New developed Color Conversion OLED Backlight

Oun Gyu Lee, Nam Heon Lee, Jong Ho Kim, Kyoung Sun Kim*
KOT Inc., 1112-8, Namchon-Ri, Oksan-Myeon, Cheongwon-Gun, Chungbuk, 363-911 KOREA
Phone : 010-7120-8201*, E-mail : oglee@kdtdisplay.com*

Woo Young Kim
HOSEO University, San 29-1, Sechul-Ri, Baebang-Myun, Asan City, Chungnam, 336-795, KOREA
Phone : 010-3116-0219, E-mail : wykim@hoseo.edu

Abstract

Color conversion technology using unique color conversion film for OLED back light was developed to achieve renovative performance for high- end display.
It can reduce the production cost more than 20% due to cheaper cost for blue OLED and conversion film and also has a free chromaticity control capability for 10% raising color gamut with respect to LCD color filter. The OLED BLU by color conversion technology also shows excellent performances such as chromaticity stability. White efficiency using PLF + Blue OLED is 17cd/A@4.4V, CIExy(0.29, 0.31).

1. Objectives and Background

LED has been used for years for side view LCD BLU (liquid crystal display back light unit) and top view lighting applications. However, all of them still struggling against the barriers such as its high prices and its color temperature that is very limited for those lighting application market. Recently, KOT (Korea Opto Technology) developed a sheet of film which is having the function of color conversion to overcome the current limitation of cost and white color stability. There are various technologies for making the white OLED and lighting product application. Color conversion white OLED is regarded as the most unique and outstanding technology to launch the OLED BLU into the market at early stage with the strong point of low cost, simple process and higher visual quality[1]. OLED device can generate high level color gamut value over 75% by controlling the whole spectrum profile by selecting the appropriate materials and device structure. It can be thinner than any other lighting devices having the light sources such as fluorescent lamp or LED. Ultimately, bendable lighting can be achieved with OLED technology when we use the flexible substrate or the like[3]. Therefore, it surely will make the thinnest cell phone products substantially. However, white OLED using 3 stacking EML(R/G/B) probably have a couple of problem. Changing the white spectrum according to operating voltage because of generating incomplete energy transfer[2] and to different life time of each EML(emission material layer).

2. Results

KOT studied another method of white OLED to overcome the problems stated above. Fig. 1. shows the schematic structure of very simple WOLED using KOT's color conversion film + Blue OLED technology. Fig. 3. shows the comparison between BLU using blue OLED in combination with color conversion film and the conventional BLU which has 2 peak wavelength from the normal white LED. Spectrum profile which is generated from conversion film and blue OLED light source can be easily modified and tuned by controlling the structure and composition of materials inside of film. This means that required lighting properties including color gamut depending on various applications can be easily matched by controlling the constitution of materials as introduced in Fig. 2.We observed luminancevoltage & luminance-current characteristics of the blue OLED having 455nmpeak wavelength

