LIPIDS AND BIOMOLECULES CONFINED IN TWO-DIMENSIONAL LAYERS

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Monomolecular films at the air/water interface are interesting model systems to study different problems in biophysics or material science. The structures formed in two dimensions can be compared with 3-dimensional structures to elucidate the role of confinements. The interactions of dissolved biomolecules (DNA, peptides, enzymes) with lipid layers can be studied using surface sensitive methods such as pressure-area isotherm measurements, Brewster angle microscopy as well as X-ray techniques in terms of structural changes, binding affinities, and reaction yield. Additionally, Infrared Reflection Absorption Spectroscopy (IRRAS) at the air/water interface provides information about the secondary structure of biomolecules adsorbed at the interface.
Some examples will be presented: 1) Amphiphilic molecules confined at the air-water interface show a rich polymorphism. The chain lattice structures have been determined by GIXD. In rare cases, molecular lattices are observed. 2) The structures of antimicrobial peptides (AMPs) are studied in different solutions and at the air–water interface. The amphiphilic peptides are surface-active and form Gibbs monolayers at the air–buffer interface. In some cases, very crystalline adsorption layers have been observed. The interacting AMPs reveal a strong influence on the phase transition and condensed structures of anionic phospholipid monolayers. 3) Helical intermediates of amyloidogenic model peptides transforms into β-sheets depending on different factors - increased concentration, orientation due to compression, and metal ions. The effectiveness of the different triggers will be discussed. 4) DNA and cationic lipids build lipoplexes. Efficacy and toxicity are still two major problems that have to be faced on the way to an outstanding transfection system. Therefore, new lipids are constantly synthesized and investigated with respect to their transfection rates. Here, an approach is made to correlate the transfection efficacies of new lipids with similar chemical structures to their physical-chemical properties in 2D and 3D model systems.