Advancing the cleavage of bio-derived vicinal diols using Fe/zeolite catalysts

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Background: The vast majority of the chemical industry is based on fossil fuels, especially crude oil, as starting material for the synthesis of fuels, plastics and other commodity chemicals. However, the chemical industry is striving to switch to renewable and sustainable resources such as biomass. In contrast to crude oil, biomass is a highly diverse feedstock containing heteroatoms like O and functional groups such as carboxylic acids, C=C bonds, and alcohols. To make use of biomass feedstock, catalytic systems need to be developed that are able to convert molecules containing such functional groups into value-added products. Just last year, we reported the use of Fe^{3+} supported on ZSM-5 zeolites (Fe-ZSM-5) as catalysts for the oxidative cleavage of vicinal diols, such as ethylene glycol, glycerol, or monosaccharides, giving carboxylic acids valuable product.[1] This process uses renewable H_2O_2 as oxidizing agents under mild and benign conditions. However, due to the highly oxidizing capabilities of Fe-ZSM-5 in combination with H_2O_2, over-oxidation to CO/CO_2 can occur, decreasing the yield of our desired products.

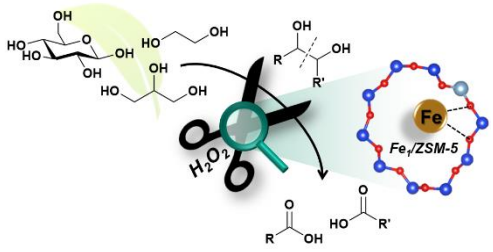

Figure 1. Scheme of Fe-ZSM-5 for the cleavage of C-C bonds of vicinal diols.

Aim of thesis: The aim of this project focuses on the suppression of the side reactions during the vicinal diol cleavage of ethylene glycol as model compound over Fe-ZSM-5 catalysts. To achieve this, two directions will be followed: i) the elemental compositions of the ZSM-5 zeolite supports will be tuned while maintaining the high surface area and Fe-loading capacity, and ii) Reaction conditions such as temperature, pressure, H_2O_2, solvent, time, substrate concentration, etc. will be varied with the aim to optimize yields of desired products.

Results obtained from this study will provide valuable insights into improved process of biomass-derived substrates and on rational design of zeolite-based catalysts.

What we offer: You will gain experience in catalyst preparation and a range of characterization methods. Moreover, you will learn about liquid-phase batch-reactions, as well as various analytics equipment. We conduct cutting-edge research and most MSc thesis in our group result in peer-review publications. The working atmosphere in our group endorses highly engaging scientific discussions, learning curiosity (also for other topics in our group) and social activities.

What you offer: Bachelor's degree in chemistry, chemical engineering, or related fields. Strong academic record and passion for sustainable chemistry. We are looking for a talented and highly motivated MSc student that wants to carry out a well-structured MSc thesis while having the opportunity to implement own ideas.

Contact us by **September 30, 2023**.

1. P. Treu, B. B. Sarma, J. D. Grunwaldt , E. Saraci, Chemcatchem, **2022**, 14.

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