

NanoCell3D

Development of innovative bio-based and functional materials for the production of smart objects by 3D printing

Développement de matériaux bio-sourcés fonctionnels pour impression 3D par extrusion

- ▷ Début de parution : 15/03/2016
- ▷ Date limite de candidature : 30/04/2016

Project Description

During the last decade, a particular interest was exponentially paid to nanocellulose due to the outstanding properties of these bio-based and renewable nanofibers. Owing to their ability to form entangled networks with outstanding mechanical properties, nanocelluloses are widely used as: i) reinforcing phase in bio-nanocomposites, ii) barrier films in packaging materials, iii) structural backbone for cellulose foams/aerogels manufacturing and iv) more recently, as rheology modifiers and binders in the formulation of aqueous inks and pastes with conductive/electroactive properties

In parallel 3D printing has become a promising technology to produced quickly architecture functional materials. However, most of 3D printed products do not using the outstanding properties offered by nanocellulose.

To that extent, the PhD candidate will develop a new and outstanding protocol based on the use of microfibrillated cellulose mixed with functional particles to print these 3D objects. The PhD work will be organized in 3 phases:

- ➔ Phase 1 will be dedicated to the raw material selection and to the formulation of cellulose-based 3D printable suspensions (both inert and functional solution).
- ➔ Phase 2 will focus on the 3D printing processability of the developed materials. The target will be to insure prolonged printing (several hours) at speeds ranging between 1000 and 5000 mm/min without variations in the paste dispersion state. The preservation of the object structure and dimensions during the drying phase will constitute also a major point of concern.
- ➔ Phase 3 will be dedicated to the characterization of the printed objects both at the macroscopic (mechanical properties, ageing, etc.) and microscopic scales (X-ray microtomography, volume fraction of pore, granulometry, spatial repartition, etc.)

This will allow a demonstrator of cellulose based printing object with designed properties to be develop.

To carry on this challenging process, two research laboratories from Grenoble, France, will gather their expertise: the Laboratoire de Génie des Procédés Papetiers (LGP2, <http://pagora.grenoble-inp.fr/research/research-lgp2-536023.kjsp>) and the Laboratoire Sols, Solides, Structures, Risques, (3SR Lab, <https://www.3sr-grenoble.fr/?lang=en>). The first one is specialised on the processes for the conversion and the valorization of the vegetal biomass such as ligno-cellulosic components. The second laboratory develops researches focused on the multiscale mechanics and multiphysical couplings in divided systems (powders, fibers) and porous media.

Candidate profile:

- ▷ Holding a Master or Engineer degree in material science
- ▷ Given the multidisciplinary nature of the project, different skills can be promoted :
 - Expertise in Cellulose-based materials
 - Expertise in process engineering (printing processes, Additive manufacturing...)
 - Expertise in complex fluid formulation and characterization (Rheology)
 - Expertise in microstructure of material characterization (Visible, X-ray or electron microscopy...) and in mechanical properties characterization
- ▷ Good english level
- ▷ Autonomy, professionalism, capacity to analyze and synthesize, motivation, ability to work in a team

To apply for this PhD offer, please send a detailed CV, a letter stating the reasons of your application and the contact information of a referring person if possible.

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