

平面基板上的脂質ナノ膜の特性解析に関する研究

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Study on characterization of lipid nanomembranes on planar substrate (*Graduate School of Engineering Science, Osaka University*) ○Chikara Inoue, Nozomi Watanabe, Hiroshi Umakoshi, Yukihiro Okamoto

A Supported Lipid Bilayer (SLB) is an artificial membrane immobilized on a planar substrate. Two-dimensional diffusion realized by the presence of a hydration layer between the lipid membrane and the substrate can reproduce the dynamics of biological membranes. This material can be applied in the study of heterogeneous lipid membranes and their use in sensors. However, there are problems such as the risk of changes in membrane properties due to immobilization on the substrate and the difficulty of analysis due to the small number of molecules.

In this study, we attempted to evaluate the effect of substrate immobilization on lipid membrane properties in comparison with SUV. For this purpose, the viscosity and phase transition temperature of SLB were analyzed using the fluorescence anisotropy of DPH after the spectrofluorometric method for SLB was developed. As a result, the anisotropy of the SLB was higher than that of the SUV in all temperature regions. In addition, the transition temperature of SLB ($T_{m,SLB}$) was approximately 30°C, which was higher than that of the SUV ($T_{m,SUV}=24^{\circ}\text{C}$). These results could be attributed to the higher order inside the membrane due to immobilization on the substrate.

Keywords : supported lipid bilayer, fluorescence, viscosity, phase transition, vesicle fusion

Supported Lipid Bilayer (SLB) は、平面基板上に固定化された人工的な膜であり、脂質分子-基板間の水和層の存在から実現される二次元拡散が、生体膜のダイナミクスを再現可能にする。その応用として、不均一系脂質膜の研究やセンサーへの応用が報告されている¹⁾。しかし、分子数の少なさから解析が容易ではない、基板への固定化により膜物性がベシクルとは異なるおそれがある、という懸念が生じる。

そこで、最初に、SLB 解析のための蛍光分光解析を可能とした。続いて、蛍光分子 DPH を使用した蛍光異方性測定により SLB の粘性や相転移温度を解析し、small unilamellar vesicle (SUV) のそれら特性との比較を行った。その結果、異方性は SUV と比較し、すべての温度領域で高い値を示した (Fig.1)。また、相転移温度 ($T_{m,SLB}$) は 30°C 付近であり、SUV ($T_{m,SUV}=24^{\circ}\text{C}$) と比較し、高い値を示した。これらの結果は基板への固定化により脂質膜が平面化し、秩序性が向上したことに起因すると思われる。

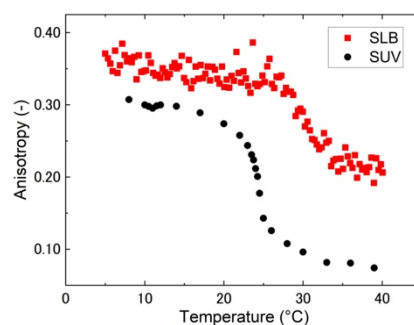


Fig.1 Temperature-dependent changes in fluorescence anisotropy of SLB (Red square plots) and SUV (Black circle plots).

1) The application of SLBs to biosensors has been reported. A. Görner, A. K. Marel, Biosensors. **2024**, 14(6), 270.