

## STRUCTURAL GRADIENTS IN SOFT SOLIDS TO IMPROVE PUNCTURE RESISTANCE

**LABORATORY :** Institut Lumière Matière

**IN COOPERATION WITH** Institut Lumière Matière

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**TEAM(S) :** LIQ@INT

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**KEYWORD(S) :** Soft solids / mechanical gradients

### SCIENTIFIC CONTEXT :

Planetary limits require savings in both energy and raw materials. As we are transitioning out of fossil fuels towards bio-sourced materials, soft solids are expected to be increasingly used in a host of medical and industrial applications, from tissue engineering to soft robotics. Softness being usually antagonist to mechanical resistance, it is thus essential to develop strategies that improve the robustness and durability of soft solids. To achieve a balance between these antagonist properties, many natural soft protective layers, including human skin, adopt a gradient in stiffness. Stiffer on the outer side and softer on the inner side, these materials conform to a large range of deformations while resisting tear and puncture.

The aim of this project is to test whether mechanical gradients improve the puncture resistance of soft solids, using micromechanics puncture experiments on a model gradient soft polydimethylsiloxane (PDMS). The project will be divided into two parts. Building a well-controlled gradient soft PDMS, and studying the puncture failure mechanisms in homogeneous and gradient PDMS. The project will be hosted at the Light and Matter Institute (iLM), in collaboration with the Engineering of Polymer Materials laboratory (IMP).

### MISSIONS :

The successful candidate will develop silicone-based model materials and an experimental set-up combining mechanical testing, conduct microscope observation, analyze the resulting data using pre-written Matlab codes, and write up the results obtained in the form of scientific articles for publication in international journals.

### OUTLOOKS :

Candidates must have a Masters Degree in Materials Science, Physics, or Mechanical Engineering.