

Supplementary Information

Constructing a full-space internal electric field in hematite photoanode to facilitate photogenerated-carrier separation and transfer

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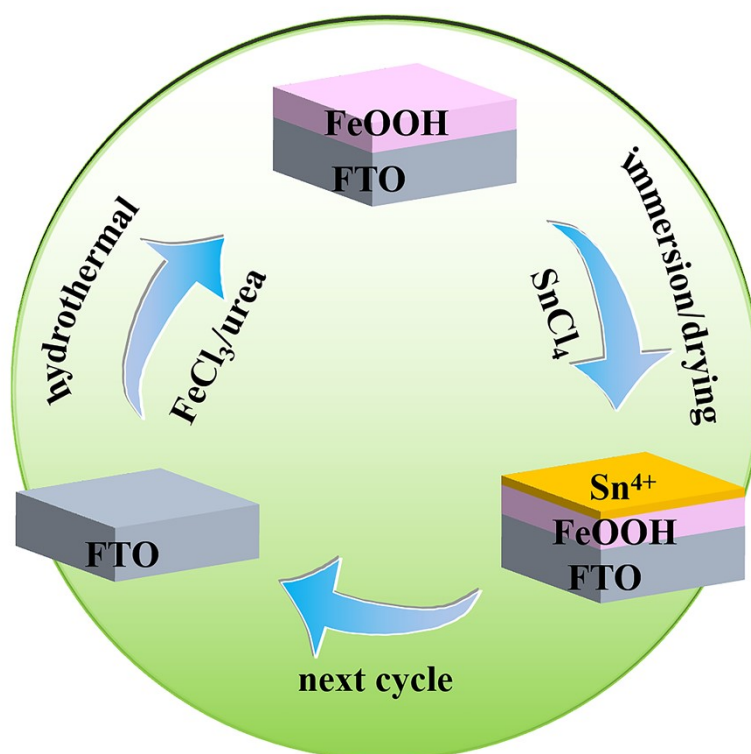


Fig. S1 Schematic illustration of one-cycle growth process of the FeOOH film with Sn-dopant absorption. The FTO glass was used as the conductive substrate.

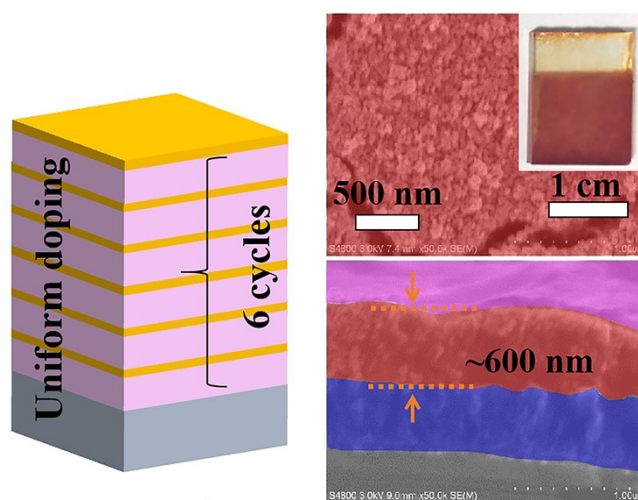


Fig. S2 Schematic of the α -Fe₂O₃ photoanodes prepared with six growth cycles. The corresponding SEM images and digital photos are also included.

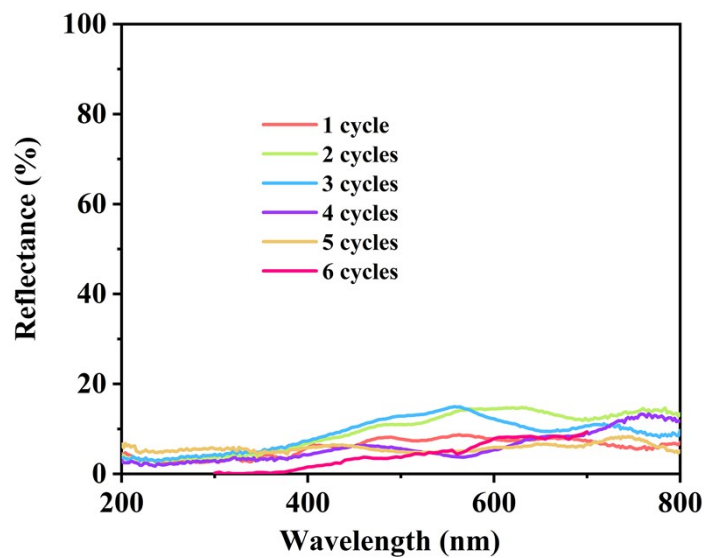


Fig. S3 Reflectance spectra of the α -Fe₂O₃ photoanodes with uniform doping prepared by different growth cycles.

