

Multi Domain Effect using the UV Exposure for Wide Viewing Angle and High Transmittance in In-Plane Switching Liquid Crystal Mode

Ki-Woong Park¹, Byung-June Mun¹, Joun Ho Lee², Byeong Koo Kim², Hyun Chul Choi², and Gi-Dong Lee¹

¹Dept. of Electronics Engineering, Dong-A University, Busan, 604-714, Korea

Tel.: 82-51-200-7704, E-mail: gdlee@dau.ac.kr

²LG Display Co., Ltd., Gumi, Gyungbuk, 730-731, Korea

Various liquid crystal display (LCD) modes, such as vertical alignment (VA) [1], in-plane switching (IPS) [2], and fringe-field switching (FFS) [3], have been developed to improve the optical performance of LCDs. Generally, the IPS mode can exhibit the high contrast ratio and fast response time. It also provides the high optical intensity by using the stripe patterned electrodes. In spite of its superior optical performance, viewing angle properties in diagonal direction still remains as serious problems in the IPS mode. To overcome this optical drawback, the super IPS (S-IPS) mode technology, which contains the zigzag patterned electrodes in a dot has been developed for wide viewing angle property. However, zigzagged electrodes lead to reduce the aperture ratio in the mode and also generate the several disclinations so that the poor brightness can be induced. Therefore, study for IPS mode which can provide both high brightness and wide-viewing angle properties becomes very important for high resolution display devices, especially.

In this paper, we propose an IPS mode which can provide the multi-domain effect in a pixel by using the photo-alignment method to achieve both the high brightness and wide viewing angle properties. For the multi-domain effect, we partially exposed the linear polarization UV light on two areas of single cell by shifting the black mask which can block the exposure on each domain area. Initial alignment directions in each domain were optimized to $\pm 0.5^\circ$ from the simple calculation and experiment so that we could achieve the excellent dark mode in the initial state and the multi-domain effect on the stripe electrode structure in bright state. From measured results of fabricated sample, we could confirm that the multi-domain effect could be realized in the proposed IPS mode using the UV exposure in Fig. 1(a), and the excellent optical transmittance in bright state at 26V could be achieved without any loss of the light compared with that of the conventional IPS mode as shown in Fig. 1(b).

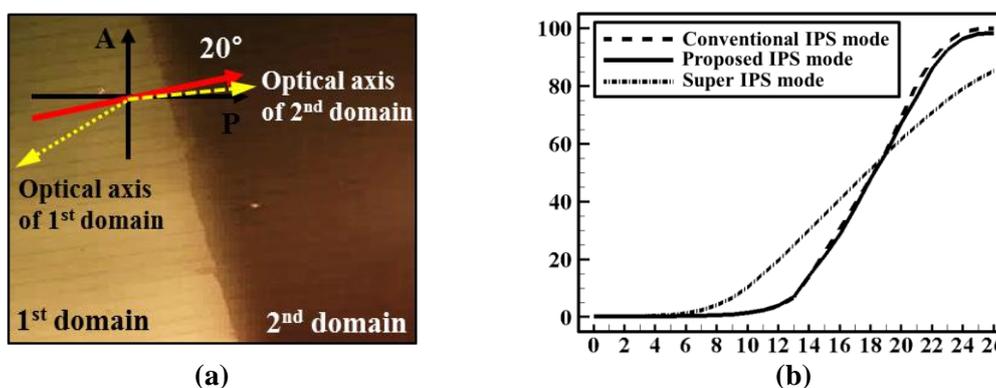


Fig. 1. (a) The microscopic image of the proposed IPS mode at middle voltage state and (b) the comparison of the voltage-transmittance (V-T) curve of each of the IPS mode.

Acknowledgment

This work was supported by LG Display and the Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Education, Science, and Technology.

References

1. S. G. Kim, S. M. Kim, Y. S. Kim, H. K. Lee, S. H. Lee, G.-D. Lee, J.-J. Lyu and K. H. Kim, *Appl. Phys. Lett.* **90**, 261910 (2007).
2. M. Oh-e and K. Kondo, *Appl. Phys. Lett.* **67**, 3895 (1995).
3. S. H. Lee, S. L. Lee and H. Y. Kim, *Appl. Phys. Lett.* **73**, 2881 (1998).