CHAPTER 6

PHOTOCATALYTIC ACTIVITIES OF PURE AND DOPED CdS NANOPARTICLES

6.1 INTRODUCTION

Semiconductor nanomaterials play a pivotal role in distinct fields such as heterogeneous photocatalysis, photo electrochemistry, photochemistry and supramolecular photochemistry. Photocatalysis is one of the key technologies to solve both energy and environmental problems using mainly solar energy, in which an efficient photocatalyst is necessary. Although remarkable progress has been made in recent years for photocatalysts working under ultraviolet light, there are limitations for the photocatalysts to be applied under visible light. The problem could be resolved by using visible light-induced photocatalysts with proper band gap energy, to absorb the photons and enhance the catalytic activity.

II-VI Semiconductor nanoparticles are successfully utilized in photocatalytic applications. Heterogeneously dispersed semiconductor surfaces provide both a fixed environment to influence the chemical reactivity of a wide range of adsorbates and a means to initiate light-induced redox reactivity in these weakly associated molecules. Upon photoexcitation of several semiconductors nonhomogeneously suspended in either aqueous or nonaqueous solutions or in gaseous mixtures, simultaneous oxidation and reduction reactions occur. This conversion often accomplishes either a specific, selective oxidation or a complete oxidative degradation of an organic
substrate present. Molecular oxygen is often assumed to serve as the oxidizing agent although details about the mode of its involvement have not been unambiguously demonstrated except in a few gas/solid reactions. The incident light that initiates this sequence is in a wavelength region (the visible or low-energy range of the ultraviolet regions of the spectrum) absorbed by the semiconductor rather than by the substrate of interest. These reactions therefore involve photosensitization, i.e., an indirect photoactivation of the heterogeneously dispersed particulate absorber rather than the direct formation of an excited state of the substrate. Furthermore, the suspended semiconductor particle that acts as the photocatalyst is often stable to the photolysis conditions (particularly when a metal oxide is employed) and a large number of oxidative conversions per active site on the catalyst can be attained without significant degradation of the semiconductor's redox catalytic capacity (Fox and Dulay 1993). In a heterogeneous photocatalytic system, photo-induced molecular reactions take place at the surface of the catalyst. Depending on where the initial excitation occurs, photocatalysis can be generally divided into two classes of processes: (1) Initial photoexcitation occurs in the adsorbate molecule, which then interacts with the ground state catalyst substrate, the process is referred to as a catalyzed photoreaction; (2) The other hand, when the initial excitation takes place in the catalyst substrate and the excited catalyst transfers an electron or energy into a ground state molecule, this process is referred to as a sensitized photoreaction.

A photocatalytic process is initiated by the absorption of photons by a molecule or the substrate to produce highly reactive electronically excited states. The efficiency is controlled by the system’s light absorption properties. Three fundamental steps are of relevance: (1) the electronic excitation of a molecule upon photon absorption, (2) the band-gap excitation of the semiconductor substrate and (3) the interfacial electron transfer. The initial process for heterogeneous photocatalysis of organic and inorganic
compounds by semiconductors is the generation of electron-hole pairs in the semiconductor particles. Once excitation across the bandgap has occurred, the lifetime is sufficient for the created electron-hole pair to undergo charge transfer to adsorbed species on the semiconductor surface from solution or gas phase. Naturally, electron and hole recombination is detrimental to the efficiency of a semiconductor photocatalyst. Modifications to semiconductor surfaces, such as metal addition, dopants, or combination with materials, can be beneficial in decreasing the recombination and concurrently increasing the quantum yield of the process. An efficient means to retard the recombination of photoexcited electron-hole pairs may proceed via the trapping of charge carriers. The occurrence of surface and bulk irregularities resulting from the preparation process is associated with surface electron states; these may serve as charge carrier traps and can suppress the recombination of electrons and holes. The charge carriers trapped in such states are localized to a specific site on the surface or in the bulk; their population is dependent on the energy difference between the trap and the bottom of the conduction band.

Due to the quantization effects, by decreasing the particle’s size, it is possible to shift the conduction band to more negative potentials and the valence band to more positive values. Therefore, redox processes that cannot occur in bulk materials can be facilitated in quantized semiconductor particles. The energetic of the semiconductor valence band and the oxidation potential of the redox couple influence this photocatalytic oxidation.

