

## Supporting Information

### Spontaneous polarization-driven charge migration in BaTiO<sub>3</sub>/Co<sub>3</sub>O<sub>4</sub>/C for enhanced catalytic performance

Yan Wang<sup>a,\*</sup>, Hua Li<sup>a</sup>, Bin Cui<sup>b,\*</sup>, Fei Pei<sup>c</sup>, Yaping Li<sup>a</sup>, Rui Zhao<sup>a</sup>, Jie Zhang<sup>a</sup>, Furong Wang<sup>a</sup>,

Zixuan Gao<sup>a</sup>, Shan Wang<sup>a</sup>

<sup>a</sup> Engineering Research Center for Titanium Based Functional Materials and Devices in Universities of Shaanxi Province, College of Chemistry and Chemical Engineering, Baoji University of Arts and Sciences, Key Laboratory of Phytochemistry of Shaanxi Province, Baoji 721013, PR China

<sup>b</sup> Key Laboratory of Synthetic and Natural Functional Molecule of Ministry of Education, Shanxi Key Laboratory of Physico-Inorganic Chemistry, Department of Chemistry, Northwest University, Xian, Shaanxi 710069, PR China

<sup>c</sup> School of Civil Engineering, Xi'an Traffic Engineering Institute, Xi'an 710300, PR China

\* Corresponding author. E-mail address: [wangyan7144279@bjwlxy.edu.cn](mailto:wangyan7144279@bjwlxy.edu.cn) (Y. Wang).

## **Supplementary Text**

### **1. Characterisation**

X-ray diffraction (XRD) pattern of the solid product was determined in the diffraction angle range  $15^{\circ}$ – $80^{\circ}$  by XRD (D8 Advance, Bruker Co.) equipped with Cu  $K\alpha$  radiation. The morphology and microscopic structure of the solid products were characterized by scanning electron microscopy (SEM, Hitachi Ltd. Quanta SU8010 series). SEM-EDS mapping images were obtained using an SU8010 series SEM with energy dispersive spectroscopy (EDS) at 20 kV and 10 mA. The surface elemental composition and chemical state distribution of the catalytic material were analysed by photoelectron spectroscopy (XPS, Thermo Scientific NEXSAX-ray) as the reference C1s peak of the surface adventitious carbon. The extent of mineralisation of MB was tested using a micro total organic carbon (TOC) analyser (Shimadzu TOC-V CPN). The nitrogen sorption isotherms of the products were obtained using a Micromeritics ASAP 2460 analyser operating at 77 K. A ferroelectric test module (TF Analyzer 2000, axiACCT) were used to evaluate the ferroelectric properties of the catalytic materials.

### **2. Electrochemical tests**

The electrochemical properties of the catalytic materials were determined using an Ametek ModuLab XM multi-functional electrochemical test system using  $\text{Na}_2\text{SO}_4$  solution (0.5 mol/L) as the electrolyte. Each working electrode was fabricated by dispersing 20 mg of catalysts into 1 mL Nafion solution (12.5wt%) with sonication to generate a catalyst ink. 50  $\mu\text{L}$  of catalyst ink solution was then dropped onto

the pretreated ITO surface and allowed to dry in air for 12 h at 60 °C. The cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and linear sweep voltammetry (LSV) tests were performed on an electrochemical analyzer in a standard three electrode system with the catalysts as the working electrode, the Ag/AgCl (saturated with KCl) and the Pt wire were used as the reference and counter electrodes, respectively.

### **3. Electron paramagnetic resonance (EPR) measurements.**

The type of the generated ROS was evaluated by EPR at room temperature (Bruker EPR EMX Plus spectrometer. Center field: 3500 G, sweep width: 1000 G) with DMPO and TEMP as radical trapping agents in water. In a typical procedure, 10 mg PMS was added to 5 mL of the prepared catalytic materials solution (1 mg/mL) with a vigorous shake, then 5 mL DMPO (0.2 M) or TEMP (0.1 M) was mixed with the above solution mixture. The characteristic signals of ROS can be detected by the EPR spectrometer.

