Electronic Supplementary Information (ESI)

Discovering a selective semimetal element to increase hematite photoanode charge separation efficiency

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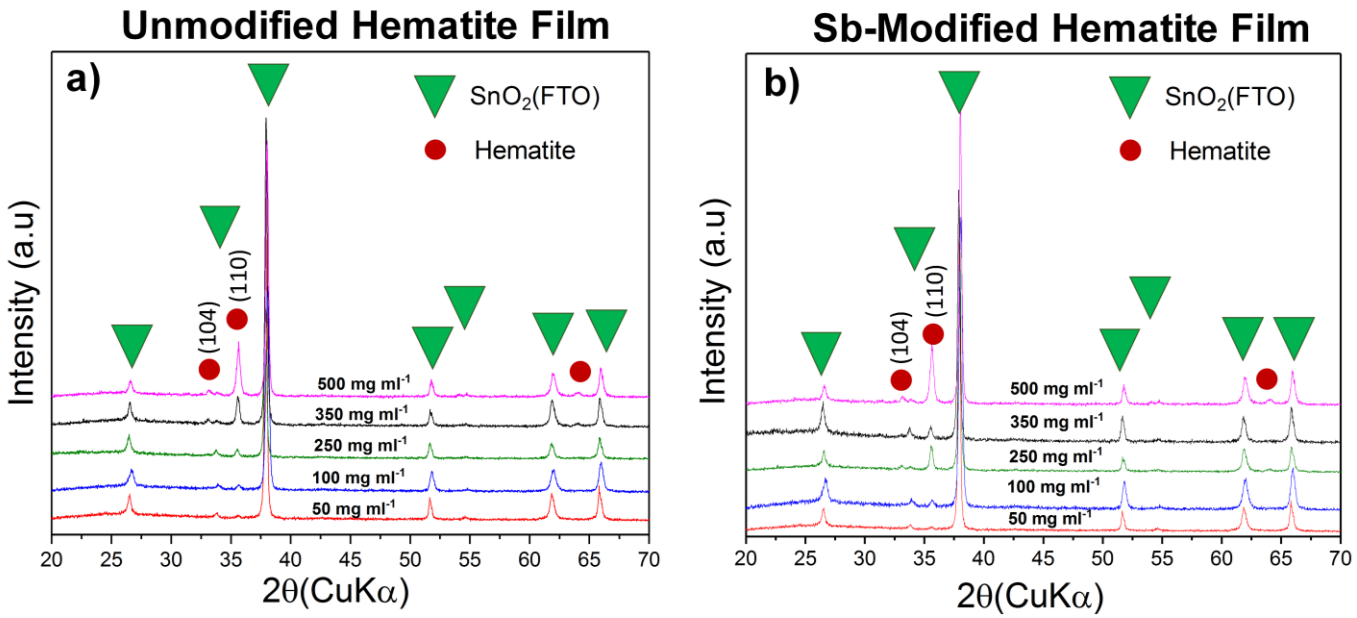

Figure S1. X-ray diffraction patterns of the hematite thin films deposited with different concentrations of the colloidal solution (50 to 500 mg.ml-1): a) unmodified Hematite film; b) Sb-modified hematite film.

