Electronic Supplementary Information for

Visible light induced electrons transfer from semiconductor to insulator enables efficient photocatalytic activity on insulator-based heterojunctions

Hong Wang [a], Yanjuan Sun [a], Wenjie He [a], Ying Zhou [b], Shun Cheng Lee [c], Fan Dong *[a, b]

a Chongqing Key Laboratory of Catalysis and New Environmental Materials, College of Environment and Resources, Chongqing Technology and Business University. Chongqing 400067, China.

b The Center of New Energy Materials and Technology, School of Materials Science and Engineering, Southwest Petroleum University, Chengdu 610500, China.

c Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hong Kong, China.

* To whom correspondence should be addressed. E-mail: dfctbu@126.com (Fan Dong). Phone: +86 23 62769785 605. Fax: +86 23 62769785 605.

There are 7 pages, including 9 figures and 3 tables in the supporting information.

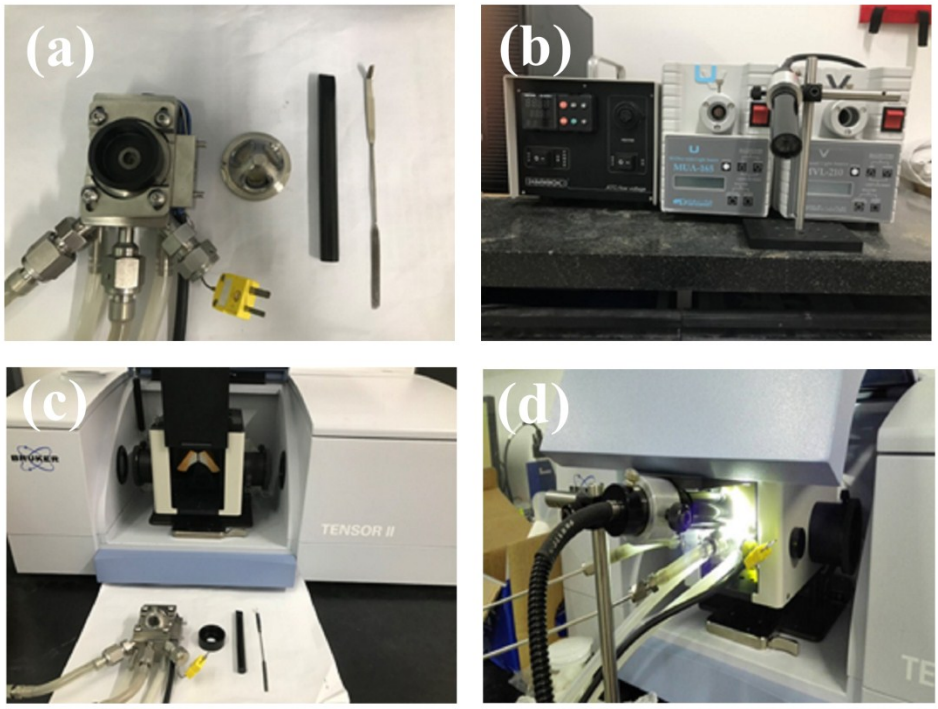

Fig. S1. *In situ* reaction bin and loading parts (a), Pretreatment equipment and light source (b), Tensor II FT-IR spectrometer (Bruker) (c) and *in situ* FT-IR measurement working condition (d)

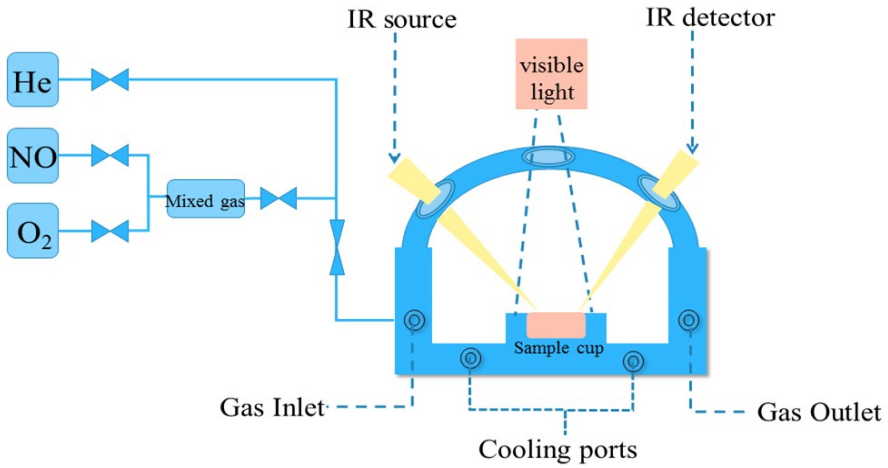

Fig. S2. Scheme of the in-situ FT-IR apparatus equipped with a visible light source.

