Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting information

Enhanced Photocurrent Density of Hematite Thin Films on FTO Substrates: Effect of Post-Annealing Temperature

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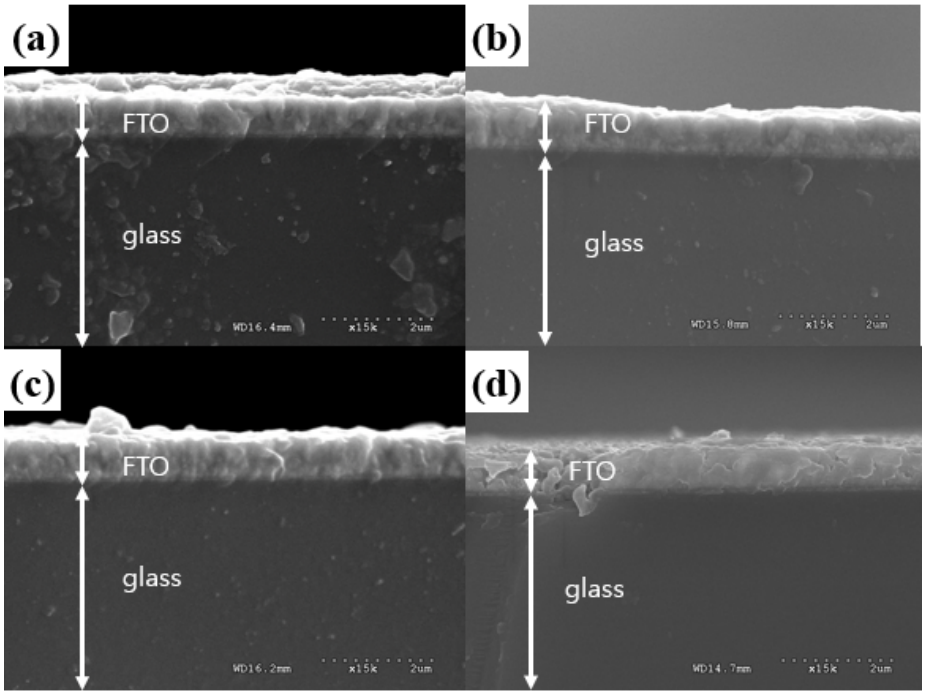

Figure S1. Cross-sectional SEM images of 10DA hematite films (a) H550 (b) H 600 (c) H700 and (d) H800 (all scale bars are 2μm).

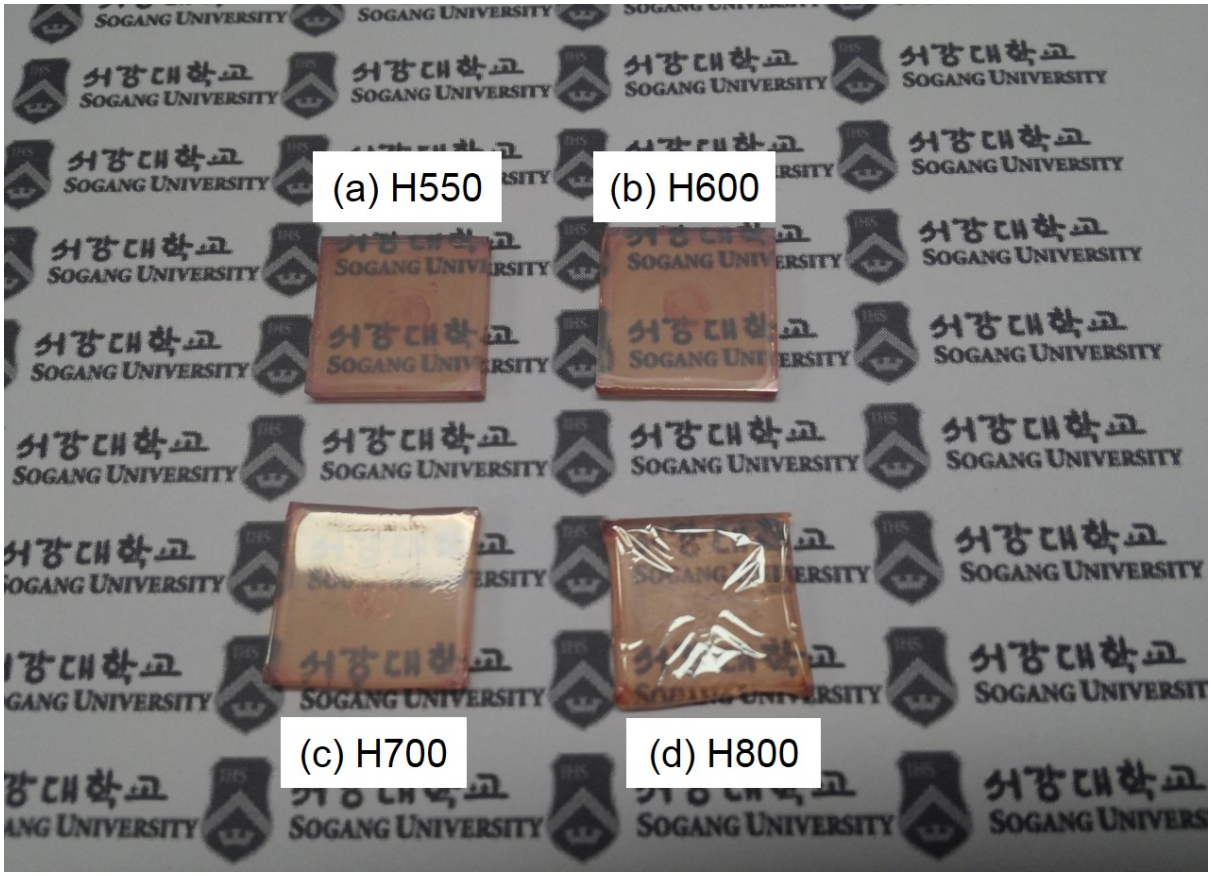

Figure S2. Digital pictures of H550, H600, H700 and H800 hematite thin films prepared by deposition and annealing (DA) method of 10 DA cycles.

