

Master 2 internship proposal

Physique et Mécanique des Milieux Hétérogènes

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Cracks propagation in colloidal gels

Many ubiquitous materials are prone to failure upon drying as seen in mud cracks or craquelures in ancient paintings (Figure 1a) [1-2]. The nucleation and propagation of cracks is a complex process at the crossroads between the physico-chemistry of solvent evaporation and transport through porous media, the structural evolution of out-of-equilibrium colloidal systems, and the associated formation, propagation and relaxation of internal mechanical stresses. The project will aim to observe and characterize experimentally the cracks formation and propagation within a model soft colloidal gel of controlled mechanical properties in a 2D cell. Using Small Angle Light Scattering (SALS) techniques, we will first measure the dynamical evolution of the colloidal structure of the gel upon failure to identify precursors of the fracture (Figure 1b) [3]. Furthermore, we will image the propagation of cracks within gels of various softness (Figure 1c). The expected results will contribute to a better understanding of cracks nucleation and propagation within soft materials.

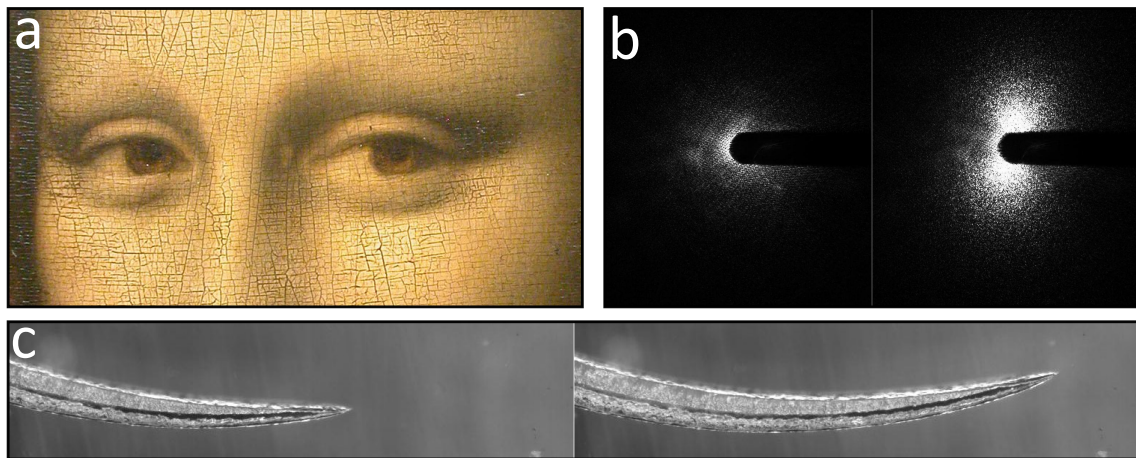


Figure 1: Cracks formation and propagation. **a)** Craquelures in ancient paintings add a layer of mystery on iconic gazes. **b)** Structural changes (from left to right) observed in colloidal gel upon drying prior to failure. **c)** Cracks propagation (from left to right) within a soft colloidal gel.

References:

- [1] L. Pauchard and F. Giorgiutti-Dauphiné, Craquelures and pictorial matter. *Journal of Cultural Heritage* 46 (2020).
- [2] P. Bourrienne, P. Lilin, G. Sintès, T. Nirca, G.H. McKinley and I. Bischofberger. Crack morphologies in drying suspension drops. *Soft Matter* 17 (2021).
- [3] S. Aime, L. Ramos and L. Cipelletti. Microscopic dynamics and failure precursors of a gel under mechanical load. *Proceedings of the National Academy of Sciences* 115 (2018).

The applicant should have interests in fluid mechanics and soft matter.
Possibility to apply for PhD position.