



ENCONTRO
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Exploiting bio-based nanofibers for the development of sustainable materials

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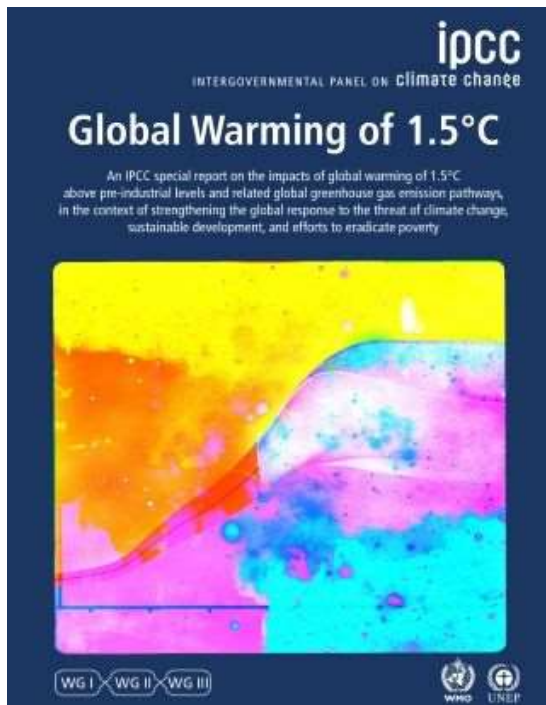
BioPol4fun is a research team within CICECO Line 3- Sustainability and Health- that is working towards **innovation in biopolymer based functional materials and bioactive compounds.**



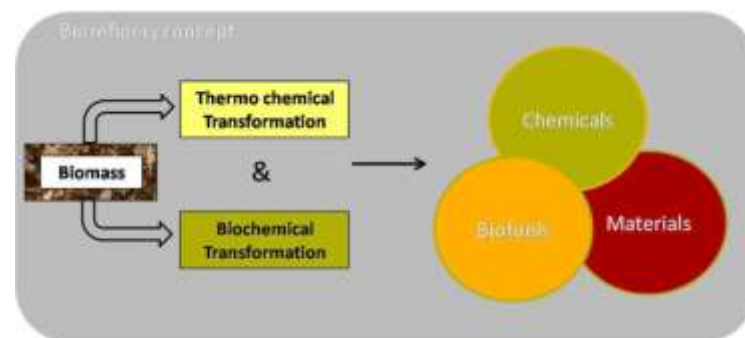
<https://pt.linkedin.com/in/biopol4fun-group-1398a315b>

<https://twitter.com/BioPol4>

The imminent risks posed to our society **by climate changes and associated pollution issues**, clearly spotlight the importance for the present and the next generations do definitely move forward to a **fully sustainable economy**

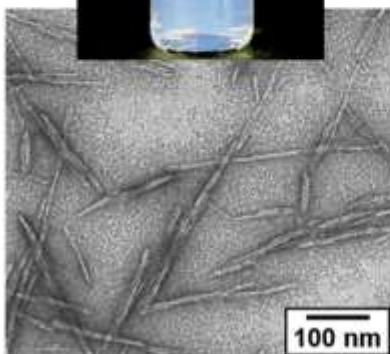


Pectins Starch Collagen
 Renewable Resources Cellulose
 Chitosan Biorefinery Proteins
 Protein Nanofibers
 Pullulan Bio-based Materials
 Polysaccharides Biodegradable
 Circular economy Gelatin Lignin
 Nanocellulose Fibers
 Silk Fucoidan Biopolymers

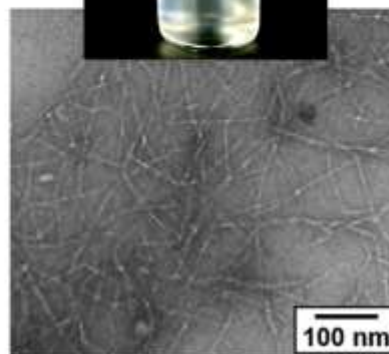


CELLULOSE (nanoscale forms)