### **4. Detection of radical species**

Hydroxybenzoic acid (HBA) and 9,10-anthracenediyl-bis(methylene) dimalonic acid (ABDA) were used to detect  $\text{SO}_4^{\bullet-}$  and  $^1\text{O}_2$ , respectively. Briefly, the catalyst (0.05 g) was uniformly dispersed in HBA or ABDA solution (100 mL,  $5 \times 10^{-5}$  mol·L<sup>-1</sup>) under magnetic stirring at room temperature. 0.02 g PMS was then added to this system. Aliquots of the reaction solution (3 mL) were collected under specific reaction time intervals, and centrifuged to extract the liquid supernatant. Next, the absorbance of the residual HBA or ABDA in the supernatant was tested using an

ultraviolet–visible (UV–vis) spectrophotometer.

## Supplementary Figures

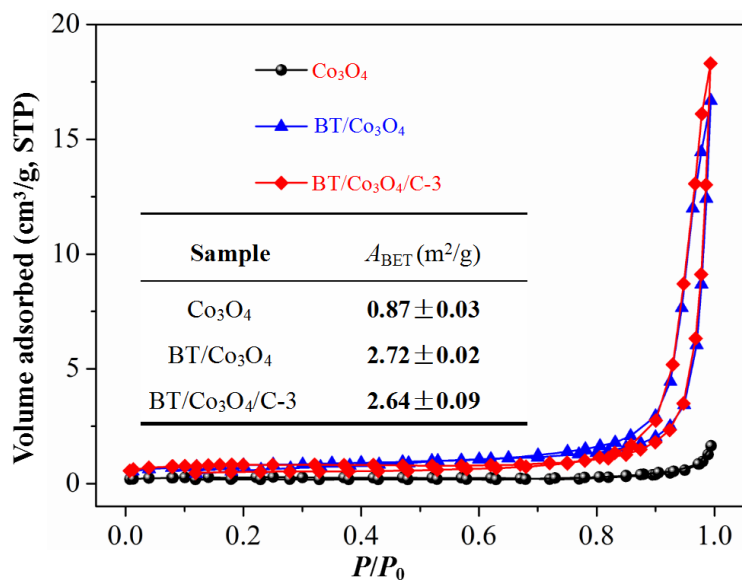


Fig. S1 N<sub>2</sub> adsorption-desorption and specific surface areas (A<sub>BET</sub>) of the different samples.

