

Supporting Information

**Aqueous dispersed bismuth-ablated species and their capability  
of serving as colloidal Bi precursors in synthetic strategies**

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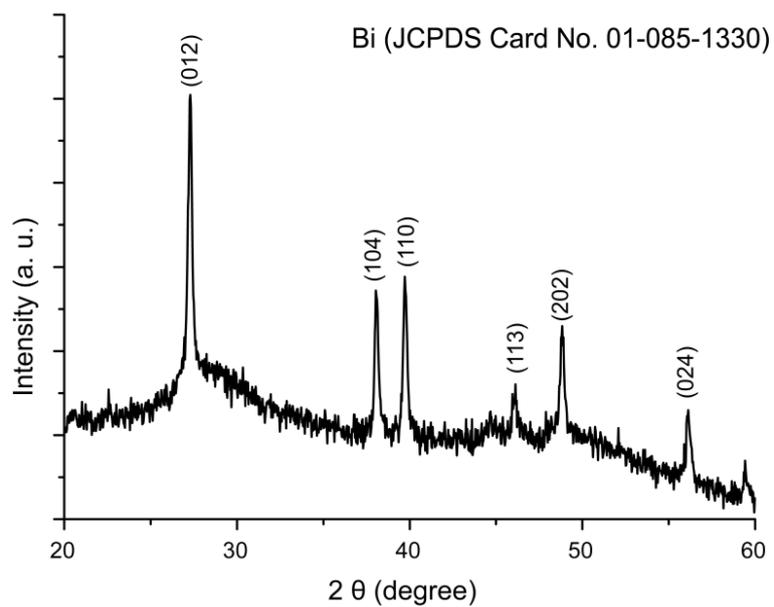
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Hefei Institutes of Physical Science, Chinese Academy of Sciences

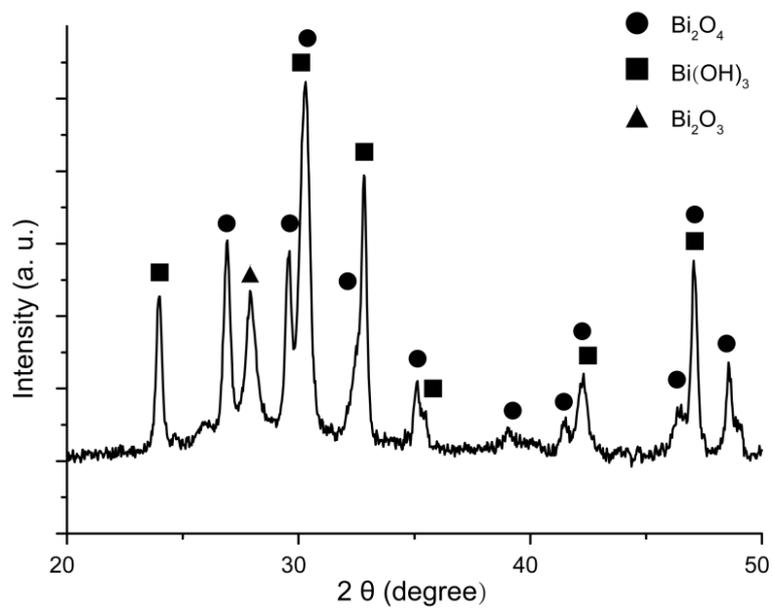
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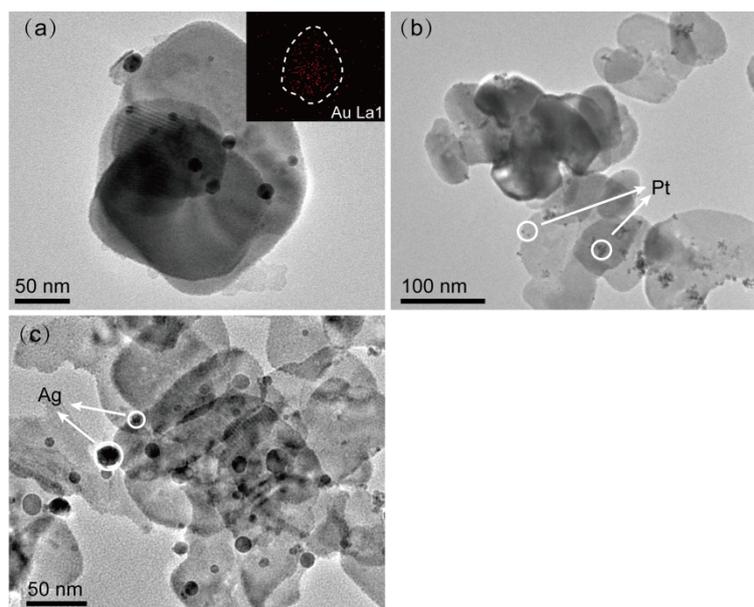
E-mail address: [chliang@issp.ac.cn](mailto:chliang@issp.ac.cn) (C. H. Liang).



