Electronis Supplementary Information (ESI)

A facile spray pyrolysis method to prepare Ti-doped $ZnFe_2O_4$ for boosting photoelectrochemical water splitting

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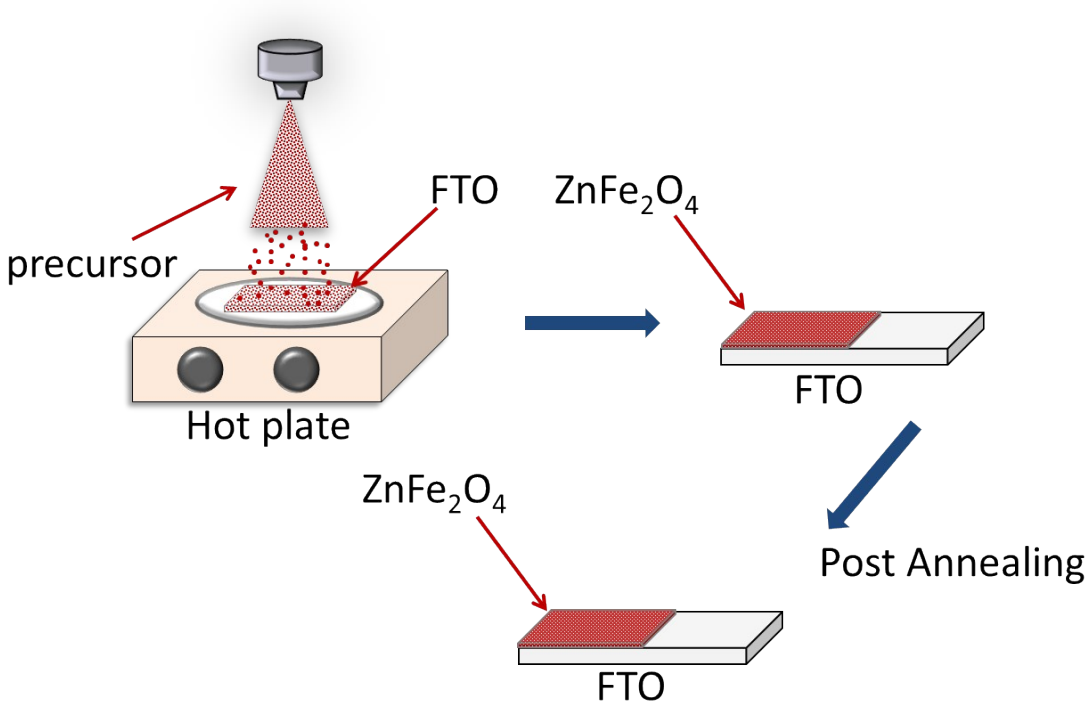

Scheme S1 Schematic illustration of the $ZnFe_2O_4$ photoanodes preparation procedure. When the temperature of the hot palte was 400 °C, the films were coated on FTO by spray pyrolysis.

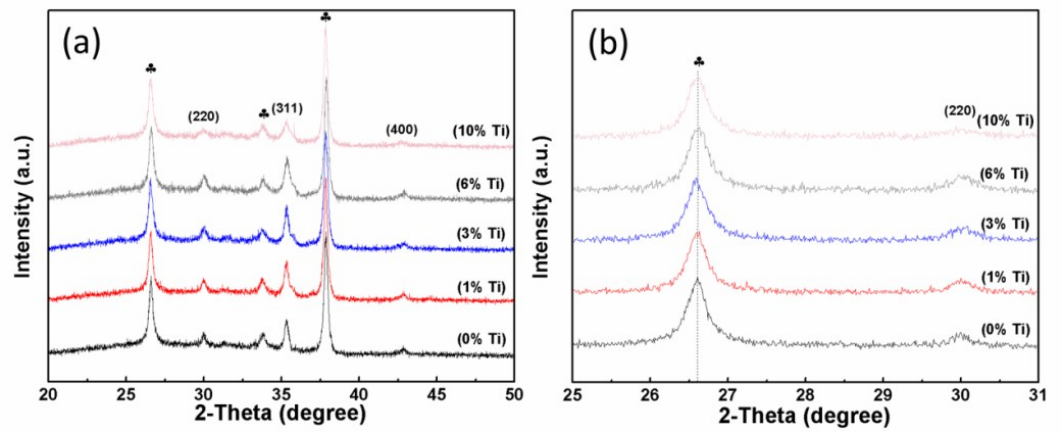

Fig. S1 XRD patterns of $ZnFe_2O_4$ with different Ti doping concentrations. (♣ = peaks from FTO). The peaks in Fig. S1 (a) at 2θ = 30°, 35.2° and 42.8° represent (2 2 0), (3 1 1) and (4 0 0) crystal planes of the cubic spinel $ZnFe_2O_4$. (b) Magnified view from 25° to 31°.($ZnFe_2O_4$: PDF#22-1012, SnO_2 : PDF#46-1088)