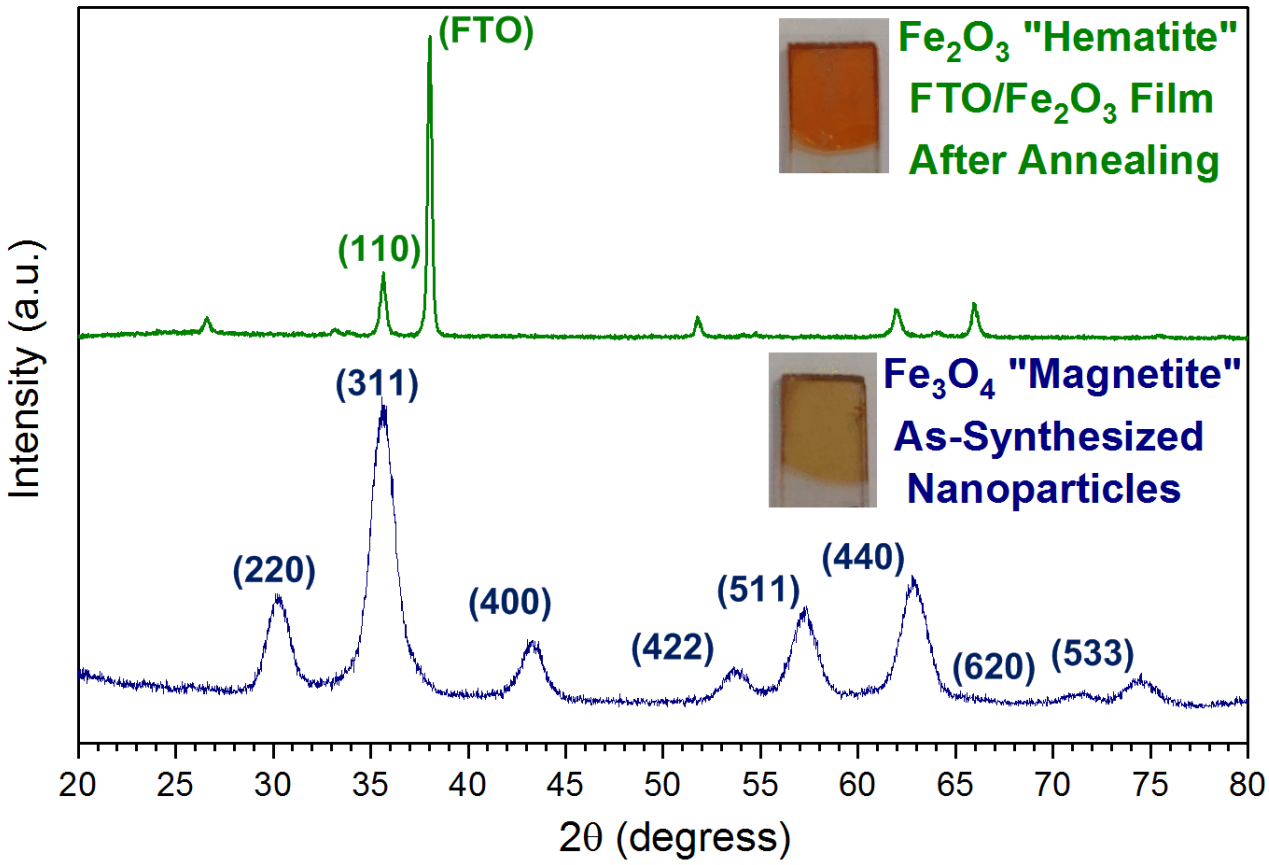

Figure S2. X-ray diffraction pattern of the hematite (Fe_2O_3) thin films deposited over FTO substrate along with the pattern of the as-synthesized magnetite (Fe_3O_4) nanoparticles. The inset photographs show the FTO films before and after phase transformation from magnetite to hematite at 850°C.

