# Molecular, Macromolecular Chemistry, and Materials

ESPCI Paris, 10, rue Vauquelin, 75005 Paris, France

## PhD position in Yieldgap ITN consortium
## Elasticity and plasticity in yield stress fluids

**General information about YIELDGAP**

The YIELDGAP project is an Innovative Training Network (ITN – Marie Slodowska Curie action) involving 9 academic and 4 industrial partners from 7 European countries, dedicated to a better understanding of yield-stress fluids, from fundamental systems to industrial fluids, using experimental and modelling approaches. This ITN will develop a European multi-disciplinary, intersectoral educational research framework, to comprehensively train 12 early stage researchers (ESR) to PhD level, among which the PhD offer described below. For more information: https://codris.europa.eu/project/id/955605

**Location**

The position will be based in the Molecular, Macromolecular Chemistry and Materials laboratory (C3M) at ESPCI Paris. ESPCI-Paris is a leading French "Grande Ecole" founded in 1882, educating undergraduate and graduate students through an original syllabus combining fundamental science and engineering, as well as a world-renowned research institution. ESPCI Paris has setup a tradition of excellence in research, with distinguished scientists that have contributed to its history. Five Nobel Prize awardees are a testimony of the culture of excellence in the Institute. The C3M laboratory conducts fundamental researches inspired by, and oriented towards, real applications and their transfer to industry. It is internationally renowned for contributions in molecular chemistry, dynamic covalent chemistry, functional polymers and soft colloidal materials.

**Summary of the project**

Yield stress fluids, such as emulsions, foams, or dense suspensions, form a broad class of materials behaving like elastic solids under small stresses, and flowing like fluids under large stresses. The transition between solid-like and fluid-like behavior is called yielding. Yielding manifests itself with strikingly similar macroscopic features in a wide variety of materials, suggesting some common underlying origin. Yielding is generally associated with the onset of stress-induced microscopic rearrangements that dissipate the elastic energy stored in the material. Presently little is known about the nature of these rearrangements, how they depend on the detailed microscopic structure of the material, and their connection with the mechanical

properties. Presently there is a lack of experiments capable of probing plasticity at the microscale.

**Job description**

The ESR will build and calibrate a state-of-the art multispeckle dynamic light scattering apparatus coupled to a shear cell. He/she will measure both shear-reversible and -irreversible microscopic events and, by selectively probing non-affine microscopic dynamics during a variety of rheological tests, he will characterize the emergence and full development of plastic events at the microscale, and connect the results with the mechanical signatures of yielding measured using conventional rheology. The materials will be yield stress fluids based on soft colloids that will be characterized using static and dynamic light scattering, and SAXS. To discriminate general features from sample-specific properties, we will start with concentrated emulsions and suspensions of soft microgel particles as tunable model samples. By changing sample parameters such as volume fraction, particle microstructure and softness, or the interaction between droplets or microgels, we will formulate materials with widely different mechanical properties, thereby allowing to test the generality of the results. To extend the analysis of experimental data beyond the capabilities of commercial softwares, the ESR will receive a training in data science, statistics and Bayesian inference. He/she will also have the opportunity to interact with colleagues with theoretical backgrounds and/or develop numerical simulations on model soft particle glasses.

**Qualifications**

The successful ESR will be an experimentalist with a strong background in Soft Matter physics, physico-chemistry, or chemical engineering. He/she will have good competences in oral and written English, collaborative skills and ability to communicate. He/she will have the willingness to interact with other partners of YIELDGAP.

At the time of recruitment by ESPCI, ESRs must not have lived or carried out their main activity (work, studies, etc.) in France for more than 12 months in the 3 years immediately prior to the date of appointment. Applicants must have a diploma (or obtain a diploma before their employment starts) granting access to doctoral studies (typically a MSc degree). Candidates may apply prior to obtaining their master's degree but cannot begin before they receive it.

**Supervision**

Michel Cloitre (michel.cloitre@espci.psl.eu) and Stefano Aime (stefano.aime@espci.psl.eu), in collaboration with Valérie Ravaine and Véronique Schmitt (University of Bordeaux).

**Contract terms**

Full-time temporary employment according to H2020-EU rules. The ESR is expected to complete a PhD degree in three years.

**Application procedure**

Send a CV and a motivation letter to introduce yourself, describe your previous experiences of relevance for the position, and present your future career focus. Deadline for applications: 1 May 2021.