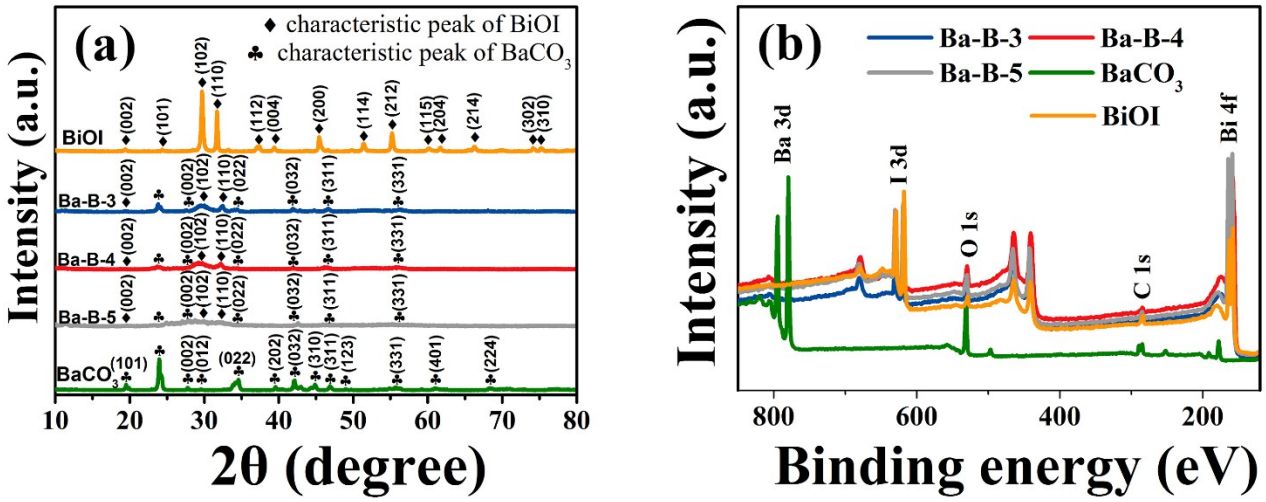

Fig. S3. XRD (a): tetragonal BiOI (JCPDS 10-0445) and orthorhombic $BaCO_3$ (JCPDS 01-0506) and XPS-survey spectra (b)

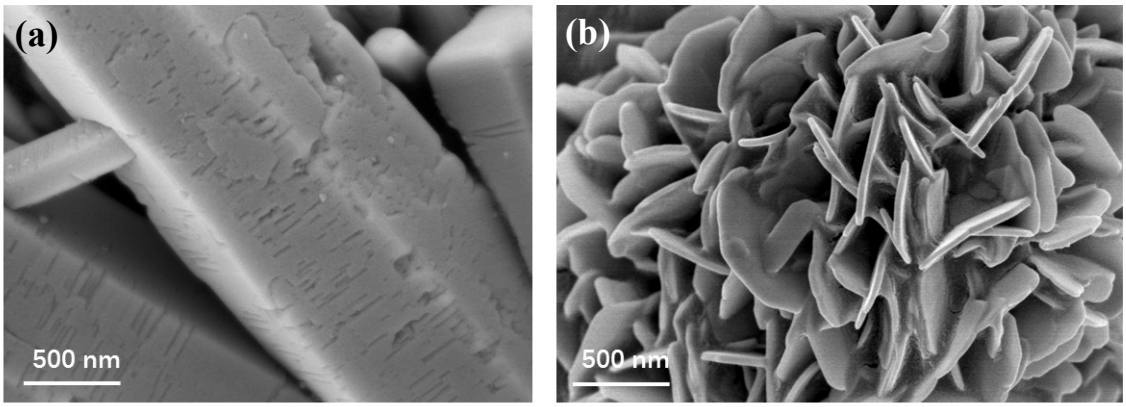

Fig. S4. SEM images of pure $BaCO_3$ (a) and BiOI (b)

