

Supporting Information for:

Facile synthesis of free-standing Ag@AgCl film for high performance photocatalyst and photodetector

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Experimental Section

Formation of AgCl films: A clear aqueous solution was prepared in a container at room temperature, which contained silver nitrate (130 mg), poly (vinyl pyrrolidone) (PVP-K30, molecular weight: 40,000) (16 mg), sodium chloride (100 mg), and ammonium hydroxide (1.48 M). All chemicals in the study were of analytical grade used as received without further purification. The solution was covered by a watch glass, and then heated to 80 °C in a water bath. It remained clear throughout the heating process. After 10 minutes, the watch glass was removed allowing the solution to be exposed to the atmosphere for another 10 minutes. A translucent thin film formed almost instantaneously covering the entire surface of the solution. Then, the film was transferred onto a piece of glass for further characterization.

Characterization of the AgCl film: The SEM images were taken with a XL30 field-emission scanning electron microscope at an accelerating voltage of 15 kV. XRD patterns were collected by a D8 ADVANCE (Germany) with Cu K α radiation ($\lambda=1.54056$ Å) in the range of 20-80° (2 θ). XPS analysis was carried on an

ESCALAB-MKII X-ray photoelectron spectrometer. UV-vis diffuse reflectance spectra were obtained with a Shimadzu UV-3600 spectrophotometer.

Evaluation of Photocatalytic Activity: The obtained AgCl film was dispersed in MO dye solution, which was first irradiated with a 500 W Xenon lamp equipped with an ultraviolet cutoff filter to provide visible light with $\lambda \geq 400$ nm. The resulting Ag@AgCl power was washed and dried in air. Photocatalytic degradation of MO dye was then carried out with 0.01 g of the powdered photocatalyst suspended in 10 mL of MO dye solution prepared by dissolving 5 mg of MO powder in 500 mL of distilled water in a homemade quartz photochemical reactor at room temperature under air. Before light irradiation, the mixture was first sonicated for 5 min and then kept in the dark for 30 min with stirring to reach the adsorption-desorption equilibrium. The optical system for detecting the catalytic reaction included a 500 W Xenon lamp (CHFXQ500W) with a UV cutoff filter (providing visible light with $\lambda \geq 400$ nm). At the given time intervals, analytical samples were taken from the suspension and immediately centrifuged at 13000 rpm for 1min. The concentration analysis of MO was determined by using a Cary 50 UV-Vis-NIR spectrophotometer (Varian, USA). We also investigated the MO degradation of Ag/AgCl film under dark (shown in Fig. S7), confirming that 30 min stirring is enough for achieving adsorption-desorption equilibrium.

Construction of AgCl film-Based Nanodevice: AgCl-based visible photodetector was constructed using ITO as the interdigital electrodes which were fabricated through standard photolithography and etching. The ITO substrate was immersed into

the water and was withdrawn at a certain angle at a slow speed. Then the AgCl film was transferred onto the surface of the interdigital electrodes and the as-prepared device was kept in air at 60 °C until all water was evaporated. Before measuring the I–V characteristics of AgCl film-based nanodevice through a CHI 832C electrochemical workstation (Chenhua Co., Shanghai), the obtained AgCl film were first irradiated with a 500W Xenon lamp equipped with an ultraviolet cutoff filter to provide visible light with $\lambda \geq 400$ nm to form the Ag@AgCl film.

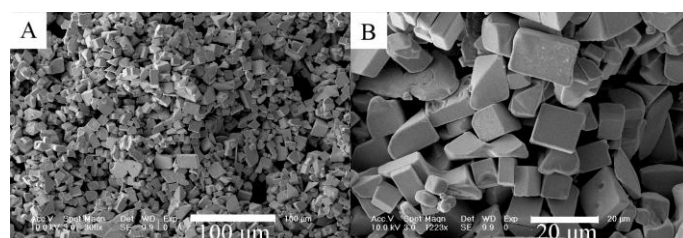


Fig. S1 (A) Low resolution and (B) high resolution of SEM images of the as-prepared AgCl.

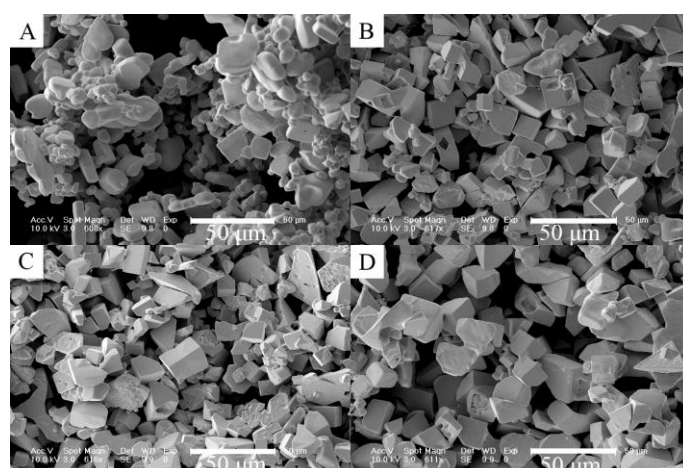


Fig. S2 The typical SEM of the as-prepared AgCl with different addition amount of PVP: 0 g (A), 0.260 g (B), 0.520 g (C) and 0.780 g (D), respectively.