The CdS is a good candidate for photocatalytic water reduction and pollutant oxidation. However, it has the fatal photocorrosion problem due to the self oxidation by the photogenerated hole. Lin et al (2008) and Bao et al (2007) found that the hexagonal CdS nanoparticles synthesized via solvothermal method have much better photocatalytic activity for degradation of methylene blue and better hydrogen production activity for water
photolysis. Many factors can influence the photocatalytic activity of CdS, such as phase composition, crystallite size, morphology, specific surface area and energy gap. Based on these considerations, we expected the occurrence of N-deethylation of rhodamine B, which is one of the typical dyes frequently employed in the spectral sensitization of a number of semiconductors, upon photoexcitation in the adsorbed state. In order to obtain a high yield of the possible reaction product of the dye, dye solutions suspended with powdered CdS were illuminated with UV light. The experimental results are consistent with the electron transfer mechanism from the excited singlet state of adsorbed rhodamine B to the conduction band of CdS.

The photocatalytic activities of pure and doped CdS nanoparticles using rhodamine B as a dye chemical for photo oxidation study under UV irradiation were carried out. The objective of this research was to investigate the photocatalytic activity of pure and doped CdS nanocrystals for the degradation of rhodamine B and to provide an experimental base for further study and practical application in textile effluent and wastewater treatment processes. In addition, some influencing factors, such as size of the nanocrystals, time and mass of CdS added, initial concentration, UV irradiation time on photocatalytic degradation were also studied.

6.2 MECHANISM OF SEMICONDUCTOR PHOTOCATALYSIS

During the photocatalytic process, the illumination of a semiconductor photocatalyst with ultraviolet (UV) radiation activates the catalyst, establishing a redox environment in the aqueous solution (Zhang et al 1994). Semiconductors act as sensitizers for light induced redox processes due to their electronic structure, which is characterized by a filled valence band and an empty conduction band (Hoffmann et al 1995). The semiconductor photocatalyst absorbs impinging photons with energies equal to or higher than its band gap or threshold energy. Each photon of the
required energy that hits an electron in the occupied valence band of the semiconductor atom can elevate that electron to the unoccupied conduction band leading to excited state conduction band electrons and positive valence band holes (Schiavello 1989).

The fate of these charge carriers may take different paths as shown in Figure 6.1. Firstly, they can get trapped, either in shallow traps or in deep traps. Secondly, they can recombine, non-radiatively or radiatively, dissipating the input energy as heat. Finally, they can react with electron donors or acceptors adsorbed on the surface of the photocatalyst. In fact, it was shown that any photo redox chemistry occurring at the particle surface emanates from trapped electrons and trapped holes rather than from free valence band holes and conduction band electrons (Serpone et al 1996).

Figure 6.1 Simplified mechanism of semiconductor photocatalytic process
The competition between charge-carrier recombination and charge-carrier trapping followed by the competition between recombination of trapped carriers and interfacial charge transfer determine the overall quantum efficiency for interfacial charge transfer. Also of great importance are the band positions or flat band potentials of the semiconductor material. The above said also indicate the thermodynamic limitations for the photoreactions that can take place (Hagfeldt et al 1995).

Nanosize semiconductor particles have diameters smaller than the wavelength of the incident light. Their dispersions are optically transparent with the dimensions of the particles being small enough to render scattering of light negligibly small. Thus nanosize semiconductor particles have the added advantage of providing transparent solutions for detailed mechanistic studies of photoredox processes by laser photolysis techniques. When a semiconductor particle is illuminated with wavelengths corresponding to photon energies larger than the bandgap, valence band electrons are excited to the conduction band and holes are produced in the valence band. Most of the electron-hole pairs produced recombine again after some tens of picoseconds and the energy is released as photons, phonons or both. Coordination defects at the surface of the particle and lattice defects inside the particle trap the remaining charges. The holes trapped at the surface have a highly reactive oxidation potential and the electrons have a highly reactive reduction potential. Because of this, the holes and electrons can induce photocatalytic reactions at the surfaces.

6.3 RHODAMINE B

Rhodamine B (RhB), whose molecular structure is shown in Figure 6.2, is a common fluorescent dye used in many different applications, from water tracer studies to cell membrane studies. It has many advantageous properties like high photostability and water solubility. The quantum yield of
the fluorescence of RhB is dependent on several factors, but except from concentration, the most important one is the temperature. The quantum yield increases with decreasing temperature. This factor can easily be corrected for by letting RhB samples adjust to for example room temperature before the fluorescence is measured. Another factor to consider is the pH value, but between pH 6.5 and pH 9.5 RhB has a stable quantum yield. Figure 6.3 shows the absorption and emission spectra of RhB respectively.