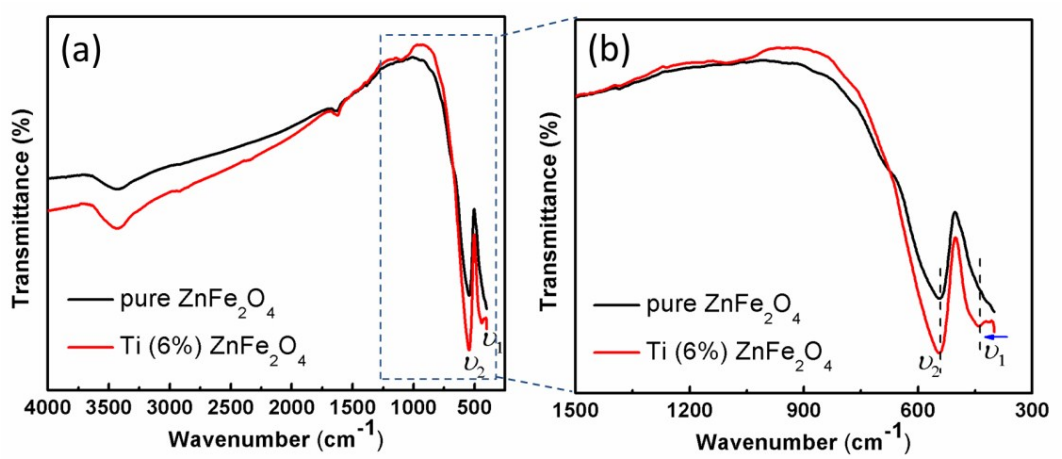

Fig. S2 FTIR spectra of pure and 6% Ti-doped $ZnFe_2O_4$ samples: (a) wavenumbers from 4000 to 400 cm^{-1}, (b) Magnified view from 1500 to 400 cm^{-1}.

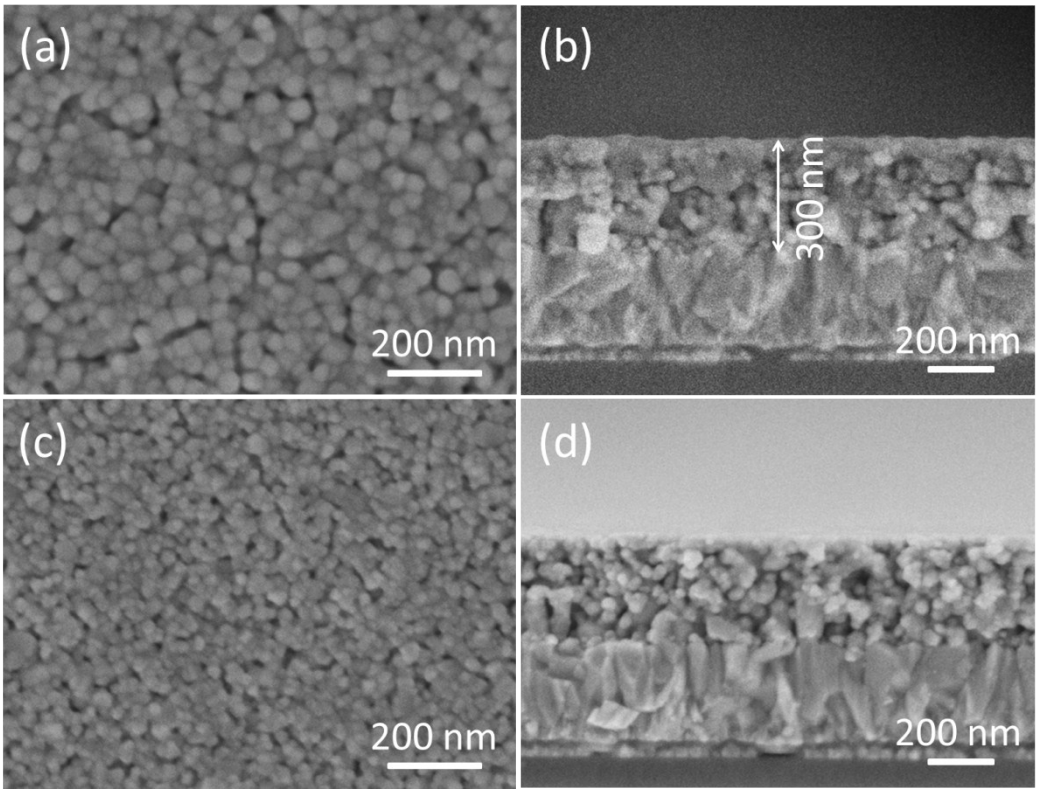

Fig. S3 SEM images for the (a) top view of pure $ZnFe_2O_4$. (b) cross section view of pure $ZnFe_2O_4$. (c) top view of 6% Ti-doped $ZnFe_2O_4$. (d) cross section view of 6% Ti-doped $ZnFe_2O_4$.

