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Polyethylenimine-Ethoxylated Dual Interfacial Layers for High-Efficient Quantum Dot Light-Emitting Diodes

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Abstract : We controlled the electron injection rate in inverted quantum dot light-emitting diode (QLED) by inserting PEIE layer between ZnO electron transport layer(ETL) and quantum dots(QDs) layer and successfully demonstrated high efficiency of QLEDs. The inverted QLED has the layer structure of ITO(cathode)/ ZnO NPs/PEIE/QDs/PEIE/P-TPD/MoO3/Al(anode). The PEIE between poly-TPD hole transport layer (HTL) and quantum dot emitting layer protects QD EML during HTL coating process and improves the surface morphology. In addition, the hole injection barrier is reduced by upshifting the valence band maximum (VBM) of QDs. An additional layer of PEIE was introduced between ZnO and QD to balance charge within QD emissive layer in device, which serves as an effective electron blocking layer without changing device operating condition such as turn-on voltage and emissive spectra. As a result, the optimized QLED with 5nm PEIE shows a ~36% improved current efficiency and external quantum efficiency (EQE) compared to the QLED without PEIE.(maximum current efficiency, and EQE are achieved 70cd/A and 17.3%, respectively). In particular, the maximum brightness of the optimized QLED dramatically improved by a factor of 2.3 relative to the QLED without PEIE. The main reasons for these QLED performance improvement are due to the suppressing the leakage current across the device and well confined exciton by inserting PEIE layers.

Keywords : quantum dot light-emitting diodes, interfacial layer, charge-injection balance, suppressing QD charging
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