Wide Viewing Angle emiflective Display

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***Abstract*— We propose a high brightness and wide viewing angle emiflective display consisting of a polarized OLED and 4D TN LC cell. Because the emission and reflection mode acts simultaneously under bright environment without any optical path difference, we can get higher brightness characteristics.**

I. Introduction

Transflective liquid crystal display (LCDs) was proposed for good visibility under both bright and dim or dark environment while maintaining good characteristics such as low power consumption and legibility [(1)]. Variable transflective mode was proposed such as single cell gap with dual LC or single LC mode and cholesteric LC mode. However these modes have a problem such as complex fabrication process, different LC response to the applied voltage, difference threshold voltage, and low transmittance.

In our previous work, we reported that high brightness emiflective display consisting of the polarized OLED and twisted nematic (TN) LC cell [(2)]. However, the conventional TN mode has very narrow viewing angle characteristics. In this paper, we proposed the emiflective display mode using a polarized OLED and 4-domain TN mode for wide viewing angle as well as high brightness characteristics.

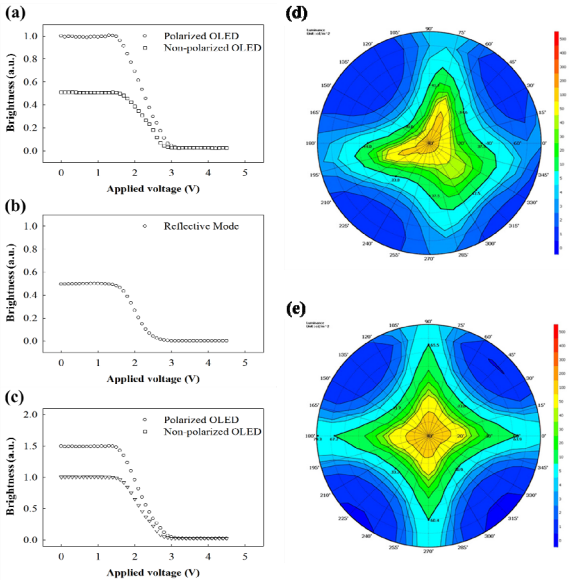
II. Result and Discussion

The emiflective display consists of 4-domain (4D) TN LC mode with crossed two polarizers and polarized OLED. We fabricated a stable 4D TN structure by introducing a high pre-tilt angle approach incorporating stacked planar and vertical alignment layers [(3)]. In order to produce multi-domains, reverse rubbing processes were carried out on stacked alignment layers with rubbing masks. As a result, sub-pixels consisted of two left-handed and two right-handed sub-pixels. Owing to the different twisting senses in the 4D TN structure, we could get symmetrical wide viewing angle characteristics. For a polarized OLED, conjugated polymer, which has mesophase at high temperature, was coated on rubbed a hole transport layer (HTL) to induce unidirectional alignment of conjugated polymer.

Under bright environment such as daylight, reflective mode is appropriate for high brightness characteristics because the ambient light is very strong. In field-off state of LC cell, ambient light pass through LC cell with wave guide effect by TN LC mode. After reflected by cathode of the OLED, entered light pass through TN LC cell and we get bright state. In field-on state of LC cell, LC molecules vertically aligned along the electric field. Thus, wave guide effect does not happened and ambient light is blocked by cross polarizer. As a result, we can get the black state.

Under dim or dark environment such as indoors, we used emissive mode. Unlike unpolarized light which was absorbed by polarizer with half of intensity, polarized emitting light from polarized OLED pass through polarizers with low loss of intensity. Thus, brightness is almost 2 times higher.

In this paper, we proposed the emiflective display for high brightness and wide viewing angle characteristics. Our system is consists of 4D TN LC mode cell and polarized OLED. Polarized OLED and 4D TN mode improved brightness and azimuthal viewing angle characteristics, respectively.



[Fig. 1] Measured voltage-transmittance characteristics of (a) emissive mode, (b) reflective mode, (c) emiflective mode. And viewing angle characteristics of (d) TN cell and (e) 4D TN cell.

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