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Optimization of quantum dots-OLED multistacking EL devices

Recently, colloidal quantum dots (QDs) have attracted great attention for the next generation display technology. Since the first report of electroluminescence (EL) from QDs in the simple organic materials based structure, the performance of colloidal quantum dot-light-emitting diodes (QLEDs) has been dramatically improved and is now comparable with commercial OLEDs. However, most of QLEDs works has been fulfilled in the form of monochromatic device, while multi-colored QLEDs still remains a long way to go. The OLED technology has many advantages over LCDs (vivid color, no back light unit and high contrast ratio) and the multilayered emission for white lighting is well developed. However, all charge transport layers and emission layer (EML) should be formed using evaporation deposition under high vacuum and the performance of solution based devices for large area displays is not good enough yet.
Here, we report the hybrid EL devices combined OLEDs with QDs. After solution-processed deposition of electron transport layer (ETL) and the first EML based on colloidal quantum dots, the second EML based on organic host-dopant system and hole transport layer (HTL) were deposited using thermal evaporation. The inverted structured EL devices with double EMLs were sophisticatedly fabricated to show two EL emissions by matched charge balance. The shift of the color coordinates by increasing the voltage was shown due to change of each peak intensity. The generation of magenta color was accomplished by the sequential structure of blue emitting QLEDs and red emitting OLEDs. The unique hybrid EL devices have a great potential to generate a high-quality white light with a high color rendering index. The detailed I-V-L characteristics and CIE color coordination were studied to get brighter and more efficient emission.

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