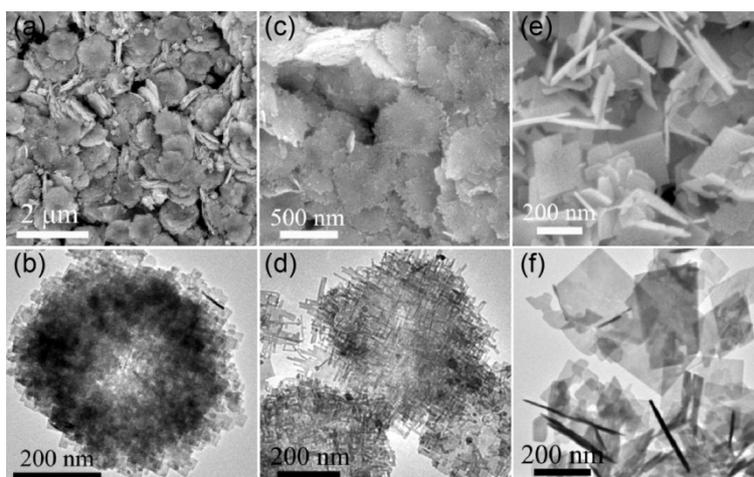
**Figure S1** XRD pattern of LAL-generated bismuth colloidal species in DI water ( $\sim 4$  °C).



