Supplementary Information

PRED treatment mediated stable and efficient water oxidation performance of Fe_2O_3 nano-coral structure

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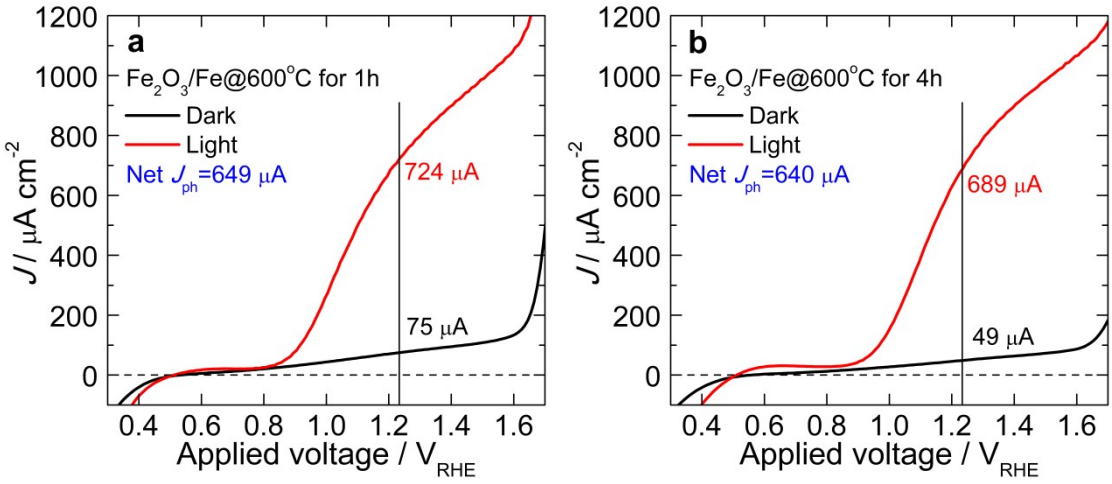

Figure S1. Photocurrent density-voltage curves of Fe_2O_3/Fe electrodes fabricated by conventional annealing (heating@5°C and cooling naturally) of 5 min PRED-treated Fe foil at low temperature 600°C for (a) 1 h and (b) 4 h recorded under dark and light (1 sun) at the scan rate of 50 mV s^{-1}.

