

Self-Improvement of Ti:Fe₂O₃ Photoanodes: Photoelectrocatalysis Improvement after Long-Term Stability Testing in Alkaline Electrolyte

Jiale Xie,^{,†,‡,⊥} Pingping Yang,^{†,‡,⊥} Xiaorong Liang,[‡] and Jinyun Xiong[‡]*

[†] Institute of Materials Science and Devices, Suzhou University of Science and Technology, Kerui Road, Suzhou, 215009, People's Republic of China.

[‡] Institute for Clean Energy & Advanced Materials, Faculty of Materials and Energy, Southwest University, Tiansheng Road, Chongqing 400715, People's Republic of China.

Corresponding Author

*J.L. Xie, E-mail: jialexie@usts.edu.cn

[⊥] J.X. and P.Y. contributed equally.

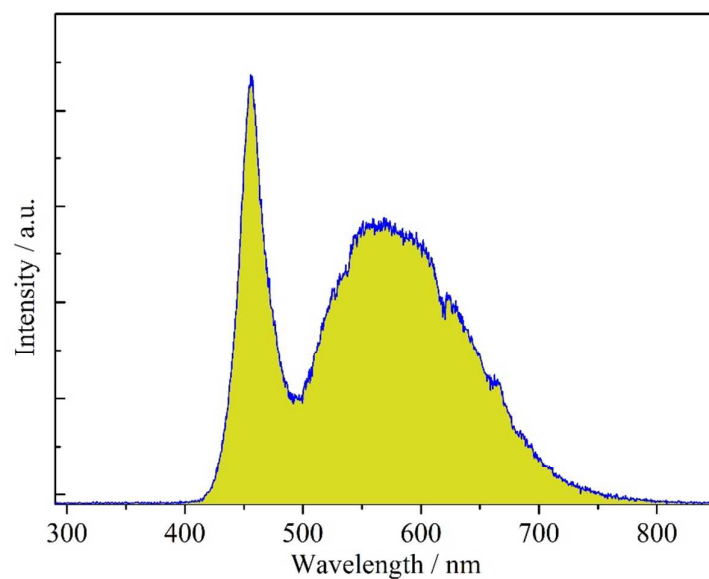


Figure S1. Light spectrum of used cold LED light source.

