

Improving Cu-Al₂O₃ catalyst stability for glycerol hydrogenolysis by incorporation of lanthanum

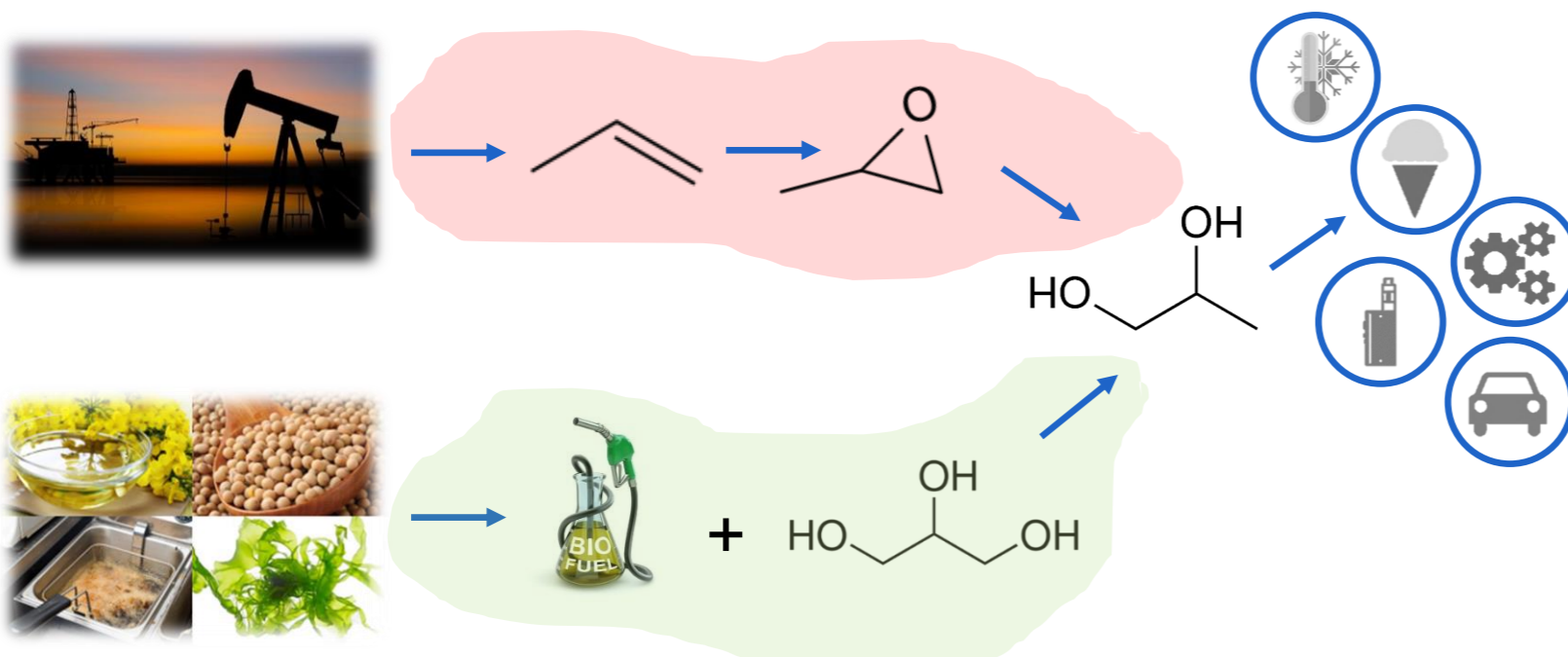
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“Green” propylene glycol from glycerol



