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EFFECT OF MWNTS ON PHOTOCATALYTIC ACTIVITY OF ZnS NANOCRYSTALS

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ABSTRACT

ZnS nanocrystals have been decorated with multiwall carbon nanotubes (MWNTs) by chemical route. Optical absorption studies have been performed by using dye (methylene blue) as a probe on ZnS nanocrystals and ZnS/MWNTs composites. Methylene blue degradation on ZnS/MWNTs composites revealed that carbon nanotubes could effectively increase the photocatalytic activity of ZnS nanocrystals as well as rate of electron induced redox reaction. CNT decorated photocatalysts can be utilized for ultrafast nonlinear optical switching, super capacitance and improved optical luminescence.

Key words: ZnS, ZnS/MWCNTs, MB, UV-Vis, PACS: 43.66, 61.25H, 72.80Le.

INTRODUCTION

ZnS is an important II-VI semiconductor and can be applied in luminescence materials[1-4] and photocatalysis[5-7]. The photocatalytic activity of ZnS nanocrystals is very low, owing to the fact that the generated electron/hole (e^-/h^+) pairs are easily recombined. Jiang and Gao[8] found that CNTs could promote the photocatalytic performance of ZnO. In present work ZnS nanocystals have been decorated with MWNTs and their photocatalytic activity has been measured by using methylene blue dye as a probe.

EXPERIMENTAL

Synthesis of MWNTs and ZnS/MWNTs

The synthesis of MWNTs has been performed by chemical vapor deposition (CVD)

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technique. ZnS/MWNT composites have been synthesized by chemical reaction and mixing of MWNTs in ZnS has been done by ultrasonication in colloidal form. For phocatalytic activity methylene blue (MB) dye as a probe has been used.

RESULTS AND DISCUSSION

UV-Vis spectra for ZnS/MWNTs composites with MB dye reaction

Figs. 1 and 2 are showing optical absorption spectra for ZnS, ZnS/MWNT and ZnS/MWNT/MB systems. The emission band shown in the spectra can be attributed to the band gap emission and the strong band gap emission demonstrates the high crystalline nature of ZnS.

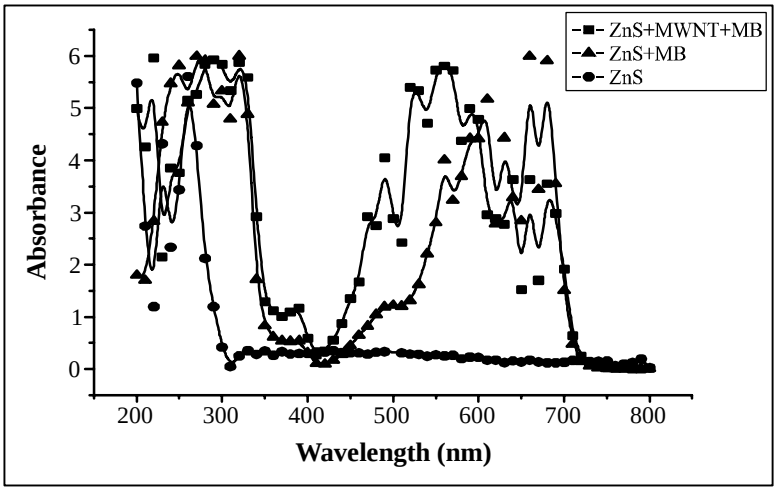

Fig. 1: UV-Vis spectra for ZnS and ZnS/MWNT composites

The figure also shows that absorption for ZnS/MWNT composite is higher than that of ZnS nanocrystals indicates ZnS/MWNT composites would exhibits more excellent photoactivity than ZnS nanocrystals. MWNT acting as electron acceptor for improving the photocatalytic activity of ZnS/MWNT composites. Under the light irradiation the valence band electrons of ZnS are excited and move towards its conduction band, giving rise to formation of electron and hole pair. Due to the strong interfacial connection between ZnS nanocrystals and MWNTs. The excited electrons of conduction band of ZnS NCs can migrate to CNTs, which are relatively good electron acceptor, so the recombination of e^-/h^+ pair is retarded. To demonstrate the effect of MWNTs on the photocatalytic activity of ZnS nanocrystals, we have investigated the photocatalytic performance of pristine ZnS nanocrystals and ZnS/MWNT composites for the degradation of methylene blue dye.

