Common red layer in full-color phosphorescent organic light-emitting diodes for simple fabrication of RGB subpixels

***Jeonghun Kwak*[1], *Hyunkoo Lee*[2] *and Changhee Lee*[3]**
[1]Dept. of Electronic Engineering, Dong-A University, Busan 604-714, Korea
Tel.:82-51-200-7707, E-mail: jkwak@dau.ac.kr
[2]Soft I/O Interface Research Section, Electronics and Telecommunications Research Institute (ETRI), Daejeon 305-700, Korea
[3]Department of Electrical and Computer Engineering, Inter-university Semiconductor Research Center (ISRC), Seoul National University, Seoul 151-744, Korea
Tel.:82-2-880-9093, E-mail: chlee7@snu.ac.kr

Since the first organic light-emitting diodes (OLEDs) were introduced,[1] they have been in the spotlight as a next-generation full-color displays and lighting devices. However, the manufacturing cost of OLED panels is higher than that of liquid crystal display (LCD) panels due to complicated process and expensive materials. Thus, multilateral research and the development of, for instance, low-price materials, simplified fabrication process, and effective device structures are required.

In this paper, we introduce a novel common red layer (CRL) structure in phosphorescent OLEDs for simple fabrication of red (R), green (G), and blue (B) subpixels in full-color displays. In contrast to the conventional structure and the previous common blue layer structures in the electron transport layer (ETL),[2,3] the CRL, which is a red phosphorescent dye-doped layer, was placed in the hole transport layer (HTL), as shown in Fig. 1(a). We examined the hole transporting properties of the red dye-doped CRLs by changing the highest-occupied-molecular-orbital (HOMO) energy level of hole transporting host materials. From the experiment, we could find that the trap-level, which defined as the difference of the HOMO levels between the host and dopant materials, significantly affects to the emission wavelength, device efficiency, and current density of HTLs. Based on the results, we could finally demonstrated efficient RGB-emitting devices by incorporating the CRL. Because the electroluminescence (EL) spectra of the green and blue devices with the CRL were nearly identical to those of the green and blue devices without the CRL, the color coordinates of green and blue was almost same with the devices without the CRL, as shown in Fig. 1(b). Therefore, the CRL enables us to fabricate practical full-color OLED displays much simply by reducing one metal mask step and cost. We believe that the concepts and results shown in this work are interesting and helpful for both academic and industrial researchers.

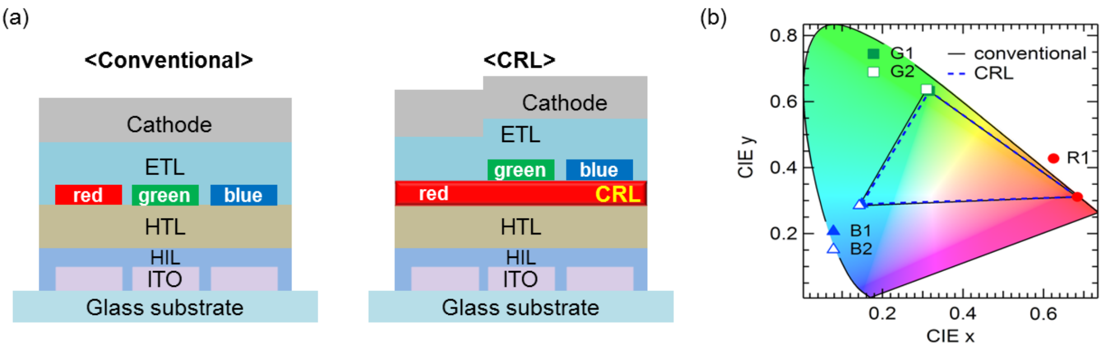

Fig. 1. (a) Comparison between the conventional and CRL structures and (b) their color gamut.

Acknowledgment

This work was partly supported by the ICT R&D program of MSIP/IITP[10041416, The core technology development of light and space adaptable energy-saving I/O platform for future advertising service]. This work was also supported by the Industrial strategic technology development program funded by the Ministry of Trade, Industry and Energy of Korea (10041556), and by the Basic Science Research Program through the National Research Foundation of Korea (NRF-2011-0022716) funded by the Ministry of Education.

References

1. C. W. Tang and S. A. VanSlyke, *Appl. Phys. Lett.*, vol. 51, p. 913 (1987).
2. M. H. Kim *et al.*, *SID Int. Symp. Dig. Tech.*, vol. 37, p. 135 (2006).
3. S. Chen and H.-S. Kwok, *Org. Electron.*, vol. 13, p.31 (2012).