

Ag₃PO₄/UiO-66-NH₂@PET for light-responsive desorption toward sulfamethoxazole

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MATERIALS AND METHODS

Chemicals.

Silver nitrate (AgNO₃, purity ≥ 99 %), 2-aminoterephthalic acid (H₂BDC-NH₂, purity ≥ 99 %), Zirconium (IV) and chloride (ZrCl₄, purity ≥ 99%) and sulfamethoxazole (SMX) were brought from J&K company. Dimethylformamide (DMF), acetic acid and methanol (MeOH) (purity ≥ 99.5 %) were obtained from Tianjin Fu Chen Chemical Co., Ltd. (China). Both sides of the PET plastic bottle were roughened with 1000 measure sandpaper before cutting into slices. Then the polished PET plastic was washed twice with tap water and deionized water, respectively, and then put in the oven at 60 °C to dry. PET plastic slices (1 cm × 1 cm) are obtained by cutting recycled mineral water bottles (Aikua) with scissors. All chemicals were directly used without further purification.

Characterization

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The powder X-ray diffraction (PXRD) patterns were recorded on a Dandonghaoyuan DX-2700B X-ray diffractometer in the range of $2\theta = 5^\circ$ - 50° with Cu K α radiation. Fourier transform infrared spectra (FT-IR) were measured by a Nicolet 6700 infrared spectrophotometer. The morphologies were determined by a Hitachi SU8020 scanning electron microscopy (SEM), JEM 1200EX transmission electron microscopy (TEM) and TecnaiG2 F20 high resolution transmission electron microscope (HRTEM). The X-ray photoelectron spectra (XPS) was observed using a ThermoFisher Escalab 250XI electron spectrometer with Al K α radiations. The concentration of SMX were analyzed by LC-20A, Shimadzu, Japan.

Synthesis of UiO-66-NH₂@ PET.

0.83 g H₂BDC-NH₂, 6 g PET plastic slices, 40 mL DMF and 17 mL acetic acid were added to the 250.0 mL round-bottom flask. The flask was placed in a microwave reactor at 6 stages, which was subjected to conduct microwave reaction at 650 W for 30 min, then cooled to room temperature. The faint yellow compound PET@UiO-66-NH₂ was washed three times with MeOH. At last, the UiO-66-NH₂@PET was dried for 12 h at 60 °C.

Synthesis of PAU-X.

1 g as-prepared PET@UiO-66-NH₂ and 50 mL deionized water were added to the petri dish. Then, 0.1 g of AgNO₃ was added to the petri dish. PET@UiO-66-NH₂ was soaked in this solution for 12 hours under dark. After that, 10 mL of Na₂HPO₄·12H₂O aqueous solutions with different concentrations (0.3, 0.7, 1.4, 2.1, 4.2, 7.0 g/L) were added to each petri dish, stirred for 5 min, and then left it in dark for 12 hours. Finally, the as-obtained PAU-1(0.3 g/L), PAU-2 (0.7 g/L), PAU-3 (1.4 g/L), PAU-4 (2.1 g/L), PAU-5 (4.2 g/L), PAU-6 (7.0 g/L) were dried for 12 h at 60 °C under dark conditions.

Adsorption-desorption experiment

The light-responsive adsorption-desorption activities of PAU-X toward SMX were carried out at 25 °C in a 60 mL quartz reactor containing 50.0 mL SMX (10 ppm) aqueous solution suspended with 1.0 g PAU-X slices. After being stirred for 60 min to achieve adsorption-desorption equilibrium in the dark, the suspensions were irradiated by a 350 mW LED lamp (PCX50A, Beijing Perfect Light Technology Co., Ltd) to provide visible light with wavelength longer than 420 nm. During the adsorption-desorption process triggered by visible light, the samples were collected at regular time intervals using a 0.22 μm syringe filter for LC (LC-20A, Shimadzu, Japan) analysis.

