

# Press release

22 January 2021

## Flax fibres modification for the development of biocomposites

On December 10, 2020, Estelle Doineau defended a doctoral thesis from the University of Grenoble Alpes prepared under the supervision of Professor Jean-Charles Bénézet (IMT Mines Alès) and Julien Bras, Associate Professor HDR (Grenoble INP-Pagora / LGP2) and the co-supervision of Bernard Cathala, Research Director (INRAe Nantes).

Estelle Doineau presented the results of her research entitled *Flax fibres modification by cellulose nanocrystals and xyloglucan for the development of hierarchical biobased composites*. This thesis project aims at developing flax fibres surface treatment for the improvement of the mechanical properties of biocomposites with polymeric matrix and flax reinforcements.

This surface modification is inspired by the hierarchical structures present in biological systems (bone, nacre or wood), composed of nano-objects which allow a better transfer of loads in these materials. This presence of nano-sized objects makes it possible to reach impressive strength and toughness values and to limit cracks propagation.

In this project, products derived from lingo-cellulosic biomass, namely cellulose nanocrystals (CNC) and xyloglucan (XG), were chosen for their interesting properties and mutual affinity to create hierarchical flax fibres. In a first step, the adsorption of XG and CNC on flax fibres was localized and quantified using fluorescent markers. In addition, atomic force microscopy measurements of adhesive force revealed the creation of an extensible XG/CNC network on the fibre surface. Subsequently, two paths were proposed with the elaboration of thermoplastic (polypropylene/flax fibres) and thermoset (epoxy resin/flax fabric) biocomposites using these nanostructured fibres. In both cases, an increase of the work of rupture has been measured by micro- and/or uniaxial tensile tests, allowing dissipating more energy upon breakage.

All this work has allowed evaluating the potential of different hierarchical natural reinforcements (unidirectional fabric or short flax fibers) for the development of structural biocomposites with a focus on the fiber/matrix interphase zone.

Contact LGP2 Evelyne.Mauret@grenoble-inp.fr - Logo logo-lgp2.eps

---

**Grenoble INP-Pagora, the international school of paper, print media and biomaterials.** The school is Quality, Safety & Environment certified and part of Grenoble INP, an engineering and management institute geared towards training “engineers who are creative, responsible and committed to a sustainable world”. It trains engineers for the sectors of green chemistry, paper, printing, packaging, biomaterials and printed electronics. Its wide range of courses, pedagogical expertise and strong partnerships with industry allow it to continuously tailor its training to the needs of businesses and to the 60 graduates it produces each year, thus enabling them to embark upon stimulating careers in France and abroad. Grenoble INP-Pagora also develops international training: it offers a 2<sup>nd</sup> year engineering course, international semesters and a Biorefinery & Biomaterials Masters, taught in English. The innovative research performed by its LGP2 laboratory helps to improve processes and create products that meet all the latest requirements, notably those linked to the environment. These various activities ensure that the training offered is up to date with the latest scientific and technological advances. [pagora.grenoble-inp.fr](https://pagora.grenoble-inp.fr)

**The Laboratory of Pulp and Paper Science and Graphic Arts (LGP2)** is a joint research unit (UMR 5518) run by the CNRS, Grenoble INP and the AGEFPI. It conducts its scientific activities in conjunction with the academic community of Grenoble Alpes University. LGP2 comprises three teams: *Biorefinery: chemistry and eco-processes – Multiscale biobased materials – Surface functionalization through printing processes*. Their research strives to meet society's expectations when it comes to sustainable development (green chemistry, clean processes, recycling, biobased materials, renewable energy) and traceability & safety (functional materials, smart paper and packaging). [pagora.grenoble-inp.fr/lgp2](https://pagora.grenoble-inp.fr/lgp2)