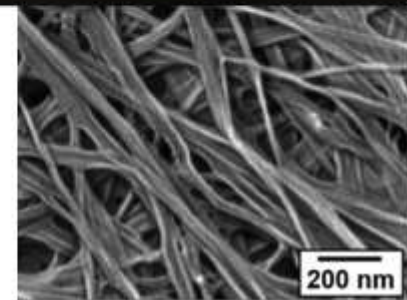
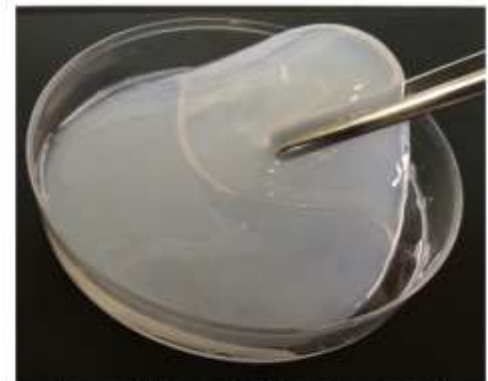
**Cellulose
nanocrystals**
CNCs



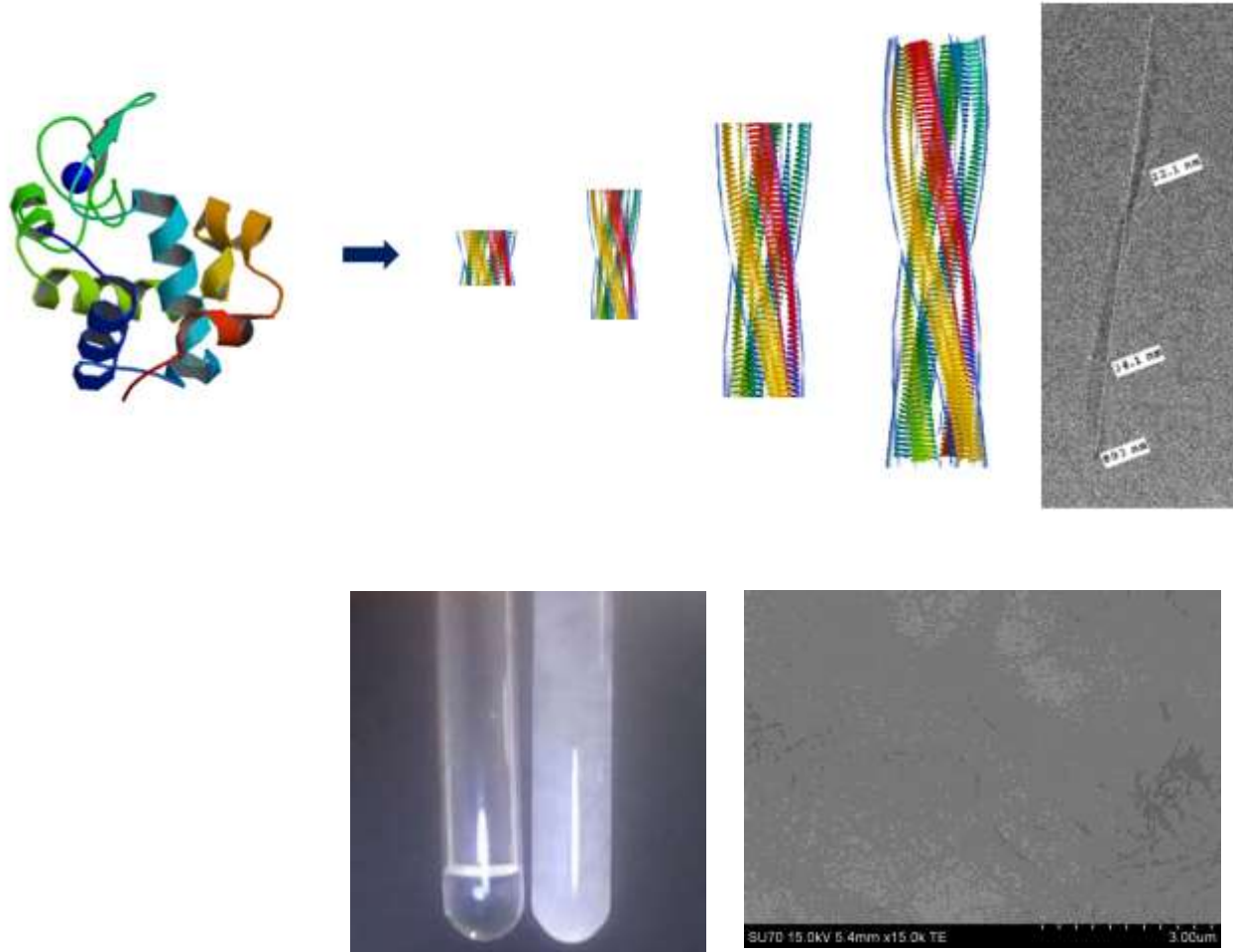
**Cellulose
nanofibrils**
CNFs

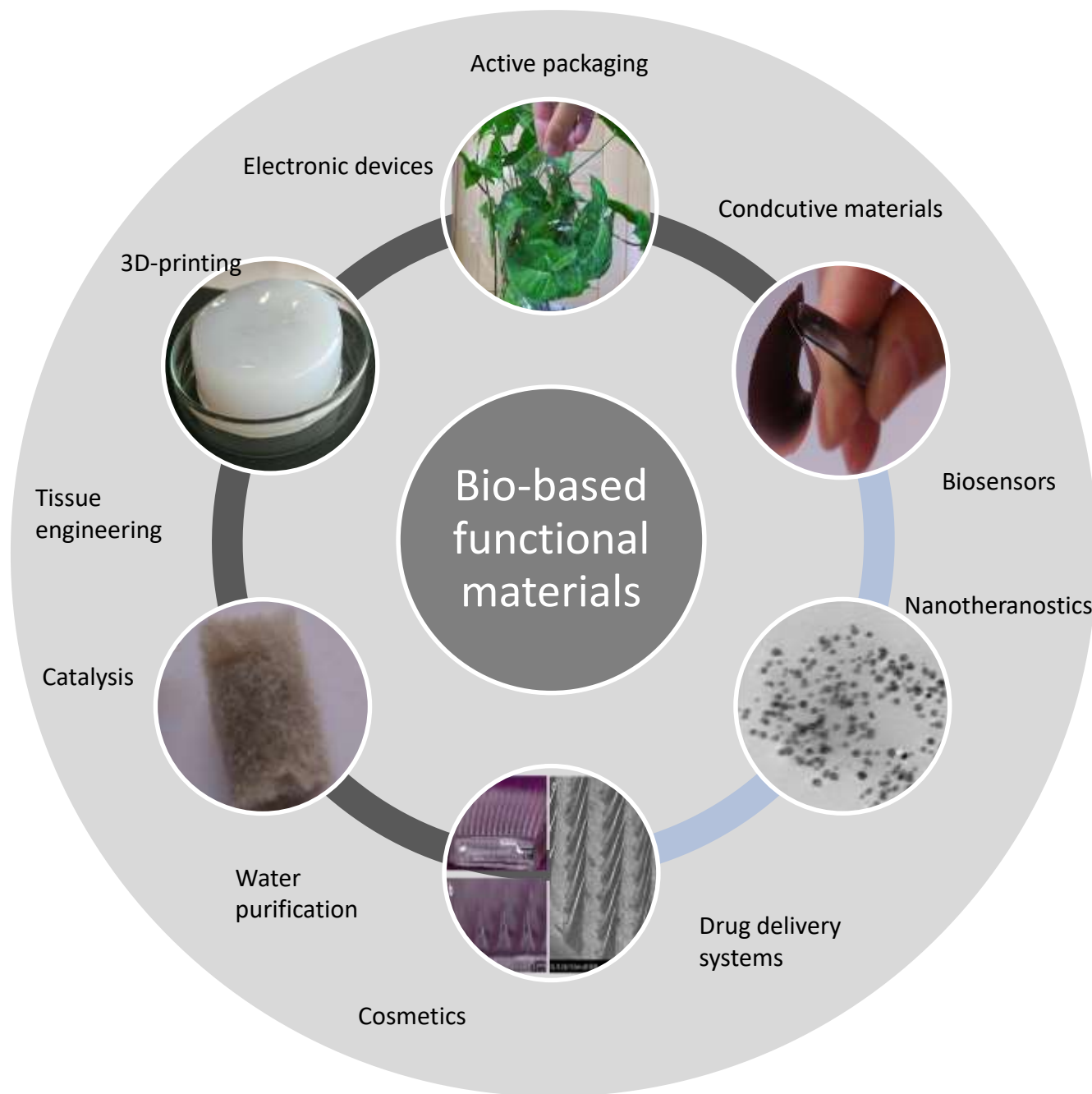


