Manganese-Doped ZnS QDs: an Investigation into the Optimal Amount of Doping

© S. Tomar[1,2], S. Gupta[2], S. Mukherjee[3], A. Singh[4], S. Kumar[5], R.K. Choubey[2,¶]

[1] Applied Science & Humanities Department, ABES Engineering College,
Campus-1, 19th KM Stone, NH-24, Ghaziabad U.P.-201009, India
[2] Department of Applied Physics, Amity Institute of Applied Sciences (AIAS), Amity University,
Noida Campus, Sector-125, Noida 201313, Uttar Pradesh, India
[3] Department of Physics, National Institute of Technology,
Patna 800005, Bihar, India
[4] Department of Physics, Faculty of Natural Sciences Jamia Millia Islamia, Central University,
New Delhi-110025, India
[5] Department of Physics, Indira Gandhi University,
Meerpur-122502, Rewari, Haryana, India

¶ E-mail: ravikantchoubey@gmail.com

Received July 7, 2020
Revised July 7, 2020
Accepted for publication July 15, 2020

In the present study, undoped and Mn-doped ZnS, $Zn_{1-x}Mn_xS$ ($x = 0$, 0.02, 0.06, 0.10) quantum dots (QDs) were successfully synthesized using the simple co-precipitation method. The synthesized samples were thoroughly studied using X-ray diffraction (XRD), UV-visible absorption, high-resolution transmission electron microscopy (HRTEM) with selected area of the electron diffraction, scanning electron microscope with energy dispersive X-ray spectra, photoluminescence emission (PLE), and Fourier transform infrared spectroscopy. The XRD pattern confirmed the cubic zinc-blende phase at low doping concentration; however, at higher Mn-doping concentration hetaerolite phase formation was observed. The calculated particle size using Debye–Scherrer relation was found between 1.90−2.35 nm, which was also confirmed by HRTEM analysis. The blue shift in the absorption peak of all the prepared ZnS QDs as compared to bulk ZnS was indicative of the formation of nanoparticles and the calculated band gap was in the range of 3.94−4.11 eV. The PLE spectroscopy of the synthesized QDs was performed at the excitation wavelength of 280 nm and corresponding emission spectroscopy confirmed the surface defects in synthesized ZnS QDs.

Keywords: ZnS, Mn, quantum dots, XRD, photoluminescence emission.

Full text of the paper will appear in journal SEMICONDUCTORS.