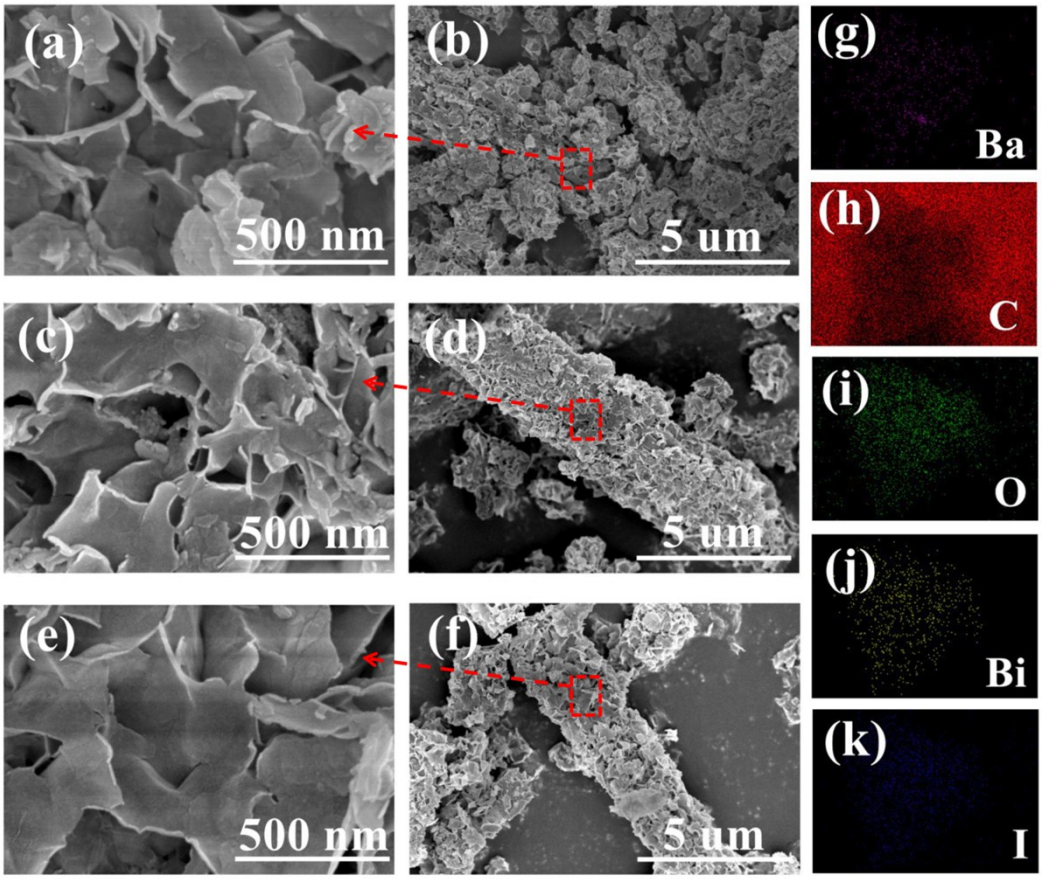

Fig. S5. SEM image of Ba-B-3 (a-b), Ba-B-4 (c-d) and Ba-B-5 (e-f) and EDX elemental mapping of Ba (g), C (h), O (i), Bi (j) and I (k) in Ba-B-4.

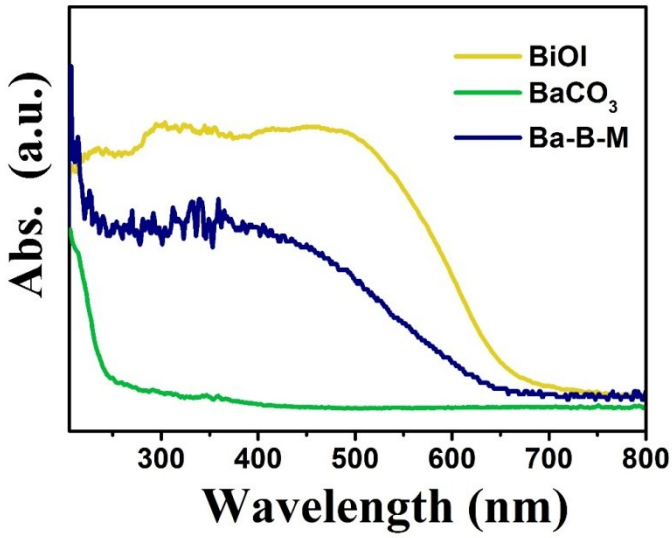

Fig. S6 UV-vis diffuse reflectance spectra of BiOI, $BaCO_3$, the physical mixture of BiOI and $BaCO_3$ (Ba-B-M)

