Summary

This thesis deals with Investigations on the Photoinduced Interaction of Certain Porphyrins, Xanthene Dyes and Albumins with Colloidal CdX (X = Sulphur, Selenium and Tellurium) Semiconductor Nanoparticles.

CHAPTER I

Basic principles pertaining to the general concepts of photochemistry involving Jablonski diagram, different types of fluorescence quenching (dynamic, static and combined static and dynamic), different methods for fluorescence quenching analysis (steady state and time resolved) are outlined in Chapter I. Introduction about colloidal semiconductor nanoparticles and quantum dots and their applications in various fields such as photocatalysis, solar energy conversion and in life sciences has also been discussed. A description on the electronic states of quantum dots and their emission nature is provided. For improving the efficiency of emission and avoiding the surface traps which decrease the emission yield the modification of quantum dots surface with capping agents and their importance has been indicated. A short survey of the literature on the photochemistry of porphyrins and xanthene dyes is discussed. The structure and binding mechanism of albumins has also been discussed. The scope of the present investigation is included in this chapter.

CHAPTER II

The details of general experimental materials and instruments used for this study are provided in this chapter. The experimental details for the preparation procedures for nanoparticles and quantum dots are documented in respective chapters.
CHAPTER III

In this chapter preparation and characterization of colloidal CdS nanoparticles and its interaction of porphyrins has been studied by using various spectroscopic techniques. Adsorption of porphyrins on the surface of colloidal CdS nanoparticles has been observed. The apparent association constant ($K_{\text{app}}$) was calculated from absorption changes as well as fluorescence quenching data. The fluorescence quenching is due to ground state complex formation which has no fluorescence and the static nature of quenching mechanism was confirmed by ground and excited state absorption and fluorescence measurements. The process of electron transfer from excited state TMPyP to the conduction band of CdS has been confirmed by the decrease in fluorescence lifetime and the rate of electron injection has also been calculated.

CHAPTER IV

This chapter deals with the photoinduced interaction between xanthene dyes and colloidal CdS nanoparticles. Xanthene derivatives namely rose bengal, eosin, erythrosine and fluorescein, were examined as sensitizers for colloidal CdS nanoparticles. The effect of colloidal CdS on the interaction with dyes has been studied by absorption, steady state and time resolved fluorescence spectroscopic measurements. There is an electrostatic type of interaction observed and thus the perturbation of the absorption spectrum shows the surface complex formation through adsorption of dyes on the surface of colloidal CdS nanoparticles. This adsorption leads to increase in optical density as well as quenching of the emission intensity of dye molecules. The apparent association constant was calculated from both the absorption and fluorescence data, they were found to match. Static nature of quenching has been confirmed by unaltered fluorescence lifetime measurements. The fluorescence quenching is attributed to electron
transfer from excited state dyes to the conduction band of colloidal CdS which is proved by the calculations on energetics.

**CHAPTER V**

In this chapter preparation and characterization of CdTe QDs based on the reported methods and photoinduced interaction of the prepared QDs with porphyrins has been studied by using absorption, steady state, time resolved fluorescence and transient absorption spectroscopic techniques. The QDs surface was negatively charged due to thiol capping agent containing carboxylic group (TGA). The porphyrins adsorbed on the surface of CdTe QDs. Negatively charged porphyrins involved an energy transfer mechanism and the related parameters were calculated. Where as positively charged porphyrin involves electron transfer from QDs to porphyrin which is proved by Rehm-Weller calculation, lifetime and transient absorption measurements. The neutral porphyrin doesn’t have any interaction with the QDs surface. The association constant, quenching rate constant and rate of electron transfer have been calculated. Hence making the combination of porphyrins and QDs are potential candidates for applications as photosensitizers in photodynamic therapy.

**CHAPTER VI**

In this chapter colloidal uncapped and starch capped CdS nanoparticles, TGA and MPA capped CdSe and CdTe QDs respectively were prepared and their interaction with BSA, lysozyme and HSA has been studied by using UV-Visible, steady state, time resolved and synchronous fluorescence spectroscopic measurements. The albumins adsorbed on the surface of colloidal CdX through capping agents. The apparent association constant has been calculated from absorption studies. The results indicated that the nanoparticles and QDs quenched the fluorescence of albumins through complex formation. The quenching rate
constant, binding constant, and number of binding sites were calculated according to the relevant fluorescence data. From the synchronous fluorescence spectra, it is established that the conformational changes of albumins occurred especially in the tryptophan micro region. The static quenching mechanism was confirmed by fluorescence lifetime measurements. This type of interaction studies having applications in the field of biological imaging, cancer therapy and drug delivery etc.