

## Study of structural and optical properties of CdS:Mn quantum dots

Piyali Maity<sup>1</sup>, Shiv Kumar<sup>1</sup>, Ranjan Kumar Singh<sup>1</sup>, Sandip Chatterjee<sup>2</sup>  
and Anup Kumar Ghosh<sup>1\*</sup>

<sup>1</sup>Department of Physics, Institute of Science, Banaras Hindu University, Varanasi-221005, India;

<sup>2</sup>Department of Applied Physics, Indian Institute of Technology (Banaras Hindu University),  
Varanasi-221005, India

\*Email: akghosh@bhu.ac.in; anupkg66@gmail.com

A systematic study has been carried out to understand the influence of Manganese (Mn) doping on various properties of CdS QDs. Cd<sub>1-x</sub>Mn<sub>x</sub>S (0 ≤ x ≤ 0.06) QDs have been prepared at moderate low temperature by chemical precipitation method. X-ray diffraction (XRD) pattern, transmission electron microscopy (TEM) and Raman spectroscopy have been employed for phase identification and structural characterization of pure and Mn-doped CdS QDs. Fourier transform infrared (FTIR) spectroscopy, UV-Vis spectroscopy and photoluminescence (PL) spectroscopy have been used to study optical properties. Figure 1 shows Fluorescence under UV light of pure CdS QDs.

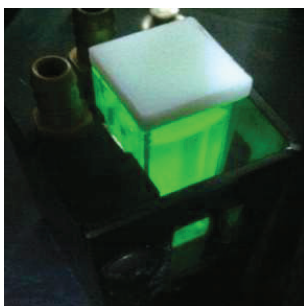


Figure 1: Fluorescence under UV light of pure sample

X-ray diffraction reveals that both undoped and Mn-doped CdS QDs exhibit zinc-blende (JCPDS 75-0581) structure without any impurity phase. The size of the particle in the range of 2–4 nm has been confirmed by XRD and TEM measurements (Figure 1). Interplaner spacing and size of CdS QDs increase slightly with increasing Mn-concentration. TEM images demonstrated nearly monodisperse size distributions of as prepared CdS QDs. Raman spectra show two prominent peaks viz. 1-LO (stronger) and 2-LO (weaker) at frequencies ~297 and ~597 respectively

(Figure 2). The peak 1-LO decreases strongly with increasing Mn-concentration due to increased compositional and structural short-range disorder. The absorption band observed at ~620 cm<sup>-1</sup> in FTIR spectra is assigned to Cd–S bond stretching. Band gap of the samples have been measured by UV-Vis spectroscopy which shows that the band gap is increasing linearly (~ 2.42eV for x= 0 to 6) with Mn-concentration. The blue shift shows the quantum confinement effect, as well as Mn concentration effect.

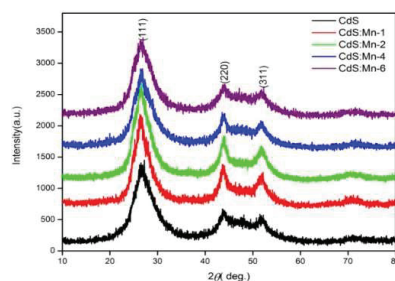


Figure 2: XRD pattern of Cd<sub>1-x</sub>Mn<sub>x</sub>S(0≤x≤6)

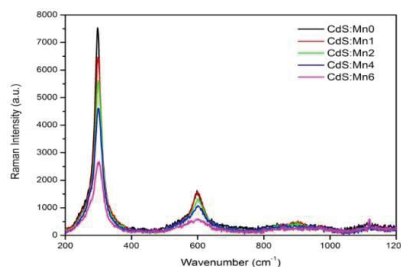


Figure 3: Raman spectra of Cd<sub>1-x</sub>Mn<sub>x</sub>S(0≤x≤6)

### References

1. Xiao et al. J. Am. Chem. Soc. 136, 1559-1569 (2014)
2. Zeng et al. Chemistry of Materials 22, 2107(2010)
3. Hazarika et al. Physical Review Letters 110, 267401 (2013)
4. Silva et al. J. Phys. Chem. C 117, 1904 (2013)