**Bacterial
nanocellulose**
BNC



Protein nanofibers resulting from the self-assembly of unfolded proteins or polypeptides, are characterized by a highly organized quaternary structure consisting on conformed β -sheets

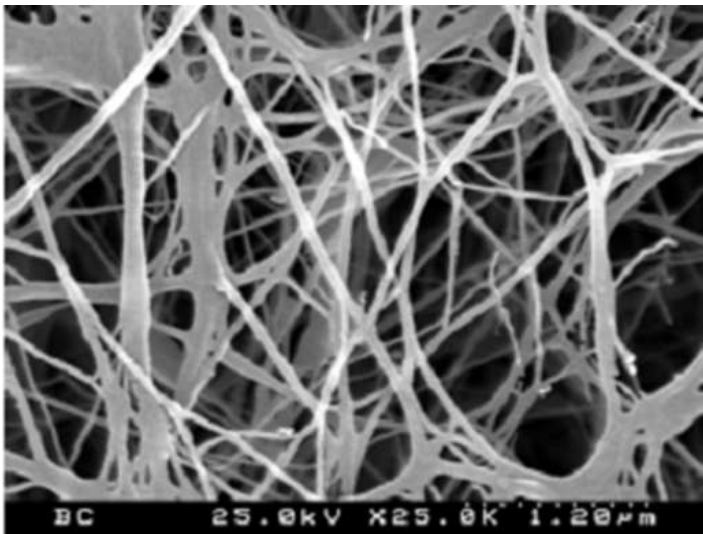




Nanocellulose based drug delivery systems

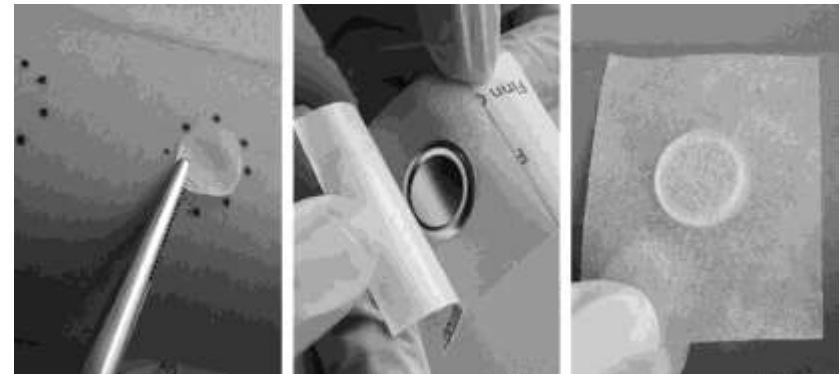
BNC membranes have high potential in topical drug delivery

