Supporting Information

Photocatalytic activity and photocorrosion of oriented $BiVO_4$ single crystal thin films

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Sample preparation

The BVO thin films were deposited on YSZ(110) by PLD. The pulse repetition rate was 1 Hz. Target and substrate distance was 65 mm. Energy density of the laser was 42 mj/cm^2. The substrate temperature was controlled to be 680°C. Deposited time was 0.5 h and O_2 partial pressure was about 7.8 mTorr during the deposition of films.[1]

Photodegradation of dichlorophenol

Photocatalytic activity was estimated from the photodegradation of Dichlorophenol under full spectrum illumination, which was emitted from a 300-W Xe lamp, 1 mL of 48 mg/L dichlorophenol solution and a 1 cm × 1 cm sample was placed in a cuvette for photocatalytic reaction. The reaction was initially carried out in dark environment for 30 min to achieve the adsorption-desorption equilibrium. The distance between the Xe lamp and the cuvette was 11 cm, and the concentration of

dichlorophenol was measured every 20 min under the illumination of the lamp. The dichlorophenol solution concentration (C) after a certain reaction time (t) was monitored by measuring the absorbance of the reactant solution during the photodegradation process on the aforementioned UV-vis equipment.

Cyclic experiment

It is consistent with the photodegradation process of Rhodamine B (RhB) under full spectrum illumination mentioned in the experimental part of the manuscript. The concentration of RhB is measured every 20 minutes under illumination, and the total illumination time is 2 hours as a cycle. The experiments were repeated five times in turn.

Table S1. The ratio of Bi and V atoms determined by XPS and dissolution of V for BVO films grown on different substrates.

samples	The rate of Bi : V		Dissolution of V(mg/L)
	Before degradation	After degradation	
BVO/YSZ(001)	1.02	1.13	4.22
BVO/YSZ(111)	2.12	2.41	4.25

Table S2. The thickness, coverage and roughness by AFM for BVO films grown on different substrates.

samples	Thickness (nm)	coverage	Roughness (nm)
BVO/YSZ(001)	50	61%	14.1
BVO/YSZ(111)	65	46.7%	20

Table S3. The ratio of EPR signal intensity before and after degradation for BVO films grown on different substrates.

samples	EPR Signal Intensity		
	Before degradation	After degradation	Ratio of EPR signal intensity before and after degradation
BVO/YSZ(001)	59488.82	12412.24	21%
BVO/YSZ(110)	41654.37	13848.64	33%
BVO/YSZ(111)	30475.21	15765.23	52%