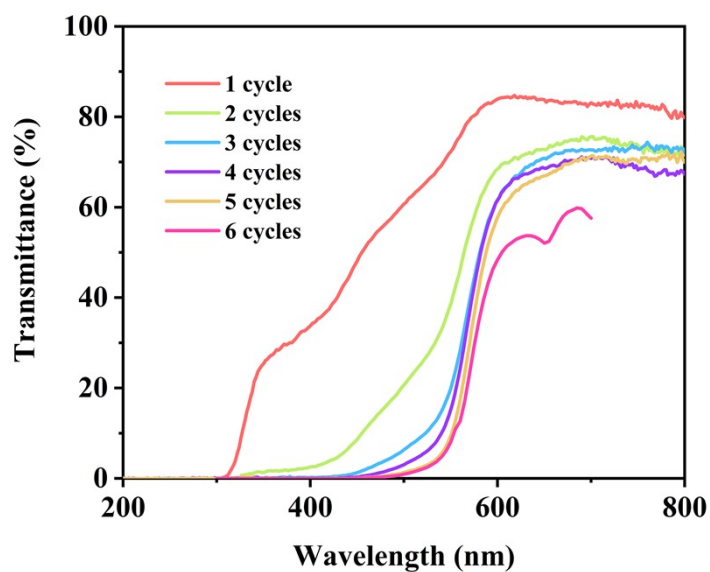


Fig. S4 Transmittance spectra of the α -Fe₂O₃ photoanodes with uniform doping prepared by different growth cycles.

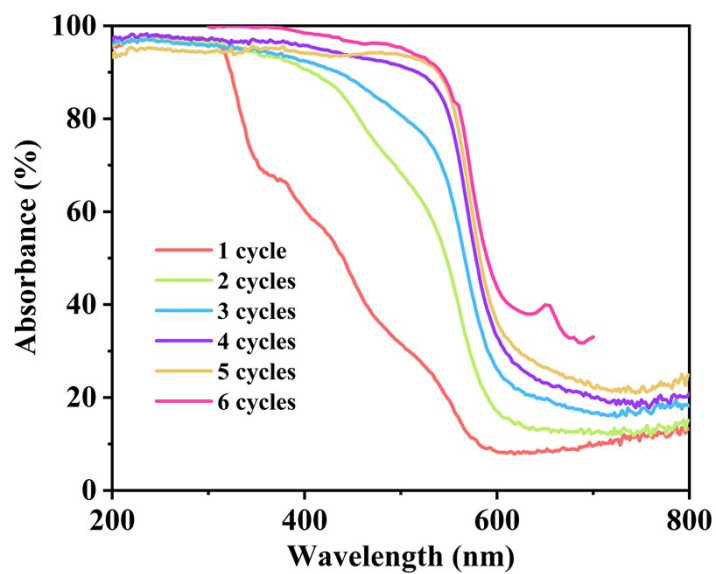


Fig. S5 Absorbance spectra of the α -Fe₂O₃ photoanodes with uniform doping prepared by different growth cycles.

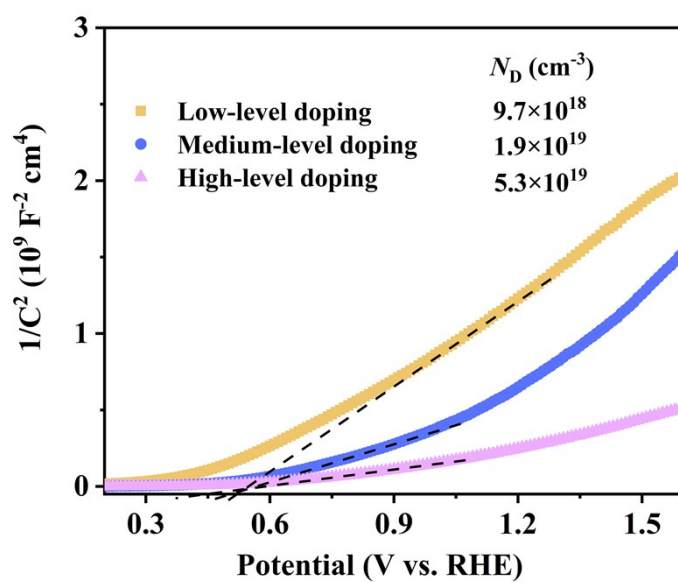


Fig. S6 Mott-schottky plots of the α -Fe₂O₃ photoanodes with low-level, medium-level or high-level doping of Sn.

