Study of Fast Response on Vertically Aligned In-plane Switching Liquid Crystal Display with Polymer Networks

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Liquid crystal displays (LCDs) have been widely used since they possess a lot of attracted properties [1]. However, the slow switching response is regarded as the major drawback of LCDs, which is attributed to the slow response of LC molecules and significantly affects the image quality [2]. To enhance the display performance, the various advanced display modes are purposed, such as in-plane switching (IPS) and vertical alignment (VA). IPS mode provides the wide viewing angle and is one of the most prospective technologies in the LCD industry, but the light leakage revealed in the dark state and causing the poor contrast ratio (CR) [3] requires improving. In contrast, VA LCDs exhibit a high CR because of LC molecules vertically aligned against the substrates with an excellent dark state, but such an alignment is usually with the longer response time, resulting from the backflow effect related to the rotational viscosity of the negative LC molecules (Δε<0).

Recently, the LC cell with polymer networks (PNs) [2, 4, 5] is the potential candidate for well controlling the molecular orientation of LC and further reducing the turn-off response time of the cell. The in-cell polymer-stabilized networks form the sustained pretilt angle with respect to the substrate surface in order to improve the switching process of the LC cell, while the other electro-optical properties such as the transmittance, driven voltage, and CR may be adverse. Today, the IPS driving mode is widely applied on the VA-type LC cell, but the cell incorporating with PNs for the uncomplicated fabrication and improving the performance are rarely revealed.

In this paper, to improve electro-optical characteristics of VA LCDs, PNs and IPS field produced by interdigital electrodes are employed in LC cells. The fast switching response and well optical transmittance of the VA-IPS display mode are successfully achieved by mixing the nematic E7 LC with TA-9164 PNs. This is attributed to the surface anchoring resulting from the morphology of PNs, and the molecular orientation of the LC cell will be governed effectively. In addition, the increased concentration of monomer into the LC cell can significantly improve the response time; however, light scattering effect and the high threshold voltage are also accompanied. This study is essential in the selection of the appropriated polymer material and a compromise between the concentration of monomer and electro-optical performance.

References:

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