Figure 6.2 The molecular structure of rhodamine B dye

The emission has a maximum at around 577 nm and the absorption maximum is found at 554 nm. In order to be able to distinguish between the excitation light and the emission light and to filter out the excitation wavelengths, the RhB was excited using a wavelength of 405 nm. This wavelength coincides with a smaller maximum in the absorption spectrum, as can be seen in Figure 6.3.
Figure 6.3 The emission and absorption spectra of rhodamine B dye

Rhodamine B was chosen as a model organic compound to evaluate the photo activity of the prepared samples and the effects of photocatalytic conditions on their catalytic performance. By choosing RhB as pollutant, the concentration in the sample can be found by simply measuring the fluorescence from the sample. To ensure a high signal from the sample, a high initial concentration of the pollutant should be used. When too high concentrations are used, the transparency of the solution is reduced and the whole sample is not evenly illuminated. This reduces the efficiency of the photodegradation process. Because the degradation process mostly occurs at the surface of the particles, when the surface is covered with the pollution molecules, a further increase in the pollutant concentration does not give an increase in the degradation rate (Carp et al 2004).
6.4 PURE AND Zn, Mn DOPED CdS NANOPARTICLES

The pure and doped CdS nanoparticles were prepared as discussed in chapters III, IV and V. The nanoparticles synthesized by different heating process with different concentrations were used as a catalyst for the photodegradation studies of rhodamine B.

6.5 PHOTODEGRADATION EXPERIMENT

The photocatalytic activity experiments with pure and doped CdS for the decomposition of RhB under UV irradiation were performed. The 125 W halogen lamp with wavelength filters is used as the UV source. The wavelength of 415 nm was chosen and used for our studies. Figure 6.4 shows a scheme of the experimental set up.

In each experiment, 0.050 g of photocatalyst CdS was mixed with 100 mL of reactant solution with an initial concentration of 2.5×10⁻⁵ molL⁻¹ of RhB. The reaction solution was sonicated to obtain a homogeneous suspension. The reactant was adsorbed on the catalyst surface in a dark environment with magnetic stirring for 20 min to achieve the adsorption/desorption equilibrium. The processes were carried out at room temperature. To determine the change in RhB concentration in solution during the process, a few millilitres of the solution was taken from the reaction mixture at the same time interval, subsequently centrifuged, filtered through a millipore filter to separate the catalysts and loaded into a UV-Vis spectrometer (SHIMADZU UV-2450, Japan). The RhB concentration was calculated from the absorbance at 556 nm using a calibration curve. The measurements were repeated for each catalyst with the same experimental procedure.
6.6 RESULTS AND DISCUSSION

In order to evaluate the photocatalytic activity of the pure and doped CdS samples, the experiments were carried out with samples of different stoichiometries of Cd and Zn/Mn. The concentration changes of Rhodamine B solutions versus UV irradiation time are shown in Figures 6.5, 6.6, 6.7 and 6.8. The excitation of RhB under irradiation with UV rays is followed by the reduction of $O_2$ to $O_2^-$ by RhB*. $O_2^-$ reacts with a proton to OOH. In the absence of a catalyst, RhB degrades very slowly under UV irradiation (Figure 6.5). The concentration only decreases by about 10% during the experiment (4 hours). UV irradiation on RhB in the absence of a catalyst shows slow degradation of the dye, indicating that it needs an electron-transfer mediator for faster degradation. The apparent rate constant has been chosen as the basic kinetic parameter to compare the system, since it
is independent on the concentration and therefore, enables one to determine the catalytic activity. Also, to have a better knowledge on the degradation process, the time necessary to reduce to 50% the initial concentration known as half-life time \( t_{1/2} \) is to be considered. The rate constant \( (K) \), half-life time \( t_{1/2} \) and the degradation efficiency \( (\eta) \) can be calculated for the degradation of RhB and given in Tables 6.1 and 6.2. The relation for \( K \), \( t_{1/2} \) and \( \eta \) is given by,

\[
Kt = -\ln\left(\frac{C_t}{C_0}\right) \quad (6.1)
\]

\[
t_{1/2} = \frac{\ln 2}{K} \quad (6.2)
\]

\[
\eta = \left(\frac{C_0 - C_f}{C_0}\right) \times 100 \quad (6.3)
\]

Where \( C_0 \), \( C_t \) and \( C_f \) are the concentration of RhB at \( t = 0 \), \( t \) and final respectively.

