Institute for Micro Process Engineering



Master Thesis

for

Immobilisierung von Photokatalysatoren in Mikrokanälen für eine nachhaltige H₂O₂-Produktion Immobilization of Photocatalysts in Microchannels for Sustainable H₂O₂ Production

Motivation

Hydrogen peroxide (H_2O_2) is an essential and environmentally friendly oxidant with broad applications in the chemical industry, healthcare, energy, and environmental sectors. However, conventional H_2O_2 production via the anthraquinone oxidation process is energy-intensive and generates harmful organic waste, making it neither cost-effective nor sustainable.

Photocatalytic H_2O_2 production offers a green and sustainable alternative, utilizing only water, gaseous oxygen, and sunlight as an energy source. This approach eliminates hazardous waste, enhances safety, and provides a more economical and environmentally friendly solution for H_2O_2 synthesis. However, practical implementation faces challenges, including inefficient light utilization, poor mass transfer, and catalyst deactivation.

To address these limitations, microflow technology presents a promising solution. By confining reactions within microchannels, microreactors improve light penetration, enhance mass transfer efficiency, and maximize catalyst utilization. These advantages enable higher reaction rates, reduced byproduct formation, and continuous, scalable H₂O₂ production.

Building on previous research at the Institute for Micro Process Engineering (IMVT), this project aims to develop an optimized method for photocatalyst immobilization in microchannels. The focus will be on advanced deposition techniques such as inkjet printing and spray coating to create stable and highly active photocatalytic layers. The performance of these immobilized catalysts will be systematically evaluated for efficient H_2O_2 production under continuous microflow conditions.



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Task Description

The student will conduct a literature review, optimize photocatalyst immobilization methods in microchannels, and develop structured photocatalytic layers. The student will set up and perform photo-flow experiments for H_2O_2 production, analyzing catalyst performance under different conditions. The student will also handle data analysis and present findings at project milestones.

Research Objectives

- Conduct a literature review on coating technologies and photocatalytic H₂O₂ synthesis.
- Investigate and optimize photocatalyst immobilization techniques (inkjet printing, spray coating, etc.).
- Develop and characterize structured photocatalytic layers in microchannels.
- Set up and perform photo-flow experiments for H₂O₂ production
- Presentation and discussion of the results during an interim presentation to the working group and in a seminar lecture at IMVT.

Basic Conditions

Start Date: as soon as possible Submission Date: 21.03.2025 Supervising Professor: Prof. Dr.-Ing. Roland Dittmeyer Supervisor: Dr. Jinju Zhang

Prof. Dr.-Ing Roland Dittmeyer