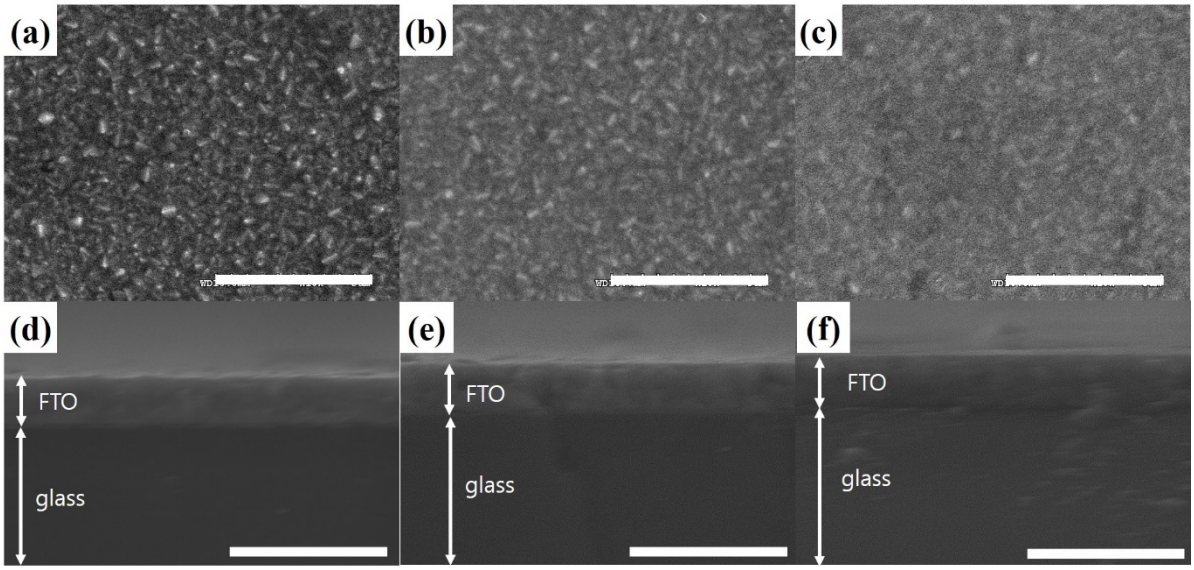

Figure S3. Top-view SEM images of H550 samples with (a) 20 DA (b) 30 DA and (c) 40 DA cycles (all scale bars are 5μm). Cross-sectional SEM images of H550 samples with (d) 20 DA (e) 30 DA and (f) 40 DA cycles (all scale bars are 2μm).

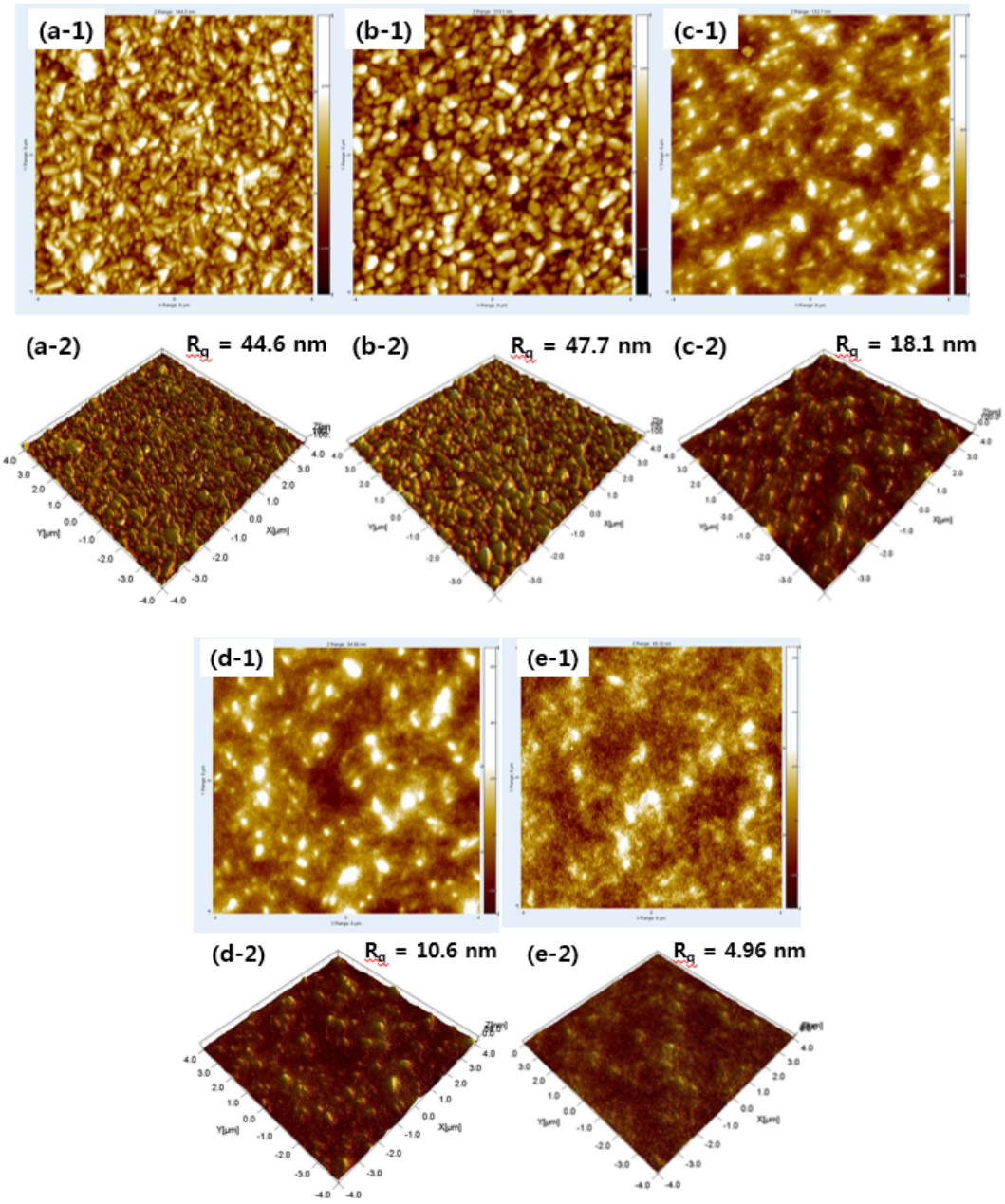

Figure S4. 2D and 3D atomic force microscopy scan images of bare FTO (a-1) and (a-2), H550 with 10 DA (b-1) and (b-2), H550 with 20 DA (c-1) and (c-2), H550 with 30 DA (d-1) and (d-2), H550 with 40 DA (e-1) and (e-2). (8x8 μm image scale, R_q is root mean square roughness of surface).

