consortium a chance to share and talk about the key results of the SHERLOHCK project with a diverse audience, including academics, industry professionals, the Clean Hydrogen partnership, and members of the European Commission.Stay tuned to our social media channels, especially LinkedIn, to get the last updates about the workshop.
