Institut für Chemieingenieurwesen
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Bachelor/Masterthesis, Research Internship:

Investigation of photocatalytic reactions in a flowthrough reactor using a dynamic process control and hydrodynamic installations

Scope of the Project:

In recent years, heterogeneous photocatalytic reactions gained more and more attention in the scientific community. Usually, these reactions are applied in organic synthesis on lab and industrial scale by using semiconductors such as TiO_2 as photocatalyst. For chemists and engineers this special reaction type raises some new challenges to the reactor design. Compared to homogeneous systems not two but three components (substrate, photon and catalyst) have to be brought into contact. This means that a high suspension quality as well as a high adaption to the light source characteristics is mandatory in order to reach high conversions or selectivities.

The QuinoLight project is a cooperative work between the group Ziegenbalg, the research institute of the DECHEMA and the group Marschall from Bayreuth University. Utilizing the photocatalytic synthesis of quinoline, the project's objective is the development and optimization of reactors for photocatalytic systems by application of 3D-printing.

Current scientific work and possible working packages:

Photocatalytic reactions are fascinating systems with complex kinetics. Nevertheless, an engineer's aim is to find options and parameters to control and optimize the conduction of such reactions. A crucial parameter for homogeneous and heterogeneous photoreactions is the irradiation condition. Especially application of a dynamic irradiation seems to open new opportunities for process intensification, which makes it attractive for researchers.

In the flowthrough reactor setup, shown in the figures below, a dynamic irradiation can be realized by two ways: Firtstly, by simply pulsing the light source, which is typically an UV-LED, or secondly, by hydrodynamic installations such as static mixers if irradiation is kept constant. In recent studies at the ICIW, such installations were designed and manufactured utilizing 3D-laserprinting. Application in the conduction of the photocatalytic quinoline synthesis revealed interesting results. Not only the reaction rate was enhanced, but also selectivities and product spectra changed. To elucidate this further, additional experimental evaluations are necessary. More mixer geometries, for example propeller shaped designs, need to be tested. Furthermore, as a reference, conduction of the photocatalytic quinoline synthesis using a pulsed light source needs to be done.

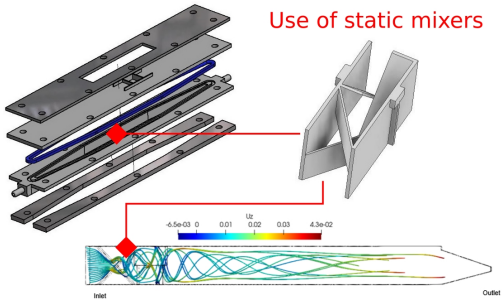

Figure 1: *Static-mixer-installation in the flowthrough-reactor.*

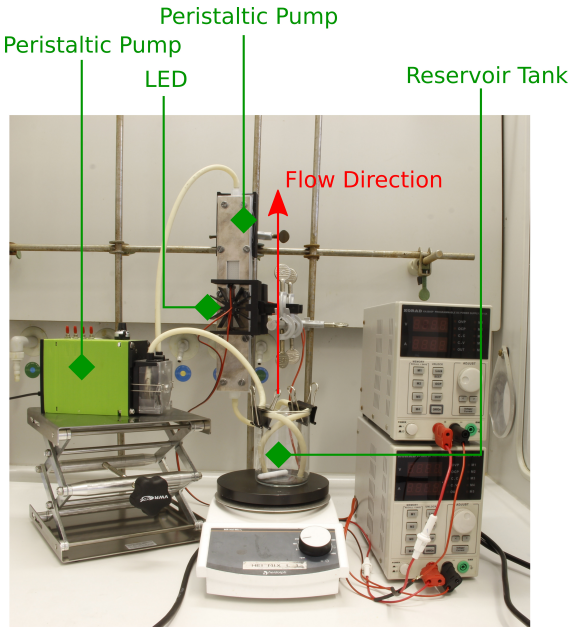

Figure 2: *Experimental setup of the 3D-printed photo-flowthrough reactor.*

If interested please contact:

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