Supplementary Materials

Template-free hydrothermal synthesis of $MgWO_4$ nanoplates and their application as photocatalysts

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Experimental section

Preparation

All reagents were analytical stage in this experiment without further purification. The $MgWO_4$ nanoplates were prepared by one-step hydrothermal reaction. Firstly, an exact stoichiometric amount of sodium tungstate dehydrate (Na_2WO_4•$2H_2O$, 5 mmol) and magnesium acetate tetrahydrate of ($Mg(CH_3COO)_2 \cdot 4H_2O$, 5 mmol) were dissolved in 35 mL deionized water to form a clear solution under stirring for 10 min. Subsequently, the above aqueous solution was transferred into a 50 mL Teflon-lined stainless autoclave, heated at 180 °C for 12 h in an oven and cooled to ambient temperature by furnace cooling. Finally, the obtained white precipitates were washed, centrifuged and dried at 80 °C for overnight to get the $MgWO_4$ nanoplates (namely MWO nanoplates).

For comparison in photocatalytic reaction, the $MgWO_4$ nanoparticles (namely

MWO nanoparticles) were prepared by solvothermal treatment using ethylene glycol (30 mL) and H_2O (10 mL) as solvent. The amounts of Na_2WO_4•$2H_2O$ and $Mg(CH_3COO)_2 \cdot 4H_2O$ are all 10 mmol. The other procedures were similar to those mentioned above in $MgWO_4$ synthesis.

Characterization

The field emission scanning electron microscopy (SEM) and transmission electron microscopy (TEM) with an energy dispersive X-ray spectrometer (EDX) for elemental analysis were performed on Hitachi SU-70 and Tecnai G^2 F20, respectively. X-Ray photoelectron spectra (XPS) were carried out on an Escalab 250Xi for the surface electronic states. The crystalline phase of as-prepared $MgWO_4$ samples was characterized by X-Ray powder diffraction (XRD) on a PANalytical X'Pert PRO X-ray powder diffractometer with monochromatic Cu Kα radiation in the range of 10-90°. UV-vis diffuse reflectance spectra were recorded with a spectrophotometer (Persee TU-1900) using $BaSO_4$ as the reflectance standard. Photoluminescence (PL) spectra were collected by fluorescence spectrometer (Edinburgh instruments FLS920) with a xenon lamp. The specific surface area was determined by the the Brunauer-Emmett-Teller (BET) method from N_2 adsorption isotherms (Micromeritics ASAP2020 V4.0).

Photocatalytic reaction

Photocatalytic reaction was performed in a closed circulation system bought from Beijing Perfectlight Technology Co. Ltd (Labsolar-IIIAG photocatalytic system) mainly consisting of vacuum system, cooling water, and gas analysis device. The samples (0.05 g) were dispersed in a quartz reaction cell filled with 100 mL of aqueous solution (90 mL H_2O and 10 mL triethanolamine as sacrificed agent). Prior to irradiation, the reaction system was evacuated to remove the dissolved oxygen. The reaction was proceed under the illumination of a UV Xe lamp (200-400 nm). The produced hydrogen was analyzed through an on-line gas chromatograph with a TCD detector using argon as carrier gas (GC9790, FULI).

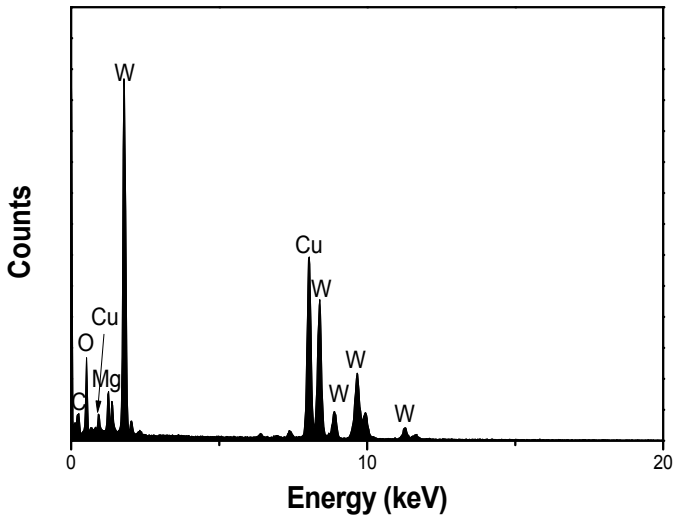

Fig. S1 EDS spectrum of $MgWO_4$ nanoplates.

