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Recent developments in soft-matter related sample environments at the Institut Laue Langevin

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The neutron scattering facilities worldwide constantly replace or upgrade their instrumental suite to provide the scientific community with unprecedented capabilities. Progresses all-along a neutron scattering beamline, from the improved production and optics to more sensitive detectors, allow nowadays experiments which were unthinkable until some time ago. However, not less relevant are the strong progresses which have been made with sample environments, allowing samples to be probed under extreme conditions, with high throughput or under in-operando or in-vivo conditions.

Herein, we provide an overview of some of the recent sample environment developments achieved at the ILL for soft condensed matter. By showcasing different experimental studies, we provide an overview of the following setups:

- **High-pressure** equipment to probe colloidal systems in solution and at interfaces will be presented. Using the example of polymer-surfactant assembly, or polymer phase transitions, the use of high-pressure cells optimised for small-angle neutron scattering, neutron spin-echo and neutron reflectometry is described. The setup allows also to perform time-resolved SANS experiments with time resolution of few tens of milliseconds.
- A recently developed **foam column**, entirely made in quartz and integrating optical prisms and electrodes, allows to probe liquid foams with small-angle neutron scattering, mesoscopic photography and electrical conductivity. The setup, associated with a fully consistent analysis, allows to characterize the relevant aspects of a liquid foam structure: liquid content, plateau border size and specific area, bubble size distribution, and thin film thickness and specific area.
- Controlling the **humidity** in a system allows for a precise control of the water chemical potential in the system. Accordingly, it is an excellent tool to probe the role of water and the swelling behaviour of colloidal systems. A new setup has been developed, in which saturated vapours of D2O, H2O and an optional liquid are mixed with dry nitrogen or an additional gas. The setup precisely tunes the humid content in the system and allows to perform contrast variation experiments in humidity-controlled environments. The potential of the setup is showcased using the examples of time-resolved swelling of historic woods or of CO2-driven structural rearrangement in polymer coatings.

In summary, recent development in sample environment allow to address challenging scientific questions in very different domains of soft condensed matter and to exploit to a maximum the neutron scattering instruments.

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