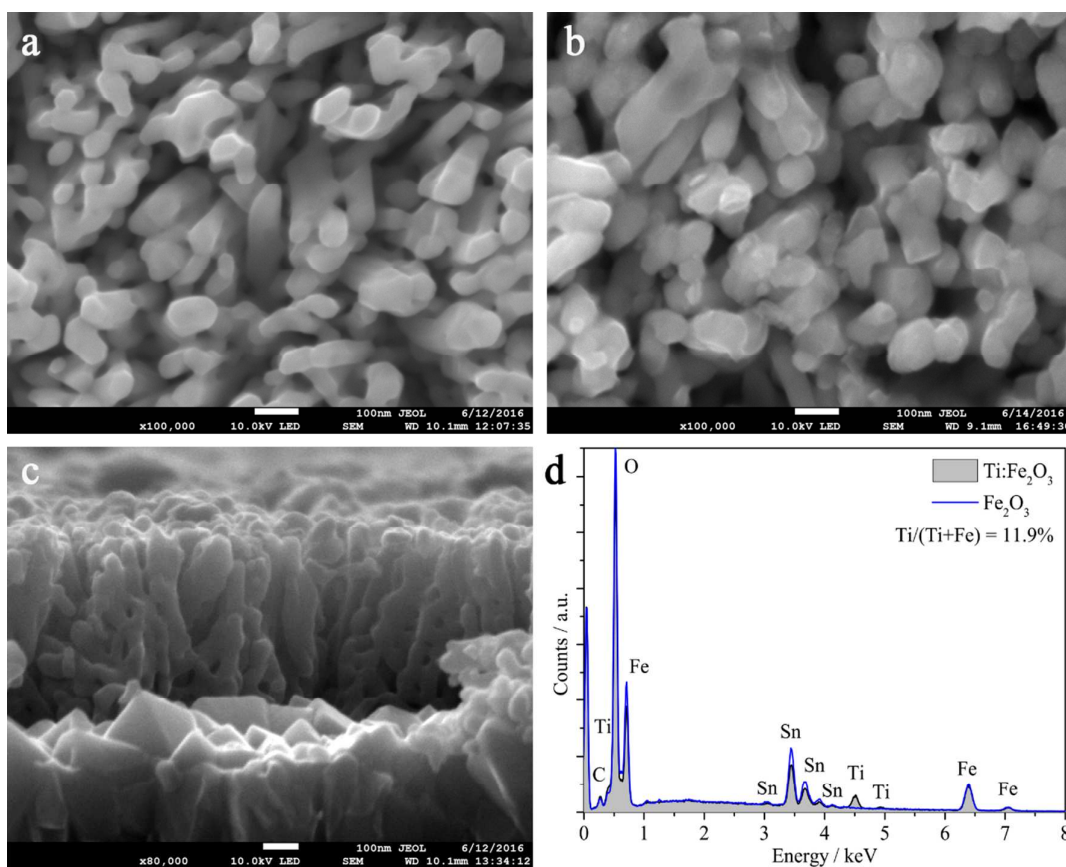


Figure S2. (a) SEM image of as-prepared Fe_2O_3 photoanode. (b) SEM image of as-prepared Ti doped Fe_2O_3 photoanode. (c) Section SEM image of $\text{Ti}:\text{Fe}_2\text{O}_3$ photoanode. (d) EDS spectra of Fe_2O_3 and $\text{Ti}:\text{Fe}_2\text{O}_3$ photoanode.

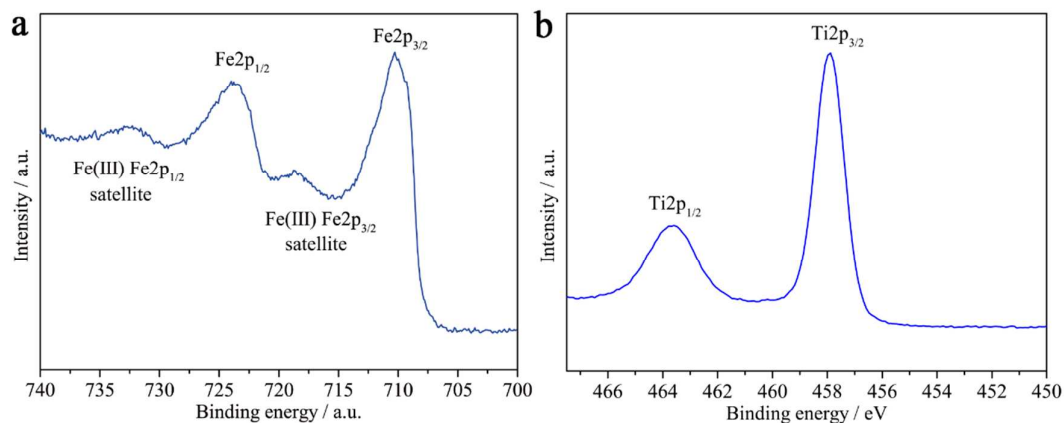


Figure S3. (a) XPS spectrum of Fe2p on Ti:Fe₂O₃ photoanode. (b) XPS spectrum of Ti2p on Ti:Fe₂O₃ photoanode.

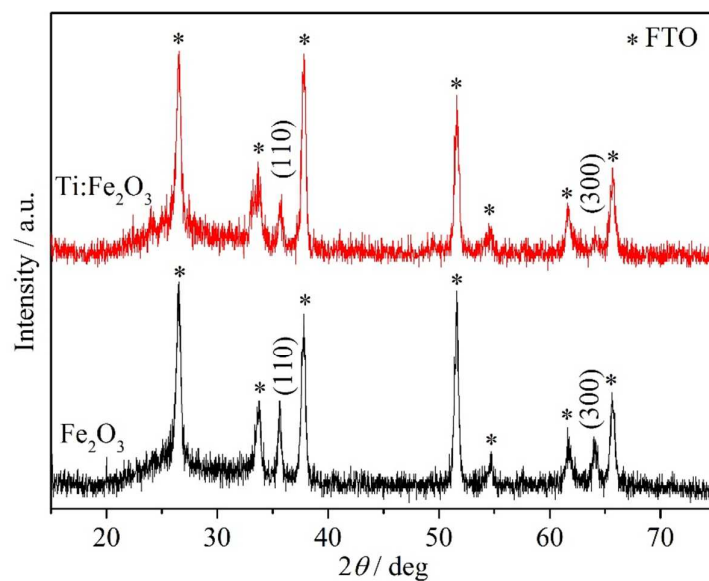


Figure S4. XRD patterns of Fe₂O₃ and Ti:Fe₂O₃ photoanode.