Porous Structure



3D network of cellulose nanofibrils

Human skin compatibility



Sequential steps of the patch test using Finn Chambers®

Nanocellulose based drug delivery systems

Pristine BNC membranes for dermal drug delivery



BNC membrane
(wet)

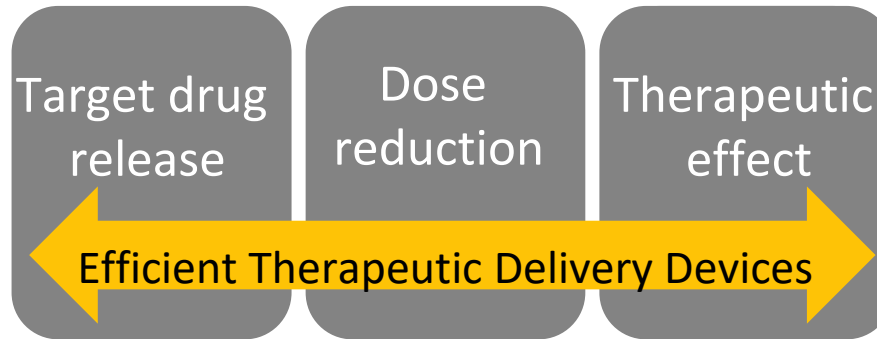


LIDOCAINE
or
IBUPROFEN
or
DICLOFENAC
or
CAFFEINE



BNC/Drug membrane (dry)

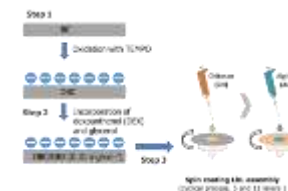
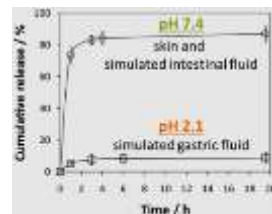
Nanocellulose based drug delivery systems



Systems with stimuli-responsiveness and tailored architecture

pH-sensitive BNC-based systems

Multilayered BNC membranes or microneedles systems

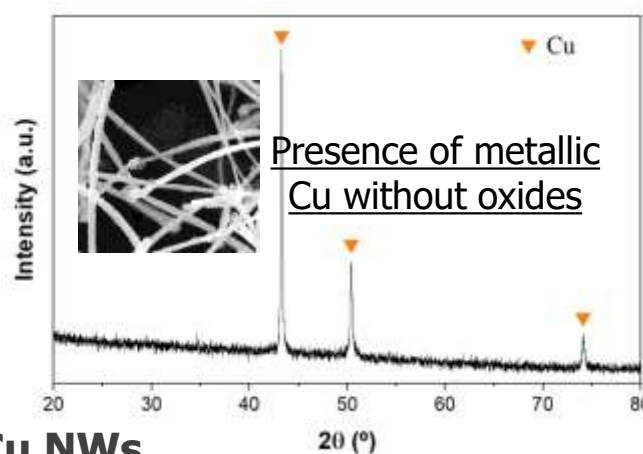


Nanocellulose based hybrid materials

Conductive nanocomposites of NFC/Cu nanowires



Green synthesis of Cu NWs



NFC

1. Direct mixing

2. Filtration

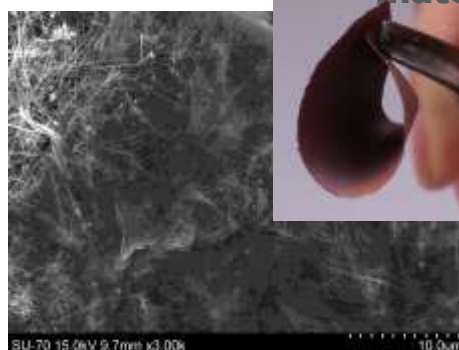
3. Drying

5 wt.% Cu NWs



CONDUCTIVITY:

Up to 736 S.cm⁻¹
(constant for 3 months)



