

## **Heterostructural design of I-deficient BiOI for photocatalytic decoloration and catalytic CO<sub>2</sub> conversion**

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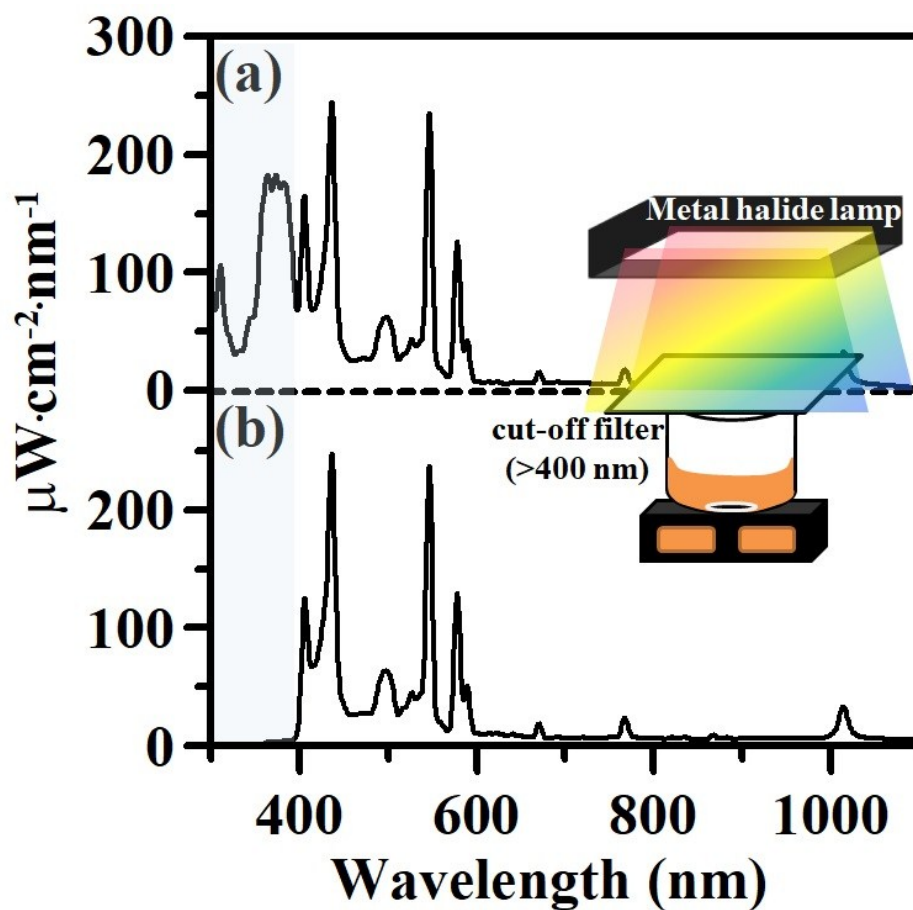
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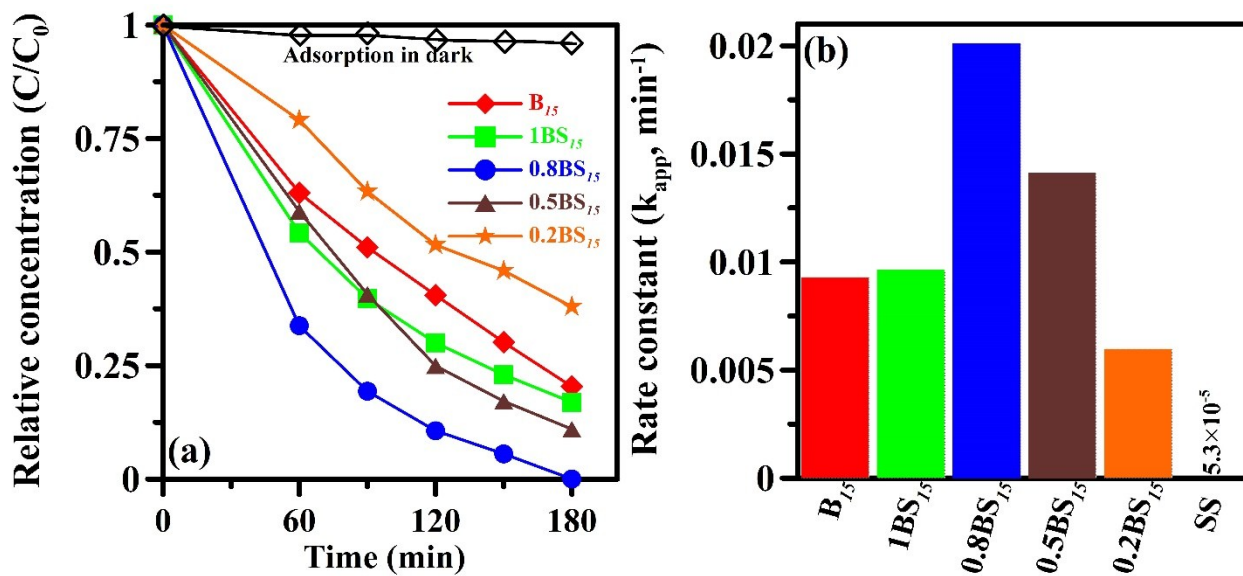
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**Table S1** XRD intensity ratios of  $B_{15}$ ,  $1BS_{15}$ ,  $0.8BS_{15}$ ,  $0.5BS_{15}$ ,  $0.2BS_{15}$  and SS samples.