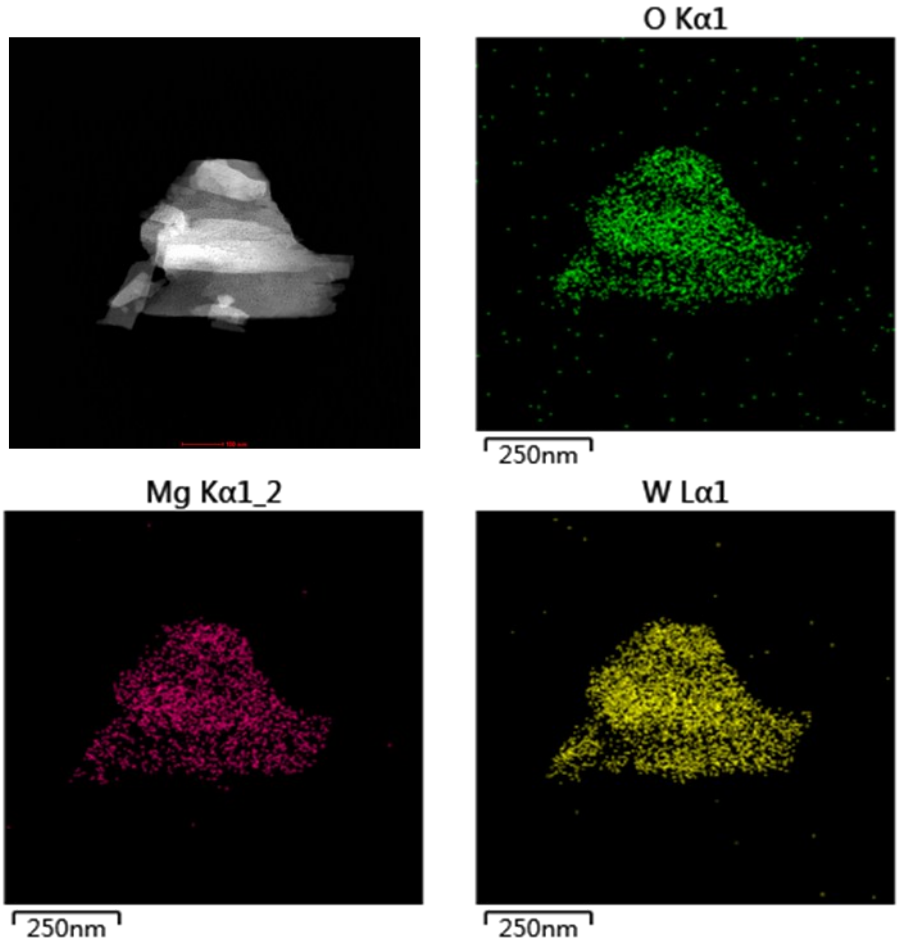

Fig. S2 EDS mapping of $MgWO_4$ nanoplates.