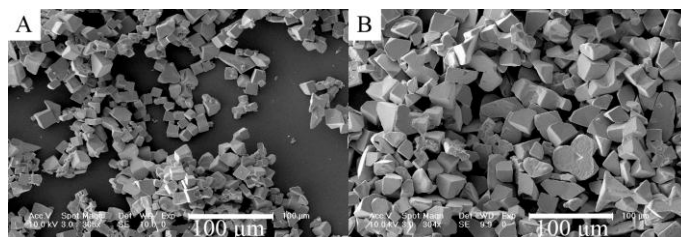


Fig. S3 The typical SEM of the as-prepared AgCl with different addition amount of AgNO₃: 0.130 g (A) and 0.390 g (B), respectively.

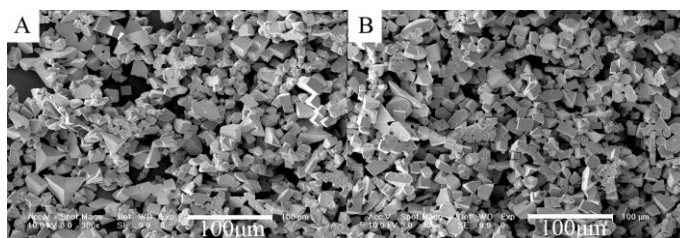


Fig. S4 The typical SEM of the as-prepared AgCl with different growth time: 60 min (A) and 120 min (B), respectively.

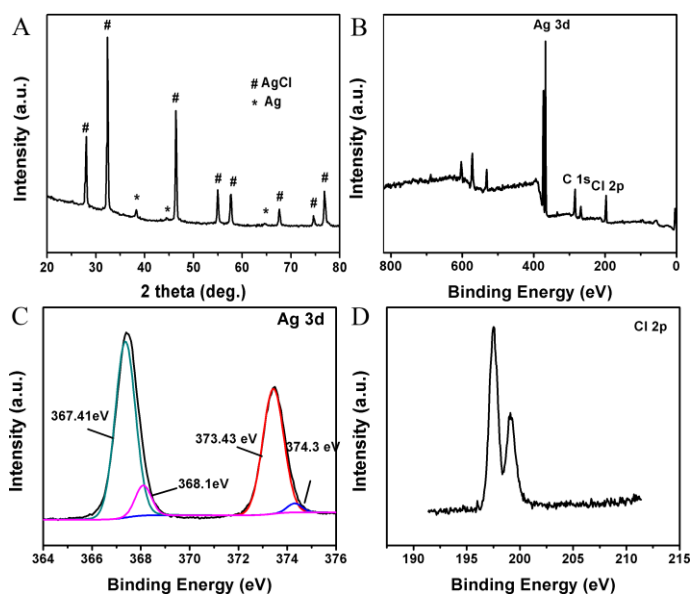


Fig. S5 (A) The XRD pattern of the as-prepared Ag@AgCl film. (B) The survey XPS spectrum of the as-prepared Ag@AgCl film. (C) Ag 3d and (D) Cl 2p XPS spectra.

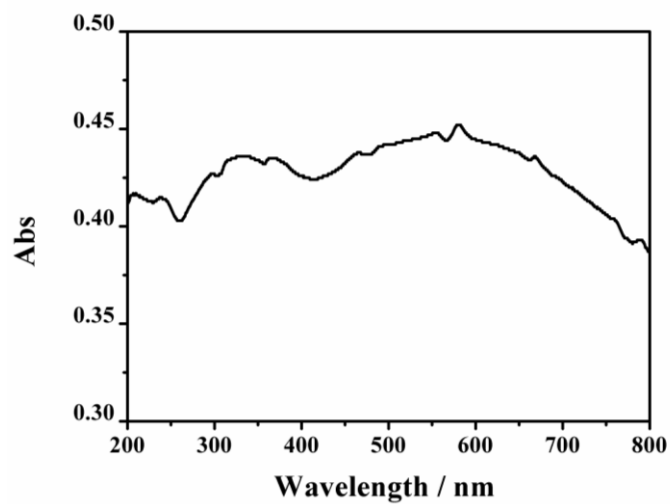


Fig. S6 A UV-visible diffuse reflectance spectrum of the as-prepared Ag@AgCl sample.

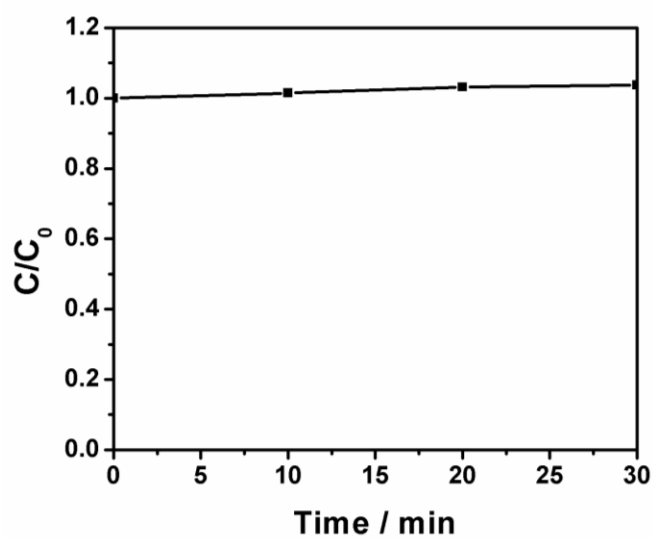


Fig. S7 The MO degradation results of Ag/AgCl film under dark.

