LIQUID CRYSTAL ALIGNMENT INDUCED BY PERFLUOROPOLYMER FILMS EXPOSED TO LINEARLY POLARIZED ULTRAVIOLET LIGHT

Kiyoaki Usami

Department of Information Systems Engineering, Osaka Sangyo University,
3-1-1 Nakagaito, Daito-Shi, Osaka 574-8530, Japan,
e-mail: usami@ise.osaka-sandai.ac.jp

In liquid crystal (LC) displays (LCDs), weak anchoring of the LC molecules at the interface with the alignment layer can in principle lead to lower operating voltages and improved steepness of the electro-optic response [1]. J. M. Russell-Tanner et al. reported on Langmuir-Blodgett (LB) films of UV-curable perfluoropolyether (Fluorocur®, Liquidia Technologies) having a weak surface anchoring energy for bend deformation, which was in the order of 10^{-5} J/m^2 for 4-n-pentyl-4'-cyanobiphenyl (5CB) [2]. Moreover, we succeeded in inducing a uniform LC alignment by using Fluorocur films exposed to linearly polarized ultraviolet (UV) light (LPUVL)[3]. Since Fluorocur is a liquid before UV curing, one can easily prepare the film on a substrate. However, it was difficult to prepare the *uniform thin* film (less than 100 nm thickness) without LB technique. As alignment films for LCDs, thickness less than 100 nm is desired. Here, we focused on CYTOP (Asahi Glass Co., Ltd.)[4]. Since CYTOP is also a perfluoropolymer including ether bonds, we can expect that the films also have a weak surface anchoring energy. In addition, CYTOP can be dissolved in an organic solvent. Thus it is expected that one can easily form the film and control the thickness. In this study, we have investigated the LC alignment on CYTOP films exposed to LPUVL.

The CYTOP resin was spin-coated on ITO-coated glass substrates and then it was baked at 250 C°. The thickness of the films was about 9 nm. The films were exposed to LPUVL at the wavelength of ~250 nm at 10 J/cm^2 in air condition. To examine the LC alignment, parallel-aligned LC cells were assembled by using the LPUVL-exposed CYTOP films as the cell walls. The cells were filled with 5CB or ZLI-4792 (Merck Ltd.), which is a fluorinated LC mixture, in its isotropic phase by capillary action. The LC alignment was observed by polarizing microscopy.

The 5CB molecules on the CYTOP films aligned perpendicular to the substrate surface (vertical alignment). On the other hand, homogenous alignment of ZLI-4792 was observed on the LPUVL-exposed CYTOP films. This result indicates that the LC alignment on the CYTOP films strongly depends on the class of LC material. In addition, we found the substrate dependence of LC alignment for ZLI-4792. In the case of using the CYTOP films prepared on bare glass substrate, random orientation of ZLI-4792 was observed even though the films were exposed to LPUVL.

Acknowledgment: A part of this work was supported by the HRC project (MEXT.HAITEKU 2006-2010) of the Ministry of Education, Culture, Sports, Science and Technology of Japan.

References: [1] G. P. Bryan-Brown, E. L. Wood, I. C. Sage, Nature **399**, 338 (1999). [2] J. M. Russell-Tanner, S. Takayama, A. Sugimura, J. M. DeSimone, E. T. Samulski, J. Chem. Phys. **126**, 244706 (2007). [3] K. Usami, A. Sugimura, E. T. Samulski, Mol. Cryst. Liq. Cryst. **516**, 38 (2010). [4] J. K. Kim, F. Araoka, S. M. Jeong, S. Dhara, K. Ishikawa, H. Takezoe, Appl. Phys. Lett. **95**, 063505 (2009).