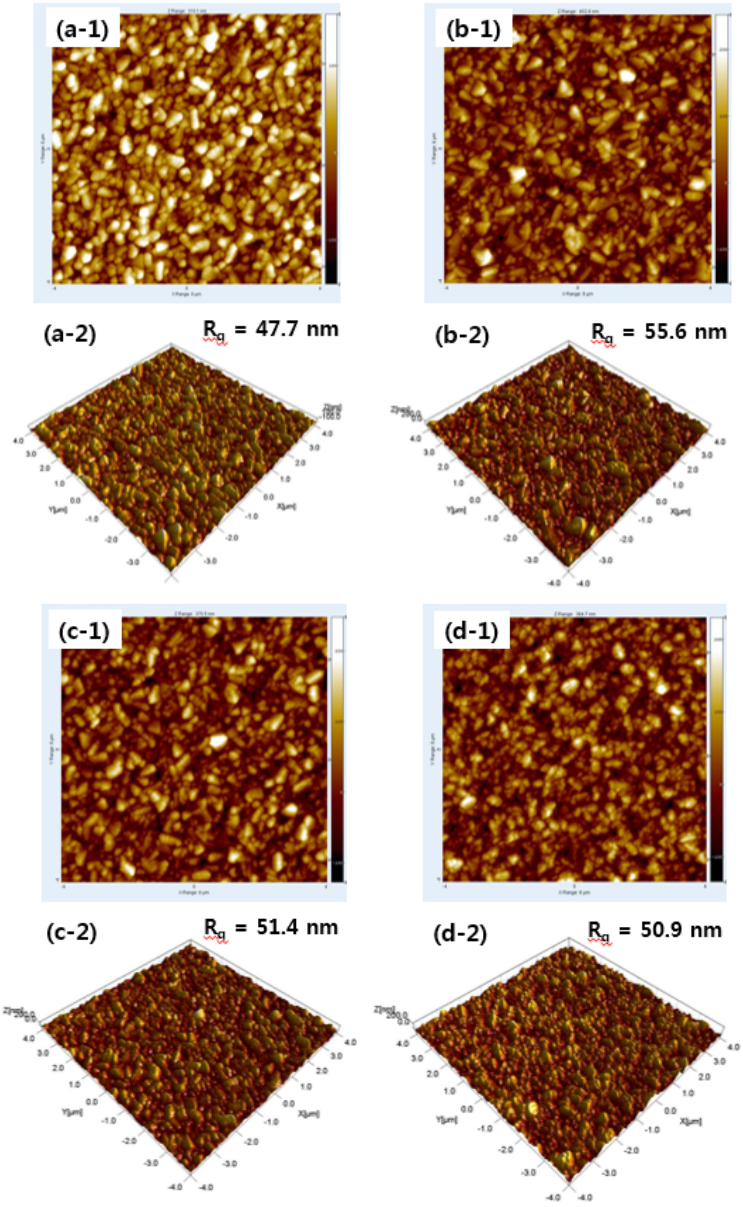

Figure S5. 2D and 3D atomic force microscopy scan images of 10DA hematite films H550 (a-1) and (a-2), H600 (b-1) and (b-2), H700 (c-1) and (c-2), H800 (e-1) and (e-2). (8x8 μm image scale, R_q is root mean square roughness of surface)

