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Supporting Information

Orientational Transition of Liquid Crystal Molecules by Photoinduced Transformation Process into Recovery-free Silicon Oxide Layer

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- **The surface energy change via UVO treatment and its reliability**

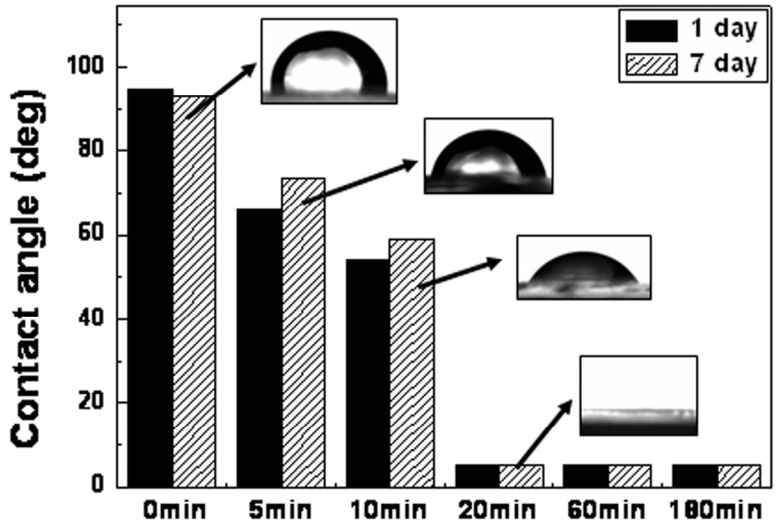

Figure S1. *The contact angle in several samples with different UVO treatment time immediately after UVO treatment and in 7 days.*

To observe the effect of UVO treatment on surface energy of the PDMS layers, the contact angle of several samples with different UVO treatment times was measured by the sessile drop technique using distilled (DI) water utilizing a Phoenix 300 surface angle analyzer (Surface Electro Optics, Korea) and ImagePro 300 software. As seen in Figure S1, the UVO treatment continuously controlled the PDMS surface from hydrophobic to hydrophilic, and the contact angle was saturated after a UVO exposure above 20min. This unique capability to continuously control the surface energy suggested the research potential concerning the property changes of electronic devices in various surface conditions. In addition, the recovery phenomenon to the original PDMS layers with hydrophobic property in the photoinduced silicon oxide layers was examined through measuring the contact angle in 7 days after UVO treatment. While UVO exposures less than 20 min resulted in a slight increase of the contact angle over 7 days, UVO exposures above 20 min didn't change the contact angle. It meant the UVO exposure above 20 min induced a recovery-free property. These results were attributed to the difference in the degree of transformation to silicon oxide according to UVO exposure time. In UVO exposure times less than 20 min, the general recovery mechanism acted on the silicon oxide layers due to residual low molar mass PDMS chains. On the other hand, in UVO exposure times above 20 min, the PDMS layers were able to perfectly transform to the silicon oxide layers because the thickness of PDMS layers (~10nm), coated by a chemical reaction, was within the thickness of the silicon oxide able to achieve through the UVO treatment (~160nm). Therefore, there were no residual low mass PDMS chains in the silicon oxide and the fully transformed silicon oxide layer couldn't return to its original states.

- **The transmittance of the conventional polyimide alignment layer and the silicon oxide layer**

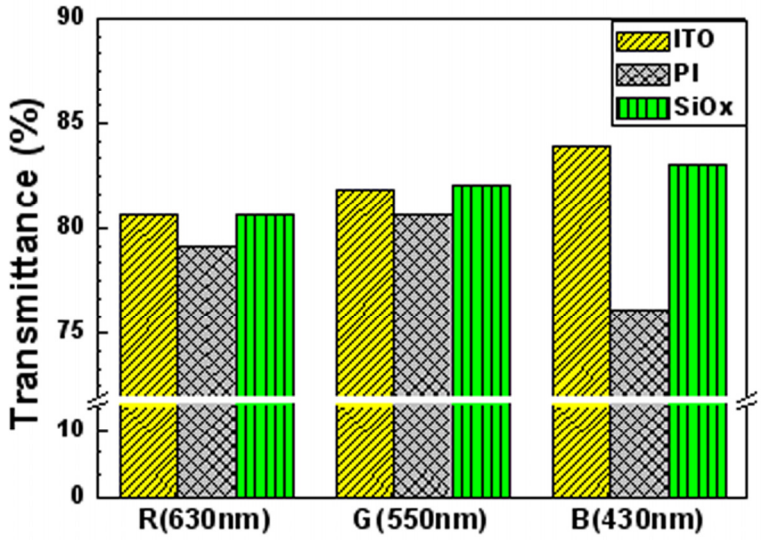

Figure S2. *The transmittance of conventional polyimide alignment layer and the silicon oxide layer*

The transmittances of the conventional polyimide for vertical LC alignment and the silicon oxide, which was fabricated by the UVO treatment of PDMS (UVO treatment time = 60 min), were compared. The polyimide was prepared by spin-coating on the ITO glass for 5 sec at 500 rpm and then for 70 sec at 2600 rpm, followed by thermal curing at 200℃ for 1 h. After preparing the silicon oxide sample and polyimide sample on ITO glass, the transmittance was measured utilizing UV/Vis spectroscopy (Cary5000, Varian). As seen in Figure S2, the silicon oxide layer showed higher transmittance, which was attributed to the intrinsic transparent property and antireflection effect. Generally, antireflection film should satisfy the $n_0/n_f=n_f/n_s$ with n_o, n_f, and n_s being the refractive indices of air, film and substrate respectively, in which the reflected light from the air-film and film-substrate interfaces interfere destructively to maximize the light transmission into the transparent substrate. However, because the polyimide doesn't satisfy this condition, light loss occurs in the polyimide/ITO glass. On the other hand, the silicon oxide satisfies this condition and can play a role in antireflection film. Eventually, the silicon oxide alignment layer showed higher transmittance and secured the fabrication of the brighter LCD.

