Homogeneously Catalyzed Transfer Hydrogenation in Microfluidic Flow Reactor

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Nowadays, microreactor technology is both highly advanced and safe technology offering an accurate control of reaction conditions. High heat, mass, and momentum transfer are ensured by the high active surface to reaction volume ratio. These necessary characteristics are absolutely required by pharmaceutical and fine-chemical industries. The benefits of microreactor technology seem to be profitable for the homogeneously catalysed asymmetric transfer hydrogenations of functionalized β-keto esters. And so we focused our attention to this challenge. As the model reaction the homogeneously catalysed transfer hydrogenation of methyl acetoacetate to methyl hydroxybutyrate was selected. In transfer hydrogenation, the organic molecules (e. g. 2-propanol) are used as the hydrogen donors in the presence of a transition-metal catalyst such as Ru-BINAP complexes as one of the most active and selective catalytic structures.

The application of accurately controlled microreactors to highly sensitive reaction will provide tailored reaction conditions resulting in better process performance, improved utilization of the homogeneous catalyst and increased selectivity.

For the purpose of model reaction, the glass microcapillary reactor was selected. First of all, the microreactor system had to be designed and fully optimized. The microreactor system contains the microfluidic chip that serves as an ideal mixing unit with the integrated staggered oriented ridge mixing elements. The chip is connected to the microcapillary wrapped on the heating cartridge extending the reaction zone of the microreactor system. The whole assembly is closed into the glove-box with nitrogen atmosphere for the prevention of the catalyst contamination due to the sensitivity of Ru-BINAP to oxygen, CO_2 and moisture. For chemical analysis the GC was calibrated and the analytical method established.

Experimental microreactor system is ready for the optimization of the reaction conditions for the model reaction with racemic Ru-BINAP catalyst.

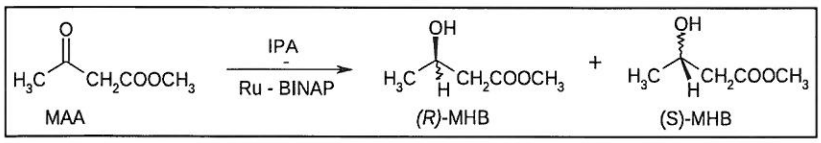

Fig. 1: Simple reaction schema