

## Supporting Information

# Facile synthesis of uniform $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> crystals and the facet-dependent catalytic performance in photo-Fenton reaction

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### Characterization:

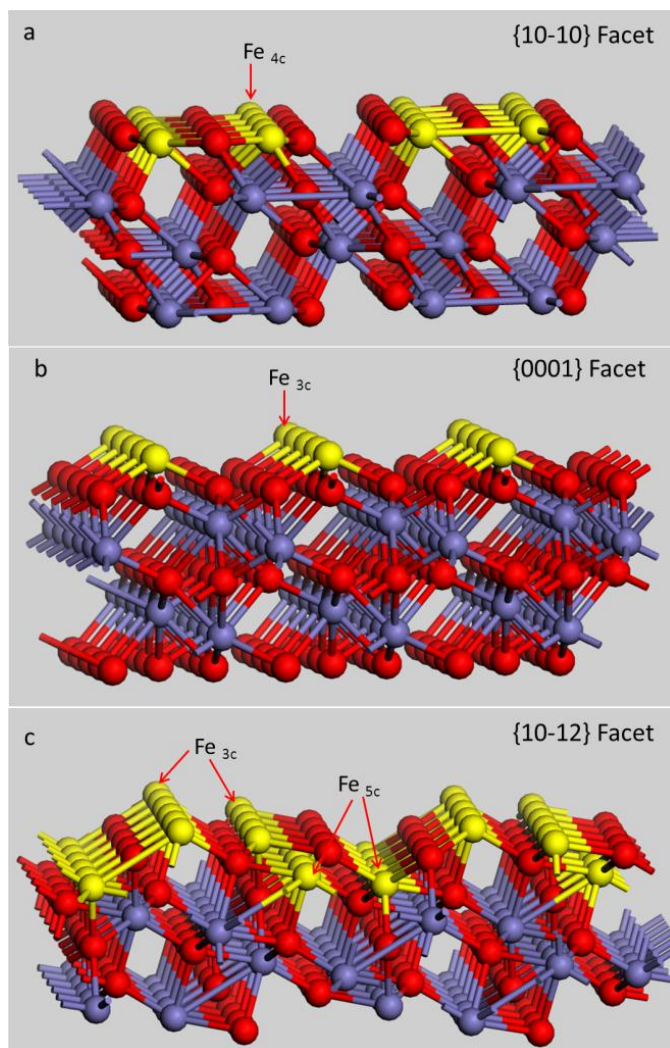
The morphology of the catalyst samples were determined by scanning electron microscope (SEM) and high resolution transmission electron microscope (HRTEM) on JEOL 6700F and JEOL 3010, respectively. X-ray diffraction patterns of the catalysts were obtained on a Rigaku D/MAX 2500 diffractometer with Cu radiation (Cu  $K\alpha=0.15406$  nm). BET surface area was measured via nitrogen sorption at 77 K on a surface area analyzer (QuadraSorb SI); the samples were degassed at 150 °C for ten hours before nitrogen adsorption

