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Ph.D. thesis (2020-2022)
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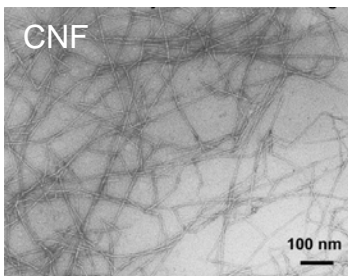


Functional polymer composites based on natural polysaccharides: preparation and performance

Context

Natural polysaccharides

- Cellulose, starch, chitin, etc.
- Renewability, abundance, design flexibility
- Various forms of polysaccharides are used in the preparation of polymer composites: cellulose nanofibrils (CNF), regenerated cellulose, chitin nanocrystals, etc.



Saito et al., *Biomacromolecules*, 2007, 8, 2485-2491.

Trends in Polymer composites

- Sustainability and high performance
- Functionality and intelligence



Funded by



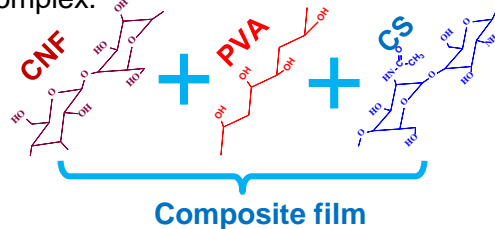
In collaboration with South China University of Technology

Objectives

Construction of functional PVA composites based on CNF and chitosan (CS)

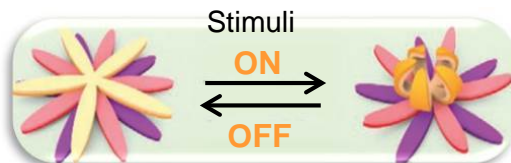
Based on the co-precipitation strategy

The non-solvent destroys polysaccharide solution/suspension system to build a complex.



Performance:

- High mechanical properties
- Good thermal performance
- Multi-stimuli responsiveness (Ionic strength, pH, and so on.)
- Repeatability and sensitivity
- Actuation performance



Responsive PNIPAM/PAAM-Alginate, Lu et al., *Small*, 2020, 16, 2005461.

Methods

Process analysis of co-precipitation

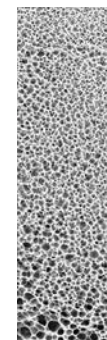
Exploration of process parameters

For various polysaccharide systems, the influence of different parameters (such as precipitation time) on the structure and performance is studied.

Structure and performance of polymer composites

Characterization

- Morphological and structural analysis**
 - SEM (EDS)
 - AFM
 - XRD
 - FTIR
- Performance Testing**
 - Tensile test
 - DMA/TGA
 - Swelling in different solutions
 - Multiple stimulus responses



Gradient Structure

Conferences:

Tan et al., *ACS Appl. Mater. Interfaces*, 2018, 10, 40125-40131.

Wang et al., *PNAS*, 2020, 117, 14602-14608.

Publications:

Huang et al., *Biomacromolecules*, 2019, 20, 3969-3979.

Huang et al., *Carbohydr. Polym.*, 2020, 245, 116445.

