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The mitotic spindle performs accurate segregation of chromosomes during cell division and is mainly composed of microtubules. In general, the polymerization of the microtubules proceeds at the plus end, while the depolymerization proceeds at the minus end. These phenomena occur randomly, ensuring the dynamic instability, which is the most famous and interesting feature of the microtubules. Owing to these dynamic properties of microtubules and numerous motor/non-motor proteins located within the mitotic spindle, at any time the spindle maintains its shape and size. Even after it has been perturbed mechanically by a microneedle, the spindle recovers its configuration. How are the dynamic behaviors regulated to produce such robustness? I test this question by imaging the fluorescence of EB1 (End Binding Protein 1) in the meiotic spindle self-organized in the *Xenopus* egg extract. EB1, a non-motor protein and one of the MAPs, assists the binding of tubulin to the microtubule's plus end. It localizes at the plus tip during polymerization and detaches from there during depolymerization. By using this property of EB1, we were able to track the behavior of the plus tip. We observed the spindles transformed by microneedles in order to examine the functional response of microtubules while the spindle was restoring its configuration. Here, we report how the microtubule dynamics contribute to the recovery and the maintenance of the spindle's shape and size.

3P215 複雑系化学物理 XXXVIII : サイン振動ズリ流動における多層球状構造へのラメラベシクル転移
Complex Chemical Physics XXXVIII : The lamellar - vesicle transition of Multilamellar Vesicle in sine oscillatory shear flow

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When the phase transition is described by phenomenological function, the discrete part can be seen. Such a discontinuous part has been investigated and they have been trying to describe with various functions. Fractional function, trigonometric function, power function and exponential function are frequently proposed. In this research, we focus on the stretched exponential function. It is known that unique size of multilamellar vesicles are formed by controlling the shear and its constitution of surfactant/oil/water system. This formation process can be regarded as the phase transition from lamellar phase to vesicle phase. The formation process depends on the way of shearing. According to our previous research, the formation process can be highly described by the stretched exponential formation. And it can be applied to the process of oscillatory shear. But its formation process is improved when the frequency of oscillation increase, it suggests that it might be necessary to take another parameter into account. In this research, to develop the discussion, we discuss the formation process of sine oscillatory shear. Sine oscillation shear is expected to be more complicated because the acceleration and slowdown effect may influence the process. Through this research, we discuss the mechanism of the phase transition.

3P216 スフィンゴミエリン/ステロールからなる単層膜巨大ベシクルの弾性率測定
Effect of sterols on elastic properties of sphingomyelin large unilamellar vesicles

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Cholesterol distributed widely in biomembranes is one of the major targets for lipid researchers and has been studied by a variety of methods. However, relationship between its modulation effect on membrane properties and its detailed molecular structure is still unclear. In this study, we examined the elastic properties of the sphingomyelin/sterol binary bilayers by the micropipette aspiration method to clarify the effect of sterol structure on the elastic properties of the bilayers. We used sterols with similar structure to cholesterol such as stigmaterol. The binary bilayers are known to exhibit liquid disordered-to-liquid ordered phase transition, which is expected to be detected as a change in the bilayer elasticity depending on the sterol molar fraction. A large unilamellar vesicle was prepared by the cast method and sucked partially into a micropipette with the diameter of about 10 μm . The temperature of the vesicle was kept above its main transition temperature. The membrane tension was calculated from the aspiration pressure, which was changed stepwise in the range from 2-200 Pa and plotted vs the area expansion to obtain the bending

elastic modulus and the area compressional modulus. We found that the bending elasticity increased in the presence of low concentration of cholesterol and went down to the minimum at the molar fraction of about 0.1. Similar tendency was also observed in the case of stigmaterol.

3P217 電子線回折法による皮膚角層脂質からなる LB 膜の構造解析
Electron diffraction study on LB films composed of stratum corneum lipids

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The lateral packing structures of the intercellular lipids in the stratum corneum (SC) play a crucial role for the skin barrier function. In this study, we examined the structure of the Langmuir-Blodgett (LB) films composed of the main components of SC lipids, i.e., ceramide, cholesterol and fatty acid, by the low-dose electron diffraction method. In order to analyze interaction between these molecules, we prepared their mixed monolayers on the water surface in a trough for surface pressure-area measurements at the surface pressure of 30 mN/m. The mixed monolayers were in the liquid condensed phase at the surface pressure. The monolayer was transferred onto an amorphous carbon film mounted on a grid for electron microscopy to make an LB film. Low-dose electron diffraction was carried out using a high sensitivity CCD camera (Gatan ES500W). Six diffraction spots with the hexagonal symmetry were clearly observed in the ceramide LB film. The spacing was estimated to be about 0.426nm, which is larger than that in L_{β} phase and smaller than that in L_{α} phase in the bilayer system. Since the selected area for the electron diffraction was about 60 μm^2 , polarity of the packing structure must have persisted over several μm . Addition of cholesterol induced only a slight change in the packing structure up to the molar fraction of 0.3. In contrast, a broad Debye ring was obtained at the mole fraction of 0.4.

3P218 ジバルミトイルホスファチジルコリン/パルミトイルセラミド混合膜内に形成されるセラミド局在領域の特性
Characterization of Ceramide-rich Domains in Dipalmitoylphosphatidylcholine/Palmitoyl-Ceramide Mixed Bilayers

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It has been reported that ceramide (Cer) molecules heterogeneously distribute in phosphatidylcholine (PC)/Cer mixed bilayers, forming the Cer-rich ordered phase. Though the phase behavior is known to depend on the composition of lipid hydrocarbon chains, only a little information is available on the ordered phase induced by Cer with a specific fatty acid. In this work, using palmitoyl (C16)-Cer/dipalmitoyl-PC (DPPC) mixed bilayers, we examined the membrane properties of the Cer-induced ordered domain. Differential scanning calorimetry (DSC) showed that addition of Cer into DPPC bilayers induces extension of the main transition to higher temperatures, suggesting appearance of the Cer-rich domain. On the basis of the transition enthalpy, the molar ratio of Cer to DPPC in the Cer-rich domain was estimated to be about 0.2, assuming that the surrounding matrix consists of pure DPPC. To obtain the information on the lipid packing in the Cer-rich domain, we examined the density of the Cer-rich domain by the neutral floatation method and it was estimated to be 1.014 g/cm³. Comparing with the densities of pure DPPC bilayers in the L_{β} (1.061 g/cm³ at 25°C) and L_{α} (0.996 g/cm³ at 45°C) phases, the estimated Cer-rich domain density was intermediate between those of these two phases. Together with DSC results, turbidity measurements revealed that the Cer-rich domain shows higher detergent-resistance than the pure DPPC domain on the former was solubilized by TritonX-100 at the higher temperature than the latter.

3P219 Structure and thermal properties of binary lipid bilayers of partially fluorinated and normal phosphatidylcholine

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Fluorinated lipids have attracted much attention from the viewpoints of biotechnological and medical applications in that they have unique properties such as rigidity of the fluorinated segments, high thermal stability and high permeability. Recently, Takagi et al. have designed and developed partially fluorinated phospholipids as matrices for reconstitution of membrane proteins*. In the present study, thermal analysis and structural characterization of 1,2-di(14,14,14,13,13,12,12,11,11-nonafluorotetradecanoyl)-sn-glycero-3-phosphocholine (F4-DMPC), a partially fluorinated analog of 1,2-dimyristoyl-sn-glycero-3-phosphocholine (DMPC), have been performed by means of differential scanning calorimetry (DSC) and X-ray diffraction. The gel-to-liquid crystalline phase transition of F4-DMPC bilayer was ob-