Supporting Information

Design of 2D/2D $ZnIn_2S_4$/MgAl-LDH core-shell nanostructures toward enhanced photodegradation of organic dyes

Qiang Gao [a,*], Lingchun Ye [a], Wei Liu [a], Junxi Li [b], Yuchen Cui [b], Naicai Xu [a], Mingjin Zhang [a]

[a] School of Chemistry and Chemical Engineering, Qinghai Normal University, Xining 810008, P. R. China

[b] State Key Laboratory of Heavy Oil Processing, China University of Petroleum (East China), Qingdao 266580, P. R. China

*Corresponding authors: Professor Q. Gao; E-mail addresses: qhchemistry@qhnu.edu.cn

Chemicals and Materials

Aluminum nitrate nonahydrate ($Al(NO_3)_3·9H_2O$), magnesium nitrate hexahydrate ($Mg(NO_3)_2·6H_2O$), glycerol ($C_3H_8O_3$), thioacetamide (C_2H_5NS), hydrochloric acid (HCl, 35%), and zinc chloride ($ZnCl_2$), and urea ($CO(NH_2)_2$) were purchased from Sinopharm Chemical Reagent Co., Ltd. Indium chloride hydrate ($InCl_3·4H_2O$) and ethyl alcohol (EtOH) were acquired from Aladdin. Deionized distilled water was used throughout in the experiment.

Characterization

X−ray diffraction (XRD) patterns were taken with a D8 Advance X−ray diffractometer system using a Cu−Kα source. The field emission scanning electron microscopy (FESEM) analysis was collected with an S−4800 accelerating voltage of 15 kV. Transmission electron microscopy (TEM) was carried out with JEOL−2100F system at an acceleration voltage of 200 kV. The high angle annular dark field scanning transmission electron microscopy image (HAADF−STEM) mapping was acquired on FEI TITAN G2 (200 kV). X−ray photoelectron spectroscopy (XPS) was analyzed by an AMICUS ESCA 3400 using Al Kα radiation. UV−visible diffuse reflectance spectroscopy (DRS) was examined on Hitachi U−4100 using with $BaSO_4$ as reference material. The photocurrent tests and electrochemical impedance spectroscopy (EIS) were carried out via a CHI760 electrochemical workstation with a standard three-electrode probe.

Photocatalytic activity assessment

For each photodegradation experiment, a typical reaction of MO (50 mL, 20 mg/L) decomposition was carried out at room temperature, and 10 mg of catalyst was added with a constant stirring of 400 rpm for 40 min in the dark in order to establish an adsorption−desorption equilibrium. Then the degradation reaction was initiated by irradiating under a 300 W Xenon lamp with a UV cutoff filter ($\lambda > 420$ nm). At given intervals of degradation, samples were withdrawn and an aliquot of 1 M methanol as a quenching reagent was immediately added to prevent further reaction, which was then filtered through 0.22 μm membrane filters to remove suspended catalyst for analysis. The concentration of MO, MB, RhB, and CR was measured on a UV−vis spectrophotometer (Shimadzu UV−2450) at 462, 665, 554, and 496 nm, respectively. After each reaction, the used catalyst was separated, washed dried to perform subsequent photoreaction cycles. All the experiments were repeated three times and the reported data represented the average of the triplicates to ensure accurate data acquisition and interpretation.

Table S1. Comparison of photocatalytic performance with other previously reported photocatalysts for degradation of refractory pollutant in recent years.

Photocatalysts	Catalyst dose	Target pollutant	Reaction conditions	Degradation efficiency	Refs.
$ZnIn_2S_4$@Fe_3O_4	0.2 g/L	RhB	50mL 20mg/L + 300W Xe lamp	96.4% in 180 min	[1]
$ZnIn_2S_4$/$In(OH)_3$	0.1 g/L	MB	100mL 5×10^{-5}M + 300W Xe lamp	95% in 3.5 h	[2]
$WO_{2.72}$/ $ZnIn_2S_4$	1 g/L	Tetracycline	100mL 50mg/L + 300W Xe lamp	97.3% in 60 min	[3]
La-doped $ZnIn_2S_4$	2 g/L	MO	50mL 4×10^{-5}M + 300W Xe lamp	95% in 90 min	[4]
$ZnIn_2S_4$/CQDs	0.25 g/L	Tetracycline	80mL 10mg/L + 250W Xe lamp	85.1% in 90 min	[5]
$ZnIn_2S_4$/g-C_3N_4	0.4 g/L	Tetracycline	50mL 50mg/L + 500W Xe lamp	85% in 120 min	[6]
$ZnIn_2S_4$/In_2O_3	0.4 g/L	MB	50mL 50mg/L + 500W Xe lamp	84.5% in 240 min	[7]
ZIS@CeO_2	0.2 g/L	Tetracycline	50mL 40mg/L + 300W Xe lamp	84.5% in 40 min	[8]
ZIS/LDH	0.2 g/L	MO	50mL 20mg/L + 300W Xe lamp	100% in 20 min	The present work

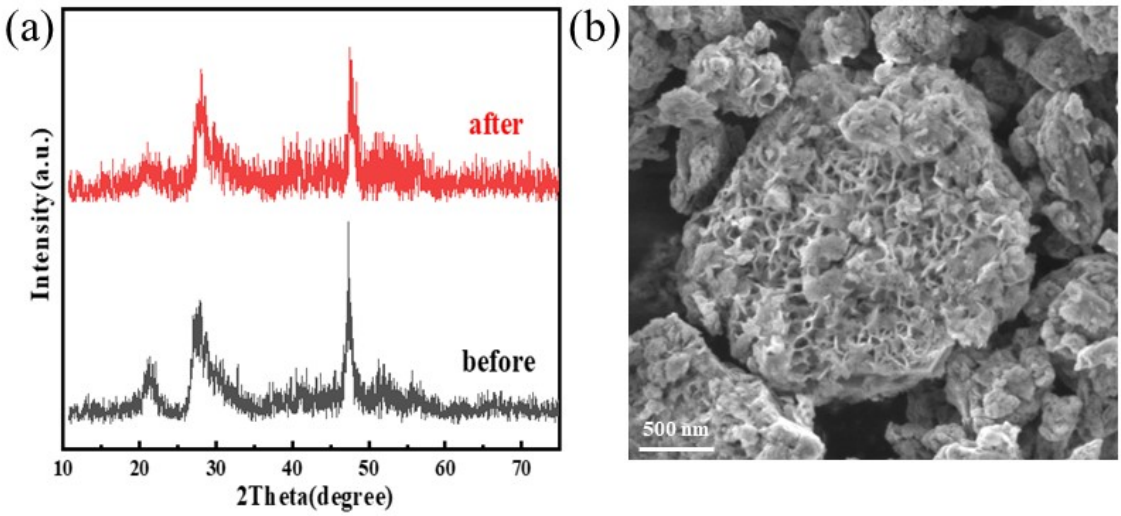

Fig. S1 XRD patterns (a) and SEM image (b) of ZIS/LDH-80 composites before and after four cycles for MO degradation.

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