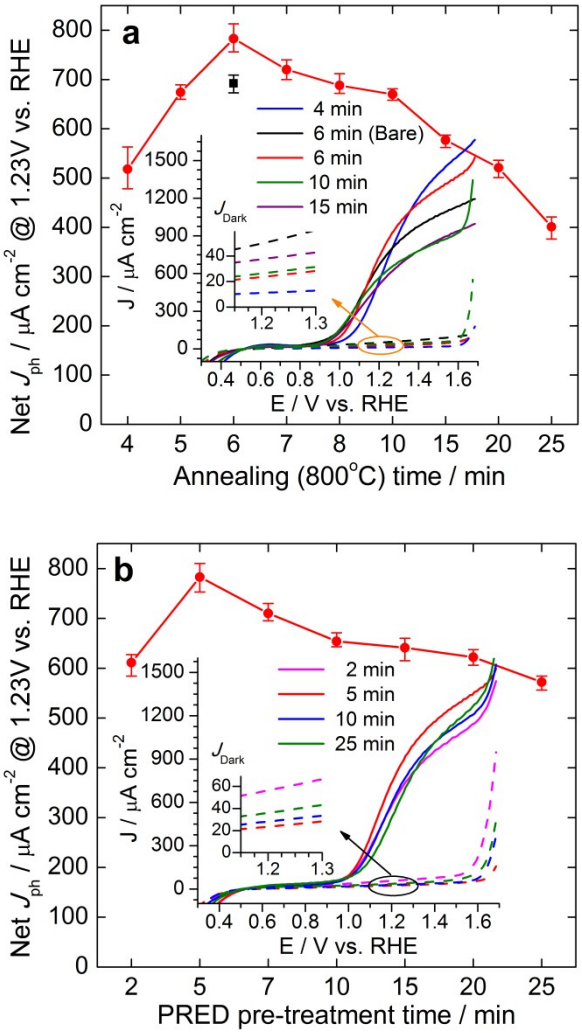

Figure S2. Photocurrent density (J_{ph}) measured at 1.23 V_{RHE} of Fe_2O_3/Fe electrodes fabricated (a) with 5 min PRED pre-treatment time and annealed at different annealing times and a bare Fe_2O_3/Fe electrode annealed at 800 °C for 6 min; (b) with different PRED pre-treatment times annealed at 800 °C for 6 min. Inset shows the *J*–*V* curves of representative PRED-treated α-Fe_2O_3/Fe electrodes with different PRED pre-treatment times. Light illumination, 1 sun; scan rate, 50 mV s^{-1}.

