Design and synthesis of non-cadmium quantum dots for the application in high performance light emitting diodes

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Our understanding of the fundamental design principles of quantum dot can provide new opportunities to develop next-generation flat panel display (FPD) technology. Recently, non-cadmium-based quantum dots (non-Cd QDs) gained a great amount of attention because of their potential as an environmentally friendly alternative to Cd-based QDs as emitting layer for light-emitting diodes (LED) providing a wide colour gamut, good material stability and enabling low-cost solution-based processing[1-2]. However, yet the device efficiency of non-Cd QDs based EL luminescence QD-LEDs r lags behind the well investigated Cd-based systems[3]. Here, we propose a new design strategy consisting of three stages for non-Cd QDs for highly efficient LED. Firstly, we achieved the alloyed QD which smoothens quantum confinement in the core to minimize Auger recombination. By utilizing heating-up melt synthesis, the peak wavelength, FWHM and QY of QD could be tuned from 519 nm to 618 nm, 47 nm to 76 nm and 53% to 69%, respectively. Secondly, InPZnS/ZnSe/ZnS QDs have been designed upon the consideration of an alloyed core/multishell system to achieve reduced lattice mismatch by the ZnSe shell and effective exciton confinement by the outer ZnS shell. Finally, surface modifications of QDs via aromatic ligand can result in a better device performance with balanced injection rates of charge carriers through the tunnel effects of aromatic ring π-electrons [4].

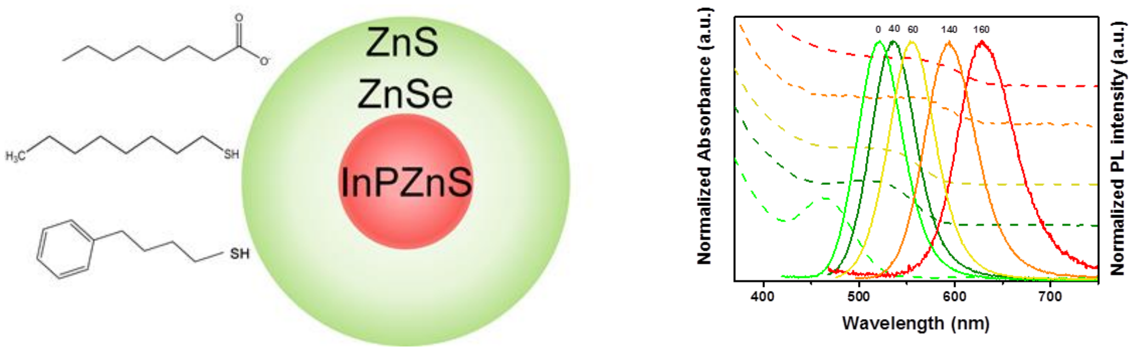

Figure 1. The structure of InPZnS/ZnSe/ZnS alloyed core/multishell quantum dots (left). The optical properties of InPZnS core with different peak wavelengths (right)

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