RHEOLOGY OF POLYMERS IN CONFINED CONTACT

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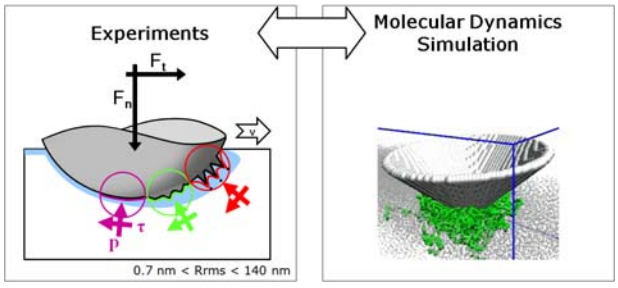
Studying the contact between two surfaces is at the crossroad of mechanics, physics and surface chemistry. In the case of amorphous polymers in dry contact with rigid spherical indenters, several mechanical transitions can be observed during scratch experiments using a home-made specific micro-scratch apparatus [1]. Some prospective studies are friction evolution under confinement for artificial joints in biomedical implantation where nano-roughness and lubrication are two major parameters. The next step focuses on the understanding of the mechanical properties of confined surfaces at micro and sub-micro scales under dry or lubricated conditions (with various model macromolecular systems).

To investigate the rheological behaviour under confinement of macromolecules and/or bilayers versus the roughness an original set-up has been developed to link velocimetry and friction force measurements experiments (under high confined condition, typically of 10 MPa). The work on the project will consist on three major axis:

- To develop the mechanical behavior analysis of a nanocontact using all available measurements (load, contact area…) for bulk viscoelastic materials as for thin viscoelastic film under confinement;
- To analyze the influence of lubrication under confinement depending on the nano-roughness;
- To go further into the influence of nano-texturation on the friction coefficient and to compare the experimental results with simulations based on Molecular Dynamics (collaboration with J. Baschnagel team, ICS). First results on the molecular orientation around a single tip have been obtained for the analysis of the nanoscratch [2], and tools developed will be used for the analysis of the experimental results.

The candidate should be a physicist or have a good background in material sciences. The candidate interests should balance between experimental tests and numerical simulations.



[1] A. Rubin, C. Gauthier, R. Schirrer, “The friction coefficient on polycarbonate as a function of the contact pressure and nanoscale roughness”, J. Polymer Sciences Part B: Polymer Physics, 2012, 50, 580–588.
[2] M. Solar, C. Gauthier, H. Meyer, C. Fond, O. Benzerara, H. Pelletier, R. Schirrer, J. Baschnagel, “Molecular dynamics simulations as a way to investigate the local physics of contact mechanics: a comparison between experimental data and numerical results” Journal of Physics D: Applied Physics 43 (2010) 455406.