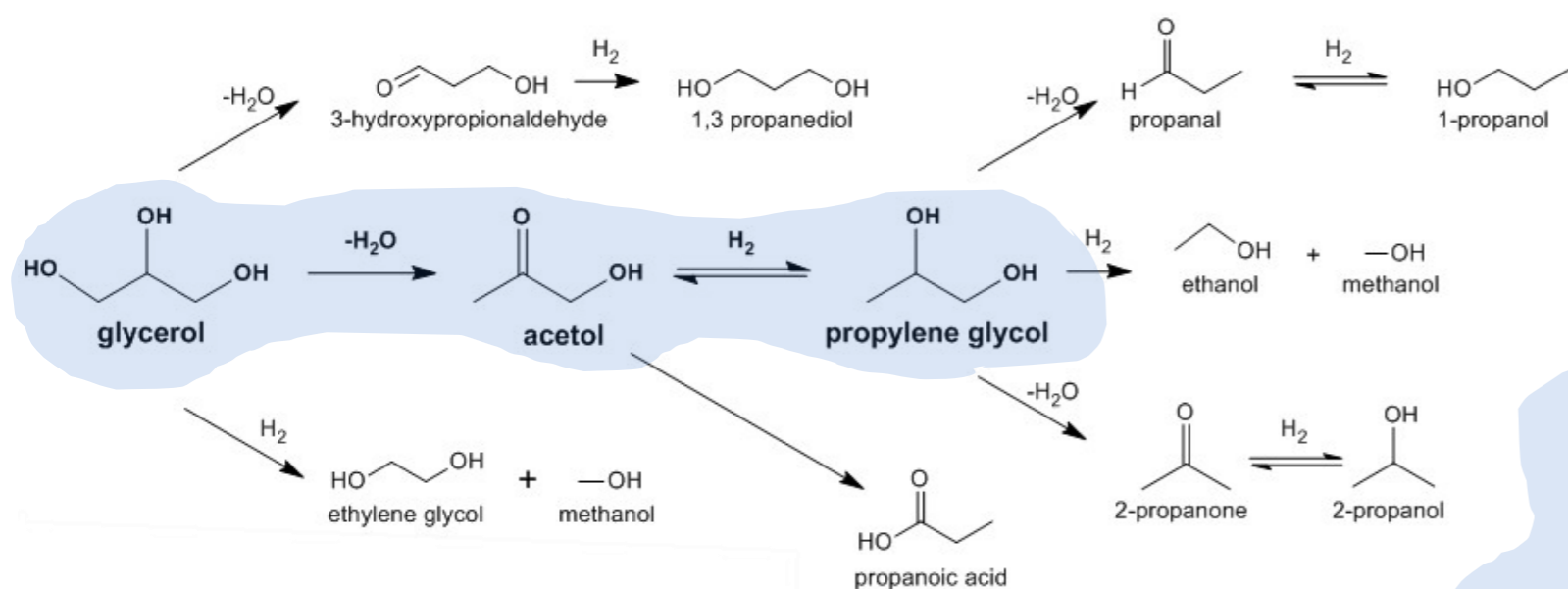
Catalyst selection



✗ sensitive to deactivation

Commercial catalysts*

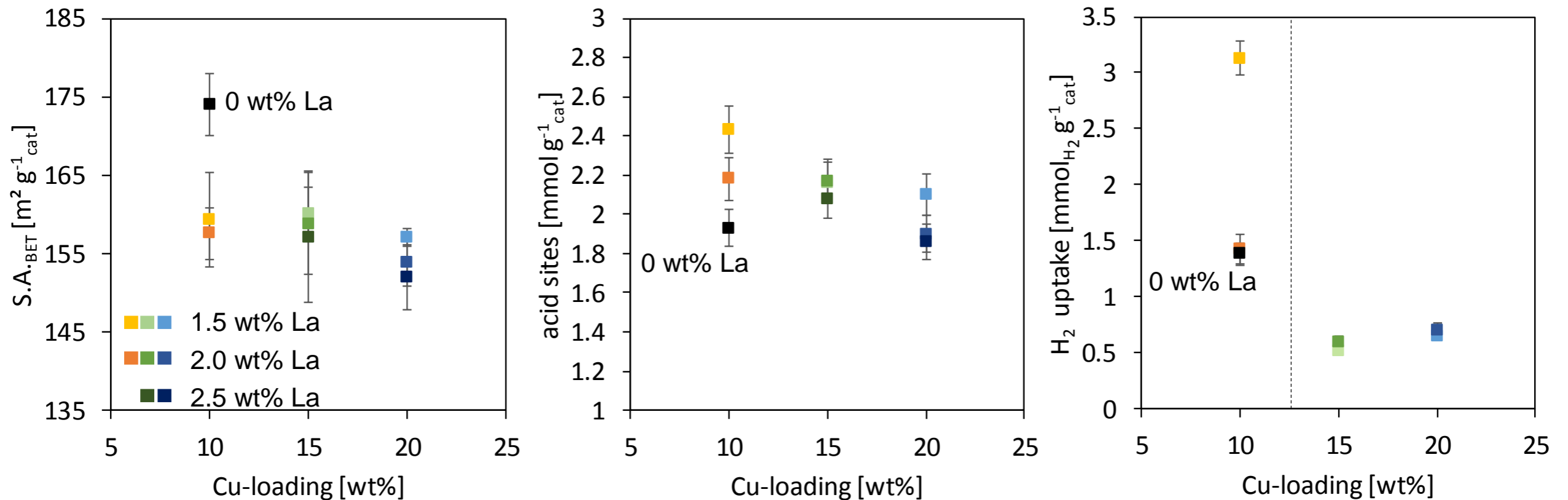
