

## Electronic Supplementary Information

### Influence of carbon doping concentration on photoelectrochemical activity of TiO<sub>2</sub> nanotube arrays under water oxidation

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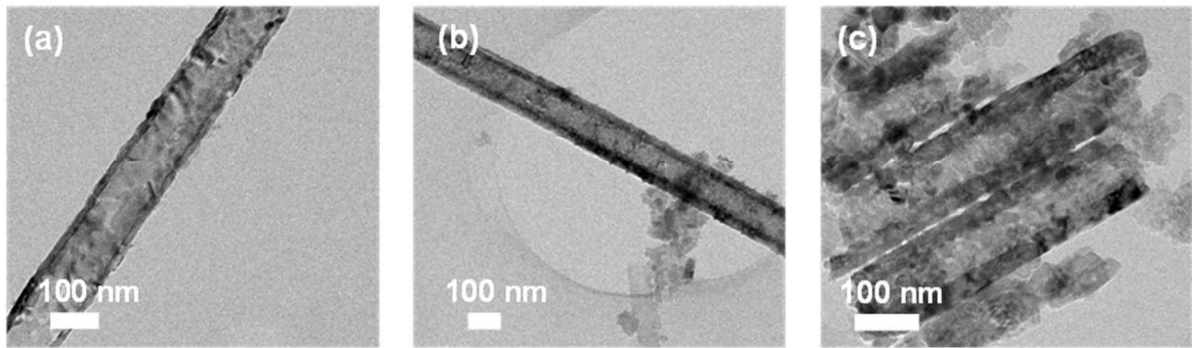
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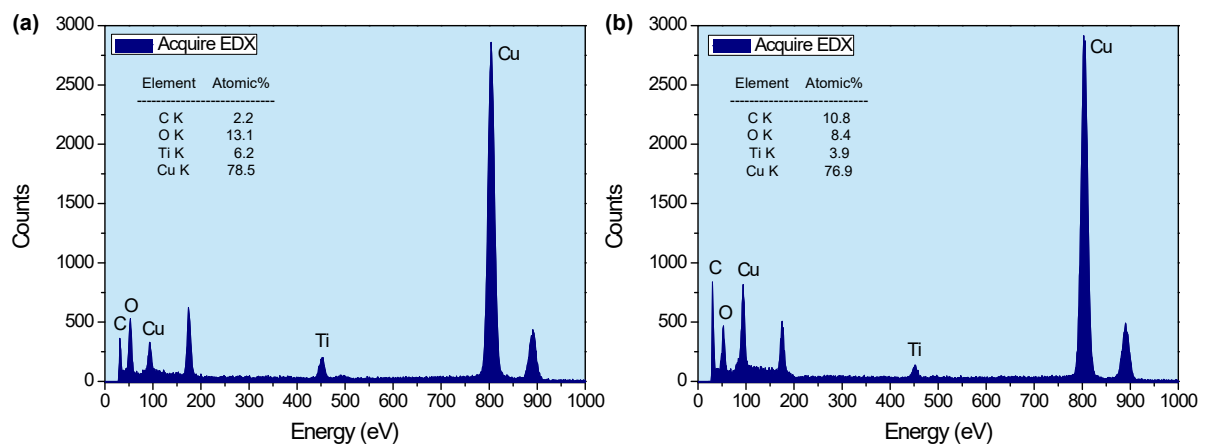
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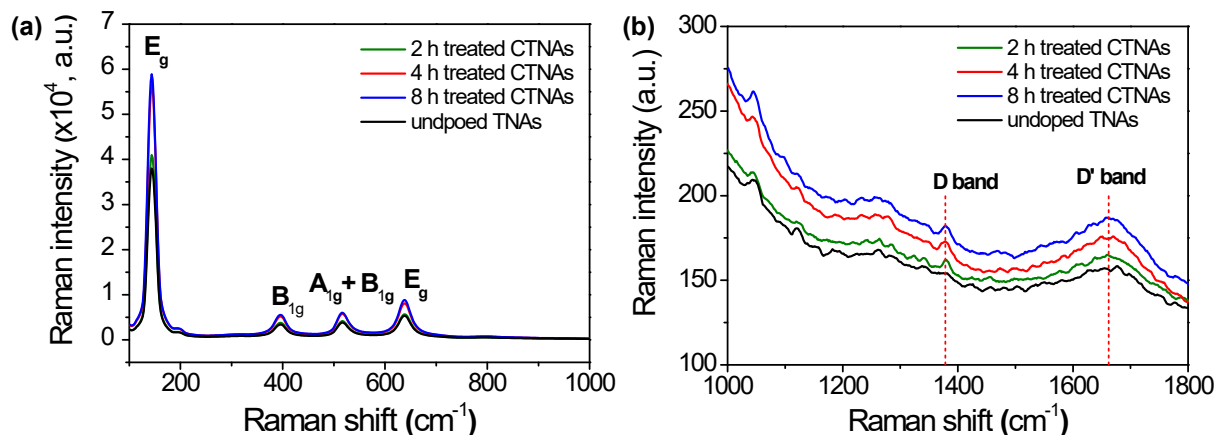
† Electronic Supplementary Information (ESI) available: details of any supplementary  
information available should be included here. See DOI: 10.1039/x0xx00000x