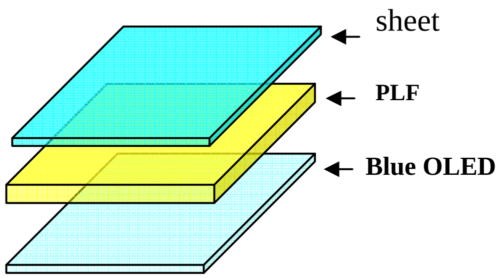

Fig 1. Schematic structure of OLED planar lighting

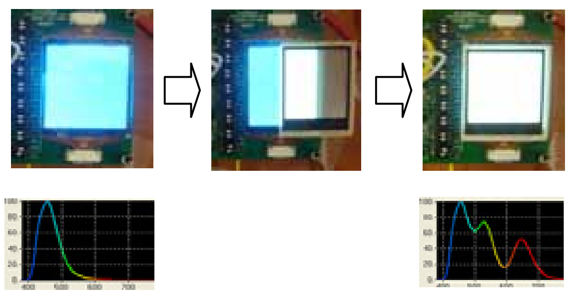

Fig.2. various spectrum made by OLED + PLF

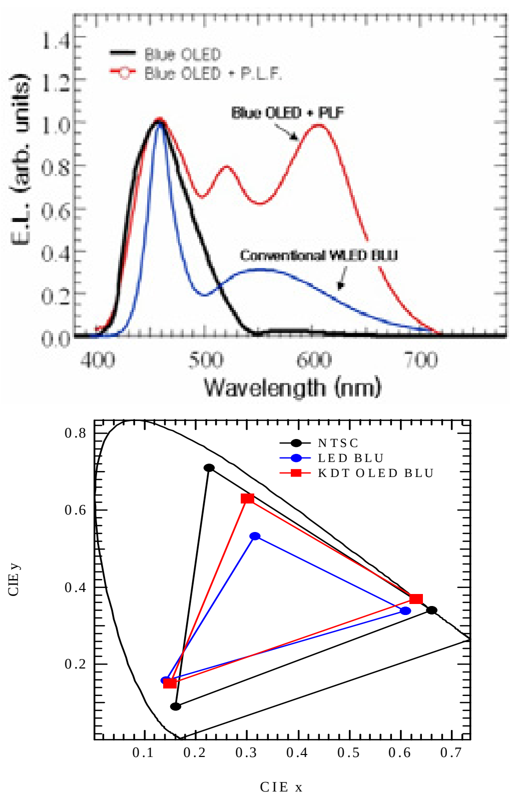

Fig. 3. peak wavelength spectrum and CIE coor -dinate showing the improved color gamut by PLF

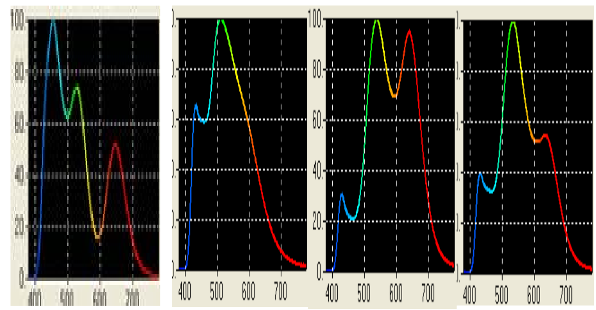

Fig. 4. Color conversion process in OLED BLU

as an excitation light source for color conversion film. The current efficiency of blue emitter is 9cd/A @ 4.5V with 6.31 lm/W of power efficiency and CIExy(0.15,0.16).

This results implying that the performance of quantum efficiency is over 6%. Meanwhile, color conversion current efficiency is 17cd/A@1900cd/m2 at 4.5V, CIExy(0.29, 0.31). This results show that Color conversion White OLED can be easily achieved high efficiency and no color change at any voltage or current. We also employed special device structure to obtain higher reliability against the progressive defects and pursue optimization of microcavity effect[4]. the luminance uniformity, life time of wide size OLED BLU and Planar lighting is readily worsen by the total amount of current and the resistance of the electrode, which means OLED device with high efficiency employing low current. Electrode and active area design could obtain desirable uniformity over 80%. Fig. 4. shows the color conversion by blue emitting at 455nm via color conversion film. Fig 5. shows the considerable improvement of color image quality though LCD module. The calculated color gamut is higher than 80% and this is 10~15% better result than the case of conventional white LED.

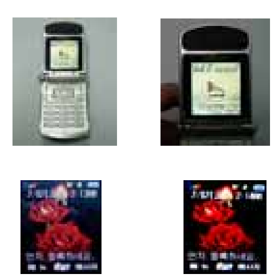

Fig. 5. Cell phone image comparison

3. Impact

OLED applied color conversion white technology has been developed to achieve a high level color gamut white light with superior performance results for various applications. The OLED BLU by using color conversion technology reduce the production cost and have a free control ability of chromaticity. This technology also shows high performances such as color gamut and thickness of device.

4. References

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[2]. S.S. Lee et al. / Material Science and Engineering B00 (2002) 1-5
[3]. C. Charton et al. / Thin Solid Films 502 (2006) 99– 103
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