Universität Rostock

Traditio et Innovatio

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Nanofiltration for the Separation of Catalysts from Aqueous Systems

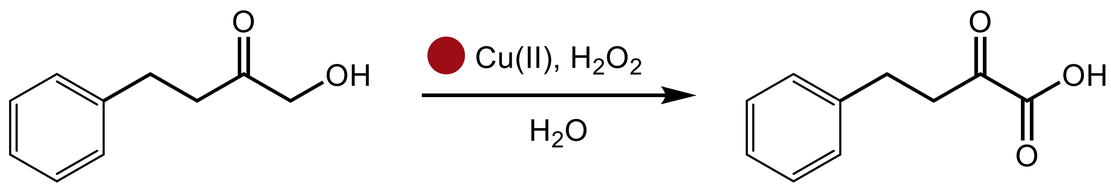
Henrik Schröter[1], **Udo Kragl**[1]

[1] University of Rostock, Institut of Chemistry, Albert-Einstein-Straße 3a, 18059 Rostock

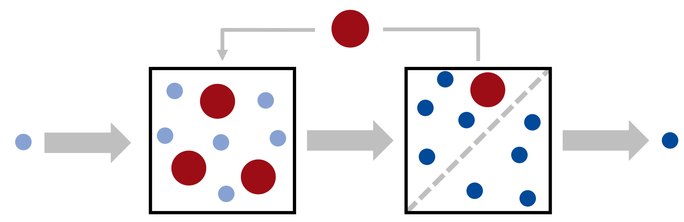
The separation of homogeneous catalysts from reaction mixtures has been a pressing problem ever since. Due to its adjustable selectivity and energy efficiency, nanofiltration is a promising method for removing catalysts from reaction mixtures in order to facilitate their reuse. Until now, such systems have mainly been explored in the field of solvent-resistant nanofiltration, while aqueous systems are far less common. In this work, the use of nanofiltration for the separation of inorganic oxidation catalysts from aqueous solution is investigated.

Selective Oxidation Using Earth-abundant Metals

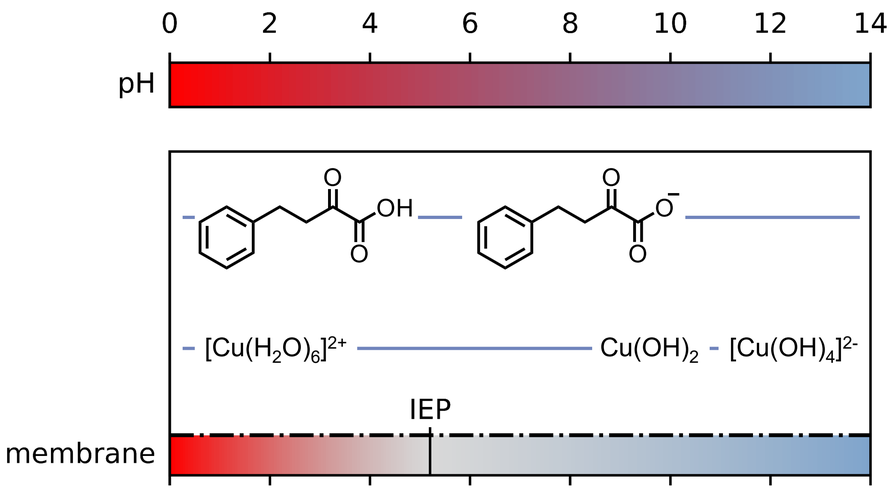
Prof. Nora Kulak, Isabell Prediger, University of Potsdam

