MSc Internship (2025–2026)

Microfluidic characterization of natural rubber latex: interfacial properties, viscoelasticity and portable field tools

Supervisor: Jacques FATTACCIOLI (CPCV, Institut Pierre-Gilles de Gennes, Department of Chemistry, ENS-PSL)
Co-supervisor (optional): Stefano AIMÉ (C3M, ESPCI)

Keywords. Natural *Hevea brasiliensis* latex · Complex fluids · Interfacial properties · Viscoelasticity · Microfluidics · Droplets and sinusoidal channels · Portable field tools

Background. Natural latex from *Hevea brasiliensis* is a complex colloidal suspension made of rubber particles, lipids, proteins and small solutes dispersed in an aqueous phase. Its flow, stability and mechanical response strongly impact plantation productivity, rubber quality and, more broadly, the sustainability of the rubber industry. Despite its major economic importance, our understanding of its interfacial (tension, interfacial composition, protein adsorption) and viscoelastic properties remains limited, partly due to the intrinsic time-dependent instability of latex (coagulation, ageing, pH variations, etc.).
This internship is part of a collaborative project aiming to connect the physico-chemical properties of latex to its behaviour under realistic collection conditions, and to develop microfluidic tools for *in situ* monitoring directly in rubber tree plantations in Côte d'Ivoire.

Questions and approach. The main goal of the internship is to quantitatively characterize the interfacial and viscoelastic properties of natural latex, and to explore how controlled parameters (pH, composition, dilution, flow conditions) affect its stability and flow behaviour.
The student will:

- Establish protocols for sample preparation and conditioning of natural latex (filtration, dilution, pH adjustment, etc.).
- Microfabricate PDMS and/or glass microfluidic chips (femtosecond laser, FLAE, soft lithography) suited for latex studies (sinusoidal channels, contraction/expansion regions, drop relaxation geometries).
- Produce and observe latex droplets and/or filaments in microfluidic geometries to measure relaxation times, flow profiles and viscoelastic signatures.
- Implement microfluidic methods to probe interfacial tension and viscoelastic properties (e.g. drop relaxation, flow instabilities, deformation in sinusoidal channels).
- Quantify the effect of pH variations and other physico-chemical parameters on latex stability (coalescence, flocculation, changes in apparent viscosity).
- Contribute to the design and testing of a simplified microfluidic prototype tailored for field use (robustness, ease of readout, possible integration with portable optical sensors).

This work will provide an experimental framework to link latex physico-chemical parameters to robust microfluidic observables, with the long-term goal of rapid field diagnostics.

Interdisciplinary dimension and perspectives. The project lies at the interface between colloid and interface science, microfluidics, complex fluid mechanics and, more broadly, materials science and engineering for agriculture.
The intern will be trained in:

- Microfabrication and handling of microfluidic chips (design, fabrication, experimental implementation).

- Manipulation of colloidal suspensions and complex emulsions, and basic characterization techniques (microscopy, flow measurements, stability monitoring).
- Core concepts in soft matter and interfacial biophysics (viscoelasticity, interfacial tension, flow instabilities) applied to real-world systems.
- Quantitative data analysis tools (ImageJ/Fiji, Python, possibly additional statistical analysis tools).

Future developments may include comparisons between latex samples from different plots or varieties, and stronger interactions with partners in agronomy and materials science.

Candidate profile. We are looking for a motivated, curious and rigorous MSc student in:

- Physics, chemistry, physical chemistry, materials science, chemical engineering or related disciplines.
- With a strong interest in complex fluids, microfluidics and experimental work.

Skills in microfabrication, microscopy and/or data analysis (Python, Matlab, etc.) are appreciated but can be acquired during the internship. Enjoying experimental work and team work is important.

Practical information.

- **Location:** Institut Pierre-Gilles de Gennes (IPGG) / Department of Chemistry, ENS-PSL, 6 rue Jean Calvin and 24 rue Lhomond, 75005 Paris, France.
- **Duration:** 5–6 months (spring 2026).
- **Starting date:** from February 2026 (flexible).
- **Allowance:** MSc internship allowance according to current French regulations (project-based funding).

Application. Please send a CV, a short motivation letter and MSc transcripts to:

- Jacques Fattaccioli – jacques.fattaccioli@ens.psl.eu
- Stefano Aime – stefano.aime@espci.psl.eu