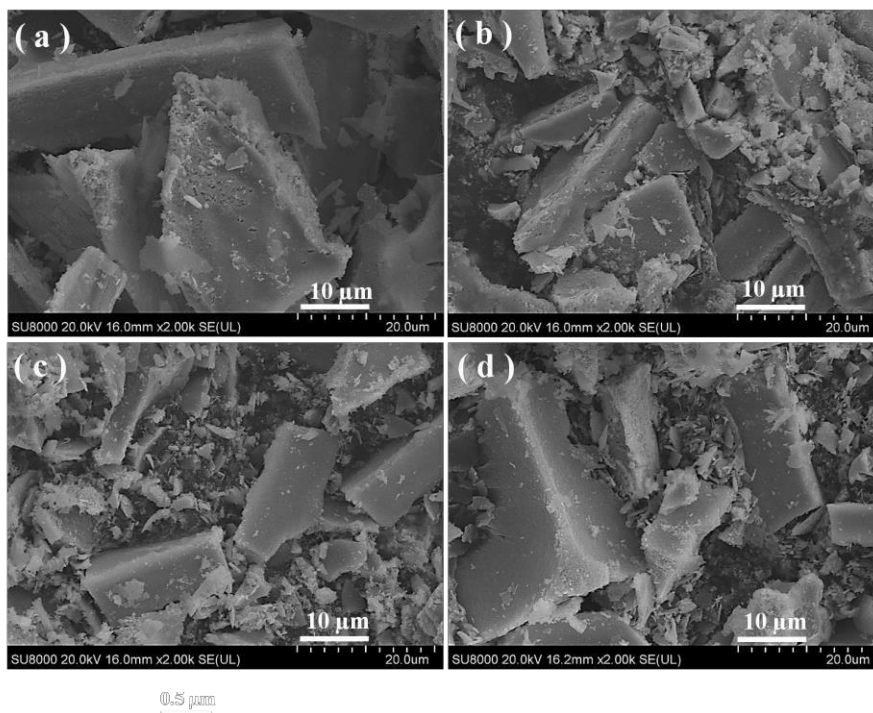


Fig. S2 SEM images of BT/Co<sub>3</sub>O<sub>4</sub>/C-1 (a), BT/Co<sub>3</sub>O<sub>4</sub>/C-2 (b), BT/Co<sub>3</sub>O<sub>4</sub>/C-3 (c), and BT/Co<sub>3</sub>O<sub>4</sub>/C-4 (d) samples.

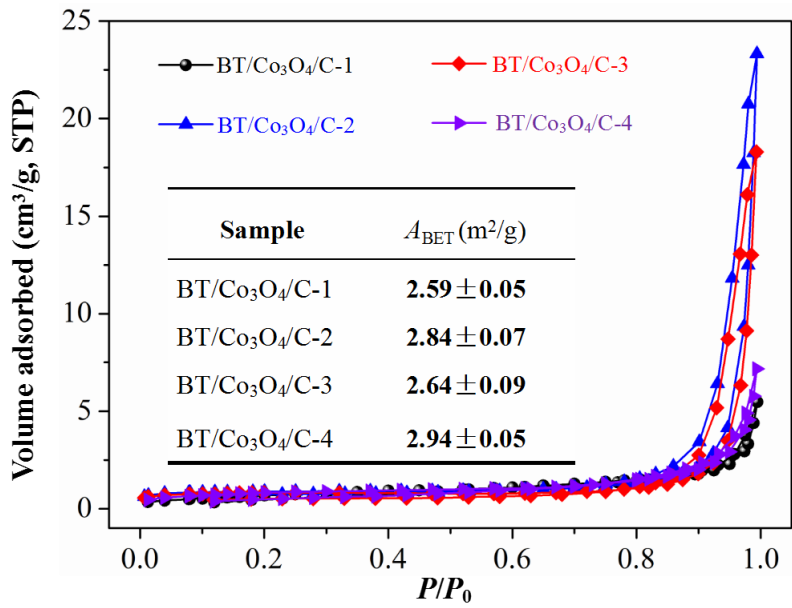


Fig. S3 N<sub>2</sub> adsorption-desorption and specific surface areas ( $A_{\text{BET}}$ ) of the different samples.

