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Dong-Myung Shin [a], Mi-Kyoung Park [a], Mi-Hie Yi [b] & Kil-Yeong Choi [b]

[a] Dept. of Chem. Eng., Hong-Ik University, Seoul, 121-791, KOREA

[b] Advanced Materials Division, Korea Research Institute of Chemical Technology, Taejon, 305-350, KOREA

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# A Study on Pretilt Angle of Liquid Crystal with Polarized UV Light Irradiation on Soluble Polyimide Alignment Films

DONG-MYUNG SHIN[a], MI-KYOUNG PARK[a], MI-HIE YI[b] and KIL-YEONG CHOI[b]

[a]*Dept. of Chem. Eng. Hong-Ik University, Seoul, 121–791 KOREA and* [b]*Advanced Materials Division, Korea Research Institute of Chemical Technology, Taejon, 305–350, KOREA*

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We prepared photo-crosslinkable polyimide(PI) film, which contains $CF_3$ moiety. The ketone peak (at 1678cm$^{-1}$) of PI was decreased and broad hydroxyl bond appeared. The decrease of ketone peak was also confirmed with UV-visible spectroscopy. The dichroic ratio of LC cell was obtained. The LC molecules are uniformly aligned perpendicular to polarization direction of irradiated light on PI layers. The pretilt angle of LC on alignment PI films was obtained to be about 3.3°.

*Keywords:* Photo-alignment layer; Photocrosslinkable polyimide; Pretilt angle

## INTRODUCTION

Most LCDs with pretilted homogeneous LC alignment are prepared using rubbed polyimide(PI) surfaces, but it has some problems such as the dust and static charge due to the mechanical contact of rubbing cloth on the alignment layer. Rubbing-free techniques for LC alignment can be advantageous. However, the anchoring energy obtained from the photo-alignment films was found to be 10 times smaller than rubbed surface.

LC alignment on linearly polarized UV irradiated photo-polymer polyvinyl cinnamate films has been reported. The anisotropic photo-

polymerization occurred and LC molecules were uniformly aligned on the polymer layer.[1,2] Also recently reported is LC alignment on a linearly polarized UV light irradiated PI surface, including a discussion on the anisotropic dispersion force caused by the photo-depolymerization of the PI main chains parallel to the electric field of UV light.[3]

In this paper, we report new PI with $CF_3$ moiety that has photo-crosslink ability. The alignment and pretilt angle generation in LC cells was investigated.

## EXPERIMENT

The synthesis of soluble polyimide (PI) was reported in a previous paper.[4] The PI with $CF_3$ moiety that is soluble in organic solvent was synthesized. The molecular structure is shown in FIGURE 1.

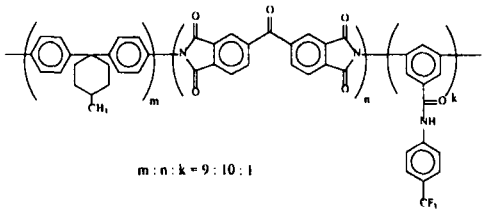


FIGURE 1. Molecular structure of polyimide, BTDA/BAME/4FAM

Alignment films were prepared by spin-coating of dilute solution of PI on the substrates. The substrates are Si-wafer, quartz plate and glass. After polymer coating, the substrates were baked at 220 ℃ for 15min to evaporate the solvent. The samples were irradiated with 500W high pressure mercury lamp equipped with Glan-Laser polarizer.

Infrared spectra were obtained from the Nicolet Magna IR 560 FT-IR spectrophotometer. The UV absorption spectra were measured with HITACHI U-2000 UV/visible spectrophotometer and HP 8452 spectrophotometer.

The sandwich type cells were assembled in a parallel to each other with a cell thickness of 50μm. The dichroic ratios of LC cells containing dichroic LC (BL002, Merck™ mixed with dichroic dye, Serilene Navy Blue by 1wt%) were obtained from the absorption ratios of parallel and perpendicular to the irradiation direction. The pretilt angle of the LC cell was determined by crystal rotation method.

**Results and Discussion**

FIGURE 2 displays the FT-IR spectrum of BTDA/BAME/4FAM on Si-wafer. With UV irradiation, ketone peak (1678cm$^{-1}$) of BTDA decreased and the hydroxyl band appeared. This indicated that ketone was converted to the hydroxyl group, which was confirmed by the decrease in 270nm peak in UV spectra. As irradiation time increased, UV absorption peaks decreased and the dichroic ratio($A_{\perp}/A_{\parallel}$) increased, as shown in FIGURE 3. After 150min irradiation, the UV absorption spectrum showed maximum dichroic ratio of 1.027. This indicated that the ketone aligned parallel to the polarization direction of irradiated light was converted to hydroxyl group, which did not

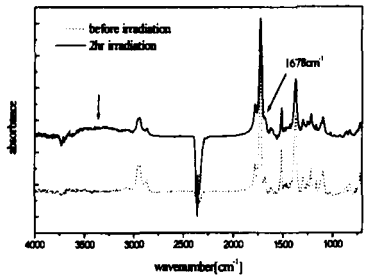


FIGURE 2. FT-IR spectra of photo-PI with non-polarized UV irradiation

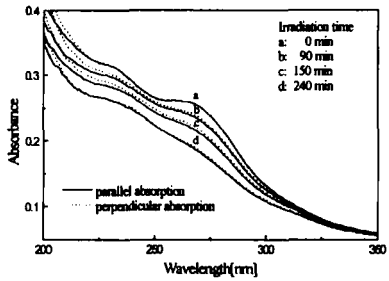


Figure 3. The dichroic UV absorption spectrum of BTDA/BAME/4FAM film. The direction of parallel absorption is equal to the direction of the polarization direction of irradiated light.

absorb light at 270nm region. FIGURE 4 shows UV-visible absorption peak intensity at 622nm, which is plotted against rotation angle of the polarizer. The visible absorption perpendicular to the polarization direction of irradiation is stronger than that obtain with parallel direction. This indicated that LC molecules are uniformly aligned perpendicular to polarization direction of irradiated light on PI layers. The maximum pretilt angle of LC on alignment PI films was about 3.3° from the PI with 150min photo-irradiation. The pretilt angle decreased after prolonged irradiation, which may due to the photodecomposition reactions by UV light..

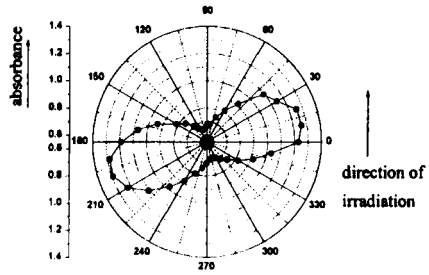


FIGURE 4. UV absorbance for 622nm against rotation angle of polarizer of LC cell.

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## *References*

[1] T. Hashimoto, T. Sugiyama, K. Katoh, T. Seitho, H. Suzuki, Y. Iimura, and S. Kobayashi, SID 95 Digest (1995), 877.
[2] M. Schadt, K. Schmitt, V. Kozinkov, and V. Chigrinov, Jpn. J. Appl. Phys., 31(1992), 2155.
[3] D. S. Seo, L. Y. Hwang, and S. Kobayashi, Liquid Crystals, 23(1997), 923.
[4] M. H. Yi, W. Hwang, J. T. Jung, S. K. Kwan, and K. Y. Choi, J. Marcromolecular Science, in press.