



Structural, Optical and Magnetic Investigations on Pure and Copper Doped ZnO@ZnS Core Shell Nanoparticles for Biological Applications

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Research Article

Volume 2 Issue 2

Received Date: October 08, 2024

Published Date: November 05, 2024

DOI: 10.23880/oaja-16000137

Abstract

ZnO nanoparticles were synthesized by co-precipitation with no capping agent followed by covering with ZnS using a solution-based chemical method at low temperature. By varying the solution concentration, it was found that the fully-covering ZnS shell forms by a reaction of Na₂S with ZnO NPs followed by the formation of ZnS nano-crystals by the reaction of Na₂S with ZnCl₂. The mechanism that led to full coverage of the ZnO core is proposed to be the addition of ZnCl₂ at a later stage of the growth which guarantees a continuous supply of Zn ions to the core surface. Moreover, the ZnS nano-crystals that uniformly cover the ZnO NPs show no epitaxial relationship between the ZnO core and ZnS shell. The slow atomic mobility at the low reaction temperature is attributed to the non-epitaxial uniform ZnS shell growth. The rough surface of the ZnO grains provides initial nucleation positions for the growth of the ZnS shell nano-crystals. The low growth temperature also inhibits the abnormal growth of ZnS grains and results in the homogeneous coverage of ZnS nano-crystals on the ZnO core surface. The morphology and structure of samples are verified by X-ray diffraction (XRD). Identification of unknown substances and quantitative analysis can be done by FTIR. The absorption and reflectance of the nanoparticles were analyzed by UV Visible spectroscopy.

Keywords: ZnO @ZnS; Core Shell Nanoparticles; Microstrain; PL; FTIR; Biological Application

Abbreviations

CSNP: Core Shell Nano Particles; XRD: X-ray Diffraction; NPs: Nanoparticles; SAED: Selected Area Electron Diffraction; NBE: Near-Band- Edge; PL: Photo Luminescence; ROS: Reactive Oxygen Species; FT-IR: Fourier Transform Infrared; ZnO: Zinc Oxide.

Introduction

Over the years, nanotechnology has attracted a lot of interest where its essential component is nanoparticles.

Nanoparticles are made up of Carbon, metals, metal oxides or organic matters and exhibit unique physical, chemical, optical and biological properties at nanoscale when compared to the corresponding bulk materials. This phenomenon might be due to increased reactivity, surface area to the volume, stability and enhanced mechanical strengths. Apart from their chemical composition, the nanoparticles may vary in size, shape, and dimensions. Nanoparticles can be of zero dimensional such as nano dots where length, width, height are all fixed in single axis. They can also be of 1D such as Graphene where it may have one parameter, 2D such as Carbon nanotubes where it has both length and breadth