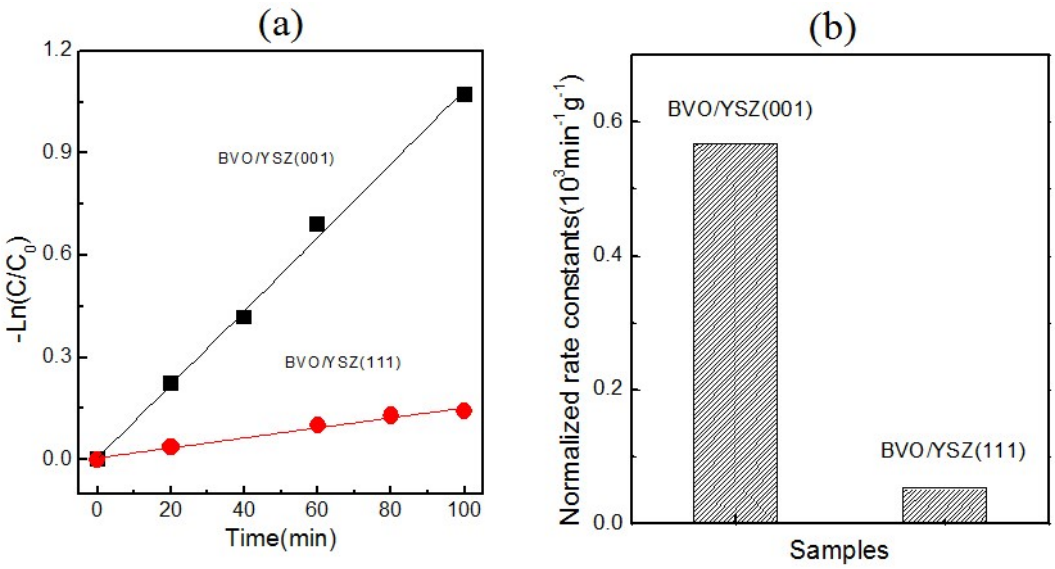

Figure S1. (a) Plots of –(LnC/C_0) vs. irradiation time. (b) Rate constant of BVO/YSZ(001) , BVO/YSZ (111).

Figure S1. shows the rate constant of degradation of dichlorophenol by BVO/YSZ(001) and BVO/YSZ(111). In Figure S1(a), the *k* values of BVO/YSZ(001) and BVO/YSZ(111) for Dichlorophenol degradation are 10.8×10^{-3} and 1.5×10^{-3}min^{-1}. After mass normalization as shown in the Figure S1(b), the rate constants value of BVO/YSZ(001) is much higher than that of BVO/YSZ(111).

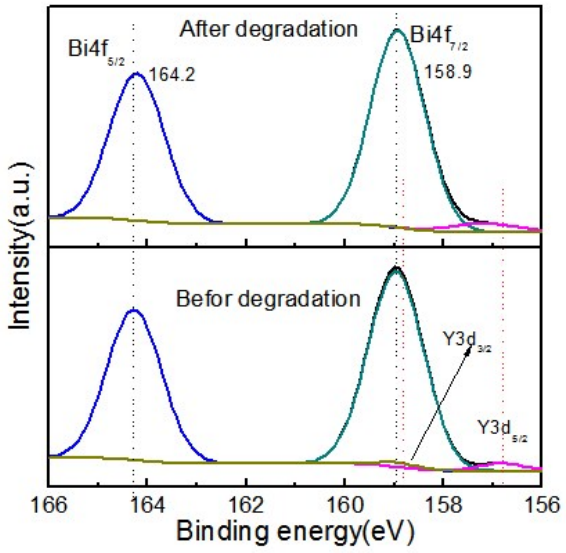

Figure S2. XPS spectra of Bi 4f for BVO/YSZ(001) before and after degradation.

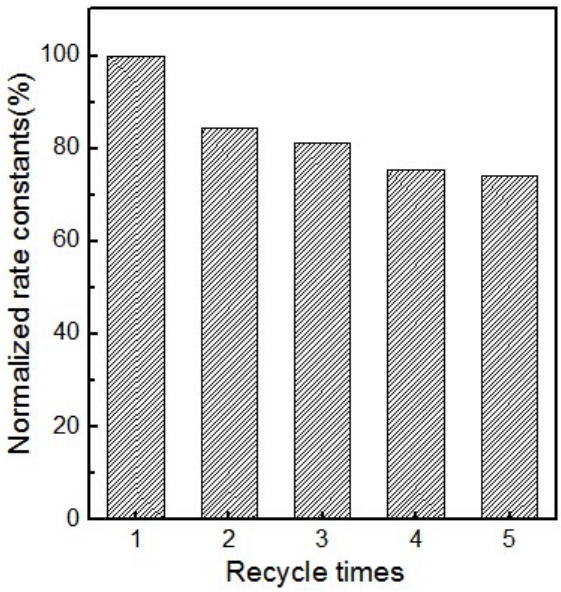

Figure S3. Rate constant of BVO/YSZ (001) for RhB degradation in cyclic experiments.

References

1. Li, G.; Kou, S.; Zhang, F.; Zhang, W.; Guo, H., Target stoichiometry and growth temperature impact on properties of BiVO4 (010) epitaxial thin films. *CrystEngComm* **2018,** 20, (43), 6950-6956.