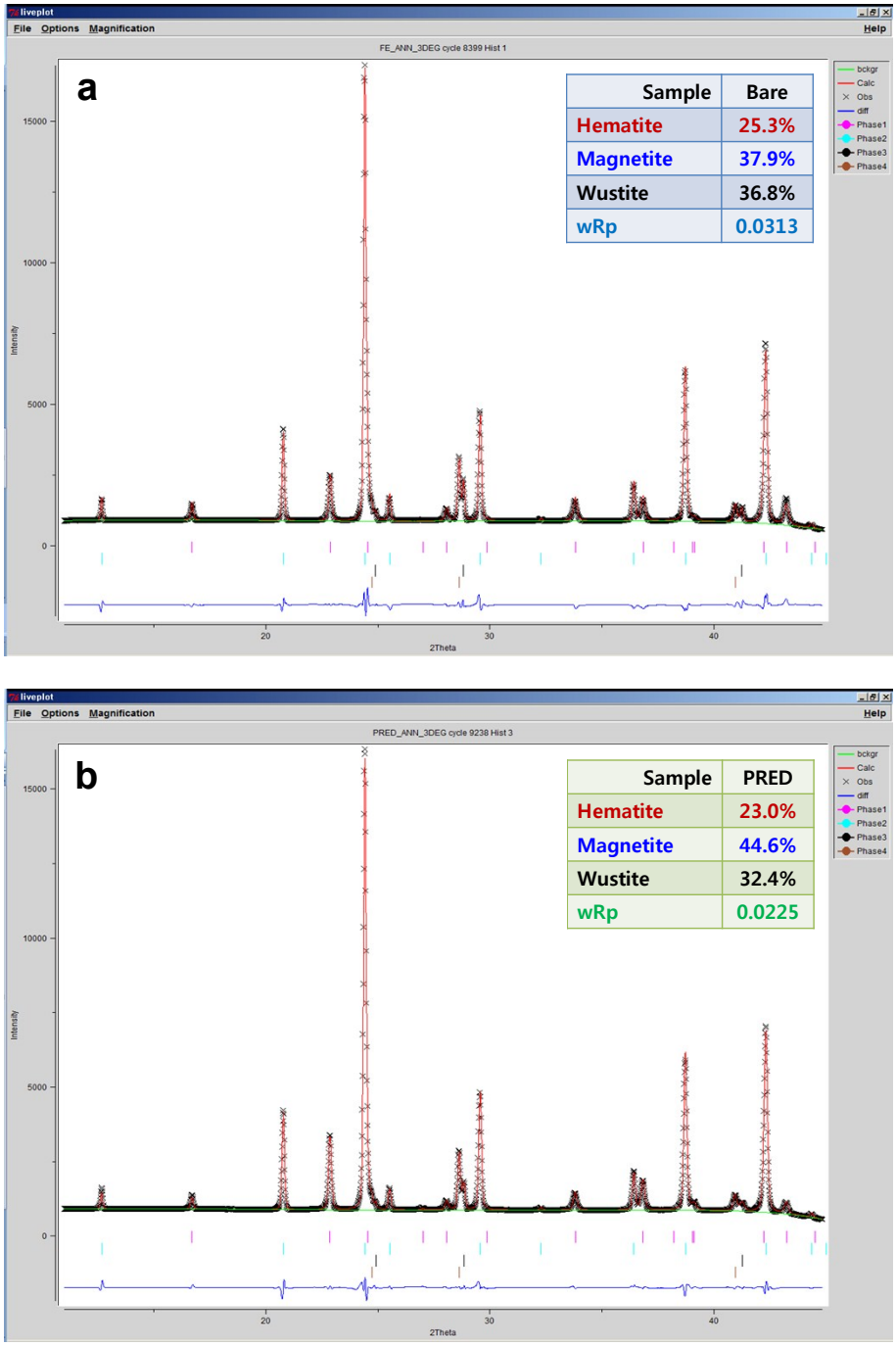

Figure S3. Rietveld analysis (GSAS program) from synchrotron X-ray diffraction patterns of (a) bare and (b) PRED-treated iron oxide/Fe electrodes prepared by annealing at 800 °C for 6 min. Insets show the phase fractions of different phases of iron oxide.

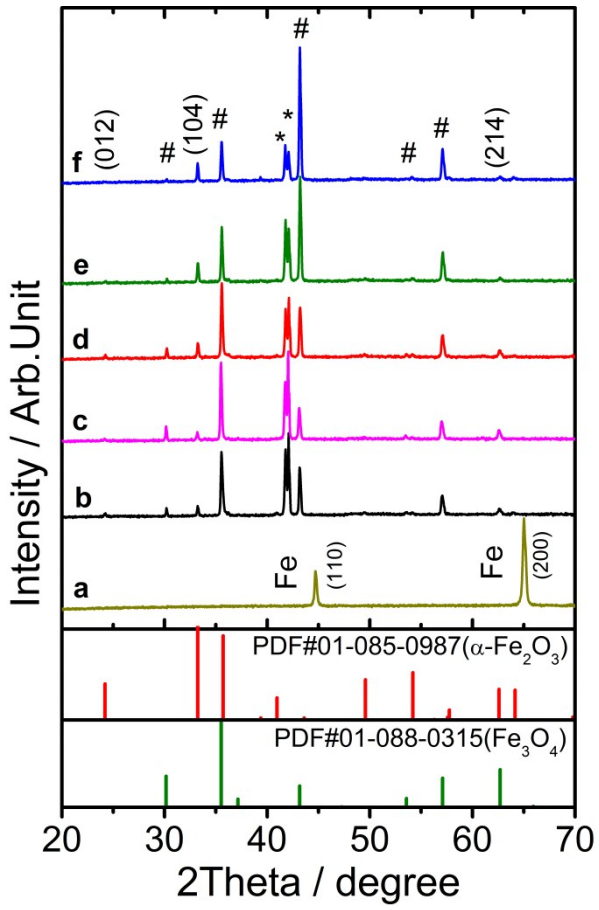

Figure S4. XRD patterns of (a) un-annealed PRED-treated Fe foil, (b) bare Fe foil annealed at 800 °C for 6 min, and PRED-treated Fe foils annealed at 800 °C for different annealing times: (c) 4 min; (d) 6 min; (e) 10 min; (f) 15 min. The symbols * and # represent the Wustite (FeO) and magnetite (Fe_3O_4) phases of iron oxide.