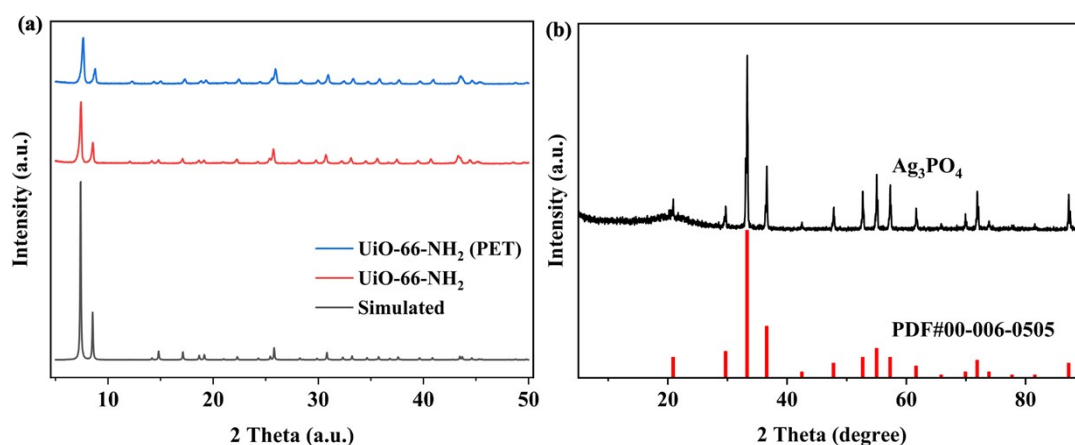


Fig.S1 The PXRD patterns of powder (a) UiO-66-NH₂ and (b) Ag₃PO₄.

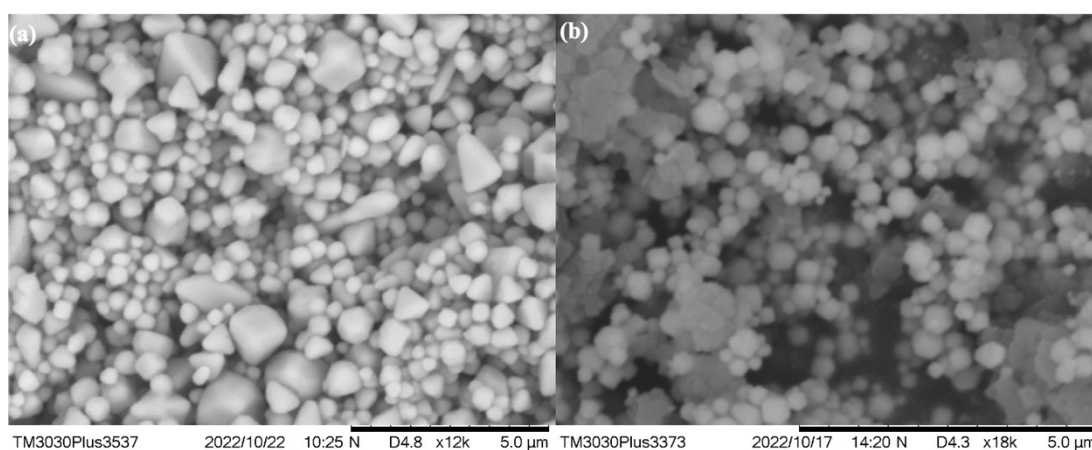


Fig.S2 SEM of pure Ag₃PO₄ and the associated Ag₃PO₄ powder during the synthesis of PAU-2.

