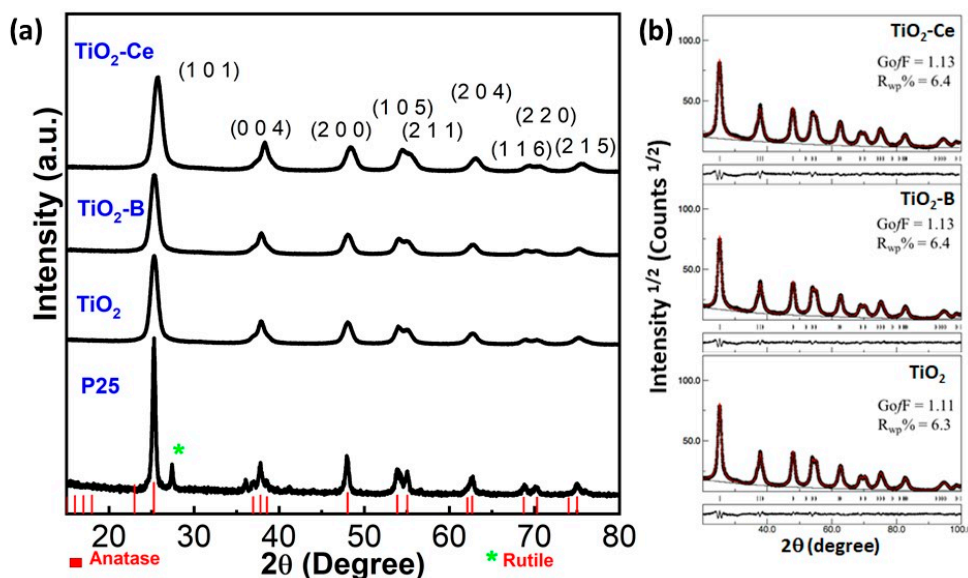


# Supplementary information: The Cerium/Boron Insertion Impact in Anatase Nano-structures on the Photo-electrochemical and Photocatalytic response

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## Section 1: XRD and SEM



**Figure S1.** (a) XRD diffraction pattern overview of P25, TiO<sub>2</sub>, B and Ce-doped anatase. (b) Rietveld analysis of TiO<sub>2</sub>, B and Ce-doped anatase. Inset: Fitting parameters on average R<sub>wp</sub>% (Weighted Rprofile), and GoF (Goodness of Fit).

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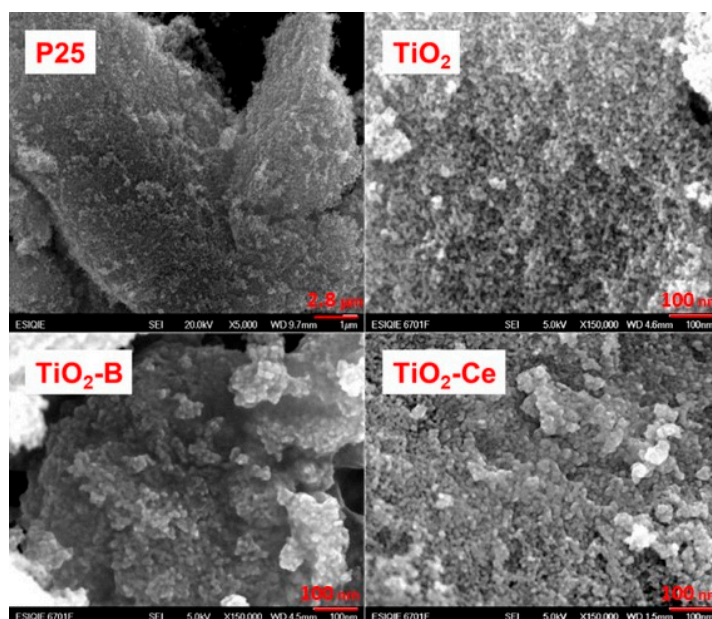
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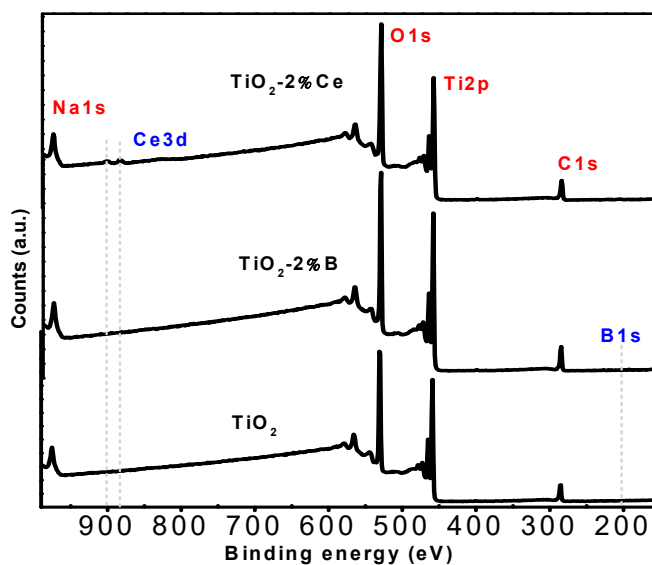
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**Table S1.** Structural properties from Rietvel analysis for TiO<sub>2</sub>, TiO<sub>2</sub>-B and TiO<sub>2</sub>-Ce samples (cf. Figure S1(b)).