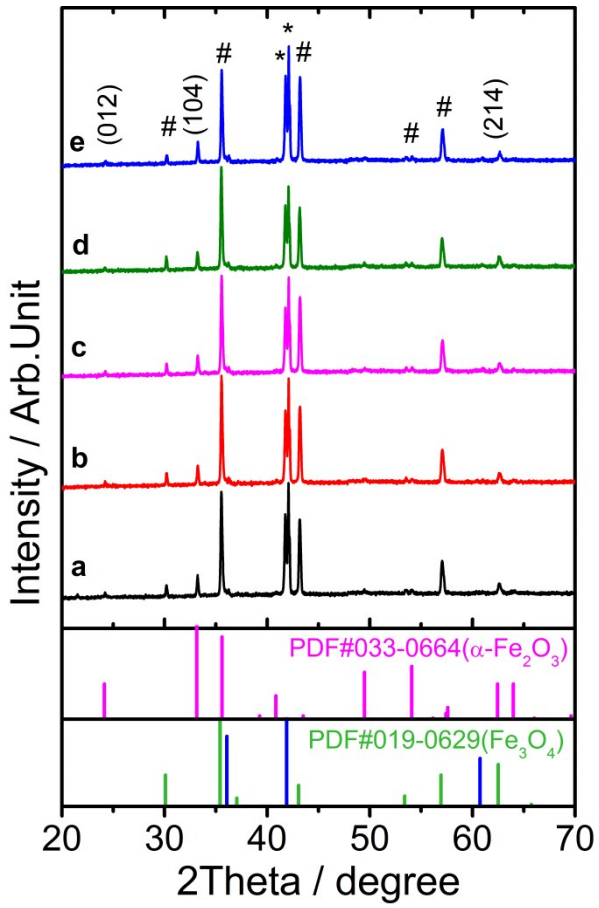

Figure S5. XRD patterns of PRED-treated electrodes for different PRED times: (a) 2 min, (b) 5 min, (c) 10 min, (d) 15 min, and (e) 25 min, all annealed at 800 °C for 6 min. The symbols * and # represent the Wustite (FeO) and magnetite (Fe_3O_4) phases of iron oxide.

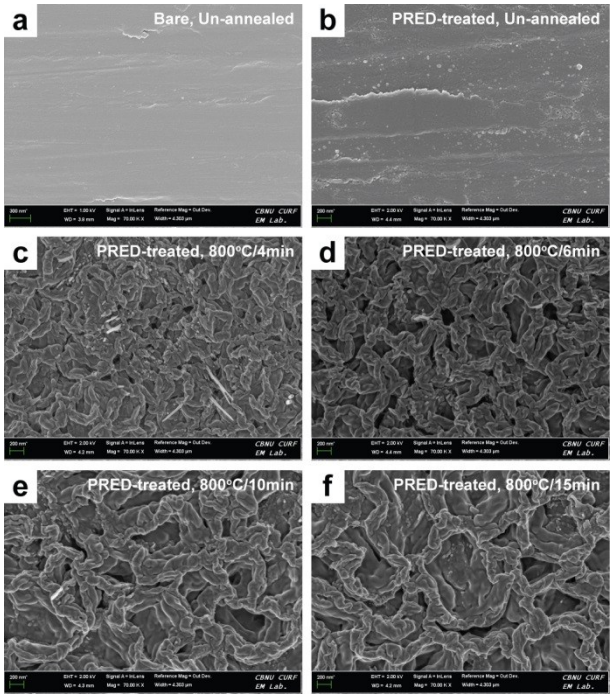

Figure S6. FESEM surface images of bare: (a) un-annealed Fe foil, PRED-treated Fe_2O_3/Fe electrodes for different PRED times: (a) 2 min, (b) 10 min, (c) 15 min, and (d) 25 min, all annealed at 800 ^oC for 6 min.

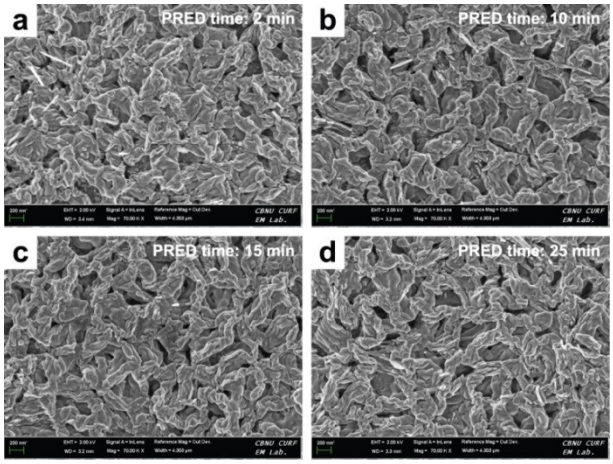

Figure S7. FESEM surface images of PRED-treated Fe_2O_3/Fe electrodes for different PRED times: (a) 2 min, (b) 10 min, (c) 15 min, and (d) 25 min, all annealed at 800 ^oC for 6 min.

