Supporting Information for

Necklace-like mesoporous MgO/TiO_2 heterojunction structures with excellent capability for water treatment

Yong Jia, Xin-Yao Yu, Tao Luo, Zhen Jin, Bai Sun, Jin-Huai Liu and Xing-Jiu Huang*

Experimental Section

Synthesis of necklace-like MgO/TiO_2 heterojunction structures: The precursor of porous MgO nanowire, hydrated magnesium carbonate hydroxide nanowire, was prepared according to the our previous report,[1] and was used to synthesis of necklace-like MgO/TiO_2 heterojunction structures. In a typical experiment, 0.05 g of hydrated magnesium carbonate hydroxide nanowire was ultrasonic dispersed in 50 mL of ethanol, then 0.5 mL of tetrabutyl titanate was dorped into the above suspension. After stirring for about 10 minutes, a mixed solution of 2 mL water and 2 mL ethanol was droped in it, and then further stirred for 2 hours. After filtration and vacuum drying at 60 ºC for 12 h, the products were calcined at 450 ºC for 2 hours to obtain the MgO/TiO_2 heterojunction structures.

Reference:

1 Y. Jia, T. Luo, X. Y. Yu, B. Sun, J. H. Liu and X. J. Huang, *RSC Adv*., 2013, **3**, 5430.

Materials characterization: The structure and morphology of the products were examined with field emission scanning electron microscopy (SEM, FEI Sirion 200 FEG, 10 kV), transmission electron microscopy (TEM, JEOL-2010, 200 kV), and X-ray photoelectron spectroscopy (XPS, VG ESCALAB MKII spectrometer, Mg KR

X-ray source, 1253.6 eV, 120 W). The crystal phase was studied with powder X-ray diffraction (XRD) analysis (X'Pert ProMPD, Cu Kα radiation, wavelength 1.5418 Å). The N_2 adsorption and desorption isotherm was obtained using a Micromeritics ASAP 2020 M+C instrument with a degassing temperature of 300 °C.

Removal of As(V) ions: The solutions containing different concentrations of As (V) were prepared using $Na_3AsO_4\cdot12H_2O$ as the source. To obtain the adsorption isotherm, 10 mg of the MgO/TiO_2 heterojunction structures was added to 10 mL of the above solution under stirring at room temperature. After stirring for 24 h, the solid and liquid were separated immediately, and inductively coupled plasma-optical emission spectroscopy (Jarrell-Ash model ICAP 9000) was used to measure the concentration of As (V) ions in the remaining solution. The MgO/TiO_2 heterojunction structures after MB photodegradation were collected by centrifugation, washed with deionized water, and dried at 60 ºC. The removal properties towards As(V) of the MgO/TiO_2 heterojunction structures after MB photodegradation was the same as the above process.

In the kinetics study, the initial As(V) concentrations were 20.15 mg L^{-1}. The amount of adsorbent was 100 mg, and the volume of the As (V) solution was 100 mL. To explore the competitive effects of various coexisting anions (Cl^-, SO_4^{2-}, NO_3^-,CO_3^{2-}, HCO_3^-, and PO_4^{3-}) on the removal of As(V), 10 mL of 9.97 mg L^{-1} As(V) solutions containing each of various components (0.1 mM, 1 mM, and 10 mM) and 10 mg adsorbent were shaken for 24 hours. Then, the adsorbent was separated via centrifugation and the supernatant was collected for metal concentration measurements. The effect of pH on the adsorption of As (V) was studied by varying the initial pH of solutions between 3 and 12, and the initial As (V) concentration was 49.88 mg L^{-1}. The pH value was adjusted using 1 M HCl and 1 M NaOH. All the adsorption experiments were carried out at room temperature (298 ± 2 K).