Sample	a / Å (error)	c / Å (error)	< d > / nm (error)	ε / microstrain (error)	Unit Cell volume (Å <sup>3</sup> )
TiO <sub>2</sub>	3.7872 (1.5E-4)	9.5032 (4.2E-4)	14.1 (0.03)	0.0039 (2.0E-5)	136.30
TiO <sub>2</sub> -B	3.7875 (1.6E-4)	9.5038 (4.6E-4)	13.3 (0.03)	0.0040 (8.4E-6)	136.33
TiO <sub>2</sub> -Ce	3.7942 (2.0E-4)	9.5105 (5.8E-4)	11.4 (0.03)	0.0046 (2.5E-5)	136.91

**Figure S2.** SEM morphologies of P25, TiO<sub>2</sub>, B and Ce-doped anatase.

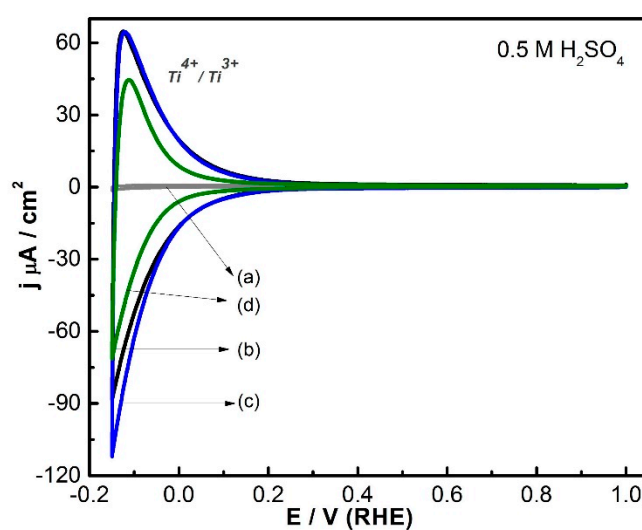
## Section 2: XPS Survey

**Figure S3.** XPS general spectra of TiO<sub>2</sub> nanoparticles modified with boron and cerium: TiO<sub>2</sub>-B and TiO<sub>2</sub>-Ce.

