



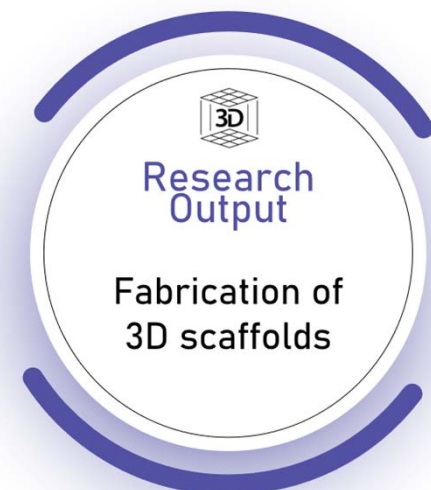
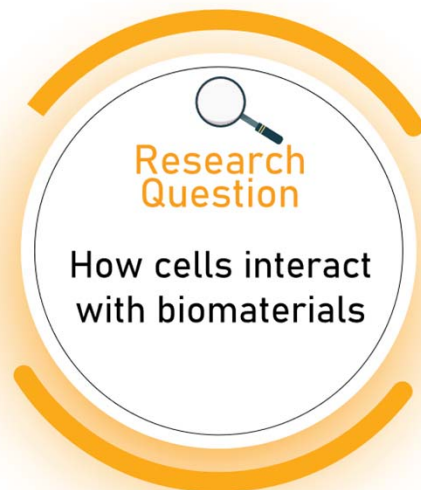
Interactions between Cells and Bio-based materials: from Quantitative Analysis to 3D-printed Scaffolds for Medical Applications

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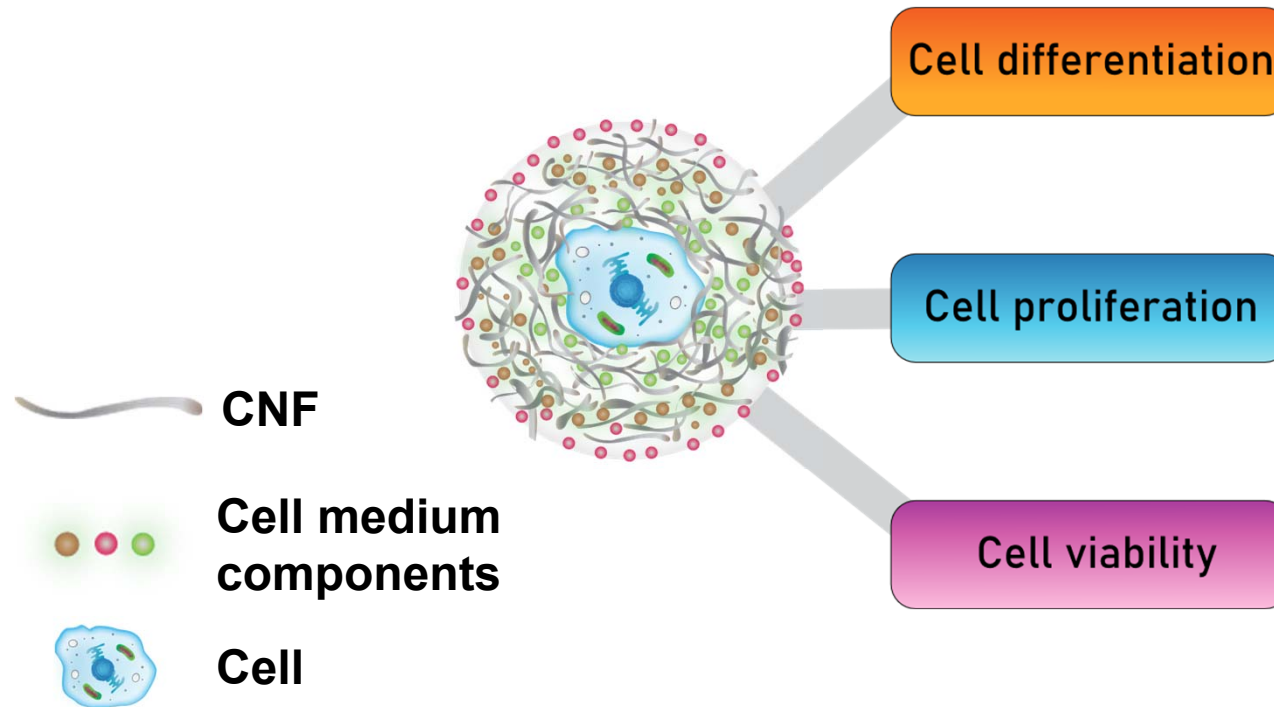


