Hydrostatic High-Pressure Cell for the SAXS-Beamline at Elettra

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Based on the experience of a previously developed high-pressure SAXS system at the SAXS-beamline at the synchrotron ELETTRA (Trieste, Italy), we have improved and redesigned the existing system [1-2]. The new system consists of a novel and compact pressure cell and an automated pressure control system for numerous applications to study nanostructure as a function of pressure with SAXS. The cell itself is machined out of stainless steel with cube dimensions of 3 x 2 x 2 cm and has two disc-shaped diamond windows with a diameter of 4 mm and a thickness of 0.75 mm each, serving as the X-ray entrance and exit windows, respectively. The cell is connected to a motor-driven spindle press using water as the pressure transmitting medium and the system can be operated in automated pressure or temperature scans. Additionally p-jumps triggered by pneumatic pressure valves, separating two reservoirs of different pressures can be applied, following the nanostructural changes by time-resolved SAXS. The sample in the cell can be pressurized up to moderate 3000 bar and above and its angular range encompasses 0\degree - 20\degree (2\theta). Changing temperature in the cell can be achieved either by a circulating flow of water through copper plates or by Peltier elements between which the cell is sandwiched.

The application range is widely spread from studying phase diagrams of lyotropic or thermotropic liquid crystalline systems, proteins, lipoproteins or polymers and their barotropic phase transitions. The pressure cell can also be utilized in experiments with supercritical CO\textsubscript{2} and in the grazing incidence mode (GISAXS) for oriented and aligned lipid systems on solid supports.

Selected examples of high-pressure SAXS experiments and their results will be shown. In this example, studies with reversible pressure-scans (at constant T) and T-scans (at elevated p) have been performed on various LDL-samples (low-density lipoprotein) differing in the amount of triglycerides.

References