Sustainable Process Engineering
Micro Flow Chemistry & Synthetic Methodology

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Application of Metal Oxide Semiconductors in Photocatalysis

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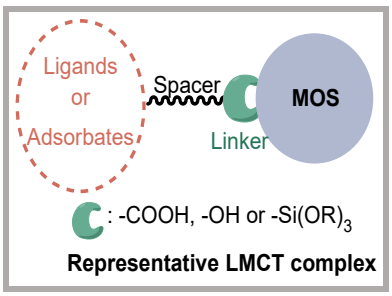
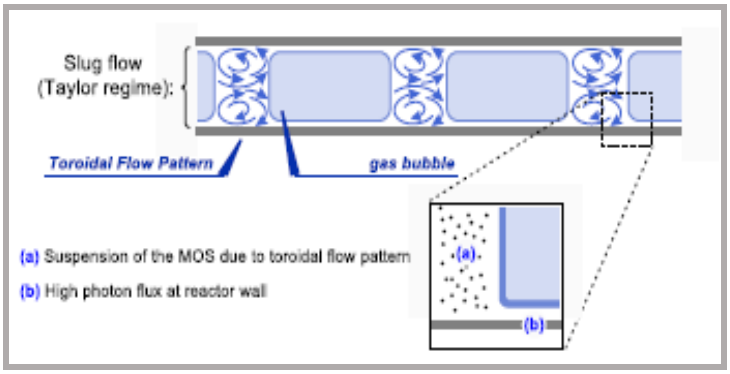
Introduction

Metal oxide semiconductors (MOS) present ability to form both oxidizing and reducing species under appropriate irradiation, being a promising alternative for the use of expensive and toxic transition metal-based complexes to promote important organic reactions. However, their band gaps present low spectral response in the visible light region limiting their application. This drawback can be overcome by doping the surface of the catalyst. Ligand-to-metal charge transfer (LMCT) sensitization is one of the methods available for expanding the spectral response of wide bad gap semiconductors.

Project summary

The first part of the project mainly focusses on the preparation of stable LMCT complexes, using as ligands common colorless organic molecules with a variety of wide band gap MOS. The efficiency of the LMCT complexes as photocatalysts will be evaluated by testing their visible light catalytic activity toward valuable organic reactions involving the formation of C-C and C-N (or F) bonds.





The second focus is on the application of these photocatalysts to relevant processes in flow. For this purpose, and due to the solid nature of the LMCT complexes, slurry Taylor flow regimes will be used in a photomicroreactor. Taylor flow is a type of a gas-liquid flow pattern that consists of elongated bubbles separated by liquid slugs. The solid photocatalyst is suspended in a liquid bubble and it is transported through the photomicroreactor. This avoids blockage of the channels.

Project goals

The main goal of the project is to study the formation of LMCT complexes between common adsorbates and MOS and explore its application as low cost and eco-friendly visible light photocatalysts in organic reactions carried out in batch and flow, as well as to understand the mechanisms involved in these photocatalytic systems.

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