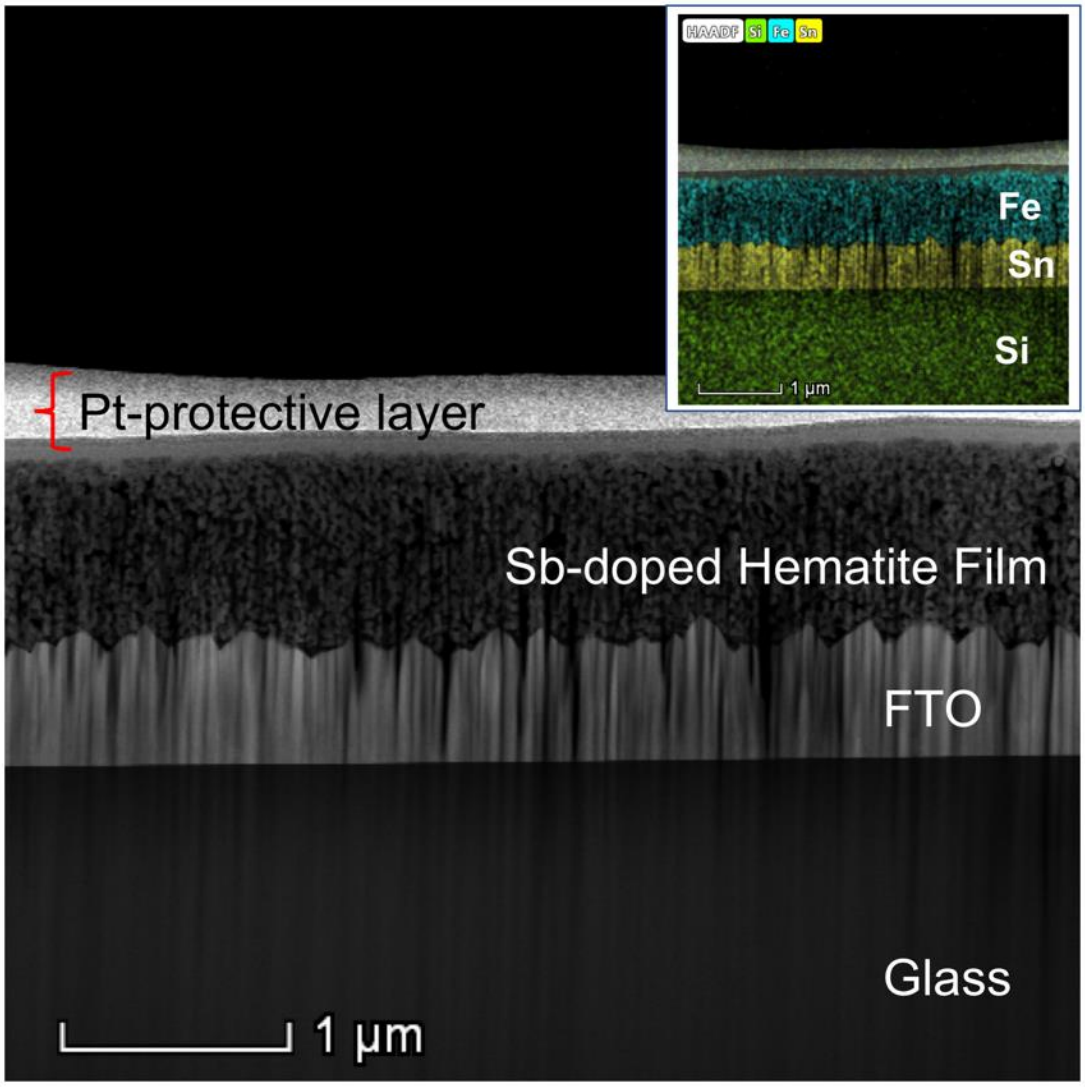

Figure S3. HAADF-STEM image of the cross-section analysis of the Sb-hematite film sintered at 850^{o}C. The inset shows the EDS maps of the same region.

