

Electrical Supporting Information (ESI)

H₂ oxidation driven by its losing electron behavior over B doped TiO₂ under UV irradiation

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1. Light resource

(a) Four UV lamps with a wavelength centered at 365 nm (4 W, Philips TL/05) were used as the irradiation source and the total light intensity on the surface of sensing film was 7.3 mW cm^{-2} ,

(b) The UV light was supplied by a 500W Xe lamp, which was as the light source in other experiments, including electrochemical testing, electron paramagnetic resonance (EPR) and photocatalytic performances.

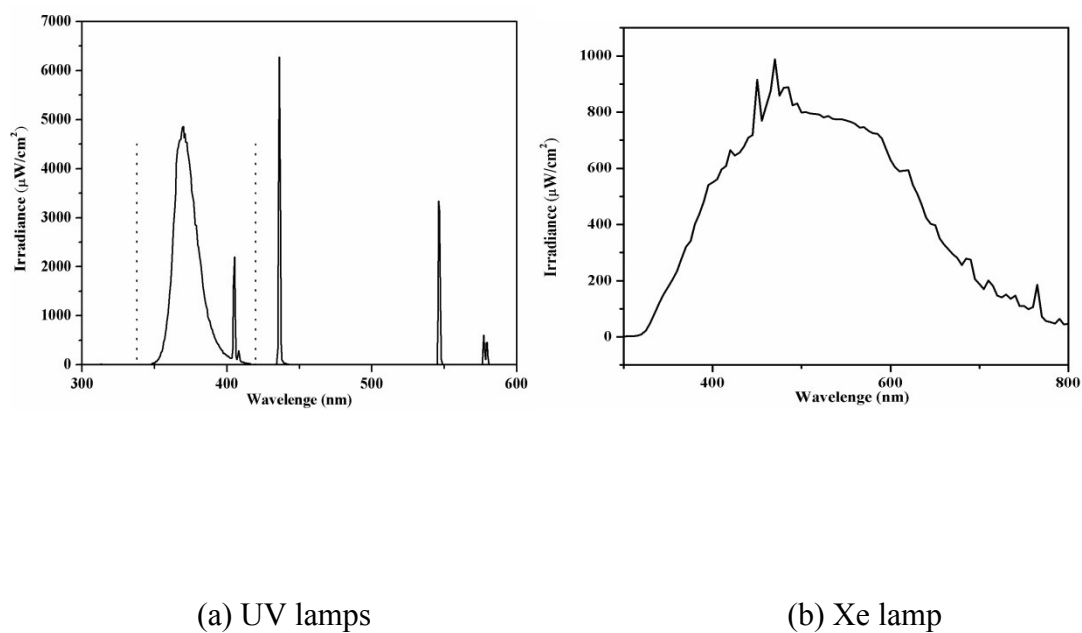


Fig. S1 Spectrogram of the two light sources used in the experiment: (a) UV lamps and (b) Xe lamp.

2. Photo-current response results of TiO₂ and B-TiO₂

In Fig. S2, we could find that both TiO₂ and B-TiO₂ generated a certain photo-current when the ultraviolet light was introduced, and the current intensity was large. When the light source was cut off, the current decreased rapidly, and the photo-current intensity of two samples was different. The photo-current curve of TiO₂ generally showed a declining trend with the extension of the test time, and then maintained a relatively stable state, while the photo-current intensity of B-TiO₂ was significantly less than that of TiO₂, but the overall decay degree was weaker. After doping B, the photo-current intensity became weaker, this was due to the lack of electron characteristics of boron. The hole density increased after doping B, which could capture photo-generated electrons, causing the photo-current intensity to weaken.

