

OPPORTUNITÀ TECNOLOGICHE NEL SETTORE COSMETICO

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Progetto: Modificazione di Polimeri Sintetici e Naturali

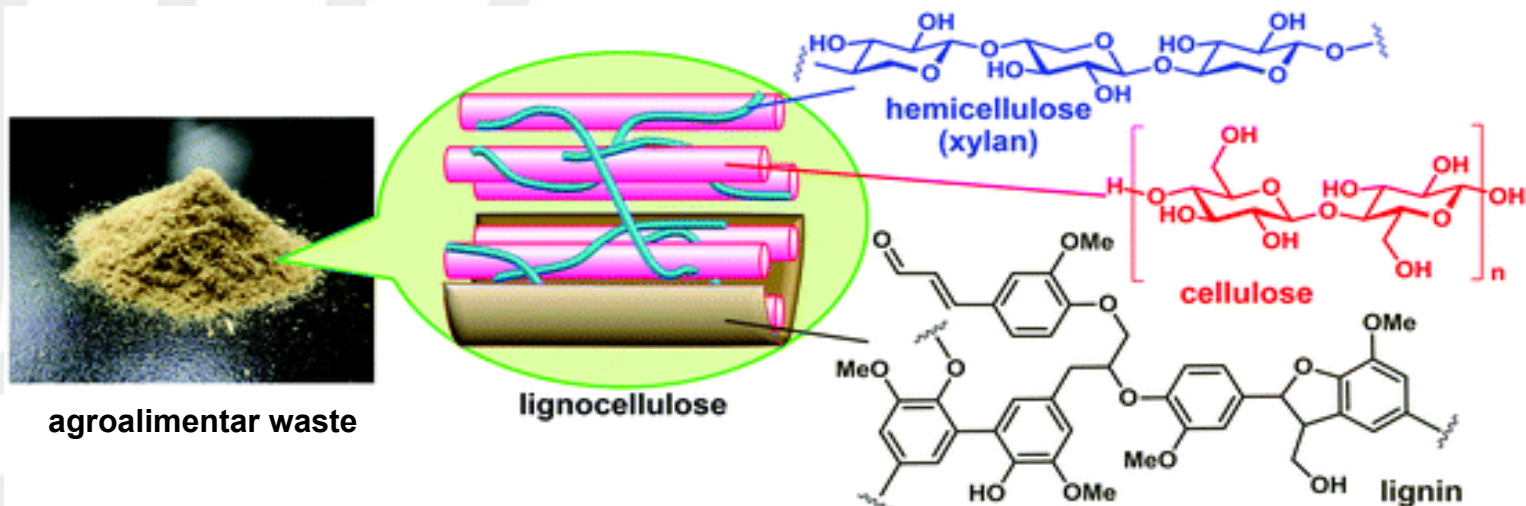
Research Aims

- Cellulose, Emicellulose and Lignin extraction from waste agricultural residues.
- Synthesis and Chemical derivatization of Cellulose Nano-Crystals (CNCs).
- Lignin modification to obtain poliphenols and phenols with antioxidant and antibacterial properties.
- Modification and crosslinking of natural polysaccharides.

Cellulose, Hemicellulose and Lignin extraction from waste agricultural residues.

LIGNOCELLULOSIC BIOMASS:

- ✓ High yields from agricultural waste
- ✓ The most abundantly available raw material on the Earth
- ✓ Composed of carbohydrate polymers (**cellulose**, **hemicellulose**), and an aromatic polymer (**lignin**)



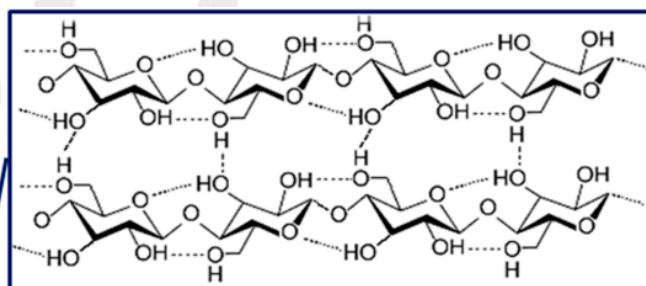
- Chemical Extraction of **cellulose** and lignine using “green chemistry
- Characterization of obtained biopolymers

Synthesis and Chemical derivatization of Cellulose Nano-Crystals (CNCs).

