NANOPHOSPHORS FOR DISPLAY APPLICATIONS

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Abstract

The semiconductor nanocrystals show a variety of unique optical, electronic and chemical properties which originate mainly due to two reasons, i.e., quantum confinement effects and large surface to volume ratio. In recent years, the luminescent nanocrystals, also termed as nanophosphors, attracted considerable interest after the observation of enhanced luminescence efficiency and shortening of radiative lifetime by orders of magnitude from milliseconds to nanoseconds when compared with the bulk counterparts. These promising properties along with the possibility of synthesizing such materials by wet chemical methods will bear a great potential for their applications in a number of high technology areas such as high density displays, bio-markers, lasers, sensors, etc

In the present work, we report a novel aqueous wet-chemical method for the preparation of ZnS and Y_2O_3 based nanophosphors doped with transition metal (Mn^{2+}), metals (Cu^{+}, Al^{3+}) or rare earth elements (Eu^{3+} or Tb^{3}) elements and their applications in electroluminescence or field emission displays. The reaction parameters such as pH, temperature, host stoichiometry, dopant ion species, -combinations, -concentrations and post synthesis treatments, etc have been optimized in order to obtain desired emission colors from blue (434nm) to red (612nm) as shown in Figs. 1 and 2. The nanoparticles surfaces are passivated with suitable organic (polyvinyl pyrrolidone/polyethylene glycol) or inorganic (ZnO) capping agents. The materials have been characterized using TEM, XRD, PL and EL techniques. Studies show the formation of ZnS and Y_2O_3 nanoparticles both with cubic crystal phase. Interesting physical phenomena observed from the materials such as competitive emission between lattice-vacancies and dopant-pairs, energy-transfer from the molecular orbitals of organic surface caps to luminescent centers in nanocrystals, mesoscale self-assembly of nanocrystals leading to the formation of doped nanorods with enhanced photo- and electro-luminescence properties are discussed.

Figure 1. Luminescence emission from doped ZnS nanophosphors under UV excitation

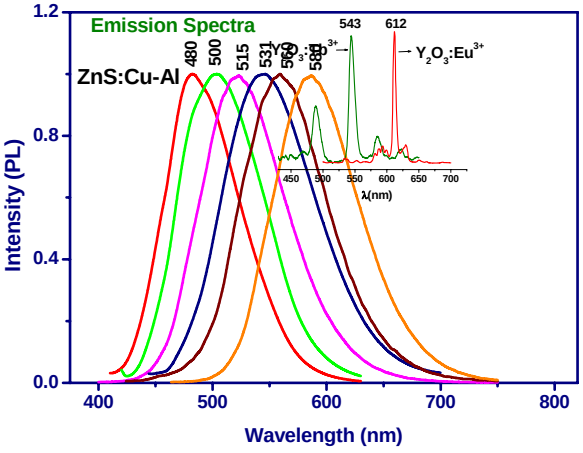

Figure 2. PL spectra of ZnS and Y_2O_3 nanophosphors