

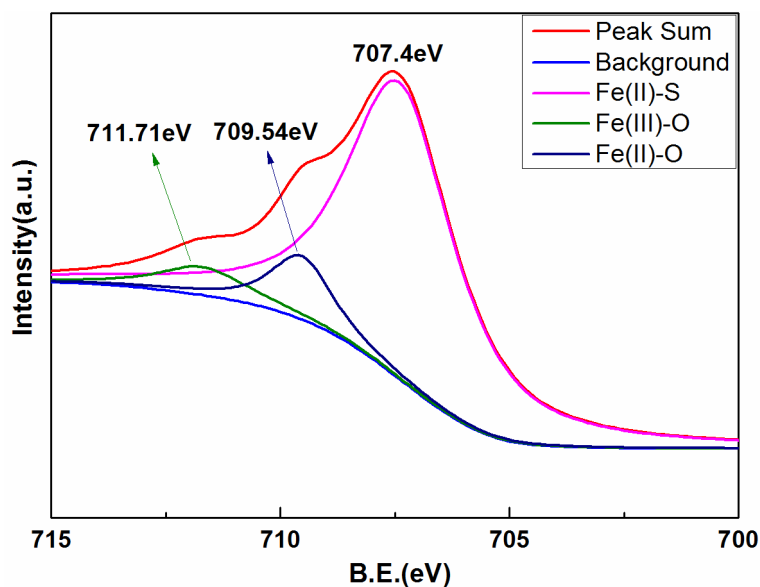
## Supplementary Material

**Table S1**

Table S1. Some critical factors of the MB solutions with various catalysts, including the residue  $K^+$ , the value of pH, iron ions and sulfate radicals concentration

Sample	FeS <sub>2</sub> nanotube	Fe <sub>2</sub> O <sub>3</sub> nanotube	FeS <sub>2</sub> microparticle
$K^+$ (g/L) (residue concentration after immersion)	0.91	0.89	1.07
pH (after immersion in the dark condition)	6.3	6.7	6.5
iron ion (mg/L) (after immersion in the dark)	0.21	0.21	0.151
iron ion (mg/L) (after the photodegradation)	0.51	0.82	0.73
SO <sub>4</sub> <sup>2-</sup> (mg/L) (after immersion in the dark condition)	<0.01	/	<0.01
SO <sub>4</sub> <sup>2-</sup> (mg/L) (after the photodegradation)	<0.01	/	<0.01

**Figure S1**

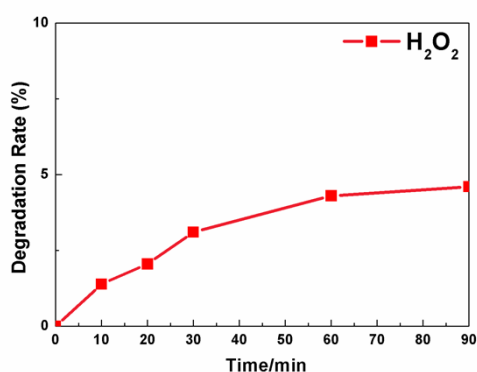


**Figure S1.** XPS spectra of FeS<sub>2</sub> nanotube after degradation experiment

XPS technology has been always employed to determine of the different valence states of elements. In order to further clarify the oxidation of FeS<sub>2</sub> nanotubes in MB solution under the dark, the XPS was used to investigate the oxidation behavior of pyrite. The XPS analysis of Fe species of FeS<sub>2</sub> nanotube was shown in Figure S2. Fe 2p spectra were caused by the contributions of Fe

(II) and Fe (III) species. The peak with the binding energy of 707.4 eV should be ascribed to the ferrous sulfide which has been demonstrated in the elucidation about the Figure 2d. The peak of 709.54eV was mainly caused by the ferrous oxide. Most importantly, the peak with binding energy of 711.71eV was associated with the ferric iron which indicated that the ferrous iron was oxidized.

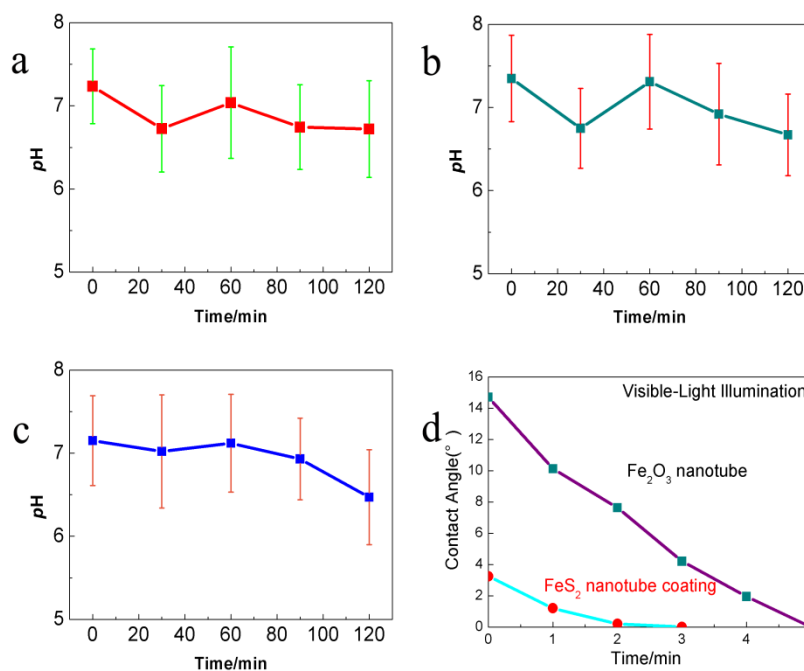
## Figure S2



**Figure S2.** Degradation of MB for H<sub>2</sub>O<sub>2</sub> under the dark

In order to investigate the effect of H<sub>2</sub>O<sub>2</sub> on the degradation of MB under the dark, 0.5mL hydrogen peroxide was added into the 50mL methylene blue solution (5mg/L). As Figure S3 shown, the degradation rate of MB with H<sub>2</sub>O<sub>2</sub> was 4.6% in 90min, which indicated that H<sub>2</sub>O<sub>2</sub> hardly had any catalytical reactivity.

## Figure S3



**Figure S3.** pH value of the MB solution during the photodegradation process: (a) pyrite nanotubes, (b) Fe<sub>2</sub>O<sub>3</sub> nanotubes, (c) pyrite nanoparticles, (d) the wetting characteristic of pyrite nanotubes and Fe<sub>2</sub>O<sub>3</sub> nanotubes under the visible light illumination