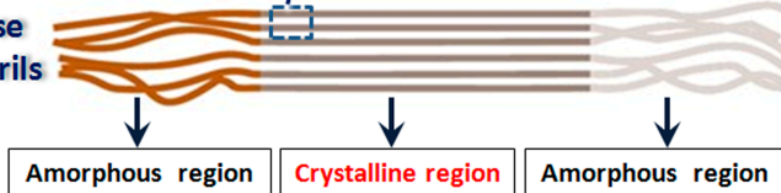
Cellulose

- Long chain of linked sugar molecules
- Chains assembled into sheets
- High strength
- Hydrophilic bulking agent

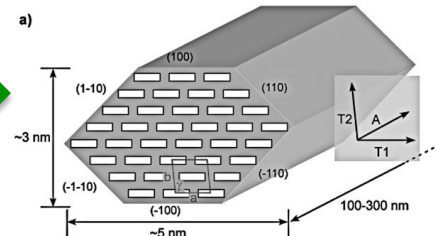
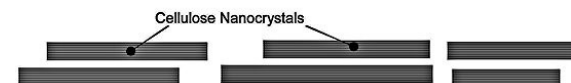
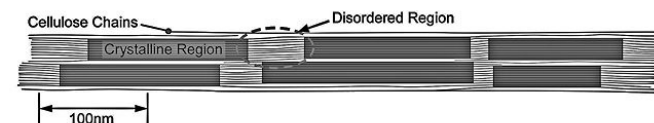
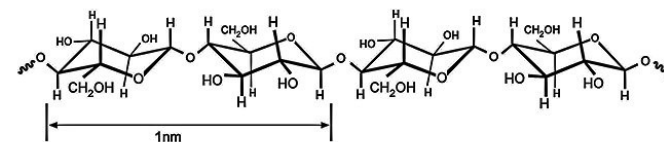
Hydrogen bonding within and between cellulose molecules



Cellulose microfibrils



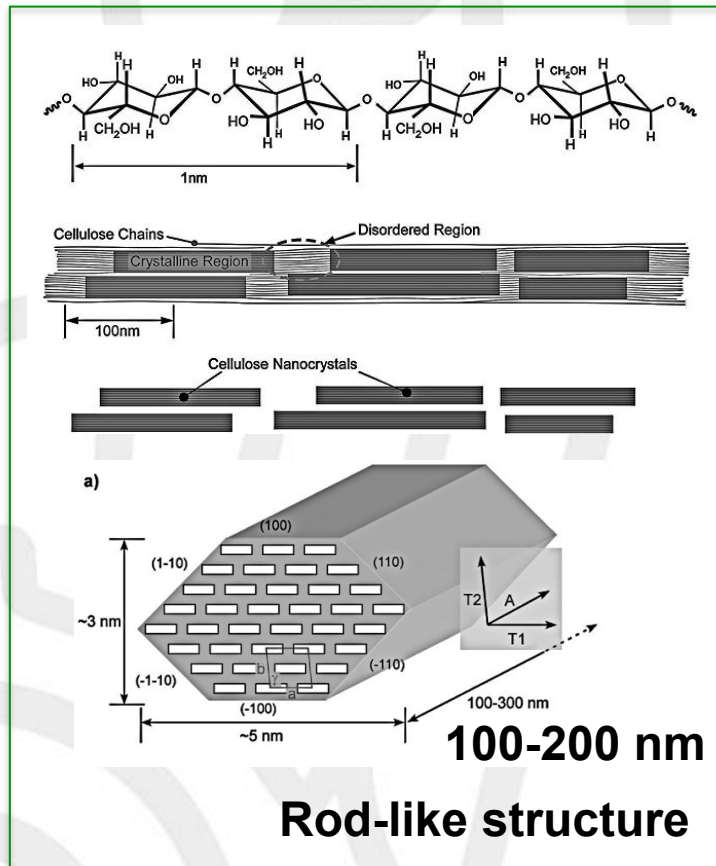
Cellulose Nano-Crystals (CNCs)



Controlled hydrolysis of amorphous domains and retention of crystalline domains

Synthesis and Chemical derivatization of Cellulose Nano-Crystals (CNCs).