Outline



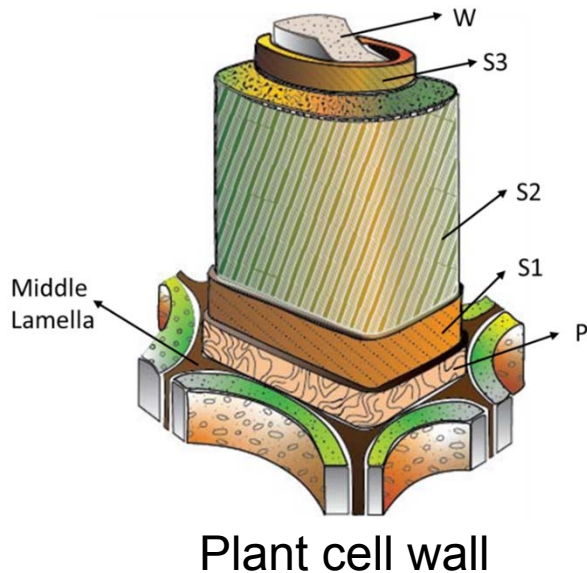
AFM: atomic force microscopy
SPR: surface plasmon resonance

Background

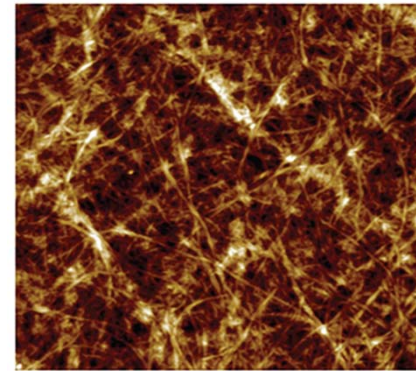


Cellulose Nanofibrils

- Renewable
- Biocompatible
- Porous network



Fibrillation

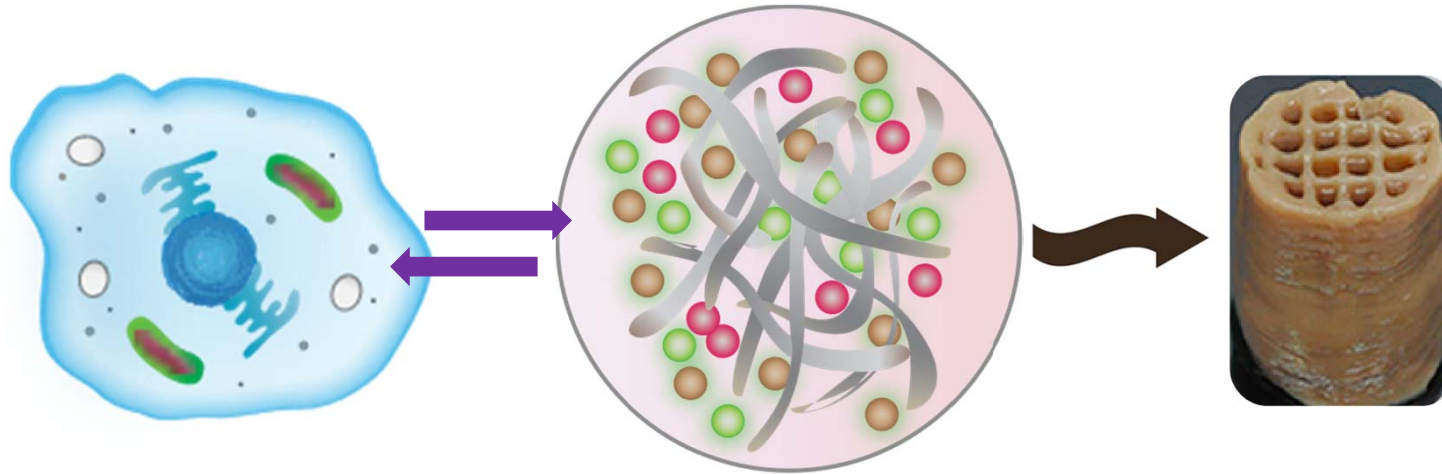


Height

1.0 μm

Diameter: 5-60 nm
Aspect ratio: 50-100

Objectives



- To know the interaction between CNF and human living cells
- To understand the influence of cell medium on the interactions
- To develop 3D cell culture model

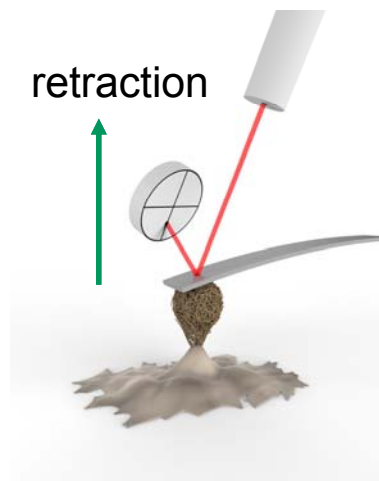
Hypotheses

- ❑ CNF interaction with living cells is **weak** and **non-specific**.
- ❑ Laminin-521 (protein) coating on CNF will **enhance** cell interaction on CNF surface.
- ❑ The inclusion of colloidal lignin particle (**CLPs**) will **improve** the shape fidelity and mechanical strength of CNF hydrogel scaffolds.

