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Ph.D. thesis (2018-2021)
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Cyclodextrin functionalized nanocellulose for medical applications

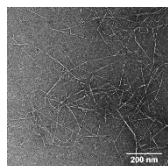
Fonctionnalisation de nanocellulose par des cyclodextrines pour des applications médicales

Context

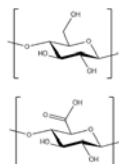
Cellulose Nanofibrils (CNF)

- Bio based and biocompatible
- High specific area
- Surface chemistry reactivity
- Good mechanical reinforcement
- Presence of -OH or -COOH surface groups (TEMPO-oxidized CNF)

Recent studies assess the **good cytocompatibility** of wood-based CNF.



TEM image of to-CNF



Down : to-CNF

Cyclodextrin (CD)

- Natural molecule produced from starch
- Complexation with hydrophobic compounds (« **Cage molecule** »)
- Currently used in **pharmaceutical** and **drug delivery**

Biomedical application

This project aims at combining CNF and CD to address challenges for two different medical applications :

• Tissue engineering

Building a biological substitute that **restore, maintain, or improve** tissue function or a whole organ.

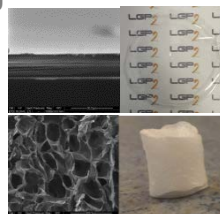
▪ Drug Delivery

Increase the bioavailability of **poorly soluble drugs** for topical / Internal applications

Methods

Material processing

- Films by solvent-casting
Oven-dried At 40°C
Drug delivery
Topical applications



Up : Film
Down : Cryogel

- Cryogels by freeze-drying
3D structured scaffold with potential for tissue engineering

Mechanical characterization

- Swelling
- Water Adsorption/Absorption analysis
- Compression tests of dry and swollen cryogels

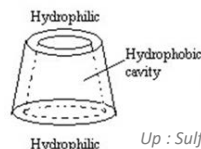
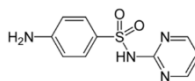
Multiple binding strategies

- Adsorption
- Direct grafting
- Cross-linking
- Chemical modification of CNF and CD

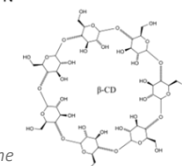
Inclusion complex analysis

One model molecule : **Sulfadiazine**

- Phase solubility diagram
- Isothermal Titration Calorimetry
- Solid inclusion complex preparation



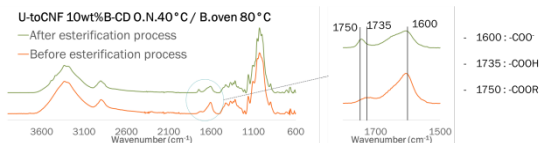
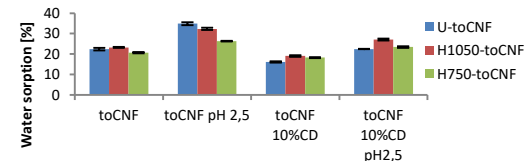
Up : Sulfadiazine
Down : β -Cyclodextrin



Results

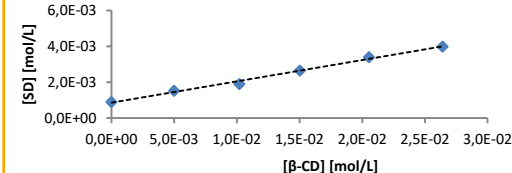
- Impact of various parameters on mechanical properties : density, pH, charge content, quantity of cyclodextrins.

Water sorption equilibrium toCNF



- Effective complexation between Sulfadiazine and β -CD in 1:1 stoichiometry

Phase solubility diagram Sulfadiazine - B-CD



Conferences:

Michel,B et al. (2019). *6th EPNOE International Polysaccharide Conference*, Aveiro, Portugal. (Oral)
Michel,B et al. (2019). *2nd Glyco@Alps Days*, Atrains, France (Oral)
+ 3 poster presentation

Funded by