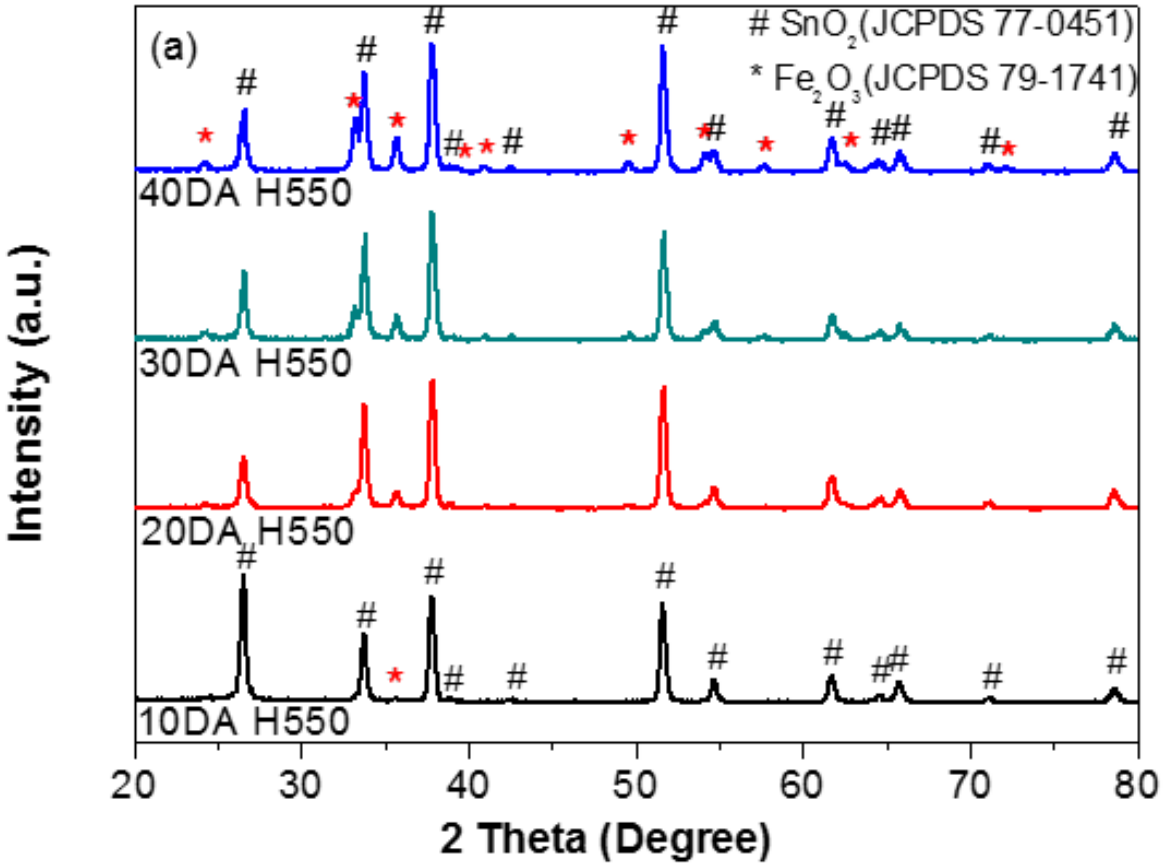

Figure S6. X-ray diffraction (XRD) patterns of H550 samples prepared with 10 DA, 20 DA, 30 DA, and 40 DA cycles (SnO_2 for JCPDS No. 77-0451 and a-Fe_2O_3 for JCPDS No. 79-1741).

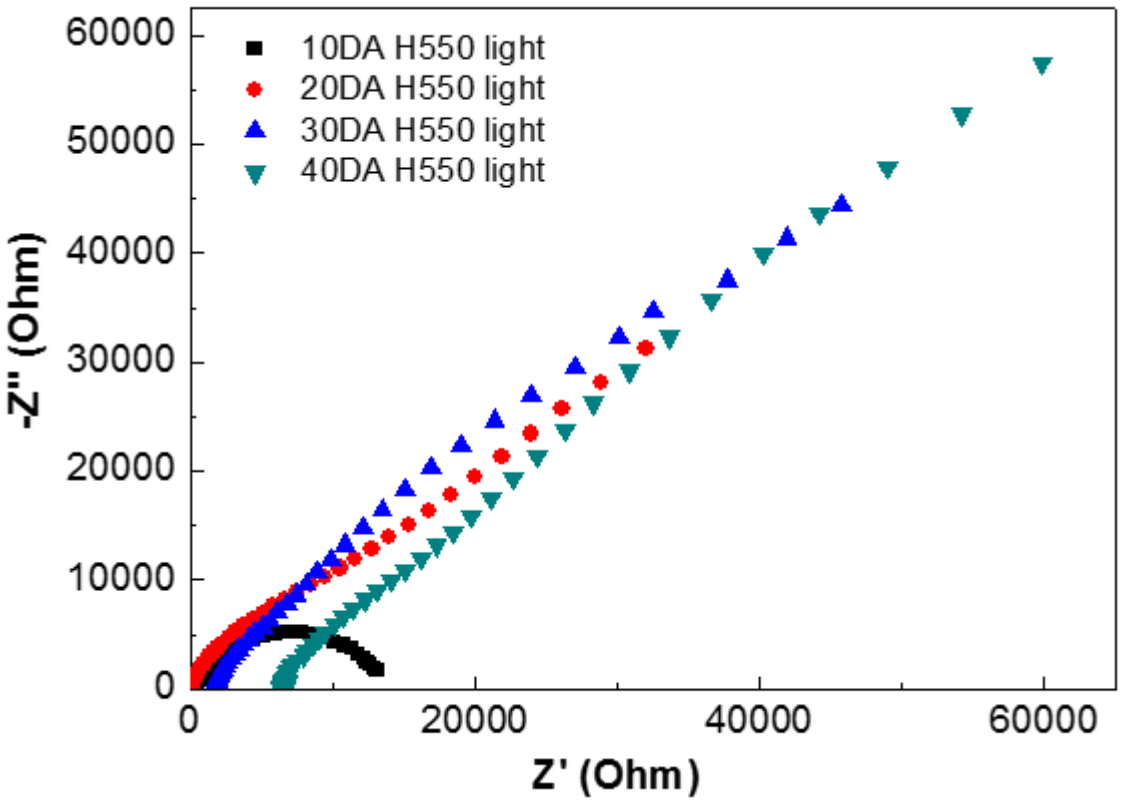

Figure S7. Nyquist plots of H550 films with 10 DA, 20 DA, 30 DA, and 40 DA, with 1 sun illumination condition.