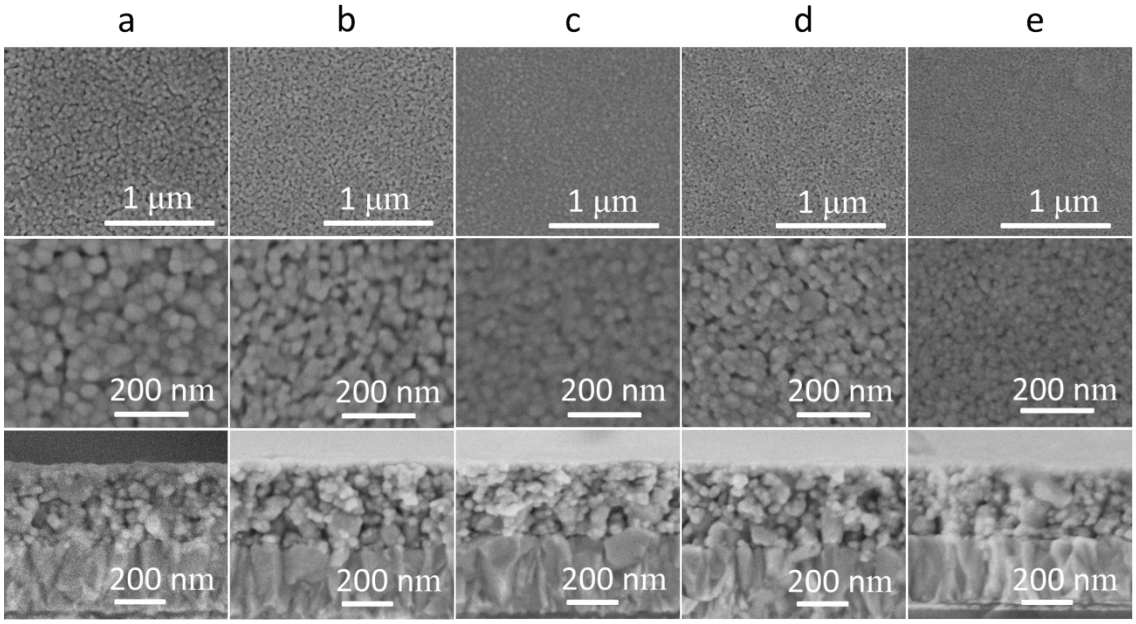

Fig. S4 Top view and cross section view SEM images of $ZnFe_2O_4$ with different Ti doping concentrations. (a = 0%, b = 1%, c = 3%, d = 6%, e = 10%).