✗ various promoters



Scope

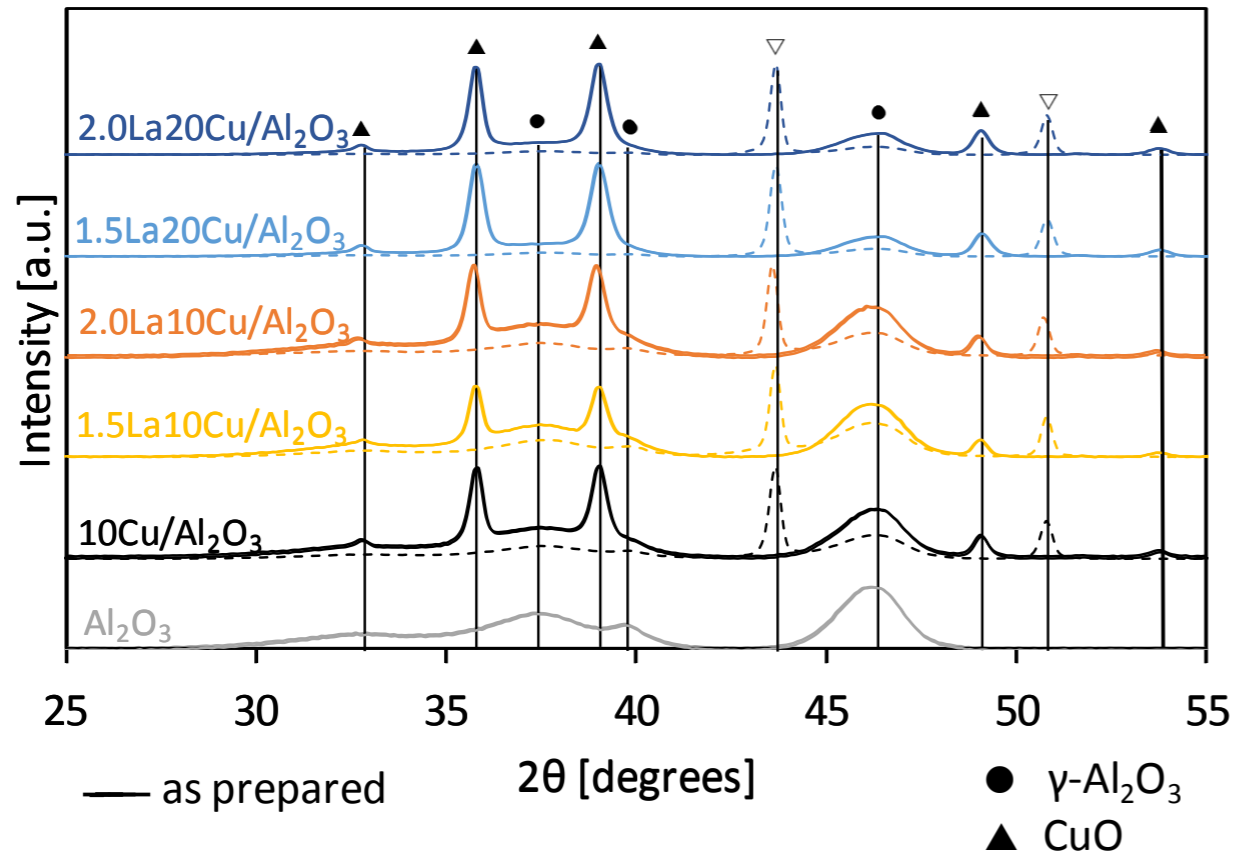
investigating the impact of catalyst properties on the glycerol hydrogenolysis reaction