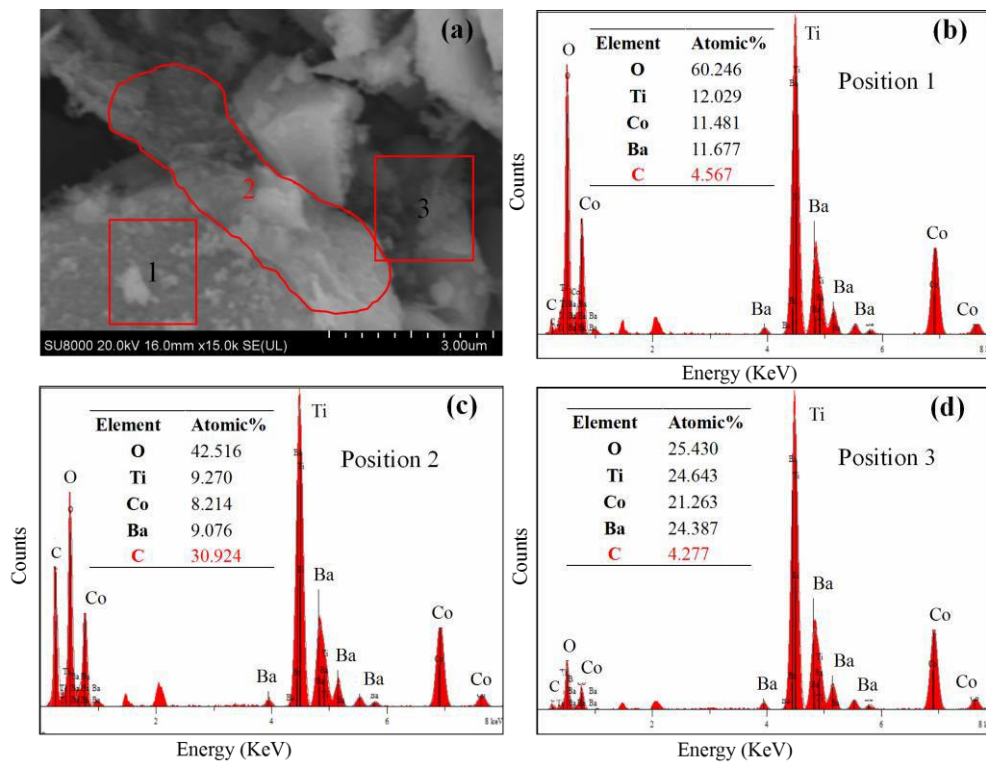


Fig. S4 EDS spectra of the BT/Co<sub>3</sub>O<sub>4</sub>/C-3 samples.

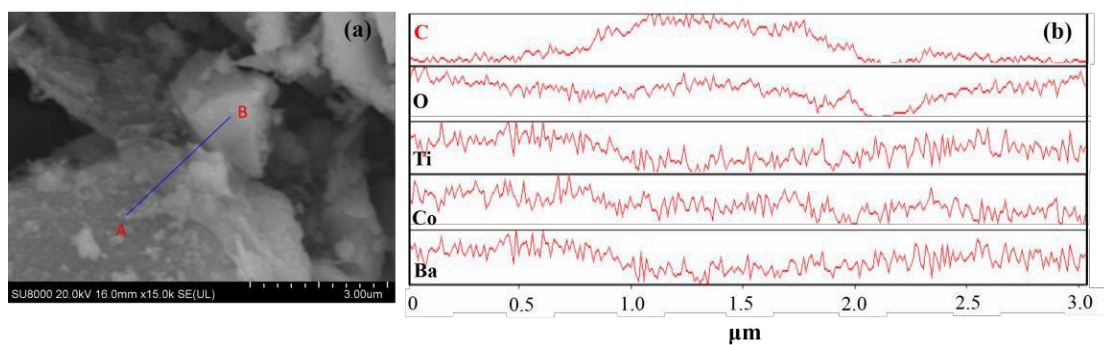


Fig. S5 EDS analysis results for the powers shown in the corresponding parts of the red line along the path from A to B.

