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Efficient sunlight driven photocatalytic degradation of organic dyes by CdS/bentonite nanocomposite

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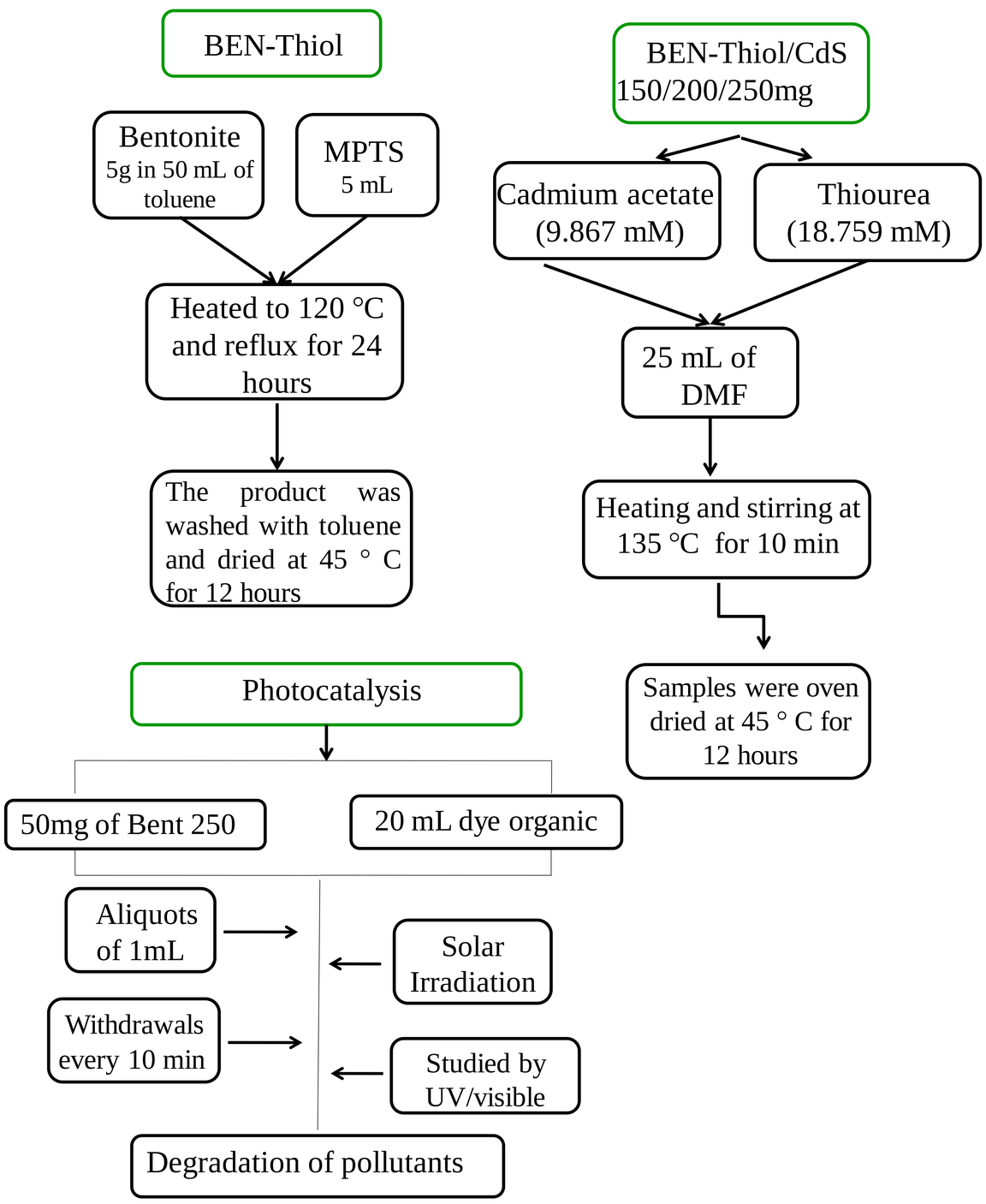
Introduction

In the past few decades, the significant increase of environmental pollution caused by anthropogenic source has stimulated an intense research effort on optimizing and developing materials, specially in nanoscale, as a fast, economical and environmentally friendly alternatives for the conventional treatment methods. Among these environmental problems, the decontamination of natural water emerges as the most challenging field as it deals with all the biosphere health. In this work, bentonite was thiol-functionalized with 3-mercaptopropyl)trimethoxysilane (BEN-thiol) and used to prepare nanocrystalline cadmium sulfide (CdS) by a simple one-pot method. BEN-thiol/CdS was used as a solar photocatalyst for the degradation of organic dye solutions. Thus, CdS nanocrystals were synthesized using cadmium acetate and thiourea aqueous solutions as precursors of Cd^{2+} and S^{2-}, respectively. The reaction was performed at different reaction times and using different amounts of BEN-thiol to evaluate the growth of CdS nanocrystals. In addition, solar irradiation was used in photocatalytic studies in the degradation of organic dyes, since it behaves as an economically viable, renewable and ecological process. The samples are were characterized by UV-vis spectroscopie, TEM, COD and XRD.