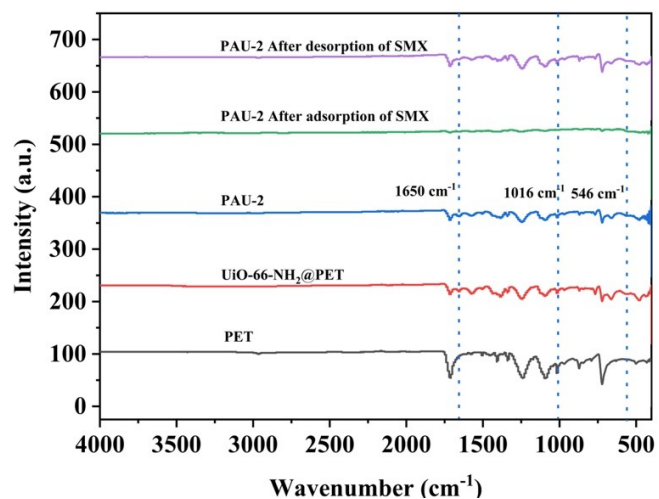


Fig.S3 The FT-IR spectra of PET, PET@UiO-66-NH₂, PAU-2, PAU-2 after adsorption of SMX and PAU-2 after desorption of SMX.

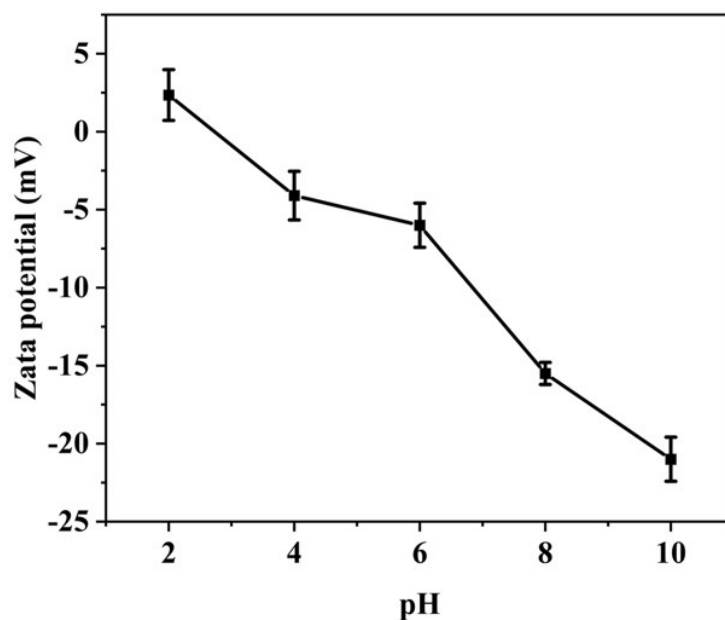


Fig. S4 The zeta potential of Ag₃PO₄ at different pH.

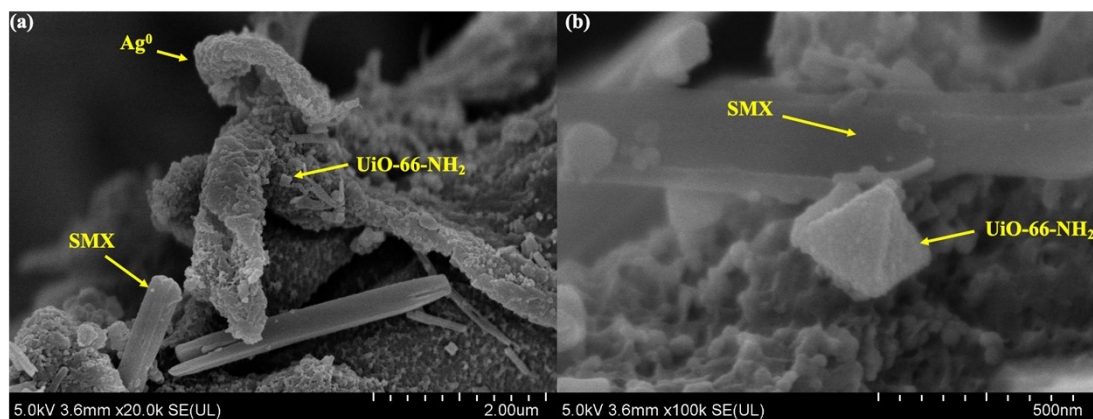


Fig. S5 The SEM images of PAU-2 after light-responsive desorption of SMX.

