Investigating Phase Behaviour in Multiphase Catalysis

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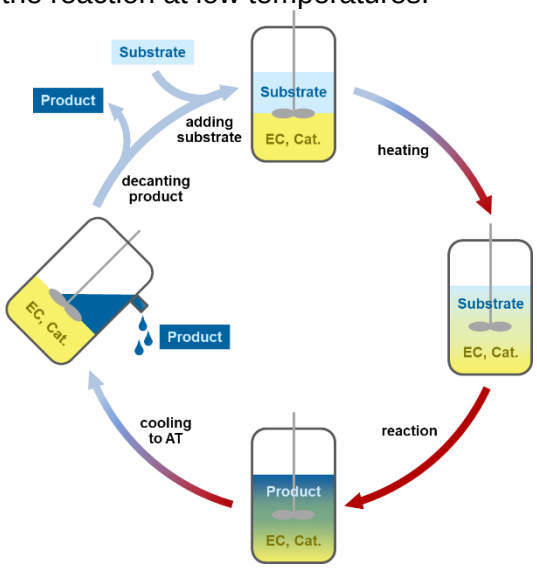
Abstract

The hydroformylation reaction is one of the most important and most used homogeneously catalysed processes.[1] Olefins react to aldehydes using transition metal complexes such as rhodium/phosphines. The recycling of such catalysts and their removal from the product are a focus in research and industry.[2] A method to achieve this is through multiphase catalysis. While short-chain olefins can be converted in the water-based Rhône-Poulenc Process, long-chain olefins require less polar solvents such as glycols and carbonates.[3] However, it is important to investigate the phase behaviour of a reaction system in detail when developing a multiphase reaction system. Depending on the components used, a thermomorphic multicomponent systems (TMS) may form. In these systems, the solvents are miscible at increased temperatures and turn biphasic again after the reaction at low temperatures.[4]

Herein, we present two Rh/sulfoXantphos catalysed hydroformylation reaction systems with a complex phase behaviour during the reaction. An ethylene carbonate-based system was developed using a crystallisation of the entire catalyst phase for catalyst recycling. [5] Ethylene carbonate and the reaction product nonanal formed a reaction induced TMS system which caused a precipitation of the catalyst. Modifications have been investigated to avoid this effect and remain in the biphasic regime.[6]

Another investigated system is the hydroformylation Aldol condensation tandem reaction with a NaOH as an Aldol condensation catalyst and PEG-200 as a polar solvent. The phase behaviour in this system changes during the course of the reaction due to the different polarity of the various components.[3]



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