

SURFACE TENSION VERSUS ELASTICITY GRADIENT

LABORATORY : Institut Lumière Matière
IN COOPERATION WITH : Institut Lumière Matière

LEVEL : M1 / L3
TEAM(S) : LIQ@INT

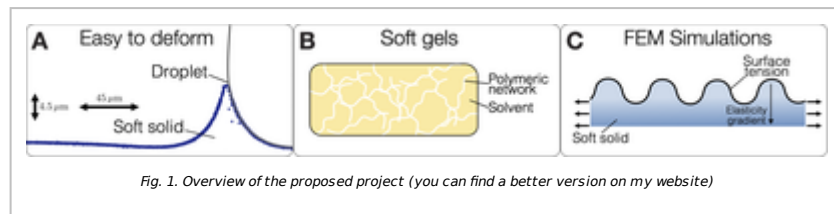
CONTACT(S) : BAIN Nicolas

CONTACT(S) DETAILS: nicolas.bain[at]univ-lyon1.fr /

KEYWORD(S) : Soft mechanics / Finite Elements Simulations / Elastocapillarity

SCIENTIFIC CONTEXT :

In most solids, small forces lead to small deformations. A soft solid, on the contrary, can experience large deformations under minute forces: a phenomenon as minor as depositing a millimetric droplet



leads to divergent deformations of its surface (Fig.1A). Such materials, which can take the form of gels, pastes, or elastomers, are ubiquitous in our lives: They amount to most of our body tissues, and can be used as lubricants, glues, and water-repellent coatings. In past years, it has been shown that surface stresses are essential in wetting, adhesion, and fracture, and can be harvested in composites. **Yet, the physical origins of surface stresses are poorly understood.** This statement is especially true in gels, in which cohabitation of a crosslinked polymer network and a liquid solvent complexifies the link between molecular structure and mechanical properties (Fig.1B).

To tackle this fundamental question, the dominant approach is to investigate surface elastic properties. For instance, surface topography measurements of a stretched patterned silicone gel revealed an elastic surface, with surface stresses that increase with surface deformations. This result hints towards a role of the crosslinked polymeric network in the surface constitutive behavior of silicone gels. **Recent preliminary results, however, suggest that soft materials may exhibit a gradient in elastic properties.** This unexpected feature could overturn experimental interpretation on the topography of soft solids.

MISSIONS :

In this project, we will conduct Finite Elements Simulations of soft materials with a surface topography, surface stresses, and a gradient of surface elasticity (Fig.1C). We will use the software COMSOL, and put emphasis on understanding the effect of elasticity gradient on surface mechanics. The results will be directly compared with existing experimental results.

OUTLOOKS :

You will be learning state-of-the-arts computational tools