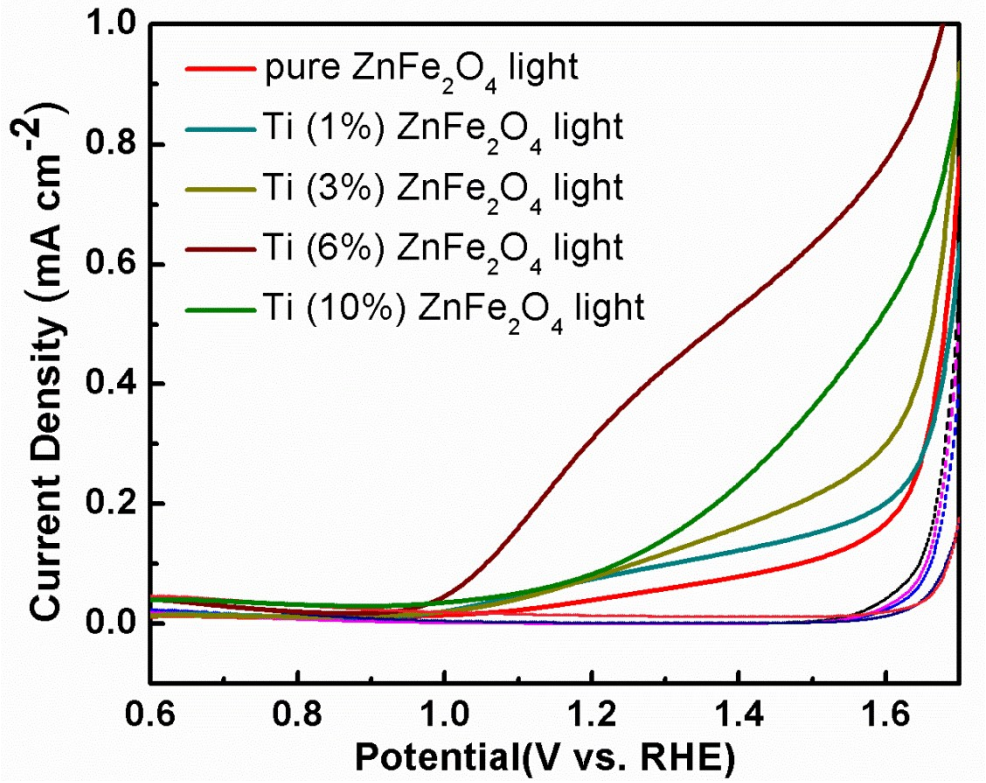

Fig. S5 Current-Potential curves of $ZnFe_2O_4$ photoanodes with different Ti doping concentrations measured in 1 M NaOH aqueous solution under AM 1.5 G illumination (100 mW cm^{-2}).

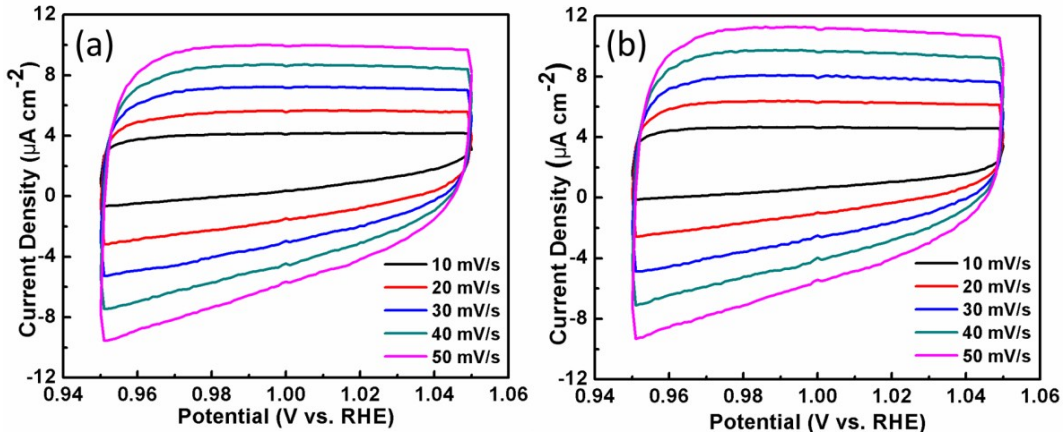

Fig. S6 Cyclic voltammetry with different scan rates of (a) pure $ZnFe_2O_4$ photoanode and (b) 6% Ti-doped $ZnFe_2O_4$ photoanode.

