Chapter VII

Conclusions

7.1 Summary of work

The present work investigates the opto - electronic properties of cadmium sulphide nanoparticles and zinc sulphide nanoparticles. The bandgap of these semiconductors is engineered by the control of the crystal size that leads to tunable band – edge emission. An analysis of doping the semiconductor nanomaterials with manganese and yttrium has also been investigated to understand the effect of doping on the opto-electronic properties and the morphology. The nature of applications for which these nanomaterials can be used will depend on the type of solvent used for their synthesis. For example, the fluorescence properties of paint can be enhanced with these semiconductor nanoparticles and these paints can be water soluble / insoluble. Accordingly, the nanomaterials have to be synthesized in aqueous phase or organic phase. The present work also provides a mechanism to synthesize the nanoparticles in aqueous and organic media.

The simplicity in the method of synthesis of these nanoparticles in ambient room temperatures makes a profound impact on the application of these semiconductors. The critical issues for nanostructure synthesis fall into two categories. They pertain to the control of the size and composition of the nanoclusters and control of the interfaces and distributions of the nanoparticles within the fully formed materials. Investigative experiments to address these issues have been attempted and encouraging results have been obtained. UV-vis absorption and the band edge photoluminescence spectra of the nanoparticles synthesized are consistent with narrow size distribution and excellent ***particle quality***. The TEM micrographs suggest that the nanoparticles exhibit polycrystalline structure. An enhancement in the luminescence due to doping with manganese and yttrium is observed.

7.2 Scope for future work

The potential of chemical synthesis route described in this thesis is limited only by the imagination of the researcher. The synthesis of semiconductor nanoparticles may be extended to other technologically important semiconductor materials like Indium sulphide (InS), Cadmium Selenide (CdSe) and gallium arsenide (GaAr). The exploitation of the quantum effects for technological applications is the most driving force behind the current miniaturization.

There is a growing interest in the synthesis of multifunctional nano-optical devices which use these quantum dots. The unique optical properties of nano-optic devices derive from appropriately patterning material on the nanoscale with structures whose critical dimensions are sized to be several times lesser than the wavelength of light at which they operate, thereby creating optical materials with highly useful modified optical functions. Through a proper combination of materials and structures, nano –optic devices can perform any passive optical function like polarization filtering, spectral filtering etc. Thus, the semiconductor quantum dots offer the freedom in selecting the working wavelength of photonic elements. They allow manufacturers to cover almost completely the entire spectral region from ultraviolet to the far infrared [1].

The present work investigates the synthesis of nanomaterials that exhibit unique opto-electronic properties. These semiconductors also have potential application in the fabrication of organic LEDs. It needs to be investigated to understand the range of wavelengths that can be emitted by these organic – LEDs. These nanomaterials synthesized can also be used as the fabrication material for photovoltaic cells. The quantum effects enhance the efficiency of the system. This poses a need to have a rational strategy for identifying the doping agents that could enhance their efficiency. These nanoparticles may also be used for cell imaging. Their fluorescent properties can be used for detection of cancerous cells. Experimentations that will lead to large scale synthesis of semiconductor nanomaterials might also have commercial implications in future industrial processes.

References:

1) Parag Diwan, Ashish Bharadwaj, *Nanoscope : Encyclopedia of Nanoscience & Nanotechnology*, vol IV , Pentagon Press, New Delhi (India), ISBN 81-8274-141-6