Methods for Characterizing Soft Matter.

Part I. Bulk Properties

Summer Semester (2 SWS, 3 CP); Part of Modul 3

R. Buchner (lectures, Wednesday 8-10 h)

Content

1. Introduction

- Soft matter – a broad range of materials from “simple liquids” to biological structures
- What distinguishes soft matter from gases and crystalline solids? Thus, what do we want to learn?

2. Theoretical Background

- Intermolecular interactions – a brief repetition
- Linking bimolecular interactions with structure and thermodynamic properties of the bulk: The pair correlation function
- Determining dynamics: Time correlation functions
- Computer simulations – methods, advantages and problems

3. Experimental Methods for Determining Structure and Dynamics in Soft Matter

3.1. Monitoring Next Neighbours

- Vibrational spectroscopy (infrared and Raman spectroscopy)
- Nuclear magnetic resonance (NMR)
- Extended X-Ray Absorption Fine Structure (EXAFS)
- X-Ray Absorption Spectroscopy (XAS & XANES)
- UV-vis spectroscopy

3.2. From Next Neighbours to Larger Aggregates I – Dielectric Spectroscopy

- Background
- Next neighbours – investigation of ion pairs, solvation shells, solvent dynamics
- Aggregates – relaxation processes of colloidal particles (normal & reverse micelles, polyelectrolytes …)

3.3. From Next Neighbours to Larger Aggregates II – Scattering Methods

- Common background of x-ray, neutron and light scattering
- Liquids studied with high-resolution (nearest neighbours): wide-angle x-ray (WAXS) and neutron scattering (WANS)
- Monitoring colloidal particles in solution: small-angle x-ray (SAXS) and neutron scattering (SANS), light scattering
- Lyotropic mesophases: two different length scales require combination of wide- and small-angle techniques

3.4. Structure in Systems with “Large” Particles – Microscopy of Colloidal Systems

- Scanning-tunnel and atomic-force microscopy
- Cryo transmission electron microscopy