Induced Effective Charge Balance CdSe/ZnS QDs based Light-Emitting Devices using PVP-encapped ZnO Nanoparticles

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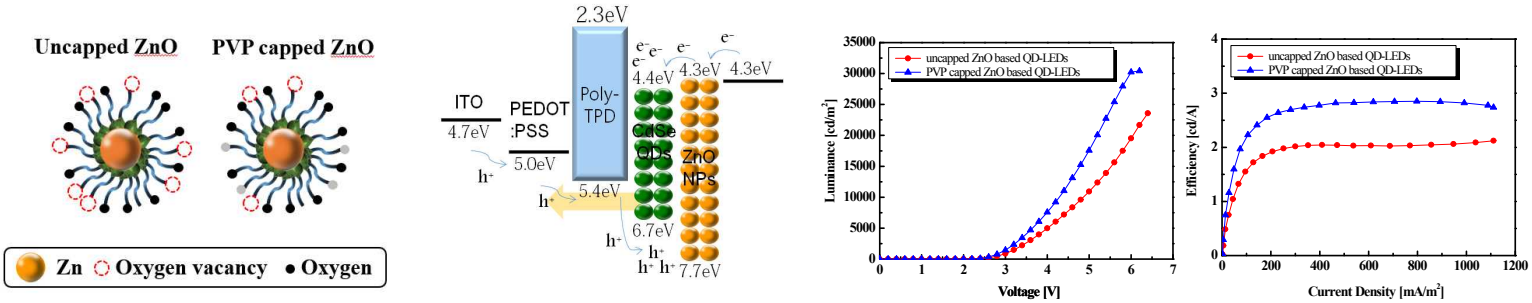
In recent years, several researchers have studied about the quantum dots based light-emitting devices (QDLEDs) because QDLEDs have many attractive characteristics, such as extremely narrow emission spectral bandwidth, luminescence efficiency, wide absorption and saturated colors [1]. Until now, many researchers have attempted to enhace the performance of QDLEDs, including the developement of novel QDs and high transportation rate materials, designing the unique device structures, and the optimazation of charge transport layer. Furthermore, metal oxide nanoparticles (NPs) such as TiO_2 NPs, Al-doped ZnO NPs and NiO NPs have been used as charge transport layers in QD-LEDs to improve the luminance and efficiency. However, these materials have shown high efficiency but does not discussed QDLEDs performance corresponding to the oxygen vacancy [2].

In order to verify the effect of oxygen vacancy control, we synthesized the surface modulated ZnO NPs with polyvinyl pyrrolidone (PVP) by using sol-gel process. The QDLEDs with PVP-encapsulated ZnO NPs as electon transport layer showed significantely enhanced luminance and current effiency due to the reduced trap density existed on the surface of ZnO NPs [3]. The bare ZnO based QDLEDs was showed the luminance of 23,570 cd/m^2 and current efficiency of 2.04 cd/A. On the other hand, PVP-encapsulated ZnO based QDLEDs was showed luminance of 33,420 cd/m^2 and current efficiency of 2.84 cd/A. Therfore, we confirmed that oxygen vacancy of ZnO NPs is very essential parameter for effective electron transportation.



(a) (b) (c) (d)

Fig. 1. Schematic diagram of (a) molecular structure of bare-ZnO NPs and pvp-capped ZnO NPs, (b) energy band diagram of QDLED, and results of (c) luminance and (d) current efficiency

Acknowledgment

This work was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIP) (No. NRF2014R1A2A1A11050377)

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