X-Ray Reflectivity (XRR) and Brewster Angle Microscopy (BAM)

Many lipids, nanoparticles, polymers, proteins etc. are insoluble in water and can easily be spread, with the help of a suitable solvent, on a water surface to form an insoluble monolayer at the air-water interface. In these monolayers or Langmuir films, all molecules are arranged in a one molecule thick layer. In this context, lipid monolayers are often used as model systems for cell membranes.

One important property of such monolayers is the so called surface pressure which can be measured as a function of the area of water surface available to each molecule. Usually an isotherm is recorded at constant temperature by compressing the film (reducing the accessible area with the barriers) at a constant rate while continuously monitoring the surface pressure. A number of distinct regions, called phases, are apparent on examining the isotherms. The phase behavior of the monolayer is mainly determined by the physical and chemical properties of the amphiphiles and the subphase composition. The combined investigation of Langmuir films by Brewster Angle Microscopy (BAM) and X-ray scattering techniques at characteristic phase transition points yields detailed information on the microscopic structure of the monolayer. Information on the formation dynamics of the monolayer and on orientational changes in the monolayer is accessible.

Further studies typically focus on the adsorption of proteins, polymers and nanoparticles from the aqueous bulk phase on the Langmuir monolayer or investigate the influence of temperature, pressure, pH, salts etc. on the molecular structure.

In our module, the students will be taught in the preparation and investigation of lipid monolayers. After a short instruction, the students will use several methods, like surface-pressure isotherms, Brewster Angle Microscopy (BAM) and X-Ray Reflectivity (XRR) to investigate the structure of Langmuir films. The results obtained will be analyzed and discussed in the group. The complete module composed of the surface-pressure isotherms, the Brewster Angle Microscopy and the X-Ray Reflectivity measurements needs approx. 5 hours, except lunch break.