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Topochemistry of Biomass Pretreatments and Interaction with Enzymes

Lignocellulose is an inexpensive, abundant and renewable resource, consisting of lignin, hemicellulose and cellulose. It can be used to produce biobased chemicals, such as ethanol, xylitol and lactic acid. However, the conversion of biomass fiber material into more high-added-value new material for food, feed, medical and pharmaceutical industries remains challenging and requires chemical pretreatment or enzymatic modification to facilitate the disassembly of fibre wall components. Thus, development of pretreatment methods that increase the material digestibility for the subsequent enzymatic hydrolysis is an important focus in this research field. The pretreatment is necessary to improve the rate of production and the total yield of monomeric sugars in the hydrolysis step. By using enzymes, it is possible to specifically tailor the conversion of cellulose and hemicelluloses into monomeric sugars. Advanced topochemical investigations of interactions between enzymes and fibres and impacts of pretreatment and enzyme hydrolysis on biomass will be performed in our project using state-of-the-art surface analytical techniques. Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS), X-ray Photoelectron Spectroscopy (XPS) and Scanning Electron Microscopy (SEM) can give outstanding new information about nano-scale localization and chemical composition of different biomass components and their interactions with enzymes.