Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Supporting Information Available

Facile in-situ synthesis of Bi/BiOCl nanocomposite with high photocatalytic activity

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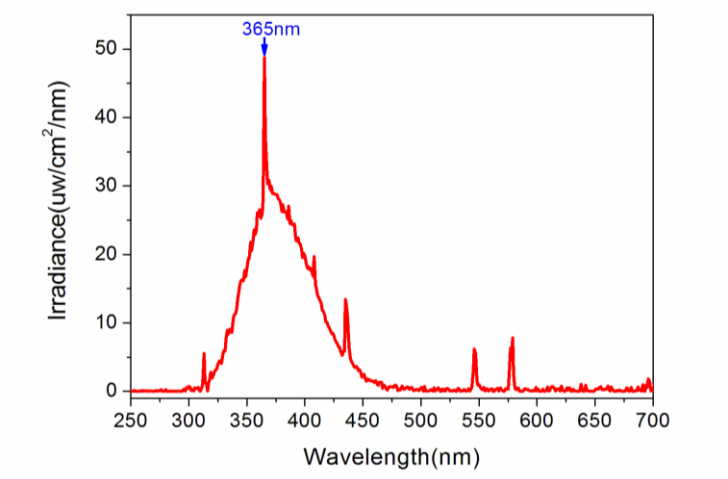

Fig.S1. Irradiance spectra of the UV lamp

The light intensities at different wavelengths were measured on a UV meter (International Light Technologies Model ILT950). The distance between the photodetector and the bulb is ~3 cm. The result suggests that the predominant wavelength of the lamps used in our experiment is at 365 nm. Moreover, the lamps were considered to emit a wideband wavelength, including ultraviolet and visible light.

Fig.S2. The photo of (a) BiOCl and (b) 5min-Bi/BiOCl

It is found that the colour of BiOCl become grey under UV irradiation with $(NH_4)_2C_2O_4$.

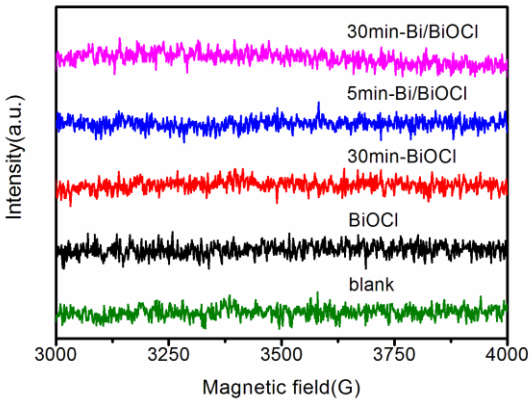

Fig.S3. ESR spectra of BiOCl, 30min-BiOCl, 5min-Bi/BiOCl, and 30min-Bi/BiOCl

No ESR signal is observed in Fig. S3, which indicates that there is no oxygen vacancies in all samples.

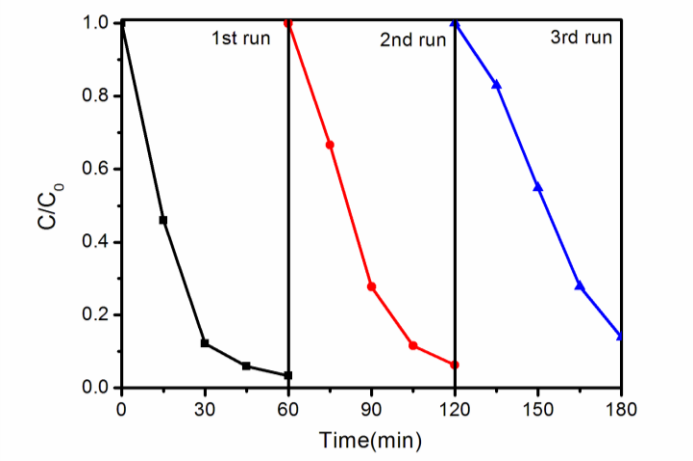

Fig.S4. Recycling test for the photocatalytic degradation of MO on 5min-Bi/BiOCl under UV light irradiation (365nm)

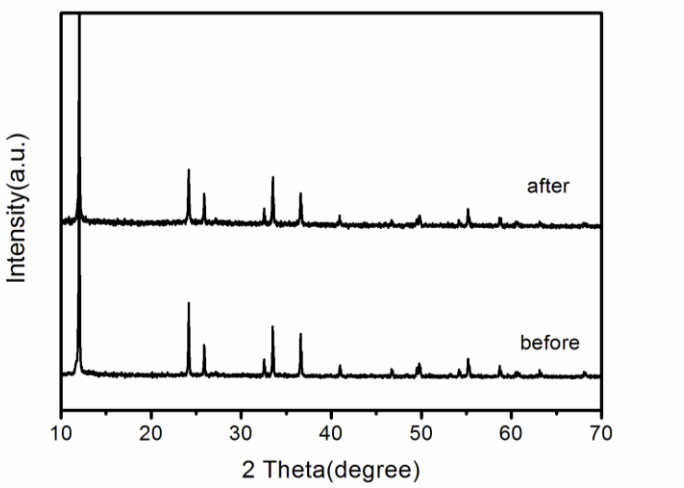

Fig.S5. XRD patterns of the 5min-Bi/BiOCl before and after three recycles for the photodegradation of MO

The stability of the 5min-Bi/BiOCl composite is evaluated through the recycle of the used catalyst. For each cycle, catalyst was collected by centrifugation. It was found that the photocatalytic activity of 5min-Bi/BiOCl did not exhibit significant loss after three recycles for the photodegradation of MO, as shown in Fig. S4. The used 5min-Bi/BiOCl is also examined by XRD, and there is no detectable difference between the as-prepared and used samples (see Fig.S5). Thus, it is supposed that the amount of metal Bi may increase rarely in the photocatalytic reactions after three consecutive reaction cycles.