Homogeneous incorporation
of **Cu NWs** onto the **CNF** films

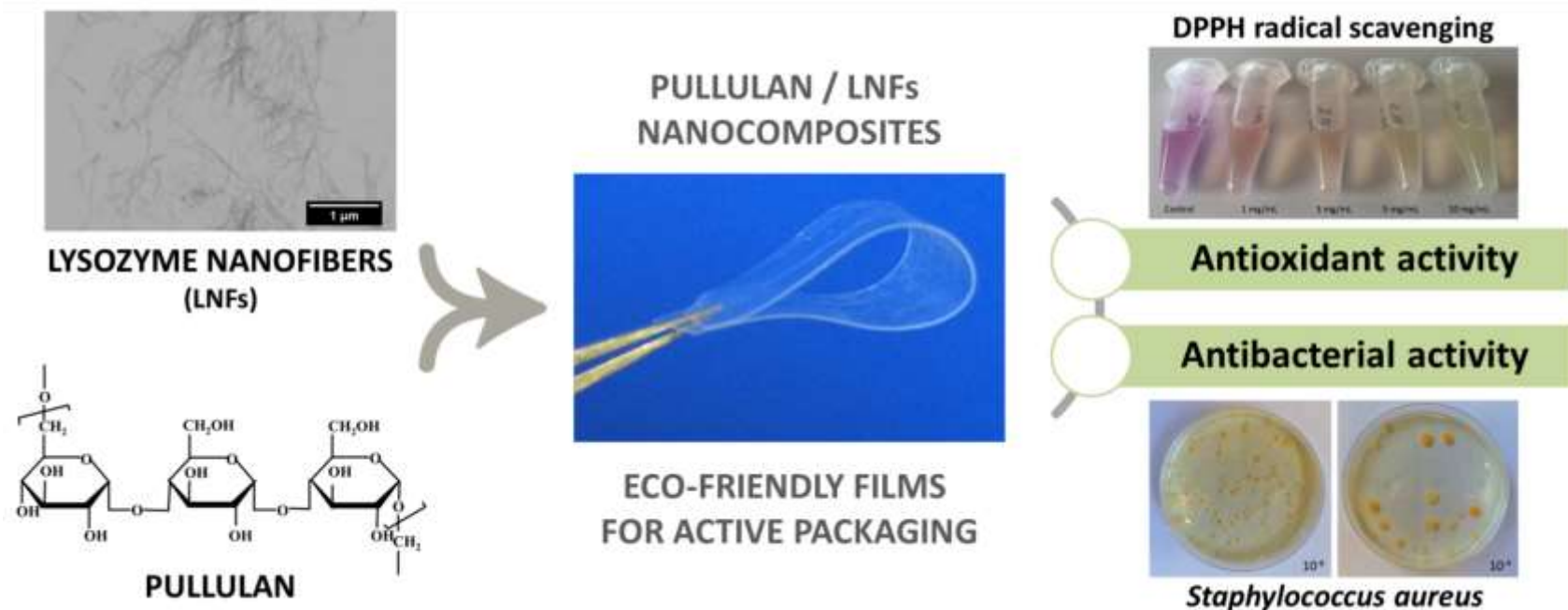
**Flexible
material**



**Films of NFC/Cu
nanowires**

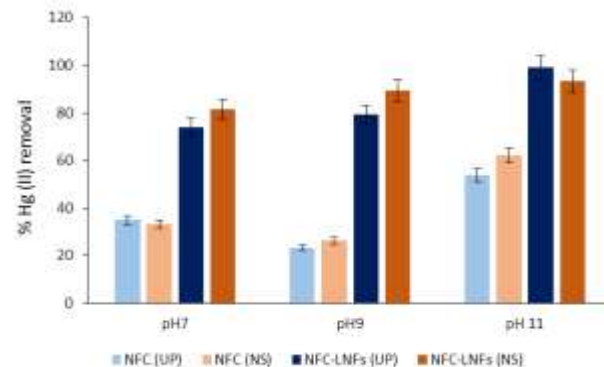
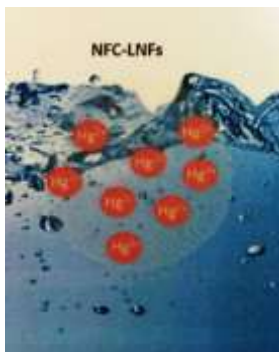