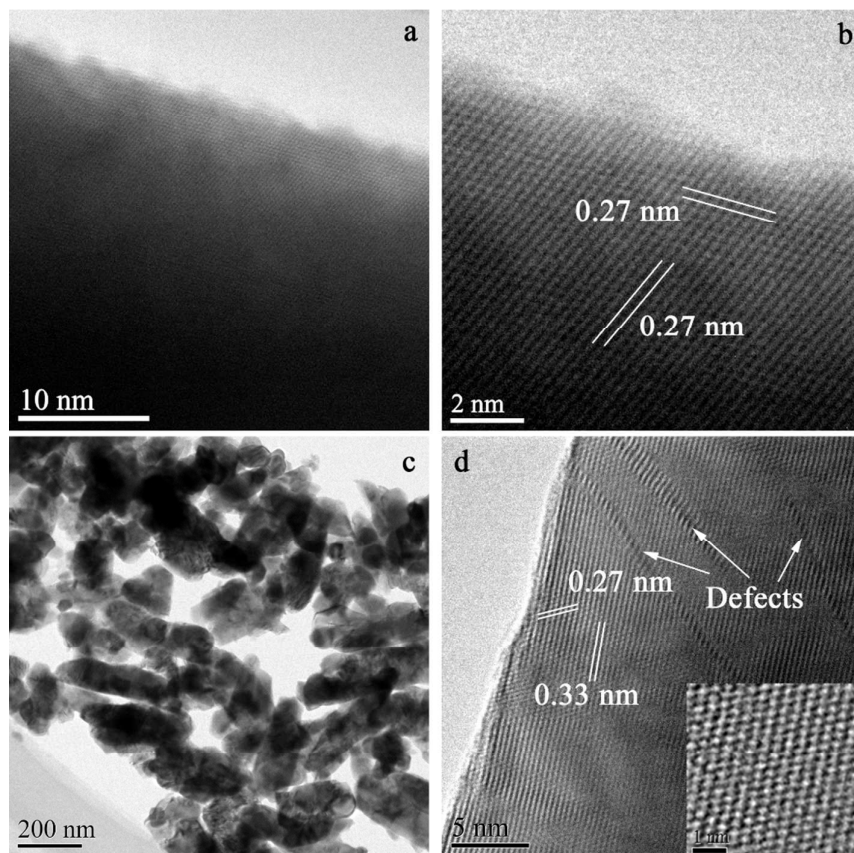


Figure S5. (a, b) TEM images of Fe_2O_3 . (c, d) TEM images of Ti doped Fe_2O_3 . Inset is the lattice resolution TEM image.

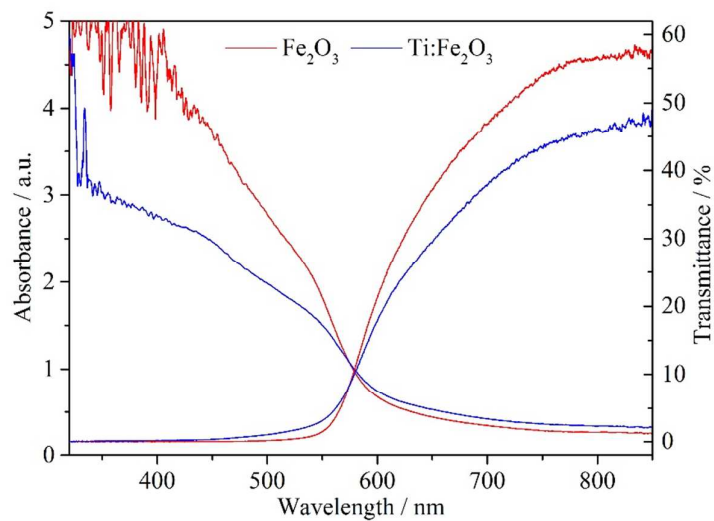


Figure S6. The transmittance and absorption spectra of Fe_2O_3 and $\text{Ti:Fe}_2\text{O}_3$ films.

