ALCHEMHY

ALTERNATIVE ROUTES FOR BASIC CHEMICALS PRODUCTION USING HYDROGEN AS FEEDSTOCK

Project progress – D3.6 Catalysts advancements for methanol synthesis (Final)

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The previous deliverable D3.1 “Catalyst advancement for methanol synthesis” reported the progress made towards catalyst development for methanol synthesis from carbon dioxide (CO2) and hydrogen (H2) for the two innovative technologies being developed within ALCHEMHY, the Small Flexible Methanol Reactor (SFMR) and Plasma Catalytic Hydrogenation (PCH). This deliverable D3.6 “Catalyst advancements for methanol synthesis_final” marks the completion of one of the Project tasks, compiling the key outcomes of catalyst development for both technologies.

For the SFMR technology, the project has successfully advanced the scale-up of a CuZn/C catalyst. The first batch was produced using pulse combustion synthesis, an innovative method that enables efficient and controlled material preparation. After synthesis, the catalyst underwent thorough treatment and characterization to better understand its properties. Its performance was tested in the conversion of CO_2 and H_2 into methanol in a lab-scale reactor. This deliverable brings together the key findings, including the scale-up approach, the catalyst’s physicochemical properties and the results of its catalytic performance.

For the PCH technology, a range of copper-based catalysts supported on different inorganic materials have been prepared. These supports include alumina (Al_2O_3), structured ZSM-5 zeolite, and MCM-41 mesoporous silica, each offering distinct properties that can influence catalyst performance. A conventional CuZnAl catalyst was prepared to serve as a benchmark for comparison. After being characterized to understand their structural and chemical features, the catalysts were tested in plasma-assisted CO_2 hydrogenation. This deliverable presents the full set of results, covering how the catalysts were prepared, their key properties and catalytic performance under plasma-assisted reaction conditions.

Overall, this deliverable offers a clear and comprehensive overview of how different catalysts can be prepared and how they perform across the two methanol production routes being explored. In the case of PCH, the findings provide an essential foundation for future project decisions, shedding light on its technical feasibility and its potential for scaling up to larger applications.

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