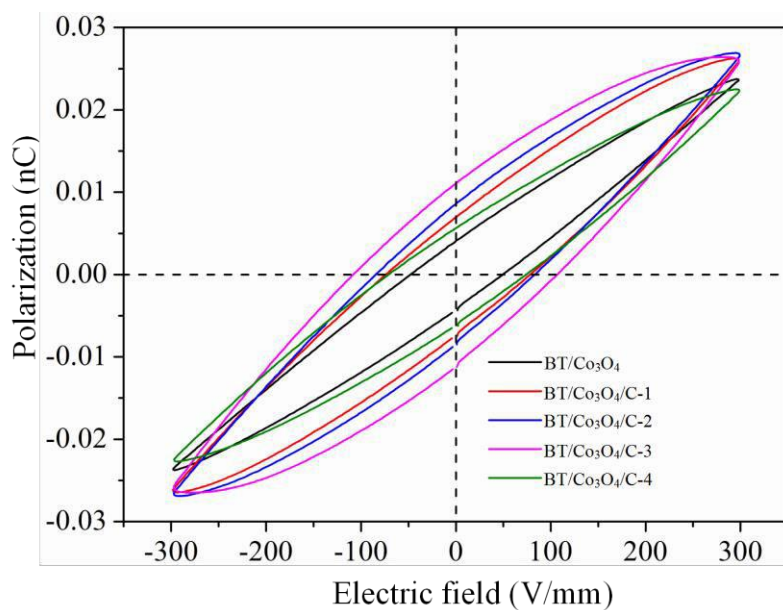


Fig. S6 The ferroelectric hysteresis loop of the different samples.

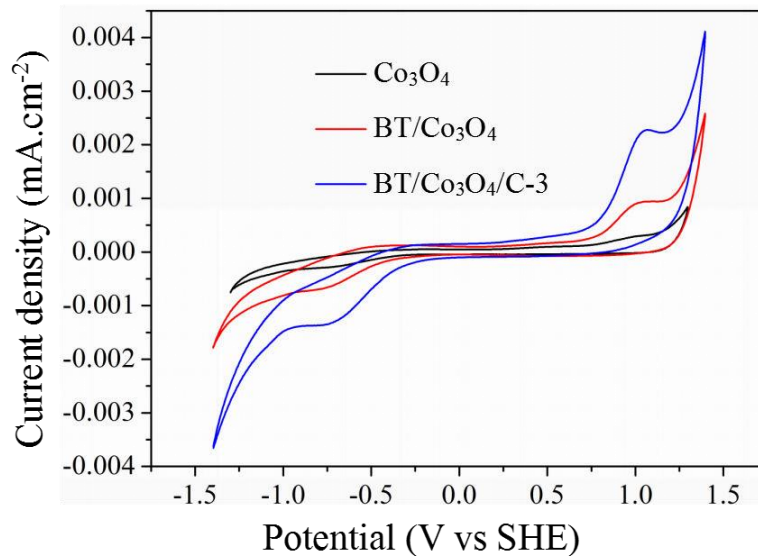


Fig. S7 CV curves of the different samples in  $0.5 \text{ mol L}^{-1} \text{ Na}_2\text{SO}_4$  solution.