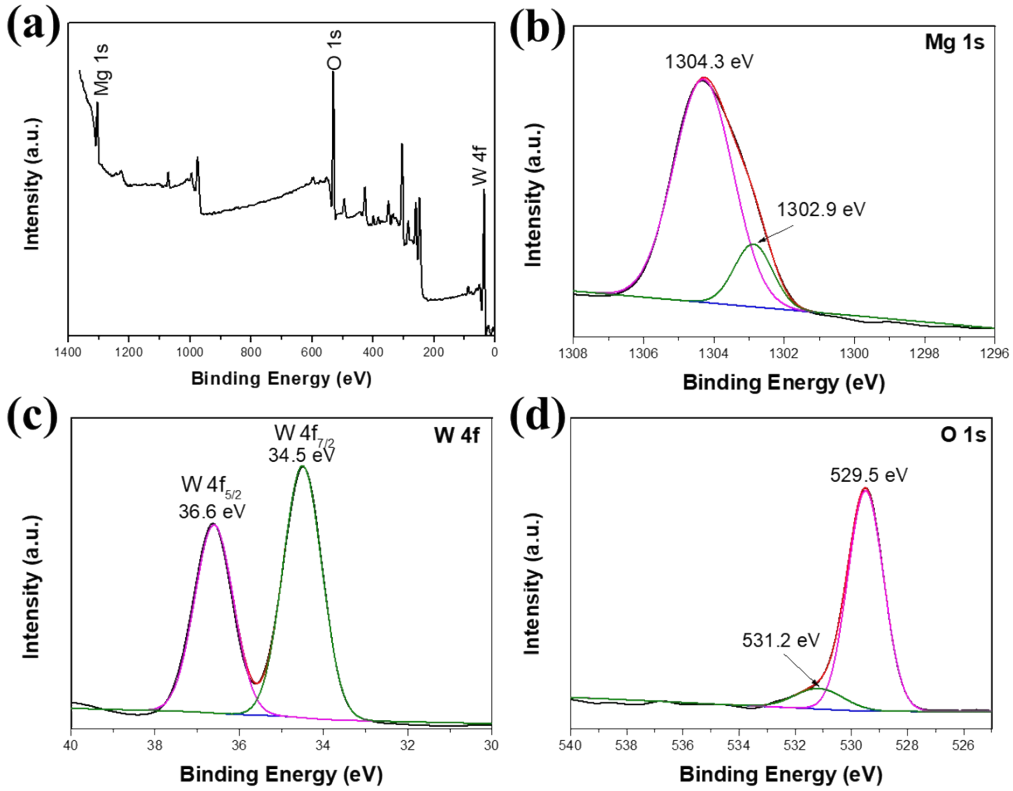

Fig. S3 XPS spectra of $MgWO_4$ nanoplates: (a) full spectrum, (b) Mg 1s, (c) W 4f and (d) O 1s.

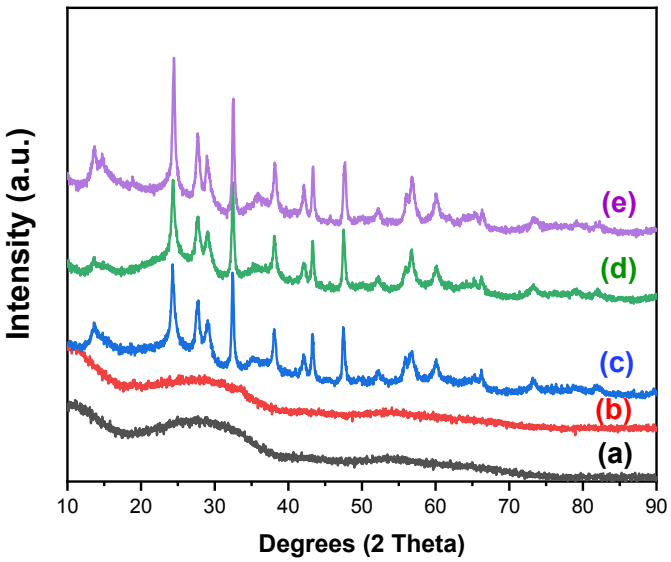

Fig. S4 XRD patterns of samples at different reaction time: (a) 10 min, (b) 30 min, (c) 1 h, (d) 2 h and (e) 12 h.

