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Ph.D. thesis (2018-2021)

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Preparation of hybrid advanced materials made of biobased nanofibers (cellulose and chitin) and lignin particles for packaging application

Préparation de matériaux hybrides à partir de nanofibres biosourcées (cellulose et chitine) et de particules de lignine pour des applications en emballage

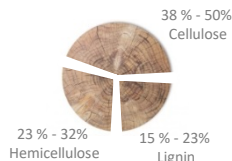
Context

Bio-based & Biodegradable food packaging

Today's need: replace petroleum-based materials

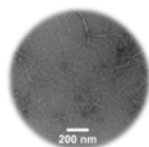
Advantages of biobased polymers:

- + They are abundant and available as waste or by-product
- + No need for chemical modifications
- + Capacity to form active packaging



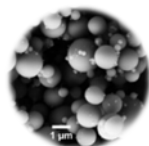
Cellulose and chitin nanofibers

- Good mechanical properties
- Particulate suspension stabilizer
- Good O₂ barrier properties



Lignin particles (LP)

- Anti-oxidant properties
- Tunable particles size
- High specific surface area



Funded by



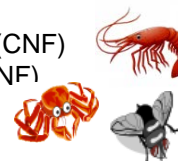
In collaboration with Aalto University

Methods

Raw materials

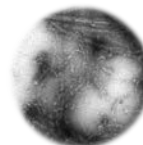
2 different types of fibers

- Cellulose nanofibers (CNF)
- Chitin nanofibers (ChNF)



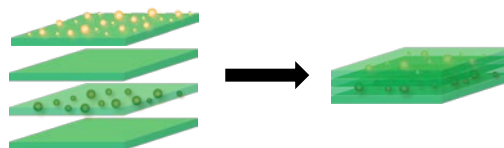
In-situ preparation of LP

Study of the interactions depending on the nanofiber surface chemistry.



Formation of functional multilayers

Optimization of each layers and of the layer's association.



Characterizations:

- Nanofibers/particles interactions
- Dispersion of the particles in the films
- Film structure and layers interactions

Lignin particles and cellulose nanofibers



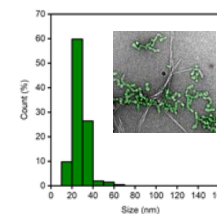
Lignin particles and chitin nanofibers



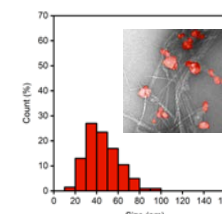
Results

Characterization of the suspensions

For in-situ LP preparation, particles sizes and distribution varies depending on the lignin amount and the fibers type.



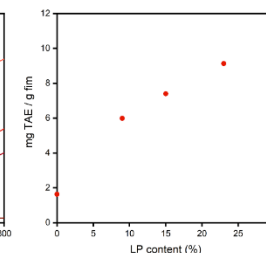
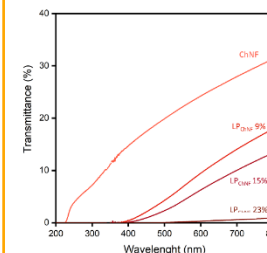
LP with CNF



LP with ChNF

Functional film analysis

- Barrier properties (oxygen and water vapor)
- Mechanical properties
- Contact angles
- Transparency
- Anti-oxidant activity



The higher lignin content, the better AO activity but the lower transparency