UFR CHIMIE & BIOLOGIE Université Grenoble Alpes

Master in Chemistry

Internship Offer - Master 2 (1 page max.)

Laboratory : **CERMAV**
Director : **Laurent Heux**

Group : SPG **Responsible of the group :** Bruno Jean
Name of the responsible for the internship: Laurent Heux **HDR oui** ~~**non**~~
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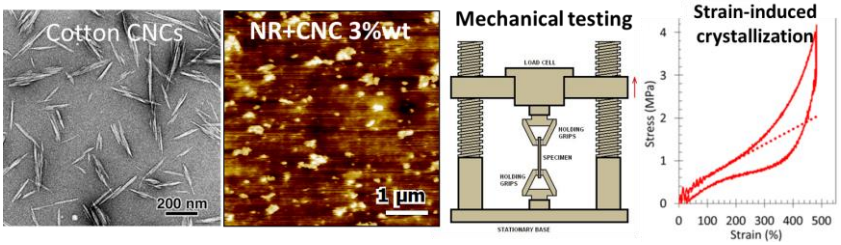
Master 2 track:
Polymers for Advanced Technologies (PTA)

Title of the subject: *Biosourced nanocomposites based on rubber with elastocaloric properties*

Objectives of the internship (5 lines max) :
Preparation of cellulose nanocrystals (CNC, cotton, tunicate), and surface modification to graft reactive and/or hydrophobic moieties. Preparation of rubber nanocomposites based on natural rubber (NR) and Styrene- Butadiene Rubber (SBR) filled with CNCs. Characterisation of the microstructure, mechanical properties and elastocaloric effect (at UPC – Spain).

Asbtract :
One of the environmentally friendly solutions showing potential for the replacement of carbon black and silica as fillers in elastomeric materials consists of the use of cellulose-based nanomaterials, in the form of nanocrystals (CNC) and microfibrils (MFC). [1] Few studies are dedicated to the identification of the impact of the CNC on the strain-induced crystallization (SIC) ability of the rubber matrix [2], a property known to generate an elastocaloric effect that can be suitable for the design of rubber based caloric machines. The elastocaloric effect occurs when stress is applied (or removed), and a phase transformation is induced, which causes the rubber to be heated rapidly up to a decade of degrees after the completion of its crystallization process. The goal of the internship is to prepare a series of vulcanized natural rubber/cellulose composites to characterize their tensile and elastocaloric performance. The addition of CNC with tailored surface properties is expected to play as a strain amplifier and hence improve the strain-induced crystallization and the resulting elastocaloric effect. This internship will open a international collaboration between ***Centre de Recherches sur les Macromolécules Végétales*** **(CERMAV – Grenoble)** and the group e-PASCOM (Eco-friendly Plastics and Composites) of the ***Universitat Politècnica de Catalunya Barcelona Tech*** **(UPC - Spain).**



[1] Fumagalli, M., Berriot, J., de Gaudemaris, B., Veyland, A., Putaux, J. L., Molina-Boisseau, S., & Heux, L. **Rubber materials from elastomers and nanocellulose powders: Filler dispersion and mechanical reinforcement**. Soft Matter, 14(14), 2638-2648, 2018
[2] Candau, N.; Cosas Fernandes, J. P.; Vasmer, E.; Maspoch, M. L. **Cellulose Nanocrystals as Nucleating Agents for the Strain Induced Crystallization in Natural Rubber**. Soft Matter, 18 (45), 8663-8674, 2022.

Approaches & materials used (5 lines max):
Cellulose nanocrystals extraction/surface modification (FTIR, solid-state NMR, TEM), cellulose nanocrystals dispersion in rubber (internal mixer, extrusion), nanostructure (AFM, TEM and WAXS), mechanical properties (tensile tests, DMA).

Competence's domains of the candidate (3 lines max):
Physical chemist with a good background in materials science and engineering.

Internship duration and dates: **6 months from 02/2024**