

ABSTRACT

The Full Hydrogen Conversion with Membrane Controlled Ethylene Hydrogenation

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Despite being exothermic reactions, which are often efficiently catalyzed by catalysts, complete conversion of the corresponding reactants is seldom achieved in continuous flow reactors. This is particularly relevant for hydrogenation reactions for chemical energy storage, where the overall efficiency is highly de-pendent on the conversion of the reactants. A common response to this challenge is to develop better catalysts [1]. In this talk, I will instead introduce the concept of membrane reactors for highly efficient conversion [2]. Using the ethylene hydrogenation reaction [3], we demonstrate the nearly 100% conversion of hydrogen when supplied by a hydrogen-selective membrane. Conversion, hydrogen efficiency, and turnover frequency are measured as a function of temperature, feed hydrogen pressure, and space velocity. The results demonstrate that hydrogen coverage controlled by permeation through a membrane [4] controls the hydrogenation of ethylene, which can be used to optimize hydrogen conversion. Prospects for novel economical membranes for less straightforward hydrogenation reactions are discussed.

- [1] J. K. Nørskov, T. Bligaard, J. Rossmeisl and C. H. Christensen, Nature Chemistry 1, 37 (2009)
- [2] J. Shu, B. P. A. Grandjean, A. V. Neste, S. Kaliaguine, S. The Canadian Journal of Chemical Engineering, 69, 1036 (1991)
- [3] H. Molero, D. Stacchiola, W. Tysoe, Catal. Lett. 101, 145 (2005)
- [4] T. L. Ward, T. Dao, Journal of Membrane Science, 153, 211 (1999)