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Investigating Lipid Membranes Adsorbed to Functionalized Air/Water and Oil/Water Interfaces

Content

Biological membranes based on lipid bilayers are major components of all life forms. X-ray and neutron scattering techniques have enabled the structural characterization of lipid bilayers and more complex membrane models at sub-nanometer resolution. Such studies on intramembrane molecular distributions, interactions of biomembranes with drug molecules, and inter-leaflet exchange have only become possible with bilayers immobilized in planar geometries, such as solid-supported or floating lipid layers. However, the presence of a solid support also has disadvantages. It prevents any investigations that involve surface deformations, such as interfacial dilational rheology to determine viscoelastic/mechanical membrane properties. Moreover, the presence of condensed bulk media on both sides of the membrane (water and solid) impede other measurement techniques, such as infrared spectroscopy and x-ray surface diffraction.

As an alternative strategy, we investigated lipid bilayers adsorbed to planar air/water or oil/water interfaces that are pre-functionalized with monolayers of amphiphiles. The formation of these bilayers through the fusion of small unilamellar vesicles is promoted by electrostatic attraction. The interfacial layers are studied by ellipsometry and various x-ray [1-3] and neutron [4] scattering techniques which, in combination, provide a comprehensive structural picture of the surface-adsorbed bilayers. Bilayers in fluid (La) and in chain-ordered (Lb) phases were studied. The Lb phase of a lipid bilayer was characterized for the first time by grazing-incidence x-ray diffraction at the air/water interface and the chain ordering was found to be significantly different from that in regular monolayers of the same composition.

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