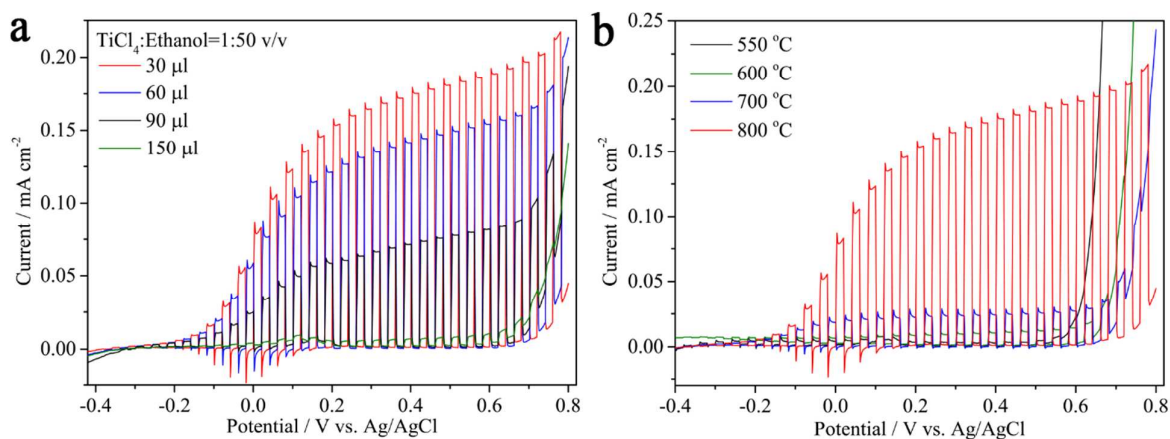


Figure S7. Optimization of the amount of TiCl_4 ethanol solution (a) and the annealing temperature (b).

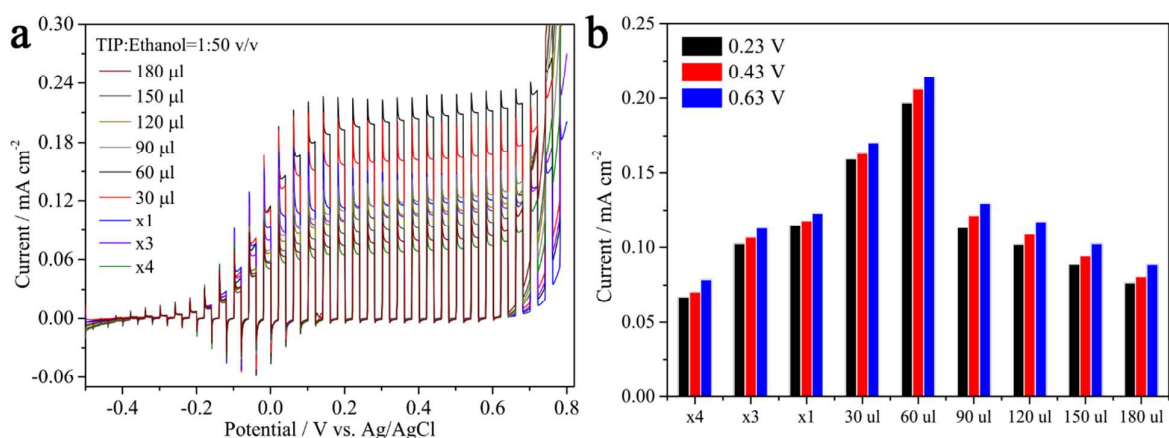


Figure S8. (a) Optimization of the amount of TIP ethanol solution. Note, $\times 1$, $\times 3$, and $\times 4$ mean the TIP ethanol solution was diluted by 1, 3, and 4 times respectively, and 30 μl diluted solution was used. (b) The current density derived from LSV curves at 0.23 V, 0.43 V and 0.63 V (vs. Ag/AgCl).

