Supporting Information

Superior Photocatalytic Performance of Novel Bi₂SiO₅ Flower-like Microsphere via Phase Junction

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Supplementary information for confirmation of the phase composition of S-1.5

Firstly, it can be found from Fig. S2(A,a) that the sphere-like nanoparticles emerged in S-1 and can be attributed to the tetragonal Bi_2SiO_5 phase (JCPDS No. 36-0288) through the lattice identification. From observations of Fig. S2(B,b), it can be seen that the amount of sphere-like nanoparticles in S-1.5 was more than that of S-1. However, S-2 was found to contain only one phase of Bi_2SiO_5 (JCPDS No. 36-0287) along with the disappearance of the sphere-like nanoparticles. It suggests that the nanoparticles should belong to an intermediate and metastable phase.

Secondly, in the materials preparation part of this work, the hydrolysis of Na₂SiO₃ would make the solution alkaline. As previously reported, ^[1] under the basic reaction condition, OH⁻ may gradually replace Br⁻, resulting in the formation of O-rich/Br-poor bismuth oxybromides. If increasing addition of SiO₃²⁻, BiOBr may first evolve into Bi₄O₅Br₂ and Bi₂₄O₃₁Br₁₀ through OH⁻ substituting Br⁻. Only when the adding amount of SiO₃²⁻ is high enough, can bismuth oxybromides evolve into Bi₂SiO₅ through SiO₃²⁻ substituting Br⁻. The reaction process can be described as follows:

 $4BiOBr + 2OH^{-} \rightarrow Bi_4O_5Br_2 + 2Br^{-} + H_2O$

 $24BiOBr + 14OH^{-} \rightarrow Bi_{24}O_{31}Br_{10} + 14Br^{-} + 7H_2O$

 $6Bi_4O_5Br_2 + 2OH^- \rightarrow Bi_{24}O_{31}Br_{10} + 2Br^- + H_2O$

 $2BiOBr + SiO_3^{2-} \rightarrow Bi_2SiO_5 + 2Br^{-}$

As a result, S-1 was found to contain $Bi_4O_5Br_2$, $Bi_{24}O_{31}Br_{10}$ and Bi_2SiO_5 . It is also worth noting that the sacrificial template of BiOBr belongs to the tetragonal phase, thus it is reasonable and

easy for the sacrificial template of BiOBr firstly transforming into the tetragonal Bi_2SiO_5 phase (JCPDS No. 36-0288) through ion exchange. Furthermore, the tetragonal Bi_2SiO_5 phase which has been reported to be a metastable phase ^[2] is easy to transform into a more stable phase. At the same time, less clear lattice fringes of the nanoparticles embedded in the surrounding sheets can be seen in Fig. S2b, indicating a low crystallization quality of these nanoparticles. This just suggests that the nanoparticles which are attributed to a metastable phase of Bi_2SiO_5 (JCPDS No. 36-0288) would experience a process of transforming into a more stable phase of the orthorhombic Bi_2SiO_5 (JCPDS No. 36-0287). As a result, the phase junction (S-1.5) should be a product originating from the phase transformation process.

Finally, based on the discussion above and XRD/HRTEM results, in S-1.5, the sphere-like nanoparticles can be attributed to a metastable phase of tetragonal Bi_2SiO_5 (JCPDS No. 36-0288) and the sheets can be ascribed to the orthorhombic Bi_2SiO_5 phase (JCPDS No. 36-0287). At the same time, less clear lattice fringes of the nanoparticles embedded in the surrounding sheets can be seen in Fig. S2b, indicating a low crystallization quality of these nanoparticles. This just suggests that the nanoparticles which are attributed to a metastable phase of Bi_2SiO_5 (JCPDS No. 36-0288) would experience a process of transforming into a more stable phase of the orthorhombic Bi_2SiO_5 (JCPDS No. 36-0287).



Fig. S1 XRD patterns of S-1(A), S-1.5(B) and S-2(C).



Fig. S2 TEM and HRTEM pictures of S-1(A, a), S-1.5(B, b) and S-2(C, c).



Fig. S3 FTIR spectra (a) and BET specific surface areas (b) of the as-prepared products.



Fig. S4 Cycling runs in the photocatalytic degradation of phenol in the presence of S-1.5 (a); XRD patterns of S-1.5 before and after 4 cycles of the photocatalytic reactions (b).

Table S1. Calculated band-gap energy (E_g), valence band edge potentials (E_{VB}), and conduction band edge potentials (E_{CB}) of the as-prepared products.

Sample	Eg	E _{VB} (vs vacuum level)	E _{VB} (vs NHE)	E _{CB} (vs NHE)
BiOBr	2.81 eV	1.53eV	2.97 eV	0.17 eV
S-1.5	2.93 eV	1.64eV	2.86 eV	-0.07 eV
S-2	3.73 eV	1.64eV	2.86 eV	-0.87 eV
(Bi ₂ SiO ₅ JCPDS 36-0287)				

Reference:

[1] Hong Deng, Junwei Wang, Qing Peng, Xun Wang and Yadong Li, Chem. Eur. J. 2005, 11, 6519.

[2] Y. Dimitriev, M. Krupchanska, Y. Ivanova and A. Staneva, *Journal of the University of Chemical Technology and Metallurgy*, 2010, **45**, 39.