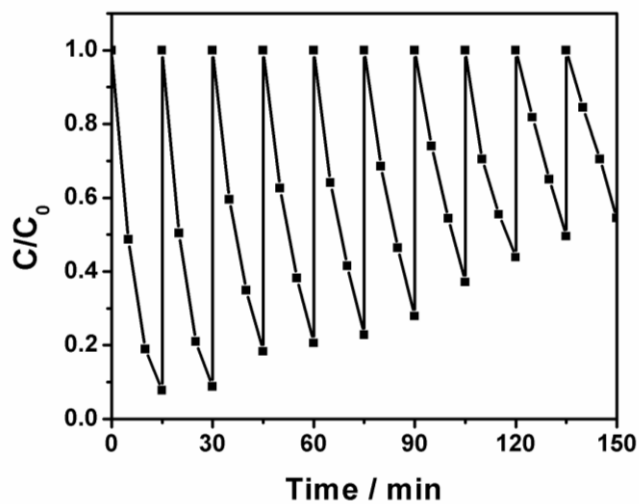


Fig. S8 Ten cycling experiment results of the as-prepared Ag@AgCl sample.

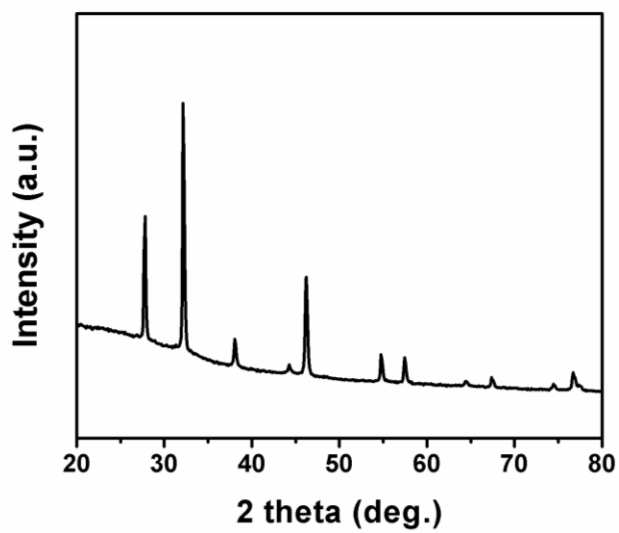


Fig. S9 The XRD pattern of the as-prepared Ag@AgCl sample after ten cycling experiment results

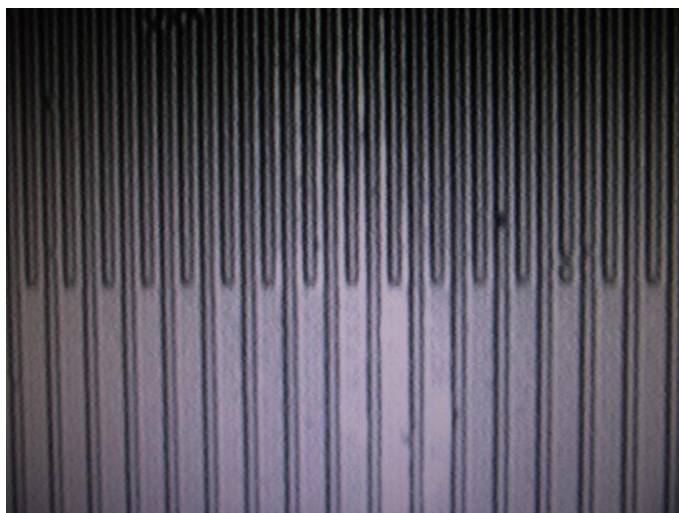


Fig. S10 Photograph of the as-prepared the interdigital ITO electrodes.

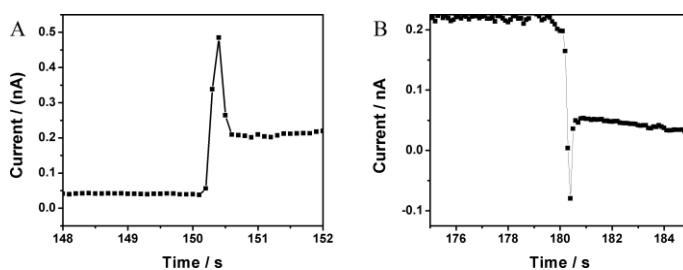


Fig. S11 The enlarged spectra of (A) 148-152 s (from light-off to light-on state) and (B) 175-185 s range (from light-on to light-off state) showing the fast decay times upon 455 nm light illumination.