e-ISSN:2320-2459
p-ISSN:2347-2316

Cd-free Quantum Dot Synthesis

Joe A*

Editorial Office, Pure and Applied Physics, India

Commentary

Received date: 20/08/2021
Accepted date: 24/08/2021
Published date: 30/08/2021

***For Correspondence**

Editorial Office, Pure and Applied Physics, India,

E-mail: appliedphys@journalres.com

COMMENTARY

Quantum Dots (QDs) are nano-sized semiconductor nanoparticles that are as small as ten-thousandth the dimensions of a person's hair. Especially, it's a high color reproduction performance and reproduces natural colors, making it suitable for its application in high dynamic range (HDR), which is employed in ultra-high definition displays. Moreover, the fabric has higher color purity and photostability than other luminescent materials, emerging because the new material for various photoelectric devices, including next-generation displays.

The color reproduction performance of QDs improves because the Full Width at Half-Maximum (FWHM) of the light-emitting wavelength of QD becomes smaller. Moreover, before the event of the proposed technology, the technical limit on the FWHM of Photoluminescent (PL) peaks for the green-emitting Cd-Free QDs was 35nm. Quantum dot emitters (QDs) became common in wide color gamut LCD displays using quantum dot enhancement film. Several new display architectures using QDs also are under development. QDs have the potential to impact many various future display designs including LCD backlight units as is within the marketplace today; pixel-based color conversion of OLED, LCD, or micro-LED technologies; or as electroluminescent emitters in “OLED-like” displays. This chapter will describe the structure, benefits, and development status of every sort of QD display, including the challenges all faces relative to competitive technologies.

Prof. Jong-Soo Lee and his research team from the Department of Energy Science & Engineering, DGIST, developed a green-emitting Cd-Free quantum dot synthesis technology with high color reproduction rate. The newly developed quantum dot material is predicted to be utilized in various photoelectric devices, including next-generation displays like AR/VR. Prof. Jong-Soo Lee and his team used a heat-up process to optimize the synthesis of InP-based QDs, and used zinc chloride (ZnCl2) and octanol (1-Octanol) for the stabilization of QD surface and succeeded in reducing the FWHM of QD PL peaks to but 33nm.

In addition to achieving 80% Quantum Efficiency (QE), the research team also succeeded in securing an equivalent level of stability because the existing QDs, which helped in solving the matter of quantum efficiency losses and reduction in stabilization. Colloidal Quantum Dot (QD) Light-Emitting Diodes (QLEDs) hold the promise of next-generation displays and illumination due to their excellent color saturation, high efficiency, and solution processability. For achieving high-performance Light-Emitting Diodes (LEDs), engineering the fine compositions and structures of QDs is of paramount importance and attracts tremendous research interest. The recently developed continuously graded QDs (cg-QDs) with gradually altered nanocompositions and electronic band structures present the foremost advanced example during this area.

It can be summarized that present progress in LEDs supported cg-QDs, mainly concentrating on their synthesis and advantages in addressing the good challenges in QLEDs, like efficiency roll-off at high current densities, short operation lifetimes at high brightness, and low brightness near the voltage round the bandgap. Additionally, approaches exploiting the cutting-edge mechanisms and techniques to further optimize and improve the performance of QLEDs are proposed. The impedance spectroscopy on the devices with the pristine and hybrid QDs before and after bias stress revealed that hole accumulation at the opening transport layer/QD interface significantly affected the operational lifetime of the QLEDs. This work offers a design for the QD emission layer to realize efficient and stable QLEDs with systematic understanding of the origins.

The efficiency and operational lifetime of quantum dot based Light-Emitting Diodes (QLEDs) are essentially suffering from the electron–hole charge balance. Although various methods are reported to enhance the charge balance, these methods cause issues at an equivalent time, like increasing a driving voltage and complicating a tool structure.