Supporting Information

Experimental Section

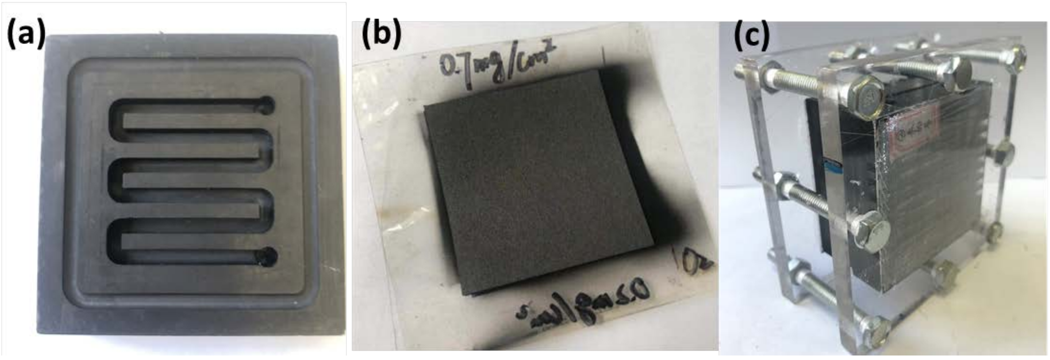

Fig. S1 The practical photo of (a) graphite collector; (b) MEA; (c) F-HFC.

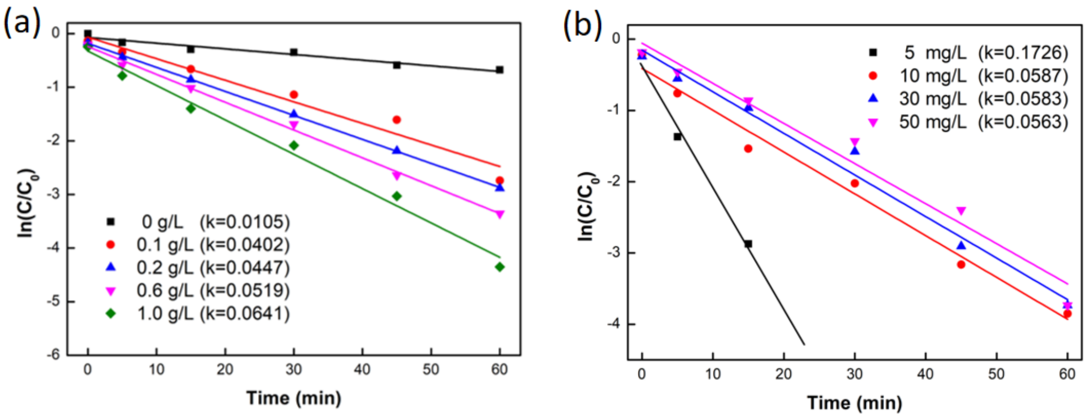

Fig. S2 Kinetic investigation of RhB photocatalytic degradation with different (a) photocatalysts' dosage; (b) initial solution concentration.

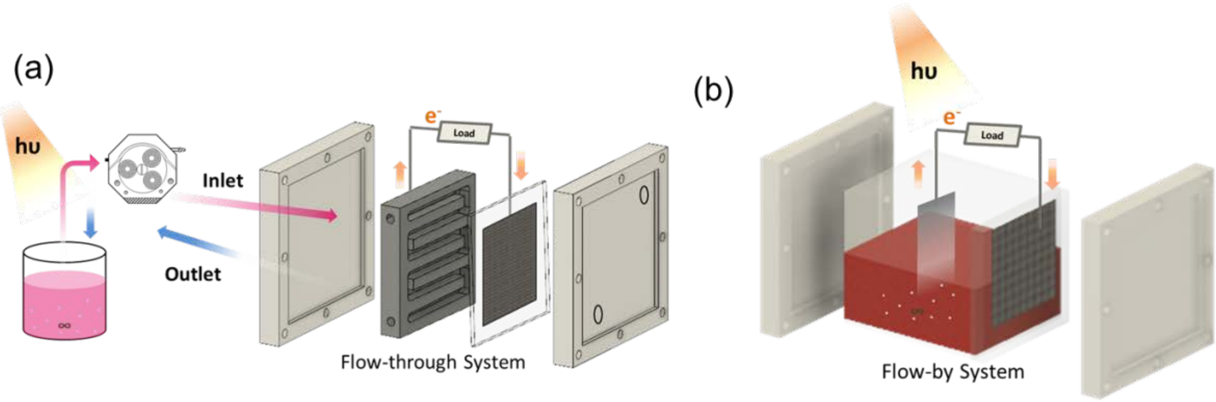

Fig. S3 Schematic diagrams of the (a) flow-through configuration; (b) flow-by configuration.