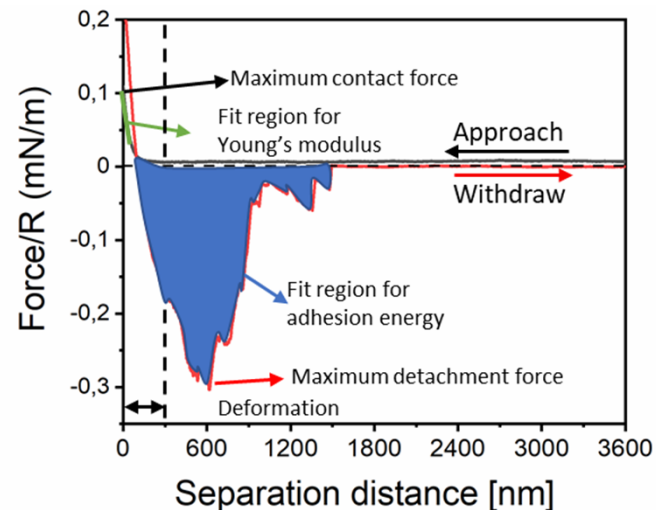
Quantification of cell- biomaterial interactions by AFM

Materials: Cellulose nanofibrils (CNF), Laminin 521 (LN-521)

Cells: WA07 (a human pluripotent stem cell line) and HepG2 (a human liver cancer cell line)