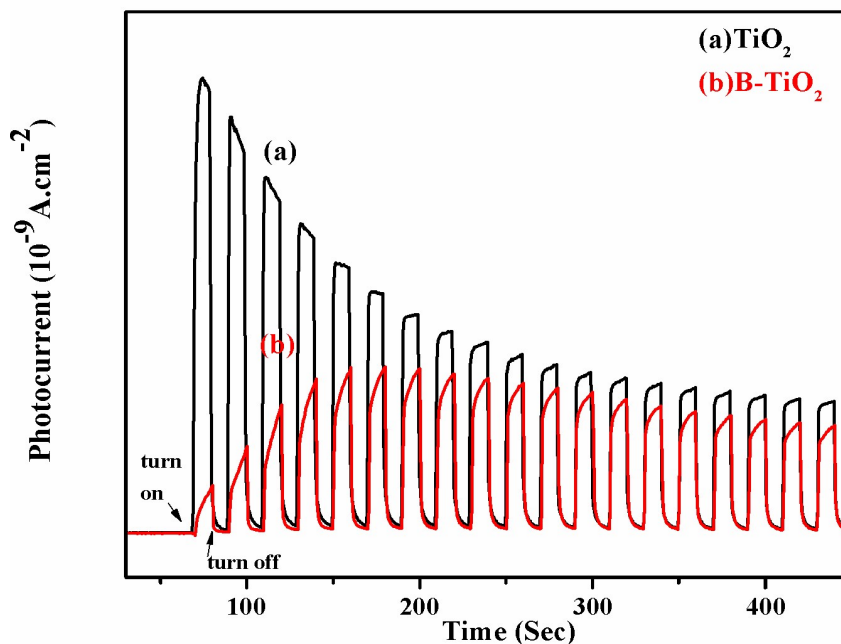


Fig. S2 Photo-current response results of (a) TiO₂ and (b) B-TiO₂ in 0.02 M Na₂SO₄ (aq) under the UV light irradiation.

3. Electrochemical impedance spectroscopy of TiO₂ and B-TiO₂

Fig. S3 shows the impedance plots of TiO₂ and B-TiO₂ under UV irradiation and the equivalent circuit model in Fig. S3 was used to fit the Nyquist plot. We could find that TiO₂ had a smaller radius of the arc in the EIS spectra than B-TiO₂, which implied that doping B was unbenefit for efficient separation of the photogenerated charges and electron transport. The EIS result was consistent with the photo-current result. The reason for it may also because B is an electron-deficient element, which would capture the photo-generated electrons.

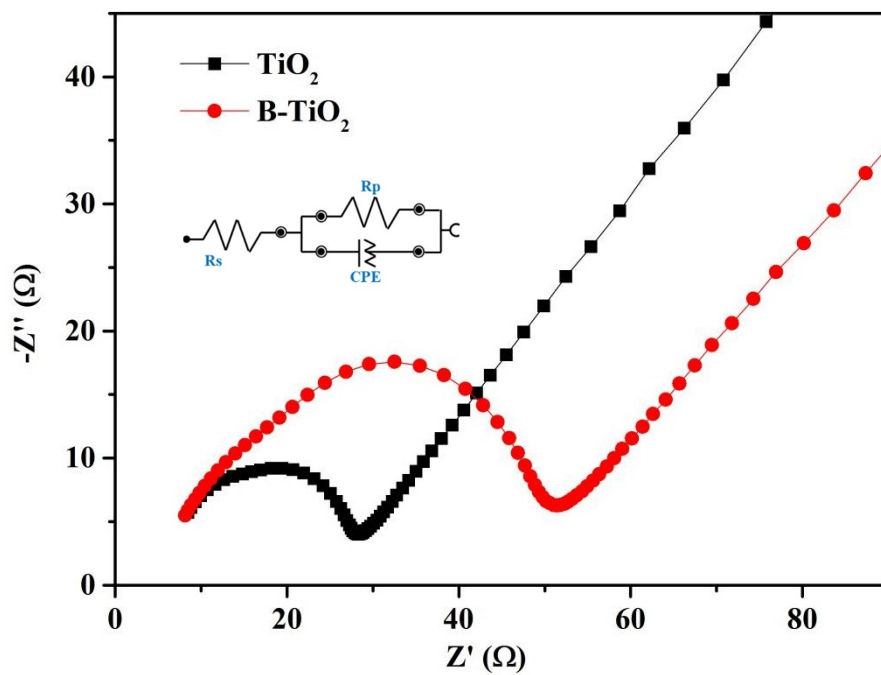


Fig. S3 Electrochemical impedance spectroscopy (EIS) of TiO_2 and B-TiO_2 under the UV light irradiation.

