MWP – Young Researcher Abstract 2024

Project title: Controlling nanostructures from nanocellulose and tailorable nanoparticles	
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Abstract (approx. 200 words)**:**

As nanoscopic building blocks derived from the forest, cellulose nanofibrils (CNFs) offer great potential for fabricating biomimetic and nanostructured materials to push forward the envelope of what synthetic materials can achieve. However, the structure-property relationships in CNF-based materials remain largely unexplored. Our research investigates CNF properties by hybridizing them with polymeric nanoparticles, and we find that the self-assembly and macroscopic properties can be tuned via their facile incorporation.

The nanoparticles have tailorable surface properties, allowing us to control interactions with the cellulose surface. The particles can be fabricated in various sizes, and apart from spherical shape can also take complex morphologies such as worms and vesicles, through an eco-friendly process called polymerization-induced self-assembly in water. This green synthesis method facilitates their integration into cellulosic materials.

Our current focus is on developing advanced characterization techniques, such as x-ray scattering, to study the impact of polymeric particle additives on cellulosic assemblies and their mechanical properties. We have observed that cationic particles can either stiffen or plasticize the material, and linked this closely to the ordering of CNFs. Future work will explore the interactions between cellulose and particle surfaces to further develop understanding of structure-property relationships.

Key words:
Nanocellulose, tailorable nanoparticles, structure-property, biomimetic