Abstract
Lignocellulose presents a promising alternative carbon source for the production of novel platform chemicals as well as biofuel compounds and is produced in amounts of $170 \times 10^9$ t plant material per year.\(^1\) The major fraction of lignocellulose is cellulose a polymer of glucose accounting for a fraction of around 50%. Starting from hydrolysis of cellulose to glucose various promising platform chemical are available including 5-hydroxymethylfurfural (5-HMF) and levulinic acid via dehydration, sorbitol via hydrogenation of glucose and γ-valerolactone via hydrogenation of levulinic acid.\(^2,3\) Main challenges concern the development of suitable catalysts and processes for the efficient utilization of renewable feedstocks. While fossil based transformations are almost exclusively based upon gas-phase processes at high temperatures to functionalize non-polar molecules, lignocellulosic feedstocks are highly polar and require defunctionalization processes in liquid-phase at rather low temperature.\(^4,5\) Additionally, the recovery of high-boiling polar products from aqueous reaction systems poses challenges on process development and product separation. Herein, strategies for the controlled chemo-catalytic valorization of cellulose are discussed. Interesting examples include the one-pot hydrolytic hydrolysis of cellulose into sugar alcohols catalyzed by novel noble-metal free catalysts systems and subsequent etherification with isobutene over solid acid catalysts. Additionally, multiphase reaction systems allow combining multiple transformations in one reaction system and facilitate product recovery. Therein, sugars are dehydrated to 5-HMF which is continuously extracted into an organic solvent and further converted into products of lower polarity with high solubility in the polar solvent system. Consequently, the whole reaction system is shifted towards product formation suppressing site product formation and allowing efficient product recovery. Possible transformations include hydrogenation to 2,5-dimethylfuran or tetrahydrofuran, oxidation to yield 2,5-furandialdehyde or aldol condensation with e.g. with acetone. Overall, these approaches enable a selective conversion of cellulose and sugars into potential platform chemicals and biofuel motifs.