Small Angle X-ray Scattering: The answer to dynamics in matter?

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By probing the structural regime of 1 to 100 nm Small Angle Scattering is the perfect tool to investigate hierarchical self-assembly being a fundamental principle in nature with astonishing supramolecular architectures. Therefore, self-assembly of biostructures inspired many innovative materials in nanotechnology. A key issue in such studies is the fast and controlled perturbation of the system under realistic conditions and environments, in which small angle scattering is in particular suited due to the accessibility of the sample. In general, solids, liquids, films and aerosols can be investigated, therefore covering all states of matter.

Here this presentation should give the highlights regarding time-resolved experiments, which should reveal the dynamics of bio- or inorganic systems. Prominent examples for the first are the structural transitions of the Low Density Lipoprotein (LDL) induced by pressure or temperature [1,2], in situ investigation of the self-assembly of an amphiphilic designer peptide into a double helix superstructure [3] combined with the interpretation of elongated structures [4], see figure.

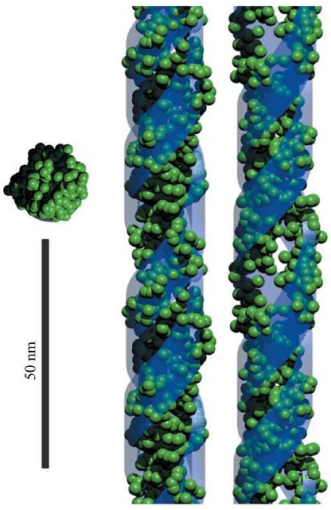

Figure: Orthogonal views of the bead model reconstructed from the scattering pattern of a double helix superstructure (green) [4] compared with the previously published analytical model (blue) [3].

Examples for the second are the photo-switching of metallo-organic-frameworks (MOF) films [5] or the self-assembly of oriented antibody-decorated metal-organic framework nanocrystals for active-targeting applications [6].

References:

[1] B. Lehofer et al., Particle & Particle Systems Characterization **10**, 1800140 (2018).
[2] R. Prassl et al., PLoS One **3**, e4079, (2008).
[3] K. Kornmueller et al., Nano Research **8**, 1822-1833 (2015)
[4] M. Burian, H. Amenitsch, IUCrJ **5**, 390-401 (2018)
[5] S. Klokic, et al., Chemical Sciences **13**, 11869-11877 (2022)
[6] K. Alt et al., Advanced Materials **34**, 2106607(2022)