Experimental details



Results and Discussion

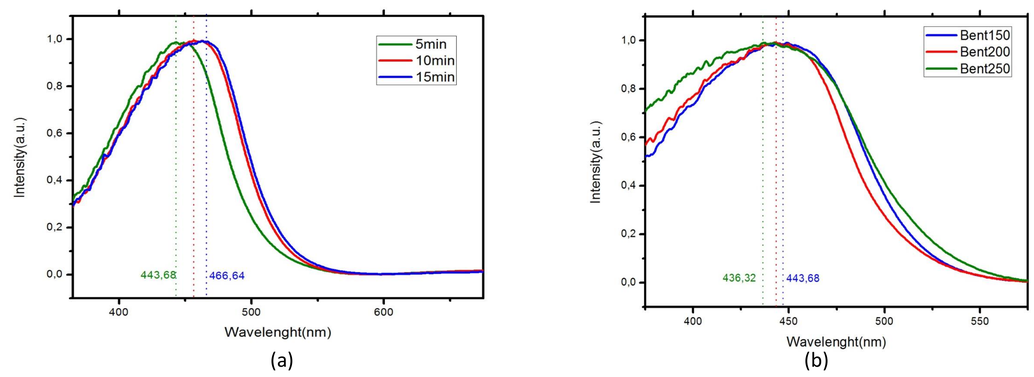


Figure 01. UV-vis spectra CdS/Bent varying the reaction time (a) and proportion the bentonite (b).

The optical properties of BEN-thiol/CdS were studied by UV/visible spectroscopy, which showed a systematically shifted towards longer wavelengths as the reaction goes on or decreasing the BEN-thiol amount, as a result of the particle growth. The XRD measurements indicated that CdS presents a cubic structure.

Table 01: Data obtained through the Brus equation.

Sample	Wavelenght(nm)	Eg(eV)	Diameter(nm)
5min	443,68	2,794	3,433
10min	456,55	2,716	3,478
15min	466,64	2,657	3,513

Table 02: Data obtained through the Brus equation.

Sample	Wavelenght(nm)	Eg(eV)	Diameter(nm)
Bent150	443,68	2,794	3,433
Bent200	443,22	2,797	3,431
Bent250	436,32	2,842	3,407

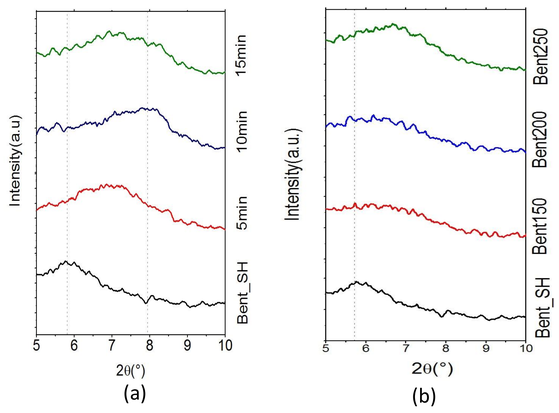


Figure 02. XRD spectra CdS/Bent varying the reaction time (a) and proportion the bentonite (b).

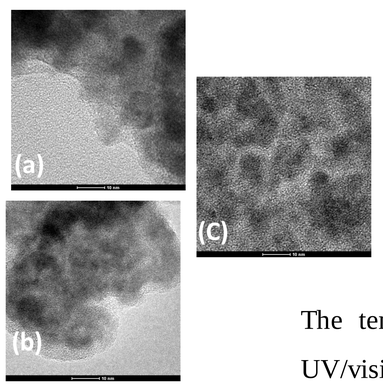


Figure 03. TEM Bent 150(a); Bent 200(b) and Bent 250(c).

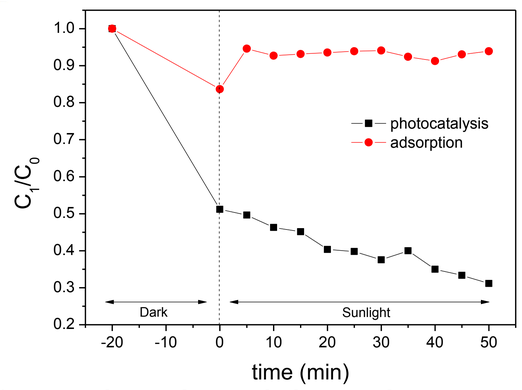


Figure 04. Photocatalysis and adsorption the Bent 250 under solar irradiation..

The temporal evolution of the dye degradation was studied by UV/visible measurement, which showed an efficiency of 70% under only 50 min of solar exposure. Measurements of COD (chemical oxygen demand) showed a reduction of approximately 60%, which gives a measure of the degree of mineralization.

Conclusion

In summary, we have demonstrated that Bent-Thiol/CdS can be prepared varying the reaction time and proportion the bentonite. Furthermore using for degradation of dye organics using photocatalysis by irradiation solar, an alternative technology, cheap, clean and renewable.

References

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Acknowledgments

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