

Development of Bottom Emission Display with Excellent Image Visibility using Quantum Dot Color Filter and In-Cell Polarizer under Bright Ambient Light

Polatechno Co. Ltd. (Joetsu City Niigata, President Hiromi Morita) is pleased to announce the successful application of an in-cell polarizer and quantum dot (QD) color filter to the development of a new bottom emissive display with excellent visibility in bright light. This is the result of a joint research and development project with the Fujikake-Ishinabe Laboratory at Tohoku University.

Liquid crystal displays (LCDs) and organic light-emitting-diode displays (OLEDs) are widely used in televisions and smart phones. However, the images displayed are hard to see under bright ambient light. This issue has been addressed by increasing the display luminance; however, this also increases the power consumption of a device.

Polatechno and the Fujikake-Ishinabe Laboratory at Tohoku University are proposing a new solution to this problem, in the development of a display that produces images that remain clearly visible under bright light. In the proposed design, a dye-type in-cell polarizer and QD color filter are incorporated into the LCD of the new display. A special feature of the display is its bottom emissive structure, which is fabricated by installing a QD color filter underneath the in-cell polarizer and LC layer, as shown in Fig. 1. The QD color filter enables the new display to realize a wide color gamut, with low power consumption. In addition, the layers above the in-cell polarizer and bottom emissive structure are designed to transmit both ultraviolet (UV) and blue light,. Hence, the QD color filter also transmits sunlight, which contributes to the visibility of the displayed color images. As it can use sunlight or ambient light as a light source, the image quality produced by the new display is excellent, even in sunlight.

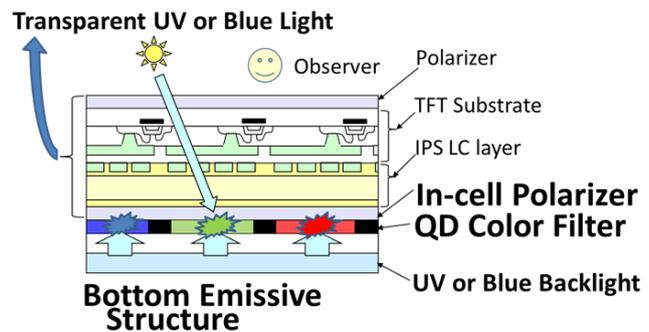


Fig.1: Structure of Bottom Emissive Display Using In-Cell Polarizer and QD Color Filter

It is difficult to make in-cell polarizers for LCDs from iodine-type polarizers, despite their wide use, due to their poor stability under high temperatures. Nevertheless, our dye-type polarizer has excellent heat stability, remains stable during the LCD assembly process, and enables the creation of an in-cell polarizer from a dye-type polarizer.

We fabricated a demonstration sample that contained the new dye-type polarizer, which polarized wavelengths around 400 nm. A QD sheet and light-emitting diode backlight, with a peak emission wavelength of 405 nm, were all housed beneath a monochrome TFT-LCD glass substrate. We used this sample to confirm the visibility of images produced by the new display under bright ambient light. In contrast to the images displayed by a conventional LCD under bright conditions, the images produced by the demonstration sample were clearly visible, as shown in Fig. 2.

We introduced the new display at the 24th International Display Workshop in Sendai, Japan, from 6–8 December 2017, where our work attracted much attention. Our projected product development target is 2020.

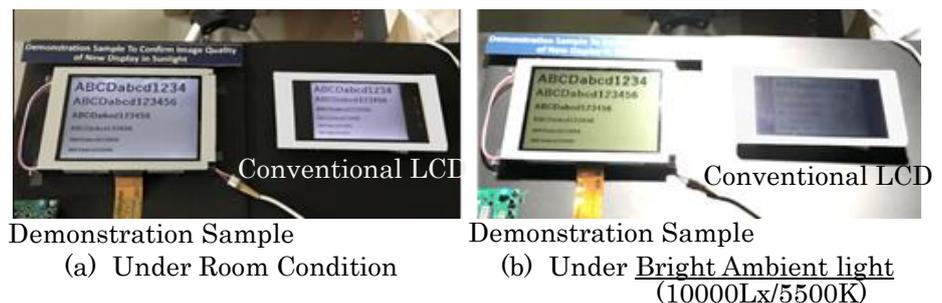


Fig.2: Display image of Demonstration Sample