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Study of Fluorescence of Yttrium Doped Zinc Sulfide Nanoparticles

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Abstract. Doped ZnS nanocrystals have attracted attention since 1994. Previous results suggest that doped semiconductor nanocrystals form a new class of luminescent materials, which have a wide range of applications in displays, lighting, sensors and lasers. In this work we synthesized Y^{3+} doped ZnS nanoparticles by a chemical precipitation method. The reaction was performed with $ZnSO_4$, Na_2S, phosphates and Yttrium acetate in aqueous solution. Fluorescence (FL) studies of these nanoparticles have been carried out. FL analysis reveals that the incorporation of Yttrium and phosphates to colloidal solution of ZnS nanoparticles enhances the FL signal by 6-7 times of magnitude compared with uncapped ZnS nanoparticles.

Introduction

The synthesis and study of nanostructured materials have become a major interdisciplinary area of research over the past 20 years. Semiconductor nanoparticles play a major role in several new technologies; intense interest in this area is due to the unique chemical, physical and electronic properties, which give their potential uses in the fields of displays, lighting, sensors and lasers [1-4]. Zinc sulfide (ZnS), a non-toxic semiconductor of II-VI compound, is one of the most typical and important crystalline phosphors for both applications and basic research [5-6]. ZnS is commonly present in one of two structural forms – cubic sphalerite or hexagonal wurtzite, which have wide band gaps of 3.72 and 3.77 eV at 300K respectively. In particular, doped-ZnS phosphors have been investigated extensively [7-13], because ZnS is a good host material. It is commercially used as a phosphor and for thin-film electroluminescence device [14-17]. Different groups have reported the optical properties of various doped nanocrystals and the potential application of these luminescent materials. Various transition metal ions or/and rare-earth metal ions such as Cu^{2+}, Mn^{2+}, Pb^{2+}, Ni^{2+}, Cd^{2+}, Co^{2+}, Eu^{2+}, Sm^{2+}, Tb^{2+} have been added as impurities into host nanoparticles of ZnS, [18-23]. Recently, many researchers have paid attention to ZnS nanoparticles doped and co-doped with Ni^{2+}-Mn^{2+}, Pb^{2+}-Cu^{2+}, Cu^{+}-Cu^{2+}, Mn^{2+}-Eu^{3+}, Cu^{2+}-In^{3+}, Tb^{3+}, Nd^{3+} and Y^{3+} because they have many interesting optical properties [24-25].

Transition metallic ions doped semiconductor nanocrystals are considered to present ns-decay process, high-quantum efficiency, surface-enhancement effect in clusters, and variation of optical properties, all of which are strongly dependent on preparation methods [26]. Soft chemical methods,