### Dye adsorption measurement:

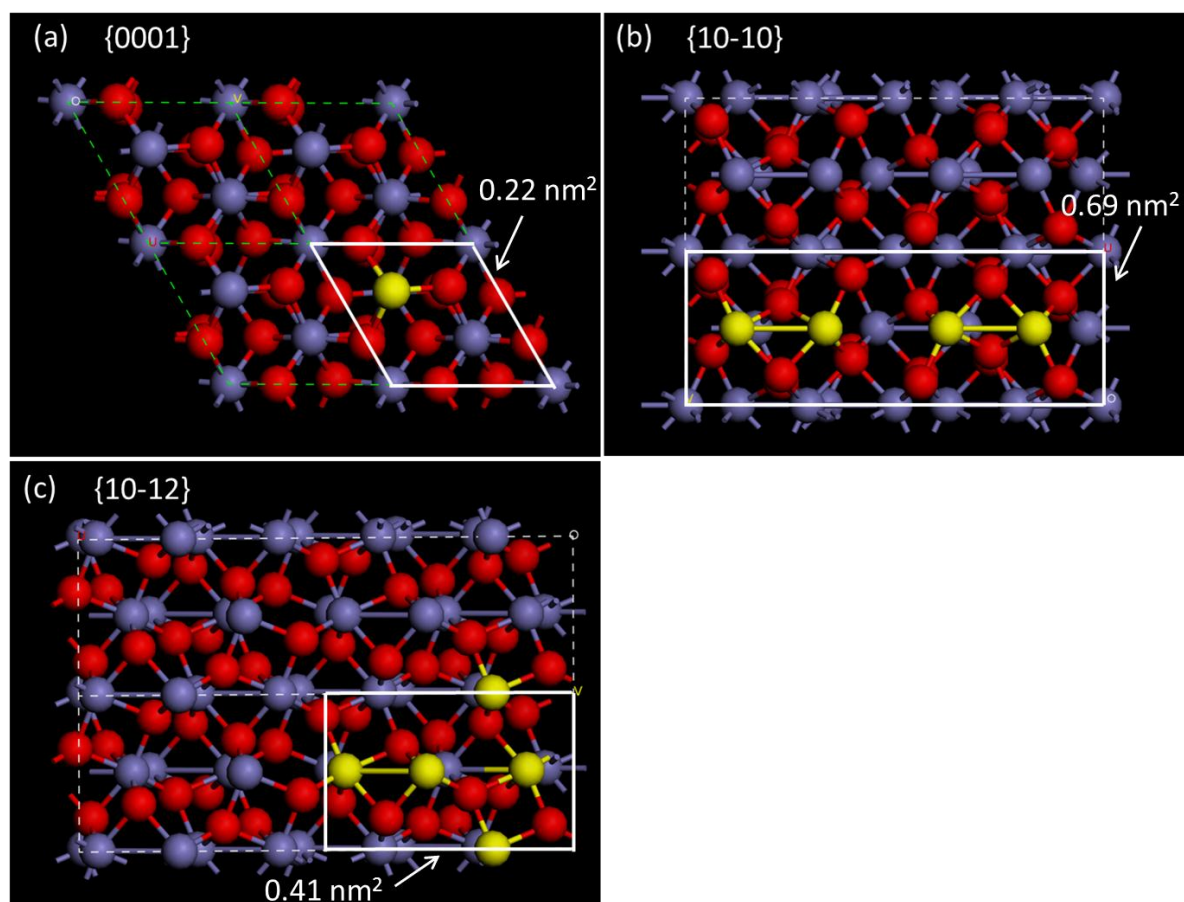
10 mg  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> catalysts, 50 ml aqueous solution containing Rhodamine B ( $2 \times 10^{-5}$  mol/L) and 0.2 ml H<sub>2</sub>O<sub>2</sub> (30 wt.%) was mixed in the Pyrex reactor. After 40 min of stirring in the dark, the solution was centrifuged and measured by a UV-Vis spectrometer. The dye adsorption on the catalyst was calculated from the following equation.

$$b = \frac{A_0 - A_s}{A_0} \times C_0 \times V \div m_{cata.}$$

$b$ : adsorption of RhB on the catalyst;  $A_0$ : the absorbance of the raw dye solution;  $A_s$ : the absorbance of filtrate after adsorption;  $C_0$ : the concentration of the raw dye solution;  $V$ : the volume of the solution;  $m_{cata.}$ : the mass of the catalyst.



**Figure S1.** Atomic arrangement of {10-10}, {0001} and {10-12} crystal facet. Red ball, oxygen atoms; yellow ball, surface exposed iron atoms; blue ball, bulk iron atoms.  $Fe_{3c}$ ,  $Fe_{4c}$  and  $Fe_{5c}$  represents 3, 4 and 5-fold coordinated Fe atoms, respectively.



**Figure S2.** Atomic arrangement of {10-10}, {0001} and {10-12} crystal facet. Red ball, oxygen atoms; yellow ball in the white line boundary, surface exposed iron atoms; blue ball, iron atoms. Surface Fe density on {0001} facet is 4.55/nm<sup>2</sup> (1/0.22 nm<sup>2</sup>); {10-10}: 5.79/nm<sup>2</sup> (4/0.69 nm<sup>2</sup>); {10-12} facet: 9.76/nm<sup>2</sup> (4/0.41 nm<sup>2</sup>).