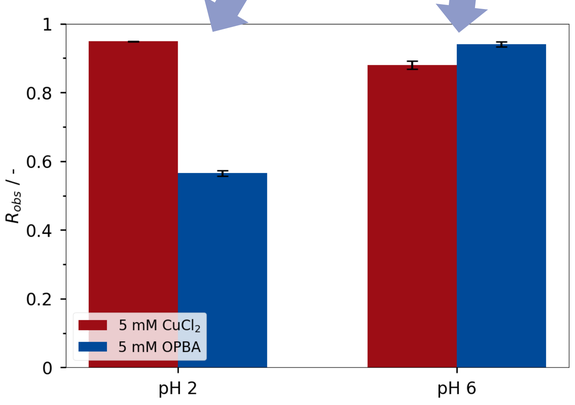


● **1** α-hydroxy ketone ● **2** α-keto carboxylic acid



Improving Selectivity

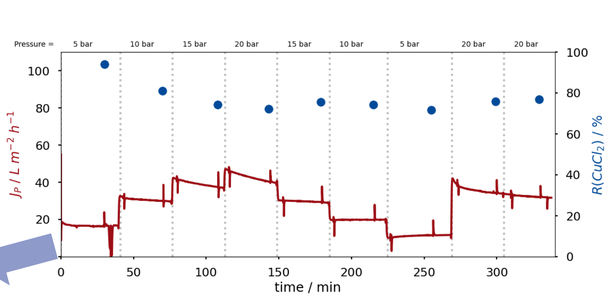




The pH modulates both the ionization of the solutes and the effective charge of the membrane. At lot pH, the charge repulsion between the carboxylic acid and the membrane is reduced, while Cu^{2+} is still retained.

Conditions: Trisep TS80, 5 bar, 10 mL min^{-1} (0.15 m s^{-1}) cross flow rate. pH of the solutions was adjusted using NaOH and HCl. Retentions were determined by photometry.

Increasing Δp reduces the retention, indicating significant concentration polarization.



Conditions: Trisep TS80, 5 mM $CuCl_2$, 5-20 bar, 10 mL min^{-1} (0.15 m s^{-1}) cross flow rate. Retentions were determined by photometry.

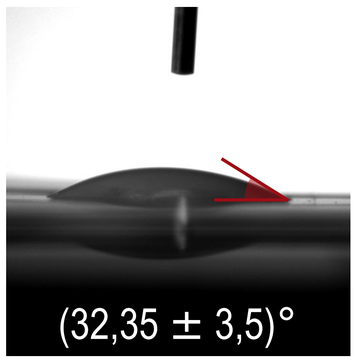
Membrane Characteristics

Provided by the Manufacturer

Trisep TS80	
Manufacturer	MANN+HUMMEL
R($MgSO_4$)	99.2 %
MWCO	< 300 Da
Material	polypiperazine