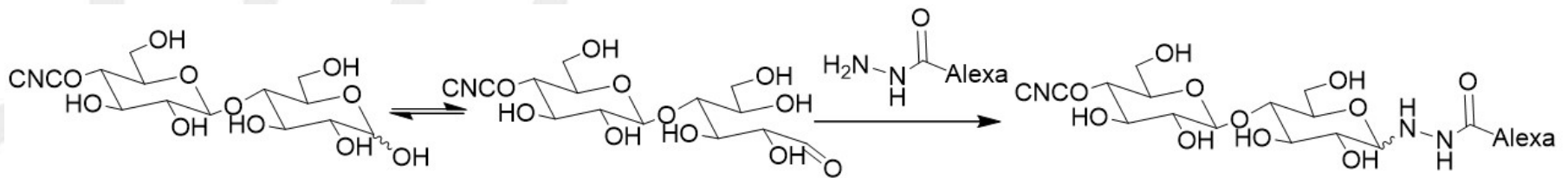
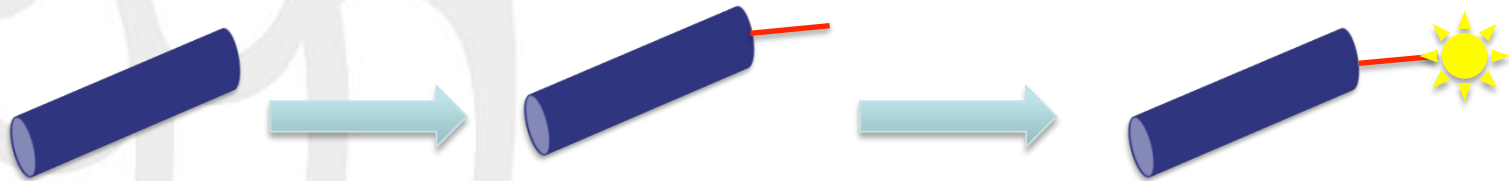
Cellulose Nano-Crystals (CNCs)



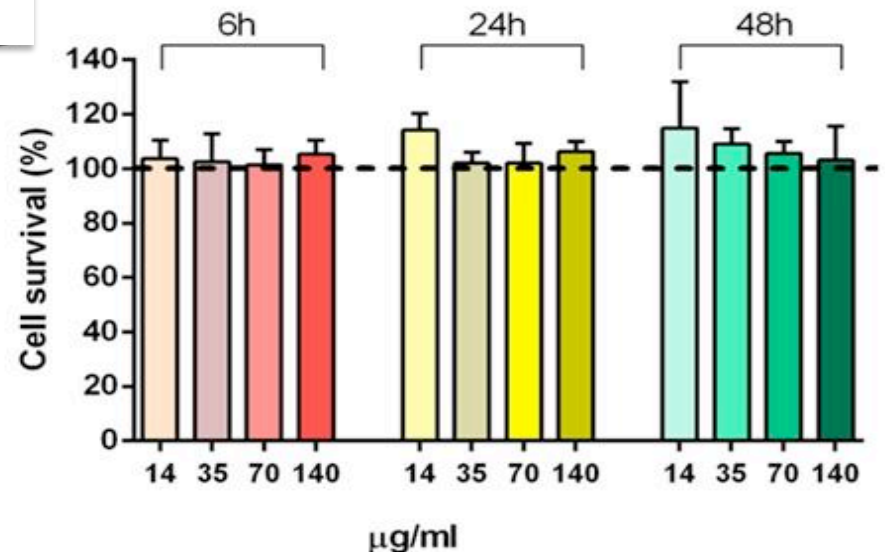
- Rod-like structure
- Lateral dimensions 5 nm
- Longitudinal dimensions 100-200 nm
- Exhibits thixotropic properties - thick (viscous) under normal conditions, but flow (become thin, less viscous) over time when shaken, agitated, or otherwise stressed

The properties of nanocellulose (e.g. **mechanical properties**, **film-forming properties**, **viscosity** etc.) makes it an interesting material for many applications

Synthesis and Chemical derivatization of Cellulose Nano-Crystals (CNCs).

