

Formation of novel concave surface structures by patterned photopolymerization induced molecular diffusion

(Laboratory for Chemistry and Life Science, Tokyo Institute of Technology) ○ Sayuri Hashimoto, Norihisa Akamatsu, Shoichi Kubo, Atsushi Shishido

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The precise control of the surface topology has drawn great attention for the fabrication of functional devices widely applicable to wettability and adhesion control, modulation of optical properties, and so on. Lithography processes have been widely used to fabricate surface structures, especially in the industrial field. Alternatively, the photoinduced formation of surface relief gratings (SRGs) using liquid crystals (LCs) has been developed to give anisotropic functions^{1,2}. The surface structures formed on LCs have advantage of reversible changes in molecular alignment in response to external stimuli such as light, electricity, and heat. Recently, we presented the formation of surface relief structures accompanied with molecular alignment in LC polymer films by patterned photopolymerization, based on a concept of molecular diffusion³⁻⁵. However, the height of the relief structures is limited to several hundred nanometers. Fabrication of surface structures with a depth of micrometers still remains a challenge.

In this study, we report on the formation of novel surface concave structures in the LC films by simple patterned photopolymerization (Fig. 1). We revealed that the surface relief structures were formed by the molecular diffusion, and the period of the surface structures depended on the width of light pattern. Interestingly, concave structures with depths of several micrometers were formed on LC polymer films when the light pattern was changed in terms of the ratio of the irradiation width to the dark width. Moreover, we successfully designed the spatial arrangement of the concave structures, i.e. canals and holes, by controlling the irradiation patterns and photopolymerization conditions. The formation mechanism of the concave structures will be discussed.

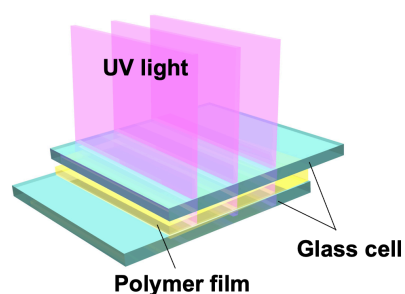


Fig. 1. Schematic illustration of patterned irradiation.

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