Physicochemical properties



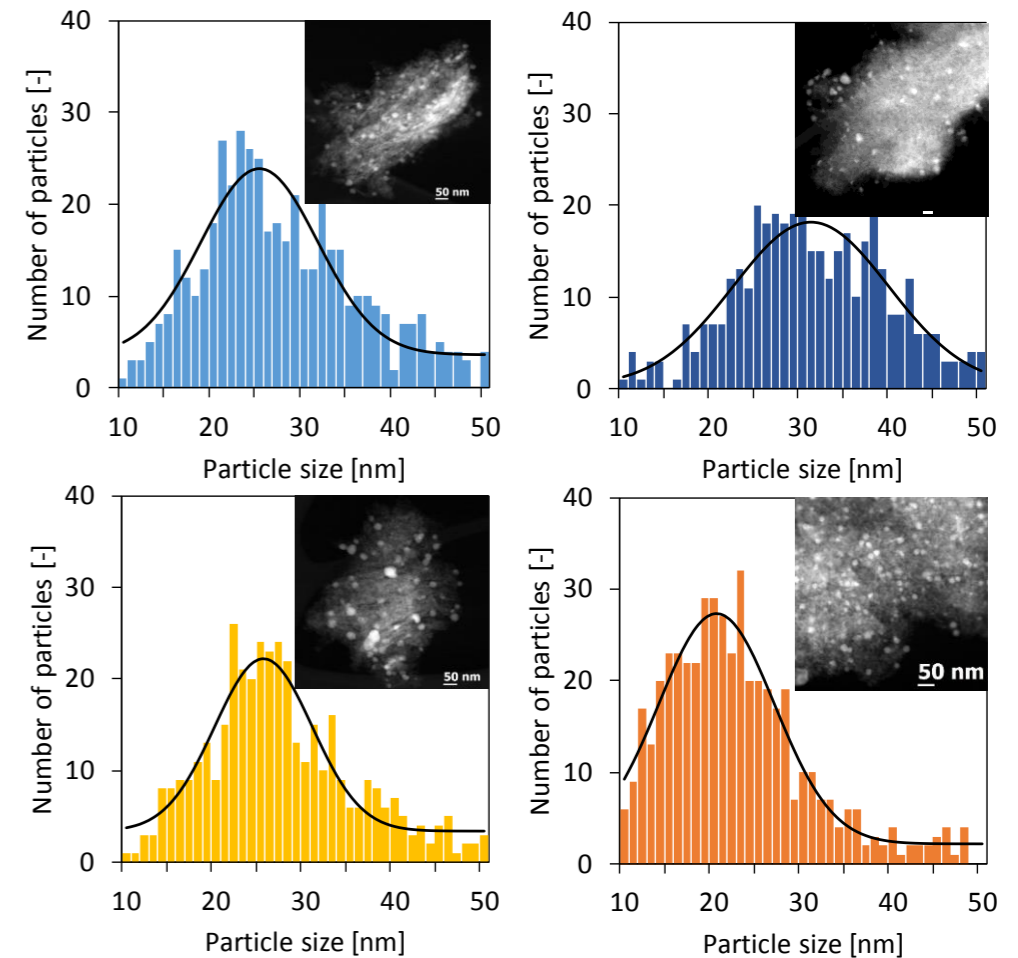
- average pore diameter (6.5 nm) did not change
 - no clogging of the pores by Cu or La particles
- TPR-results suggest well-dispersed and bulk CuO species
- H_2 -uptake decreases significant above 15 wt% Cu