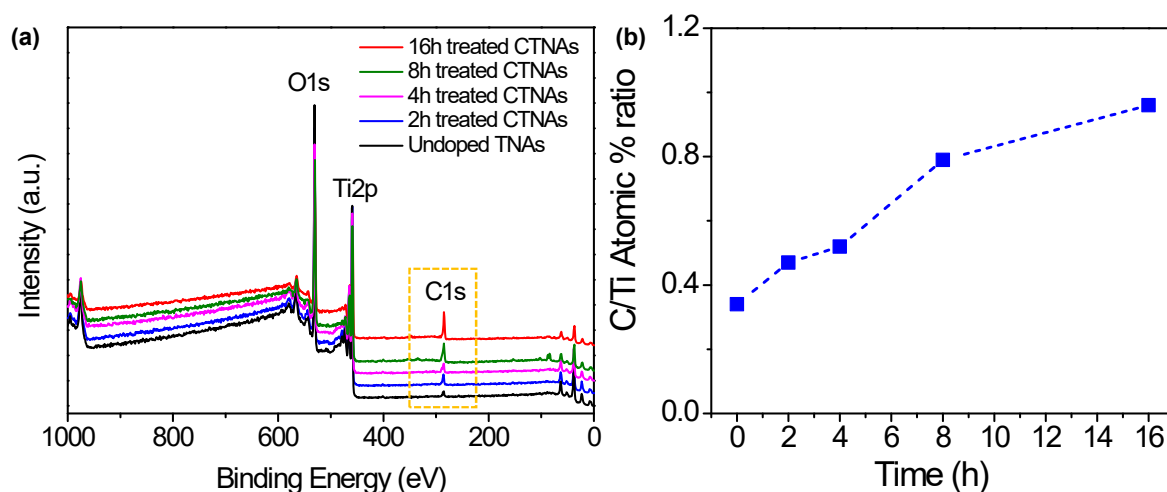
**Fig. S1** TEM images of (a) undoped TNAs, (b) 2 h treated CTNAs, (c) 4 h treated CTNAs.