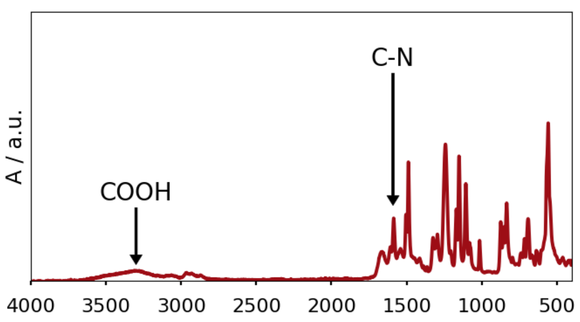
Hydrophobicity

Contact Angle



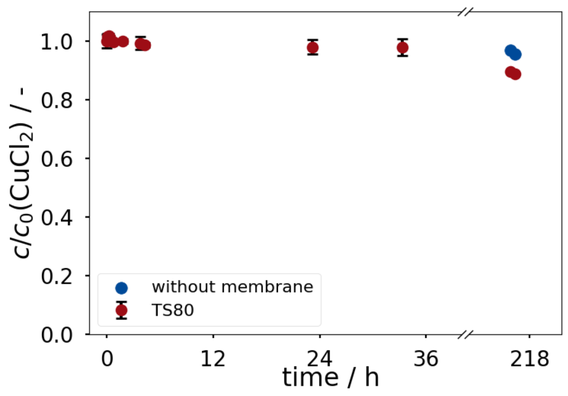
Surface Chemistry

ATR-IR



Specific Interactions

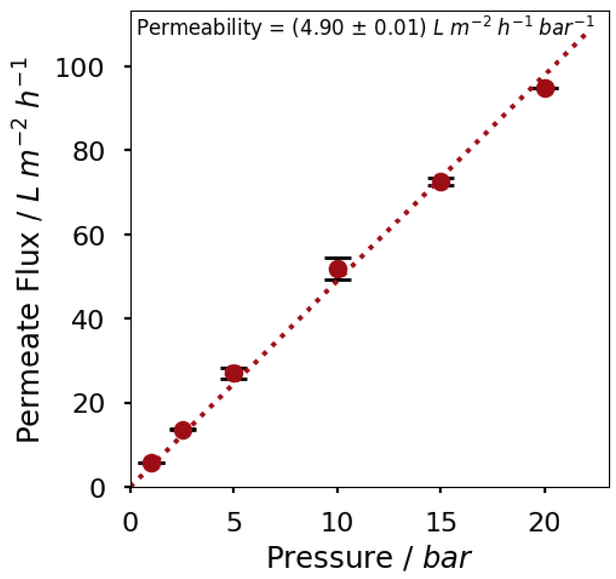
Adsorption Studies



Conditions:1 cm^2 Trisep TS80 cutouts were exposed to 20 mL 5 mM $CuCl_2$ at 25 °C for 9 days. $CuCl_2$ was determined by conductometry.

Permeability

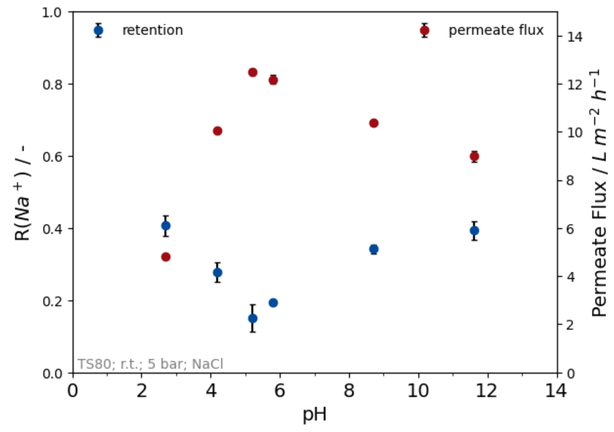
Pure Solvent Filtration



Conditions: Trisep TS80, ultrapure water, 1-20 bar, 10 mL min^{-1} (0.15 m s^{-1}) cross flow rate.

Isoelectric Point

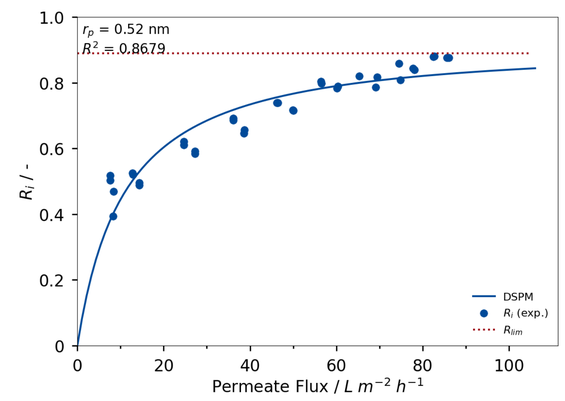
Charged Solute Filtration



Conditions: Trisep TS80, 0.1 mol L^{-1} NaCl, 5 bar, 10 mL min^{-1} (0.15 m s^{-1}) cross flow rate, pH was adjusted using NaOH and HCl. Na^+ was determined by ion chromatography.

Pore Size

Neutral Solute Filtration



Conditions: Trisep TS80, 0.2 g L^{-1} glucose, 1-20 bar, 100 mL min^{-1} (0.15 m s^{-1}) cross flow rate. Glucose was determined by HPLC.

Summary & Outlook

- the feed pH significantly impacts the selectivity
- concentration polarization needs to be adressed

→ improvement of module design

→ assessment of more (commercial) membranes

→ assessment of membrane stability

Contact:
henrik.schroeter@uni-rostock.de
Institut of Chemistry, Department Industrial Chemistry
Phone: +49 (0)381 498 6451

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