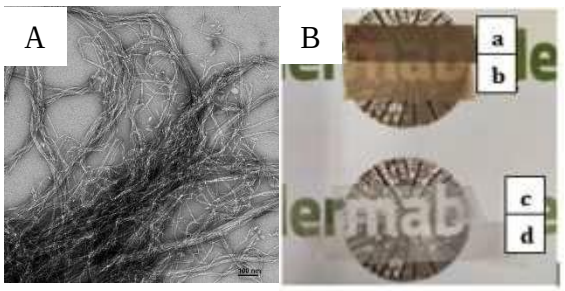
WoodNF



A- TEM of nanofibrillated beech wood (L-NMFC)
B- Nanoperes produced from beech wood
   a. Non-bleached L-NMFC
   b. Non-bleached phosphorylated L-NMFC
   c. Bleached L-NMFC
   d. Bleached phosphorylated L-NMFC

Exploded wood-based nanofibers for electrospinning technology

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With the collaboration of: Nanjing Forestry University (RPC), LCPME, Silva

Work package: WP3

Context—
The eco-friendly characteristics of the lignocellulosic micro and nanofibrillated cellulose (L-MNFCs) prompt researchers to continuously develop new materials. Benefiting from their high specific surface area, attractive physical along with mechanical properties, efforts have been made to isolate L-MNFCs for innovative utilization. However, the procedure of the L-MNFCs extraction has important shortcomings that limit their development, the high production cost of L-MNFCs being the huge obstacle to their widespread use

Objectives—
In the present project, and based on our recent advances (see NanoSteamEx project), the objective was the production of phosphorylated L-MNFCs and nano-paper from beech wood. Compared to alternative methods, the process used is steam explosion which is an eco-friendly and cost-effective process.

Approaches —
Beechwood sawdust was pre-soaked in alkali and pretreated by steam explosion (200°C, 8 min). A bleaching step (Chlorite) was eventually carried out. Phosphorylation was performed using urea and etidronic acid. The nanofibrillation using an ultrafine friction grinder produced nanofibrillated cellulose.

Key results —
- flame retarded phosphorylated lignin-containing or bleached micro/nano fibrillated cellulose has been prepared from beech wood.
- the phosphorylation of the fibers before the grinding facilitated the fibrillation producing longer and narrower fibers and nano-papers exhibited higher Young's moduli of elasticity;
- Steam explosion pretreatment led to a drastic change in the thermal decomposition of beech wood.
- Phosphorylated L-MNFCs exhibiting a remarkable elevation in their thermal degradation and flame-retardancy have been produced.
- The chemical composition and morphology of phosphorylated (L-)NMFCs was assessed by different techniques and the successful grafting of phosphate groups was verified.

Main conclusions including key points of discussion —
In this study, flame retarded phosphorylated lignin-containing or bleached micro/nano fibrillated cellulose has been prepared from beech wood. The figure given shows the transparency of the nanopapers produced especially for the bleached samples. These materials have outstanding mechanical and thermal properties.

Perspectives —
Because of its ease of implementation of its low cost, we hope that this approach opens new perspectives in the field of advanced composites. This kind of microsized phosphorylated cellulose opens promising perspectives for the manufacture of functional materials with flame retardancy and/or with biological activity.

Valorization —
- Study of the effectiveness of sulfonation in the production of nanofibrillated cellulose containing lignin (LCNF) by ultrafine grinding, Khadraoui, Malek; Khiari, Ramzi; Brosse, Nicolas; Bergaoui, Latifa; Mauret, Evelyne, Abstracts of Papers, 261st ACS National Meeting, April 5-16, 2021 (2021)
- Phosphorylated lignocellulosic micro/nano fibrillated cellulose by steam explosion, Liangsong Chenga,b, Saad Naderb, Evelyne Mauretc, Karina Antounb, Zehui Jua,b, Henri Vahabid, Xiaoning Lua, Nicolas Brosse, submitted to Int J Biol Macromol.

Leveraging effect of the project—
the project was carried out in collaboration with Nanjing Forestry University (RPC). A follow-up will be given and will allow us to reinforce our exchanges.