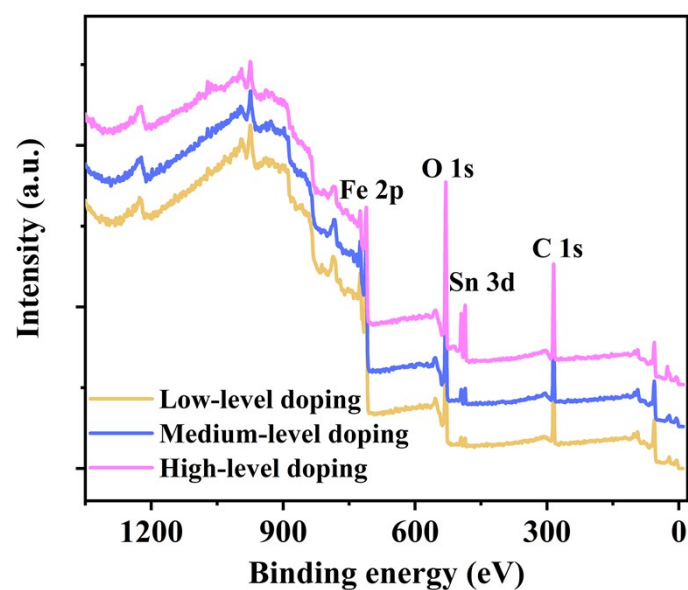


Fig. S7 XPS spectra of the α - Fe_2O_3 photoanodes with low-level, medium-level and high-level doping of Sn.

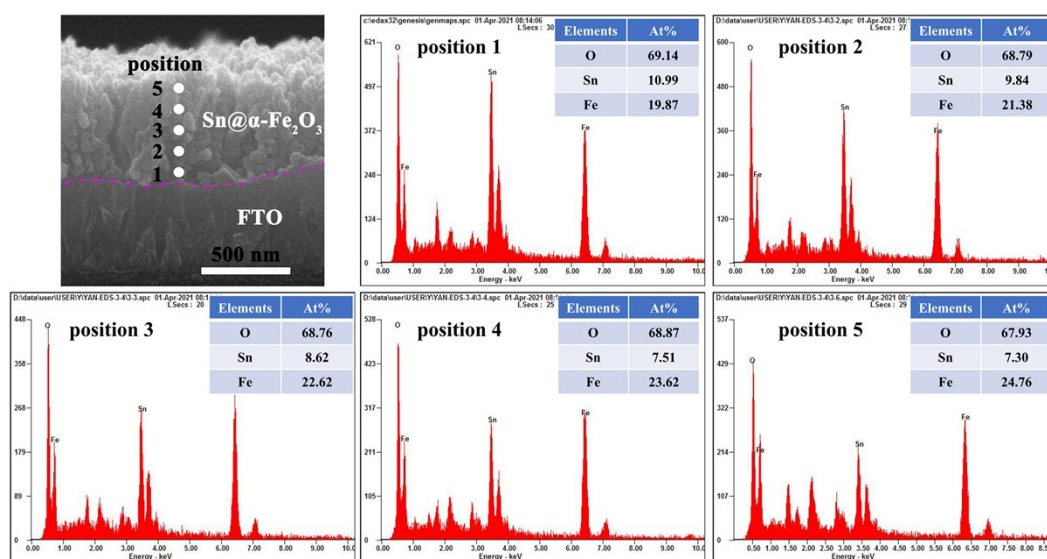


Fig. S8 EDS comparison of the α - Fe_2O_3 photoanode with gradient-decreasing doping of Sn at various positions.

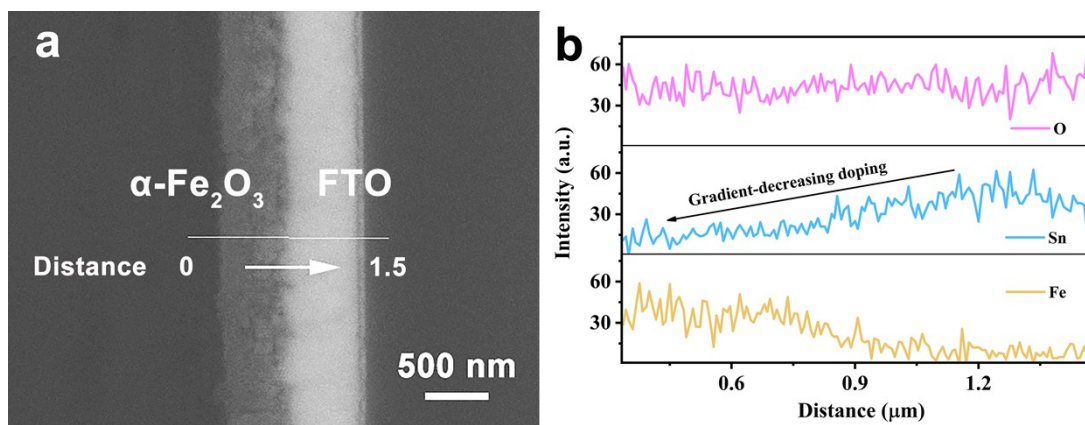


Fig. S9 Eelements linear scan of $\alpha\text{-Fe}_2\text{O}_3$ photoanodes with gradient-decreasing doping.