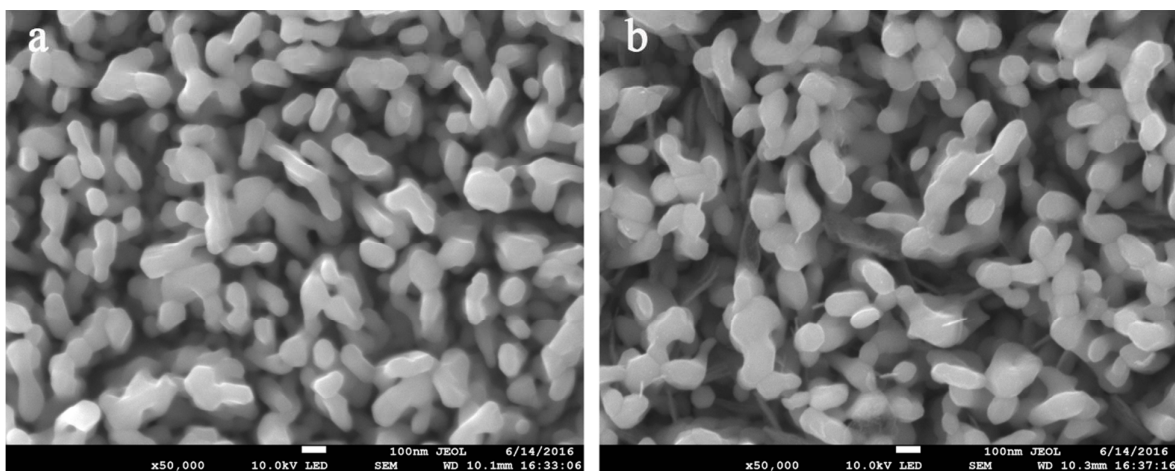


Figure S9. (a) SEM image of as-prepared Fe_2O_3 photoanode. (b) SEM image of Fe_2O_3 photoanode after long-term testing.

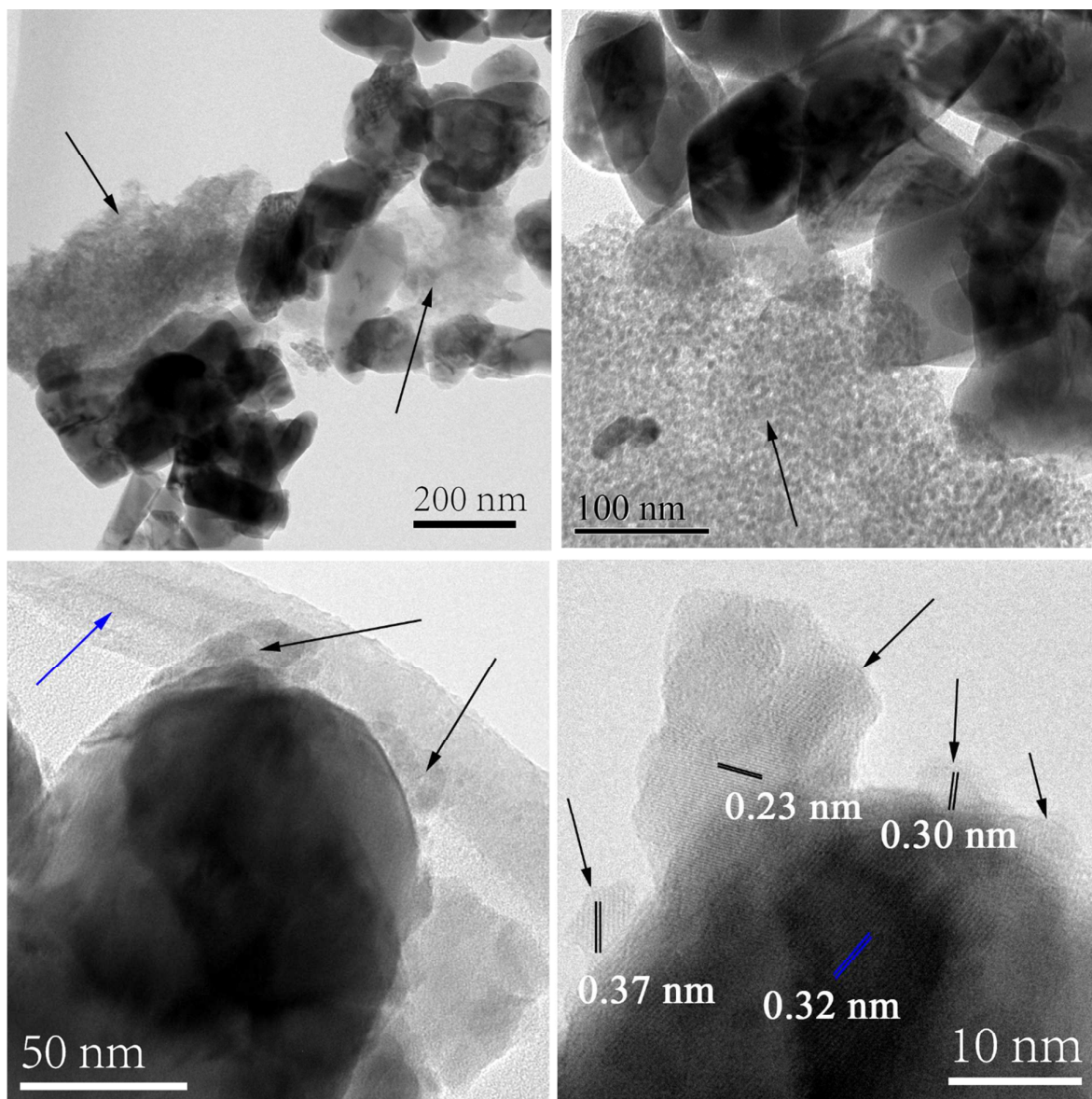


Figure S10. TEM image of tested Ti:Fe₂O₃.