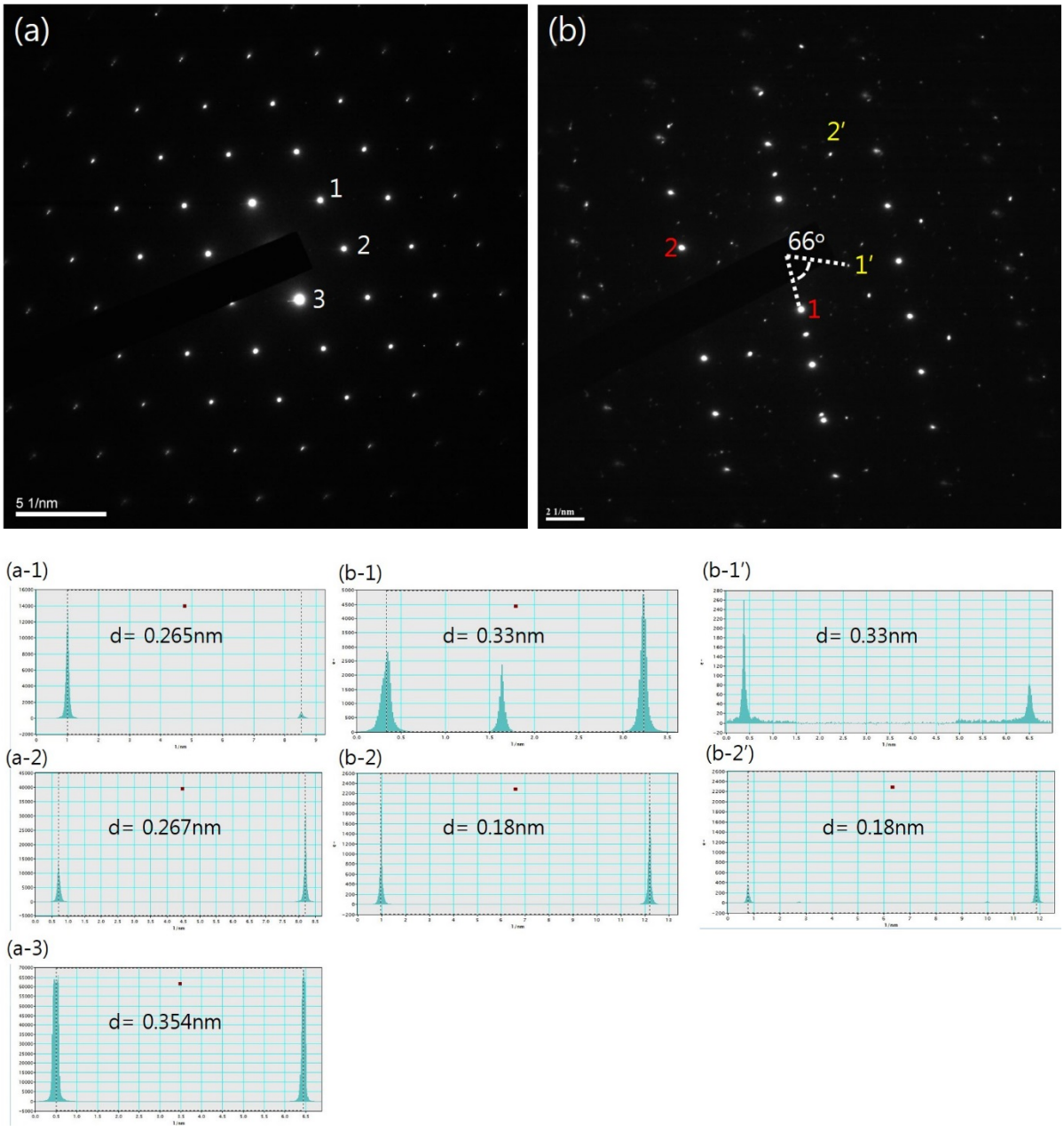

Figure S8. TEM SAED patterns of FTO substrate (SnO_2) for (a) H700 and (b) H800 with 10 DA cycles. Spectrum line profile for spot 1 in H700 (a-1), spot 2 in H700 (a-2), spot 3 in H700 (a-3), spot 1 in H800 (b-1), spot 2 in H800 (b-2), tilted spot 1' in H800 (b-1') and spot 2' in H800 (b-2').

D-spacing values have been calculated by spectrum line profiling. Distance between pattern and pattern has been measured in spectrum line profiling, take the inversed value to get d-spacing value as marked on each spectrum line profiling.

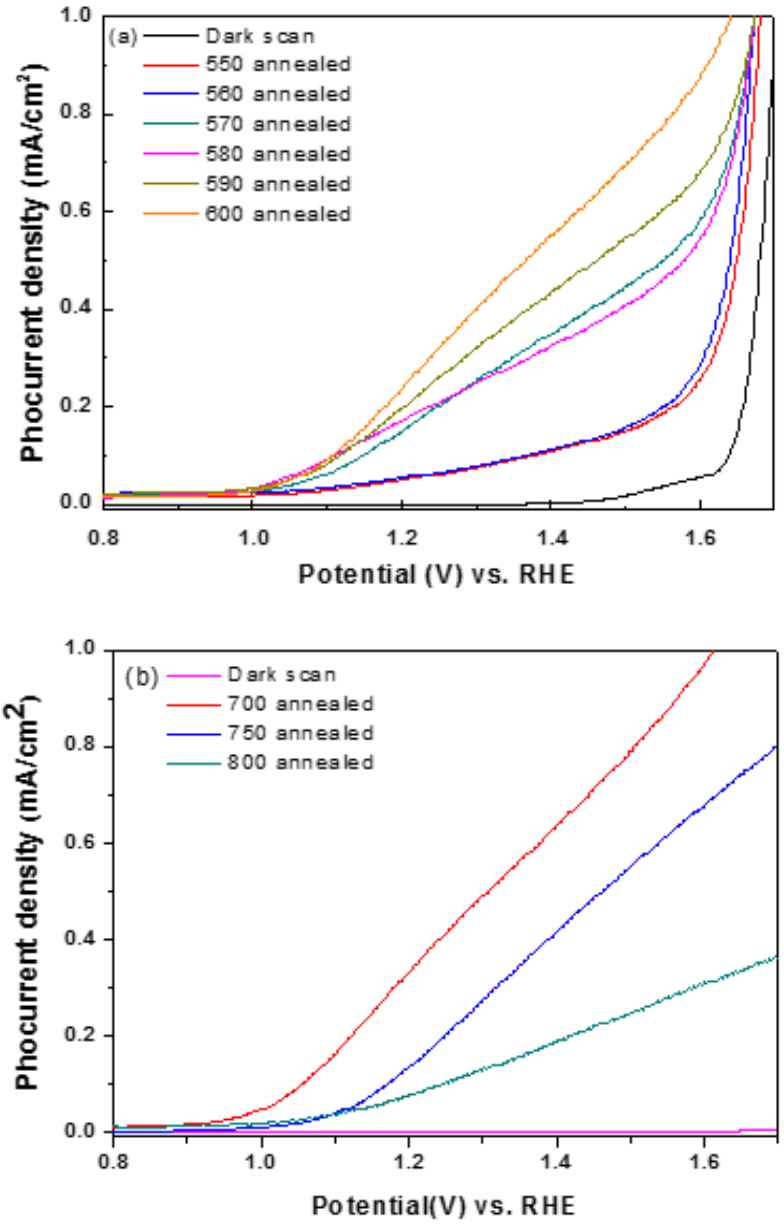

Figure S9. Photocurrent density curves of hematite thin films with 10 DA cycles at different annealing temperature. (a) 550 °C, 560 °C, 570 °C, 580 °C, 590 °C, 600 °C (b) 700 °C, 750 °C, 800 °C.

