Experimental study of lateral phase separation in multi-component membranes from the side of diffusion properties

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A cell membrane consists of a lot of components, such as amphipathic phospholipids, proteins, cholesterol and any other biomolecules. The main components of the membrane, i.e. phospholipid molecules, spontaneously assemble into a bilayer structure under an aqueous condition. The bilayer structure exhibits similar configuration to that of a biomembrane, and also exhibits a fluidic 2D system. The bilayer membrane usually takes a vesicular shape because vesicle is one of stable morphologies for this soft membrane. Thus, the phospholipid vesicle has been actively studied as a simple model of biomembranes and living cells. Particularly, giant or cell-sized vesicles, whose sizes are about a micrometer or larger, show us their diversified shapes through the traditional microscopy observations. Thus we can observe dynamic and kinetic events on the bilayer membrane in real time.

Figure 1 shows typical microscopy images of the phase separation on the bilayer membrane vesicle. The membrane is prepared from mix of unsaturated phospholipid, sphingomyelin with saturated alkyl groups, cholesterol and a small amount of fluorescent dye having an affinity to relatively disorder phase. The white circles, which seem island on the giant vesicle, are micro-domains exhibiting disorder phase with a different ratio of the constitutions from that of the dark part. Previous studies have identified that the dyed disorder phase includes larger amount of unsaturated phospholipids. In this condition, we can observe the bright circles move on the fluid membrane to fuse each other. We report here the diffusion properties of the domains estimated from the direct observation [1–3].

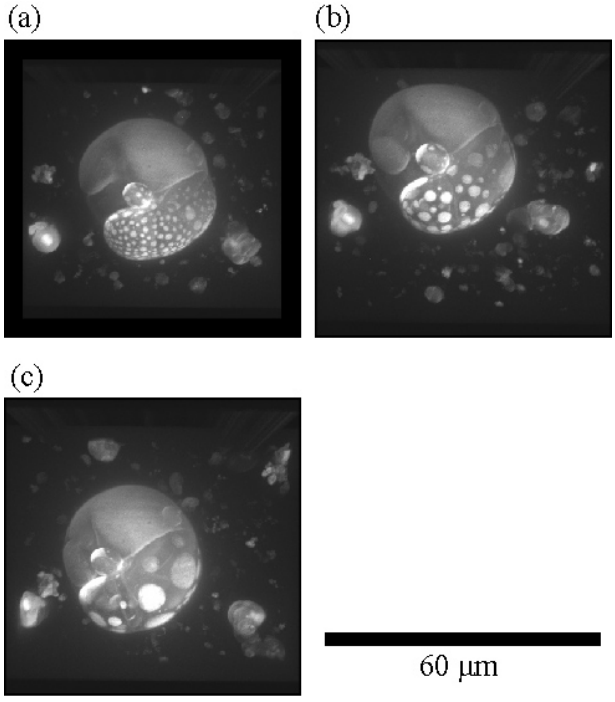

Fig. 1. Time development of a phase separated vesicle. The images are reconstructed by a confocal laser scanning microscope. The intervals of the images ((a) to (b) and (b) to (c)) are both about 5 minutes. The bar corresponds to 60 μm for the front flame of the reconstructed 3D images.

References

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[3] P. Cicuta, S. L. Keller and S. L. Veatch, J. Phys. Chem. B 111, 3328 (2007).