Chemo-Catalytic Valorization of Biomass to Biochemicals

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Introduction

- Lignocellulosic materials alongside algae and animal fat as sustainable source for biofuels and platform chemicals.
- Research focusing on tailored valorization schemes of biomass
- Major challenges comprehend a **selective depolymerisation, hydrodeoxygenation,** and selective **reduction** or **oxidation** aiming for different platform chemicals (Figure 1).
- Herein, we present a selected example of HDO of poly-alcohols derived from biomass intermediates towards 1,6-hexanediol.

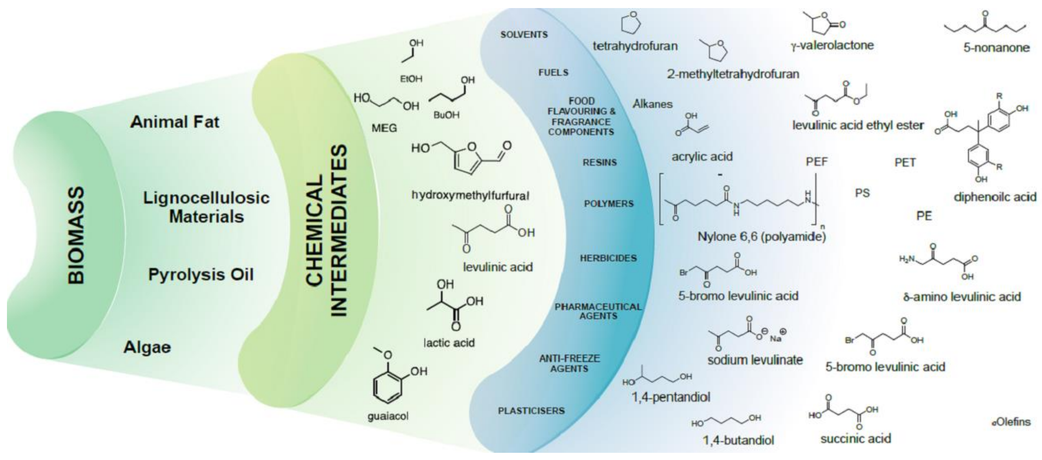


Figure 1. Selected value-chains based on Biomass

Case of Study: From Biomass to "Green" Nylon

Poly-alcohol are an example of the chemicals that can be derived from biomass

substantial efforts were put towards identifying novel synthetic routes and new fine chemicals

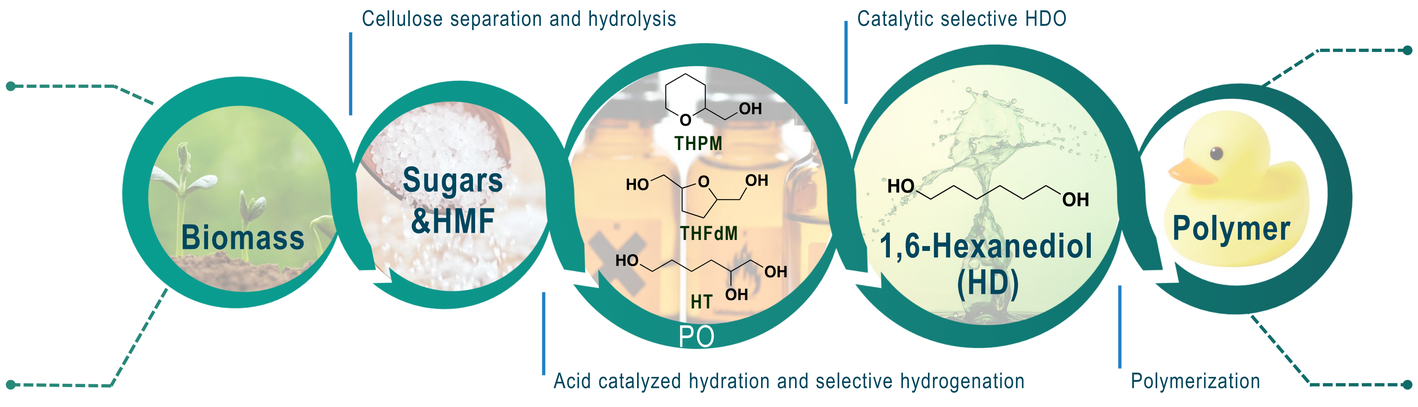


Figure 2. Chemo-conversion of Biomass to Nylon

The selective HDO of poly-alcohols (PO) into 1,6-hexanediol (HD) is a crucial step for the transformation of biomass into valuable products

HD serves as chemical intermediate for polyamide 6,6 (Nylon)

- Synthesis of ca. 500 catalysts
- Implementation of impregnation and co-precipitation techniques
- The transformation from powder to extrudates (shell coating via spray impregnation) (Figure 3)
- Optimization of the shell thickness and investigation shell thickness vs. catalytic activity

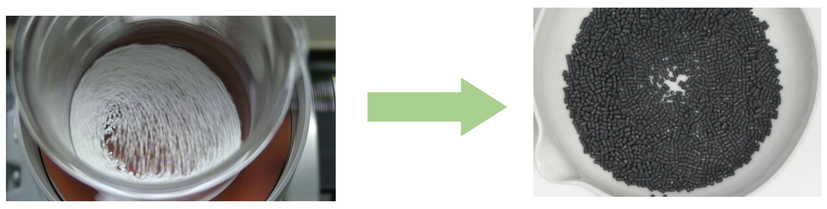


Figure 3. Shell coating using spray impregnation

- Catalyst screening and kinetic study using 26 plates (26 x 16 single reactors)
- Moving from powder to extrudates (Figure 3)
- A 8-fold unit with 100 mL catalyst capacity per reactor was used

