Light Extraction Efficiency enhancement in OLED by dielectric nanoparticles

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1. Introduction

Organic light emitting diodes (OLEDs) have attracted much attention in the past few years due to their excellent performance in display devices and illumination devices. However, the low light extraction efficiency of OLEDs due to the light trapped inside the device still remains an important issue. Only 20% of generated light is extracted out from the device in conventional cases [1]. Various approaches have been used to improve the light extraction efficiency of OLEDs [2], one of which is to apply a scattering layer [3].

We propose to incorporate the layer of dielectric nanoparticles at anode (ITO) which could enhance the light extraction efficiency of OLEDs by a factor of 1.57.

2. Proposed Structure and Simulation

OLED Structure

The conventional OLED structure set as reference is shown in Fig. 1(a). The proposed structure comprises of a single layer of dielectric nanoparticles at anode (ITO) as shown in Fig. 1(b). The purpose of dielectric nanoparticles is to scatter the light and thereby extract more power out of the device. Nanoparticles are assumed to be spherical in shape. Both the diameter (d) and interparticle spacing (s) of nanoparticles are chosen as 50 nm. The refractive indices of dielectric nanoparticles are varied from 1.32 to 2.1.

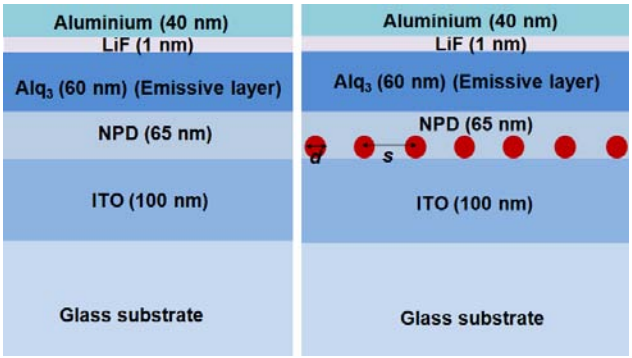

Fig. 1. Schematic of (a) Conventional OLED (b) proposed OLED with nanoparticles

The enhancement in light extraction efficiency of OLED has been calculated by finite difference time domain (FDTD) algorithm based Lumerical FDTD software [4].

Results and Discussion

Dielectric nanoparticles deposited at ITO will scatter light out of the device and hence there will be an increment in light extraction efficiency of OLED. Fig. 2 shows the enhancement in light extraction efficiency as a function of wavelength for different refractive indices of dielectric nanoparticles. The results show that the enhancement increases as the refractive index of nanoparticles decreases. This is due to the high index contrast between nanoparticles and embedded medium.

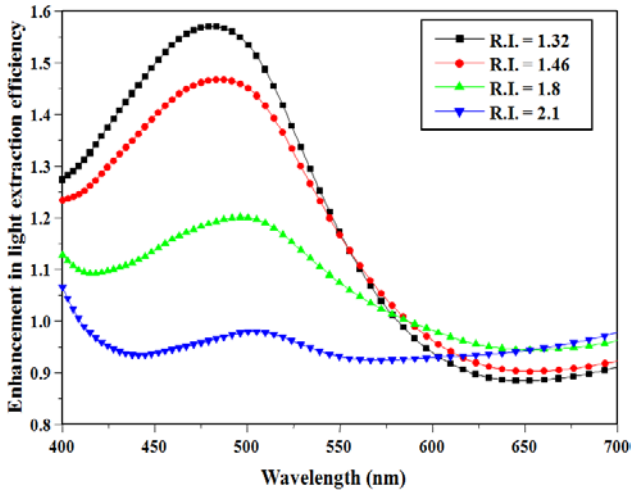

Fig. 2. Enhancement in light extraction efficiency of OLED for different refractive indices of nanoparticles

3. Conclusions

The proposed OLED design with dielectric nanoparticles provides scattering of light and enables to achieve enhancement upto 1.57 times in light extraction efficiency with refractive index 1.32 in the wavelength range 400 nm – 570 nm. The proposed structure would be useful in development of high efficiency OLEDs.

Acknowledgements

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References

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