The Lipid Bilayer. Specific and Non-specific Interactions with Surfactants, Peptides and Proteins

J. Seelig, Biozentrum, University of Basel, Dept. of Biophysical Chemistry,
Klingelbergstrasse 70, CH-4056 Basel/Switzerland
Phone: +41-61-267 2190, FAX: +41-61-267 2189, e-mail: joachim.seelig@unibas.ch

The biological membrane is a very thin sheath of biological material (thickness 10-15 nm) which constitutes the envelope of living cells and also of intracellular organelles, separating them from the environment. Membranes are made up from a lipid bilayer into which proteins are embedded. They are highly organized but are nevertheless fluid enough to allow considerable translational, rotational and flexing movements of the constituent lipid and protein molecules. The lipid bilayer is a double layer of lipid molecules organized in a tail-to-tail arrangement. It is an anisotropically ordered fluid that has a number of properties in common with smectic liquid crystals. All fast molecular motions such as rotational and flexing movements are characterized, on the average, by a cylindrical symmetry with the bilayer normal as the axis of motional averaging.

Using solid-state nuclear magnetic resonance, a quantitative analysis of the molecular ordering and dynamics of the lipid bilayer has become possible. Likewise, the availability of new, high-sensitivity titration calorimeters has made isothermal titration calorimetry increasingly popular for the thermodynamic analysis of surfactant-membrane and peptide/protein-membrane interactions. Most interactions are non-specific and can be described by a water-membrane partition equilibrium. However, the correct analysis requires the explicit consideration of electrostatic effects. Examples will be given for the anionic surfactant SDS and the biosurfactant "surfactin", for antimicrobial peptides which form helices at the membrane surface, and for Alzheimer peptides. The latter undergo a membrane-induced random coil-β-structure transition. Finally, the antimicrobial peptide Ro 09-0198 (cinnamycin) constitutes an example for a *specific* interaction between a peptide and a particular lipid, phosphatidylethanolamine.