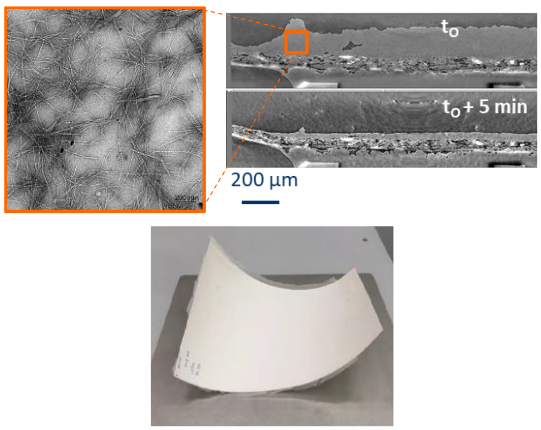
Postdoc Position

«Wet lamination and drying of cellulose nanofibrils hygrogels on paper boards for renewable and biodegradable packaging: microstructures and hygromechanical couplings»

Project summary

Designing renewable and biodegradable materials for food or health packaging is of major importance. Many research efforts are being developed purposely, in particular for looking for novel processing routes with fibers and nanofibers extracted from the vegetal biomass. The European project Celluwiz belongs to this research line. The objective of Celluwiz is to produce multilayered bio-based structures made of paper boards onto which cellulose nanofibrils (CNF) films are deposited *via* the wet lamination process. These new bio-based fibrous materials exhibit valuable specific mechanical properties and excellent permeability to gases and even to water (if CNF films are properly treated, *e.g.*, with chromatogeny). However, during the wet lamination, many complex mechanisms occur such as the high anisotropic shrinkage of the CNF hydrgogels during their drying, as well as their adhesion to the paper board substrates. These mechanisms are not well understdood and induce important defects on the produced materials: development of internal stresses and high residual strains leading to undesirable curling (see figure), clocking and delamination phenomena. **The main objective to the postdoc is to characterize these defects, by investigating the hygro-mechanical behaviors of (i) the CNF hydrogels during their drying, (ii) the paper boards, (iii) the multilayered systems.** For that purpose, various experimental analyses will be carried out:



TEM micrograph showing the typical nanostructure of CNFs (CTP-CERMAV, left upper picture) that constitute the hydrogels which are laminated onto paper boards, shrink during their drying (right upper micrographs, X-ray microtomography, 3SR Lab-CTP) and induce a macroscale curl of the multi-layered systems (lower picture).

- Mechanical tests with various mechanical loadings (uniaxial, plane strain and bi-axial tensions), controlled environment (temperature, relative humidity) and kinematical field measurements (SDIC),
- 3D imaging using laboratory (3SR Lab) and synchrotron (ESRF) X-ray micro tomography for multiscale 3D *in situ* observations of drying phenomena for the CNF hydrogels and the multi-layered systems.

Work context and practical aspects

- The proposed offer is part of the European Project H2020 Celluwiz (http://www.celluwiz.eu/) which includes academic (CNRS - 3SR lab and CERMAV) and industrial partners (CTP, ITENE, STORA ENZO, VOITH).
- Location: the postdoc project will be located in the ComHet research group of the 3SR Lab, a Solids Mechanics research lab of the CNRS and the Univ. Grenoble Alpes (Grenoble, France, https://3sr.univ-grenoble-alpes.fr/), with strong interactions with the projects partners, in particular with CTP. Some of the experiments will be carried out at ESRF, for 3D *in situ* imaging using the X-ray tomographs of the ID19 beamline.
- Duration: 18 months
- Starting date: march 2020
- Salary: around 2800€/month

Skills & Applications

- PhD in mechanics of materials or materials science
- Keywords : Bio-based materials, experimental mechanics, 2D/3D imaging for heterogeneous/fibrous materials
- Interested applicants should fill the application form and deposit their extended CV as well as their motivation letter on the CNRS recruitment site:

https://emploi.cnrs.fr/Offres/CDD/UMR5521-LAUORG-001/Default.aspx?lang=EN

For further details, please contact Laurent.Orgeas@3sr-grenoble.fr .