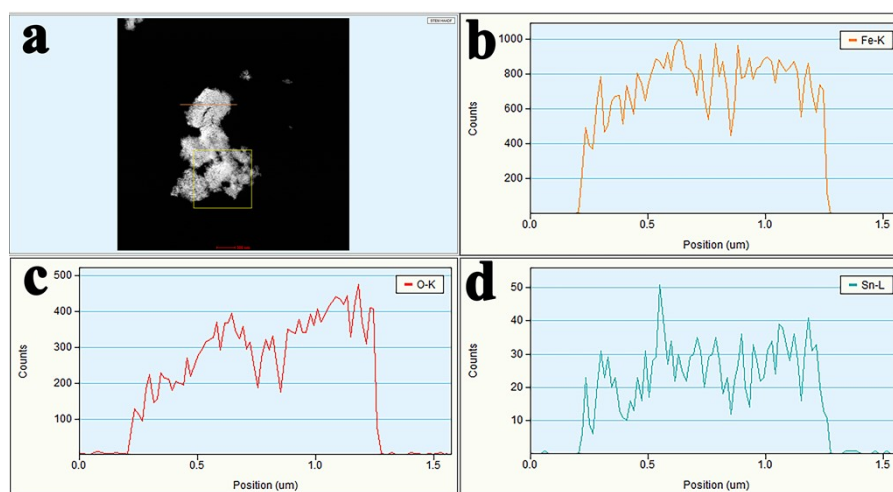


Fig. S10 EDS element line scanning for the $\alpha\text{-Fe}_2\text{O}_3$ photoanode with gradient-decreasing doping of Sn.

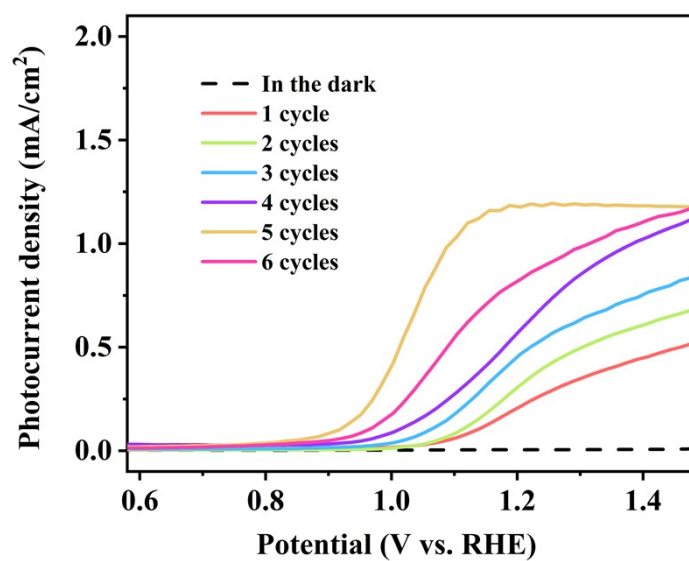


Fig. S11 J - V curves of the α - Fe_2O_3 photoanodes with uniform doping prepared by different growth cycles.

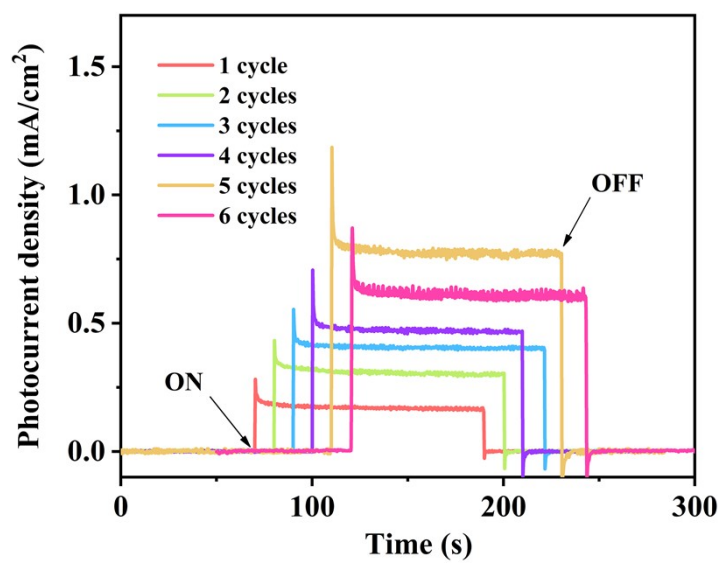


Fig. S12 J - t curves of the α - Fe_2O_3 photoanodes with uniform doping prepared by different growth cycles at $1.23 \text{ V}_{\text{RHE}}$ under ON/OFF circular illumination.

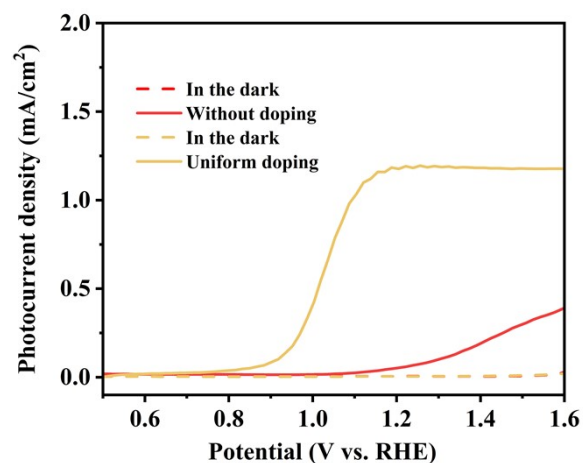


Fig. S13 J - V curves of the α - Fe_2O_3 photoanodes with uniform Sn doping and without intentional Sn doping.

