Morphological and topological transformations of giant liposome are induced by surfactants, peptides or proteins.

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Cells and cellular organelles are all compartmentalized by lipid bilayer membranes and show characteristic shapes depending on their specific functions. Their morphologies are quite changeable in response to physiological conditions. In particular, topological changes such as the fusion and the division of membranes play essential roles in cellular activities. Thus, the real-time observation of such morphological or topological transformations of membrane is important for understanding the mechanism of membrane dynamics. In the configuration, dynamic behaviors of unlabelled giant liposomes caused by interactions between membranes and proteins, peptides or surfactants were directly visualized by optical dark-field microscopy.

Surfactants or amphiphilic peptides or proteins are thought to induce many events into lipid membranes, solubilization, pore formation or fusion; however, the actual process has not been clarified. We found that liposomes exposed to them exhibited various unique behaviors, shrinkage accompanied by intermittent quakes, release of encapsulated liposomes, and inside-out inversion, as well as fusion or opening hole. These results reveal that the lipid bilayer itself possesses the ability to undergo topological transformation, and their metamorphosis is made possible through interactions with biological amphiphilic components.

Cytoskeletal networks of microtubules or actin filaments are also thought to be involved in determination of membrane morphology. Therefore, we generated giant liposomes containing subunit proteins of those cytoskeletons and reconstructed cytoskeletal networks inside to study their roles in the morphogenesis of living cells. The characteristic morphologies induced into the liposomes are indicating that the assembly and growth of cytoskeletal filaments can generate sufficient force to deform lipid membranes.