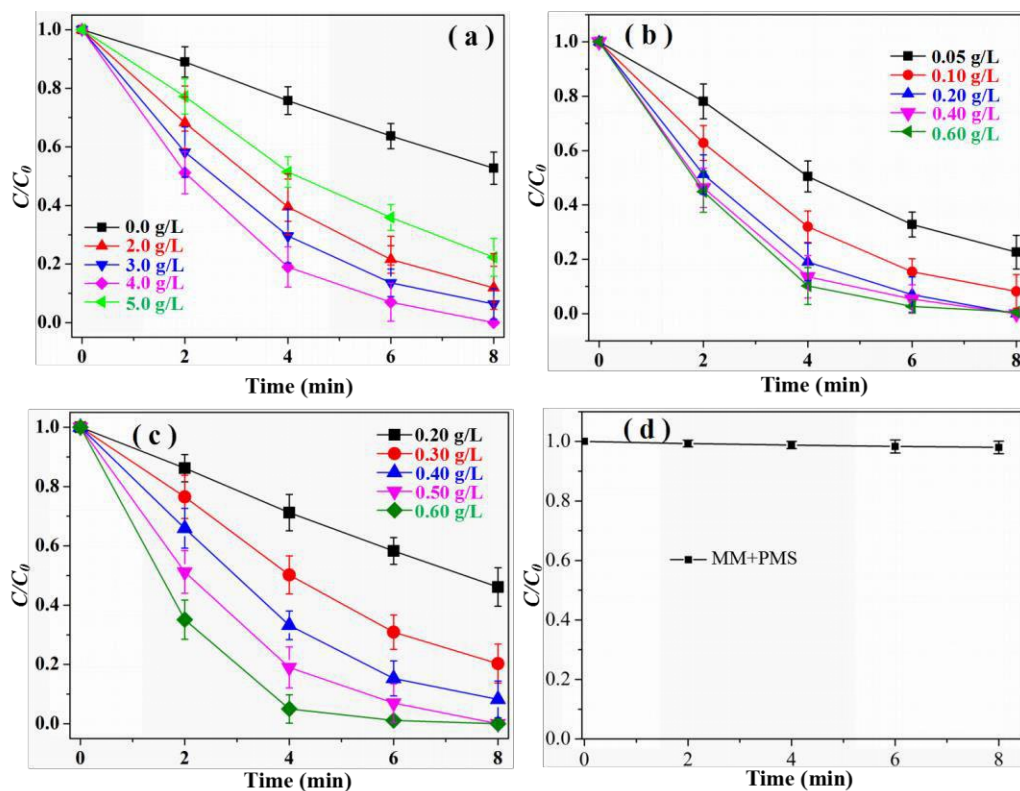


Fig. S8 (a) MB degradation rate in the BT/Co<sub>3</sub>O<sub>4</sub>/C+PMS system (conditions: conditions: [MB] =  $20 \text{ mg}\cdot\text{L}^{-1}$ , [PMS] =  $0.4 \text{ g}\cdot\text{L}^{-1}$ , [catalyst] =  $0.5 \text{ g}\cdot\text{L}^{-1}$ , T =  $25 \text{ }^\circ\text{C}$ , and initial solution pH = 6.87). Effect of the process parameters on the catalytic performance: (b) PMS concentration, (c) BT/Co<sub>3</sub>O<sub>4</sub>/C-3 dosage. (d) MB degradation rate in the MM+PMS system.



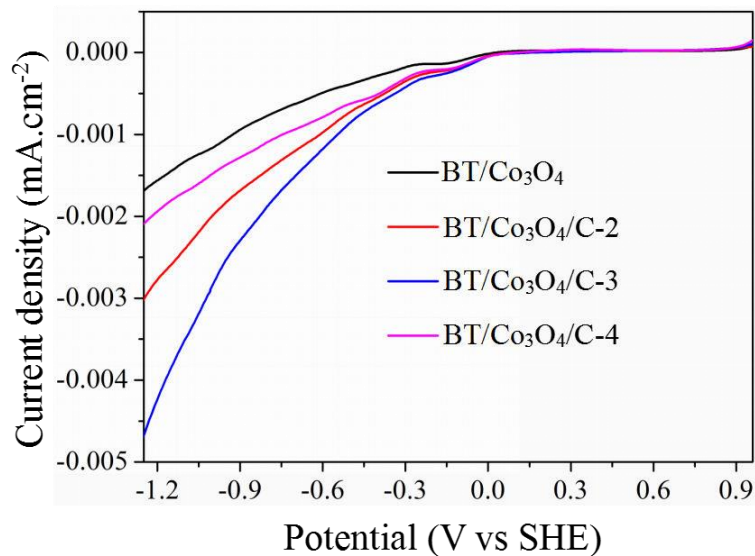


Fig. S9 LSV curves of the different samples in  $0.5 \text{ mol L}^{-1} \text{ Na}_2\text{SO}_4$  solution.