**Table S2.** Weight composition of O1s, Ce3d<sub>3/2, 5/2</sub> and B1s collected from the modified TiO<sub>2</sub>.

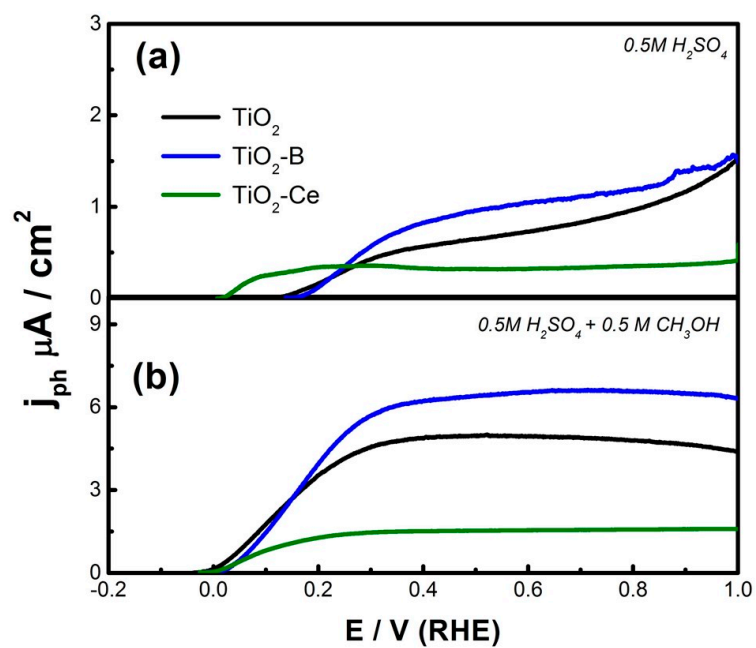
Species	TiO <sub>2</sub> -B		TiO <sub>2</sub> -Ce		
	Weight (%)	Bind energy (eV)	Weight (%)	Bind energy (eV)	
<b>B 1s</b>	B-N	6.59	190.8	-	
	H <sub>3</sub> BO <sub>3</sub>	11.44	193.7	-	
	B-O, BCO <sub>2</sub>	30.6	192.08	-	
	B <sub>2</sub> O <sub>3</sub>	51.38	192.85	-	
<b>O 1s</b>	TiO <sub>2</sub>	85.48	530.03	76.7	
	OH ads	-	-	4.3	
	Carbonates	7.84	531.19	8.6	
	B-O, Ti-O-B, Nitrates	3.99	532.15	-	
	Al <sub>2</sub> O <sub>3</sub>	2.3	528.49	-	
	B <sup>3+</sup> (B <sub>2</sub> O <sub>3</sub> )	0.39	533.07	-	
	Ce <sup>4+</sup> (CeO <sub>2</sub> )	-	-	3	
	Ce <sup>3+</sup> (Ce <sub>2</sub> O <sub>3</sub> )	-	-	7.5	
	<b>Ce 3d<sub>3/2, 5/2</sub></b>	Ce <sup>3+</sup>	-	-	72.8
		Ce <sup>4+</sup>	-	-	27.2
<b>Ti 2p</b>	4) Ti(IV)	73.7	458.71	72.76	
	3) Ti(IV)-Ce	13.4	458.05	13.24	
	5) TiO(OH) <sub>2</sub>	4.7	459.85	5	
	2) Ti(III)	4.5	456.99	4.8	
	1) Ti(II)	1.9	456	2.13	
	6) Ti-C	1.9	460.75	2.07	

### Section 3: Cyclic Voltammetry in darkness



**Figure S4.** Current-potential characteristics of oxides deposited onto SnO<sub>2</sub>: F (FTO) in dark in 0.5M H<sub>2</sub>SO<sub>4</sub>. (a) FTO, (b) TiO<sub>2</sub> anatase, (c) TiO<sub>2</sub>-B, and (d) TiO<sub>2</sub>-Ce. Scan rate: 50 mV/s.

### Section 4: Photoactivity characteristics



**Figure S5.** Photocurrent-potential characteristics of doped-oxides ( $TiO_2-B$ , and  $TiO_2-Ce$ ). Scan rate: 1 mV/s. The mass deposited on each sample was 0.2 mg/cm<sup>2</sup>.