

## MWP – Young Researcher Abstract 2025

<b>Project title:</b> Scalable Production of Customizable and Functional Cellulose-based Foam via Oven-drying	
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<p><b>Abstract</b> (approx. 200 words):            Advanced cellulose-based foams are urgently needed as sustainable packaging materials in an era of prioritizing environmental consciousness. However, transferring the mechanical properties of cellulose fibers into porous structures is always limited by gas entrapment during foaming and irreversible structural collapse upon liquid evaporation. Herein, a hierarchical assembly strategy combines cationic cellulose nanofibrils (CCNF) with a dynamic covalent tannin/borate (T/B) complex to fabricate 3D continuous foams with distinct lamellar structure via oven drying is proposed for scalable production. Specifically, CCNF facilitates the assembly of T/B complexes on cellulose fibers by electrostatic attraction and hydrogen bonding. The reversible covalent bonds among T/B complex impart shear-thinning and self-healing properties to the system, thereby ensuring foaming efficiency and facilitating the formation of solid foams by oven drying. Furthermore, the T/B foam offers a versatile platform for customization with metal ions (<math>\text{Fe}^{3+}</math>, <math>\text{Cu}^{2+}</math>, and <math>\text{Ag}^+</math>), allowing the physical and mechanical properties to be tailored. Above all, the pH-responsiveness and dynamic tunability of the T/B complex allow it to release metal ions in response to pH changes, resulting in long-term antimicrobial behaviors. Finally, 3D continuous foams with lamellar structures were scalable to demonstrate the versatility and robustness of developing the T/B foam.</p>	
<p><b>Key words:</b>            cellulose-based foam, borate/tannin complex, hierarchical assembly, scalable production</p>	