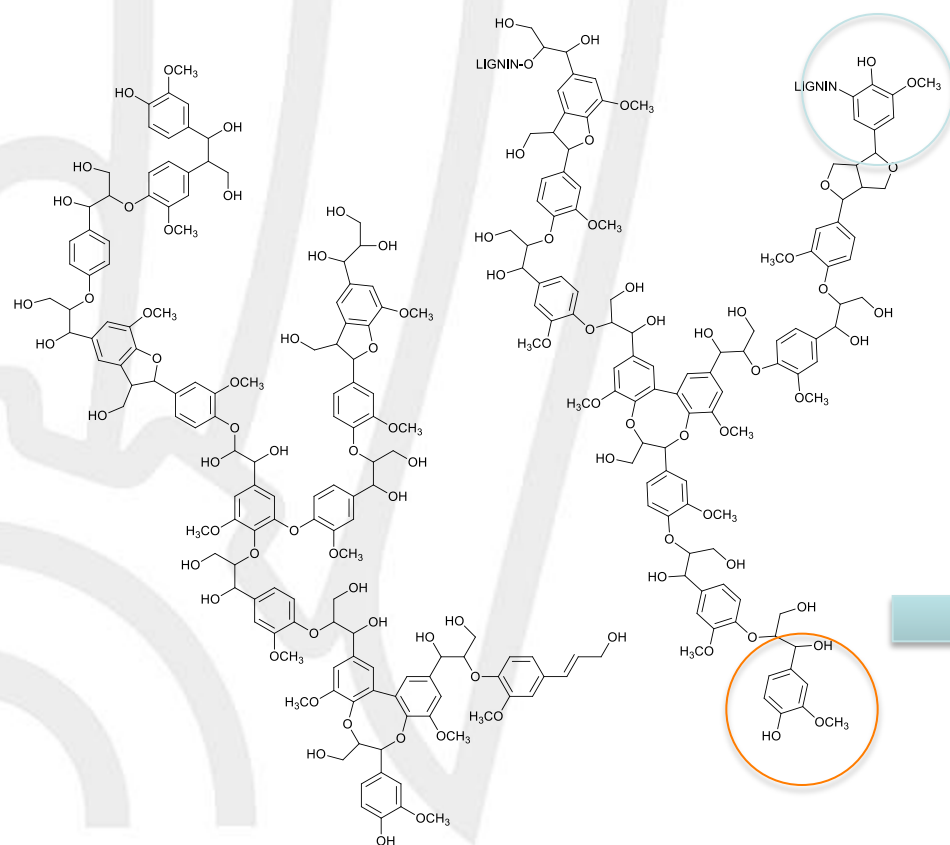


- ✓ Modification of CNCs surface
- ✓ Decoration by fluorescent molecule
- ✓ Chemical and structural characterization
- ✓ Biocompatibility assay

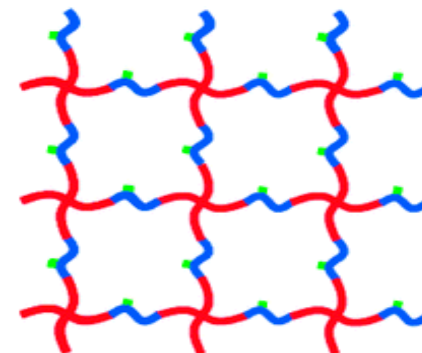


Lignin modification to obtain poliphenols and phenols with antioxidant and antibacterial properties