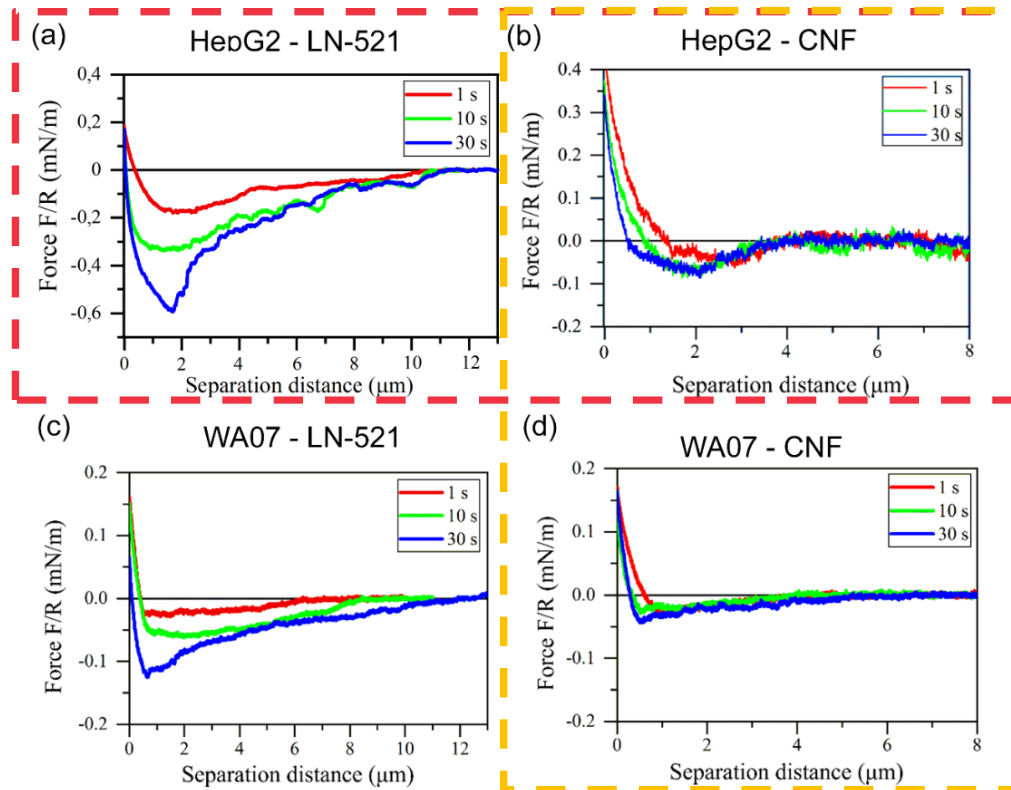


A typical force measurement by CPM

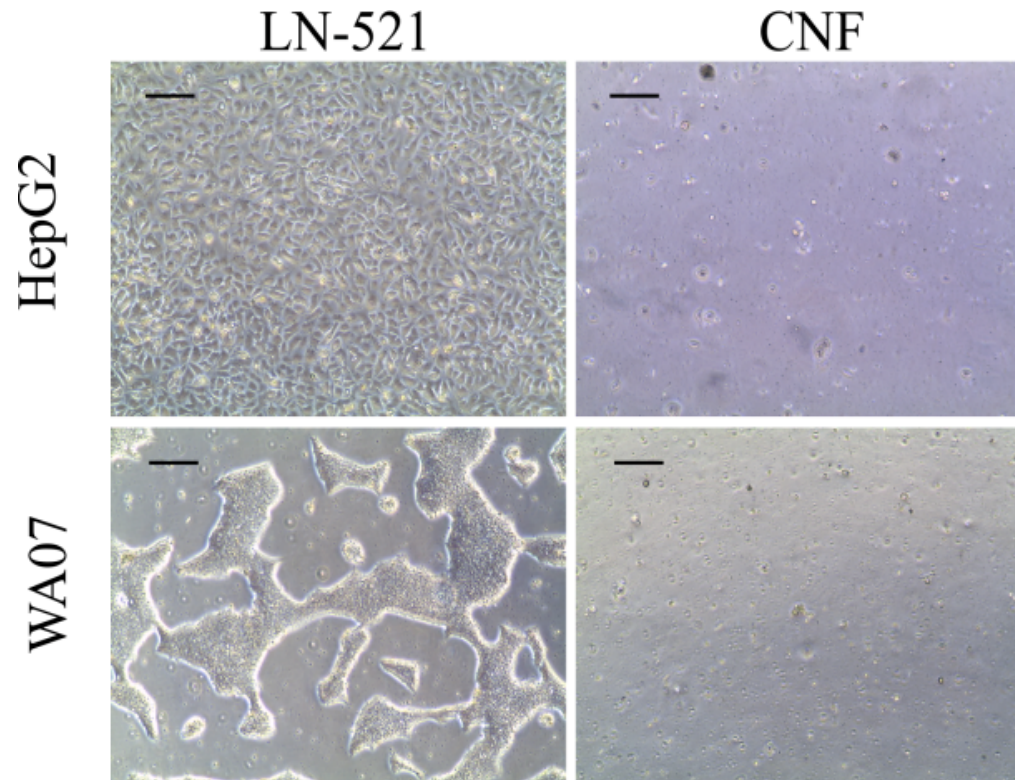


A typical AFM force curve with related information.

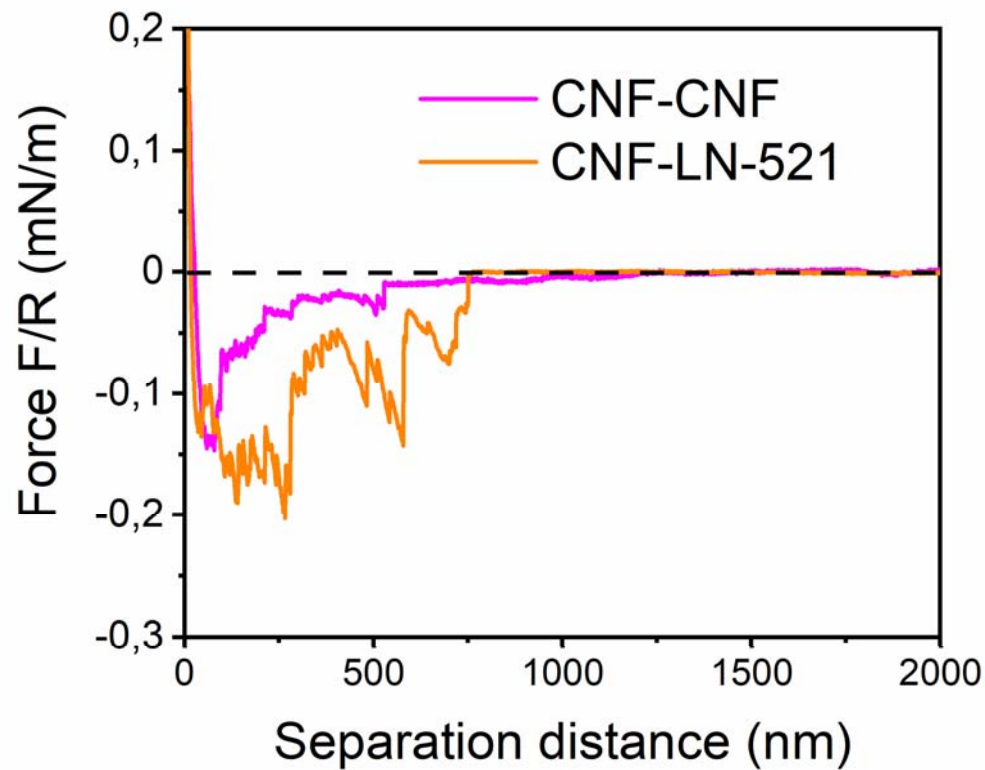
Results - Biomaterial-Living cell interactions