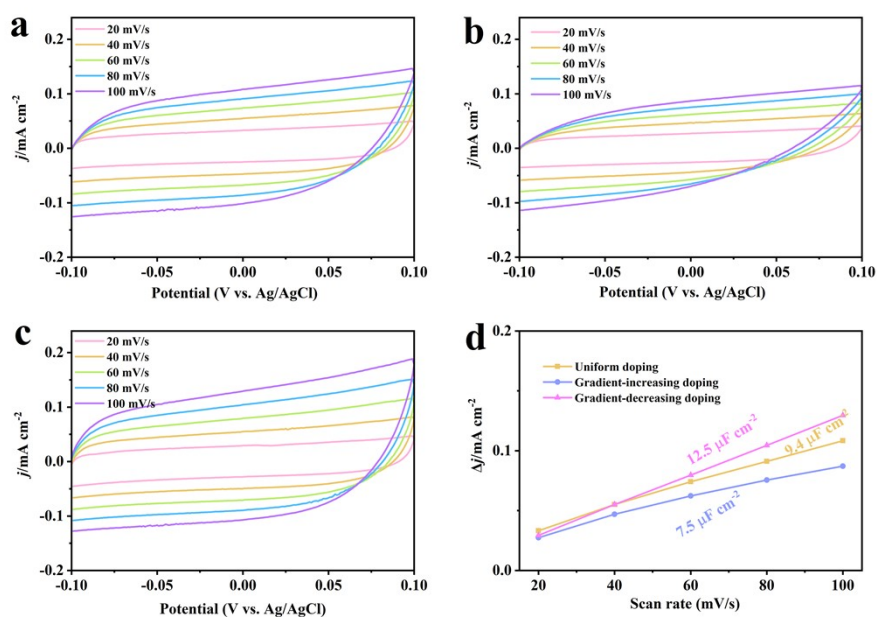


Fig. S14 CV curves for the α - Fe_2O_3 photoanodes with (a) uniform, (b) gradient-increasing or (c) gradient-decreasing doping of Sn. (d) Evaluation of C_{dl} values by plotting the Δj vs. scan rate.

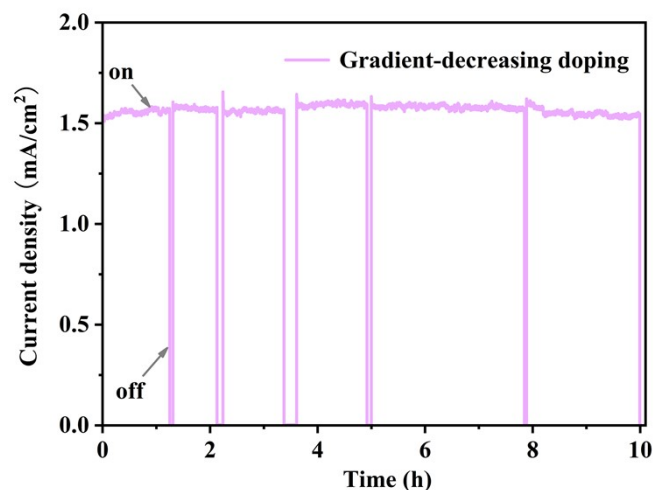


Fig. S15 $J-t$ behavior of the $\alpha\text{-Fe}_2\text{O}_3$ photoanode with gradient-decreasing doping of Sn at 1.23 V_{RHE} under the chopped AM 1.5G irradiation.

