

Tandem Fischer-Tropsch Synthesis and Reductive Hydroformylation under Mild Conditions for Optimized Higher Oxygenate E-Fuels

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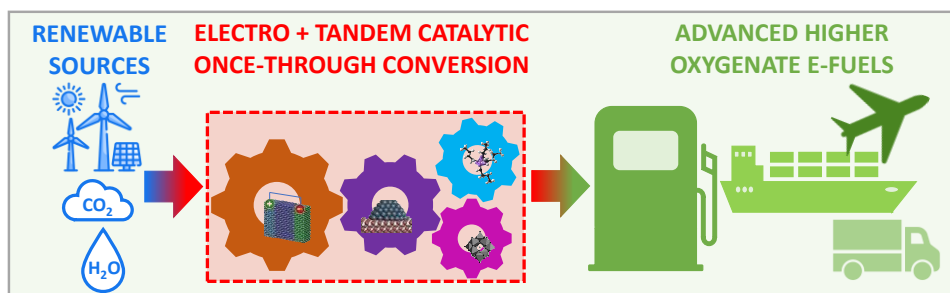
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Abstract

The EU project E-TANDEM aims to unlock an efficient and direct production of a new higher-oxygenate diesel-like e-fuel for the marine and heavy-duty transport sector in a once-through hybrid catalytic conversion process^[1]. Using renewable electricity and resources, the production of e-fuels offers a CO₂-neutral option for the energy-intensive transport sector^[2]. The process combines syngas production via co-electrolysis using CO₂ and water with a tandem catalytic e-syngas conversion coupling the Fischer-Tropsch reaction and the reductive hydroformylation reaction to produce long-chain alcohols. These alcohols can be used directly as fuel or further processed into ethers^[3]. The concept of the E-TANDEM project is shown in the figure below.



While the heterogeneous catalyzed Fischer–Tropsch and the homogeneous catalyzed hydroformylation were already successfully integrated in a tandem reaction, both the scale and the reaction conditions are not feasible for technical implementation yet. Therefore, our research is focused on operating a continuous miniplant to demonstrate the aimed reaction and the downstream processes including product separation and catalyst recycling on a larger scale. Catalyst engineering and optimization of the reaction conditions are crucial approaches to address challenges related to the technical feasibility of high pressures and undesired side product formation. This supports the potential for a synergistic collaboration between homogeneous and heterogeneous metal catalysts, ensuring efficient and selective tandem reactions.

Literature:

[1] A. Ramirez, M. Sarathy, J. Gascon, Trends in Chemistry, 2020.

[2] E-Tandem Website, <https://e-tandem.eu/>, 2025.

[3] K. Jeske, T. Rösler+, M. Belleflamme, T. Rodenas, N. Fischer, M. Claeys, W. Leitner, A.J. Vorholt, G. Prieto, Angew. Chem. Int. Ed. 2022, 61.