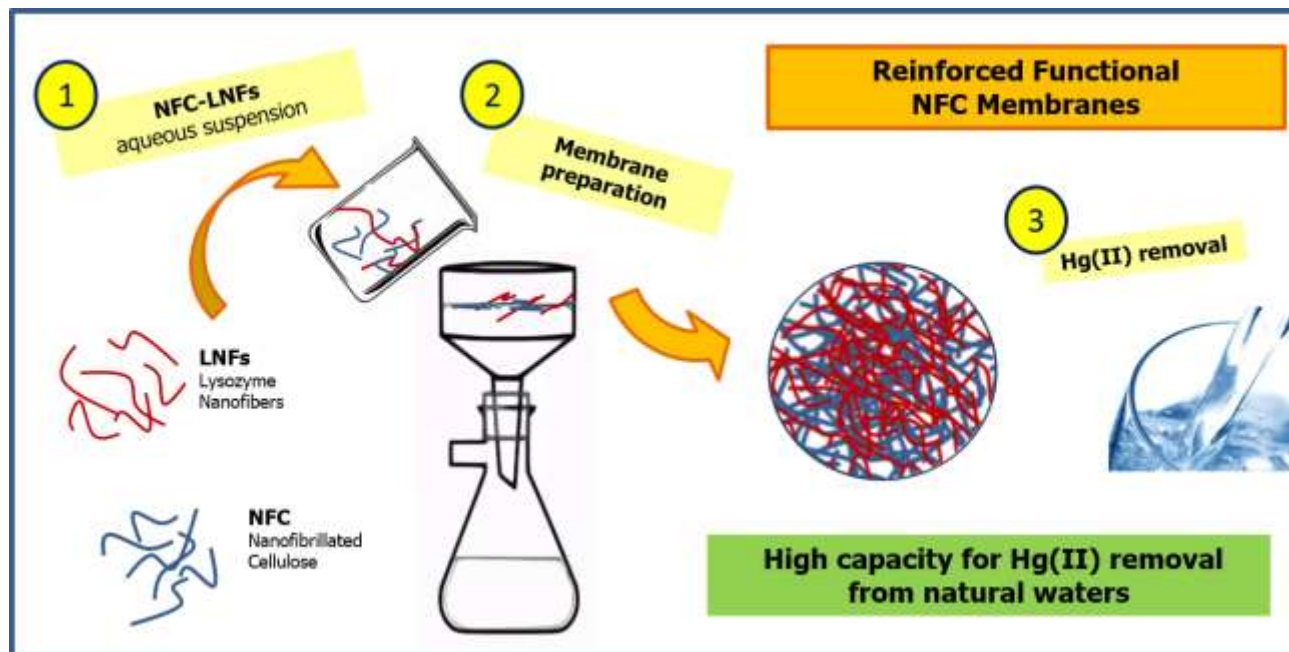
Protein nanofibers based films

Pullulan-based nanocomposite films for functional food packaging:
exploiting lysozyme nanofibers as antibacterial and antioxidant reinforcing additives