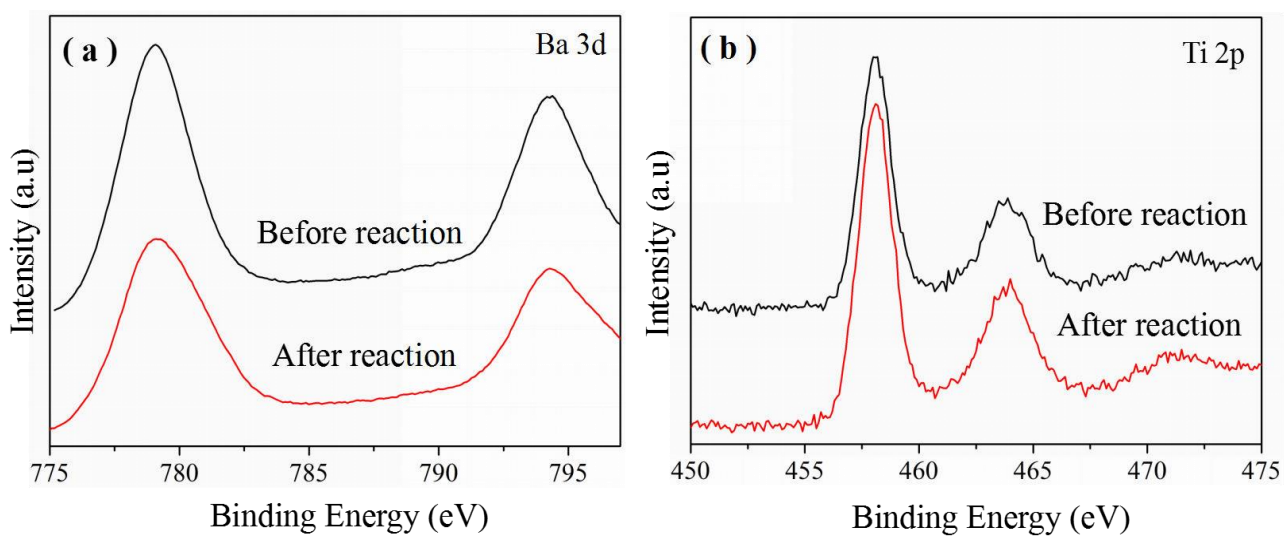


Fig. S10 XPS spectrum of the BT/Co<sub>3</sub>O<sub>4</sub>/C-3 samples before and after the catalytic reaction: (a) Ba 3d, (b) Ti 2p.



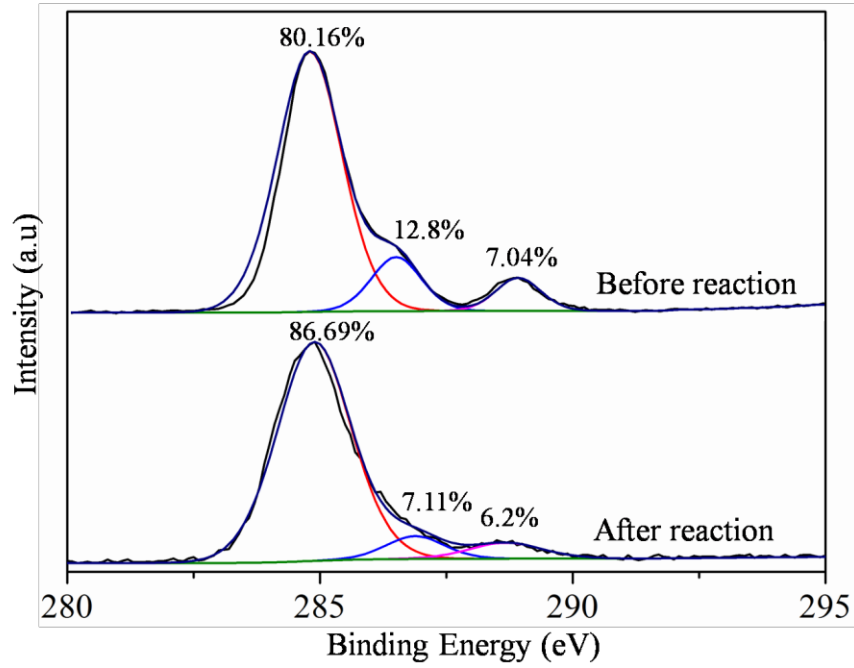


Fig. S11 The fine-scanned XPS spectra of C 1s for the BT/Co<sub>3</sub>O<sub>4</sub>/C-3 before and after the catalytic reaction.

