Enhanced Solution-processed Quantum Dot Light Emitting Diodes with Additional Organic Hole Transport Layer

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Quantum dots (QDs) have been studied as one of the emitters for next generation display because of their unique properties, such as narrow emission band width, high stability, high color purity, and solution processability. Ever since quantum dots are used as an emitting layer in light emitting diode fabrication in 1994, the performance of quantum dot light emitting diode (QD-LED) devices has been rapidly improved through designing device structures from different concepts, changing the composition and structure of the QDs. Among these factors, charge transport layer was of great importance to facilitate charge carrier injection from anode/cathode and balance the injected carriers.

In this study, we used MoO_3 and PVK as anode buffer layers and studied their effects on the device. Solution MoO_3 for hole injection layer is non toxic, and possesses deep lying electronic states with work function of 5.5eV.[1] Solution MoO_3 has great attention as an interfacial layer, owing to its relatively good hole mobility, environmental stability and transparency in the range of visible light.[2] Also, solution processed PVK for hole transport layer was much cheaper than widely used poly-TPD and quantum dots dispersing in haxane does not dissolve PVK layer, so previously deposited PVK HTL remains undamaged after spin-coating of QD solution in hexane.

So, we fabricated a red QD-LED by all-solution-process using MoO_3 and PVK as anode buffer layer. The maximum luminescence from using MoO_3 layer only and MoO_3 with PVK layer devices were 71.54 cd/m^2 and 672.1 cd/m^2, respectively. The device with an additional PVK layer showing an over 9-time higher in maximum luminescence. The reson is that the bilayer-structured anode buffer layers take an advantage of the deep highest-occupied molecular-orbit energy level of PVK to realize the efficient hole injection into the quantum dot layers and the relatively high hole mobility of MoO_3 to achieve high power efficiency.[3]

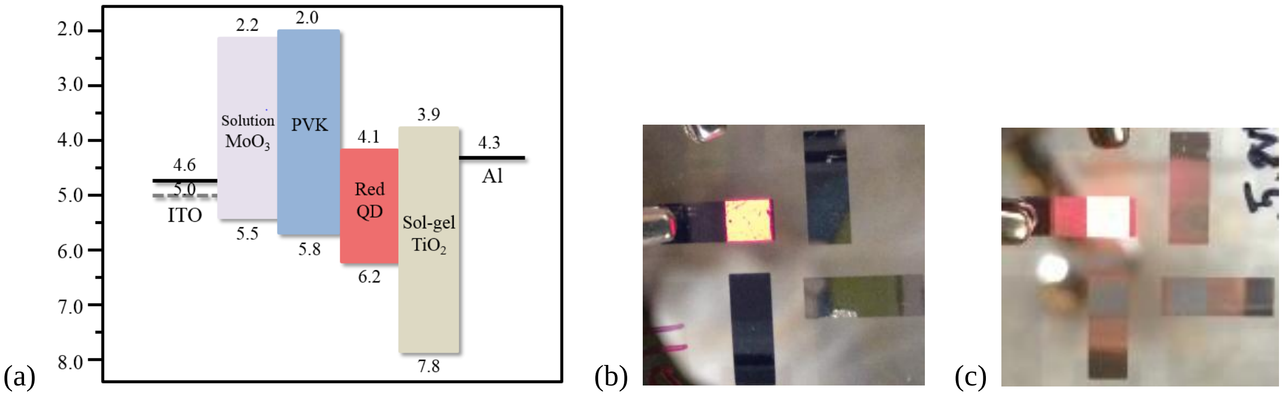

Fig. 1 (a) Band diagram of QD-LED with MoO_3 and PVK
Electroluminescent image (b) using MoO_3 layer only and (c) MoO_3 with PVK layer

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References

1. S.Murase and Y.Yang, *Adv. mater.* 24, 2459-2462 (2012).
2. J.Meyer, R.Khalandovsky, P.Gorrn and A.Kahn, *Adv. mater.* 23, 70-73 (2011).
3. X. Dai, Z. Zhang, Y. Jin, Y. Niu, H. Cao, X. Liang, L. Chen, J. Wang and X. Peng, *Nature.* 515, 96-99 (2014)