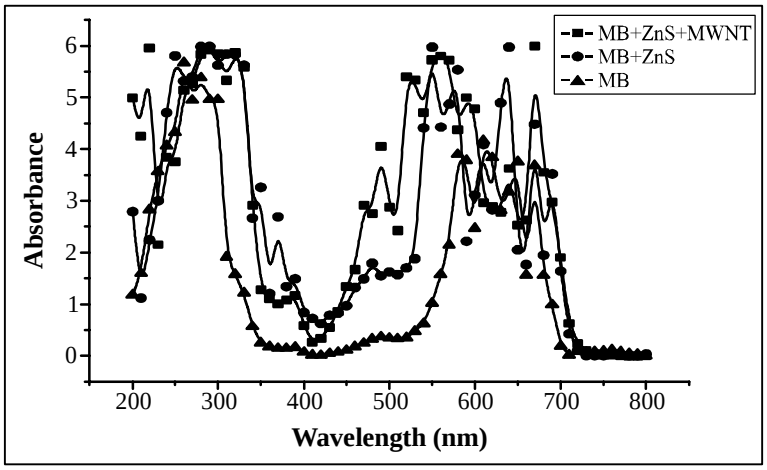

Fig. 2: UV-Vis spectra for MB, ZnS and ZnS/MWNT composites

Figure 2, shows the absorption spectrum of methylene blue aqueous solution of 20 mg/L in the presence of 100 mg of ZnS nanocrystals and 100 mg of ZnS/MWNT composites treating for 20 minute in light of visible lamp. It is found that ZnS/MWNT composites decolorizes the MB rapidly in comparison to ZnS nanocrystals.

Effect of dye concentration

Figure 3, shows the degradation of MB over ZnS/MWNT composites with amount of 100 mg under the light of visible lamp for different concentrations of methylene blue aqueous solution.

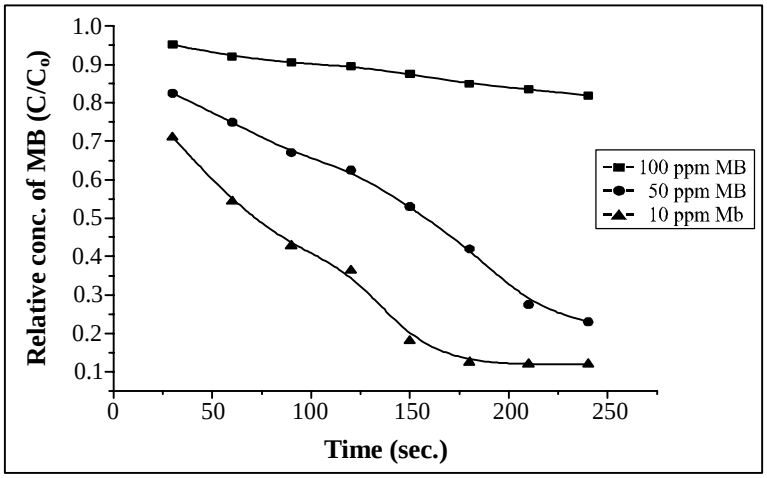

Fig. 3: Spectra for reaction time of MB on ZnS/MWNT composites

It shows that the photodegradation efficiency of the MB photocatalyzed by ZnS/MWNT composites decreased as the original MB concentration increases, the main reason is initial dye concentration may affect the rate of photocatalytic process.

CONCLUSION

In this present study, promoting effect of MWNTs on the photocatalytic activity of ZnS nanocrystals have been observed by using the methylene blue (MB) dye degradation as probe. This result also related to the interfacial connection between ZnS nanocrystals and MWNTs, which promote the interfacial electron transfer from attached ZnS nanocrystals to MWNTs, and then retards the recombination of e^{-}/h^{+} pair of ZnS nanocrystals.

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