![Absorption spectra of rhodamine B without catalysts under UV irradiation](image)

**Figure 6.5** Absorption spectra of rhodamine B without catalysts under UV irradiation
Figure 6.6 shows the absorption spectra of RhB aqueous solution in the presence of 50 mg of CdS nanoparticles under a UV-light lamp for various irradiation durations. For comparison, the photocatalytic activities of CdS nanoparticles synthesized from conventional heating and microwave irradiation, whose shapes are different, under UV irradiation have also been tested and their corresponding absorption spectra are shown in Figure 6.6 (a) and (b) respectively. In total, the cationic dye radical is degraded to carbon dioxide, water and mineral acids via rhodamine as intermediate. Basically, there are two photodegradation pathways for RhB: (1) cleavage of the whole conjugated chromophore structure and (2) N-deethylation. Following the first pathway the main peak position remains constant while the peak intensity decreases (Fan et al 2011). The fact that the degradation without a detectable rhodamine intermediate occurs was also reported by Wu and Zhang (2004). In case of our experiment, the rhodamine intermediate could not be detected in the UV-Vis spectroscopy and decrease in RhB concentration was observed. Hence, the reaction follows the first pathway of photodegradation.

The relation between the photodegradation efficiency (denoted as $C_t/C_0$) of RhB and the time under a UV light irradiation is given in Figure 6.7. The results from photocatalytic experiments indicate that the CdS nanorods synthesized by conventional heating (CH) process is somewhat efficient than the CdS nanoparticles from microwave irradiation (MWI). The photodegradation efficiency of RhB with CdS nanorods from CH rises to 95.4%, whereas, it is just 59.2 and 95.3 % for RhB without CdS and RhB with the CdS nanoparticles from MWI, respectively and these results clearly indicate that the photocatalytic activity of RhB with CdS nanorods is significantly enhanced when compared with that of CdS nanoparticles. It is believed that the rod-like structure and high specific surface areas of the $\text{Cd}_{1-x}\text{Zn}_x\text{S}$ nanorods are beneficial for the adsorption of reactant molecules, resulting in an enhanced degradation.
Figure 6.6  Absorption spectra of rhodamine B with CdS nanoparticles under UV irradiation (a) CH and (b) MWI
Figure 6.7 Decrease in rhodamine B concentration over the time of without catalyst (■), with CdS nanorods from CH (▲) and CdS nanoparticles from MWI (○)

Figure 6.8 presents the adsorption spectra of an aqueous solution of RhB in the presence of Cd\textsubscript{1-x}Zn\textsubscript{x}S nanoparticles under UV irradiation. The Cd\textsubscript{1-x}Zn\textsubscript{x}S nanoparticles with different concentrations x = 0.05, x = 0.3 were tested and the corresponding absorption spectra are shown in Figure 6.8 (a) and (b) respectively. It is found that the intensity of the characteristic adsorption peak decreases uniformly with the increase in the illumination time. The rhodamine B aqueous solution degrades almost completely when the radiation time is 120 and 90 minutes for x = 0.05 and x =0.3 respectively. Cd\textsubscript{1-x}Zn\textsubscript{x}S nanocrystal has better efficient photocatalytic properties when compared to the pure CdS nanoparticles the degradation of rhodamine B. The concentration decreases with reaction time of the photodegradation of rhodamine B with Cd\textsubscript{1-x}Zn\textsubscript{x}S nanoparticles is shown in Figure 6.9.
Figure 6.8 Absorption spectra of rhodamine B with Cd$_{1-x}$Zn$_x$S nanoparticles under UV irradiation (a) $x = 0.05$ and (b) $x = 0.3$. 
It shows the concentration of the Zn affects the efficiency of photocatalytic properties of Cd$_{1-x}$Zn$_x$S. Higher concentration ($x = 0.3$) of Zn shows more efficiency than lower concentration ($x = 0.05$) for the degradation of rhodamine B. The half-life time $t_{1/2}$ can be calculated for the degradation of RhB with CdZnS nanoparticles are given in Table 6.1.

