McGill Chemical Society

Dr. Tomiki Ikeda

Chemical Resources Laboratory, Tokyo Institute of Technology

Photomobile Polymer Materials – Towards Light-Driven Plastic Motors

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Otto Maass room 217

Recently, much attention has been paid to the study and application of crosslinked liquid-crystalline polymers (CLCPs) due to their unique combination of the anisotropic aspects of LC phases and the rubber elasticity of polymer networks. Photomobile polymers that can undergo two- or three-dimensional movements in response to light could be smart materials in the next generation [1, 2]. In this study, we focused our attention on developing photomobile polymers that show controlled three-dimensional movements by light. When the CLCP film was irradiated with unpolarized light, the monodomain CLCP film bent toward the irradiation direction of the actinic UV light along the rubbing direction, and the bent film reverted to the initial flat state after exposure to Vis light. This bending and unbending behavior was reversible just by changing the wavelength of the actinic light [3]. By selective absorption of linearly polarized light in the polydomain CLCP films, we succeeded in realizing a photoinduced direction- controllable bending in that a single polydomain CLCP film can be bent repeatedly and precisely along any chosen direction [4]. The film bent toward the irradiation direction of the incident light with bending occurring parallel to the polarization direction of the actinic light. Furthermore, the homeotropic films, in which mesogens are aligned perpendicular to the film surface, bent away from the actinic light source. This is in an opposite direction of bending from the homogeneous films with the mesogens aligned parallel to the film surface, showing that the mode of movement can be tuned by tuning the initial alignment of the photoactive mesogens [5]. CLCP films were prepared by photopolymerization of an acrylate monomer that exhibits chiral smectic C and CA phases and a diacrylate that shows a smectic A phase. The resulting film showed the bending along the alignment direction of mesogens much faster than those prepared in a nematic phase [6].
We also prepared laminated films composed of a CLCP layer containing azobenzene moieties and a flexible plastic film (CLCP laminated films) and examined their photoresponsive behavior. We could induce large motions of these laminated films by photoirradiation, which leads to three-dimensional movements such as an inchworm walk and a rotary motion.

References

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[5] Kondo, M.; Yu, Y.; Ikeda, T. Angew. Chem. Int. Ed. 2006, 45, 1378.
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