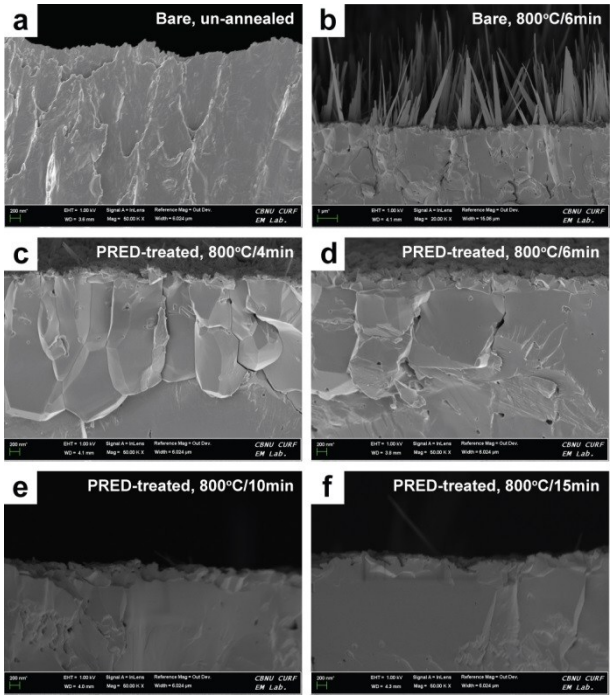

Figure S8. Cross-sectional FESEM images of Fe_2O_3/Fe electrodes, bare: (a) un-annealed Fe foil, (b) 6 min annealed, and PRED-treated: annealed at 800 °C for (c) 4 min, (e) 6 min, (f) 10 min, and (g) 15 min.

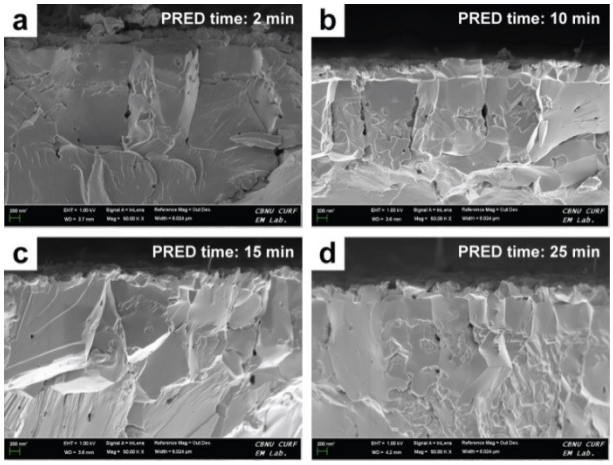

Figure S9. Cross-sectional FESEM images of PRED-treated Fe_2O_3/Fe electrodes for different PRED times: (a) 2 min, (b) 10 min, (c) 15 min and (d) 25 min, all annealed at 800 °C for 6 min.

