V. Summary and conclusion

In summary, Colloidal nanocrystals have attracted a great deal of attention in recent times for their discernible role in fundamental studies and technical applications mainly due to their size dependent properties and flexible processing chemistry. The shape and size of the nanocrystals control their widely varying electrical and optical properties. In the first part of the results and discussion, the experimental findings clearly illustrate the methodology of controlling the rod and sphere shaped morphology of the CdS nanocrystals by simple manipulation of anion (sulphide) precursor addition rate in a non-aqueous medium. The method also clearly resolves the specific addition rate of the sulphide precursor where the shape transition takes place. The study also reveals that, the variation in the precursor ratio do not alter the shape tuning mechanism. The synthesis of CdS QDs with higher concentration of the stabilising agent reveals the need for an optimum concentration of the stabilizer in shape tuning of the CdS nanoparticles. Further variation in the addition rates clearly evidence the shape transition from nanorods to nanospheres. Time resolved emission studies clearly shows the presence of two different types of emissive states i.e., the band edge state and trap state where the trap states may be sub classified as deep trap state and shallow trap state. Femtosecond up-conversion studies resolves the short lived components which is attributed to the shallow trap state components in the CdS nanorods and nanospheres
Nanocomposites provide the possibility for enhancement of functionality and multifunctional properties in contrast with their more limited single component counterpart. Among these nanocomposites, the hybrid self-assembled heterostructures have also acquired importance as that of the core-shell structures owing to their enhanced multi-functionality and novel properties. Semiconductor/metal nanocomposite is a typical example of these heterostructures. In the second part of the thesis, CdS/Au nanoheterostructure was synthesized in a nonaqueous medium with enhanced functionality. CdS/Au nanoheterostructure synthesized by a solution process resulted in a highly enhanced and blue shifted emission and a quenching in the emission lifetime. The enhanced blue shifted emission and the lifetime quenching is nicely correlated and attributed to the collective interaction of the plasmons and the excitons in the hybrid nanoheterostructure. The HRTEM images confirmed the decoration of Au nanoparticles on the surface along the length of the nanorod and similarly on the surface of the nanospheres. Higher loading of Au nanoparticles further shifted the emission maximum to the blue region with more number of Au nanoparticles deposited on CdS quantum dots ruling out the possibility of the formation of core shell structure. The TRANES spectrum resolved the emission states in the CdS/Au nanocomposite and confirmed the decrease in the density of the trap states.

The nanoheterostructure with a metal semiconductor core shell are equally important as that of the semiconductor metal nanoheterostructures. The metal-semiconductor interface induced charge separation favours photo
catalysis Au/CdS nanoheterostructure was synthesised in a nonaqueous medium by phase transfer method. Highly blue emitting nanoheterostructure assembly was obtained due to the strong surface plasmon-exciton interaction between the Au nanoparticles and CdS shells. The emission was further tuned by varying the concentration of CdS. The varied emission is due to the variation in the thickness of the CdS layer over the Au nanoparticles. More the thickness of the CdS nanosheet, larger is the red shift in the emission maximum which is due to the weaker surface plasmon-exciton interaction. The variation in the thickness of the CdS shell is confirmed by the TEM images, EDAX and also the XPS studies. The TRES spectrum also shows that the emission arises completely from the band edge emission in the blue emitting Au/CdS assembly. Femtosecond up-conversion studies also resolve the short lived components detected in TCSPC technique.