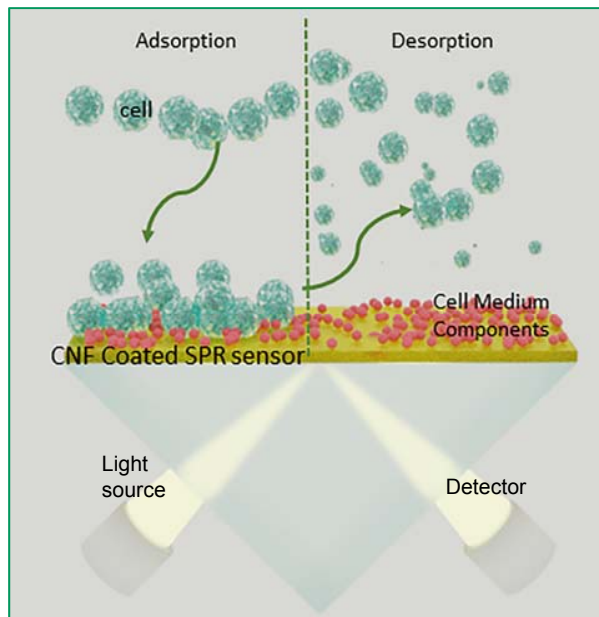
Result- 2D cell culture on flat substrates



