Synopsis of Original Research Paper

Effect of Surface Properties and UV irradiation on the Supported Lipid Bilayer Membranes on Titanium Dioxide Surfaces

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Lipid bilayer membranes on TiO_2 substrates were investigated by means of atomic force microscopy (AFM) and fluorescence microscopy. Lipid bilayer membranes deposited on flat solid surfaces are called "supported planar bilayers" (SPBs), and expected to be an effective cell-membrane-mimicking model system *in vitro*. TiO_2 is widely used in cosmetic products such as sunscreens, face-powders, foundations, etc. I propose that the SPB on TiO_2 surfaces can be a good model-system of the cell/cosmetics interface on skins.

Single-stepped rutile-TiO_2 low index surfaces were used in order to clarify the effects of surface atomic structures and chemical properties of each TiO_2 surface. Single-stepped TiO_2 (100), (001) and (110) surfaces were prepared by HF aq. immersion and thermal treatment at 700-850°C at O_2 flow. The SPBs were formed by vesicle fusion methods using extruded vesicles through 50-100 nm and sonicated vesicles. Two kinds of saturated phospholipids, dimyristoylphosphatidylcholine (DMPC) and dipalmitoylphosphatidylcholine (DPPC), an unsaturated phospholipid, dipalmitoleoylphosphatidylcholine (DPoPC), or their mixture were used for the SPBs on purpose.

After the single-stepped TiO_2 (100) surface was incubated in the 100-nm-filtered and sonicated DPoPC vesicle suspension, a defect-less and full-coverage SPB formed. Fluorescence recovery after photobleaching experiment showed that the SPB retains the fluidity. In the AFM images, the trace of the single steps was recognized on the DPoPC-SPB on the TiO_2 (100). This step-trace was also observed on both gel-phase and liquid-crystal-phase domains in a phase-separated binary SPB of DPPC and DPoPC. The gel-domains edges along the substrate steps preferentially appeared. It was also found that the nucleation of the gel-domains occurred on the terrace regions. These results indicated the atomic structure on the substrates actually affects to the assembly of lipid molecules in the SPBs.

The DMPC 50-nm-filtered vesicles transformed to planar bilayer on the O_2-annealed TiO_2 (100), but adsorbed as vesicles on the UV-irradiated TiO_2 (100). Stable hydrogen-bonded water layer formed due to the UV-induced hydrophicity on the TiO_2 surface. The water layer worked as the barrier for the interaction between the DMPC head group and the substrate.