Invasion dynamics of water in porous nanostructures

**Laboratory:** Institut Lumiere Matiere

**In Cooperation With:** iLM

**Level:** M1 / M2

**Team(s):** Liquides et interfaces (C.YBERT/ C. COTTIN-BIZONNE)

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**Keyword(s):**

**Scientific Context:**

Many materials in nature and technology are porous, including rocks, soil, wood, cement, concrete etc. Understanding how humidity penetrates these materials is crucial in many applications, but poorly understood when the porosity involves confinements at the nanometer scale.

**Missions:**

Here, we will use artificial, transparent nanomaterials of well-controlled properties (pore size, connectivity, surface properties) to study the penetration dynamics of water with optical methods (interferometry, spectroscopy, light scattering), when samples are subjected to various, well-defined conditions of external humidity. We will focus in strong confinements in the range 1 to 20 nm. As a function of the imposed humidity and sample properties, we expect to see different regimes associated with confinement-induced phase transitions in the material (e.g. capillary condensation, surface layering, desorption) and various modes of transport (capillary flow, thin-film flow, Knudsen diffusion, etc.). We will use simple theory combining these phase transitions and transport modes to interpret the experimental results. Another aspect we aim at studying is the statistics of front widening during the invasion dynamics, and its correlations to the intrinsic disorder of the material (distribution of pore sizes). Focus on different aspects of the study will depend on the background and taste of the student.

**Outlooks:**

Continuation into a PhD study is possible.

**Bibliography:**


*Water invasion in a 5-nm porous silica (preliminary)*

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