Results - CNF-LN-521 interaction by CPM

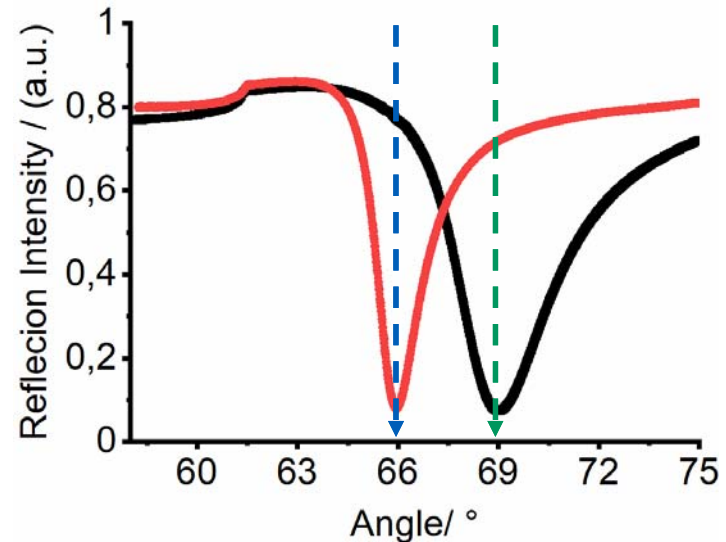


Interaction study by Surface Plasmon Resonance

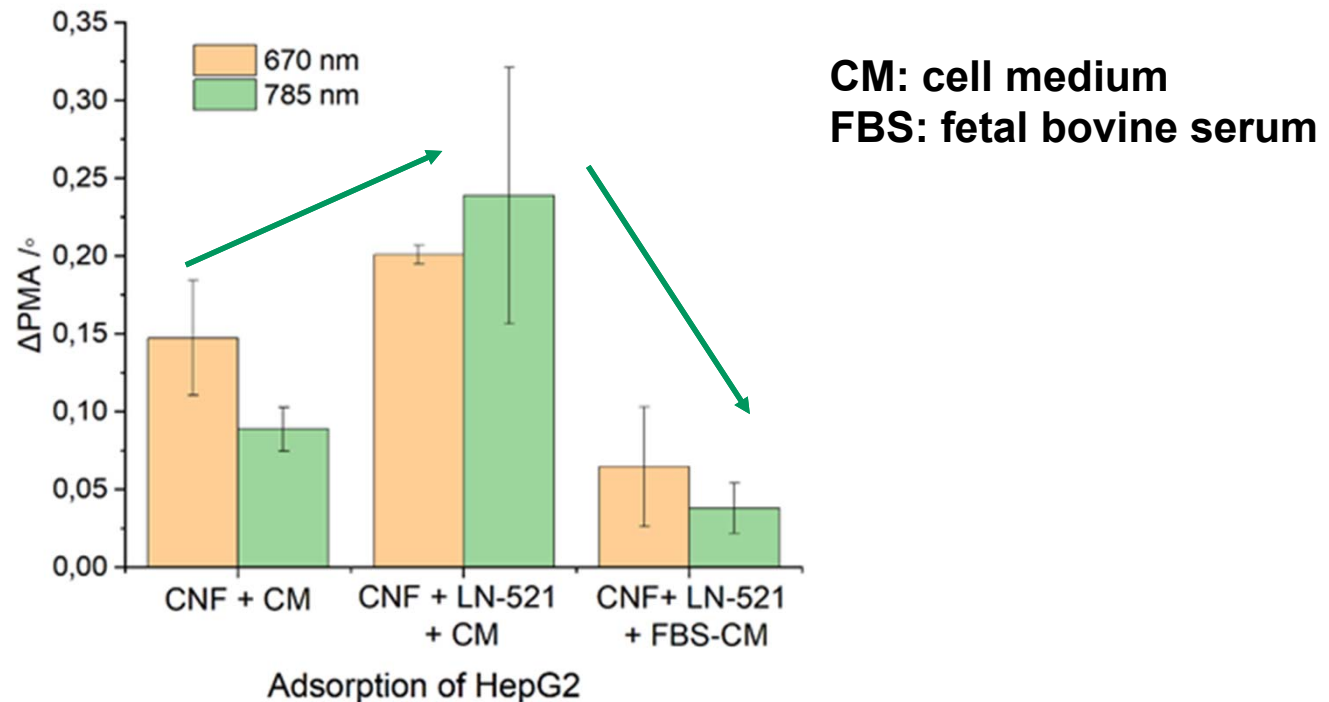


Materials: CNF, LN-521

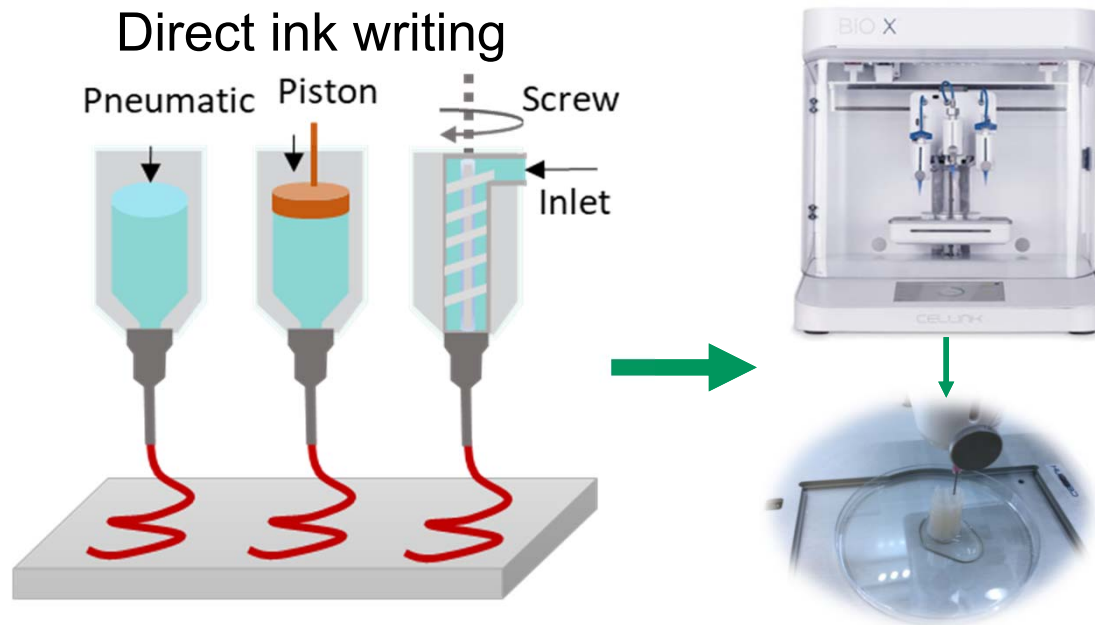
Cells: HepG2



Effect of LN-521 and FBS on HepG2 adsorption on CNF-coated SPR sensors

