Organic light-emitting diode fabrication on the ink-jet printed microdisk cavity

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1 Introduction

Organic light-emitting diode (OLED) is attractive as a light emitting device in the recent years because of their high external quantum efficiency. However, OLED has been required higher emitting efficiency and device durability. By the way, disk-shaped microcavity is focused in the optical field due to high Q-factor and small mode volume. Therefore fabricating microdisks on OLED can be expected improving emitting efficiency of OLED. Recently, we proposed ink-jet method for organic microdisk fabrication, which can easily fabricate organic microdisks on OLED. However, steric microdisk structure might cause electric field concentration and give damage to OLED [1]. In this study, we demonstrated a fabrication of OLED on the ink-jet printed microdisk.

2 Fabrication

Figure 1 shows the schematic illustration of the fabricated OLED with microdisk. After the cleaning of glass wafers with thick layer of indium tin oxide (ITO) substrate in nitrogen atmosphere, microdisk was fabricated on ITO layer by ink-jet method in air atmosphere. As the material of microdisk, triazine-based hyper-branched polymer FZ-001 (n = 1.78) was used. The diameter of microdisk was 120 μm, and 16 microdisks was fabricated in 4 mm^2. To fabricate OLED layers, we prepared N,N'-Di(1-naphthyl)-N,N'-diphenylbenzidine (NPD) as a hole-transporting layer, 0.06 : 1 mixture of 2,4,5,6-tetra(carbazol-9-yl)-1,3-dicyanobenzene (4CzIPN) : 4,4'-Bis(carbazol-9-yl)biphenyl (CBP) as a thermally activated delayed fluorescence (TADF) layer, 2,8-bis(diphenylphosphoryl)dibenzo-[b,d] thiophene (PPT) as an emitting layer and 1,3,5-tris(N-phenylbenzimidazol-2-yl)benzene (TPBi) as an electron-transporting layer. Multilayer vacuum deposition was performed NPD / 4CzIPN:CBP / PPT / TPBi / LiF layer by layer up to thickness of 35, 15, 10, 50 and 0.8 nm, respectively. Finally, an 80 nm thick Al cathode layer was evaporated.

3 Results

Figure 2(a) shows the microdisk fabricated on OLED and any defect on OLED was not confirmed. Figure 2(b) shows the emitting of the OLED with microdisk at 20.1 V. In the area of dark spot, an OLED emission was not confirmed, because OLED structure was not formed due to the existence of the microdisk. On the other hand, stable emission was confirmed in the outside of the microdisk. It indicates that a fine OLED layers were fabricated without any damage from the ink-jet fabrication of microdisks. Figure 3 shows emitting spectrum of the OLED fabricated on microdisks and a standard OLED. Compared with the standard OLED, the OLED with microdisks intensity was 92.5%, thus it indicates that microdisk structure does not inhibit the performance of the OLED outputs.

4 Conclusion

An OLED fabrication on ink-jet printed microdisks was demonstrated. Compared a standard OLED and the OLED with microdisks, microdisk structure does not depressed the performance of the OLED.

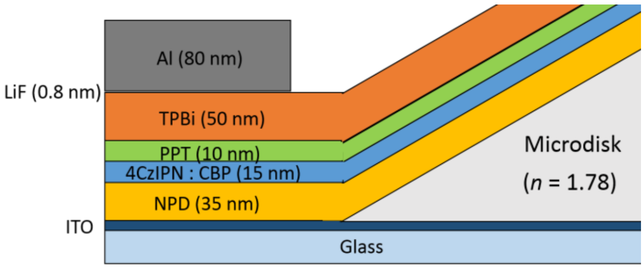

Fig.1 Schematic illustration of the OLED with microdisk.

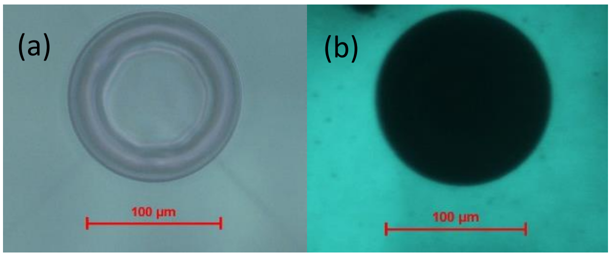

Fig. 2(a) Photograph of the fabricated OLED near microdisk. (b) Photograph of the emitting OLED near microdisk.

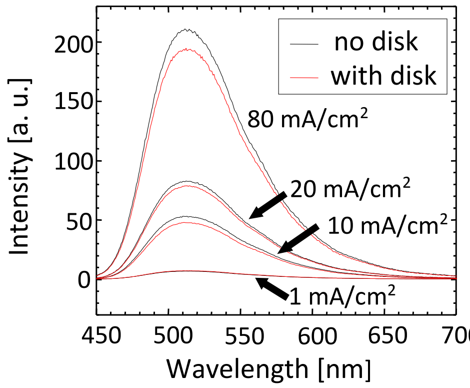

Fig. 3 The spectrum of OLED with microdisks and standard OLED.

References

[1] K.Utsumi, K.Itoh, H.Teraoka, Tosoh research & technology review Vol. 46, No.1 (2002). (In Japanese)