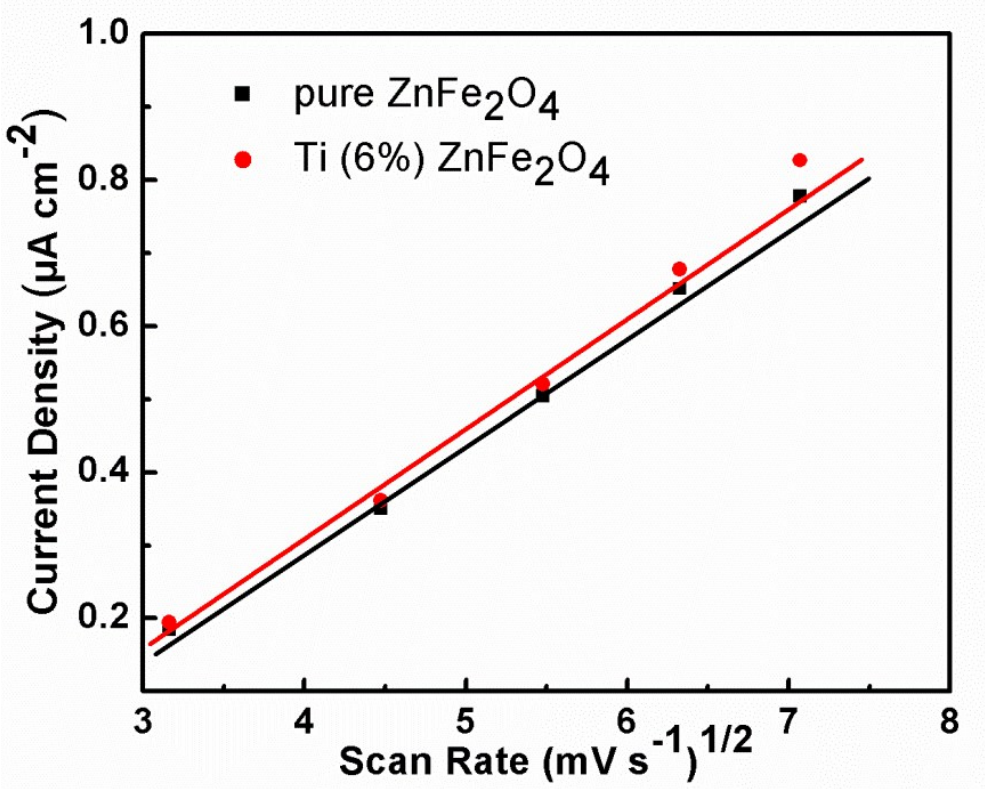

Fig. S7 The Randles-Sevčik plot of I-$\upsilon^{1/2}$.

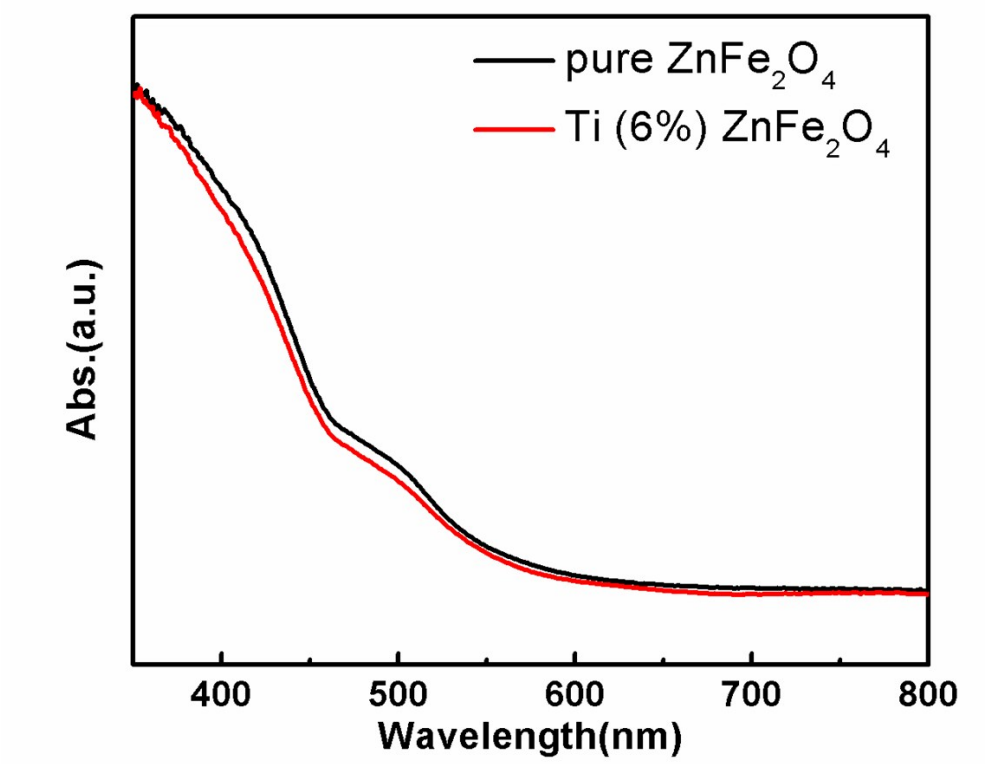

Fig. S8 UV-vis spectrum of pure $ZnFe_2O_4$ and 6% Ti-doped $ZnFe_2O_4$ photoanodes.