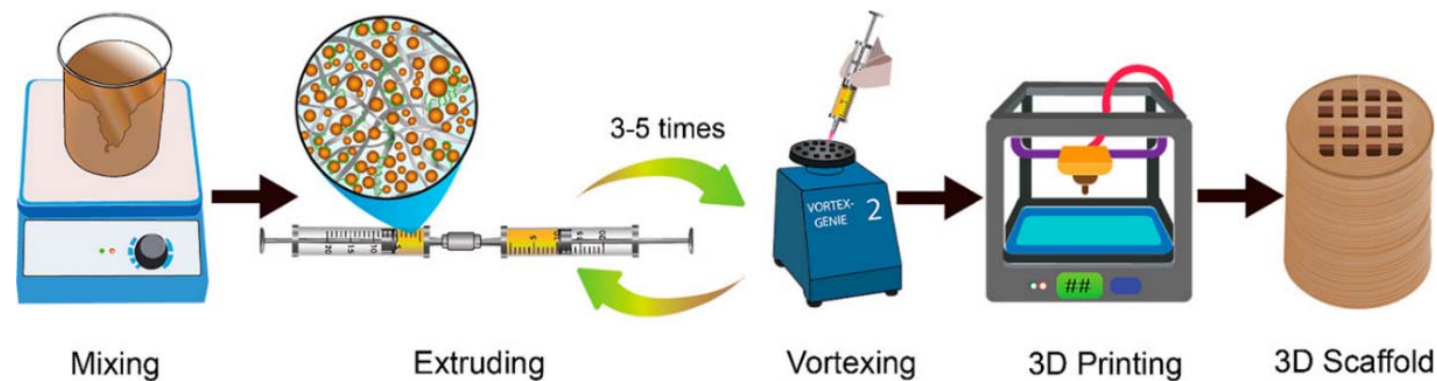


Fabrication of 3D cell culture model by 3D printing



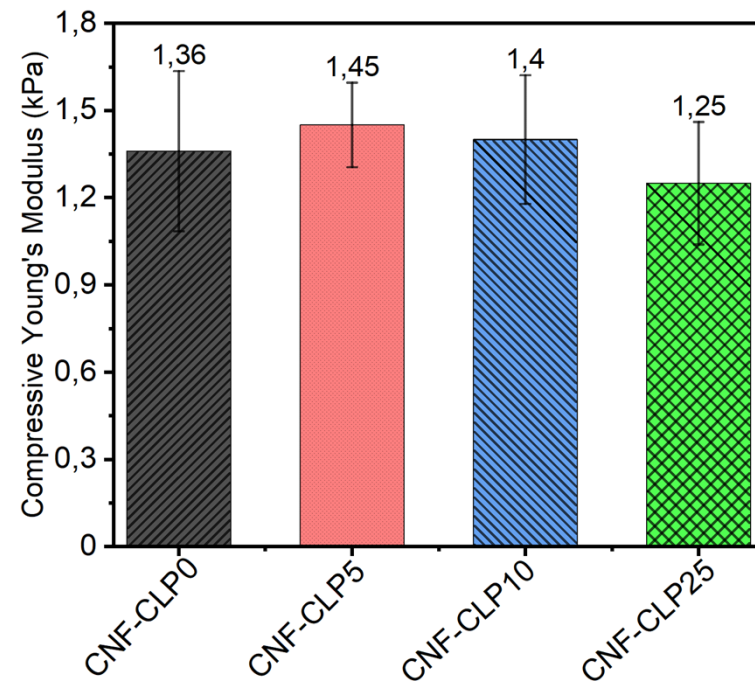
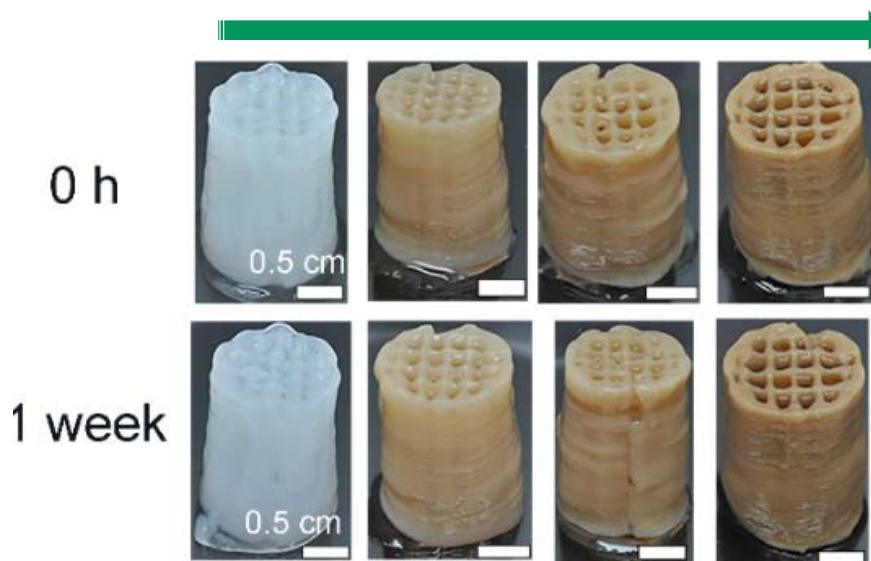
CNF-alginate-CLPs biomaterial printing

The **biomaterial inks** were made from constant concentration of CNF, alginate and varying concentrations of CLPs (0, 5, 10, 25% to the CNF).

