Three primary color single emissive white phosphorescent organic light-emitting devices on glass and flexible substrate

Jin Wook Kim[1], Seung Il Yoo[1], Jin Sung Kang[1], Song Eun Lee[2], Ho Won Lee[2], Young Kwan Kim[2] and Woo Young Kim[1,3*]

[1]Department of Green Energy & Semiconductor Engineering, Hoseo University, Asan 336-795, Korea

Tel.:82-41-540-5944, E-mail: wykim@hoseo.edu

[2]Department of Information Display, Hongik University, Seoul 121-791, Korea

[3]Department of Engineering Physics, McMaster University, Hamilton, Ontario L8S 4L7, Canada

In recent years, flexible organic light-emitting devices (OLEDs) have emerged as one of the basic components in next generation display systems owing to the evolution of portable electronic devices that require light weight, bendable and unbreakable display devices. To achieve the flexible OLEDs untilized in flexible display systems, it is essential to satisfy efficient luminescent characteristics and stable performance issues in the flexible OLEDs. In order to design efficient flexible OLEDs with desirable and efficient luminescent properties, structural optimization should be considered together with the choice of appropriate materials in the flexible OLEDs. Herein, we propose a simple white phosphorescent OLEDs (PHOLEDs) structure for flexibility consisting of single emissive layer (EML). It is also exceedingly useful to produce white OLEDs thorugh solution process. In order to fabricate high efficient white OLEDs, some complicated device structures, (for example, multiple emissive units in white OLEDs), are often employed by complex fabrication processes and are faced with cost challenges in mass production. However, white PHOLEDs with a single emissive layer may have a relatively limited exciton recombination zone and have the potential to meet the fabrication cost requirements due to their simple structure. We fabricated white PHOLEDs on both glass substrate and polyethylene naphthalate (PEN) film flexible substrate. The performance of three primary color white PHOLEDs with single emissive layer on glass substrate, with different host materials of N,N'-dicarbazolyl-3,5-benzene (mCP), 2',2',2''-(1,3,5-Benzinetriyl)-tris(1-phenyl-1-H-benzimidazole) (TPBi) and 1:1 co-doped composition both mCP and TPBi as P-type, N-type and P-, N-type host materials, was analyzed and we found its luminous efficiency is closely related to Foster and Dexter energy transfer in host-dopant system and charge balance factor. White PHOLEDs with 1:1 co-doped composition both mCP and TPBi as host materials, yielded external quantum efficiency of 9.3 % at 8 V and a high luminous efficiency of 14.1 cd/A at 8 V with CIE color coordinates of (0.331, 0.384) at 7.5 V. The results reveal that the effective charge balance factor in white PHOLEDs with a formation of wide recombination zone (1 :1 co-doped composition both mCP and TPBi) allows improving the external quantum efficiency, as compared to the devices made with mCP and TPBi. And optimized (higher performance) structure of white PHOLEDs with 1 :1 co-doped composition both mCP and TPBi as host materials on galss substrate was applied to flexible white PHOLEDs. We found out its performances are similar to the white PHOLEDs on galss substrate. Fig. 1 shows plots of external quantum efficiency of white PHOLEDs on glass substrate as function of current density. We will continue additional experiments for white PHOLEDs on flexible substrate to compare with performances of white PHOLEDs on glass substrate.

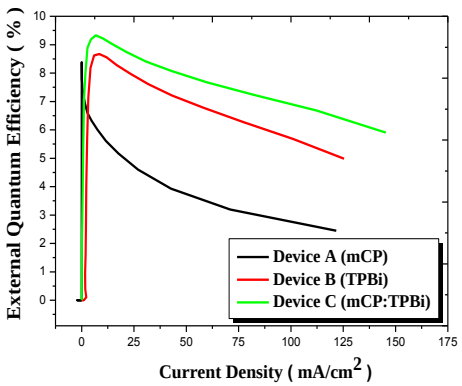

Fig. 1 Plots of external quantum efficiency of white PHOLEDs on glass substrate as function of current density