

## Black Dye Doped LCD without Polarizers

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Guest-host liquid crystal display (Gh-LCD) for transparent display that anisotropic dyes dissolved in LC phase, has been extensively investigated since its invention in the 1960s because of optical (wide viewing angle, high brightness and outdoor readability) and physical (thinner thickness, light weight) properties. The transparent LCD without polarizers can reduce the light leakage and power consumption, however, the contrast ratio is low because it cannot obtain a perfect dark phase.

In this study, polarizer-free LCDs were prepared by doping black dye into nematic LC (B-LC). Black dyes induces selective light absorption by mean of an electric field. An alignment layer for homotropic orientation of black dye doped LC mixtures (vertical alignment mode) was used. We developed a 3.5-inch active matrix TFT transparent LCD and a 3-inch passive matrix LCD by using B-LC technology. The black dye doped LC cell is composed of sandwiched glass substrates with ITO electrode and B-LC layer. The unrubbed PI film (thickness, 110 nm) was used as an alignment layer. The gap of the cells was controlled by using a ball spacer. The B-LC mixture was introduced into sandwiched substrates by mean of modified ODF (one drop fill) method at room temperature.

The obtained black dye doped LCD exhibits good optical performance, fast response time ( $T_r$ , 30ms;  $T_f$ , 44ms) of on/off operation and low driving voltage ( $< 2.5V$ ). Electro-optic behavior of the cell was dependent on cell gap, chemical structure and content of black dye and PI film thickness.



Fig. 1. 3-inch black dye doped LC Clock (PM type)      Fig.2. 3.5-inch black dye doped LCD (AM type)

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