



Supported Biomembrane Models

Neutron Reflectivity studies

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Supported Double Bilayers

Model

- Two planar lipid bilayers on silicon, separated by 20Å water layer.
- Lower bilayer acts as support, upper bilayer used as membrane model
- Controlled environment, selectively introduce components
- Utilise range of different surface and interfacial techniques

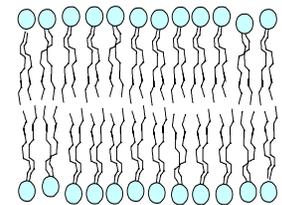
Fabrication

- Spread monolayer of lipids
- Three vertical depositions, one horizontal deposition

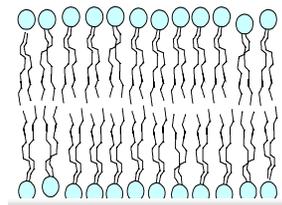
Uses

- Lipid phase behaviour studies and protein studies
- Off-Specular Synchrotron
- AFM

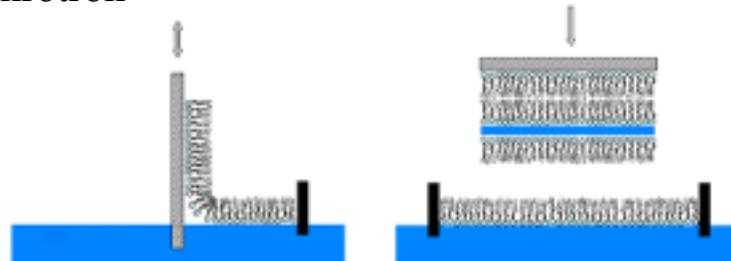
10mL water reservoir



20Å water layer



Silicon Substrate (5x8cm²)

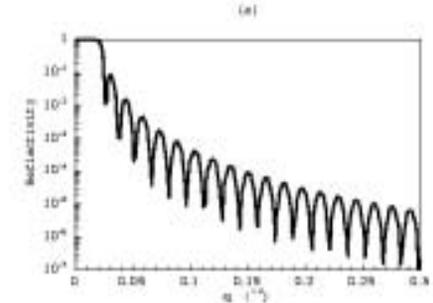
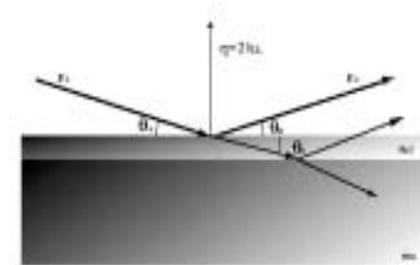


Specular Neutron Reflectivity

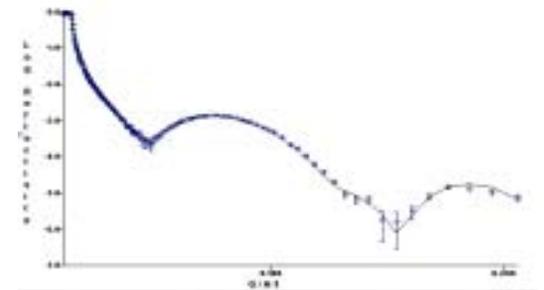
- Specular neutron reflectivity provides composition and structural attributes perpendicular to plane.
- Obtain layered structure of dimensions, roughness and coverage of sample.

$$R(Q) = \sum \frac{16\pi}{Q^2} \left| \rho(Q) \right|^2$$

- Use D17 at ILL and CRISP/SURF at ISIS
- Phase problem, so model...
- Divide sample into planar layers, then fit reflectivity of this model to data profile, changing parameters to ensure close fit and structure.
- Follow structural changes in supported bilayers vs. temperature and composition



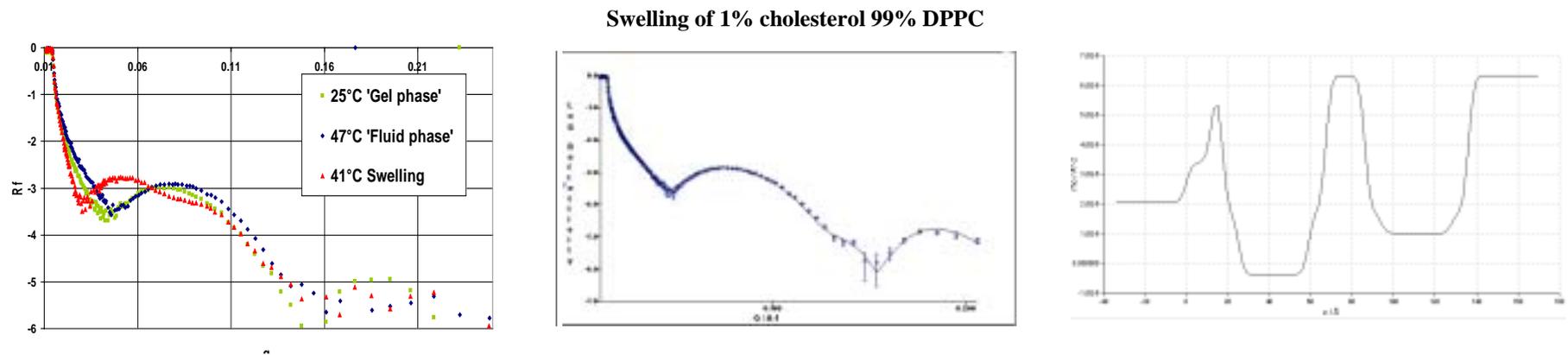
Fresnel decay and multiple interfaces give rise to Bragg fringes



Double bilayers give rise to profile with two fringes

Results of Cholesterol - DPPC Studies

- All ratios exhibited structures consistent with stable gel and fluid phases.
- Increasing amounts of cholesterol linearly increased the overall sample thickness of the gel phase.
- 0.5 - 4% cholesterol exhibited giant swelling between 42°C and 33°C on cooling.
- No swelling seen for 6% and above.
- Swelling larger than that seen for pure DPPC, greater than normal ripple phase dimensions.



Parameters used in fit: chain thicknesses: $34\text{\AA} \pm 1$ (thicker than pure DPPC), water layer thickness: $19\text{\AA} \pm 1$, Lipid headgroups: $8\text{\AA} \pm 1$, Silicon oxide: $12\text{\AA} \pm 1$

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