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SLP-catalysed gas-phase hydroformylation of 1-butylene in a continuously operated membrane reactor

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1. Introduction

Alkene hydroformylation is the only homogeneously catalysed large volume process. With over 10 million chemical products relying on the produced aldehydes as an intermediate a steady improvement is of interest for chemical companies worldwide [1].

2. Methods

The EU funded project ROMEO (Reactor Optimization by Membrane Enhanced Operation), which ended in September 2019 aimed for a fusion of homoegeneous catalysis and on-stream separation in one reactor [2, 3]. Here we present the last results with a focus on the experimental investigation of the developed reaction/separation system. The new "2-in-1" reactor that is shown in Figure 1 can reduce the required size and energy of the separation unit and thereby increasing the efficiency of the concept.

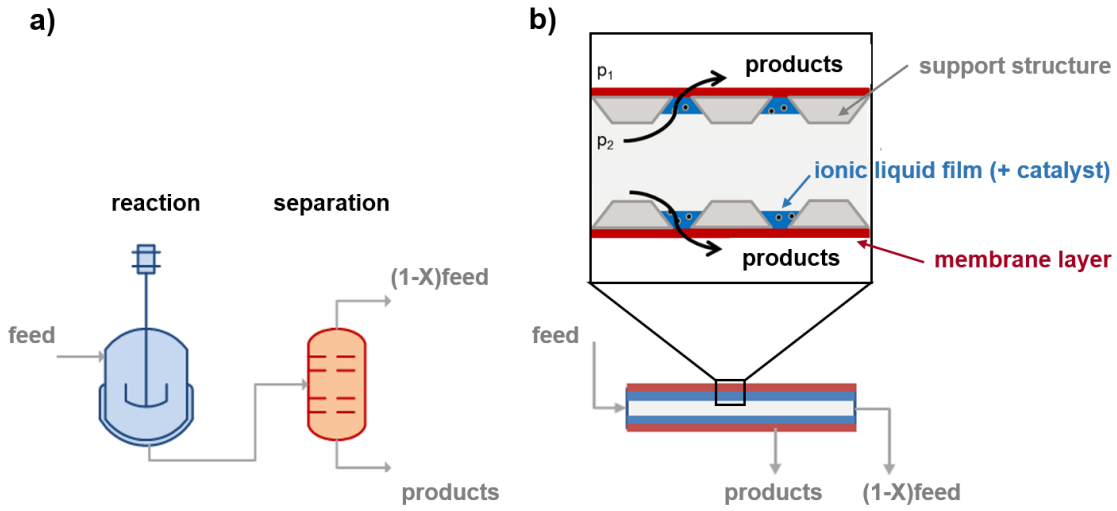

Figure 1. Schematic representation of the ROMEO approach for reaction and separation of homogeneously catalysed reactions.

3. Results and discussion

As shown in Figure 2, high activity is achieved in the 2-in-1 reactor with excellent stereoselectivity of over 95 %, high n-pentanal selectivity of and low by-product formation.

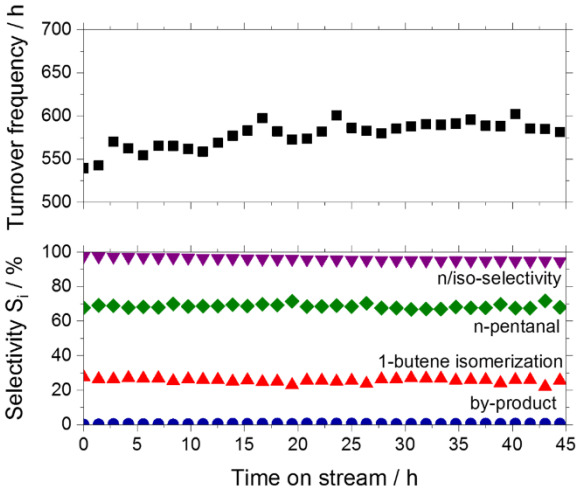

Figure 2. Catalytic activity and selectivity of the hydroformylation of 1-butylene using Rh-bpp in a continuously operated membrane reactor

When comparing the flowrates of the main substrate (1-butylene) and the desired product (*n*-pentanal) in the retentate and the permeate stream, an enrichment of *n*-pentanal of 2 was achieved.

4. Conclusions

Within the project we achieved to build a catalytically selective and active, stable reactor that also delivers an enrichment of the desired product n-pentanal compared to 1-butylene in the permeate compared to the retentate stream.

Acknowledgement

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References

[1] Robert Franke, Detlef Selent, Armin Börner. „Applied Hydroformylation“ in Chem. Rev., 2012, 112 5675-5732, DOI: 10.1021/cr3001803

[2] http://www.romeo-h2020.eu/, (last visited October 10th 2019).

[3] Jakob Marinkovic, Anders Riisager, Robert Franke, Peter Wasserscheid, Marco Haumann. „Fifteen Years of Supported Ionic Liquid Phase-Catalyzed Hydroformylation: Material and Process Developments” in Ind. Eng. Chem. Res., to be published, DOI: 10.1021/acs.iecr.8b04010