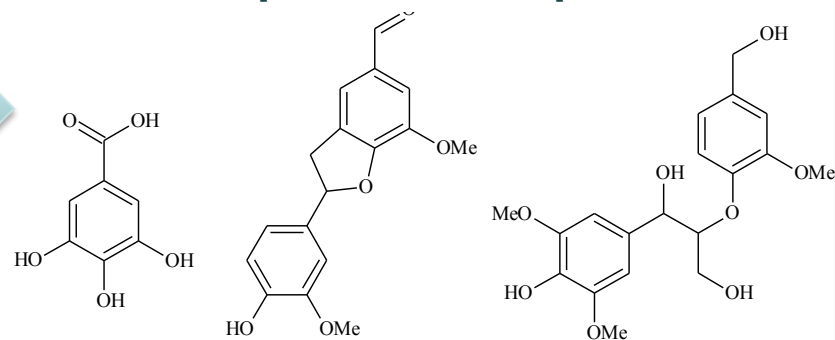
- ✓ Low cost
- ✓ High reperiability
- ✓ Acts as free radical scavengers
- ✓ provides thermal protection to several polymers
- ✓ UV protection



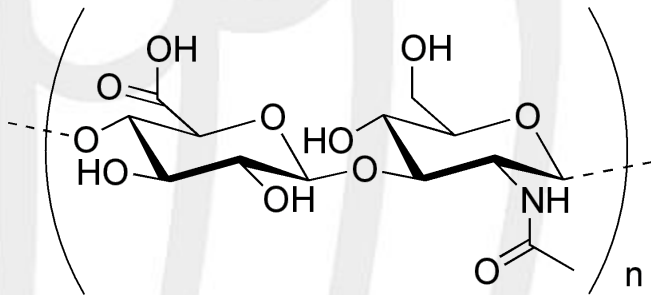
Chemical Modification



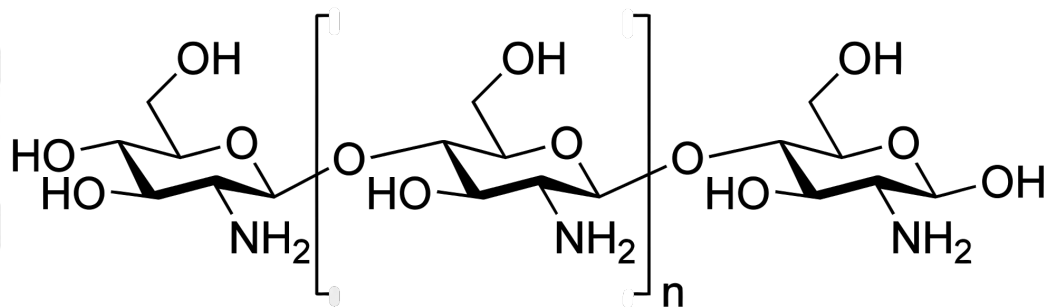
Poliphenols and phenols



Modification and crosslinking of natural polysaccharides.

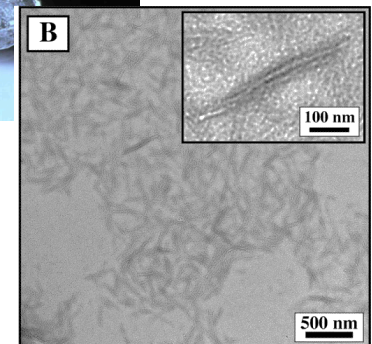
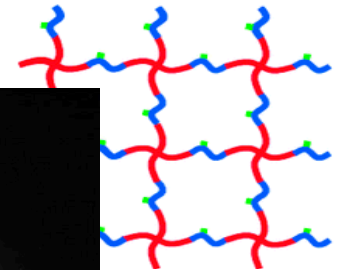
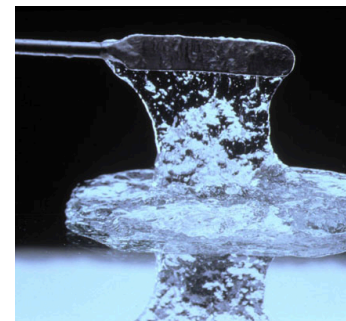


Hyaluronic acid



Chitosan

- ✓ Biocompatible crosslinking methods
- ✓ Design of alternative strategies on the basis of final application
- ✓ Characterization of obtained materials



CONCLUSIONS

- ✓ **Extraction of natural polymers from waste agricultural residues or similar sources**
- ✓ **Preparation of nanostructured cellulose and its derivatization with small molecules**
- ✓ **Modification of lignin structure and depolymerization to obtain antioxidant biomolecules**
- ✓ **Modification of polisaccharidic biopolymers with tailored properties**