**Figure S2** XRD pattern of as-prepared Bi-ablated colloidal species treated by UV irradiation.



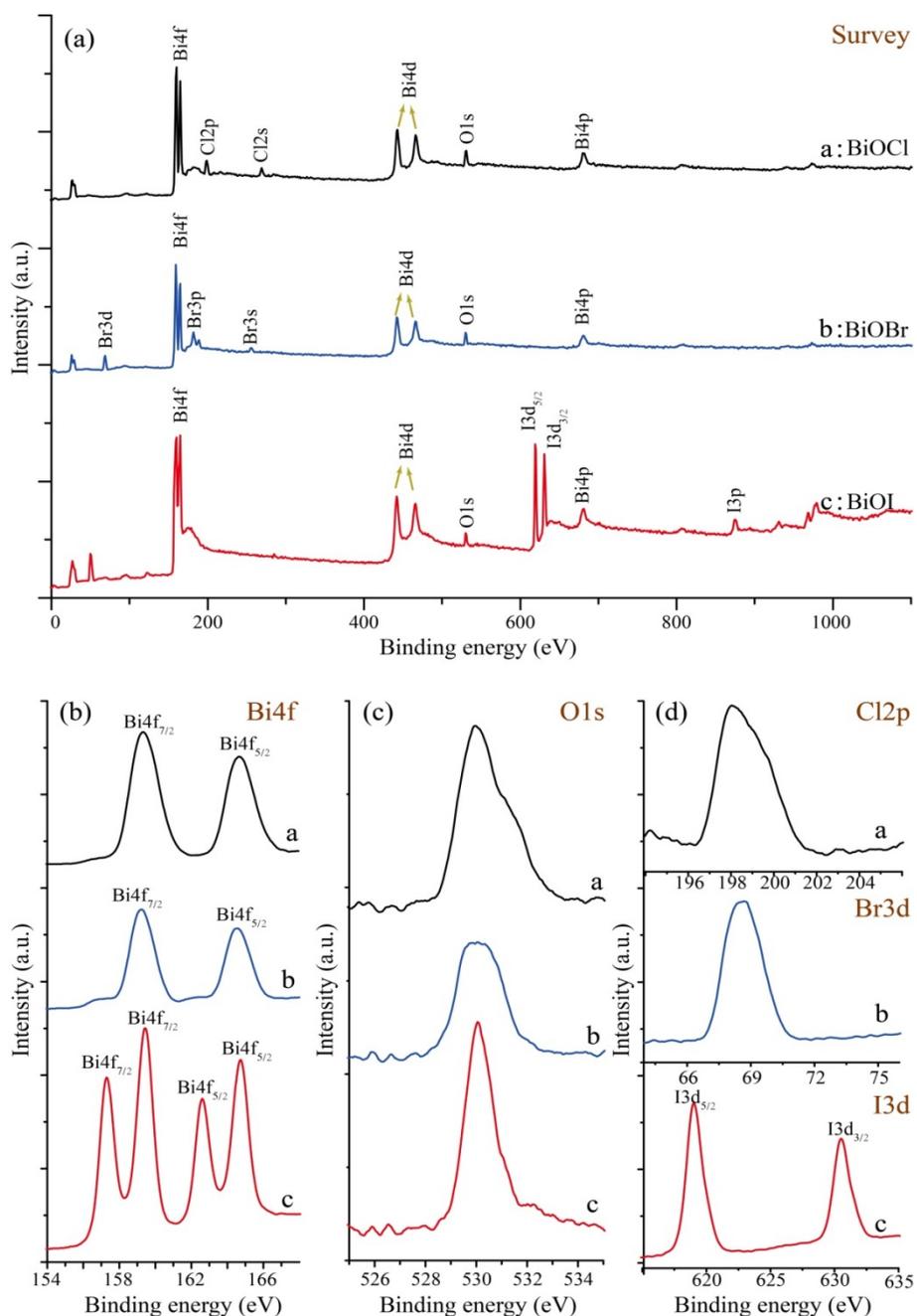
**Figure S3** TEM images of Au modified BiOCl (a), Pt modified BiOCl (b) and Ag modified BiOCl (c).



**Figure S4** SEM and TEM images of  $\text{Bi}_2\text{WO}_6$  synthesized by species-by-species reaction at different pH values of 2.0 (a), (b), 7.0 (c), (d) and 11.0 (e), (f).

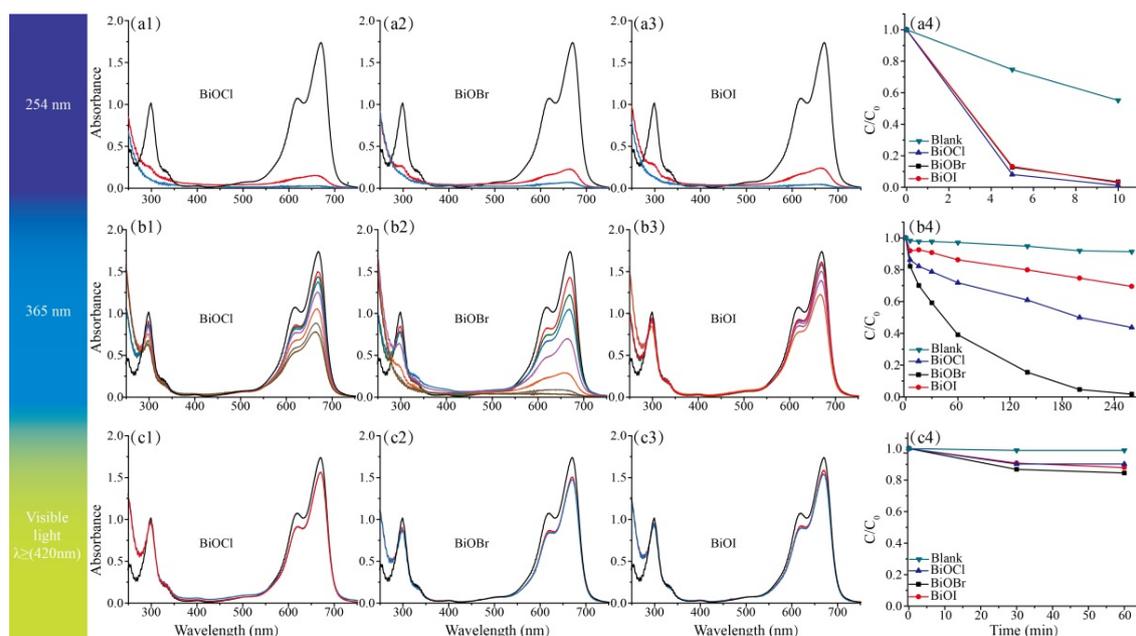
The surface element composition of  $\text{BiOX}$  ( $X = \text{Cl}, \text{Br}, \text{I}$ ) samples were studied by X-ray photoelectron spectroscopy (XPS; Thermo ESCALB 250). The XPS survey spectrum (Figure S5a) revealed the existence of Bi, O and Cl elements in BiOCl sample, Bi, O and Br elements in BiOBr sample and Bi, O and I elements in BiOI sample. As for the high-resolutions of O1s (Figure S5c, curve a-c), Cl2p (Figure S5d, curve a), Br3d (Figure S5d, curve b) and I3d (Figure S5d, curve d) XPS spectrum, the peaks are good agreement with those in BiOCl, BiOBr and BiOI. Two strong peaks at 159.5 eV, 164.8 eV in the high-resolution spectrums of Bi 4f (Figure S5b) are

