Original Research Paper

Synthesis and Characterization of Novel $Mg(OH)_2$/CdS Hetero Nanostructures for Sunlight-Induced Degradation of Phenolic Pollutant

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ABSTRACT

Mg(OH)2/CdS hetero nanostructures have been successfully synthesized by a novel precipitation method and the synthesis involves three steps. The first step involves the synthesis of $Mg(OH)_2$ nanoparticles using the homogeneous precipitation method. Then, surface-modifying agent citric acid was used to functionalize Mg $(OH)_2$. Finally, the cadmium sulfide (CdS) shell was deposited on the surface-modified Mg $(OH)_2$ by the co-precipitation method. The $Mg(OH)_2$/CdS hetero nanostructures were characterized using X-ray diffraction, scanning electron microscopy (SEM), transmission electron microscopy (TEM), diffuse reflectance spectroscopy (DRS), and photoluminescence spectroscopy. DRS results indicated a blue shift of CdS bandgap absorption with respect to the bulk CdS. XPS results showed evidence for the binding energies of $Mg(OH)_2$, Cd, and S. The Mg $(OH)_2$/CdS hetero nanostructures were explored as a catalyst for sunlight-induced photocatalytic degradation of β- naphthol pollutant. The 0.2 mg/ mL batch of Mg $(OH)_2$/CdS hetero nanostructures maintained at pH 8.5 showed maximum photodegradation efficiency (75 ± 2.1 %). Higher photocatalytic degradation efficiency for $Mg(OH)_2$/CdS hetero nanostructures could be due to the incorporation of CdS and increased reactive oxygen species (ROS) generation. The reusability of the Mg $(OH)_2$/CdS hetero nanostructures was also tested, indicating stability for up to three cycles without any loss of efficiency.

Keywords: *chemical precipitation method, $Mg(OH)_2$/CdS hetero nanostructures, nanoneedles, cauliflower-shaped, β- naphthol pollutant, Photocatalysis*

How to cite this article

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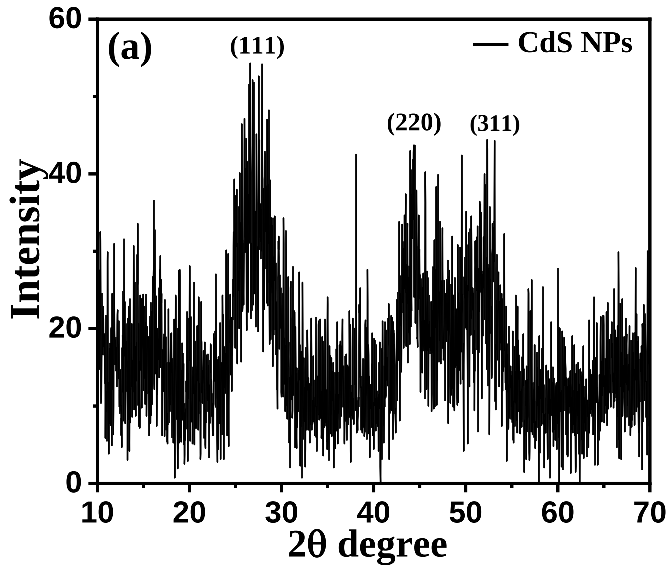