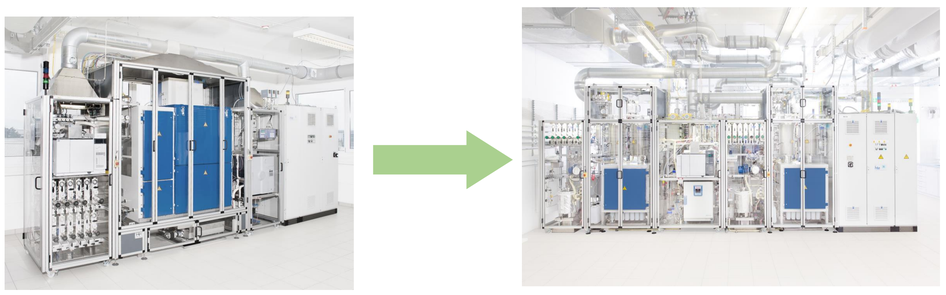
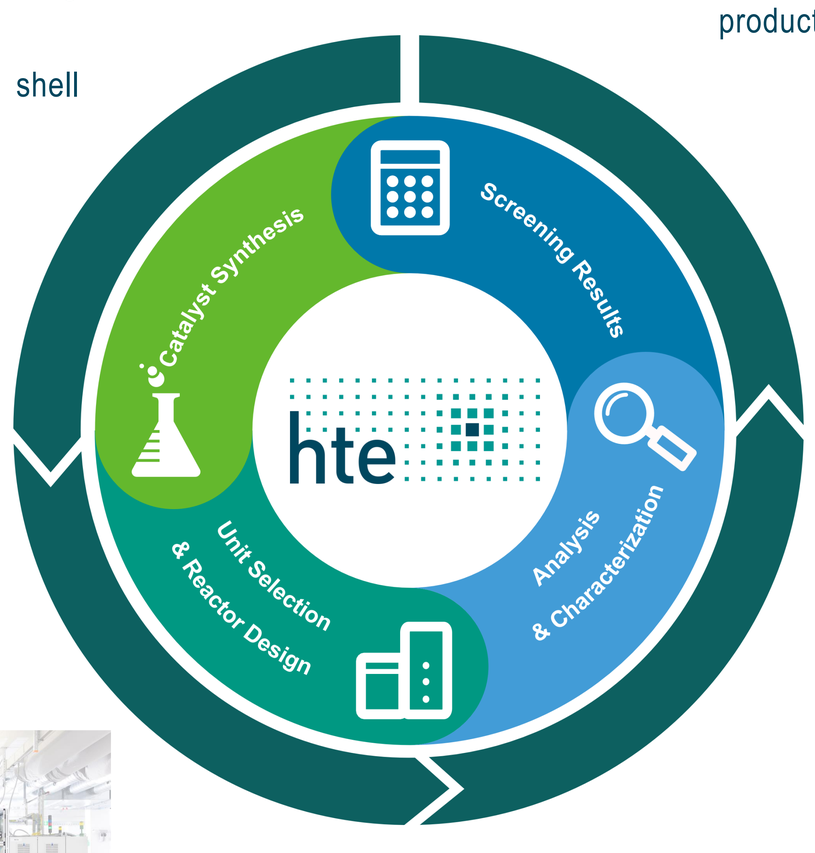


Figure 4. Scaling-Up: from powder to extrudates



- Full conversion of THF di methanol and THP methanol
- Main product HD and main intermediate 1,6-hexanetriol
  - Different catalytic system shows different activity and product distribution (Figure 5)

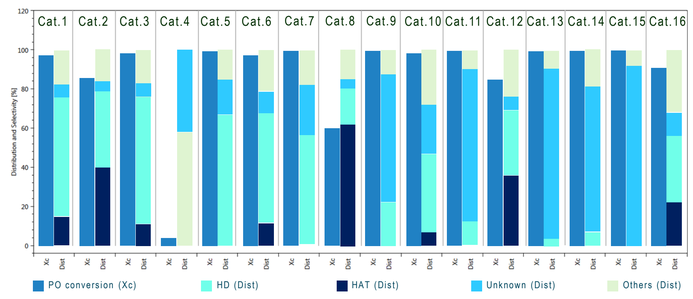


Figure 5. PO conversion and products distribution

- Full characterization of the synthesized catalysts
- Shell thickness measurements using microscope (figure 6) or SEM

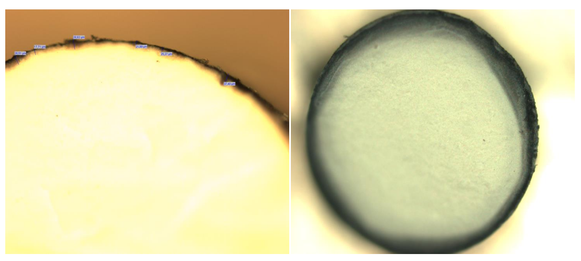


Figure 6. Measurement of different shell thickness using microscopic technique at hte

- The reaction outcomes were analyzed using offline-GC
- GC Method optimization and compound identifications using GC-MS

Summary and Conclusions

- High throughput catalyst and feedstock screening – kinetics & mechanisms
- Process optimization and upscaling
- Method development & optimization – analytics and reaction engineering

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