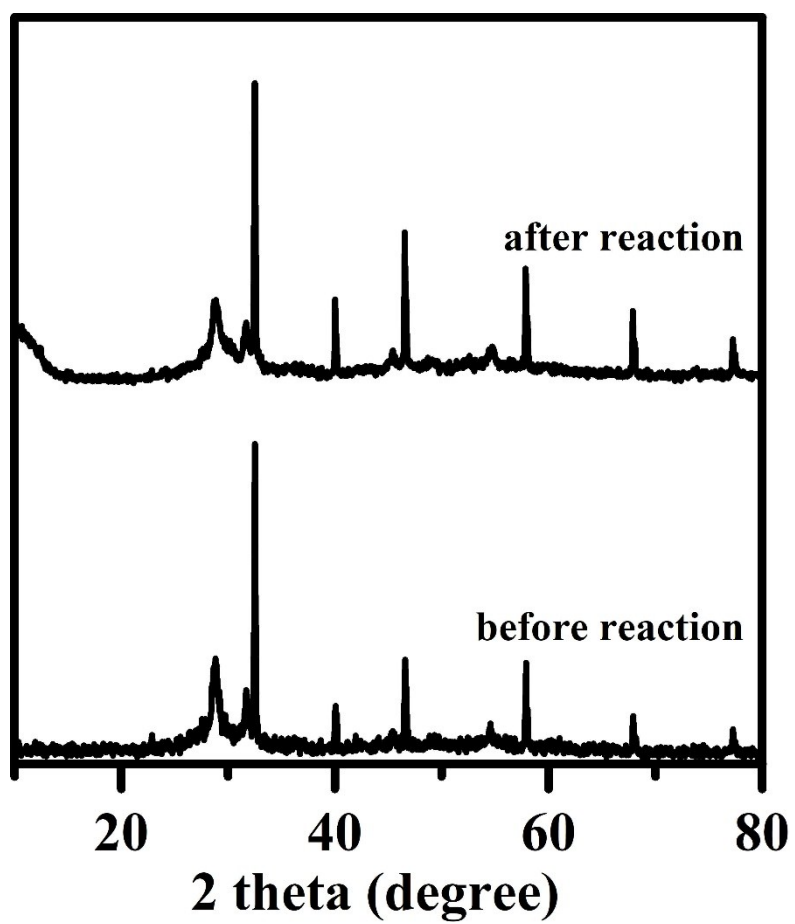
$I_{\text{BiOI}(012)}/I_{\text{SrTiO}_3(110)}$	
$B_{15}$	
$1BS_{15}$	0.541
$0.8BS_{15}$	0.329
$0.5BS_{15}$	0.207
$0.2BS_{15}$	0.133
SS	0