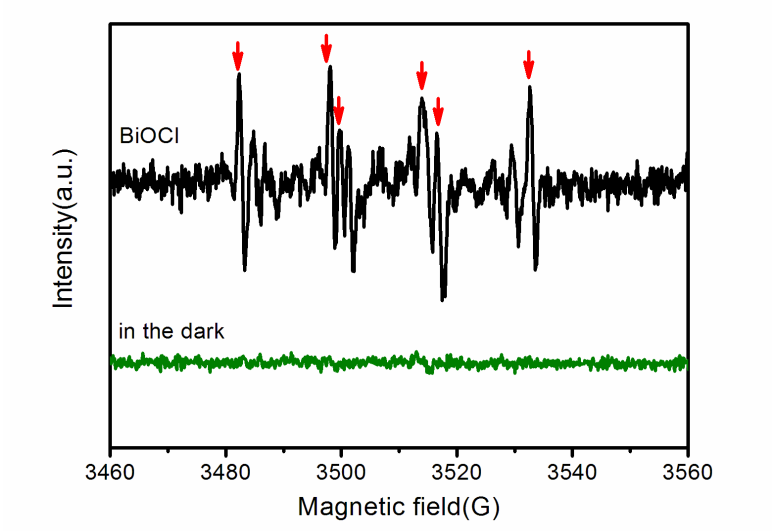

Fig.S6. DMPO spin-trapping ESR spectra of BiOCl aqueous suspension in the presence of hole scavenger ($(NH_4)_2C_2O_4$) under UV irradiation for DMPO-CO_2-• radical species

The DMPO-CO2-• radical species were generated from BiOCl aqueous suspension (20 mg of BiOCl dispersed in 0.5 mL of ultrapure water) in the presence of 5 mg of hole scavenger and 15 mM DMPO under UV light irradiation by a 300 W xenon lamp (PLS-SXE300C, Beijing Perfect Light Co) with a 365 nm ±15 nm filter. Prior to the experiment, the ultrapure water (resistivity, 14.2 MΩ•cm @ 25 ℃) was further purified by active carbon (Alfa Aesar co., 2 mm & down).As shown in Fig.S6 sextet characteristic peaks of the DMPO-CO_2-• radical species have been clearly observed only in the presence of sample BiOCl and $(NH_4)_2C_2O_4$ under UV light irradiation.[1, 2] This indicates that $(NH_4)_2C_2O$ not only serves as a hole scavenger, but also can produce active species (CO_2-• radicals) in the present system ($C_2O_4^{2-} + h^+ == CO_2 + CO_2^{-}$•). The CO_2^{-}• species have a strong reductive ability (CO_2/ CO_2^{-}•,-2.2 V vs. SCE)[3] and hence can reduce BiOCl to Bi.

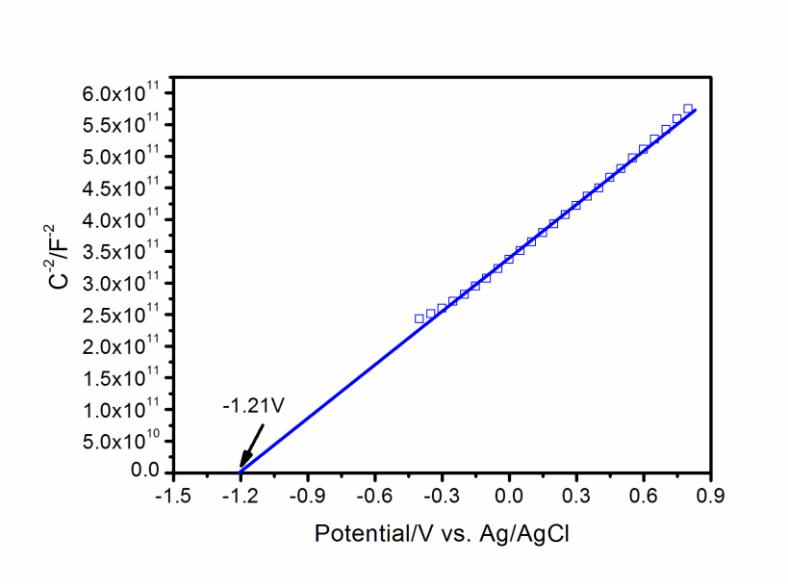

Fig.S7. Mott-Schottky plot for the 5min-Bi/BiOCl in 0.2 M Na_2SO_4 aqueous solution (pH = 6.8)

The flatband potential (V_{fb}) of 5min-Bi/BiOCl obtained by extrapolation of the Mott-Schottky plot approximately equals -1.21 V vs Ag/AgCl, -1.01 V vs standard hydrogen electrode(SHE). Notably, compared to BiOCl, a positive shift of V_{fb} in 5min-Bi/BiOCl demonstrated a decrease in bending of the band edge, thereby facilitating the electron transfer.[4]

Note: In Figure 13, some weak ESR signals are observed in the dark due to the stale DMPO.

References

1. F. A. Villamena, E. J. Locigno, A. Rockenbauer, C. M. Hadad and J. L. Zweier, *J. Phys. Chem. A*, 2006, **110**, 13253-13258.
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3. M.-M. Chang, T. Saji and A. J. Bard, *Journal of the American Chemical Society*, 1977, **99**, 5399-5403.
4. M. Ye, J. Gong, Y. Lai, C. Lin and Z. Lin, *J. Am. Chem. Soc.*, 2012, **134**, 15720-15723.