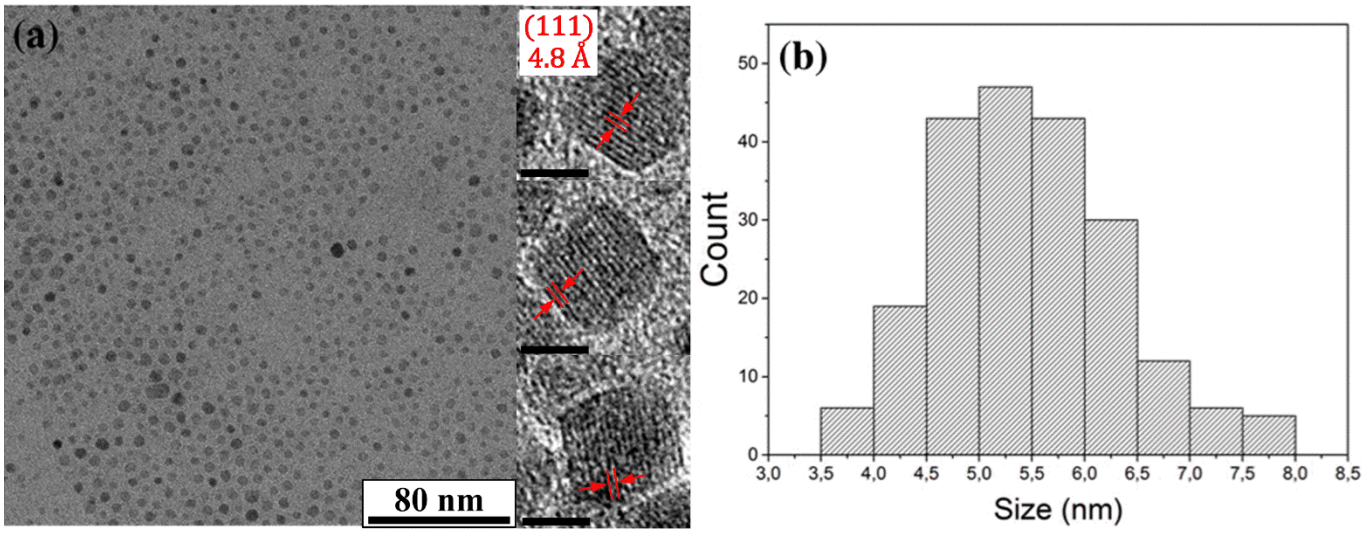

Figure S4. Magnetite nanoparticle characterization: (a) Low magnification TEM image of the magnetite nanoparticles used in this work along with HRTEM images showing the (111) lattice fringes with d_{hkl} equal 4.8 Å, the scale bars have 5 nm; b) Particle size distributions obtained from the TEM analysis.

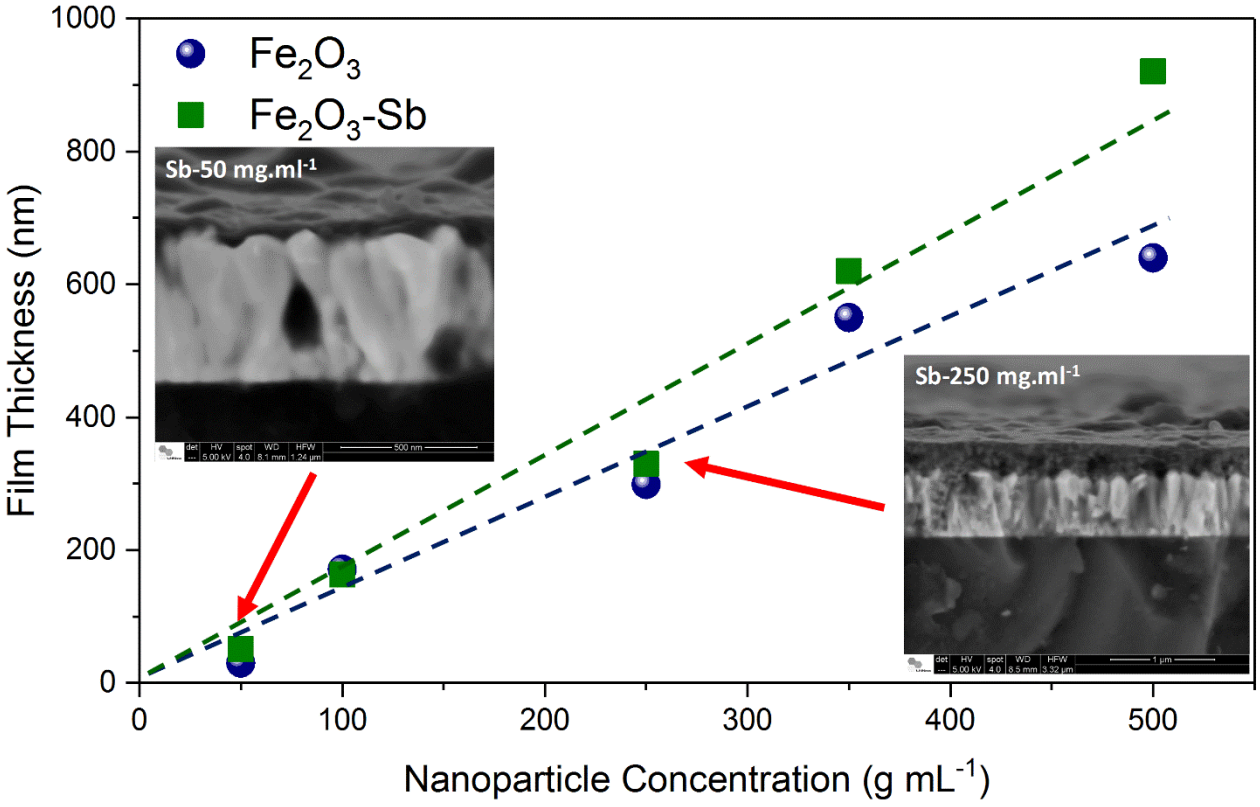

Figure S5 - Variation of the pure and Sb-hematite film thickness as a function of the magnetite nanoparticle concentration in the colloidal solution. The insets show SEM images of Sb-hematite films.