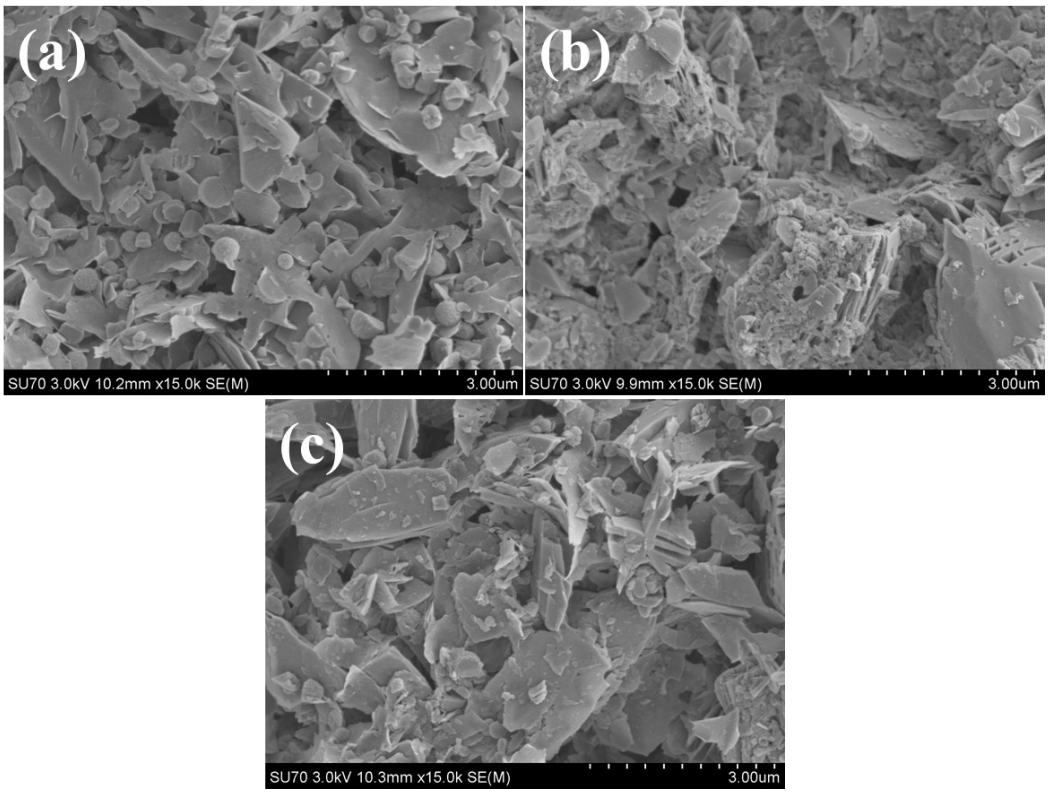

Fig. S5 SEM images of samples at different reaction time. (a) 75 min; (b) 90 min and (c) 105 min.