Figure S1. (a) XRD patterns of CdS

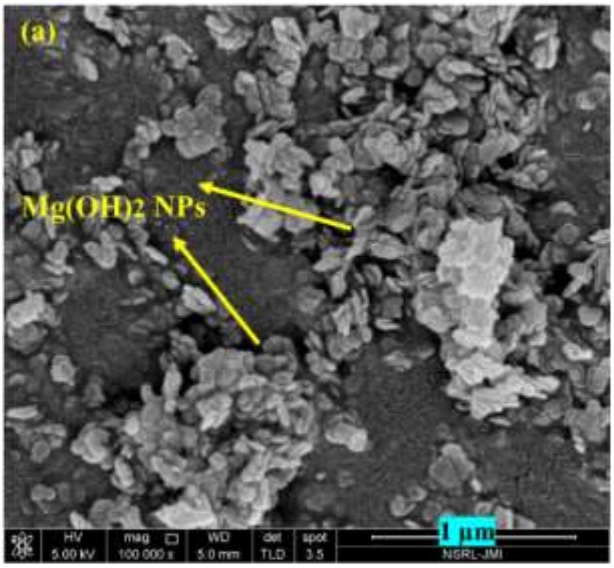


Figure S2. (a) Showing Scanning electron microscopy of $Mg(OH)_2$ NPs

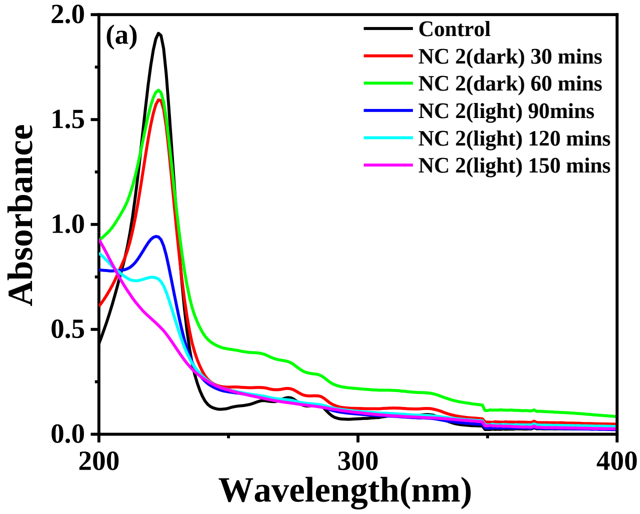
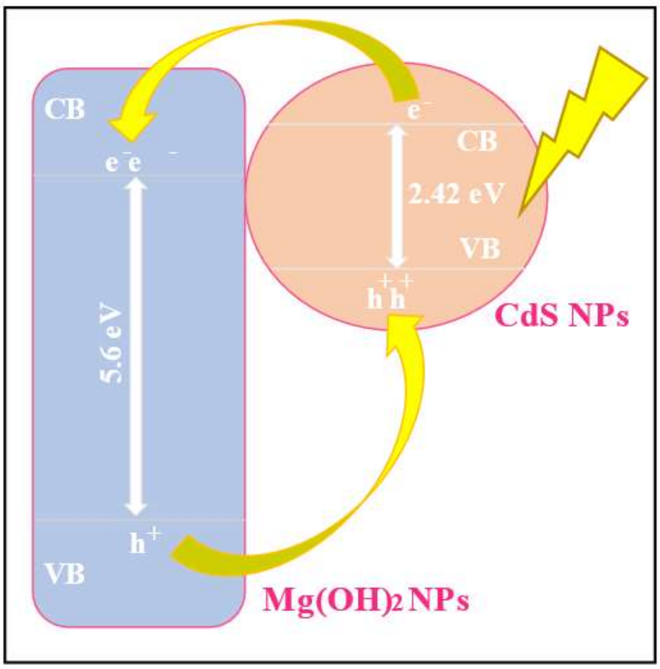


Figure S3. (a) Showing UV-vis spectroscopy results of β-naphthol degradation in natural sunlight



Scheme 1. showing the possible mechanism for the photodegradation of β-naphthol

Table S1. The VB and CB band positions of Mg $(OH)_2$/CdS heteronanostructures and bare Mg $(OH)_2$ and CdS

Sample Name	Band gap (E_g, eV)	E_{VB} (eV)	E_{CB} (eV)
Bare Mg $(OH)_2$	5.50	1.00	-4.4
Mg $(OH)_2$/CdS	2.45	-0.56	-3.01
CdS	2.95	-0.937	2.013

Table.S2. showing the degradation of β-naphthol using various photocatalysts

S.no.	Photocatalyst	Source	Degradation efficiency	Time	Ref.
1	Praseodymium oxide	400 W Mercury lamp	100%	12 min	[23]
2	Cadmium molybdate	400 W Xe Lamp	90%	6 h	[24]
3	N-TiO_2/SiO_2	25W Natural light lamp PT 2191-ExoTerra	95%	3 h	[25]
4	TiO_2/Activated Carbon	20 W UV-C light	100%	1.5h	[26]