Effect of Graphene Oxide as a Hole Injection Layer for Quantum Dot Light Emitting Diodes

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Graphene oxide (GO) is a 2-dimensional material functionalized with oxygen groups on the basal plane. GO particles can readily disperse and form stable colloid in water.[1] Aqueous GO dispersion can be used as a hole injection or hole transport layer in organic electric devices such as polymer light emitting diodes [2] and organic photovoltaic devices,[3] via solution process. In this presentation, we demonstrate that by introducing a GO layer as a hole injection layer in quantum dot light emitting diodes (QLEDs), the threshold voltage, luminance, and current efficiency can be improved.

The device was fabricated following the conventional multilayer processes; the layer structure was ITO/GO/PVK:TCTA/QD/ZnO/Al. All the layers were prepared by solution process, that is, spin coating methods, except the anode (ITO) and cathode (Al) layers as shown in Figure 1. The thickness of GO layer varied from 2 to 10 nm. As the thickness of GO film decreased from 10 nm to 2 nm, the luminance and the current efficiency were increased from 1012 to 1535 cd/m^2 and from 0.63 to 0.82 cd/A, respectively. The turn on voltage was also reduced from 8.0 V to 6.0 V due to the increase in the work function of ITO/GO interface by ~0.2 eV, as shown in Figure 2. The increases in luminance and current efficiency were caused by the decrease in the series resistance. Since GO is a dielectric material with high resistance due to the highly oxidized sp3 functional groups, the thicker GO film results in the increase of resistance.

To summarize, thin GO film can serve as an excellent hole injection layer in QLED by reducing the energy barrier height between ITO/GO interface. In addition, the thickness control is the most important factor to optimize the overall performance in the QLED using hole injection GO layer.

References

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Figures

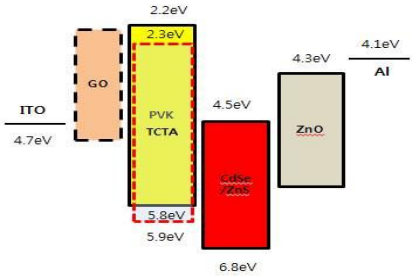

Figure 1: Energy level diagram of QLED device.

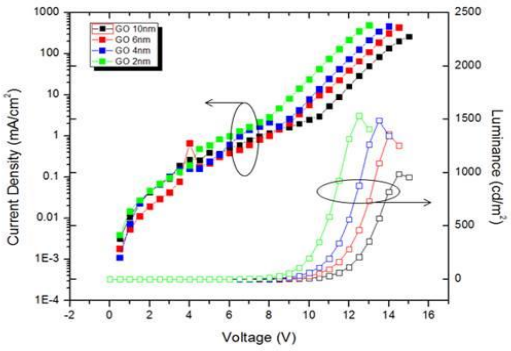

Figure 2: J-V-L characteristics of QLED which used GO for hole injection layer.