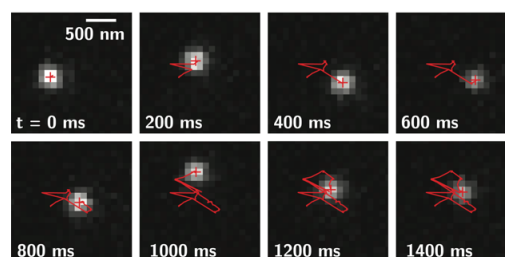
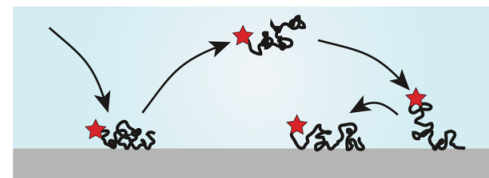


Single Molecule Investigation of Polymer Dynamics at Flowing Interfaces
M2 internship/PhD thesis

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Molecular-scale interactions between polymers in solutions and solid surfaces govern a large number of processes in soft matter, ranging from surface functionalization with adsorbed or self-assembled polymer layers, polymer flow in porous media, lubrication and friction by thin polymer layers, etc... These interfacial processes are typically probed at the ensemble level and described by average phenomenological coefficients (slip length, friction coefficients, etc...). Going beyond this traditional description and rationalizing these coefficients requires to be able to precisely measure and describe the molecular-scale processes taking place at these interfaces, which remained - until recently - experimentally inaccessible.



Heterogeneous dynamics of a single fluorescently tagged PEG chain hopping at a solid/liquid interface.

The aim of this experimental internship is to take advantage of state-of-the-art super-resolution and single molecule localization microscopy techniques to probe the full out-of-equilibrium interfacial dynamics of single fluorescently tagged polymer chains, under a hydrodynamic flow of solvent. In particular, close to attractive interfaces, polymer adsorption may compete strongly with hydrodynamic flow, leading to profound modification of the interfacial dynamics, with biased chain motion, forced desorption of the chain and modification of the hydrodynamic boundary condition, all of which remain up to now poorly characterized and understood [4, 5]. Performing direct and *in-situ* measurements at the single molecule scale will allow us to reveal the heterogeneous dynamics of the polymer chains, characterized e.g. by transient local adsorption followed by fast solvent-mediated transport [1-2]. We aim in particular, to probe how stress transfer to the adsorbed chain is influenced by the flow boundary condition at the solid/liquid interface, and chain conformation. A fine control of the molecular-scale interactions between polymer chains and surfaces will be obtained by tuning the physicochemistry of the solvent, polymer and surface, as well as the polymer chain size. These single molecule measurements will be coupled with statistical analysis of the dynamics, allowing ultimately a detailed understanding and modelling of polymer and solvent interactions with solid surfaces under flow. The internship can be followed by a PhD.

- [1] Yu, C., Guan, J., Chen, K., Bae, S. C., & Granick, S. (2013). *ACS nano*, 7(11), 9735-9742.
- [2] Skaug, M. J., Mabry, J. N., & Schwartz, D. K. (2014). *Journal of the American Chemical Society*, 136(4), 1327-1332.
- [3] Wang, D., & Schwartz, D. K. (2020). *The Journal of Physical Chemistry C*, 124(37), 19880-19891.
- [4] Dutta, S., Dorfman, K. D., & Kumar, S. (2015). *ACS Macro Letters*, 4(3), 271-274.
- [5] Zhu, Y., & Granick, S. (2002). *Macromolecules*, 35(12), 4658-4663.

Associated publications :

- Comtet, J., Grosjean, B., Glushkov, E., Avsar, A., Watanabe, K., Taniguchi, T., ... & Radenovic, A. (2020). *Nature Nanotechnology*, 15(7), 598-604.
- Comtet, J., Radenovic, A. et al. (2021). *Science Advances*.