

Plastic Liquid Crystal Display Applied for Conformable Devices

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The display market rapidly changed and for wearable devices application is gradually popular. Wearable devices generally include glasses, watch, band, and smart phone. To obtain a stylish and ergonomic shape design for user scenarios, flexible display is suitable for wearable devices due to it is thin, light-weight and bendable. Recently, OLED and EPD have begun to use plastic film to produce free-form, curved and conformable display for wearable devices, however, there is no example using flexible LCDs for wearable devices.

To obtain a flexible LCD with wide viewing angle, AHVA mode plastic LCD was fabricated by sheet-to-sheet (S2S) process. Bond/debond handling method has been chosen which consists of lamination, well-controlled low temperature LCD process and mechanical peeling process. The most challenge is finding a suitable adhesive which can fix the plastic substrate on carrier during high temperature LCD process and it is able to release in peeling process. Amount various substrate materials, FRP shows excellent birefringence ($R_0 < 1 \text{ nm}$, $R_{th} < 3 \text{ nm}$), high transmittance ($T = 92\%$), thermal stability ($T_g > 250^\circ\text{C}$) and low CTE (8-16 ppm) for dimension change, which is currently the best candidate for flexible LCDs.

3.5-inch conformable plastic LCD demonstrated excellent picture quality due to the character of AHVA mode performance. Conformable LCD module exhibits the advantages of stylish shape formation and ergonomics design for smart watch application with 44 mm curvature. The largest viewing angle is 56° for 3.5-inch conformable display in 300 mm distance lead to only 3% transmittance impact from middle to edge (Fig. 1). It shows AHVA mode flexible LCD presented wide viewing angle, remarkable image quality, and high transparency compare to the conventional TN LCD. Optical performance of AHVA plastic LCD is more suitable for conformable devices applications.

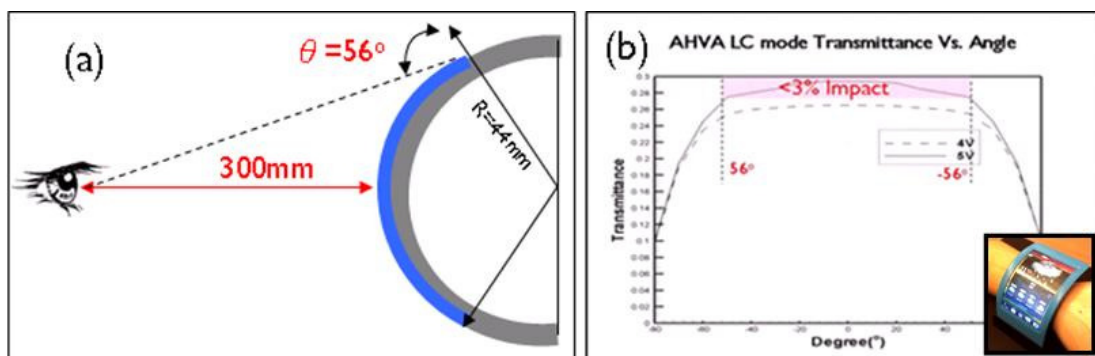


Fig. 1. (a) The largest viewing angle at 44mm curvature and (b) transmittance analysis result of optimized AHVA mode

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References

1. Y. Okada, *SID'02 Technical Digest*, vol. 33, p. 1204 (2002).
2. M. P. Hong, *SID'05 Technical Digest*, vol. 36, p. 14 (2005).
3. Y. H. Yeh, *SID'07 Technical Digest*, vol. 38, p. 1677 (2007).
4. R. Tajima, *SID'14 Technical Digest*, vol. 45, p. 367 (2014).