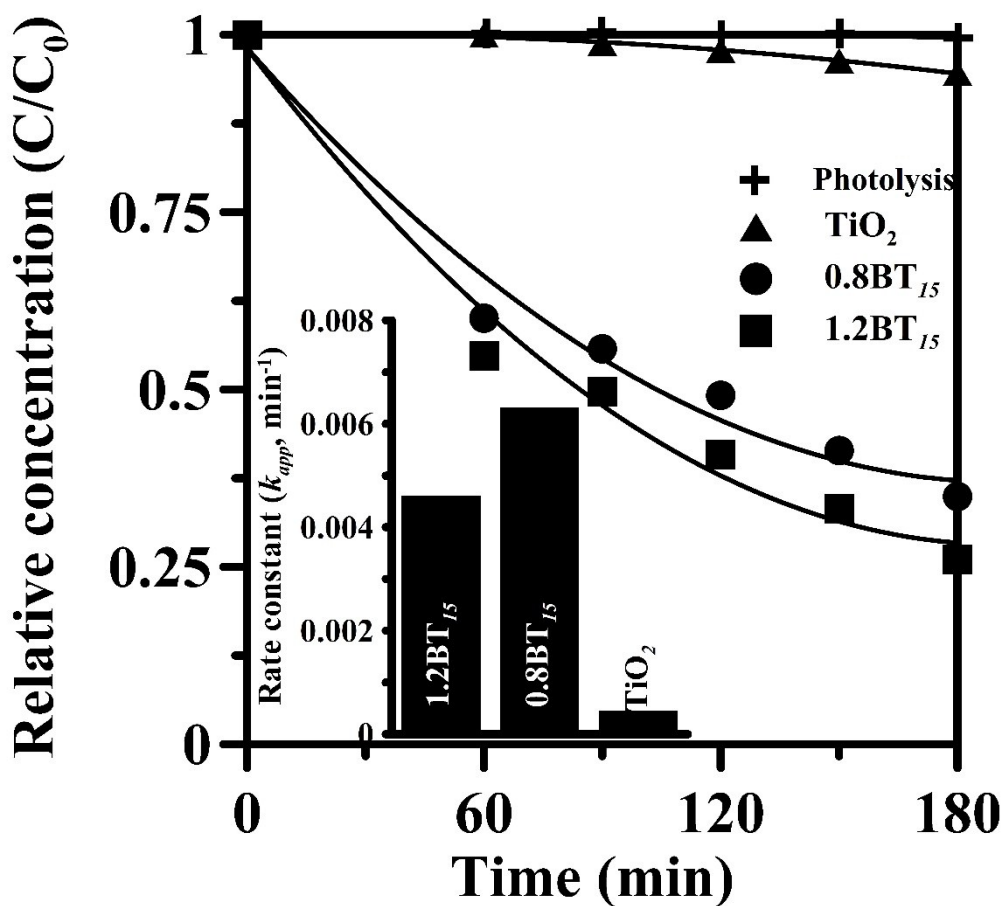
**Figure S1** Irradiance spectra of metal halide lamp: (a) without optical cut-off filter; (b) with optical cut-off filter ( $\lambda > 400$  nm). Inset shows a schematic diagram of the photocatalytic reactor irradiated with the metal halide lamp equipped with a cut-off filter.



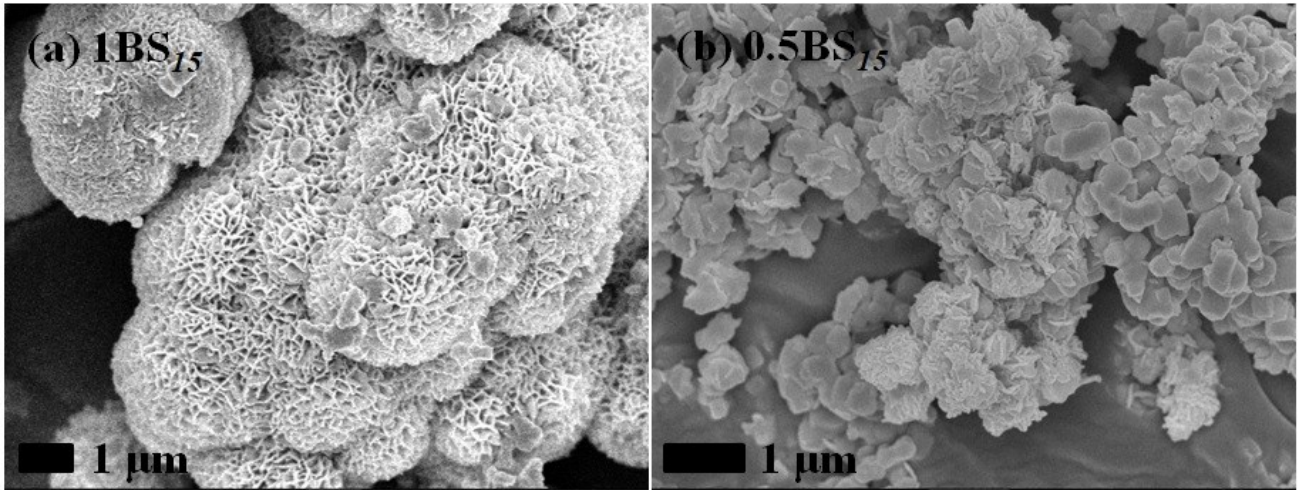
**Figure S2** (a) Photocatalytic MO degradation using  $B_{15}$ ,  $1BS_{15}$ ,  $0.8BS_{15}$ ,  $0.5BS_{15}$  and  $0.2BS_{15}$  samples under visible light irradiation ( $\lambda > 400$  nm), hollow diamond indicates the MO adsorption using  $B_{15}$  in dark; (b) apparent rate constants of photocatalytic MO degradation for these samples.



