Water transport in soft confinement
- experimental internship.

Transport of water in soft porous materials is relevant to a broad range of applications such as ultrafiltration and reverse osmosis processes, where polymeric membranes are employed in filtration/separation, or energy related processes where proton conducting media are used. It also pertains to important fields such as those dealing with wood/cellulosic materials, food processing and is of upmost importance in many biological processes (transport through cellular membranes). While water transport in *hard* porous materials such as porous silica glasses has been clarified, the situation in soft matter is much more puzzling and remains unclear in many respects, in particular because of three key points: surface heterogeneities due to hydrophilicity/hydrophobicity of the confining surface, diffuse boundary since the penetration depth of water at the surface of the confining matrix is ill-defined, and deformations or mechanical effects such as swelling which are inherent to the soft nature of the host medium and depend on the thermodynamic state of confined water. A correct description of water transport in soft confinement has therefore to consider adsorption and confinement effects, microscopic diffusion mechanisms, and local as well as global host deformations.
In this context, the present project concerns experimental investigations of soft nanoporous materials, Polymer with Intrinsic Microporosity (PIM) and self-assembled bloc copolymers, by Transient Grating Spectroscopy. This optical technique enables the characterization of the acoustic longitudinal wave (speed of sound and damping) propagating in the sample, providing simultaneous measure of elastic moduli and viscosity in the MHz frequency range, together with heat conductivity and mass flow. The measurements will be performed as a function of hydration and under mechanical loadings. When analyzed in terms of heterogeneous media, the data bring information on the quantity of water penetrating the polymer surface. The technique will also be used to investigate visco-elastic effects, on timescales that can range between 100 ns (then appearing as a structural relaxation in the signal), and seconds to days when performing the measurements at different stages of creeping.
The project will be mainly experimental, including sample environment design, experimental measurements and data analysis.

Keywords: porous media ; water transport ; optical spectroscopy.

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