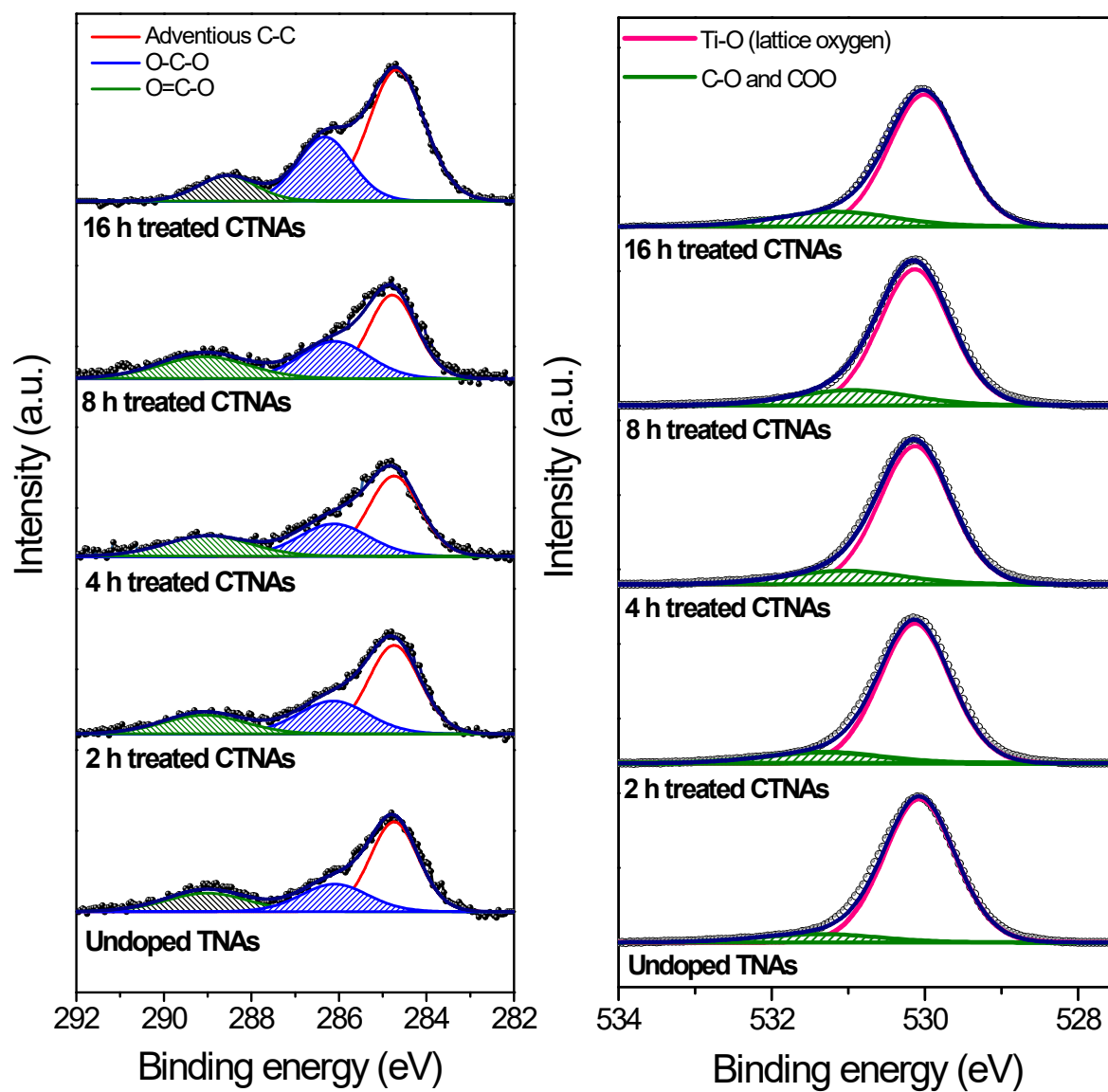
**Fig. S2** EDX spectra of (a) undoped TNAs and (b) 16 h treated CTNAs