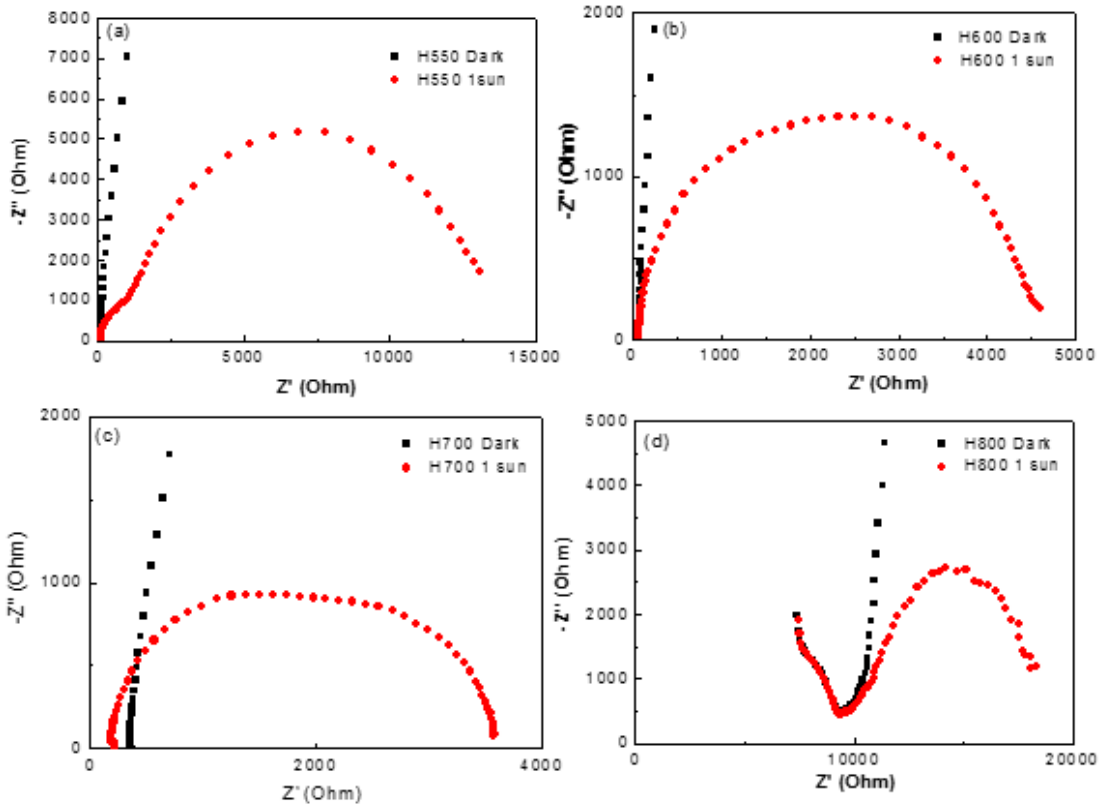

Figure S10. Nyquist plots of (a) H550, (b) H600, (c) H700, (d) H800 with 10 DA in dark condition and 1 sun illumination condition.

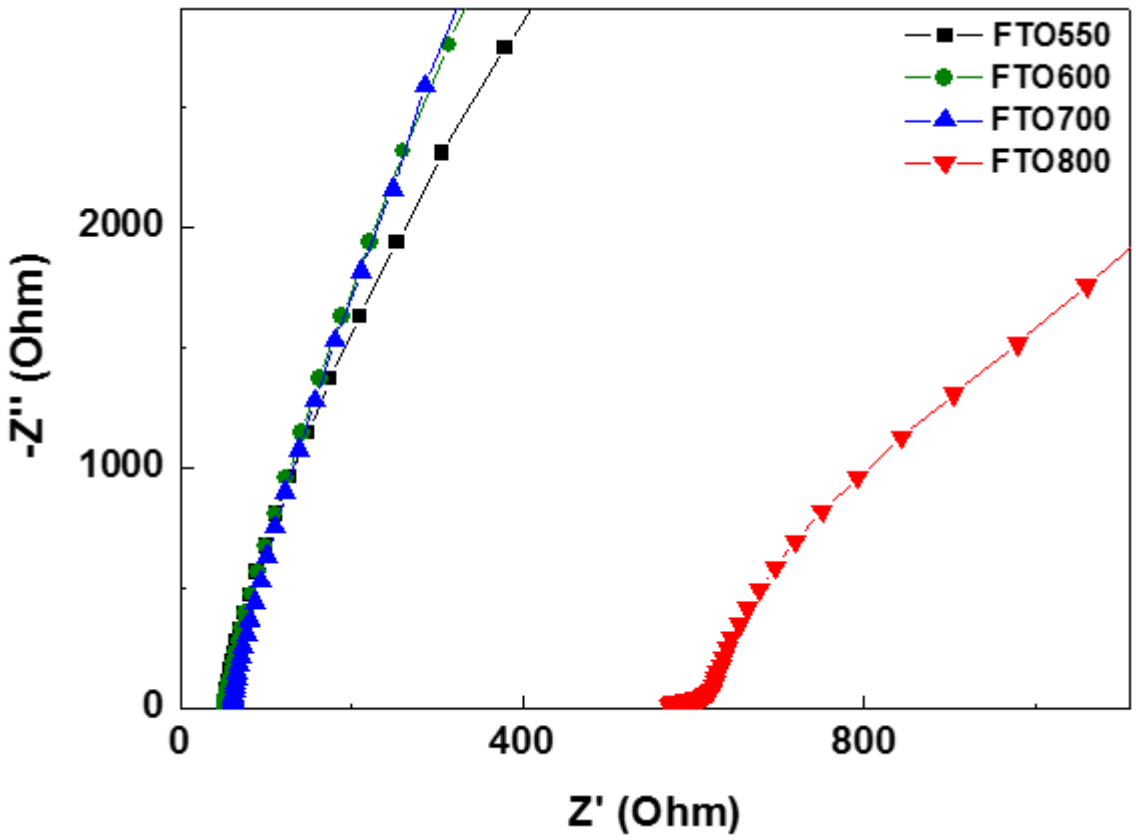

Figure S11. Nyquist plots of (a) FTO550, (b) FTO 600, (c) FTO 700, (d) FTO 800.