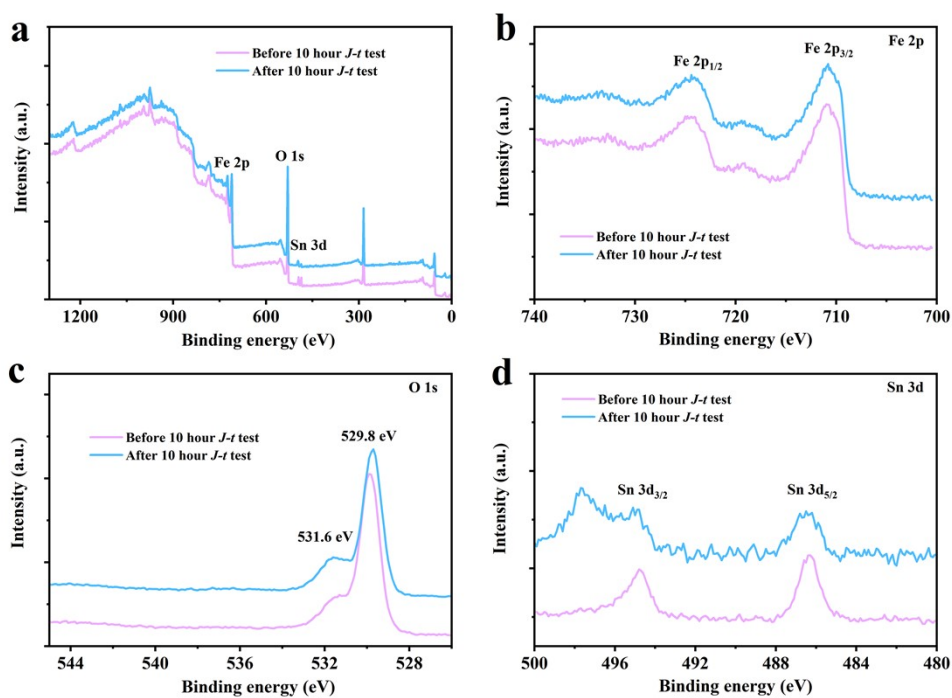


Fig. S16 XPS spectra of the $\alpha\text{-Fe}_2\text{O}_3$ photoanode with gradient-decreasing doping of Sn before and after 10 hour $J-t$ test.

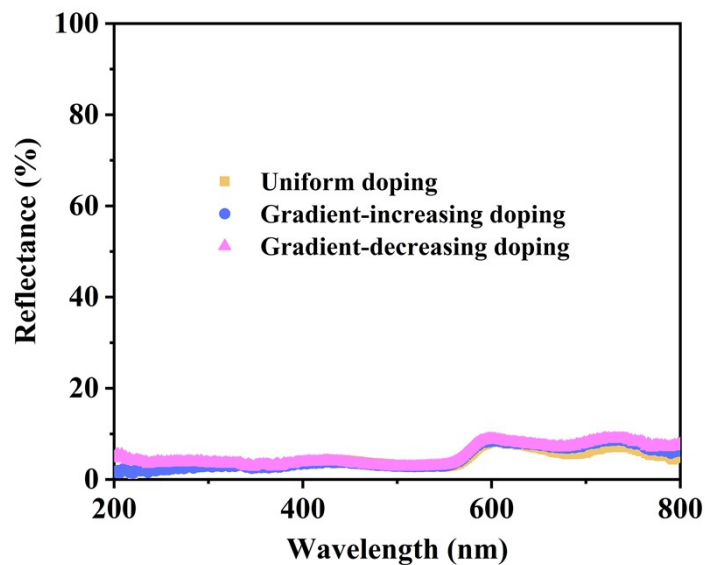


Fig. S17 Reflectance spectra of the α -Fe₂O₃ photoanodes with uniform, gradient-increasing or gradient-decreasing doping of Sn.

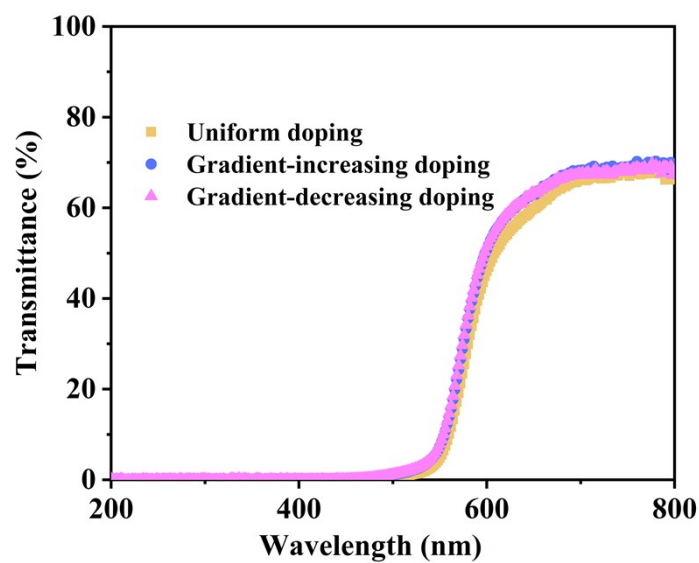


Fig. S18 Transmittance spectra of the α -Fe₂O₃ photoanodes with uniform, gradient-increasing or gradient-decreasing doping of Sn.

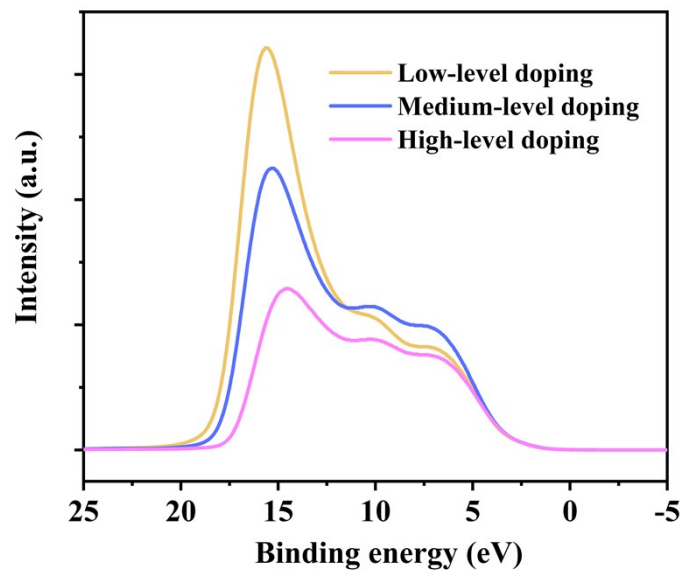


Fig. S19 UPS spectra of the $\alpha\text{-Fe}_2\text{O}_3$ photoanodes with low-level, medium-level or high-level doping of Sn.