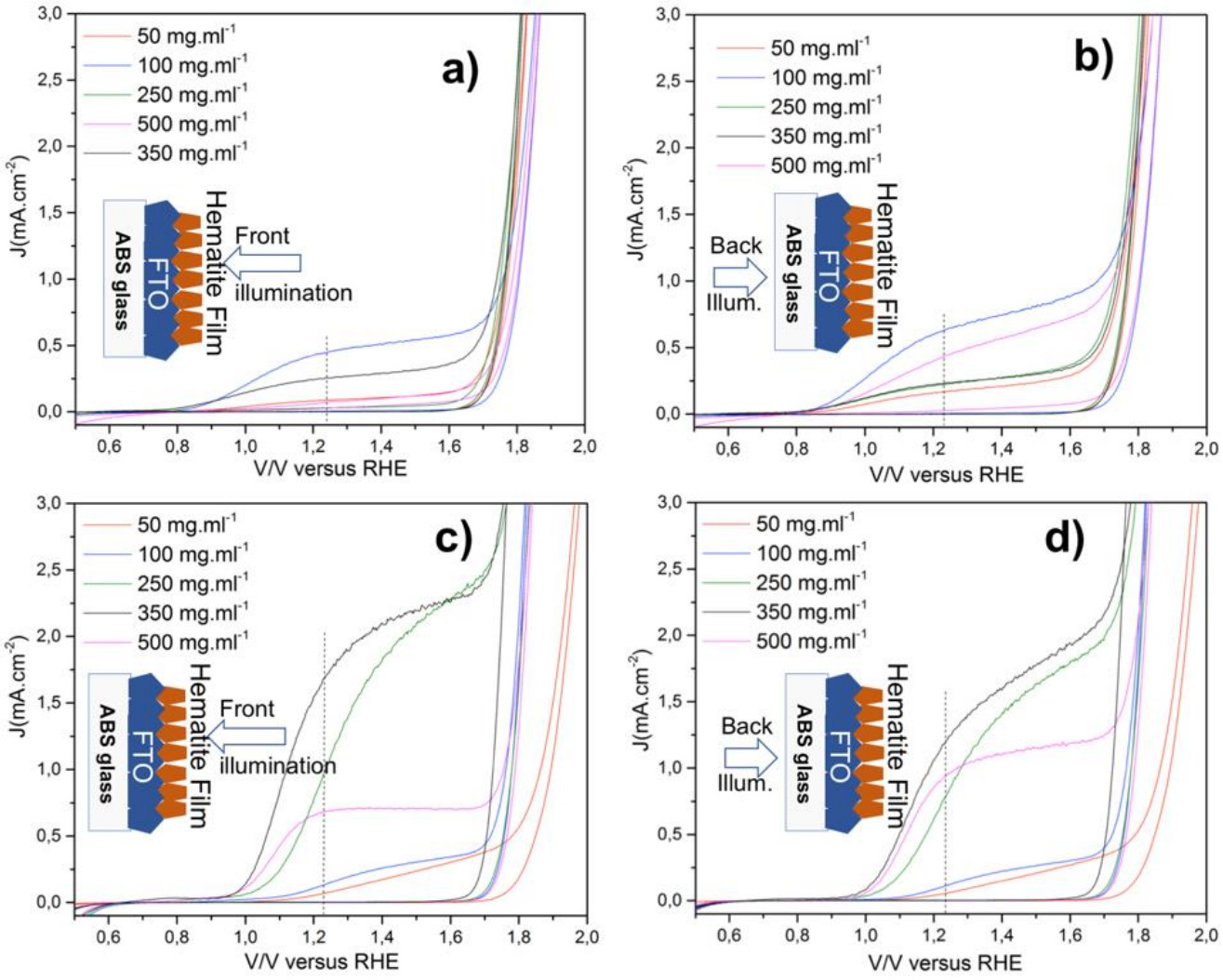

Figure S6 - Current density, *J*, against Voltage, V_{RHE}, curves for (a and b) unmodified, and (c and d) Sb-hematite films with different thickness measured under dark and simulated sunlight irradiation at front side and back side, respectively.

