Bilayers at the ILL

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Effect of oxidised lipids on bilayer structure and deposition

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Lipids are found widely in biological systems because of their unique interfacial properties. They are the primary component of cell membranes, which act as barriers containing the contents of the cells and protecting them from external threats. In fulfilling their function, the lipid membranes are exposed to oxidation processes that change their molecular structure. Such processes occur naturally through the presence of superoxides (O2-) that are released during inflammatory response, or through environmental pollutants. Oxidation can result in the hydrophobic tail region of lipids becoming more hydrophilic. This alters the physical properties of the lipids and the lipid mixture that in turn can affect their biological function. In this study we used a model system to investigate the changes in structure and physical properties that occur when a portion of the lipid in a bilayer is replaced with a lipid containing a damaged tail group, as found following oxidation.

Mixtures of 1,2-dimyristoyl-sn-glycero-3-phosphocholine (DMPC) that contained a lipid oxidation product, 1-palmitoyl-2-(5'-oxo-valeroyl-sn-glycero-3-phosphocholine (POVPC) have been investigated with a variety of surface and bulk techniques. Neutron reflectivity measured on bilayers revealed an increase in area per headgroup and significantly higher degree of hydration in the tail region when POVPC is present. In contrast, when oxidised lipids with a longer oxidised tail are present, the degree of hydration does not change. Further bilayer characterization with a QCM-D revealed that formation of bilayers containing POVPC is highly sensitive to surface preparation. Surface preparation with basic solutions, which create rough surfaces [1], inhibit vesicle adsorption and prevents bilayers from forming. Light scattering confirms that vesicles used for QCM-D containing POVPC had similar size to those of pure DMPC. Further, the stability of spread monolayers is reduced when POVPC is present.

REFERENCES
[1] F. Blachon et al. Langmuir, 2017, 33, 2444-2453

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