Morphologic properties



d_{Cu} [nm]	D [%]
28 ± 1	3
26 ± 1	3
22 ± 2	4
25 ± 2	4
43 ± 2	2

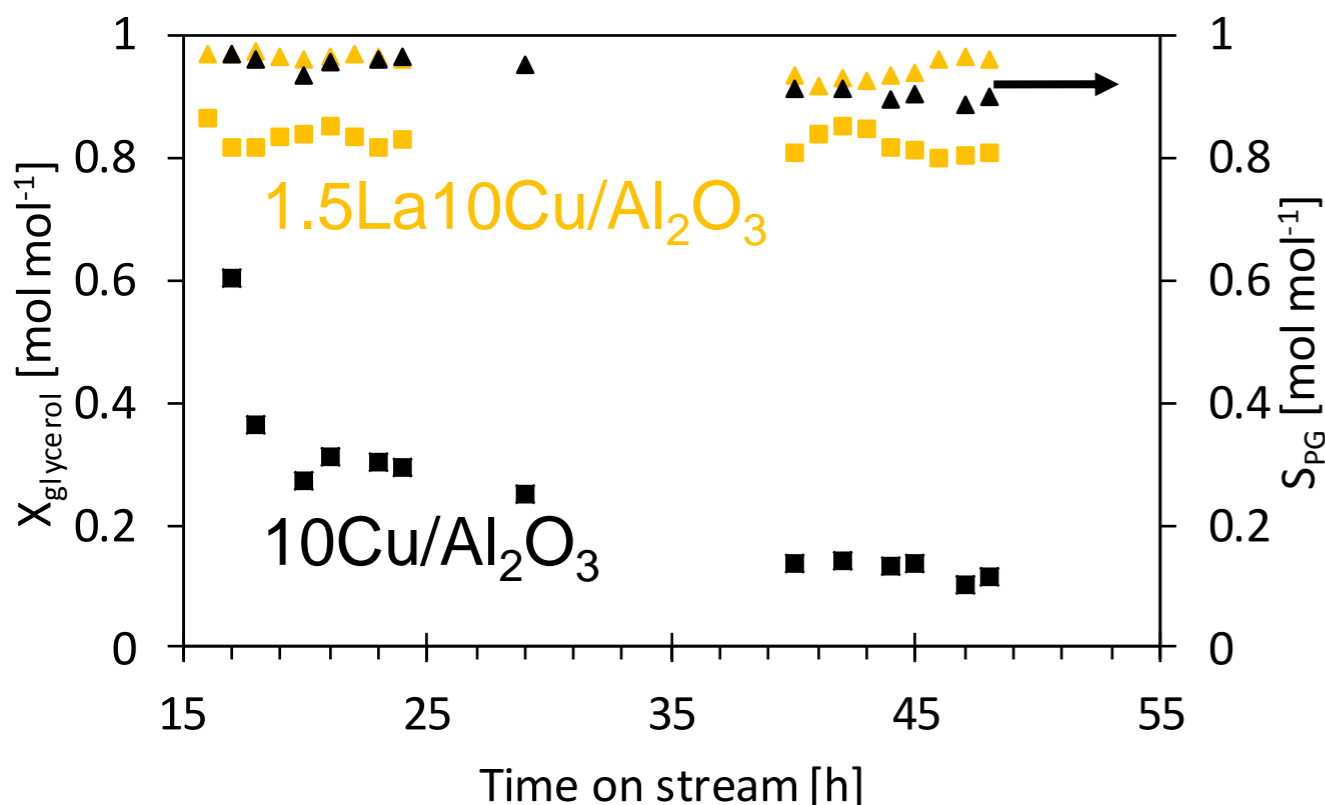
- no mixed La-Cu or Cu-Al phases
- La decreases Cu particle size
- no sintering on spent samples



Catalytic activity measurements

- trickle bed regime with intrinsic kinetics on High-Throughput Kinetic Setup*

513 K | 7.5 MPa | $125 \text{ kg}_{\text{cat}} \text{ s mol}^{-1}_{\text{glycerol}}$ | $6.33 \text{ mol}_{\text{H}_2} \text{ mol}^{-1}_{\text{glycerol}}$

