ITI HiFunMat Master Internship Proposal

☐ M 1 ☒ M 2

Title Foam-fibre systems: towards new mechanically auto-assembled architected materials

Internship supervisor

Name, first name	Hourlier-Fargette Aurélie
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Laboratory	Institut Charles Sadron UPR22
Collaboration with a HiFunMat member (*please indicate their name*)	☒ No ☐ Yes :

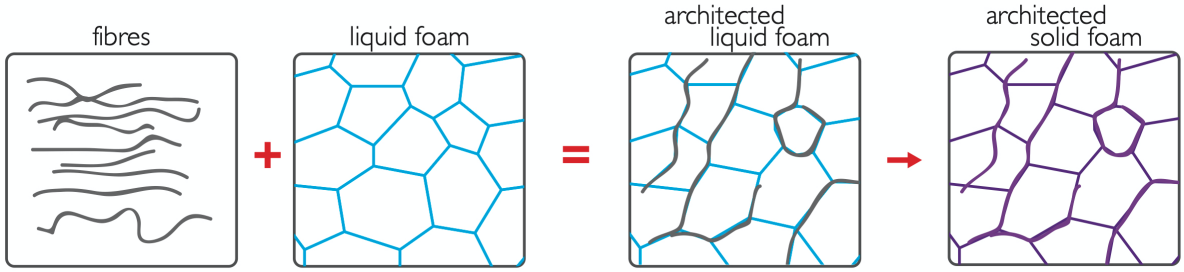
Student profile looked for

Master program (*more than one box can be ticked*)	☒ Material science and engineering ☒ Chemistry ☒ Physics
Other indications if necessary	

Internship description

Architected materials are attracting a growing interest: structural design results in intriguing features that drastically differ from that of the bulk materials, with a combination of light weight and interesting mechanical, acoustic, electrical or thermal properties. Beyond rapid prototyping and 3D printing of architected materials, polymer foams are mechanically self-assembled cellular materials for which reaching an unprecedented structural control would be highly beneficial: using bottom-up self-assembly is a key advantage in terms of production upscaling. However, the structure of foams is strictly constrained by capillary forces, and more specifically by Plateau's laws.

Our research activities aim to obtain new types of architectures of solid polymer foams through mechanical self-assembly of bubbles mixed with fibres, taking advantage of a competition between elasticity and capillarity in the liquid precursors of solid foams. These structures will be imposed not only by a minimization of interfacial energies (as for usual foams resulting from a liquid precursor for which an equilibrium state is reached before solidification), but by the combination of interfacial and elastic energies.



To produce foam-fiber systems, we will work on formulations and microfluidics (millifluidics) processes allowing the production of the different building blocks (polyurethane foams and elastic intruders). The intern will be co-supervised by Aurélie Hourlier-Fargette and Guillaume Cotte-Carluer, PhD student on this topic.

The internship will include preparation of solutions and samples, optimization of experimental setups, data analysis, and use of a cutting-edge equipment park available at ICS (rheometer, tensiometer to measure surface tensions, microscope, X-ray tomograph, mechanical characterization) when needed throughout the project. The intern will be encouraged to take personal initiatives to carry out his/her research and will be fully associated to the scientific activities of the team (seminar, scientific discussion, weekly meetings with people working around foams at ICS …) and discussions with partner groups.