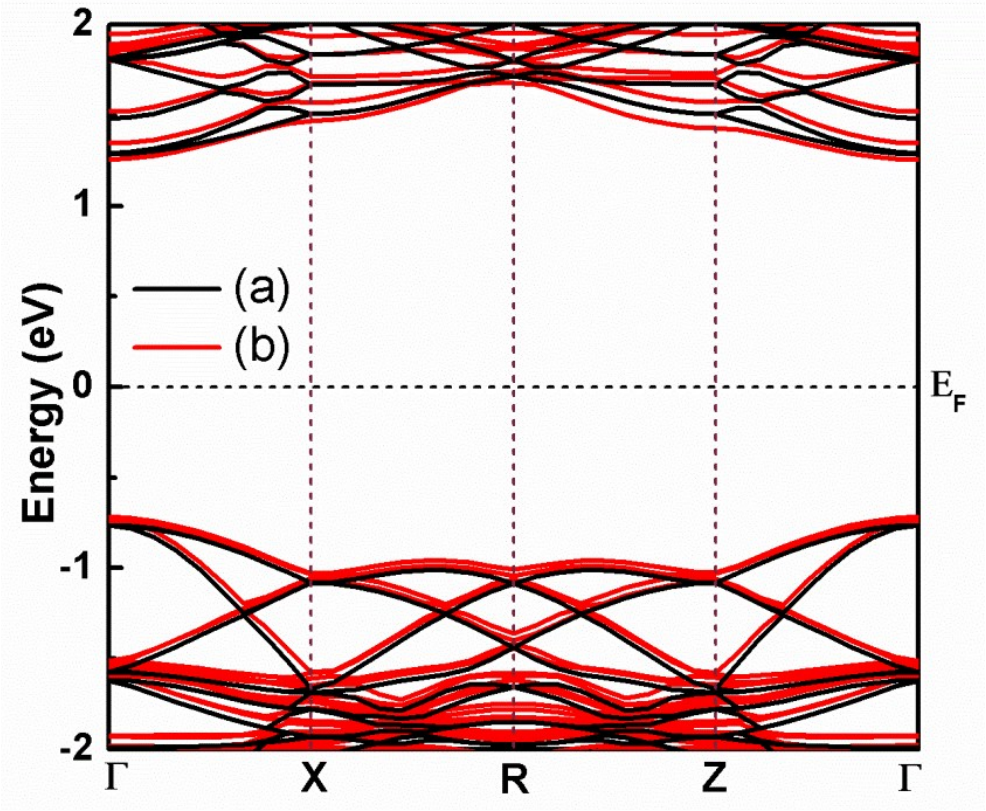

Fig. S9 Band structure of $ZnFe_2O_4$: (a) pure $ZnFe_2O_4$, (b) 6% Ti-doped $ZnFe_2O_4$.

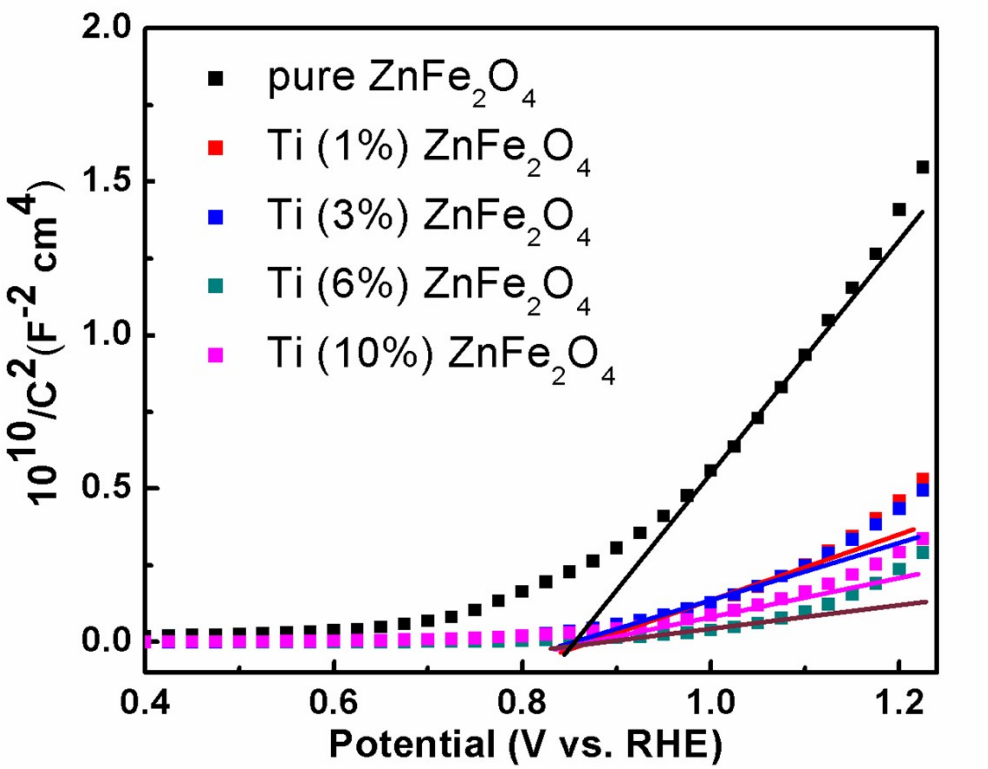

Fig. S10 Mott-Schottky plots of pure $ZnFe_2O_4$ and Ti-doped $ZnFe_2O_4$ photoanodes in 1 M NaOH, the ac amplitude is 5 mV and the frequency is 1000 Hz.

