Thienothiophene based Conjugated Porous Organic Polymers for Photocatalytic Water Splitting

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In today's world, pollution is unfortunately everywhere, including air, water and soil. Burning fossil fuels makes up the biggest part of the air pollution. Besides emitting potentially unhealthy chemicals into the atmosphere, excessive use of fossil fuels also creates other environmental problems such as increased greenhouse effect, ocean acidification or acid rains. Energy production is responsible for the generation of a large amount of greenhouse gases. Therefore, in order to remediate to this global problem, energy should be produced in a clean and sustainable way. This can be achieved by transforming solar energy directly into chemical energy through visible-light-driven photocatalysis generating hydrogen out of water. Materials used for photocatalytic water splitting need to exhibit an efficient charge separation and migration as well as an appropriate band gap alignment.

This Master thesis focuses on the development of such materials towards photocatalytic water splitting. Porous organic polymers have intrinsic properties that give them high potential to be used as heterogeneous photocatalysts. They can be synthesized through diverse synthetic pathways and present high inherent porosity, rigid conjugated skeletons, high stability and tunability. By incorporating a donor-acceptor system into the framework, the electron-hole separation is favoured, leading to an enhanced hydrogen production efficiency. *Lee et al.*[1] reported the energy band gap engineering of conjugated microporous polymers by controlling the in-situ cyclization through the strength of the acid catalysts. The aim of this Master thesis was to investigate the effects induced by an electron-donating sulfur-containing thieno[3,2-*b*]thiophene linker on a similar construct, in which the photocatalytic activity can be tuned based on the degree of in-situ cyclization. The linker was shown to have a profound impact on the porosity as well as the catalytic activity of the resulting polymer. In this thesis, the impact of the light absorption range, the band gap and the porosity of thieno[3,2-*b*]thiophene based porous organic polymers have been investigated on the photocatalytic water splitting.

[1] Lee, J.; Buyukcakir, O.; Kwon, T.; Coskun, A. Energy Band-Gap Engineering of Conjugated Microporous Polymers via Acidity-Dependent in Situ Cyclization. *J. Am. Chem. Soc.* **2018**, *140* (35), 10937–10940. https://doi.org/10.1021/jacs.8b05978.

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