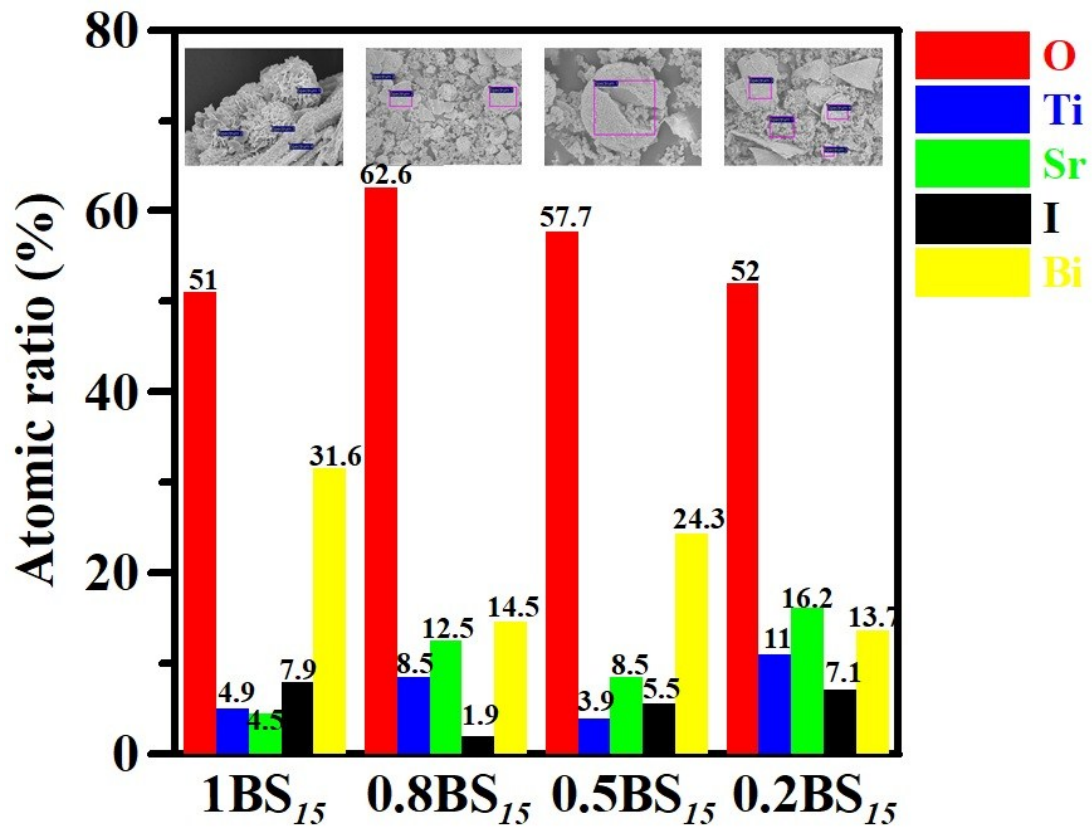
**Figure S3** XRD patterns of 0.8BS<sub>15</sub> samples before and after the photocatalytic reaction.



**Figure S4** Relative concentrations of pristine  $TiO_2$  and BiOI/ $TiO_2$  composites with molar ratios of 1.2:1, and 0.8:1 ( $1.2BT_{15}$  and  $0.8BT_{15}$ , respectively) against reaction time for photocatalytic degradation of aqueous methyl orange solutions under visible light irradiation. Inset shows the apparent rate constant of these reactions.

