Miscibility Transition in DOPC/Sphingomyelin Bilayers

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The organisation of biological membranes into microdomains is believed to play a key role in membrane function [1] and supported lipid bilayers have been studied as a model of biomembranes using AFM [e.g. 2]. In this paper we report tapping-mode AFM experiments in fluid which study the temperature dependent morphology of microdomains in mica-supported phospholipid bilayers of a binary mixture of dioleoylphosphatidycholine (DOPC) and sphingomyelin (SM) under a tris(hydroxymethyl) methylamine buffer solution. The lipid bilayers are prepared by fusion of vesicles onto the mica. Using a temperature controlled stage, the supported bilayer is heated to above the miscibility transition (T_{mix}) before recording images at stabilised temperatures below the transition temperature.

The morphology of the microdomains in these films imaged at room temperature immediately after adsorbing the bilayers has been found to be somewhat irreproducible [3]. By raising the sample temperature above T_{mix} and then cooling, we observe the formation of larger microdomains and that this behaviour is much more reproducible. We also find that T_{mix} for different supported bilayers, from the same batch of vesicles, can differ by a few degrees centigrade, suggesting that the exact conditions of vesicle fusion slightly influences the miscibility of the SM in the DOPC. The observed miscibility transition is several degrees centigrade higher than the transition temperature in giant vesicles observed by fluorescence microscopy [4].

In summary, these results suggest that temperature is an important parameter in the study of lipid bilayers around room temperature. More reproducible microdomain morphology is obtained by heating the lipid bilayers above the miscibility transition before starting experimentation, making this a good starting point for future experimentation.

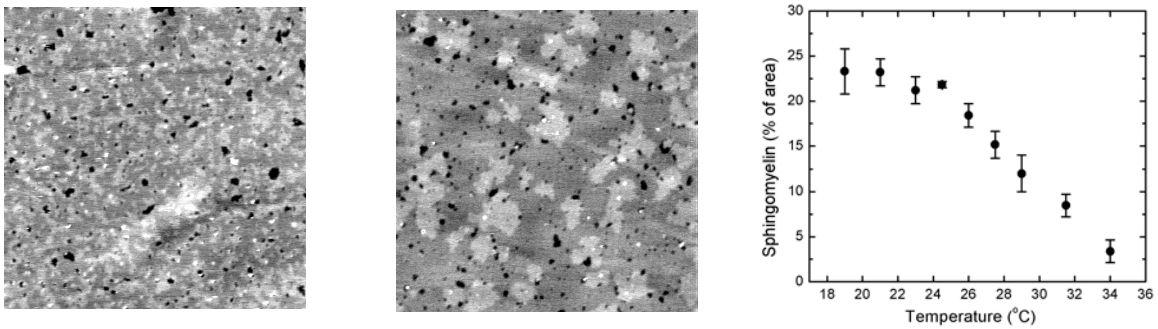

Figure 1. Left: 7μm×7μm AFM image of (2:1 DOPC:SM) bilayer at 22°C before heating; Centre: same scan size at 23°C after heating above T_{mix}; Right: SM microdomain area as a percentage of total lipid area vs. temperature after cooling.

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