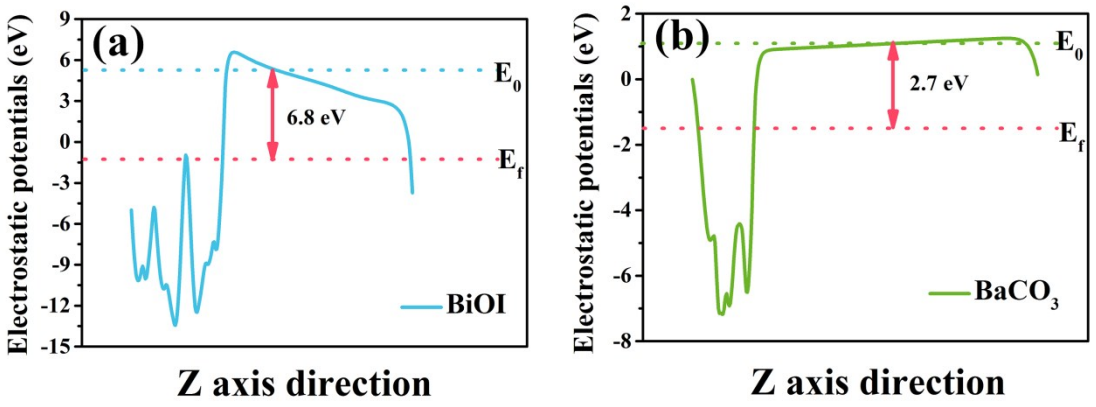

Fig. S7. The electrostatic potentials for (a) BiOI (001), (b) $BaCO_3$ (002). The red dashed lines represent the Fermi level E_f and the blue dotted lines represent the vacuum level E_0.

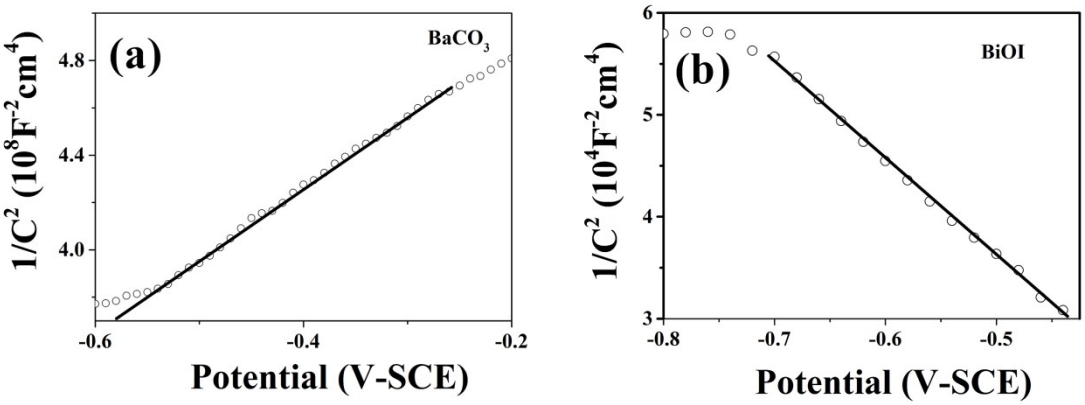

Fig. S8. Mott−Schottky curves of (a) $BaCO_3$ and (b) BiOI.

