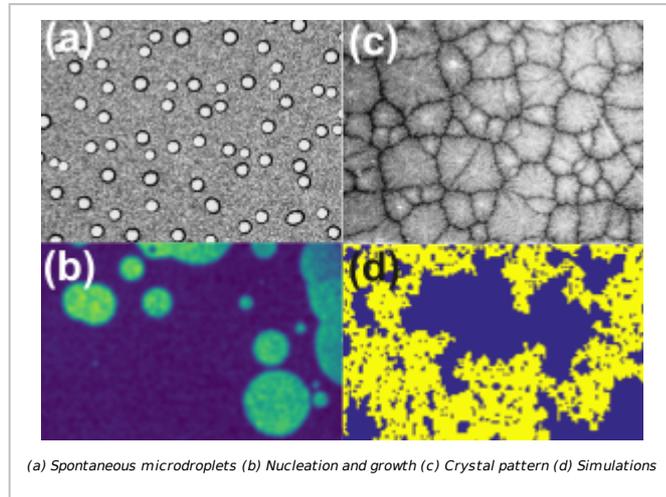


HUMIDITY-RESPONSIVE, LIQUID-INFUSED, NANOTEXTURED SURFACES

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KEYWORD(S) : Soft Matter / Porous Media / liquids

SCIENTIFIC CONTEXT :

Interaction of surfaces containing nanoscale pores with variations in humidity defines many natural and technological processes, e.g. **water harvesting** in dry climates, **cloud formation** in the atmosphere, new strategies for **energy production/conversion**, smart optical/mechanical **metamaterials**, sustainable architecture and cultural **heritage conservation**, etc. Recently, we have created model salt-infused nanoporous surfaces and shown that **rich physics** dictates the equilibrium states and dynamics of such systems (condensation/evaporation and capillary/osmotic phenomena, nanoscale confinement effects, nonlinear couplings, nucleation etc.). Still, a lot of intriguing phenomena remain to be explored and explained; in particular we are trying to characterize how **collective behavior** (e.g., regular patterns of droplets, optical scattering) emerge from nanoscale interactions.



MISSIONS :

We are pursuing several investigations that combine **experiments and modeling**. We are looking for a motivated student to contribute within our team making progress in one (or several) of these directions:

- 1) [Experiments] **Spontaneous formation of microdroplet arrays** at the surface of nanoporous media (high humidity, Fig. (a)): what dictates the typical size and spacing of these patterns?
- 2) [Experiments] Characterize the **stochastic nucleation, growth dynamics, and final patterns** of precipitation that appear from the supersaturated solution at low humidity (Fig. (b-c)).
- 3) [Simulations] **Invasion/percolation patterns** induced by the evaporation/condensation of water with continuously evolving salt content in disordered pore networks (Fig. (d)). These studies can be compared with simple **optical scattering** and **interferometry** experiments.

These investigations will use a combination of **optical techniques** (microscopy, image analysis, interferometry etc.), homemade high-precision **environmentally controlled cells, numerical simulations** (Monte Carlo), and theoretical (**analytical/scaling**) approaches. Knowledge of Python and proficiency in English will be appreciated.

OUTLOOKS :

It is possible to do an M2 internship prior to the PhD program on a related topic (see M2 section).