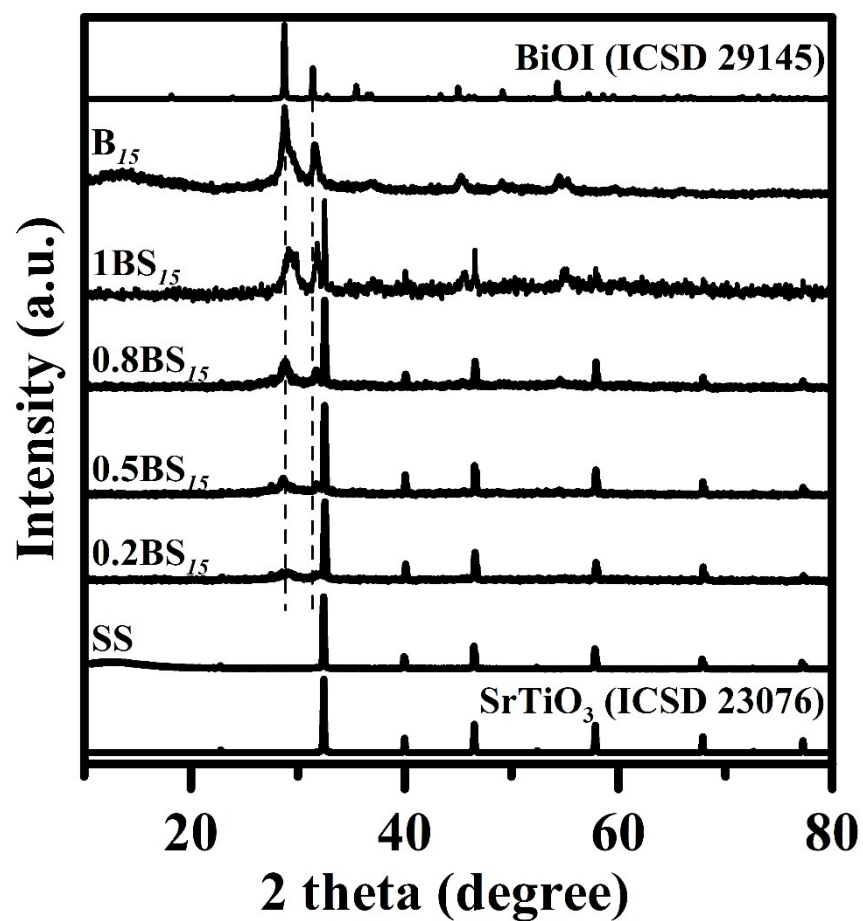


**Figure S5** SEM images of (a) 1BS<sub>15</sub> and (b) 0.5BS<sub>15</sub> samples.

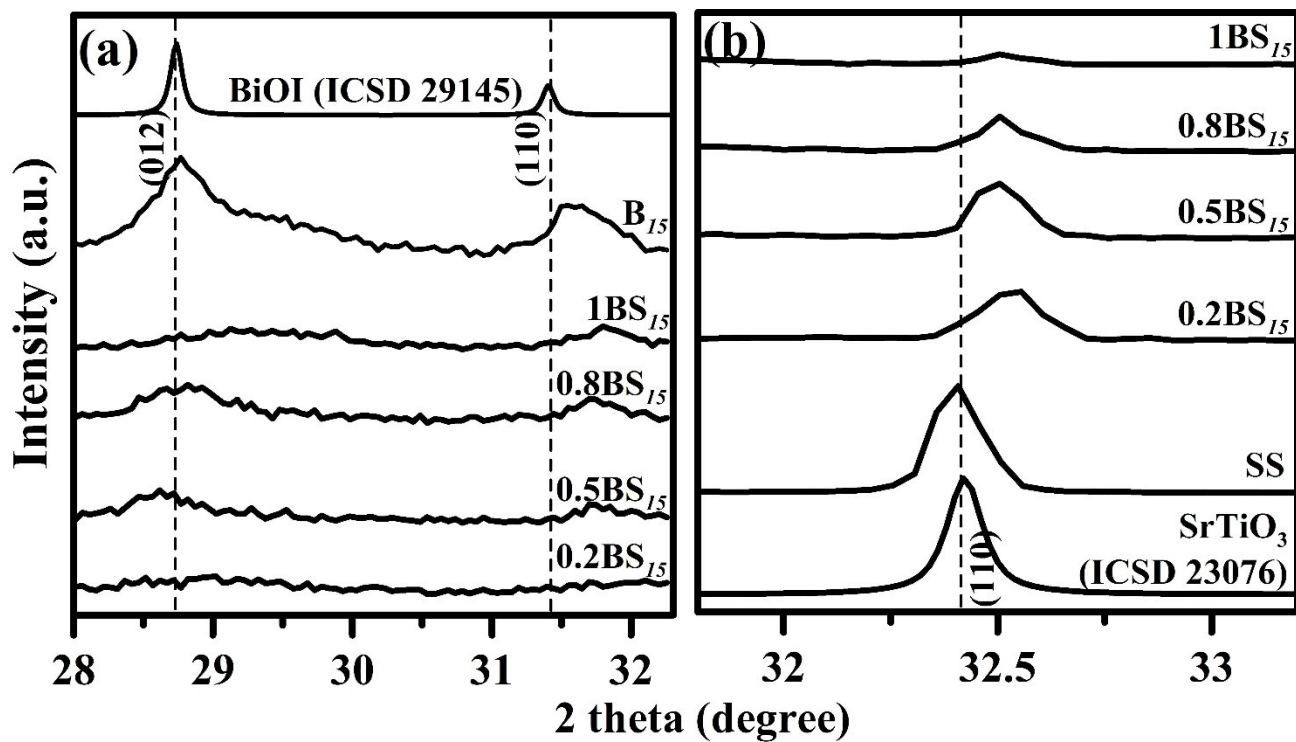


**Figure S6** Elemental analysis of 1BS<sub>15</sub>, 0.8 BS<sub>15</sub>, 0.5 BS<sub>15</sub>, and 0.2 BS<sub>15</sub> samples obtained from SEM-EDS. Insets show the corresponding zone of the SEM images.

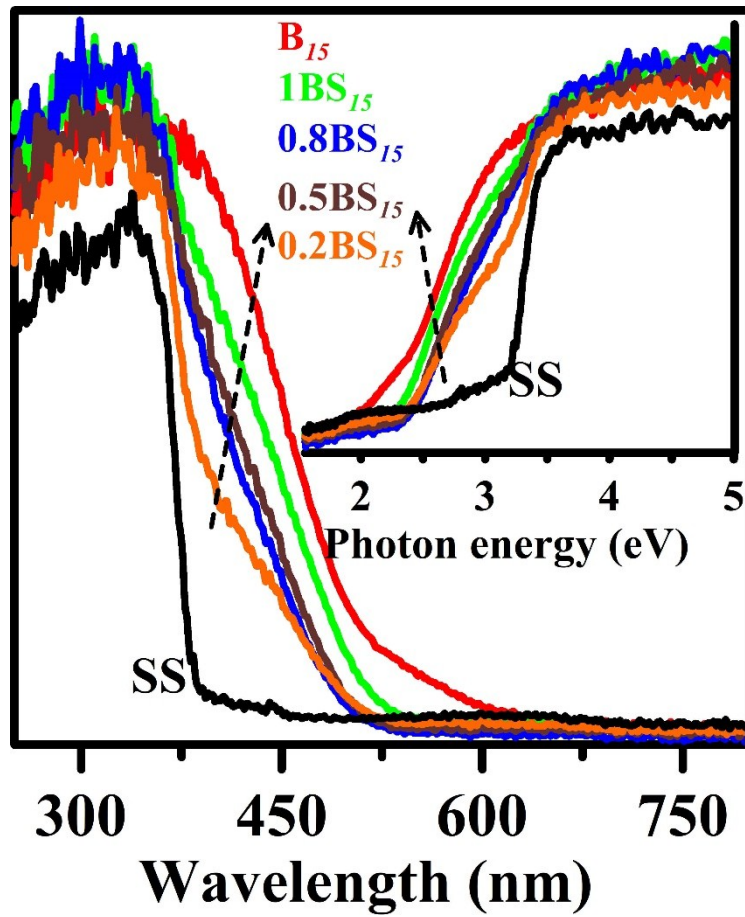




**Figure S7** XRD patterns of B<sub>15</sub>, 1BS<sub>15</sub>, 0.8 BS<sub>15</sub>, 0.5 BS<sub>15</sub>, 0.2 BS<sub>15</sub>, and SS samples. The standard XRD patterns of BiOI (ICSD 29145) and SrTiO<sub>3</sub> (ICSD 23076) are displayed at the top and bottom of the figure.



**Figure S8** Detailed inspection of XRD patterns of B<sub>15</sub>, 1BS<sub>15</sub>, 0.8 BS<sub>15</sub>, 0.5 BS<sub>15</sub>, 0.2 BS<sub>15</sub>, and SS samples; (a) shows 2-theta values from 28° to 32.3°; (b) shows 2-theta values from 31.8° to 33.2°.



**Figure S9** UV-Vis spectra of  $B_{15}$ ,  $1BS_{15}$ ,  $0.8BS_{15}$ ,  $0.5BS_{15}$ ,  $0.2BS_{15}$ , and SS samples. Inset of (a) shows the Tauc plot of these samples.