![Graph showing the decrease in rhodamine B concentration over time with Cd$_{1-x}$Zn$_x$S nanoparticles.](image)

**Figure 6.9** Decrease in rhodamine B concentration over the time of with Cd$_{1-x}$Zn$_x$S nanoparticles ($\blacksquare$) $x = 0.05$ and ($\bullet$) $x = 0.3$.

Figure 6.11 (a) and (b) show the absorption spectra of rhodamine B degraded with Cd$_{1-x}$Mn$_x$S nanoparticles with concentrations $x = 0.05$ and $x = 0.3$ respectively. During the photodegradation of RhB a clear difference in the spectral change between the CdS/CdZnS and CdMnS is observed. Distinguishable difference in the extent of blue-shift of the major absorption band of RhB is observed in CdMnS. In this case, the second pathway of photodegradation is obeyed. In the course of illumination, the absorption maximum of the solution exhibits a gradual hypsochromic shift as shown in
Figure 6.10 and the existence of a number of intermediates is also suggested. During the second pathway, which has the N-deethylation, the main peak position gradually blue shifts according to the following absorption maxima of RhB at 554 nm; N,N,N'-Triethyl rhodamine at 539 nm; N,N'-Diethyl rhodamine at 522 nm; N-Ethyl rhodamine at 510 nm; Rhodamine at 498 nm. In most cases the two degradation pathways coexist and compete. Figure 6.10 shows the samples of rhodamine B irradiated with CdZnS nanoparticles under UV light at different time interval.

Figure 6.10  The Rhodamine B with Cd$_{0.70}$Zn$_{0.30}$S nanoparticles under UV irradiation with different time interval.
Figure 6.11 Absorption spectra of rhodamine B with Cd$_{1-x}$Mn$_x$S nanoparticles under UV irradiation (a) $x = 0.05$ and (b) $x = 0.3$. 
After irradiation for 1 h, the absorption peak corresponding to RhB at 553 nm diminishes sharply with a concomitant wavelength-shift to the blue region gradually. Under UV irradiation, the dye is de-ethylated in a stepwise manner with the color of the solution changing from an initial red color to a very light yellow-green. That is, ethyl groups are removed one by one, as demonstrated by the gradual peak wavelength shift toward the shorter wavelength. The color of the solution vanishes after final irradiation, revealing that at least the chromophoric structure of the dye was destroyed. The calibration plot of the photodegradation of rhodamine B with Cd$_{1-x}$Mn$_x$S nanoparticles in Figure 6.12 shows the higher concentration ($x = 0.3$) of Mn show more efficiency than lower concentration ($x = 0.05$).

![Figure 6.12 Decrease in rhodamine B concentration over the time of with Cd$_{1-x}$Mn$_x$S nanoparticles (■) $x = 0.05$ and (○) $x = 0.3$.](image)
The degradation rate kinetics of rhodamine B with different nanoparticles was determined by plotting log of concentration versus time. The Figure 6.13 shows the kinetics of RhB without and with CdS nanoparticles obtained from microwave and conventional heating processes. In order to infer the reaction kinetics of the photocatalytic degradation process of Rhodamine B, \(-\ln(C_t/C_0)\) for the first-order reaction and \(1/C_t\) for the second-order reaction as a function of irradiation time \(t\) were calculated and checked for the two cases. The kinetics graphs for the first and second order are shown in Figures 6.14 and 6.15. In second order reaction, the straight line for all points is not perfectly fitting and the \(R^2\) values are very low when comparing with that of first order kinetics. Hence, the reactions are following the first order kinetics.

![Figure 6.13 First order calibration plot for rhodamine B without and with CdS nanoparticles.](image-url)
Figure 6.14  First order calibration plot for rhodamine B with pure and doped CdS nanoparticles $x = 0.05$ and $x = 0.3$. 
Figure 6.15 Second order calibration plot for rhodamine B with pure and doped CdS nanoparticles $x = 0.05$ and $x = 0.3$. 
In fact, the results indicate that the calculated values of \(-\ln(C_t/C_0)\) are approximately linear with the irradiation time \(t\); that is, the photocatalytic degradation reaction of Rhodamine B are all first-order kinetic reactions as shown in Figure 6.13. The apparent rate constants are obtained from the relation \(Kt = \ln \left(\frac{C_0}{C_t}\right)\) for all nanoparticles using the slope of \(\ln \left(\frac{C_0}{C_t}\right)\) versus degradation time curve and given in the Table 6.1. The results indicates that the rate of degradation of RhB is enhanced by the \(\text{Cd}_{(1-x)}\text{Zn}_x\text{S}\) nanoparticles.