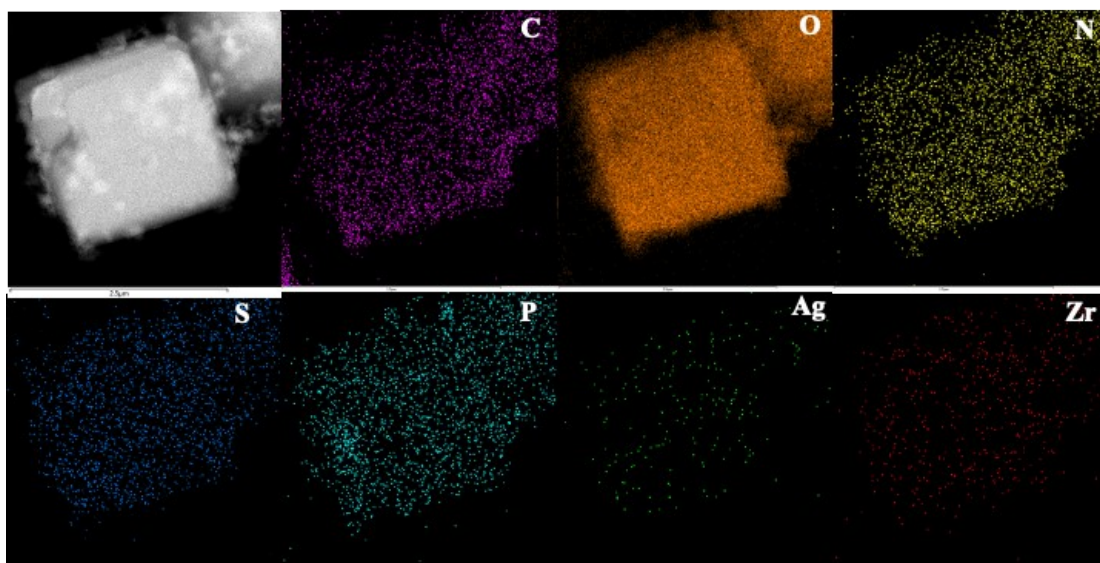


Fig. S6 The HRTEM-EDS elemental mappings of PAU-2 after light-responsive desorption of SMX.

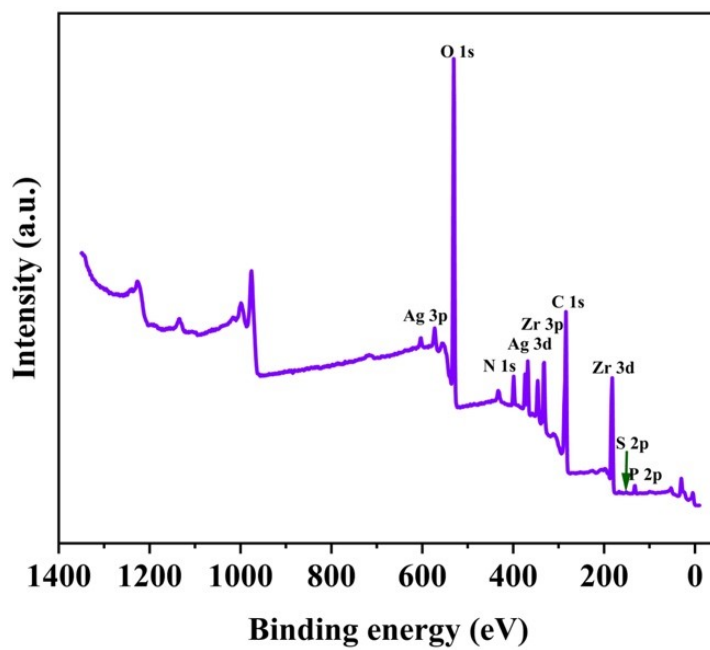


Fig. S7 XPS survey spectra of PAU-2 after light-responsive desorption of SMX.