단일 구조의 반투과형 액정 디스플레이 소자 구현

A Single Mode Transflective Liquid Crystal Display Having an Inner-patterned Retarder

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Transflective liquid crystal displays (LCDs) are becoming more and more important for mobile applications because they show superior performances.[1] In general, a transflective LCD consists of two, transmissive and reflective, subpixels that have different cell gaps.[2,3] Such structure with different cell gaps in the transmissive and reflective subpixels requires complex fabrication processes. Recently, the transflective LCDs having identical cell gaps with two different LC modes[4] or a single LC mode[5] were proposed. However, different LC modes result in an electro-optic disparity and thus require different driving schemes. In this work, we propose a transflective LCD with inner-patterned retardation layer in a single LC mode configuration with a single cell gap.

Figure 1 shows a schematic diagram of our transflective LC cell in a single configuration. In such transflective LCD, the LC molecules are homogeneously aligned both in transmissive and reflective regions. An inner-patterned retarder on a photoalignment layer because as a quarter wave plate in the transmissive region and a dummy layer in the reflective region. The incell retarder can be used for compensating optical path difference between transmissive and reflective region. In the absence of an applied voltage, a linearly polarized light coming from the rear polarizer is blocked by the front polarizer in the transmissive and reflective regions and a dark state is obtained. In the presence of an applied voltage, the LC with a positive dielectric anisotropy becomes to align vertically. Thus, the outcoming light is transmitted through the front polarizer in the whole part. Accordingly, a bright state is obtained.

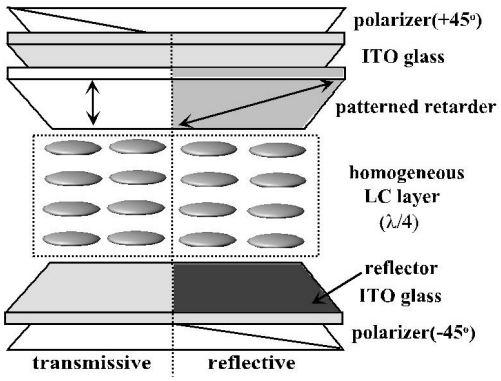

Fig. 1 Schematic diagram of transflective LC cell in a single configuration with an inner-patterned retarder.

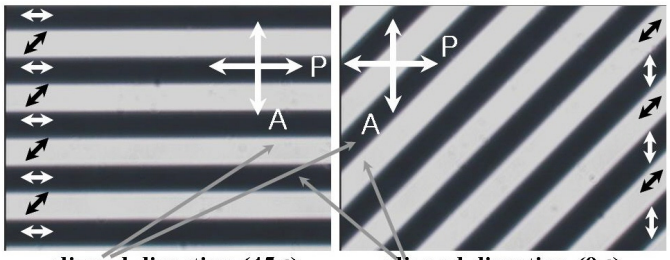

Fig. 2 Microscopic texture of inner-patterned retarder on the glass without reflector in our transflective LCD observed under crossed polarizer: (a) an angle of 0o and (b) 45o between the direction of retarder and the rear polarizer.

As shown in Fig. 2, the transflective LC cell consists of a periodically inner-patterned retarder using self-masking photoalignment to compensate optical path difference between transmissive and reflective parts. The photoalignment polymer of LGC-M0 (LG Cables) was used for aligning the photo-polymerizable liquid crystalline material of LC-298 (BASF) in a different direction, angle of 0^{o} and 45^{o} between the direction of retarder and the rear polarizer in the transmissive and reflective parts, respectively.

Figure 3 shows the electro-optic (EO) properties of our transflective LC cell. The open circles and rectangles denote the experimental results of the transmittance and the reflectance, respectively. The solid lines represent the simulation results obtained by the relaxation method in the elastic continuum theory. The transmissive curve is quite similar to the reflectance curve. Due to the use of the use of a single LC mode in the uniform structure, the electrical controllable birefringence in the LC layer provides a common EO characteristics in both transmissive and reflective regions. This allows for a single driving scheme for our transflective LCD.

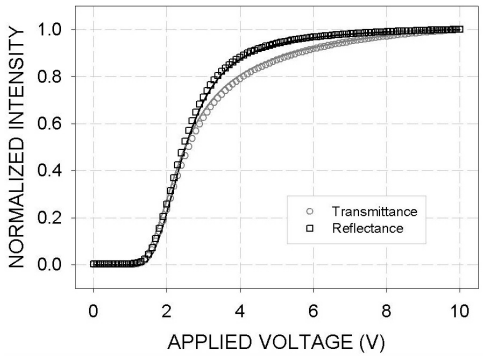

Fig. 3 The EO characteristics of our transflective LC cell.

1. S. T. Wu and C. S. Wu, Appl. Phys. Lett. 42, 1455 (1996).
2. H.-I. Baek, Y.-B. Kim, K.-S. Ha, D.-G. Kim, and S.-B. Kwon, Proc. 7th Int'l Display Workshop, 41 (2000).
3. M. Jisaki, and H. Yamaguchi, Proc. 8th Int'l Display Workshop, 133 (2001).
4. S. H. Lee, K.-H. Park, J. S. Gwag, T.-H. Yoon, and J. C. Kim, Jpn. J. Appl. Phys. 42, 5127 (2003).
5. J. Kim, D.-W. Kim, C.-J. Yu, and S.-D. Lee, Jpn. J. Appl. Phys. 43, L1369 (2004).