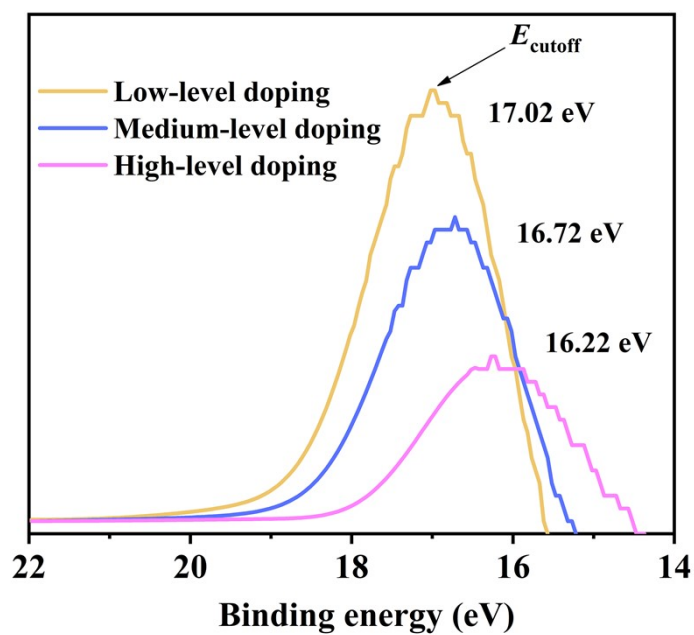


Fig. S20 Determination of E_{cutoff} , at which the secondary photoemission begins from the UPS spectra.

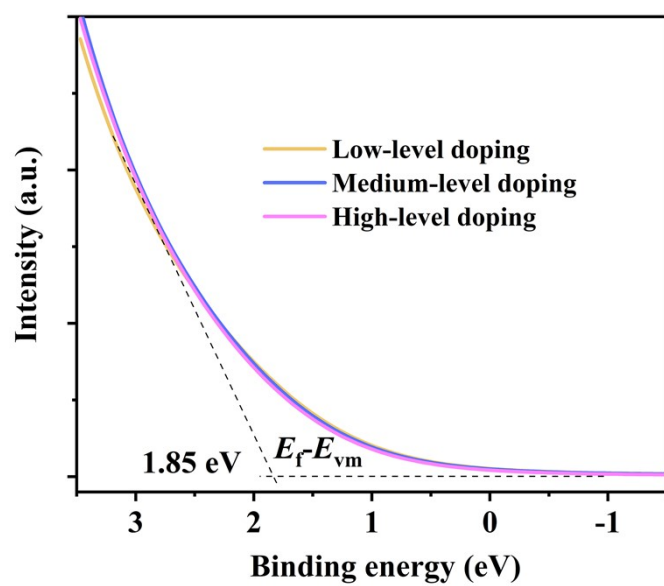


Fig. S21 Determination of E_{VM} , which represents the valence band maximum from the UPS spectra.

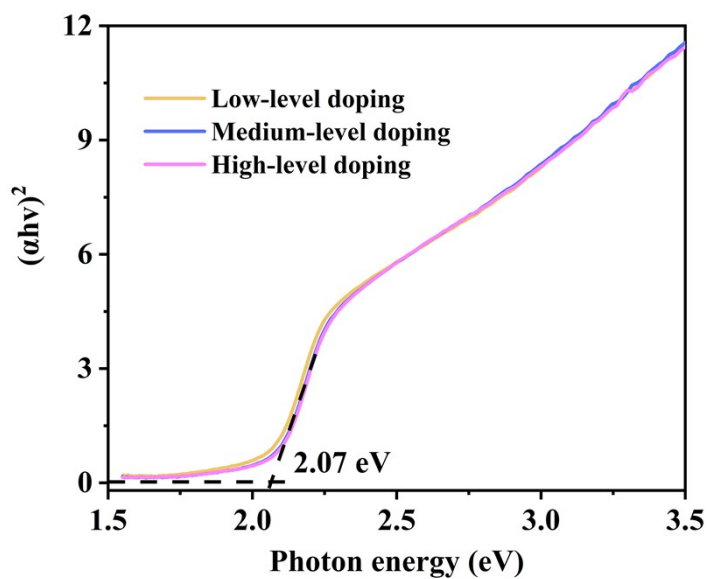


Fig. S22 Band gap determination from the optical absorption spectra of the $\alpha\text{-Fe}_2\text{O}_3$ photoanodes with low-level, medium-level or high-level doping of Sn.