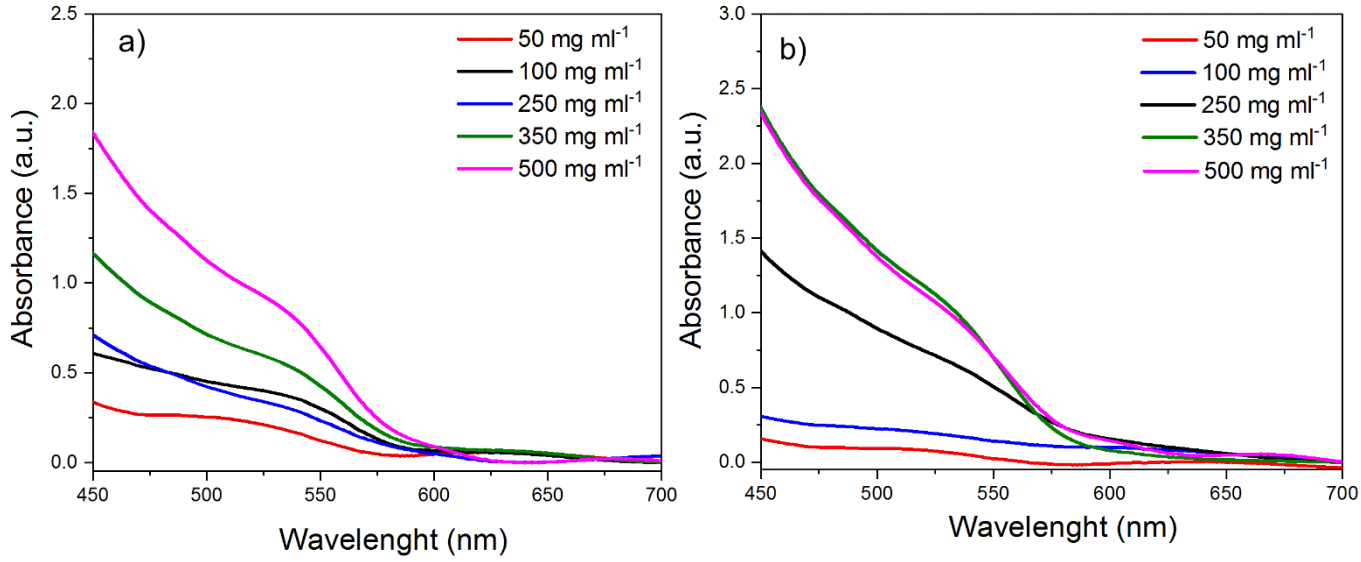

Figure S7. UV-Vis spectra of hematite films deposited with different nanoparticle concentration in colloidal solution (from 50 to 500 mg ml^{-1}): a) hematite and b) Sb- hematite film.

