Institut für Chemieingenieurwesen
Prof. Dr. Dirk Ziegenbalg

ulm university universität ulm

Bachelor/Master Thesis, Research Internship (**Chem. Eng.**):

Influence of operating conditions on mass transfer rate in soft matter immobilized photocatalytic water splitting process

Research background:

The rapid rise of energy consumption and world population urges us to explore more energy sources to meet the upcoming high energy demand. Among all available energy sources, fossil fuel will continue to be the main energy form for quite a while. However, according to the 2014 petroleum consumption rate, crude oil reserves as of 2015 will last only about 50 more years [1]. Meanwhile, concerns about using fossil fuels with regards to energy security, effects of fossil fuel emissions on the environment, and sustained, long-term high oil prices worldwide support expanded use of non-fossil renewable energy sources. In contrast, hydrogen as energy source has the following advantages [2]: 1) hydrogen can be obtained from various sustainable sources, such as biomass and water; 2) energy yield from hydrogen is high (0.26 kg of hydrogen gas is as good as 1 liter of gasoline [3]); 3) hydrogen as energy source is environmentally friendly and has high storage capacity.

Although hydrogen has been considered as a promising alternative energy source, the production of hydrogen mostly relies on fossil fuels. In order to get hydrogen from renewable sources, researchers turn to solar energy. At the current renewable energy development, solar energy is mostly used to produce electricity. However, electricity cannot be stored at any scale, which leads to wasting harvested solar energy, especially in hot season. Hence, there is a high demand for other efficient ways to use the redundant solar energy. Photosynthesis is one of the good examples for the natural way of storage and harnessing of solar energy. With this inspiration, photocatalytic water splitting has been growing to be a topic of significant research world-wide in recent years. Figure 1 gives a photocatalytic water splitting scheme.

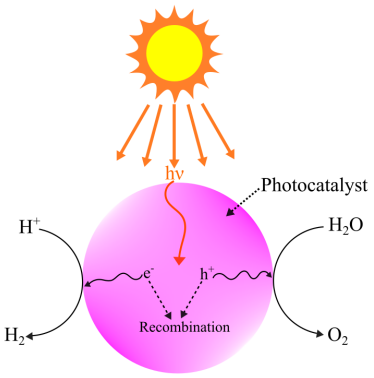

Figure 1: *Schematic representation of photocatalytic water splitting.*

Current work and possible working packages:

In order to elucidate the influence of reaction engineering parameters, in this study, soft matter immobilized photocatalysts are experimentally studied with respect to the interaction with the mass transport phenomena in photocatalytic water splitting process. There are many parameters which influence mass transfer rate during the photocatalytic reaction, such as water input flow rate, irradiation rate, photocatalyst load amount, etc. [4]. To study the influence of these parameters on mass transfer rate, different operating conditions will be experimentally investigated and the results will be compared to have a better and clearer understanding of mass transport phenomenon.

References

[1] Energy Information Administration, **2015**, https://www.eia.gov/.

[2] T. Jafari, E. Moharreri, A.S. Amin, R. Miao, W. Song and S.L. Suib, *Molecules* **2016**, 21(7), 900.

[3] J. Rostrup-Nielsen and L.J. Christianse, *Catalytic Science Series* **2011**, 10, ISBN-13 978-1-84816-567-0.

[4] F. Guba, Ü. Tastan, K. Gugeler, M. Buntrock, T. Rommel and D. Ziegenbalg, *Chem. Ing. Tech.* **2019**, 91(1-2), 17-29.

If interested please contact:

Prof. Dr. Dirk Ziegenbalg or Pengcheng Li

Office: 662 (O25)
E-Mail: pengcheng.li@uni-ulm.de
Telephone: 0731/50-25710

as of September 4, 2020