Nanocellulose-protein nanofibers based membranes

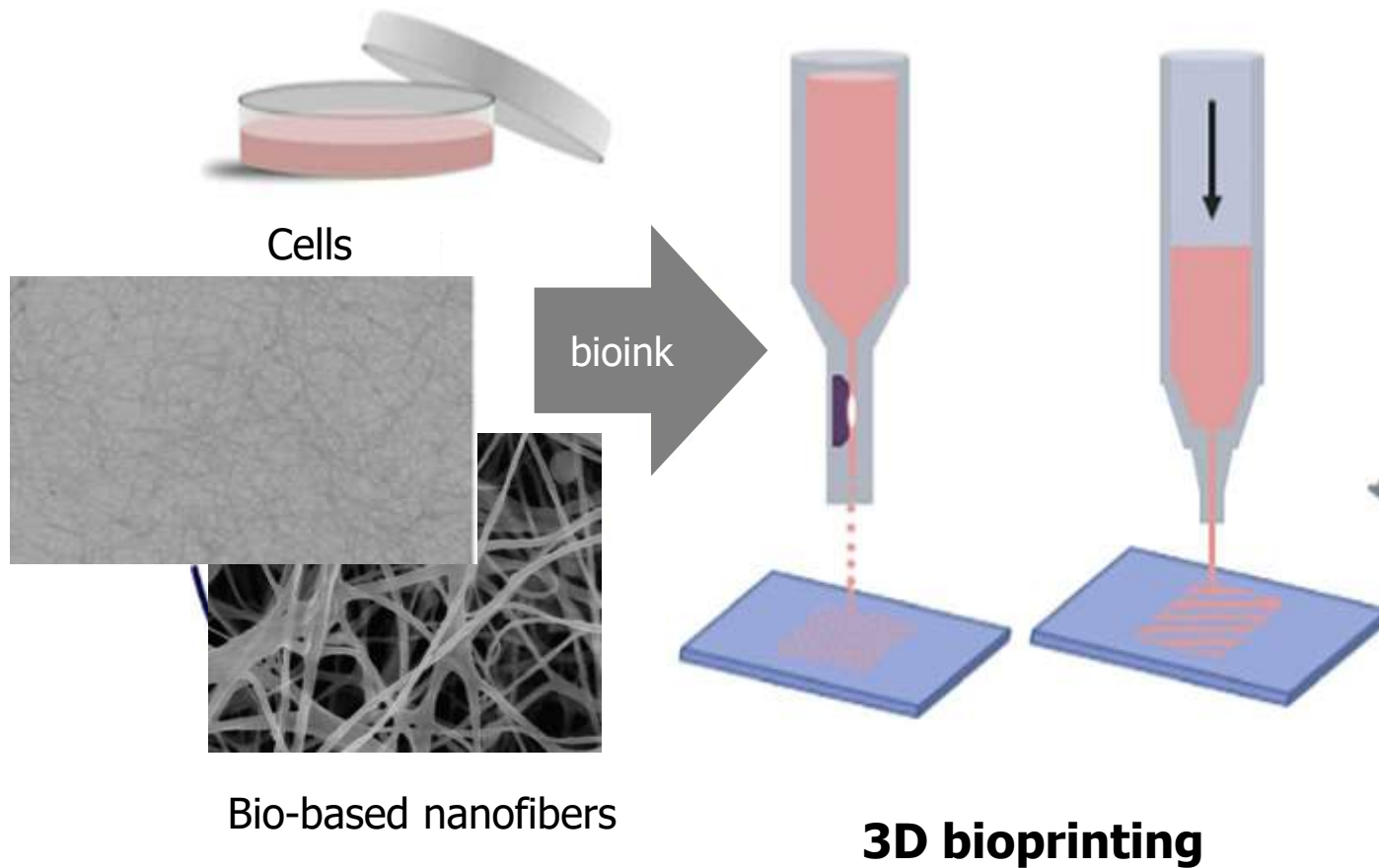
Bio-based membranes composed of nanocellulose and protein nanofibers (lysozyme nanofibers) for the removal of mercury (II) from natural waters



Use of bio-based nanofibers to produce bioinks

Novel bioinks (hydrogels and microcarriers) for 3D bioprinting -work in progress

Conclusions





BIO-BASED NANOFIBERS UNIQUE BUILDING BLOCKS FOR THE DESIGN OF SUSTAINABLE MATERIALS



THANK YOU FOR YOUR ATTENTION !