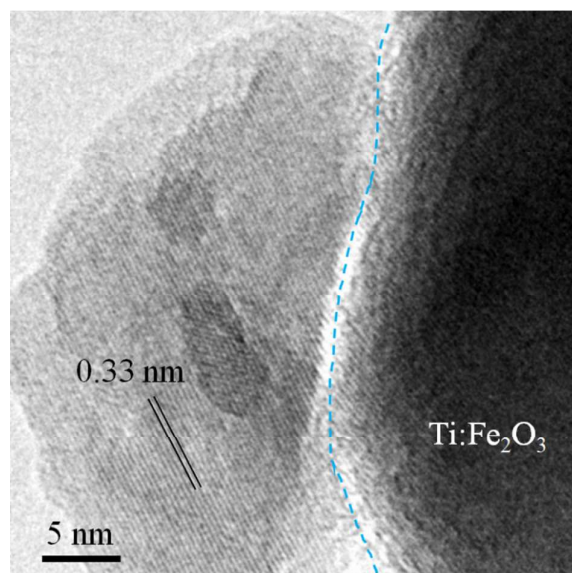


Figure S11. High magnification TEM image of tested Ti:Fe₂O₃.

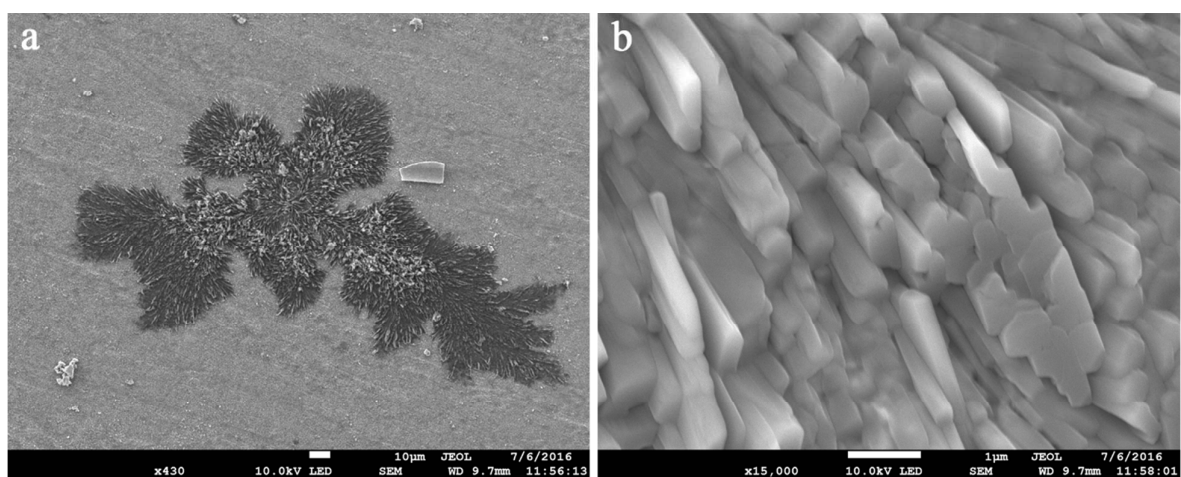


Figure S12. SEM images of tested Ti:Fe₂O₃.

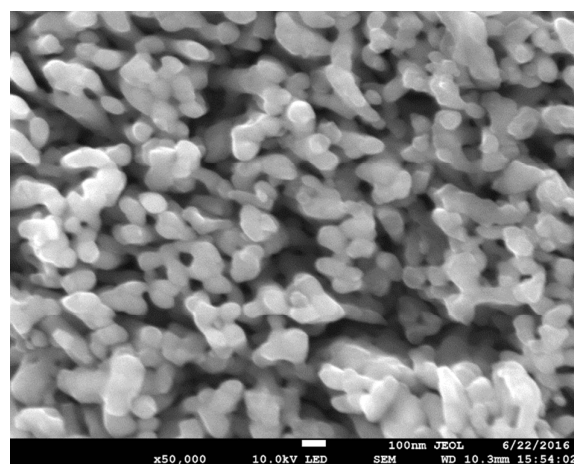


Figure S13. SEM image of tested Ti:Fe₂O₃ in Na₂SO₄ electrolyte.