Photocatalytic tests: In the photocatalytic experiments, MgO/TiO_2 heterojunction structures (30 mg) were added to an aqueous methylene blue (MB) solution (30 mL, 10 mg L^{-1}), and the reaction mixture was stirred in the dark for 24 h to ensure the adsorption/desorption equilibrium of the dye with the microspheres. Subsequently, the reaction mixture was exposed to UV radiation from a 300 W low-pressure Hg lamp with the main emission wavelength at 254 nm at room temperature. The samples exposed to the UV light for different time intervals were removed from the reaction suspension, separated, and analyzed with a UV/Vis spectrophotometer (Solidspec-3700) to investigate the photodegradation of MB.

Simultaneously As(V) removal and MB photodegradation: MgO/TiO_2 heterojunction structures (30 mg) were added to 30 ml mixed solution of As(V) and MB. The initial concentrations of As(V) and MB dye were 20.15 and 10 mg L^{-1}, respectively. Subsequently, the reaction mixture was exposed to UV radiation from a 300 W low-pressure Hg lamp with the main emission wavelength at 254 nm at room temperature. The samples exposed to the UV light for different time intervals were removed from the reaction suspension and separated by centrifugation. Then obtained solution was analyzed with a UV/Vis spectrophotometer to investigate the photodegradation of MB, and with inductively coupled plasma-optical emission spectroscopy to measure the concentration of As (V) ions.

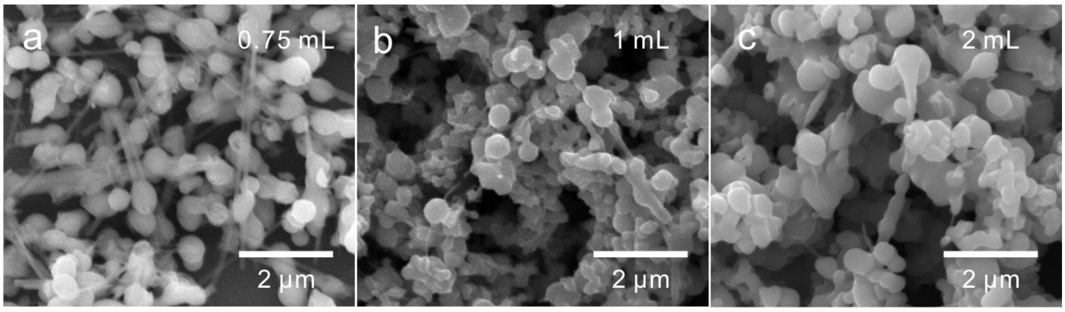

Fig. S1 SEM images of the MgO/TiO$_2$ heterojunction structures prepared using 0.75 mL(a), 1 mL (b), and 2 mL (c) of TBT.

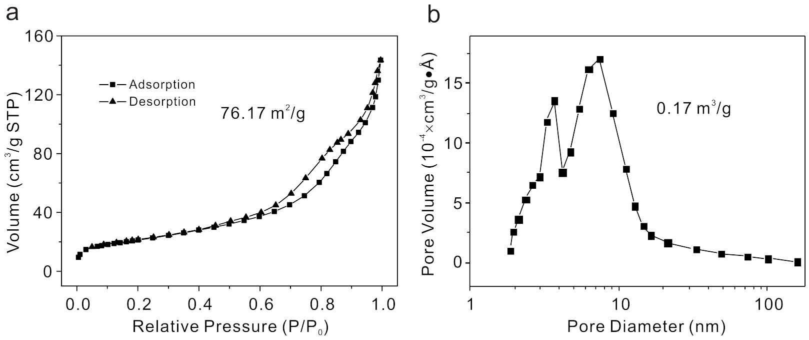

Fig. S2 Nitrogen adsorption–desorption isotherm (a) and the BJH–PSD pore size distributions (b) of the necklace-like MgO/TiO$_2$ heterojunction structures.

