

Photocatalytic alcohol oxidation followed by ATR-IR spectroscopy and online mass spectrometry

The selective oxidation of hydrocarbons offers convenient synthetic routes for specialty chemicals, but also for widely used basic chemicals such as alcohols, aldehydes, ketones, epoxides or organic acids. Currently, the oxidation of alcohols is performed by metal oxides, which are hardly recyclable, or by organic oxidizing agents, which produce byproducts that are toxic or must be recycled.[1] A new approach is the use of air or pure O₂ in combination with a heterogeneous catalyst, which offers an environmentally friendly and also cost-efficient alternative to the established processes.[1] However, the use of air or O₂ has also disadvantages, as it often leads to total oxidation. To tune the selectivity, several materials like Au/TiO₂ or Au/SiO₂ have been largely investigated for gas-phase processes.

However, as industrial scaled alcohol oxidation processes are usually performed in the liquid phase, the knowledge gained from the gas phase needs to be transferred to the liquid phase. While this process has already been started, especially supported by autoclave batch experiments, detailed knowledge about the reaction mechanism is not gained yet and deeper understanding is missing.[2]

Two powerful techniques to study liquid-phase oxidation reactions are ATR-IR spectroscopy and membrane supported online mass-spectrometry. These techniques allow a qualitative and quantitative analysis of the reaction system. However, as solvents strongly influence the corresponding IR data, reference systems are required to create models that will help to understand liquid-phase phenomena.

In this module such a reference system for alcohol oxidation will be investigated by using ATR-IR spectroscopy and online mass-spectrometry.

[1] M. Haruta, Nature 2005, 437, 1098–9.

[2] D. Heeskens, P. Aghaei, S. Kaluza, J. Strunk, M. Muhler, Phys. status solidi 2013, 250, 1107–1118.