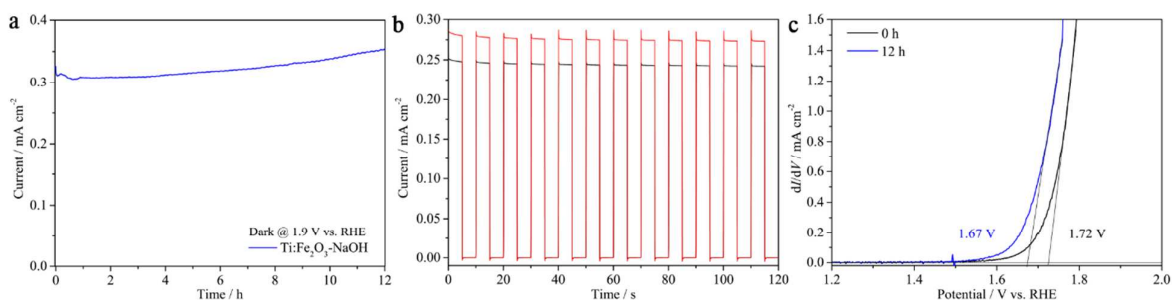


Figure S14. (a) Current vs. time plot of Ti:Fe₂O₃ photoanode at 1.9 V (vs. RHE) in the dark. (b) Photoresponse plots of Ti:Fe₂O₃ photoanode before (black line) and after (red line) 12 h stability testing in the dark. (c) IV plot of Ti:Fe₂O₃ photoanode before (black line) and after (red line) 12 h stability testing in the dark.

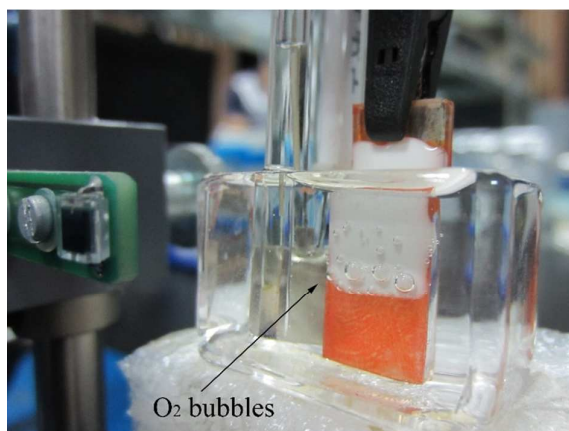


Figure S15. Digital photograph of the Ti:Fe₂O₃ photoanode in NaOH after 12 h long-term stability testing at 1.5 V vs. RHE.

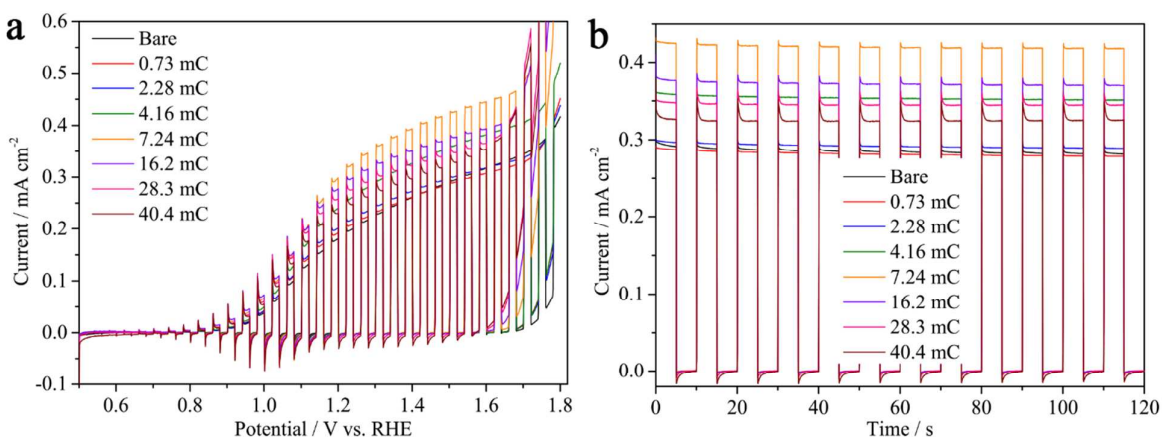


Figure S16. Optimization of the amount of photoelectrodeposited FeOOH. (a) LSV curves with chopped light. (b) Photoresponse curves.

