Synchrotron X-ray Scattering Applied to Soft Matter

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In this lecture, I shall try to give an overview of different possibilities offered by synchrotron X-ray scattering for the investigation of soft matter. These include classical techniques such as small-angle X-ray scattering (SAXS), X-ray reflectivity, grazing incidence SAXS, X-ray photon correlation spectroscopy (XPCS), etc. Recently, SAXS has received renewed importance as a powerful characterization technique for soft condensed matter and biological systems. This trend is sequel to a combination of factors, most notably developments in X-ray instrumentation at modern synchrotron sources and parallel advancements of data analysis methods. An important outcome is that the threshold of detection in scattering experiments has significantly diminished thereby allowing highly quantitative studies of extremely dilute systems, probing very early stage of kinetic processes, and so on. I shall try to illustrate these developments using a variety of examples starting from model hard-sphere colloids to highly self-assembled biological macromolecules. Underlying issues include structure and interactions in concentrated systems, dynamics of self-assembly processes, multiscale structure of hierarchically ordered systems, etc. Quantitative scattering experiments elucidate not only the transient structures and their growth dynamics but also reveal the link between nanoscale thermodynamics and macroscopic properties.

T. Narayanan, *Synchrotron small-angle X-ray scattering*, in **Soft Matter: Characterization,** Chapter 17, Vol II, Eds. R. Borsali and R. Pecora, (Springer, Heidelberg, 2008).