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Non-Confidential Description - PSU No. 3308
"Mist Fabrication of Multi-Color Nanocrystal Light Emitting Devices"

Keywords:

Quantum dots; LED displays; mist deposition; light emitting devices; QD-LED; flat panel displays; flexible displays

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Links:

Related Article
US Patent 8,222,061

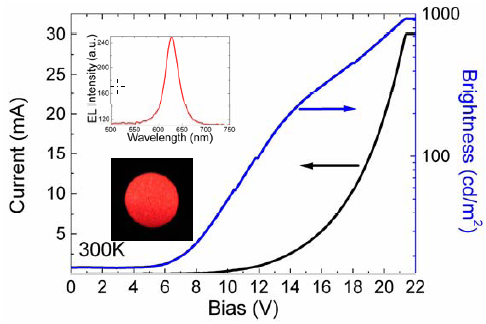

Fig 1. Results of red QD-LED fabricated by mist-deposition

Background

Semiconductor nanocrystal quantum dots (NQDs) along with quantum dot light emitting diodes (QD-LEDs) have recently commanded considerable attention from photonics researchers due to their interesting optical characteristics and easy processibility. Due to their many unique properties, semiconductor NCDs have been labeled as promising candidates for a broad range of applications including flat panel display (FPD), illumination, lightwave communication, and bio/chemical sensing. Of particular interest is the mastering of the QD-LED technology for the purpose of developing low-cost, efficient, bright, color-saturated, large-area color displays compatible with flexible substrates. QD-LEDs have shown superior performance with respect to conventional display devices such as cathode-ray tubes, liquid crystal displays, or organic light-emitting-diodes. It has become evident, however, that no technology presently exists that is capable of integrating multi-color nanocrystal light emitting devices with the advantages of high precision, low cost, flexible substrates and large area potentials.

Invention Description

In searching for a more practical and effective solution to the challenges in the fabrication and patterning of multicolor QD-LED arrays, the inventors explored **mist deposition** as an alternative thin film formation method. Mist deposition is capable of covering solid surfaces with monolayer accuracy and is compatible with selective area deposition. Further, it is mostly free from the inherent limitations of other QD-LED deposition techniques. Mist deposition was originally developed for the liquid-source misted chemical deposition (LSMCD) of ferroelectrics and high-k dielectrics for MOS gates in the microelectronics industry. The liquid in this approach is slowly delivered to the substrate in the form of a very fine mist which then uniformly coalesces on its surface with significantly lower waste as compared to spin coating. Mist deposition is independent of the shape of the substrate and does not have inherent limitations regarding substrate size. A 6×6 matrix of alternating pixels composed of 5nm-diameter NQDs (green) and 8nm-diameter NQDs (red) on a glass substrate has been fabricated by mist-depositing though shadow masks.

Advantages/Applications

- QD-LED have emissions of much higher spectral purity than LCDs and OLEDs
- QD-LED displays will consume much less power than LCD displays (no backlight needed)
- Inorganic nature of quantum dots make them more stable than organic compounds in OLEDs
- Mist deposition provides critically important control over QD layer thickness

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June-15