**Table 6.1** The rate constant of rhodamine B degradation without and with CdS nanoparticles

<table>
<thead>
<tr>
<th>S.No</th>
<th>Nanoparticles</th>
<th>Slope of the graph</th>
<th>Rate Constant (K \left(10^{-2} \text{ min}^{-1}\right))</th>
<th>(R^2)</th>
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<tr>
<td>1</td>
<td>RhB</td>
<td>0.00333</td>
<td>0.333</td>
<td>0.96577</td>
</tr>
<tr>
<td>2</td>
<td>CdS (MW)</td>
<td>0.01456</td>
<td>1.456</td>
<td>0.91324</td>
</tr>
<tr>
<td>3</td>
<td>CdS (CH)</td>
<td>0.01501</td>
<td>1.501</td>
<td>0.86576</td>
</tr>
<tr>
<td>4</td>
<td>(\text{Cd}<em>{(0.95)}\text{Zn}</em>{(0.05)}\text{S})</td>
<td>0.02771</td>
<td>2.771</td>
<td>0.91810</td>
</tr>
<tr>
<td>5</td>
<td>(\text{Cd}<em>{(0.95)}\text{Mn}</em>{(0.05)}\text{S})</td>
<td>0.02315</td>
<td>2.315</td>
<td>0.94676</td>
</tr>
<tr>
<td>6</td>
<td>(\text{Cd}<em>{(0.70)}\text{Zn}</em>{(0.30)}\text{S})</td>
<td>0.03846</td>
<td>3.846</td>
<td>0.92452</td>
</tr>
<tr>
<td>7</td>
<td>(\text{Cd}<em>{(0.70)}\text{Mn}</em>{(0.30)}\text{S})</td>
<td>0.02971</td>
<td>2.971</td>
<td>0.95355</td>
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**Table 6.2** The degradation efficiency and half-life time of rhodamine B degradation without and with CdS nanoparticles

<table>
<thead>
<tr>
<th>S.No</th>
<th>Nanoparticles</th>
<th>Efficiency ((\eta) \ (%))</th>
<th>Half-life time (t_{1/2} \ (\text{min}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RhB</td>
<td>59.2</td>
<td>208</td>
</tr>
<tr>
<td>2</td>
<td>CdS (MW)</td>
<td>95.3</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>CdS (CH)</td>
<td>95.4</td>
<td>46</td>
</tr>
<tr>
<td>4</td>
<td>(\text{Cd}<em>{(0.95)}\text{Zn}</em>{(0.05)}\text{S})</td>
<td>97</td>
<td>25</td>
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<tr>
<td>5</td>
<td>(\text{Cd}<em>{(0.95)}\text{Mn}</em>{(0.05)}\text{S})</td>
<td>97.3</td>
<td>30</td>
</tr>
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<td>6</td>
<td>(\text{Cd}<em>{(0.70)}\text{Zn}</em>{(0.30)}\text{S})</td>
<td>96.6</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>(\text{Cd}<em>{(0.70)}\text{Mn}</em>{(0.30)}\text{S})</td>
<td>97.1</td>
<td>23</td>
</tr>
</tbody>
</table>
6.7 CONCLUSION

An attractive technique for the reductive decolouration of dyes has been presented that can be potentially extendable to the photocatalytic transformation of a variety organic compounds and that can eventually have potential applications in the treatment of textile dye wastes. The product must be analyzed before considering the viability of this process to pollutant removal. Alternatively, one could couple this technique with oxidative .OH mediated photocatalysis and mineralize the intermediates formed in the reductive step. The present study has revealed that the photocatalytic activity of the pure and doped CdS nanocomposite under steady-state UV light irradiation. It was found that only Zn doped CdS nanoparticles enhances the overall degradation rate with respect to the pure and Mn doped CdS nanoparticles. Among the three samples, Cd_{(1-x)}Zn_{x}S possesses the best photocatalytic activity to the degradation of RhB under UV light. This fact must be taken into account in the design of new photocatalysts with well-tailored efficiency and long-term stability.