Fabrication of Liquid Crystal Polymer Films by Scanning Wave Photopolymerization and Mass Transfer Analysis

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Surface structure control of liquid crystal polymers (LCPs) has attracted attention as an excellent approach for functionalization, such as light diffraction, switchable wettability, antifouling. Photopatterning of the surface structures of LCPs enables the simple, effective, and high throughput method of controlling various surface topographies with high spatiotemporal resolution [1]. In the last decades, many researchers have explored the surface structuring photopatterning and proposed various mechanism such as Marangoni flow, phase transition, photoisomerization, and molecular alignment changes. Recently, we developed a novel method of controlling molecular alignment and surface topography using patterned radical photopolymerization [2-4]. This method utilizes anisotropic diffusion, inducing molecular alignment and simultaneously forms nano- to micro-scale surface topographies. In this study, we employed the patterned cationic photopolymerization without substrate interfacial constraints. We could visualize the mass transfer behavior induced by SWaP through the evaluation of the molecular alignment of the obtained film. The polarized optical microscopy observation revealed optical anisotropy reflecting the irradiation pattern and LC molecules aligned radially. Moreover, confocal laser micrographs showed that periodic convex structures formation in the surface.

References

[1] T. Seki, *et al*., "Photoinitiated Marangoni flow morphing in a liquid crystalline polymer film directed by super-inkjet printing patterns", Sci. Rep., **9**, 2556, 2019.
[2] A. Shishido, *et al*., "Scanning wave photopolymerization enables dye-free alignment patterning of liquid crystals", Sci. Adv., **3**, e170161, 2017.
[3] A. Shishido, *et al.*, "Direct Surface Patterning of Microscale Well and Canal Structures by Photopolymerization of Liquid Crystals with Structured Light", ACS Appl. Mater. Interfaces, **15**, 14760–14767, 2023.
[4] A. Shishido, *et al.*, "Recent Advances in Molecular Alignment by Scanning Wave Photopolymerization of Liquid Crystals", Liq. Cryst. Rev., **14**, 25–42, 2026.