PATTERNED PRECISION: CONSTRUCTING BIOACTIVE SUPRAMOLECULAR CARBOHYDRATE-BASED NANOMATERIALS

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The precise patterning of nanostructure surfaces with ligands offers the potential to create materials with unique physical and chemical properties. Such materials could be particularly powerful in biological signaling contexts due to the multivalent presentation of epitopes. The "bottom-up" approach based on self-assembly offers a promising pathway to develop modular and tunable supramolecular materials with patterned surfaces. However, a significant challenge remains: most scaffolds struggle to incorporate bulky or hydrophilic ligands, such as carbohydrates.

In our recent work, we demonstrated the utility of cellulose oligomers in creating nanomaterials with tunable shapes and properties [1-3]. The antiparallel chain orientation of these oligomers makes cellulose-based scaffolds particularly promising for constructing nanomaterials capable of presenting a precise pattern of various carbohydrate ligands on the surface of self-assembled nanocrystallites. To demonstrate the potential of this system, we developed glycan-functionalized nanocrystals and expanded the approach to create supramolecular carbohydrate-based hydrogels. Furthermore, we combined these concepts to produce densely glycosylated hydrogels with diverse glycan epitopes (Figure 1).

We explored the bioactivity of these materials, which serve as simplified mimics of complex extracellular matrices due to their dense glycan presentation and material properties. Notably, we observed a significant impact of carbohydrate presentation from the patterned surface on the morphology of *Candida albicans*, providing insights into host-fungi interactions. This work highlights the versatility and potential applications of these novel materials in biological contexts.

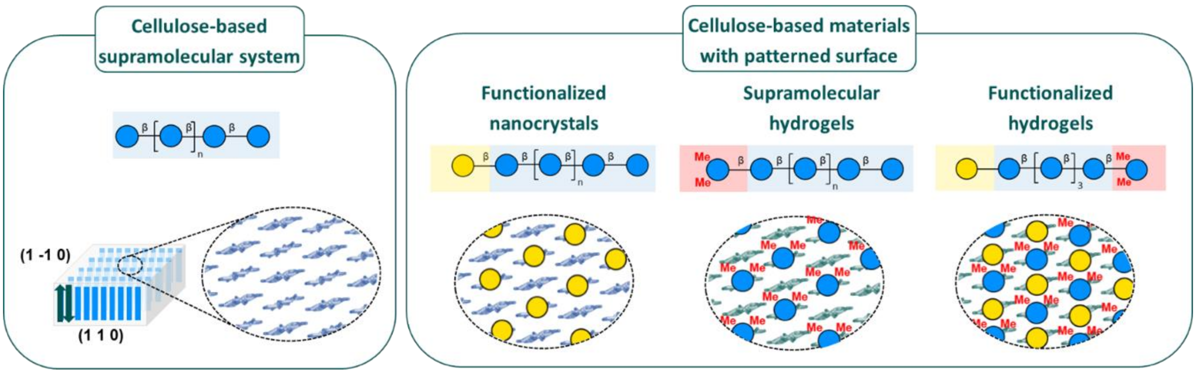

Figure 1. Cellulose-based supramolecular materials with patterned surface.

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