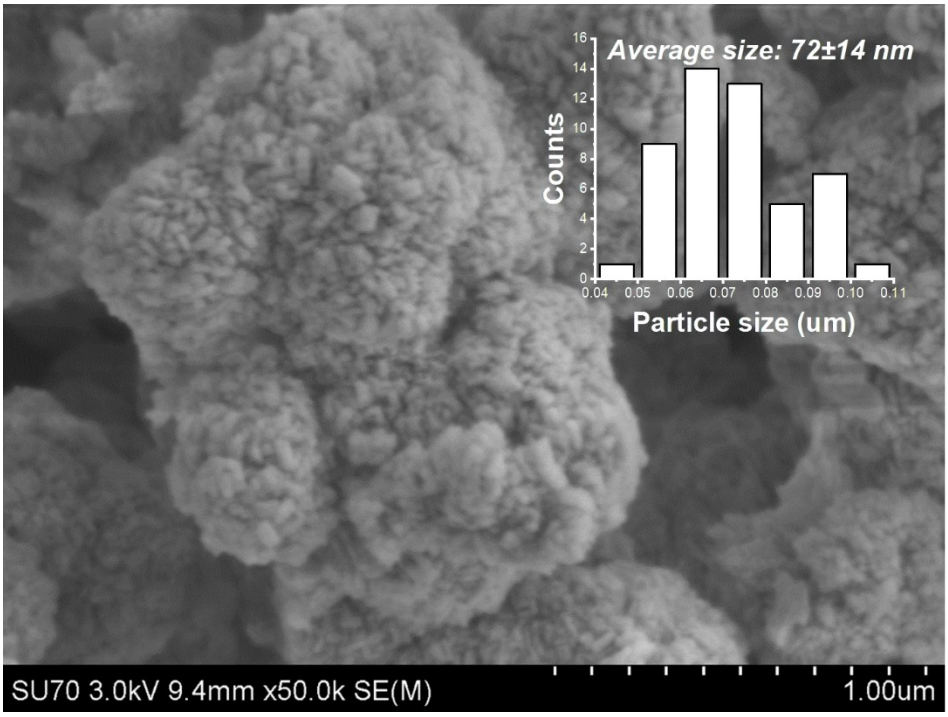

Fig. S6 SEM images of $MgWO_4$ nanoparticles (The inset image is the particle size distribution of $MgWO_4$ nanoparticles).

