Physics of Molecular and Biological Matter
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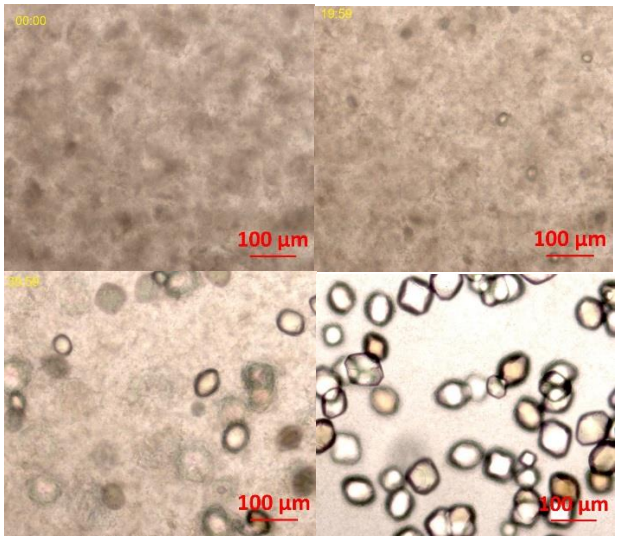
Master and Bachelor Projects: Protein Physics

Real-Time Study of Protein Crystallization

Proteins play crucial functional and structural roles in all biological domains. To grow protein crystals of adequate quality still is a major challenge in structural biology. Here we aim to understand the nucleation mechanisms behind crystallization and the exact pathway followed by crystal growth. In particular, we use multivalent metal ions to control the phase behavior in protein solutions. The projects listed below are suitable for students of various backgrounds with an interest in interdisciplinary work for their bachelor or master thesis.



Non-classical nucleation and crystal growth in protein crystallization followed by real-time optical microscope. The sample was beta-lactoglobuin with $CdCl_2$.

Topics and Methods:

- Phase diagrams and phase transitions in protein-salt solutions; Rich phase behavior induced by multivalent ions including Reentrant condensation, liquid-liquid phase separation, cluster formation, crystallization and gelation;
- Following crystal growth using optical microscopy and light scattering in real space; Together with imaging techniques, we aim to determine the crystal growth rate, nucleation rate as a function of time and experimental control parameters such as salt concentration and temperature.
- The optimized conditions will be further studied using real-time SAXS/SANS aiming for a detailed study of the early stage of nucleation, in order to clarify the existence of intermediate phases, the role of intermediates on the nucleation process and the mechanism of nucleation such as classical or multi-step.
- Methods: Video optical microscopy and image analysis, UV-vis spectroscopy, Static and dynamic light scattering (SLS/DLS), IR spectroscopy, Small angle X-ray and Neutron Scattering (SAXS/SANS).

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References and further information:

http://www.soft-matter.uni-tuebingen.de (see under publications and open positions)

1. F. Zhang et al., Phys. Rev. Lett. **101** (2008) 148101.

2. A. Sauter et al., Cryst. Growth Des. **14** (2014) 6357.

3. A. Sauter et al., J. Am. Chem. Soc. **137** (2015) 1485.