

## PhD in Enzymatic Reactive Extrusion of Biopolymers

*IMP and ICBMS are selected to present a PhD candidate at the Lyon Polymer Materials Science SFRI (Graduate+ initiative) for non-French citizen. Read carefully the requirements before applying.*

In the field of polymer processing, 'reactive' processing covers processes requiring a chemical reaction (e.g. polymerization, cross-linking, *in situ* filler generation, etc.). Today, environmental protection and ecodesign issues are moving towards the combination of ecologically virtuous processes, such as reactive extrusion, with natural polymers.

This project is part of this initiative to develop chemistry with milder conditions, by enhancing the properties of a biopolymer, chitosan, which can be found in shrimp exoskeletons, among others. Chitosan can be functionalized by grafting another polymer such as poly(caprolactone) to provide flexibility to final polymer-based materials to form biomedical films, for example. As part of a greener approach, grafting will be carried out by enzyme-catalyzed *in situ* polymerization, and will of course be free of toxic solvents. What's more, the extrusion process allows a continuous synthesis of higher quantities of polymer to be functionalized than in a batch reactor.

**The objective of this PhD project is the synthesis and characterization of grafted chitosan from the polymerization of caprolactone using the process of extrusion assisted by enzymatic catalysis.**

The scientific obstacles and challenges will be as follows:

- ✓ Carrying out the synthesis in an extruder and optimizing the process parameters, for example to limit degradation of the chitosan chains.
- ✓ Control the grafting points on chitosan according to the choice of the enzyme.
- ✓ Study grafting rate regarding the enzyme used.
- ✓ Evaluate the properties of materials obtained from functionalized polymers.
- ✓ Opening to others polysaccharides and grafted polyesters.

### Expected results and dissemination:

The results will be a proof of concept for developing new natural based-functionalized materials with an environment friendly process and wide original valorization of enzyme-based catalyzed not classically used in these experimental conditions. The new materials could also find applications in the medical domain, for example.

This project possesses a large potential of valorization since it covers fundamental to more applied aspects. On one side, we expect several articles, particularly through the PhD project, in peer-reviewed journals, and (inter)national conferences, covering the fields of this project, respecting the Open Science policies. Other forms of diffusion can be also made, for example, through seminars in the SFRI *Lyon Material Polymer Sciences* frame and even more general public events such as "Fête de la Science" and other local actions.

### Requirements:

The PhD candidate will be a polymer chemist with experience in natural polymers (polysaccharides) with strong interest in heterogeneous biocatalysis and ideally skilled in reactive extrusion. Technical skills include  $^1\text{H}$ - and  $^{13}\text{C}$ -NMR (liquid and solid, 1D and 2D), size exclusion chromatography (polymers), FTIR, enzyme assays.

The candidate will have a good English level (B2 if not French speaking), be rigorous, able to collaborate within a pluridisciplinary group and communicative.

The candidate should not have spent more than two semesters (including internship) in France. There is no gender discrimination.

If interested, please apply by sending a **complete CV** showing how you fit with the PhD project, a **motivation letter** and **master grades** to Veronique Bounor-Legaré ([veronique.bounor-legare@univ-lyon1.fr](mailto:veronique.bounor-legare@univ-lyon1.fr)) and Bastien Doumèche ([doumeche@univ-lyon1.fr](mailto:doumeche@univ-lyon1.fr)).

*Application obviously written with IA will not be considered*