Institut für Chemieingenieurwesen
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Bachelor/Masterthesis, Research Internship:

Heterogeneous Photocatalytic Water Oxidation at Polymeric Membranes under Flow Conditions

Scope of the Project:

Due to a significant increase in world population and living standards the global energy consumption is growing rapidly. About 90 % of the global energy demands are supplied by fossil fuels. This leads to increasing emissions of greenhouse gases and the depletion of carbon-based resources that could be used otherwise to produce valuable chemicals. Alternative energy sources as wind, geothermal, and solar power are relatively clean and sustainable in comparison to fossil fuels, but each of them has their limitations. The combination of solar energy and large water resources provides a platform for hydrogen generation through water splitting.[1] Hydrogen can be used for combustion and energy storage similar to fossil fuels. Water splitting can be divided into two reactions, water reduction and water oxidation. An example for a hydrolytical and oxidative stable and efficient catalyst for water oxidation is the abundant-metal-based polyoxometalate (POM) complex $[Co_4(H_2O)_2(PW_9O_{34})_2]^{10-}$.[2] While catalysis in solution is aleady established, immobilization of such a catalyst is challenging. One possibility to immobilize such POMs is to attach this negatively charged photocatalyst to a positively charged porous polymeric membrane. Such so called Pombranes can be used to investigate water oxidation catalysis (WOC) under flow conditions. Since the reaction environment of the heterogeneous Pombrane system is vastly different from the homogeneous system, reaction parameters such as flow rate, pressure drop over the membrane and the irradiation of the membrane become critical for a high catalytic performance. Therefore, the identification and control of those parameters becomes necessary for WOC under flow conditions.

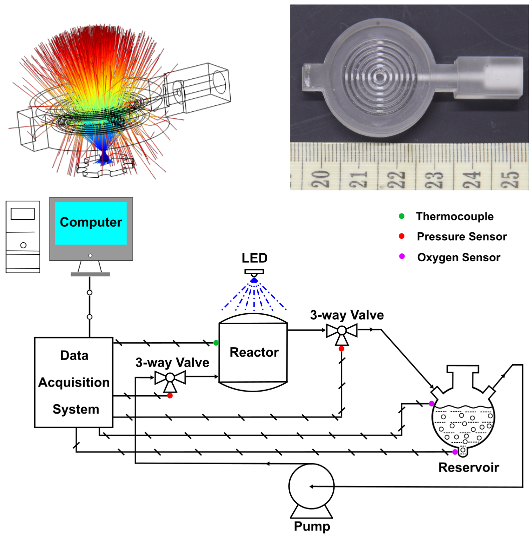

Abbildung 1: ***(Top left)*** *Raytracing of reactor distributor,* ***(top right)*** *3D-prited reactor distributor and* ***(bottom)*** *process scheme of the used setup.*

Current scientific work and possible working packages: Parameters that might be critical for the catalytical performance, such as pressure drop, flow rate, light intensity, direct or diffuse irradiation, should be checkt for their influence. The used experimental setup will be characterized photonically using radiometry, actinometry and raytracing. Different reactor materials and manufacturing mehtods should be testet and the reactor geometry should be optimized using rapid prototyping.

Source:

[1] Molecules, 2016, 21, 900
[2] J.Am.Chem.Soc., 2011, 133, 2068-2071

If interested please contact:

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