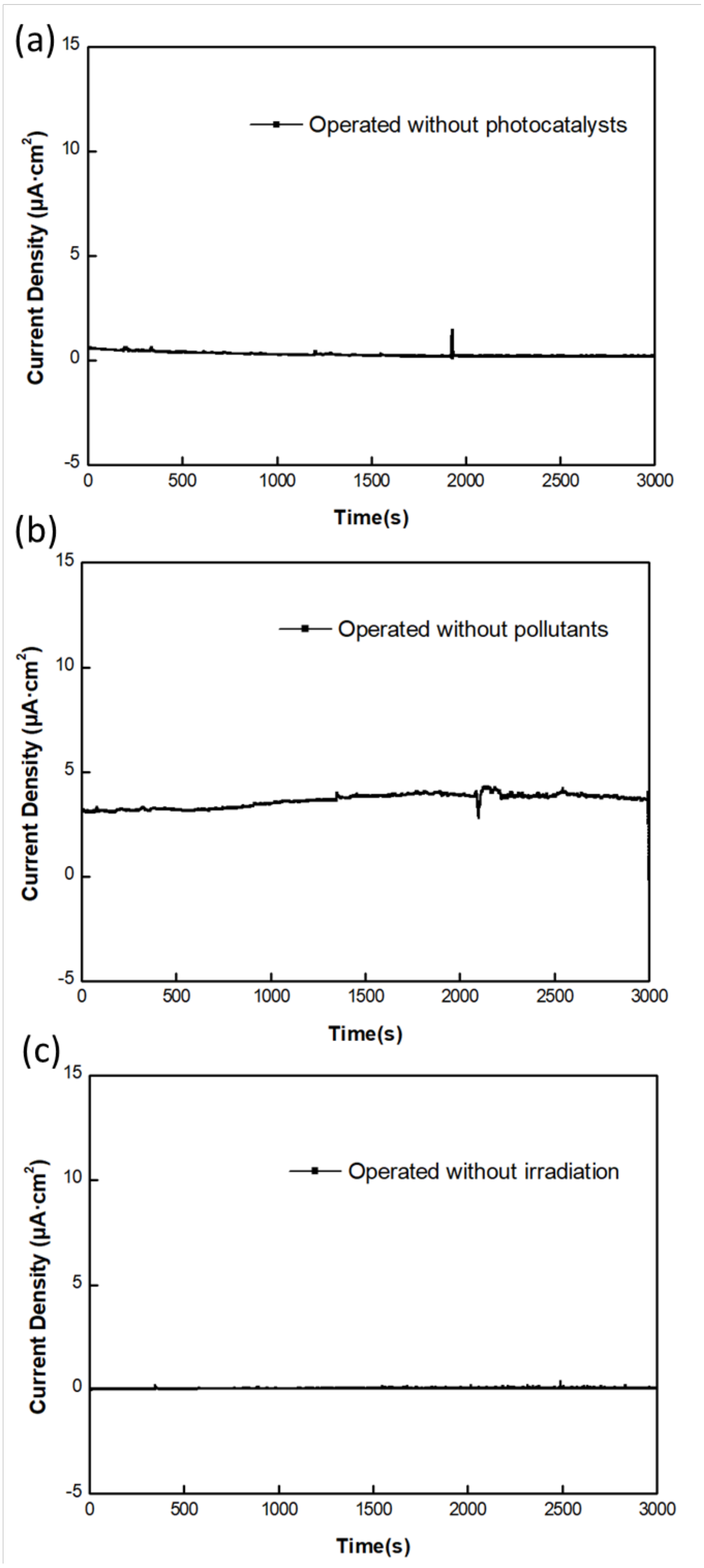

Fig. S4 The current density in F-HFC system (a) without photocatalyst, (b) without pollutant, and (c) without irradiation.

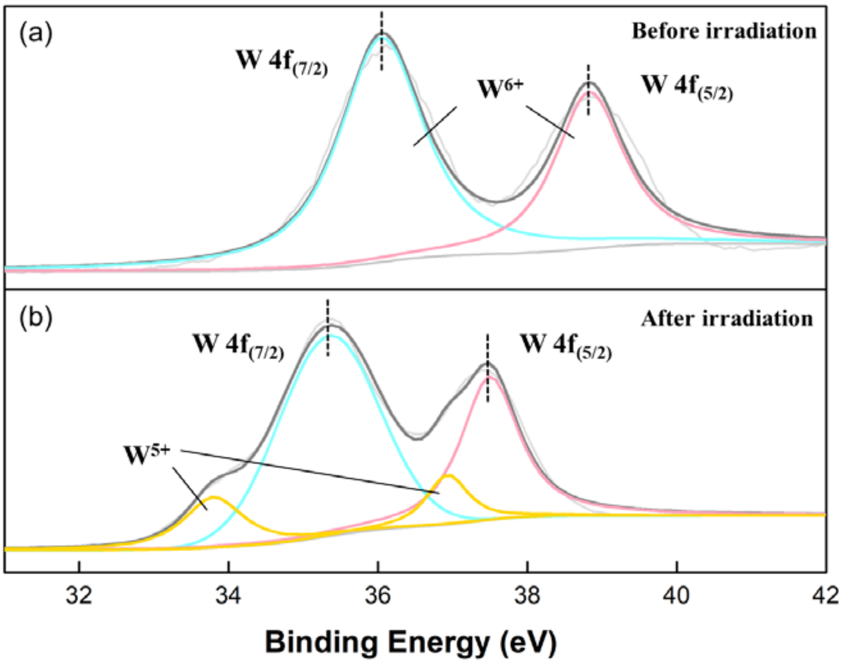

Fig. S5 XPS spectra of W signal use (a) before and (b) after 2 h irradiation.