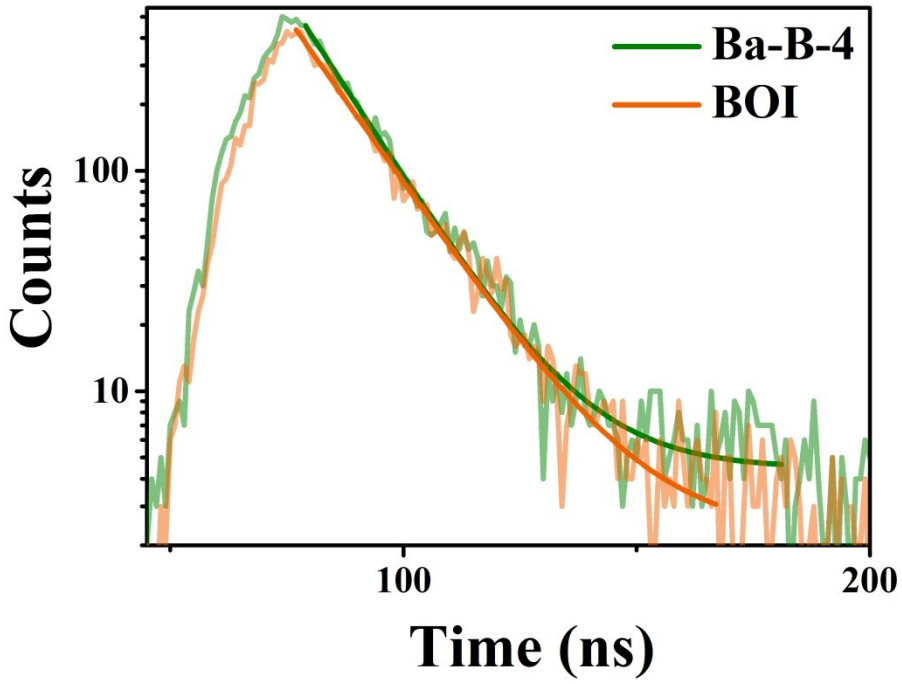

Fig. S9. The nanosecond-level time-resolved fluorescence spectra surveyed at room temperature.

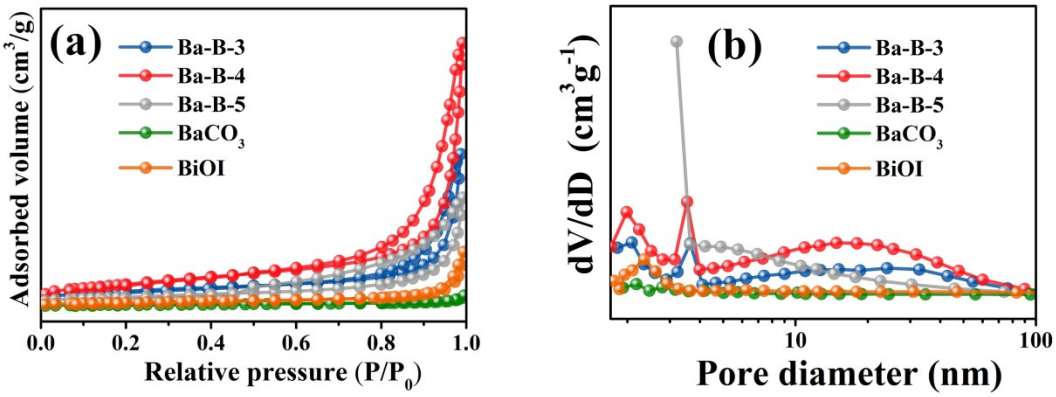

Fig. S10. N_2 adsorption-desorption isotherms (a) and the corresponding pore-size distribution curves (b).

Table S1. Assignments of the FT-IR bands observed during adsorption processes.

Wavenumber (cm^{-1})	Band assignment	References
950, 964	N_2O_3	[1]
1065-1196	$N_2O_2^{2-}$	[2]
1441, 1616	NO_2	[1-3]
1630	N_2O_2	[1]
1060, 1065	carbonate	[4]
1254	nitrite	[1, 5]
3440, 3445	N_2O	[1]

Table S2. The S_{BET} and pore size for $BaCO_3$, BiOI, Ba-B-3, Ba-B-4 and Ba-B-5

Sample name	S_{BET} (m^2/g)	Pore size (nm)
$BaCO_3$	4.98	-
BiOI	10.26	2.3
Ba-B-3	36.84	2/3.6
Ba-B-4	55.67	1.9/3.5/18
Ba-B-5	23.04	3.2

Table S3. Assignments of the FT-IR bands observed during photocatalytic NO oxidation processes.

Wavenumber (cm^{-1})	Band assignment	References
1003, 1053, 1266, 1525, 1551	nitrate	[2, 6, 7]
1069	carbonate	[4]
1405	NO_2^+	[1]

1647	N_2O_2	[1]
1699, 1744	NO^+	[2]
3440	N_2O	[1]

Reference

1. P. Jussieu, *Inorg. Chem*, 1982, 27, 1043-1050.
2. K. Hadjiivanov, *Catal. Rev*, 2000, 42, 71-144.
3. G. Ramis, G. Busca, F. Bregani and P. Forzatti, *Appl. Catal*, 1990, 64, 259-278.
4. Y. Zhou, Z. Zhao, F. Wang, K. Cao, D. E. Doronkin, F. Dong and J. D. Grunwaldt, *J. Hazard. Mater*, 2016, 307, 163-172.
5. M. A. Debeila, N. J. Coville, M. S. Scurrell and G. R. Hearne, *Appl. Catal. A-Gen*, 2005, 291, 98-115.
6. J. C. S. Wu and Y. T. Cheng, *J. Catal*, 2006, 237, 393-404.
7. K. Hadjiivanov, V. Avreyska, K. A. Dimitar and T. Marinova, *Langmuir*, 2012, 18, 1619-1625.