Sujet de thèse : Dynamics of multiple elastomer networks

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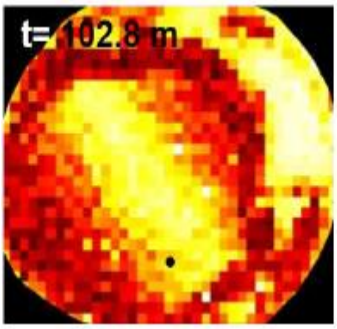
Disordered soft solids such as foams, concentrated emulsions and colloids, and gels exhibit a sudden, catastrophic failure under a modest mechanical load. Predicting and detecting such failure has far-reaching implications both in technological applications and for fundamental science.



We have recently developed a series of original methods to probe simultaneously the rheological properties of a sample and its microscopic structure and dynamics, using space- and time-resolved light scattering. As an example, the figure on the left shows a map of the microscopic dynamics obtained for a biogel under a constant shear stress on approaching failure[i] (the dynamics is increasingly faster from light yellow to dark red, the field of view is ~4 cm). Thanks to a collaboration with the team led by C. Creton at ESPCI Paris, we wish to apply these methods to multiple elastomer networks, a state-of-the-art class of soft solids with outstanding mechanical properties. The networks will incorporate mechanofluores, e.g. molecules that emit a fluorescent signal upon breaking of a crosslink.

By coupling fluorescence measurements to space-resolved light scattering and mechanical tests, the PhD candidate will investigate the relationship between local bond breaking, microscopic dynamics and macroscopic mechanic response in multiple networks, aiming at elucidating the mechanisms leading from local breakage to global failure.

The experiments will be part of the MultiNet project sponsored by ANR, gathering three partners: Montpellier, ESPCI Paris, and Liphy Grenoble, the latter being involved for the numerical simulation and theoretical modelling of failure mechanisms in multiple networks.

Local context: The Soft Matter team at the L2C

The Laboratoire Charles Coulomb (L2C, UMR 5221 CNRS and Université Montpellier, UM) is based in the Montpellier Triolet Campus. More than 100 CNRS and UM permanent researchers work at L2C, on subjects as diverse as astrophysics, particle physics, hard condensed matter, biophysics and soft matter.

The soft matter group is composed of 17 permanent researchers and about 10 PhD students and postdocs. We work on a wide range of topics covering a substantial part of the soft matter spectrum: biophysics, soft matter of interfaces, jamming and glass transition, food science, mechanics of soft materials. In addition to fully equipped chemistry rooms for sample preparation and basic characterization, a wide palette of techniques and setups are available and readily accessible to all members of the team: (confocal) microscopy, rheology, AFM, static and dynamic light scattering, small angle X ray scattering…

Several collaborative projects, regular group seminars and a lively and friendly atmosphere make the experience of students and postdocs with the soft matter group at L2C an enjoyable and profitable one.

[i] A. Pommella, L. Cipelletti, and L. Ramos, Phys. Rev. Lett. **125**, 268006 (2020)