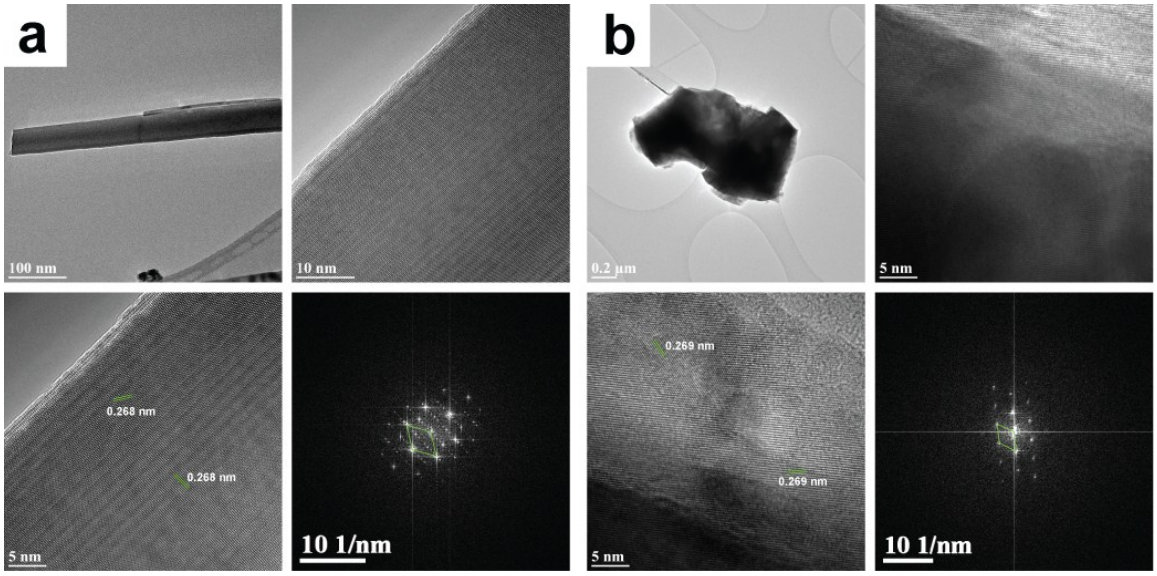

Figure S10. Low and high magnification HR-TEM images and corresponding FFTs of (a) bare and (b) PRED-treated iron oxide samples annealed at 800 °C for 6 min.

