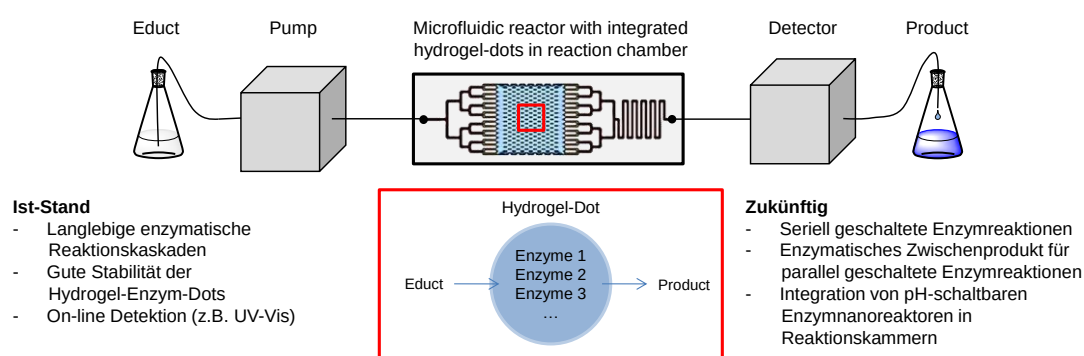


A6: Establishment of enzymatic cascade reactions with hydrogels in microfluidic processes

B. Voit (TUD, IPF) and D. Appelhans (IPF) in collaboration with A. Richter (IHM) and M. Günther (IFE)

Motivation

The use of microchannels allows for simultaneous and sequential enzyme reactions. The reversible, but also chemical conjugation of enzymes with hydrogel and their integration in microchannels as patterning materials give the chance to establish enzymatic cascade reaction in the field of miniaturization. Leibniz-Institut für Polymerforschung Dresden e.V., working together with the Institut für Halbleiter- und Mikrosystemtechnik (IHM) and Institut für Festkörperelektronik (IFE), will develop controllable hydrogel-based microfluidic processors. For that purpose hydrogels with and without enzymatic nanoreactors will be used for selective and reversible, but also permanent functionalization of enzymes and the adaption of pH-switchable enzymatic nanoreactors is used to manipulate enzymatic reactions.



State of the art and preliminary work

Microfluidic processes in reaction channels and cavities for optical, (electro-)chemical and enzymatic conversions are well known since several years. Contrary, simultaneously and sequentially switched continuous and stationary microfluidic processes as well multienzymatic conversions at defined surfaces play a minor role. First simple microfluidic processes with hydrogels are known for enzymatic conversions. Previous work focused on the fabrication of microfluidic devices consisting of one-, two- and three reaction chambers on one substrates [1, 2, unpublished work]. With two-/three-reaction chambers first sequential and parallel multienzymatic reactions were also established. The concept of enzymatic nanoreactors has been developed for different applications [3, 4].

Scientific goal and project aims

The aim of the project is to realize simultaneously and sequentially switched enzymatic cascade reactions using multifunctional hydrogels to integrate pH-switchable or steadily permeable enzymatic nanoreactors. The successful conversion will be proven by optical/chemical/piezoelectrical principals. Different combinations of functionalization of structured hydrogels/polymersomes hydride structures for enzymatic cascade reactions will be realized. Final concerns are directed to integrate additional injection channels and valves for the orchestration of differently organized reaction chambers under continuous flow. Enzymatic model reactions (hydrolysis of ester, degradation of proteins, amidation of acid groups etc.) will be integrated in fluidic microprocessors.

Literature

- [1] D. Simon *et al. React. Chem. & Eng.* **2018**, DOI 10.1039/C8RE00180D.
- [2] F. Obst *et al. React. Chem. & Eng.* **2019**, submitted.
- [3] J. Gaitzsch *et al. Angew. Chem. Int. Ed.* **2012**, 51, 4448.
- [4] X. Liu *et al. Angew. Chem. Int. Ed.* **2017**, 56, 16233.