Physical mechanism for anchoring process of liquid crystals on photopolymer layers during the exposure of ultraviolet light

Hyungwu Pae[a], Jinyool Kim[a], Chang-Jae Yu[a, b], Sin-Doo Lee[a*]

a School of Electrical Engineering, Seoul National University, Kwanak P. O. Box 34, Seoul 151-600, Korea
b Present address: Department of Electronics and Computer Engineering, Hanyang University, Seoul 133-791, Korea

Over the last two decades, photo-induced alignment of liquid crystals (LCs) has been extensively studied for understanding surface ordering of the LC molecules as well as for device applications [1-3]. However, a physical picture of the pretilt transition of a nematic liquid crystal (NLC) on a variety of photopolymers upon the exposure of ultraviolet light (UV) is not clearly understood yet. In this work, we proposed a physical mechanism for the polar anchoring transition of the NLC on photopolymer layers during the exposure of UV light. The angular distribution function of photopolymer side chains was determined in a simple photoreaction model, and then the surface free energy of NLC system was obtained in the Rapini-Papoular approximation. Within the photoreaction model, the photo-induced reorientation of polymer side chains and the resultant time evolution of the pretilt angle transition were described. Two different photopolymers used in this study are capable of controlling the NLC molecular director from the homeotropic alignment to the planar alignment depending on the exposure time of the UV light. The experimental results are found to agree well with theoretical predictions.

References

(1) Schdt, M., Schimitt, K., Kozinkov, V., and Chigrinov, V. *Jpn. J. Appl. Phys.* **1992,** *31*, 2155
(2) Ichimura, K., Akita, Y., Akiyama, H., Kudo, K., and Hayashi, Y. *Macromolecules* **1997**, *30*, 903
(3) Chen, J., Johnson, D. L., Bos, P. J., Wang, X., and West, J. L. *Phys. Rev.* E **1996**, *54*, 1599