Self-assembled Lipid Membranes Doped with Organic Molecules

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The bilayer lipid membranes with ultra-thin thickness (4~5 nm) and high insulation property have great potential to serve as an insulating layer in bio-hybrid devices. At the same time, since bilayer lipid membranes can be formed by self-assembly, it can be used as a template to build functional membrane structures. Here, we propose that by utilizing the outstanding properties of bilayer lipid membranes, functional bio-hybrid membranes can be readily formed by doping the lipid membrane with organic molecules.

In this work, copper phthalocyanine (CuPc), which has been widely used in the fields of catalysis, solar cells, and transistors, is used to dope the lipid membranes. To form the CuPc doped lipid membranes, CuPc and 1,2-diphytanoyl-sn-glycero-3-phosphochpline (DPhPC) were firstly dissolved in chloroform to form a clear solution with blue color. Then, the prepared solution was dropped onto water surface using a micro-syringe. Immediately, membranes with uniform blue color formed on the water surface. Finally, the formed membranes were transferred to a Si substrate pretreated with O_2 plasma. The morphology of the formed blue membranes was investigated by atomic force microscope (AFM). As shown in Figure. 1, a 5.0 nm-thick membrane was found on a Si substrate. It is also noticed that thicknesses of other membranes were very close to integral multiples of 5 nm, such as 15 nm, 25 nm and 45 nm. Besides, the largest area of one-piece membrane is over 1 cm^2, which is much larger than pure-lipid membranes formed by the same method. Furthermore, an experiment was designed based on fluorescence resonance energy transfer (FRET) theory. The experimental results indicated that the CuPc molecules are closer to the tails rather than heads of lipid molecules in the membranes. Therefore, it is highly possible that the hydrophobic CuPc molecules help to combine hydrophobic tails of lipid molecules to form a hybrid sandwich structure as shown in Figure. 1. And these hybrid bilayer membranes can stack up to form multilayer structures whose thicknesses are integral multiples of 5 nm. Further analyses are on the way to elucidate the structure and investigate the functionality of the hybrid membranes.

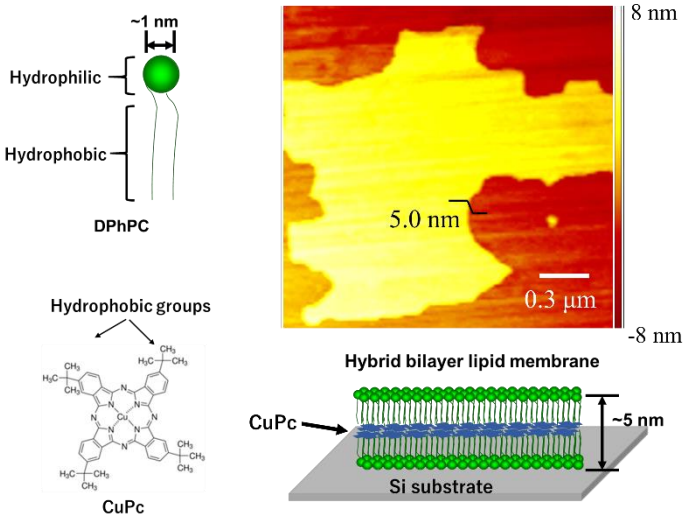

Figure 1. The components and proposed structure of hybrid lipid membrane

This work was supported by the CREST program “Development of Atomic or Molecular Two-Dimensional Functional Films and Creation of Fundamental Technologies for Their Applications” (Grant JPMJCR14F3) of the Japan Science and Technology Agency (JST).