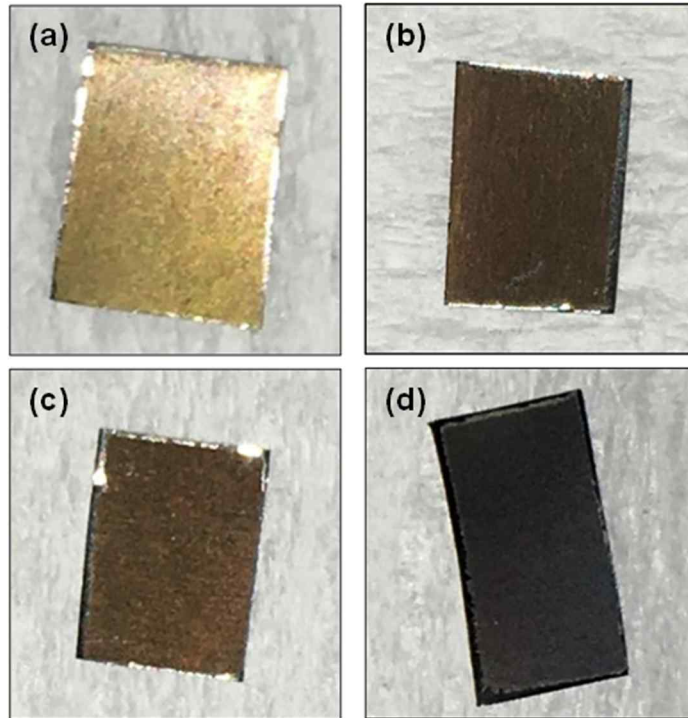
**Fig. S3** Raman spectra of undoped TNAs and various CTNAs using 514 nm radiation. (a) Anatase TNAs have  $E_g$  modes at 144, 196, and  $638.5\text{ cm}^{-1}$ , a doublet of  $A_{1g}$  and  $B_{1g}$  modes at  $517\text{ cm}^{-1}$ , and  $B_{1g}$  at  $395\text{ cm}^{-1}$ . (b) Raman spectra of the carbon D band at  $1376\text{ cm}^{-1}$  and the D' band at  $1666\text{ cm}^{-1}$ .



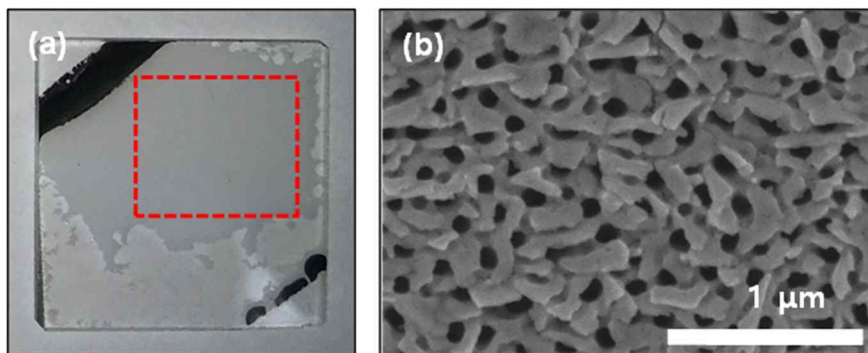
**Fig. S4** (a) XPS survey spectra of undoped TNAs and CTNAs photoelectrodes and (b) C/Ti atomic ratio (%)



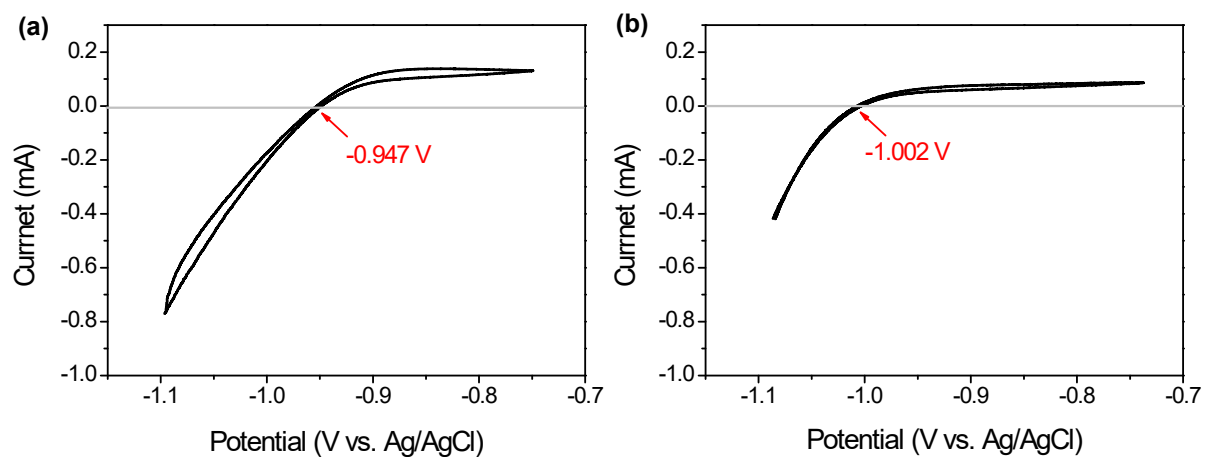
**Fig. S5** X-ray photoelectron spectroscopy of (a) carbon 1s and (b) oxygen 1s.