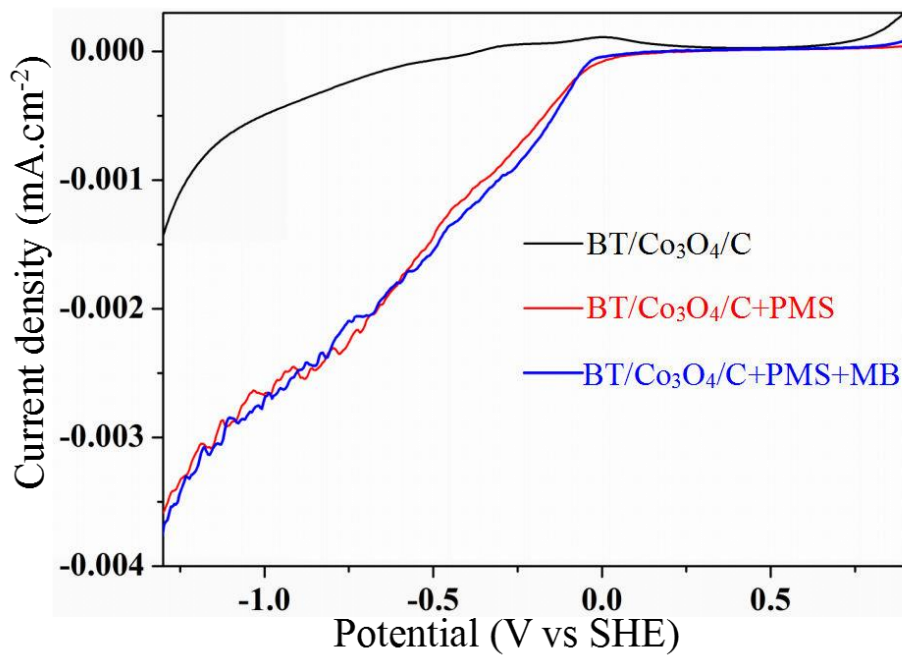


Fig. S12 LSV curves of BT/Co<sub>3</sub>O<sub>4</sub>/C-3 under different conditions.

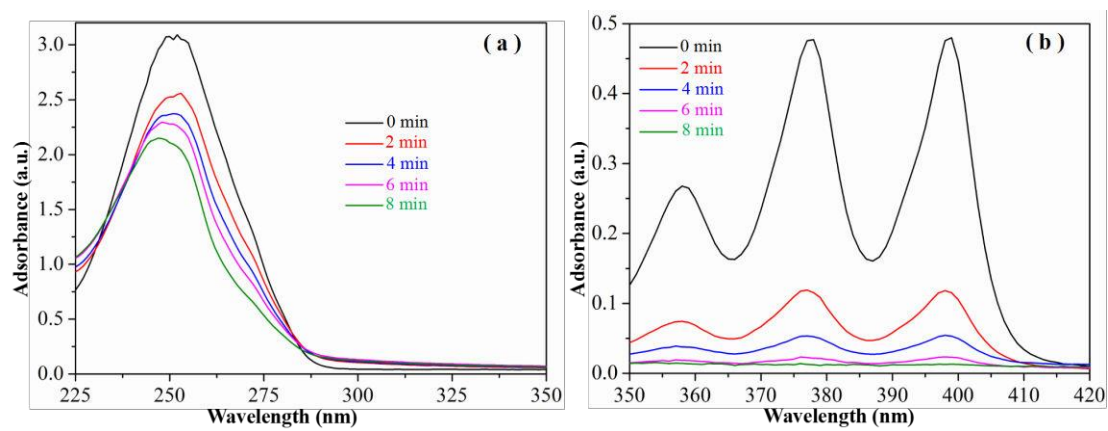


Fig. S13 UV spectra of HBA (a) and ABDA (b) under BT/Co<sub>3</sub>O<sub>4</sub>/C-3 activated PMS systems.