M2 Research internship

Humidity-controlled micro/nano-fluidics

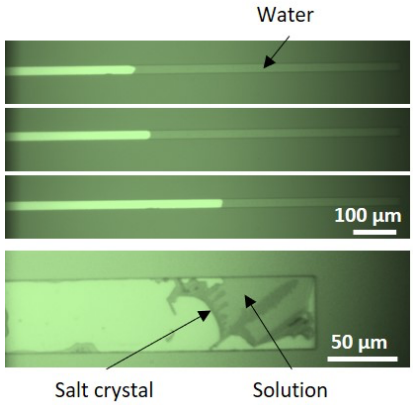
Keywords. Condensed & soft matter, surface and capillary phenomena, osmotic pressure, micro/nano-fluidics, optics, environment, salt, water.

CONTEXT

The interaction between water in materials and external humidity dictates a wide range or natural and technological processes (e.g. plant physiology, water harvesting/purification strategies, energy transport/storage, construction materials, soil science, etc.). We are interested in synthetic micro/nano-fluidic systems where the water content and transport dynamics are controlled by external changes in humidity. One way to obtain spontaneous filling/emptying of water is to combine confinement and solute-induced effects.

PROJECT

The internship aims at characterizing the filling/emptying response of micro and nanochannels containing salt solutions to humidity changes, and to characterize how the competition between various effects (capillarity, osmosis, phase change: evaporation, condensation, crystallization, deliquescence, etc.) dictate the phase diagram of filling state as a function of humidity, and the dynamics of these processes. Interestingly, the results of these fundamental investigations can be directly transferred in an ongoing European project aiming at harvesting electrical energy from natural from natural or industrial humidity cycles.



(Top): Emptying of a nanochannel with 30nm depth, triggered by a drop in external humidity **(Bottom):** Filling and emptying mechanisms are modified by the presence of salt, e.g. due to crystallization/deliquescence, or to osmotic effects.

TASKS

The student will be in change of experiments investigating wetting/drying of salt solution in micro/nanochannels using optical techniques (microscopy, image analysis, interferometry, etc.) and a high precision humidity-controlled environmental system. He/she will be involved in cleanroom fabrication, and sample characterization (electron microscopy, ellipsometry, optical profilometry etc.). The collected data will be analyzed using homemade and commercial software (Python, ImageJ, etc.).

This project is adapted for a motivated student with a background in experimental physics (or related discipline: physical chemistry, applied physics, chemical engineering, mechanical engineering). Proficiency of oral communication in English, skills in Python and motivation for experimental work will be strongly appreciated.

ENVIRONMENT & SUPPORT

The internship will take place in the *Liquids and Interfaces* team of the Institut Lumière Matière (ILM), a joint laboratory of CNRS and the University of Lyon 1 (Lyon, France). The group has international recognition in the domain of the physics of liquids, soft matter and their interaction with surfaces, at scales spanning macro to nano. The project is supported by grants from Agence Nationale de la Recherche (ANR) and the European Union (FET-Open), and by various international collaborations. Continuation into PhD program is possible and welcome.

CONTACT

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