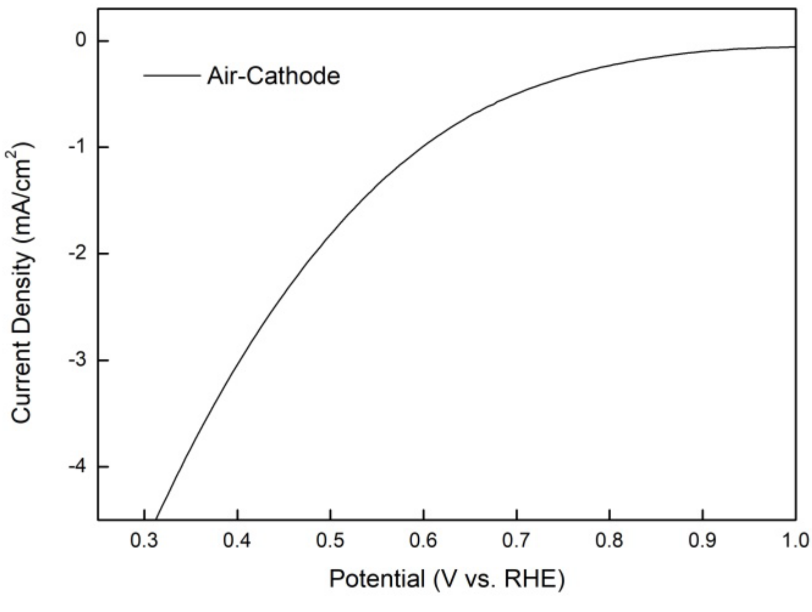

Fig. S6 Linear sweep voltammetry of Pt/C air cathode.

The preparation of electrodes for photocurrent test

The FTO substrates were cleaned by ultra-sonication in acetone, ethanol and ultrapure water for 30 min, respectively. Then, 1 mg sample powder were dispersed into 2 mL ethanol and 20 μL 5% Nafion solution under ultra-sonication for 30 min to obtain slurries. Next, the as-prepared slurries were painted on the FTO substrates and the effective areas were 1 cm×1 cm which restricted by transparent adhesive tape. The as-prepared FTO glass electrodes were plane placed and naturally dried for overnight.

Table S1 Summary of the performance of different PFC system.

Anode	**Cathode**	**Substrate**	**Current Density ($\mu A/cm^2$)**	**Ref.**
Ultrathin BiOCl (010)	Pt	RhB	8.65	Zhang et al., 2018
BiOCl	Pt	RhB	5.8	Zhang et al., 2017
BiOI/BiOCl	Copper cobalt oxide	Tetracycline	140	Zhou et al., 2019
Plasmonic Ag modified Cr-BiOCl(Ag-Cr/BOC)	Pt	RhB	7.3	Zhang et al., 2019
BiOCl/Ti	Pt	RhB	11.6	Li et al., 2013
BiOCl-NH_4PTA	Air-cathode	RhB	270.9	This work

Table S2 The estimated PL lifetimes and corresponding constants.

Samples	**τ1 (ns)**	**τ2 (ns)**	**τ3 (ns)**	**f1 (%)**	**f2 (%)**	**f3 (%)**
BiOCl	1.28	1.28	1.28	33.3	33.3	33.4
BiOCl-NH_4PTA	5.68	5.68	1.51	0.09	0.09	0.82

References

Li K, Xu Y, He Y, Yang C, Wang Y, Jia J (2013). Photocatalytic fuel cell (PFC) and dye self-photosensitization photocatalytic fuel cell (DSPFC) with BiOCl/Ti photoanode under UV and visible light irradiation. Environmental Science & Technology, 47(7): 3490–3497

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Zhang L, Liu C, Xie G, Wen X, Zhan X, Zeng G (2017). Controlled growth of BiOCl with large {010} facets for dye self-photosensitization photocatalytic fuel cells application. ACS Sustainable Chemistry & Engineering, 5(6): 4619–4629

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Zhou J, Hou C, Liu Y (2019). Persulfate enhanced pollutants oxidation efficiency and power generation in photocatalytic fuel cell with anodic BiOCl/BiOI and cathodic copper cobalt oxide. Journal of the Taiwan Institute of Chemical Engineers, 101: 31–40