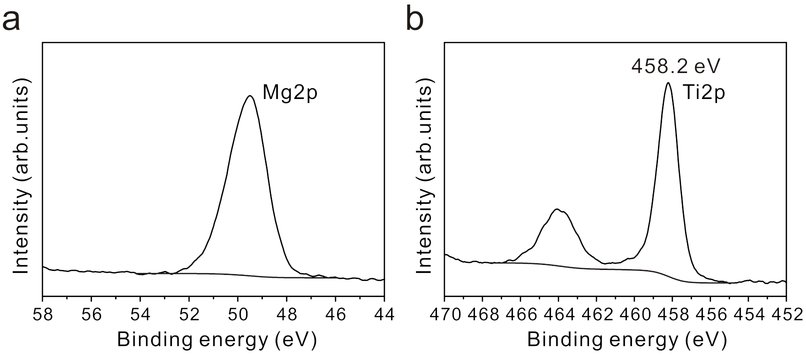

Fig. S3 XPS Mg$_{2p}$ and Ti$_{2p}$ spectra of the MgO/TiO$_2$ heterojunction structures.

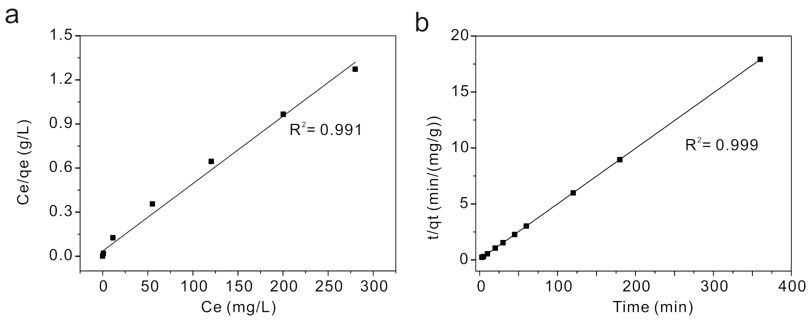

Fig. S4 (a) Linearized Langmuir isotherms obtained from As(V) adsorption necklace-like MgO/TiO_2 heterojunction structures. (b) The pseudo-second-order kinetic plots for the adsorption of As(V).

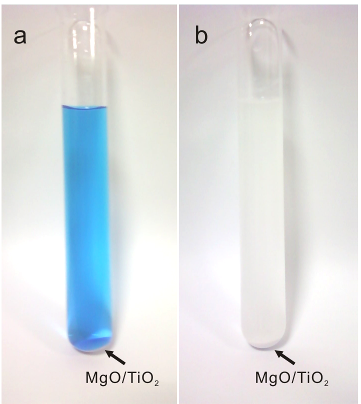

Fig. S5 The digital photographs of the MgO/TiO_2 heterojunction structures dispersed in MB solution before (a) and after (b) UV irradiation.

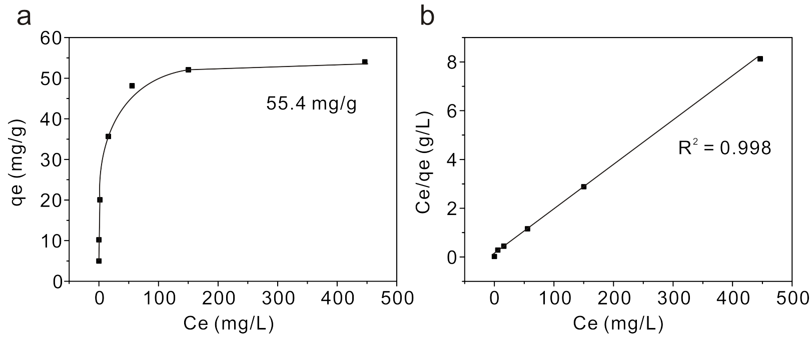

Fig. S6 Adsorption isotherm (a) and linearized Langmuir isotherm (b) obtained from As(V) adsorption onto MgO/TiO_2 heterojunction structures after degradation of MB dye under UV irradiation.