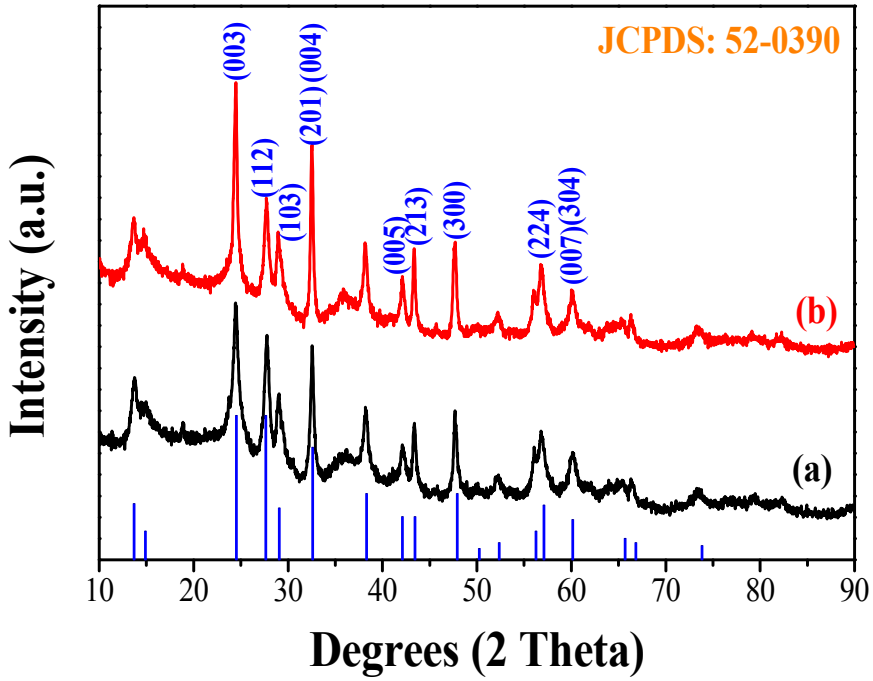

Fig. S7 XRD patterns of (a) $MgWO_4$ nanoparticles; (b) $MgWO_4$ nanoplates

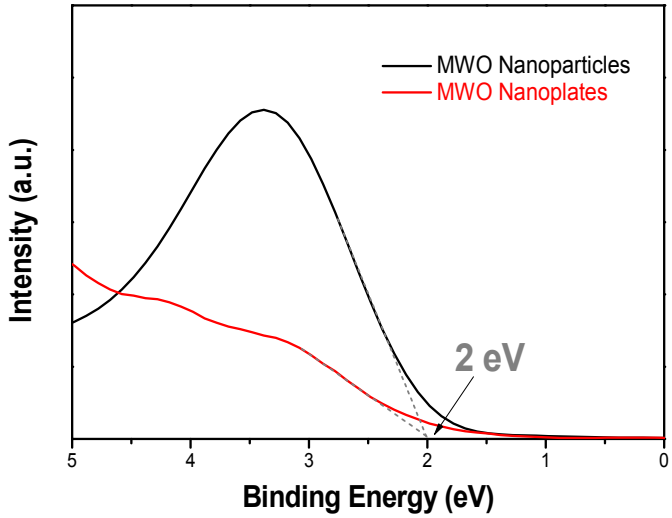

Fig. S8 XPS valence band spectra of $MgWO_4$ nanoparticles and $MgWO_4$ nanoplates.

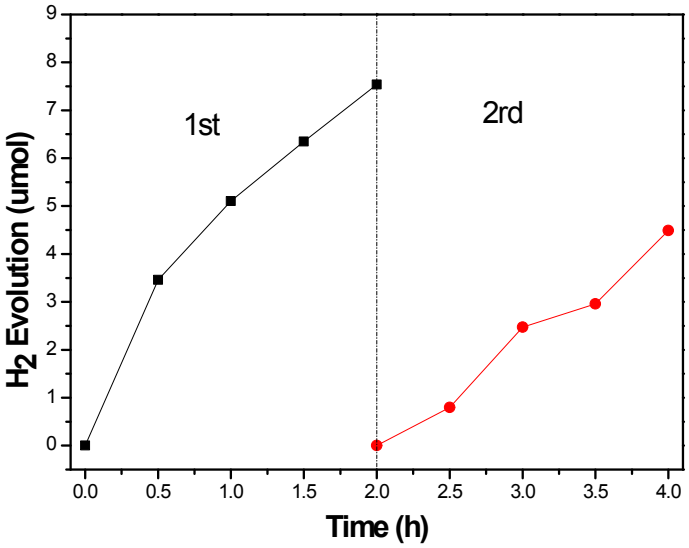

Fig. S9 The photocatalytic hydrogen evolution rates of $MgWO_4$ nanoplates (recycled test).

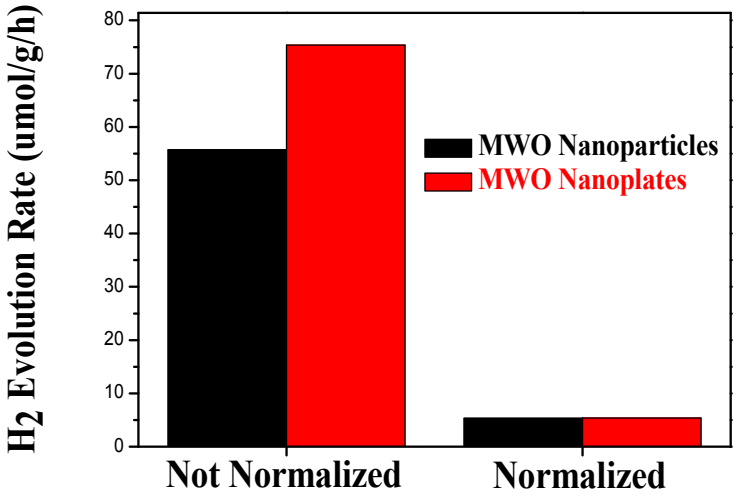

Fig. S10 The photocatalytic hydrogen evolution rates of $MgWO_4$ nanoparticles and $MgWO_4$ nanoplates (not normalized and normalized performance by specific surface area.).

Table S1

The specific surface area, pore volume, and pore diameter of samples.

	S_{BET} (m^2/g)	Pore Volume (cm/g)	Pore Diameter (nm)
$MgWO_4$ nanoparticles	10.46	0.03	13.03
$MgWO_4$ nanoplates	14.05	0.04	12.254