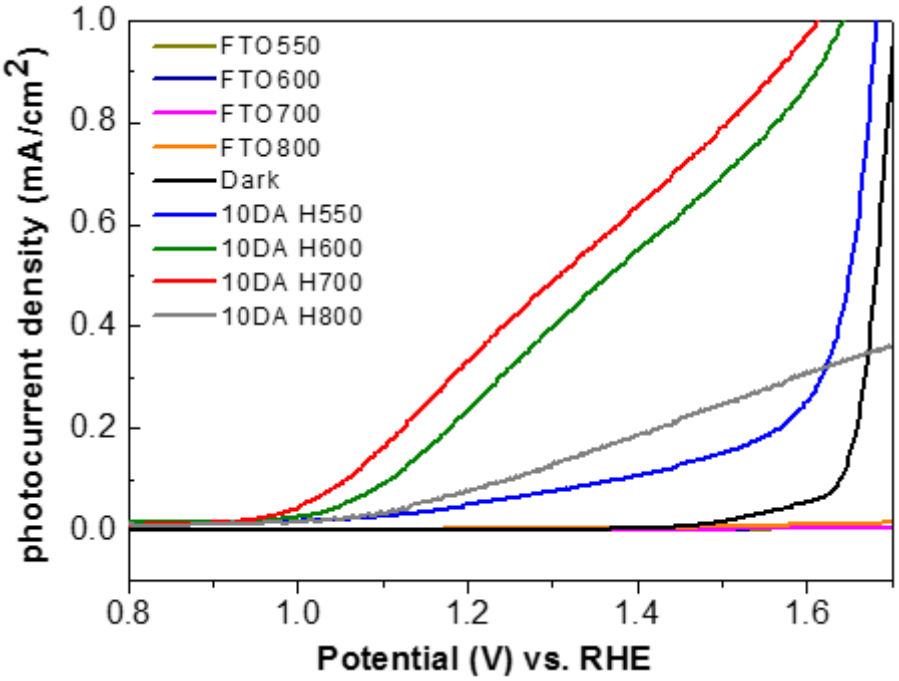

Figure S12. Photocurrent density curves of FTO550, FTO600, FTO700, FTO800, dark scan, H550, H600, H700, and H800 samples with 10 DA.

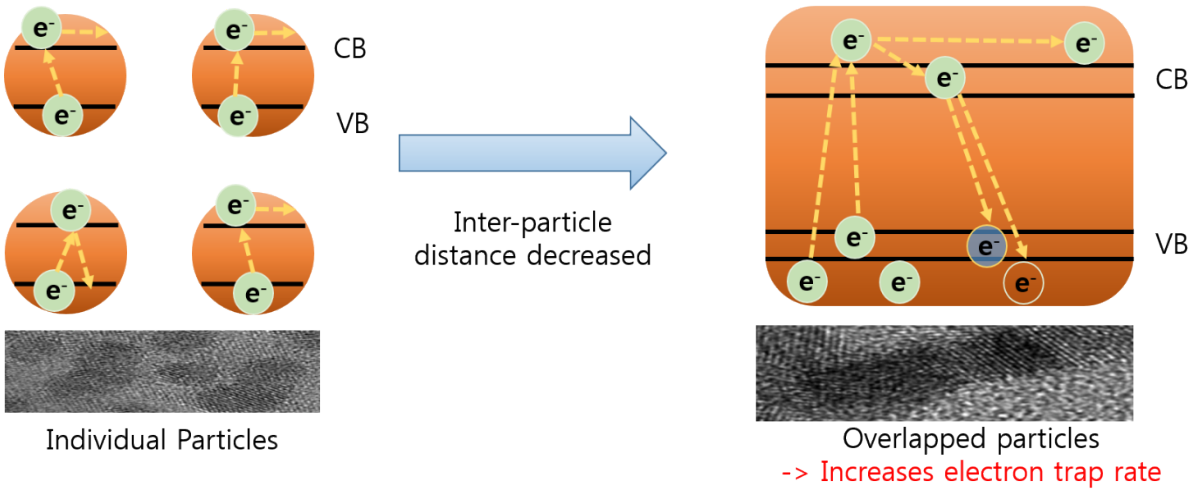

Figure S13. Schematic drawings on wave function overlap and electron-hole recombination rate along the inter-particle distance.

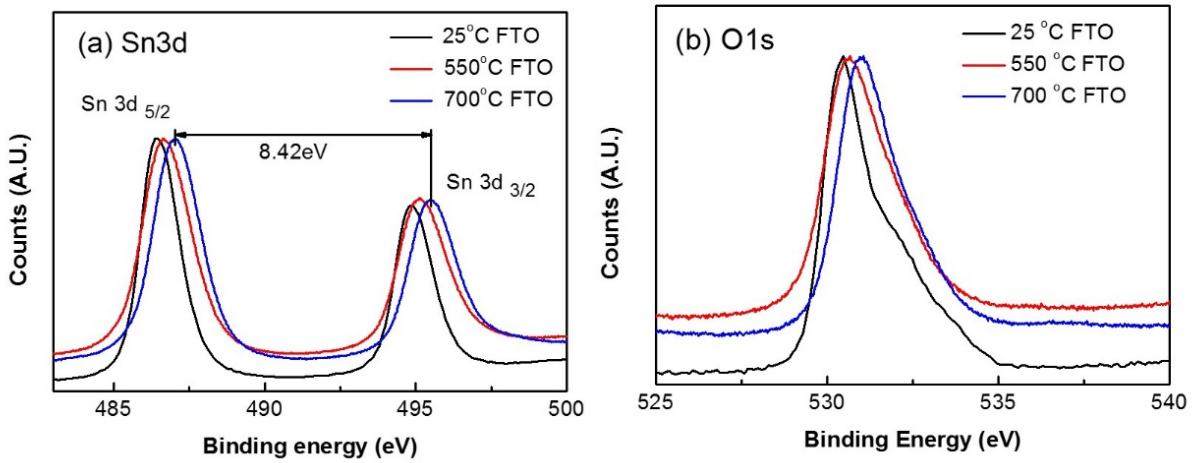

Figure S14. XPS spectra of (a) Sn3d configuration and (b) O1s configuration for 25 °C FTO substrate, FTO substrate annealed at 550 °C and FTO substrate annealed at 700 °C.