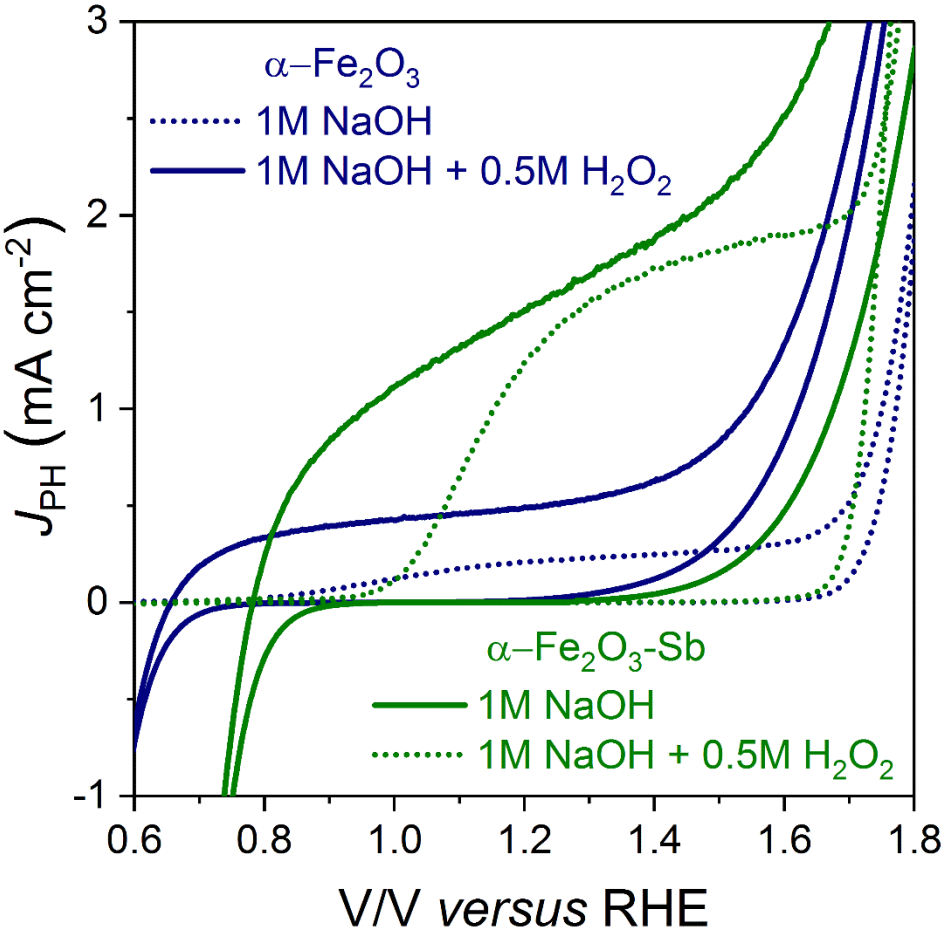

Figure S8. J_{PH} x V curves in darkness and under illumination for the unmodified hematite and Sb-hematite film in 1M NaOH electrolyte with and without 0.5M H_2O_2.

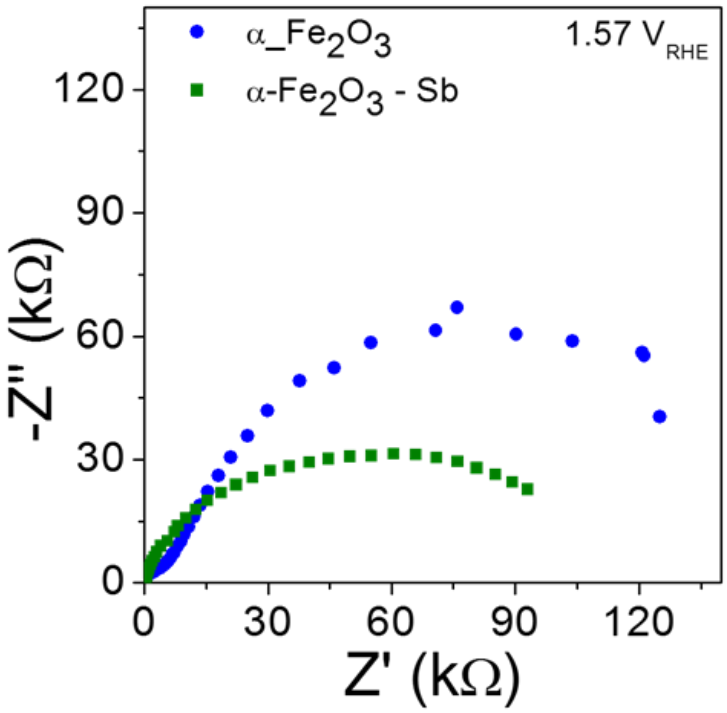

Figure S9. Electrochemical impedance spectra (EIS) obtained for unmodified (blue) and Sb-Hematite (green) films electrode in a 1.0 mol L^{-1} NaOH solution.