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Synchrotron radiation scattering methods for structural determinations on the nanoscale

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Small Angle X-ray Scattering (SAXS) is a well-established measurement tool that has been around for about 60 years. But the advent of modern third generation synchrotron radiation sources in the early nineties has opened new possibilities for structural determinations on the nanoscale which were not possible in the past. The high brilliance of maschines like Elettra in Trieste allows for fast time-resolved studies, and permits also the investigation of materials that are very poor scatterers, or are available only in small quantities.

The high-flux SAXS-beamline at ELETTRA has been designed specifically for time-resolved diffraction on non-crystalline but partly ordered samples like gels, liquid crystals, (bio)polymers, amorphous materials, muscles, and proteins in solution. At e.g. 8 keV photon energy, the SAXS-resolution ranges from 1 to about 140 nm in d-spacing, and the flux on the sample is up to 5x1012 photons/s. Simultaneously wide-angle diffraction measurements in the angular range of up to about 80o can be performed.

As an additional pre-requisite for time-resolved studies, various techniques and instruments have been developed and implemented at the SAXS beamline to trigger transitions in samples with time resolutions down to the (sub-)ms regime. Possible parameters include temperature, pressure, shear, mechanical stresses and chemical mixing. But the high brilliance is also advantageous in "static" SAXS experiments like scanning micro-spot applications (to study samples with high local spatial resolution down to 20 micron), or grazing incidence techniques like GISAXS, GIXRD and Reflectivity (to determine the structure of near-surface layers).

An overview of recent technical developments and experimental results obtained at the SAXS-beamline will be given for several representative sample systems.

Summary

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Session Classification : Session 1: applications of Small Angle Scatting to Nanoscale and Biological Systems