in particle size with 2 at.% of EDTA is observed from particle size calculations using Debye Scherrer's equation and is further supported by TEM analysis.The morphology and composition of uncapped and EDTA capped (2, 4 at.%) ZnS: Ce, Cu nanoparticles were successfully studied by scanning electron microscopy, transmission electron microscopy and energy dispersive X-ray spectroscopy respectively. The observed blue-shift in the absorption maxima is a measure of increasing band gap, attributed to the presence of smaller crystallites due to the quantum confinement effect and the effect of capping agent. From the PL spectra of ZnS nanoparticles co-doped with $Ce^{3+}$and Cu^{2+} ions and EDTA capped ZnS: Ce, Cu nanoparticles the emission peaks are observed at 540–550nm. And a blue shift in the PL peaks was observed with increasing capping agent concentration. Uncapped ZnS: Ce, Cu and EDTA capped (2, 4 at.%) ZnS: Ce, Cu nanoparticles showed Raman peaks at 276 and 351cm^{-1} and the TO mode and LO mode of samples exhibited a red shift and asymmetric broadening indicating phonon confinement effects. No additional peaks were observed due to impurities.

Acknowledgements

One of the authors, Mr. G. S. Harish, is thankful to C.S.I.R., New Delhi, for awarding a Junior Research Fellowship.

References

[1] W.S Chae, J.H. Yoon, H. Yu, D.J. Jang, Y.R. Kim, "Ultraviolet emission of ZnS nanoparticles confined within a functionalized mesoporous host," Journal of Physical Chemistry B, 108, pp. 11509–11513, 2004.

[2] L. Shen, X. Cui, H. Qi, C. Zhang, "Electrogenerated chemiluminescence of ZnS nanoparticles in alkaline aqueous solution," Journal of Physical Chemistry C, 111, pp. 8172–8175, 2007.

[3] R. Tu, B. Liu, Z. Wang, D. Gao, F. Wang, Q. Fang, Z. Zhang, "Amine-capped ZnS–Mn^{2+} nanocrystals for fluorescence detection of trace TNT explosive," Analytical Chemistry, 80, pp. 3458–3465, 2008.

[4] A. Divya, K. Siva Kumar, P. Sreedhara Reddy, "Investigations on structural and optical properties of $Zn_{1-x}Gd_xS$ nanoparticles," Applied Surface Science, 258: pp.839– 842, 2011.

[5] W. Chen, F. Su, G. Li, A.G. Joly, J.O. Malm, J.O. Bovin, "Temperature and pressure dependences of the Mn^{2+} and donor–acceptor emissions in ZnS: Mn2+ nanoparticles," Journal of Applied Physics, 92, pp.1950–1955, 2002.

[6] W.C.W. Chen, S. Nie, "Quantum dot bioconjugates for ultrasensitive nonisotopic detection," Science, 281, pp.2016–2018, 1998.

[7] V. Ramasamy, K. Praba, G. Murugadoss, " Synthesis and study of optical properties of transition metals doped ZnS nanoparticles," Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 96, pp.963–971, 2012.

[8] A. Divya, K. Siva Kumar, P. Sreedhara Reddy, "Synthesis and characterization of Cr doped CdS nanoparticles stabilized with polyvinylpyrrolidone," Applied Surface Science", 257, pp. 9515– 9518, 2011.

[9] P. Yang, M. Lu, D. Xu, D. Yuan, J. Chang, G. Zhou, M. Pan, "Strong green luminescence of Ni2+-doped ZnS nanocrystals", Applied Physics A, 74, pp. 257–259, 2002.

[10] T. Kushida, A. Kurita, M. Watanabe, Y. Kanematsu, K. Hirata, N. Okubo, Y. Kanemitsu, "Optical properties of Sm-doped ZnS nanocrystals," Journal of Luminescence, 87–89, pp.466–468, 2000.

[11] P. Reiss, "ZnSe based colloidal nanocrystals: synthesis, shape control, core/shell, alloy and doped systems," New Journal of Chemistry, 31, pp.1843–1852, 2007.

[12] A. A. Khosravi, M. Kundu, L. Jatwa, S. K. Deshpande, U. A. Bhagwat, M. Sastry, S. K. Kulkarni, "Green luminescence from copper doped zinc sulphide quantum particles," Applied Physics Letters, 67, pp. 2702-2704, 1995.

[13] A. E. Morales, E. Sanchez Mora, U. Pal, "Use of diffuse reflectance spectroscopy for optical characterization of un-supported nanostructures", Revista Mexicana De Física S, 53, pp.18 -22, 2007.

[14] P. Yang, M. Lu, D. Xu, D. Yuan, G. Zhou, "ZnS nanocrystals co-activated by transition metals and rare-earth metals a new class of luminescent materials," Journal of Luminescence, 93, pp.101-105, 2001.

[15] O. Brafman, S. S. Mitra, "Raman Effect in Wurtzite- and Zinc-Blende-Type ZnS Single Crystals", Physical Review, 171, pp.931-934, 1968.

Author Profile

Dr P. Sreedhara Reddy received Ph.D degree in Physics with specialization Thin films (Development of large band gap semi-conductor films for the fabrication of heterojunction solar cells) from S. V. Univeristy, Tirupati, India in 1989 and Currently working as Professor in Department of Physics, S.V.Univeristy, Tirupati, India.

G.S. Harish received M.Sc degree in Physics with specialization Condensed Matter Physics from S.V. Univeristy, Tirupati, India in 2011 and currently workng on nanoparticles research.