Nano-, Meso- and Macro-swelling characterisation of impregnated compression wood cell walls

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Wood cell walls behavior when contacted with humid atmosphere or an aqueous solution containing electrolytes or polymers show the phenomenon of swelling. The maximum swelling is the point for which the osmotic pressure is zero in the case of pure water, or when the RH of the atmosphere considered is matched (51% TH) in industrial norm.

In order to link the observed behaviour, it is necessary take into account, in the form of the master equation, geometrical and compositional data to quantitatively predict the water sorption. Experimental data are produced to test the prediction by exploring the effects of water and solutes, introduced by equilibration with a solution used as osmotic reservoir. Environmental setups have been developed, allowing the control of temperature, water chemical potential, ionic strength. In this work, we will describe the three techniqeues available to follow changes occurring in wood cell material:

- at the nanometric scale (Small Angle X-ray Scattering) in tomographicic mode at BESSY,
- at the microscopic level (Environmental Electron Scanning Microscopy) made in Marcoule,
- and at macroscopically observable scale under controlled mechanical stress, via a Mechanical Tensile device developed in Potsdam.

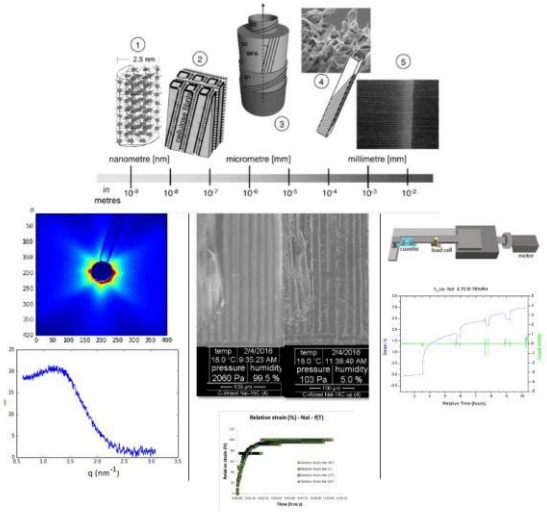

Figure 1: *Wood material hierarchical levels (represented on top) can be experimentally explored with different techniques: SAXS measurements give indications concerning the distance between cellulose crystals (bottom left: diffraction pattern and integration results for a sample immersed in NaI solution), ESEM is useful for studying the influence of temperature and humidity (bottom center: images of a sample treated with NaI at different relative humidities, and results obtained at different temperatures), the mechanical tensile device is able to quantify sample swelling due to solution sorption (bottom right: schematic representation of the device, and results of cycles of sample immersion in NaI solution).*

By comparing salt and base sorption results obtained from experiments with the three devices, we show that results obtained at the three scales are consistent and can be interpreted within the frame of a single general equation of state combining chemical, colloidal and macroscopic scale.