Development of New Strategies for Photoresponsive Soft Materials Based on the Molecular Assembly

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The cooperative interplay between soft materials and photon (light) emerges various fascinating dynamic functions. Representative processes are the photoalignment of liquid crystalline (LC) materials and light-driven motion inductions using azobenzene polymers [1,2].

Molecular orientation control is essential for drawing out the functions of various organic and polymer materials. The surface-mediated photoalignment of namatic LCs (NLCs) was first initiated by K. Ichimura et al. more than 30 years ago (in 1988) using an azobenzene (Az) monolayer, and has currently become a significant process as the alternative to rubbing in the fabrication of LC display devices [1]. The angular-selective photoreaction exerted by irradiation with linearly polarized light (LPL) leads to the molecular alignment induction. We have extended the LC photoalignment strategy to other directions such as application to polymers, mesostructured materials, polymer bushes and block copolymers. Further, the free surface-promoted photoalignment has also been demonstrated [1].

We have also recently shown that the free surface plays a significant role in the mass migration, which can be plausibly explained by the Marangoni effect [2]. The photo-triggered mass migration effectively takes place by patterned UV light irradiation onto a non-photoresponsive film whose surface is covered with an Az molecular layer. The Marangoni flow should be the major driving mechanism in the surface relief grating (SRG) formation. Many mechanisms have been proposed for such all optical (development-free) surface fabrication process. We propose here that such free-surface mediated process can be one of the key mechanisms in the SRG generation processes [2].

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