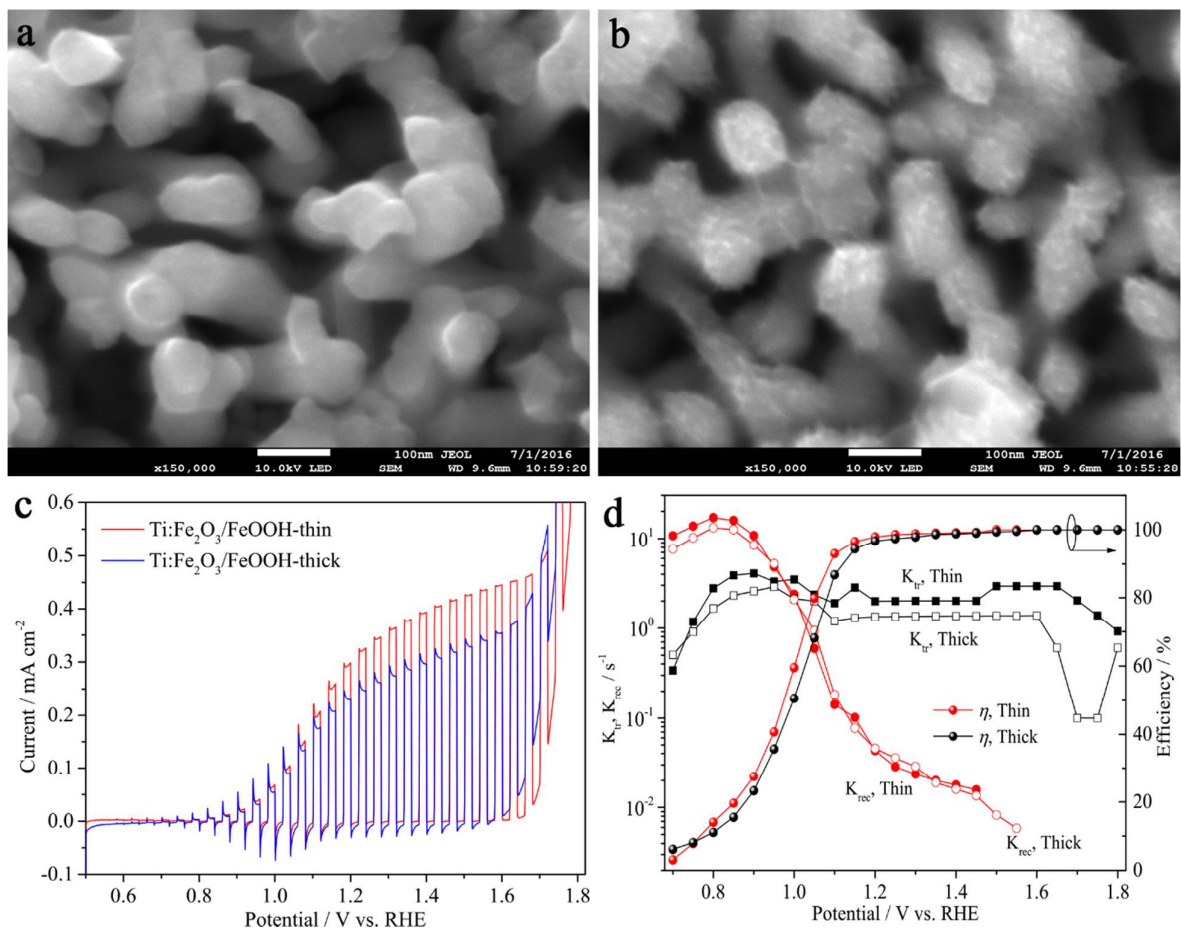


Figure S17. (a) SEM image of Ti:Fe₂O₃/FeOOH-thin photoanode (7.24 mC cm⁻²). (b) SEM image of Ti:Fe₂O₃/FeOOH-thick photoanode (40.4 mC cm⁻²). (c) LSV curves of Ti:Fe₂O₃/FeOOH-thin and -thick photoanodes. (d) Parameters extracted from IMPS spectra of Ti:Fe₂O₃/FeOOH-thin and -thick photoanodes. Transfer efficiency, η ; Rate constant for charge recombination, k_{rec} ; Rate constant for charge transfer, k_{tr} .