- **The polar anchoring energy measurement**

The polar anchoring energy of the silicon oxide alignment layer was measured by an electric field method because it is simple and reliable for measuring the anchoring energy of the vertical alignment LC cell among several measuring methods including the wedge-cell technique, light scattering technique, electric field method and magnetic field method. For this technique, the laser, sample, LCR meter and so on were set up as shown in Figure S3. The polarization direction of the polarizer and analyzer was ±45°, and the rubbing direction of the LC cell was 0°. In this set-up, the LCR meter applied the voltage to the LC cell and recorded the capacitance of the LC cell at each applied voltage. Also, the photo diode and multi-meter recorded the transmittance at each applied voltage. Then, the retardation from the transmittance was calculated, and the retardation (R) vs threshold voltage/applied voltage (V_{th}/V) (Figure S4a) and R/R_0 vs 1/(capacitance×voltage) (1/CV) (Figure S4b) figures were obtained. Because $R/R_0 = -(1/CV)(const.) + (1 + 2K_{33}/Wd)$, the y intercept meant that $1 + 2K_{33}/Wd$ in R/R0 vs 1/CV. Here, the projected intercept at 1/CV=0 was 1.00457, which led to an anchoring strength of $W=8.1\times10^{-4}$ J/m^2.

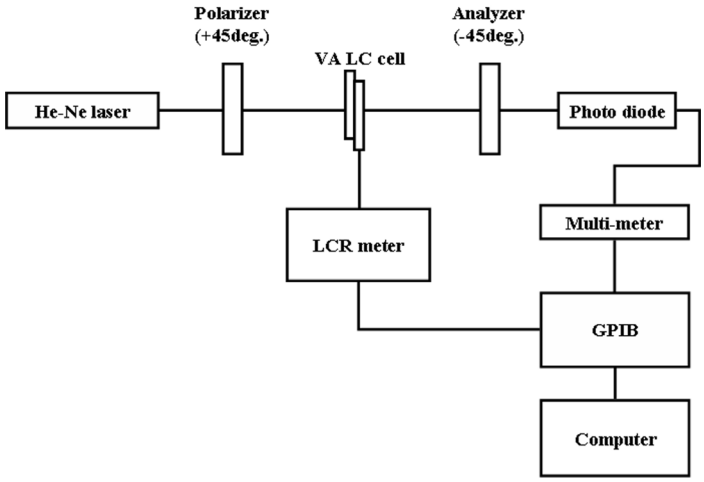

Figure S3. *The schematic set-up for measurement of polar anchoring energy by the electric-field method*

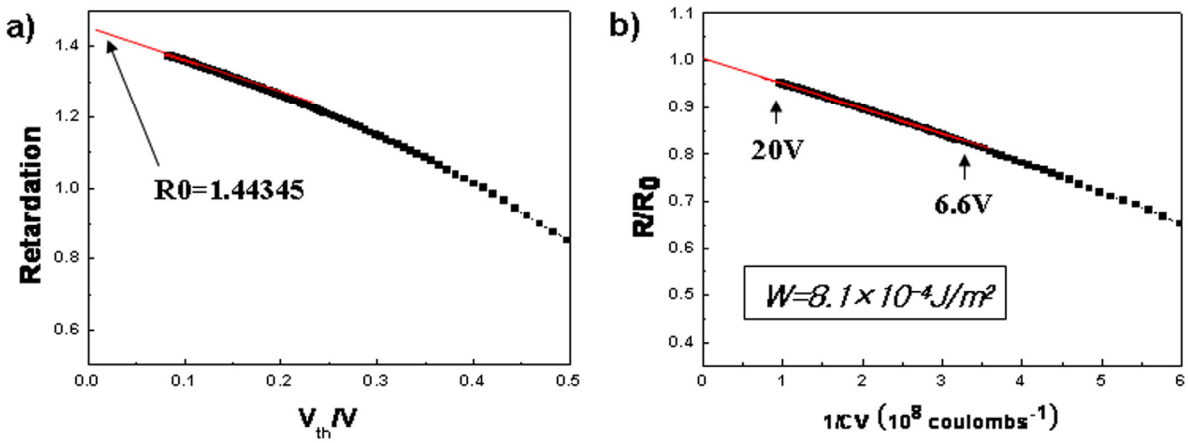

Figure S4. *The polar anchoring energy measurement by the electric field method. In this method, (a) the retardation (R) vs threshold voltage/applied voltage (V_{th}/V) and (b) R/R_0 vs 1/CV graph was made, and the extrapolation of R/R_0 vs 1/CV gave the anchoring energy ($W=8.1\times10^{-4}$ J/m^2)*