4. Photocatalytic activities of TiO_2 and different B-TiO_2 samples

A series of B-TiO_2 catalysts with different amount of B doping were synthesized

to determine the optimal amount of B doping, and the atomic ratio of B to Ti are 0, 0.5, 1, 1.5 and 2, respectively. The photocatalytic activity test results indicated that the atomic ratio of B to Ti is 1 had the best activity for H₂ oxidation, as shown in Table S1. Consequently, it was the optimal amount of B doping. In addition, the photocatalytic activity for H₂ oxidation over B₂O₃ had also been tested and the experiment result demonstrated that it could not play a role in the H₂ oxidation reaction, which was also shown in Table S1. The XRD of TiO₂ and B-TiO₂ with different atomic ratio of B to Ti were shown in Fig. S4, which indicated that the different samples were successfully prepared .

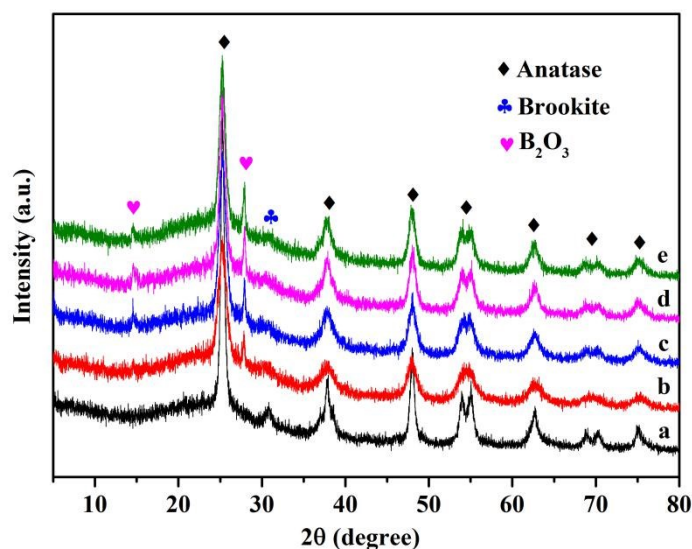


Fig. S4 XRD of B-TiO₂ with different atomic ratio of B to Ti : (a) 0; (b) 0.5; (c) 1; (d) 1.5; (e) 2.

Table S1 The results of catalytically oxidizing H₂ over B₂O₃ and a series of B-TiO₂ catalysts under UV irradiation at room temperature.

Samples	The initial concentration of H ₂ (ppm)	The concentration of H ₂ in dark for 1h (ppm)	The concentration of H ₂ under UV light for 1h (ppm)	Characteristic
B ₂ O ₃	55697.51	54485.18(-1212.33) ^a	54088.84(-396.34) ^a	H ₂ not oxidized
TiO ₂	67670.95	60491.94(-7179.01) ^a	56961.28(-3530.66) ^a	H ₂ not oxidized
0.5 ^c	65409.54	56940.08(-8469.46) ^a	47977.94(-8962.14) ^a	^b H ₂ oxidized
1 ^c	58185.24	52830.41(-5354.83) ^a	41073.32(-11757.09) ^a	^b H ₂ oxidized
1.5 ^c	61913.84	57573.54(-4340.30) ^a	51379.8(-6193.74) ^a	^b H ₂ oxidized
2 ^c	63462.28	59380.04(-4082.24) ^a	54429.73(-4950.30) ^a	^b H ₂ oxidized

a-The concentration decrease value of H₂ in dark or under UV light for 1h (ppm).

b- O₂ contents (not shown here) also decreased, indicating that H₂ was oxidized by O₂.

c-The atomic ratio of B to Ti