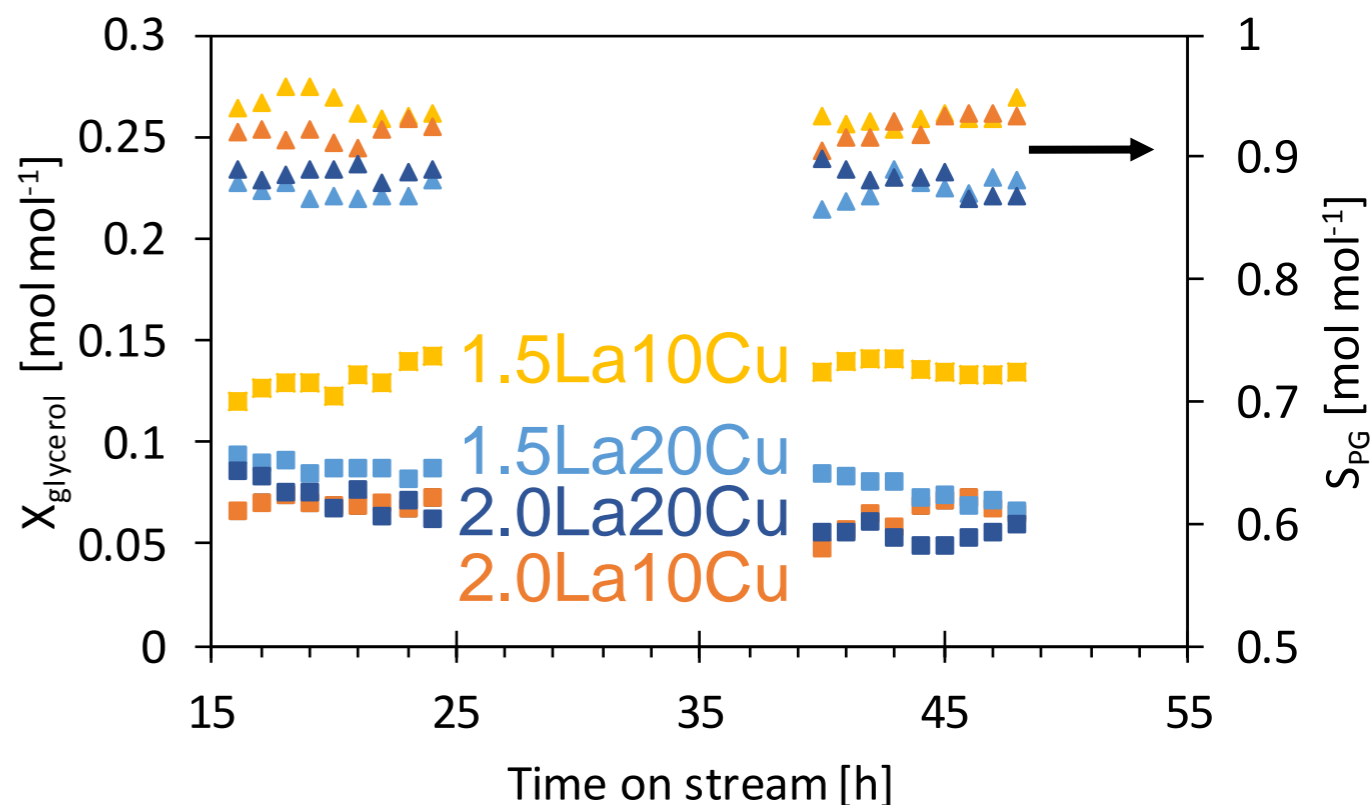


TOF_{513K,48h} [s⁻¹]

$7.75 \cdot 10^{-2}$

$2.90 \cdot 10^{-2}$

473 K | 7.5 MPa | $125 \text{ kg}_{\text{cat}} \text{ s mol}^{-1}_{\text{glycerol}}$ | $6.33 \text{ mol}_{\text{H}_2} \text{ mol}^{-1}_{\text{glycerol}}$



H₂ uptake [mmol g⁻¹_{cat}]

3.13 ± 0.15

1.42 ± 0.06

0.70 ± 0.03

0.65 ± 0.03

Conclusions

- no mixed La-Cu or Cu-Al phases are formed
- incorporation of La increases the stability remarkable
- H₂-uptake was identified as a measure for catalyst selectivity
- a minimum amount of 1.5 wt% La and 10 wt% Cu was sufficient to reach an optimal activity

Acknowledgments



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