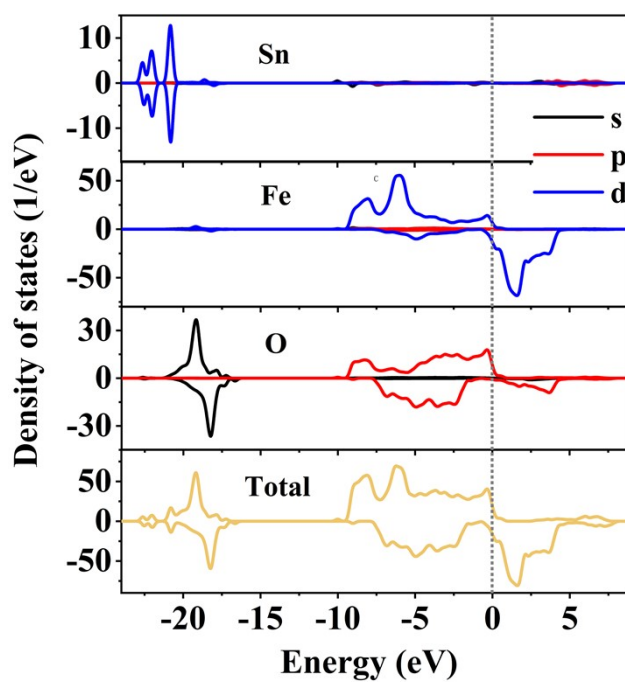


Fig. S23 Total and partial density of states of the $\alpha\text{-Fe}_2\text{O}_3$ photoanode with uniform doping for (110) surface.

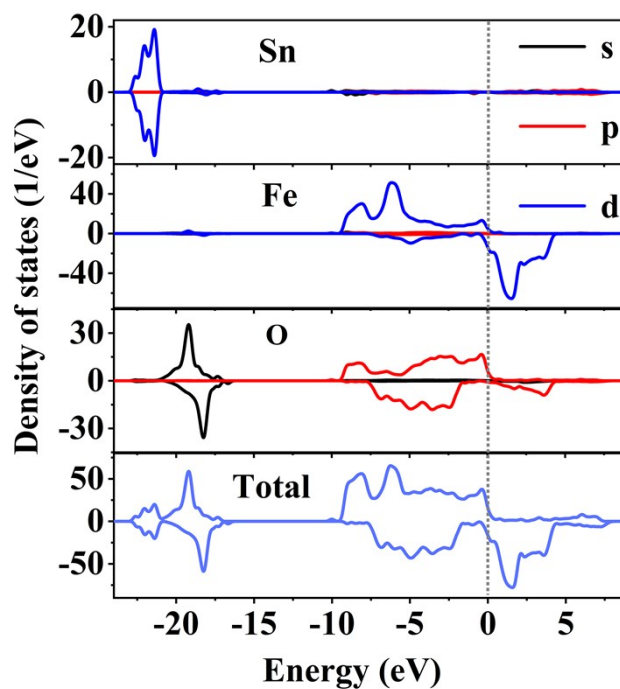


Fig. S24 Total and partial density of states of the $\alpha\text{-Fe}_2\text{O}_3$ photoanode with gradient-increasing doping for (110) surface.

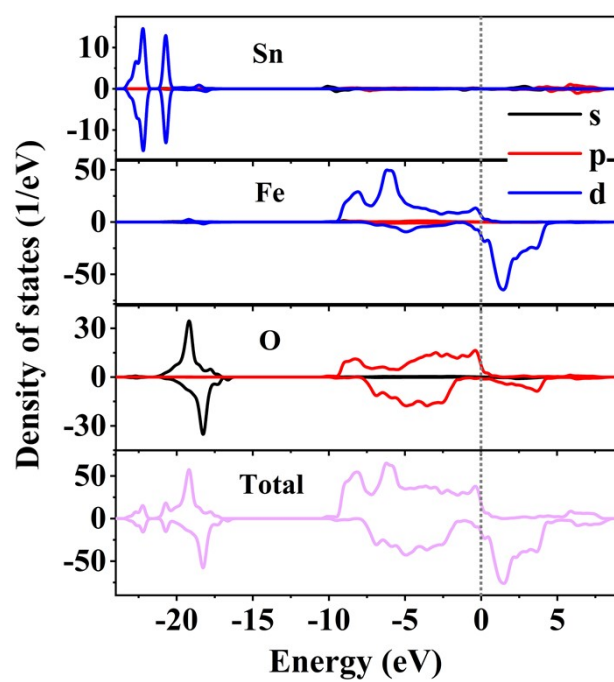


Fig. S25 Total and partial density of states of the $\alpha\text{-Fe}_2\text{O}_3$ film with gradient-decreasing doping for (110) surface.