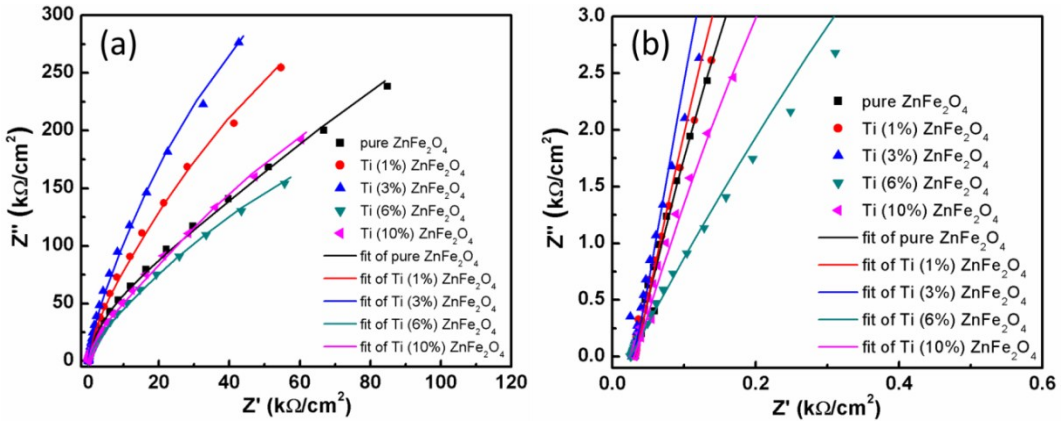

Fig. S11 (a) The Nyquist plots of pure $ZnFe_2O_4$ and Ti-doped $ZnFe_2O_4$ from the raw date and fitting data. (b) the magnified plot in the high frequency.

Table S1 Fitting data of the two-RC equivalent circuit.

Samples	Pure	1% Ti-doped	3% Ti-doped	6% Ti-doped	10% Ti-doped
Rs (Ω)	31.64	31.3	27.4	25.23	30.12
R1(Ω)	1.25×10^{6}	1.58×10^{6}	1.98×10^{6}	7.46×10^{5}	9.02×10^{5}
CPE1(F)	6.89×10^{-6}	6.26×10^{-6}	5.81×10^{-6}	9.36×10^{-6}	8.22×10^{-6}
R2(Ω)	54585	23414	21674	16035	31318
CPE2(F)	1.32×10^{-5}	2.85×10^{-5}	3.16×10^{-5}	3.35×10^{-5}	1.79×10^{-5}

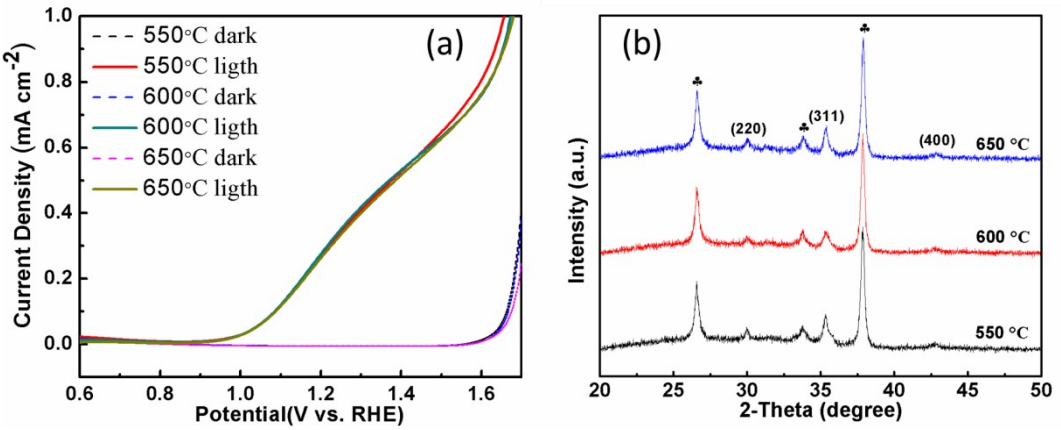

Fig. S12 Current-Potential curves (a) and XRD patterns (b) of 6% Ti-doped $ZnFe_2O_4$ calcined at different temperatures.

