MWP – Young Researcher Abstract 2025

Project title: Significance of thermodynamics in unlocking the potential of bioinspired all-polysaccharide materials	
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Abstract (approx. 200 words)**:** To alleviate dependency on fossil resources, plant-based polysaccharides are becoming increasingly more attractive as sustainable material building blocks. Simultaneously, the interest in bioinspired materials designed to mimic the hierarchical structure and function of biological materials is expanding rapidly. However, due to the complex nature of bio-based materials, there is a great need for fundamental understanding of the physicochemical properties of plant polysaccharides. Drawing inspiration from the plant cell wall in nature, known for its excellent mechanical and water transport properties, our research explores the physicochemical and entropy-driven forces governing cellulose and hemicellulose interactions for development of all-polysaccharide based materials architectures, aiming to translate cell wall functions into material properties. Due to their interesting ability to efficiently gel and hydrate nanocellulose networks, grass cell wall hemicelluloses called mixed-linkage glucans (MLGs) are applied as functional components with nanocellulose to form materials structures with tunable wet mechanical properties and water interactions. Expanding the material building block base to this currently underutilised industrial side stream available for example from brewers' spent grain alleviates the dependency on fossil resources as well as on wood biomass. Additionally, broadening the product portfolio of the forest sector with high-performance functional structures combining cellulose and MLGs has the potential to boost the value of the forest bioeconomy.	
Key words: Plant polysaccharides, (nano)cellulose, mixed-linkage glucans, bioinspired materials, all-polysaccharide structures, physicochemical properties, thermodynamic driving forces	