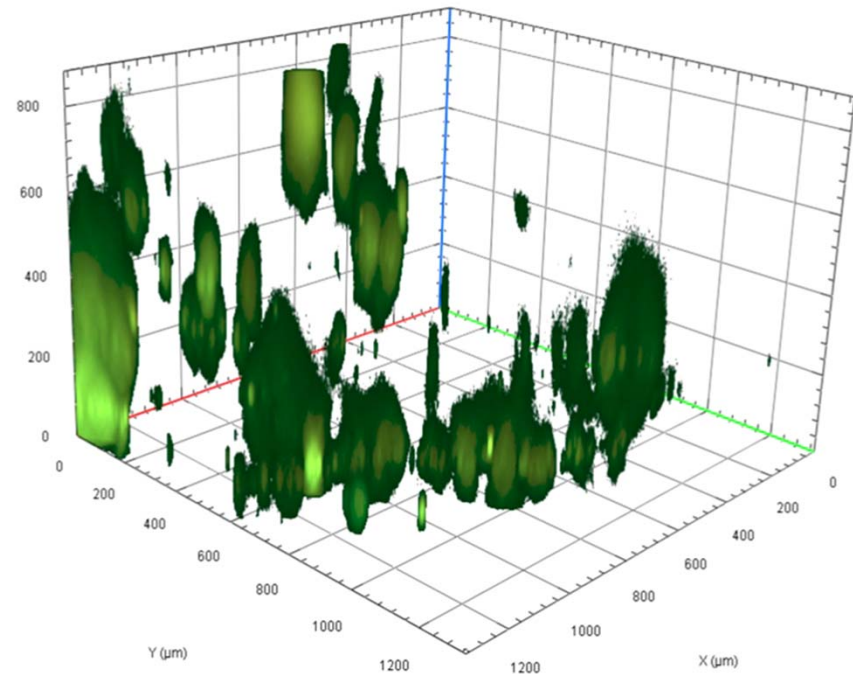
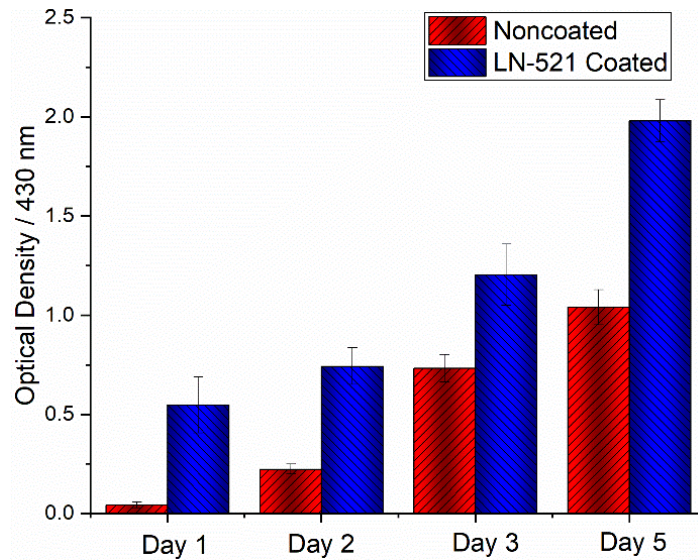


Effect of CLPs on the printability and mechanical stiffness

Improved printing resolution and stability



Results- cell cytotoxicity tested on the printed CNFCLP 25 scaffolds



Highlights

- **Quantitative** interaction information was obtained.
- CNF displayed **non-specific** and **low** adhesion to cells.
- CNF is suitable for growing cell spheroids, and for keeping stem cell undifferentiated.
- LN-521 coating on CNF can **enhance** cell adsorption in specific conditions.
- The printing **resolution** of CNF-alginate- CLPs was enhanced by the inclusion of CLPs.
- LN-521 coating on CNF-alginate-CLPs scaffolds enhanced cell proliferation.

Acknowledgement

Bioproduct chemistry group !
All collaborators !