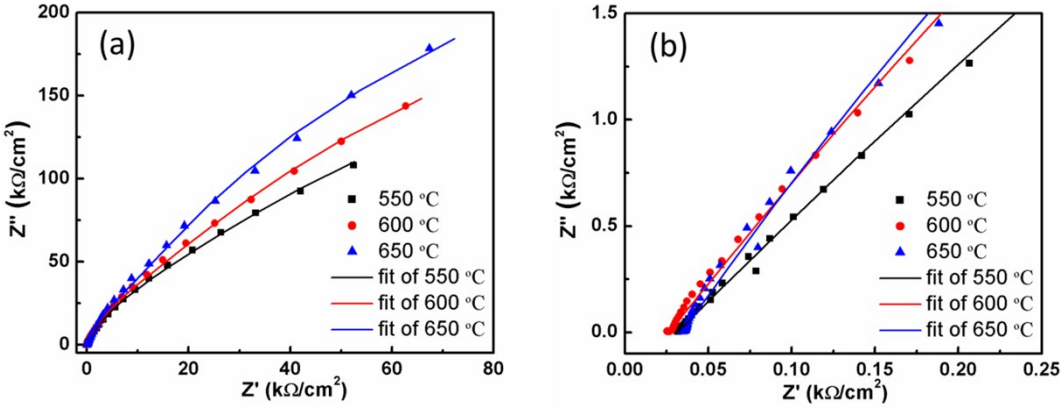

Fig. S13 (a) The Nyquist plots of 6% Ti-doped $ZnFe_2O_4$ calcined at different temperatures from the raw date and fitting data. (b) Magnified plot in the high frequency.

Table S2 Fitting data of the two-RC equivalent circuit.

Samples	550 °C	600 °C	650 °C
Rs (Ω)	31.58	26.3	34.49
R1(Ω)	5.15×10^{5}	5.8×10^{5}	7.75×10^{5}
CPE1(F)	1.36×10^{-5}	1.01×10^{-5}	7.71×10^{-6}
R2(Ω)	23421	23174	12048
CPE2(F)	2.89×10^{-5}	2.07×10^{-5}	2.44×10^{-5}

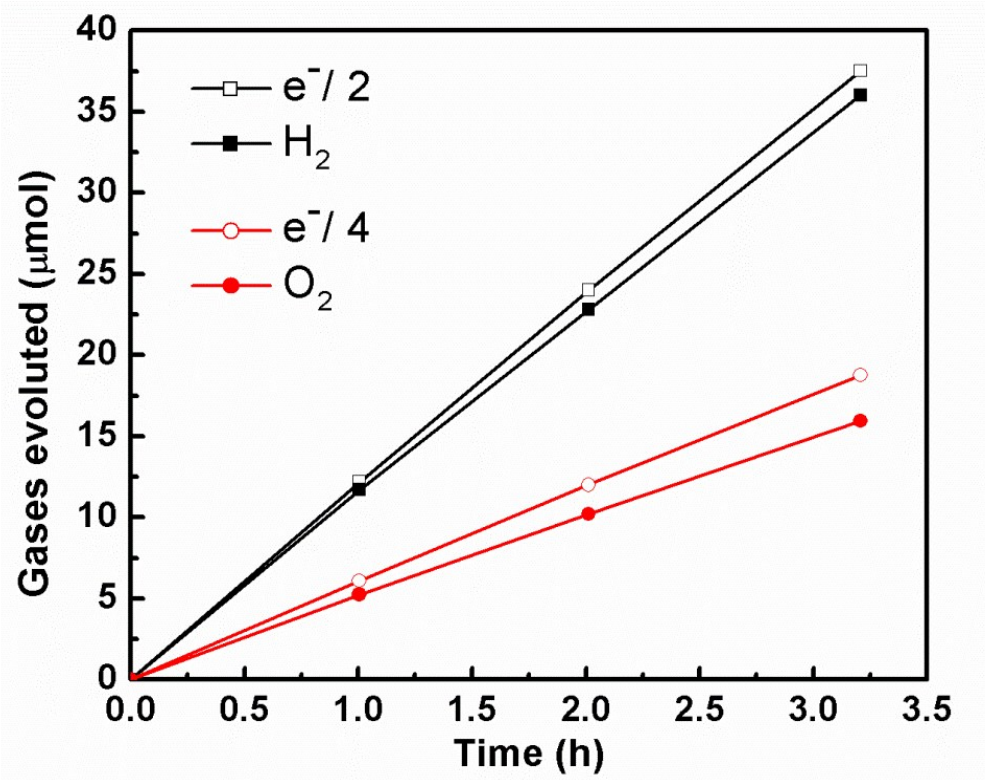

Fig. S14 The Faradaic Efficiency of 6% Ti-doped $ZnFe_2O_4$ measured at 1.23 V vs. RHE under AM 1.5 G illumination (100 mW cm^{-2}).