Kinetics of Domain Growth on a Giant Vesicle

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飽和、不飽和脂質とコレステロールの三成分系で構成されるリポソームにおいて、その膜面上での相分離の観察が近年になって報告され、分野を越えて注目を集めている。今回、共焦点レーザースキャン顕微鏡を用いてこの相分離構造を経時観察し、ドメインの成長過程の解析を行った。

Phospholipids assemble each other in aqueous solutions, and they compose micelles and bilayer membranes spontaneously. These membranes form vesicles because of the energetic instability of the edge, and this lipid vesicle is called liposome. Phospholipids show the phase transition between the gel phase, which has small intermolecular lengths, and the liquid crystalline phase, which has large ones, depending on temperature. When liposomes are made of mixed lipids(transition temperatures are different), a phase separation, into gel-rich domains and liquid-crystalline-rich domains, can be observed in the membrane. Such a domain structure is called "raft" in biology, and a lot of trials have been performed in the last few years. Recently phase diagrams of the composition of lipids have been reported[1], and the jump of curvatures at domain boundaries has been observed[2]. Though these studies have clarified equilibrium structures, the time development of this phase separation has hardly been clear. In this study, we paid attention to this process, and analyzed the time development of the domain growth.

In the experiment, DOPC(dioleoyl-phosphatidylcholine), DPPC(dipalmitoyl-phosphatidylcholine), and Cholesterol are used to prepare multicomponent liposome. Transition temperatures of lipids are -22 ℃ (DOPC) and 42 ℃ (DPPC). We can control the start of the phase separation by changing temperature from high temperature(>42 ℃) to room temperature(∼25 ℃).

Figure 1: Confocal laser scanning microscope images. The coarsening of domains with time was shown (scale bar: 10 μm).

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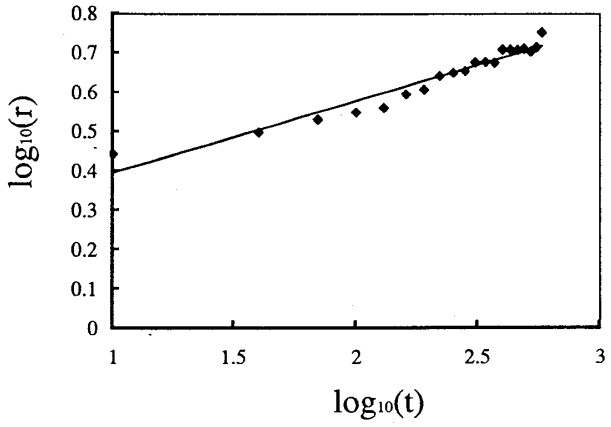

Figure 2: The profile of the average domain radius (r) versus time (t) with logarithmic function.

At the beginning of the phase separation, a number of micro domains were emerged. These domains exhibited Brownian motion, and showed the coarsening process by colliding and fusing each other (Figure 1). We found that the time development on the coarsening of the domain showed linear profile in the Log–Log plot (Figure 2).

References

[1] S. L. Veatch and S. L. Keller. *Phys. Rev. Lett.* **94**, 148101 (2005)

[2] T. Baumgart, S. T. Hess, and W. W. Webb. *Nature* **425**, 821 (2003)