

From Methanol to Olefins to Jet-Fuel: Catalyst Development

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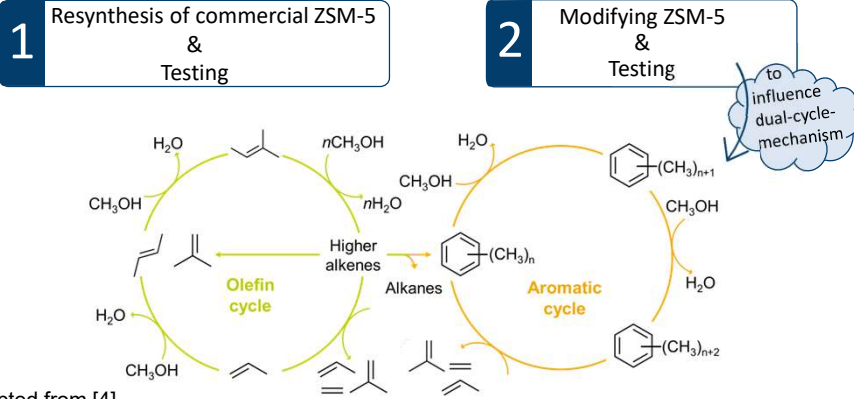
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Motivation

- Due to the ReFuelEU Aviation regulation:
 - EU-airlines will be required to use a fuel blend with synthetic/sustainable aviation fuels (SAF) until 2050 [1]
- One way to synthesize SAF is converting methanol- to-olefins (MtO) that will be oligomerized and at the end hydrogenated to achieve kerosene
- So far: MtO catalysts (e.g. SAPO-34, ZSM-5) achieve high selectivity towards one type of alkene^[2] (e.g. Lurgi Methanol-to-propene (MTP ®)^[3])
 - For kerosene: higher alkenes desirable

Approach

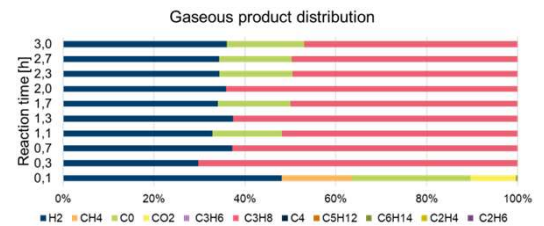
- Our goal: achieving a high selectivity to linear C₃ – C₆ by adjusting the catalyst properties



adapted from [4]

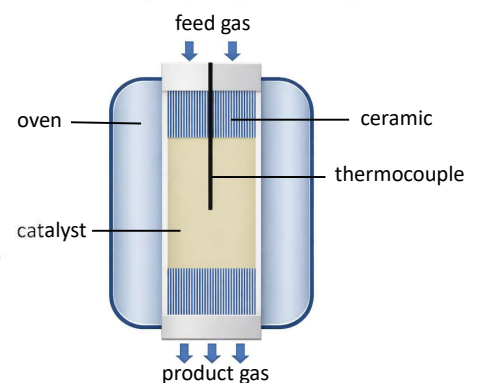
Catalytic activity test

- Using fixed-bed reactor with a micro-GC for gaseous samples and a GC-MS for liquid samples
- Preliminary test using bentonite pellets with the following conditions:
 - 30 L/h N₂, WHSV: 3 h⁻¹, 30 g/h MeOH, 400°C, 3 bar



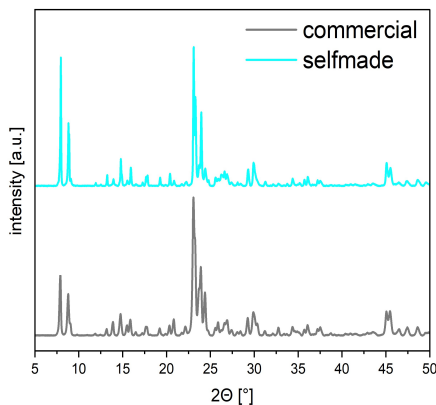
- Determining reaction conditions for new catalysts with fractional factorial design:

	P (bar)	T (°C)	N ₂ (L/h)	Pellet diameter (mm)	WHSV (h ⁻¹)
High Value	3	450	30	3	3
Low Value	1	400	10	1,5	1



Synthesis

- Precursors: NaOH, SiO₂ (40 wt%) in H₂O, Al₂(SO₄)₃ · 18 H₂O, SDA or seed
- SDAs used: TBABr, TPABr, n-Butylamine
- Synthesis protocol for selfmade ZSM-5 followed from [5]



Pelletizing

- For the catalyst tests zeolite will be mixed with a binder and pressed to pellets
- Ratios currently: 45 wt% H₂O, 10 wt% binder
- Machine used: Caleva Multi Lab Classic
- Pictures of dried + calcined pellets:



Al₂O₃ +
Hydroxyethylcellulose
Ø = 1,5 cm



Bentonite
Ø = 1,5 cm

Outlook

- Comparison of commercial and self-synthesized zeolites
- Mass balance & analysis of product spectra possible
- Development of self-synthesized zeolite catalysts using planned modification: Si/Al-ratio and pore size

References

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