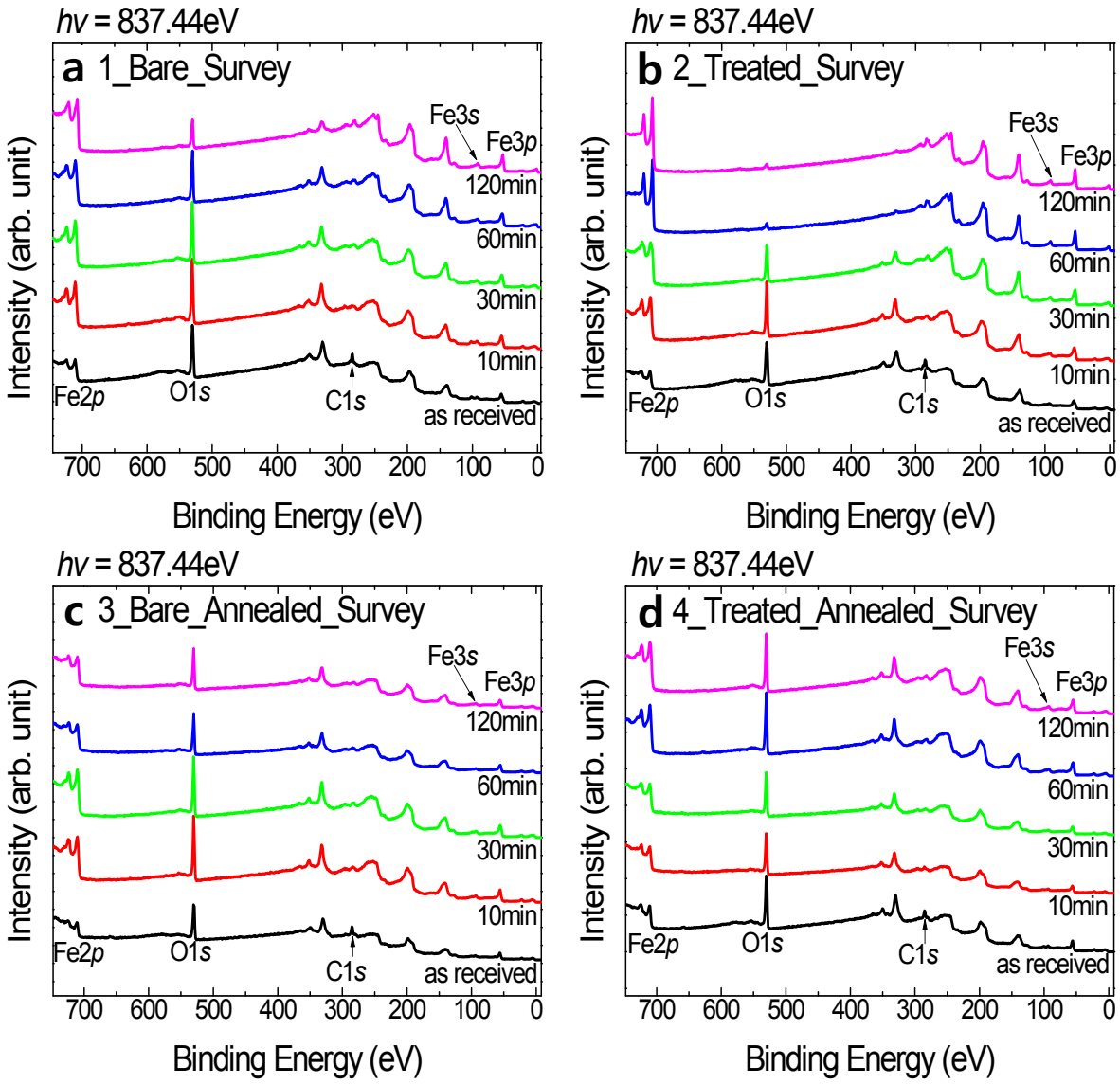

Figure S11. XPS survey spectra recorded during depth profiling of different samples (a) bare and (b) 5 min PRED-treated Fe foil, and (c) bare and (d) PRED-treated iron oxide samples annealed at 800 °C for 6 min. Sputtering depth time was varied as 0, 10, 30, 60 and 120 min.

