Transparent Optically Isotropic Liquid Crystal Mixture exhibiting High Contrast Ratio and Low Operating Voltage for Flexible LCDs

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Recently, nano-polymer dispersed liquid crystal (nano-PDLC) attract attention as a possible application for flexible display. The nano-sized liquid crystal droplets dispersed in polymer matrix has various advantages such as surface treatment free, fast response time, wide viewing angle and free touch mora [1]. However, it has some disadvantage such as high driving voltage, low transmittance, and relatively low contrast ratio due to existence of some level of scattering by binary system of LC droplet and polymer matrix [2], which needs to be overcome to be commercialized. In this paper, we propose a monomer in which the nano-PDLC is much more transparent and exhibits lower operating voltage than those in our previous works.

In this work, we mixed LC (MLC-2053, △n=0.235, Merck) and monomer (PN393, Merck) at a ratio of (A) 45:55, (B) 50:50, (C) 55:45. And then, the mixture is injected into in-plane switching cell whose cell gap was 10 μm, and the distance between the electrodes and electrode width were 4 μm, respectively. After injection, the cell were exposed with UV light (365nm). After UV exposure, all samples are clearly transparent such that they exhibit an excellent dark state under crossed polarizers and the level of the dark state was better than pure nematic IPS cell.

Fig. 1 shows voltage-dependent transmittance curve of each sample. The operating voltage of each sample at which the transmittance is 90% with respect to the maximum is (A) 21 V, (B) 16.5 V, (C) 8.3 V, which is much lower voltage than those with monomer NOA65. Rise time and decay time of each sample are (A) 377 μs, 844 μs, (B) 340 μs, 2.88 ms, (C) 402 μs, 14.5 ms. We confirm that the sample C has highest transmittance and lowest operating voltage. Especially transmittance of sample C is higher than 4 times of the sample A. However, the sample C has slowest response time. This reason is that the sample C has highest LC ratio so that the size of LC droplet is bigger than other samples although all cells are highly transparent. Consequently, high Kerr constant owing to larger-sized droplet but much smaller than visible wavelength and also better complete phase seperation between LC and monomer results in high transmittance, low operating voltage but a little slow response time.

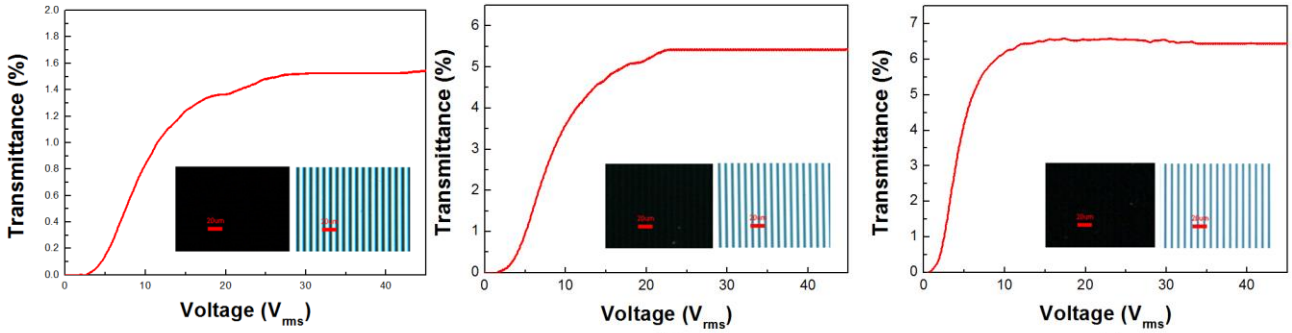

Fig. 1. Voltage-dependent transmittance curves and POM images of the samples with a ratio of LC: Monomer: (a) 45:55, (b) 50:50, (c) 55:45.

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