attributed to  $\text{Bi}4f_{7/2}$  and  $\text{Bi}4f_{5/2}$ , respectively, which are characteristic of  $\text{Bi}^{3+}$  in  $\text{BiOX}$ . However, there are another two obvious peaks with a distance of 2.2 eV (157.3 eV, 162.6 eV) between  $\text{Bi}4f_{7/2}$  and  $\text{Bi}4f_{5/2}$  in Figure S5b, curve c, which are characteristic of metal Bi. Compared to Cl<sup>-</sup> and Br<sup>-</sup> ions, the reducibility of I<sup>-</sup> ions will impede the evolution from bismuth nanoparticles to  $\text{BiOI}$  nanosheets.



**Figure S5** XPS spectra of  $\text{BiOCl}$  powder (curve a),  $\text{BiOBr}$  powder (curve b) and  $\text{BiOI}$  powder: (a) survey spectrum, (b)  $\text{Bi}4f$ , (c)  $\text{O}1s$  and (d)  $\text{Cl}2p$ ,  $\text{Br}3d$ ,  $\text{I}3d$ .

### Photocatalytic activity assessment of $\text{BiOCl}$ , $\text{BiOBr}$ and $\text{BiOI}$ .



**Figure S6** Photocatalytic degradation of MB in the presence of BiOCl, BiOBr and BiOI, and photolysis of MB. (a1-a4) Under 254nm UV-visible light irradiation, (b1-b4) under 365nm UV-visible light irradiation and (c1-c4) under visible light irradiation.

Figure S6 represents the UV-vis absorption spectrums and the variation of MB concentration ( $C/C_0$ ) with irradiation time over different BiOX ( $X = \text{Cl}, \text{Br}, \text{I}$ ) catalysts under UV-visible and visible irradiation. As Figure S6-a4 showing, MB can spontaneously decompose under 254 nm UV light irradiation. In this study, about 45% of MB has been decomposed after irradiated by 254 nm UV light for 10 minutes without using any catalyst. When BiOCl, BiOBr or BiOI were added to MB solution, the degradation processes of MB were greatly accelerated, and more than 99%, 96% and 97% MB can be decomposed in 10 minutes. The photocatalytic activity of BiOCl seems a little better than BiOBr or BiOI under 254 nm UV-visible light irradiation. Interestingly, the spontaneous decomposition behavior of MB will become much weaker with the irradiation of 365 nm UV light. About 91% of MB still existed in the solution after 260 minutes irradiation. As Figure S6-b4 showing, BiOBr has the best photocatalytic activity under 365 nm UV light irradiation and can degrade 98% of MB in 260 minutes. Meanwhile, BiOCl and BiOI could only degrade 56%, 30% of MB within the same time. However, the visible light induced photocatalytic activity of BiOCl, BiOBr and BiOI were not obvious as Figure S6- c4 displaying.