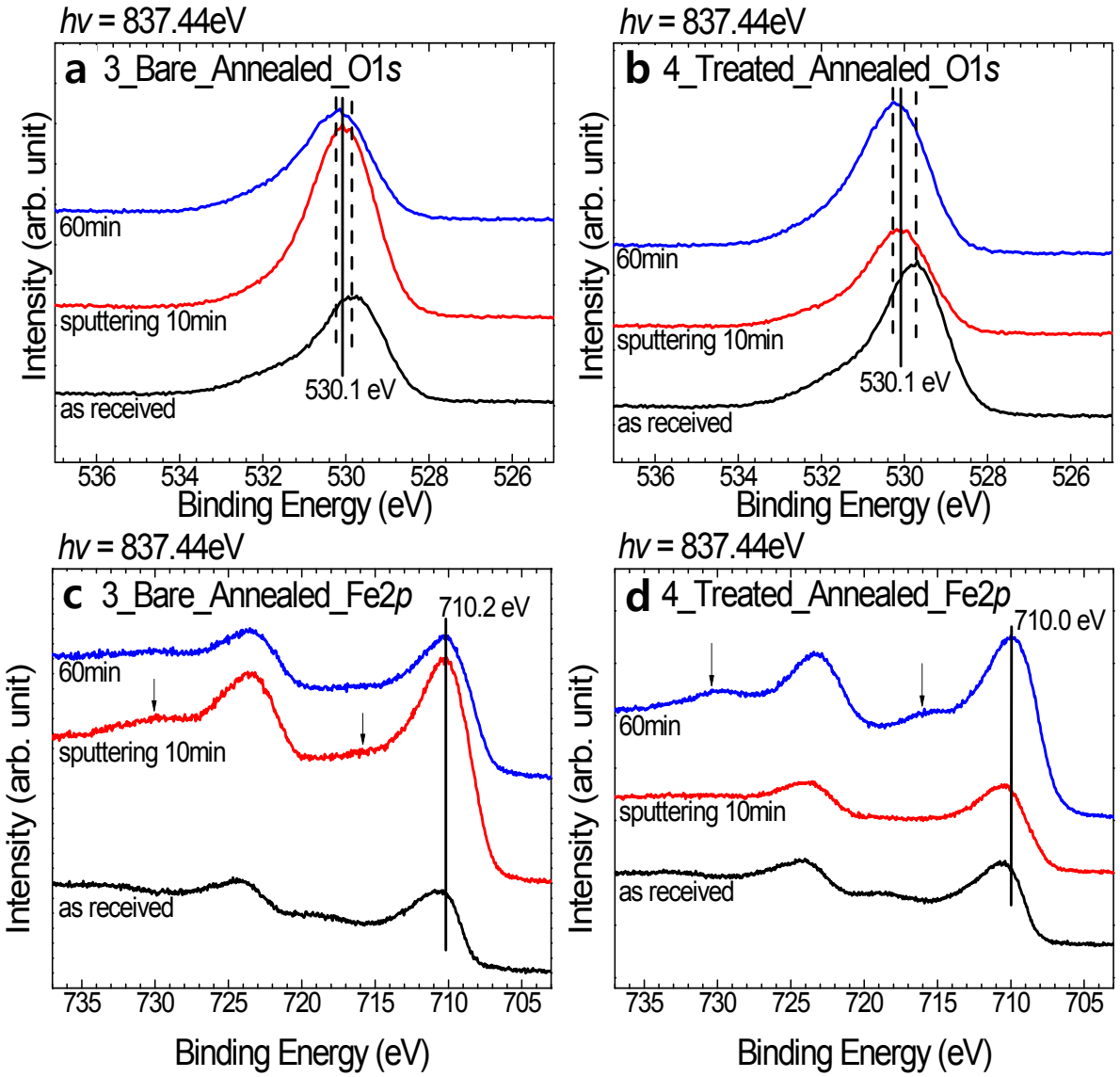

Figure S12. High resolution XPS spectra of (a-b) O1s and (c-d) Fe2p regions during depth profile analysis of bare and 5 min PRED-treated Fe foil samples annealed at 800 °C for 6 min.

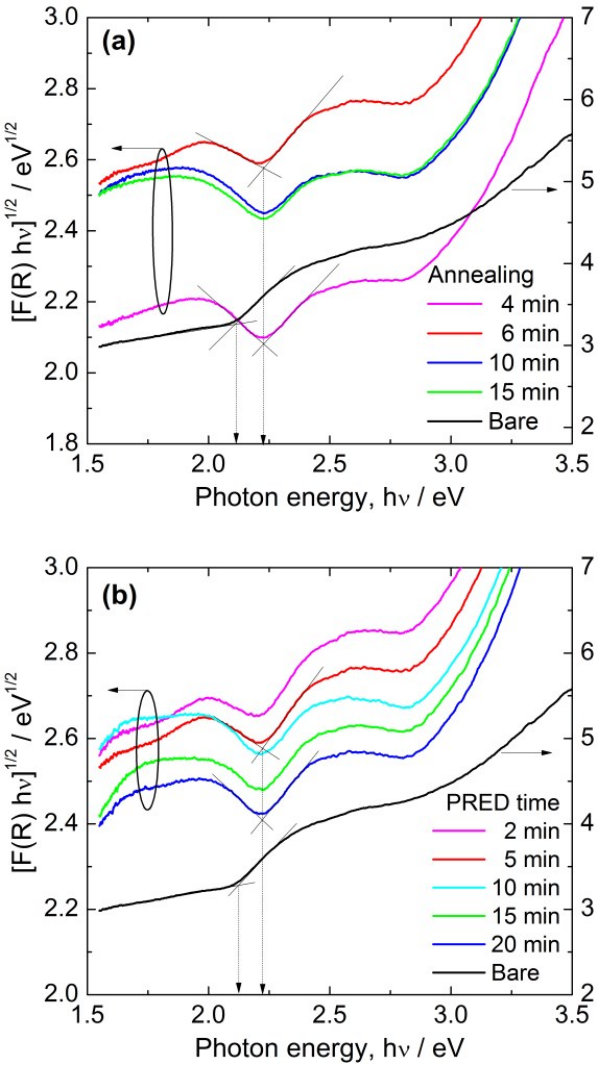

Figure S13. Kubelka−Munk plots obtained from the diffused reflectance (UV-vis) study of (a) untreated and PRED-treated Fe_2O_3/Fe electrodes annealed at 800 °C for different annealing times (b) untreated and PRED-treated Fe_2O_3/Fe electrodes annealed at 800 °C for 6 min with different PRED treatment times. The Kubelka−Munk plots revealed indirect band gap (E_g) energies in the range of 2.11−2.23 eV.

References

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