MEMBRANE FLUCTUATIONS OF A MULTIPLE-DOMAIN LIPID VESICLE MEASURED BY DIFFERENTIAL CONFOCAL MICROSCOPY

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ABSTRACT

Membrane lipid domains (also known as lipid rafts) are closely related to important cellular functions including membrane trafficking, signal transduction, etc [1]. Direct observations and measurement of the lipid domains on living cells are difficult, and therefore the model membranes of lipid vesicles are often employed for the studies of membrane micro-organizations. Coexistence of fluid domains on a vesicle has been observed [2], and the dynamics of the vesicle shape induced by domain separation is also reported [3]. However, mechanical properties such as the bending rigidity of the individual lipid domains have not been explored yet.

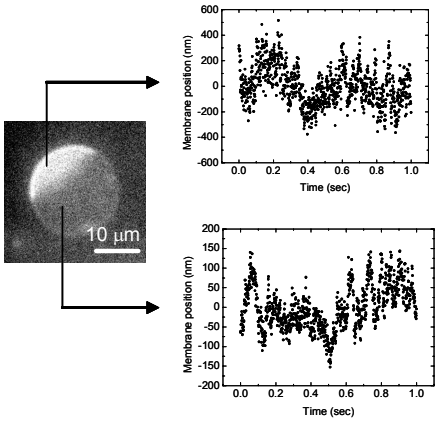

Figure 1: Membrane fluctuations measured on different domains of a two-domain DOPC:sphingomyelin: cholesterol vesicle.

Thermal fluctuations of membranes can be used to deduce the bending rigidity of lipid membranes. To study the bending rigidity of a single domain on a multiple-domain vesicle, one may use a high-sensitivity probe to measure the fluctuations on each domain. We have demonstrated that differential confocal microscopy (DCM) is a suitable technique for measuring the fluctuations and deformation of a uniform vesicle membrane [4]. Because the sizes of domains are larger than the spot size of DCM, we may also use DCM to measure the fluctuations on individual domains and reveal the variation in mechanical properties. Figure 1 shows a two-domain lipid vesicle. Only the DOPC domain, which is in the liquid-disordered phase, is fluorescently labeled. By using DCM, we measured that the mean-square amplitude of the fluctuations on the DOPC domain (~26800 nm^2) is much larger than that on the sphingomyelin domain (~3450 nm^2). Bending rigidity on each domain will be calculated from the measured fluctuation amplitudes.

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