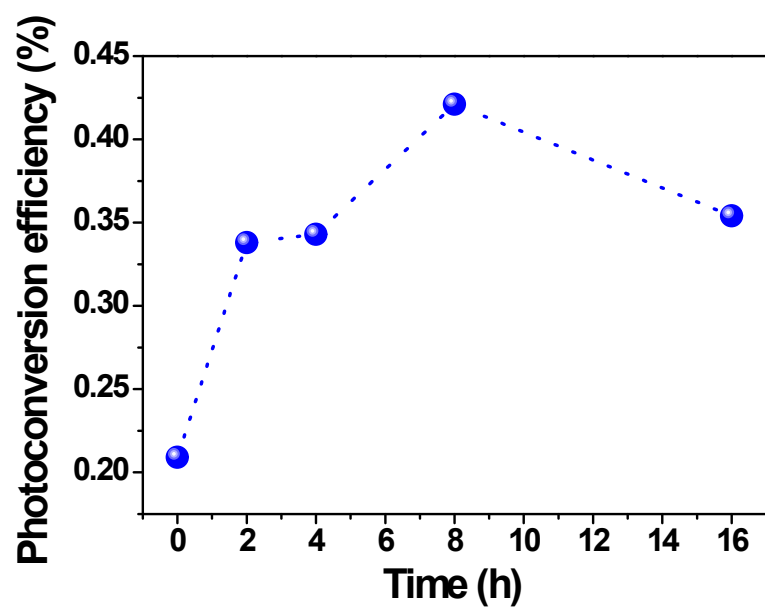
**Fig. S6** Photographs of (a) the undoped TNAs, (b) 2 h treated CTNAs, (c) 4 h treated CTNAs, and (d) 8 h treated CTNAs that were anodized on Ti foil.



**Fig. S7** (a) Photograph of CTNAs that were anodized on quartz. The opaque portion surrounded by the red dotted rectangle is the TNA. (b) Scanning electron microscopy image of TNAs on quartz.



**Fig. S8** Photoconversion efficiency of each sample at an external potential of 1.5 eV versus RHE while under  $100 \text{ mW cm}^{-2}$  of white light. Cyclic voltammetry (CV) was run at a scan rate of  $1 \text{ mV s}^{-1}$ , and the average of the two potentials at the point where the current crossed zero was taken to be the thermodynamic potential for the hydrogen electrode reaction.



**Fig. S9** Photoconversion efficiency of each sample at an external potential of 1.5 eV versus RHE while under  $100 \text{ mW cm}^{-2}$  of white light.



**Table S1** Residual content of carbon in the CTNAs samples.

Sample	Carbon contents (wt.%)
Undoped CTNAs	0.056
2 hour CTNAs	0.170
4 hour CTNAs	0.172
8 hour CTNAs	0.208
16 hour CTNAs	0.319

**Table S2** Atomic % ratio of Ti, O, and C in the XPS spectrum and % area carbonates (O–C–O and O–C=O) calculated from the C1s peak.

Sample	Atomic % of Ti (Ti2p)	Atomic % of O (O1s)	Atomic % of C (C1s)	% area carbonates
Undoped CTNAs	28.07	62.18	9.75	43.9
2 hour CTNAs	27.65	59.53	12.82	48.8
4 hour CTNAs	26.59	58.61	14.80	51.78
8 hour CTNAs	24.92	55.27	19.81	55.91
16 hour CTNAs	23.72	53.29	22.99	62.49