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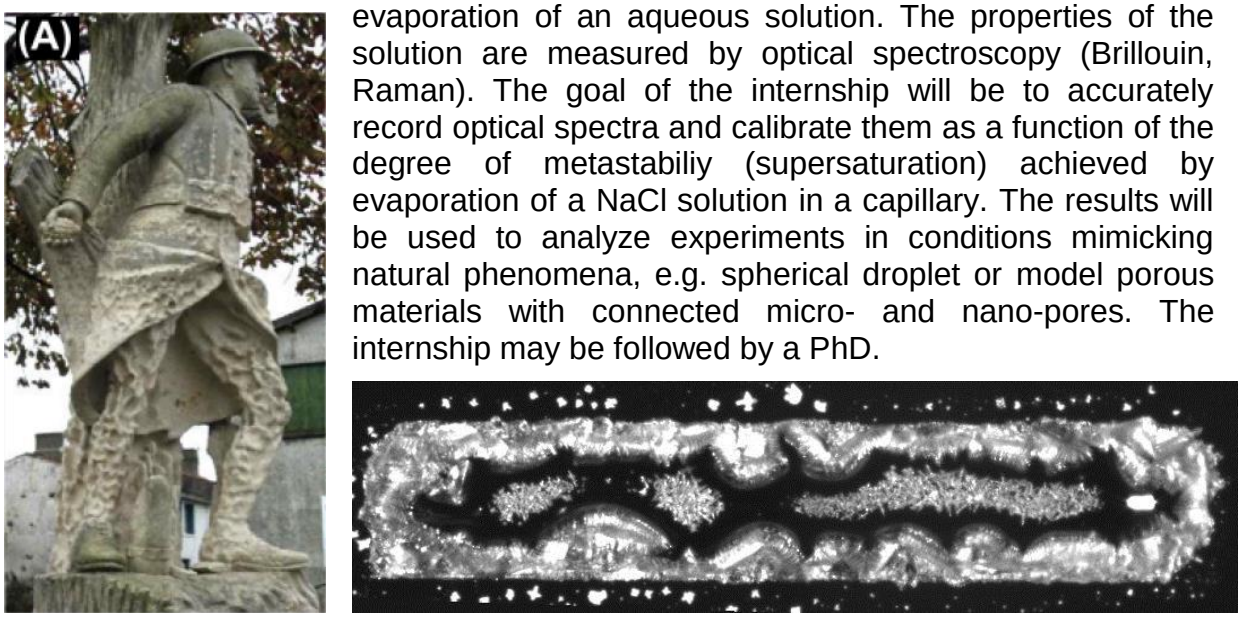
Supersaturation and crystallization in aqueous solutions

Water in Nature is rarely pure. In dry conditions, the concentration of solutes (e.g., salts) in water often exceeds the equilibrium solubility limit. Such a supersaturated solution is metastable and the solute can precipitate suddenly into a crystal. This event plays a key role in various important contexts: crystallization can strongly damage the material if it happens inside a porous medium (e.g. concrete or stones), while in the atmosphere it is thought to have an important impact on the formation and evolution of aerosols and clouds. The phenomenon thus has strong implications for historical heritage preservation, civil engineering, and climate models, but is still not well understood.

At ILM we develop model experiments to understand the thermodynamics and kinetics of supersaturation and nucleation. Supersaturation is generated by controlled evaporation of an aqueous solution. The properties of the solution are measured by optical spectroscopy (Brillouin, Raman). The goal of the internship will be to accurately record optical spectra and calibrate them as a function of the degree of metastabiliy (supersaturation) achieved by evaporation of a NaCl solution in a capillary. The results will be used to analyze experiments in conditions mimicking natural phenomena, e.g. spherical droplet or model porous materials with connected micro- and nano-pores. The internship may be followed by a PhD.



Left: erosion damage on a statue from salt crystallization. Right: nucleation and growth of various forms of NaCl crystals nucleated in an elongated droplet at 160% of the equilibrium solubility

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