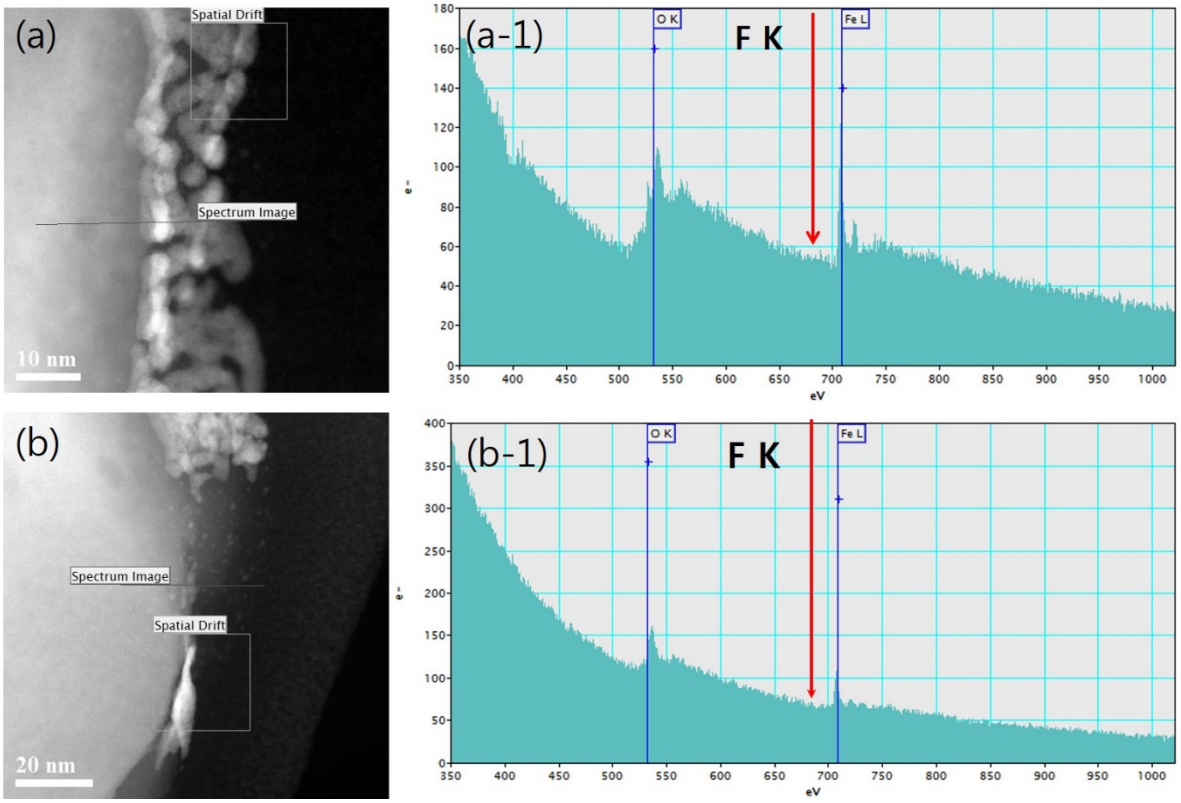

Figure S15. Electron energy loss spectroscopy (EELS) analysis for H700 sample of 10 DA cycles. (a) Image for spectrum, (a-1) spectrum of designated area in (a), (b) image for spectrum, (b-1) spectrum of designated area in (b). Red line is Fluorine K edge peak position.

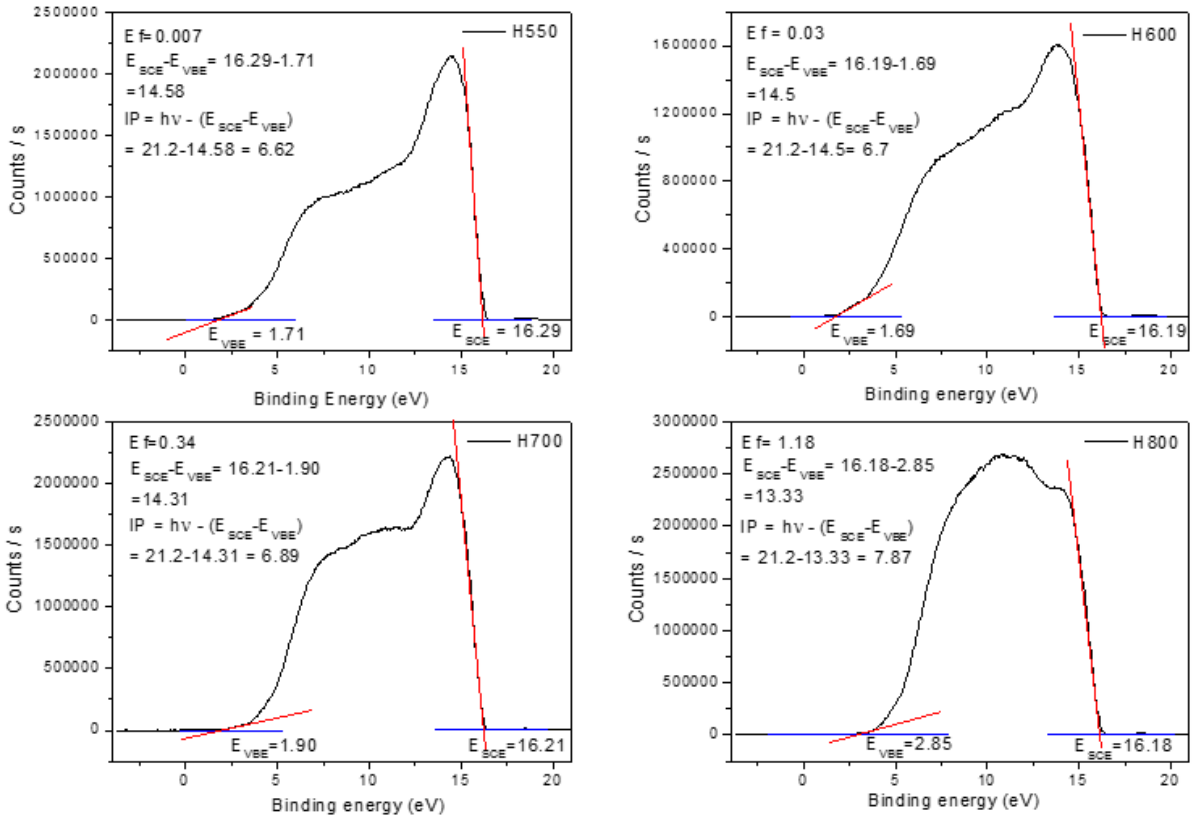

Figure S16. UPS valence band position assignment of (a) H550, (b) H600, (c) H700 and (d) H800 with 10 DA cycles.