



Synthesis, structural, and optical properties of type-II ZnO–ZnS core-shell nanostructure

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ABSTRACT

We demonstrate a facile synthesis method for the preparation of ZnO–ZnS core-shell type-II nanostructure. The synthesis was carried out by a two-step process. In the first step, ZnO nanoparticles were synthesized by a sol-gel method. In the second step, ZnS nanoparticles were grown on the surface of ZnO nanoparticles by a sol-gel method. The structure of ZnO–ZnS core-shell nanostructure was confirmed by XRD, TEM, HRTEM, and EDS. The optical properties of ZnO–ZnS core-shell nanostructure were investigated by UV–vis and photoluminescence (PL) measurements. The results show that ZnO–ZnS core-shell nanostructure has a strong absorption in the UV–vis region and a strong PL emission in the blue region.

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1. Introduction

Semiconductor nanomaterials, particularly quantum dots (QDs), have attracted much attention in recent years due to their unique physical and chemical properties which are different from the bulk materials. They have a wide range of physical applications such as light emitting diodes, biosensors, solar cells, and quantum dots. The physical and chemical properties of semiconductor nanoparticles (NPs) are controlled by a special size-dependent confinement of electrons and holes in a small but well-defined nanoscale region [1]. Due to the quantum confinement effect, a significant increase in the bandgap is observed when the size of the particles is smaller than the bulk value and results in a blue shift in the absorption spectra. The effective mass model [2] is used to analyze the size effect on the electronic properties of the semiconductor. Recently, ZnO–ZnS core-shell nanostructure has been extensively studied for their applications in solar cells [3]. It was found that the absorption coefficient of a ZnO–ZnS core-shell nanostructure is higher than that of ZnO [4].

ZnO and ZnS are two of the most important wide bandgap semiconductors and are used for various applications such as optoelectronics [5], photocatalysis [6], UV detectors [7], transparent conducting films [8], light emitting diodes [9], and solar cells [10]. It is reported that the optical properties of ZnO–ZnS core-shell nanostructure depend on the composition of the ZnO–ZnS core-shell nanostructure [11].

ZnO is a wide-bandgap semiconductor with a direct band gap which can be directly grown on ZnS. ZnO and ZnS are two of the most important wide bandgap semiconductors and are used for various applications such as optoelectronics [5], photocatalysis [6], UV detectors [7], transparent conducting films [8], light emitting diodes [9], and solar cells [10]. It is reported that the optical properties of ZnO–ZnS core-shell nanostructure depend on the composition of the ZnO–ZnS core-shell nanostructure [11]. ZnO is a wide-bandgap semiconductor with a direct band gap which can be directly grown on ZnS. ZnO and ZnS are two of the most important wide bandgap semiconductors and are used for various applications such as optoelectronics [5], photocatalysis [6], UV detectors [7], transparent conducting films [8], light emitting diodes [9], and solar cells [10]. It is reported that the optical properties of ZnO–ZnS core-shell nanostructure depend on the composition of the ZnO–ZnS core-shell nanostructure [11].

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aligned structure in the heterostructure. The UV emission in the UV region is observed due to the direct band gap nature of ZnO and the formation of ZnO–ZnS heterostructure. The present study is the first report on the synthesis and characterization of ZnO–ZnS core-shell nanostructure. The UV emission is due to the transition in the band structure.

2. Experimental

The synthesis method for the synthesis of ZnO–ZnS core-shell nanostructure is described in detail in the following section. The synthesis was carried out by a two-step process. In the first step, ZnO nanoparticles were synthesized by a sol-gel method. In the second step, ZnS nanoparticles were grown on the surface of ZnO nanoparticles by a sol-gel method.

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