Electronic Supplementary Material (ESI) for Nanoscale.

Standalone anion- and co-doped titanium dioxide nanotubes for photocatalytic and photoelectrochemical solar-to-fuel conversion

Yuchen Ding,[1] *Prashant Nagpal*[2,3,4]

1 Chemistry and Biochemistry, University of Colorado Boulder

2 Chemical and Biochemical Engineering, University of Colorado Boulder

3 Materials Science and Engineering, University of Colorado Boulder

4 Renewable and Sustainable Energy Institute (RASEI), University of Colorado Boulder, Boulder, CO 80303

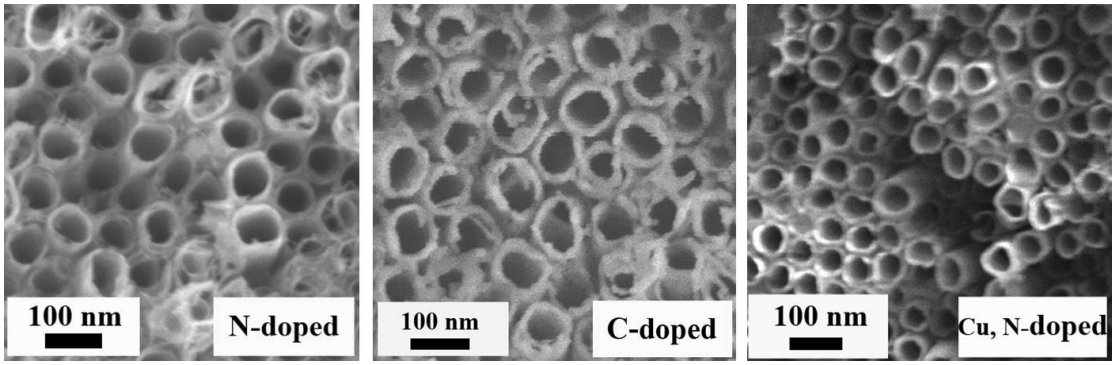

Figure S1. Field emission scanning electron micrographs (FE-SEM) of doped TiO_2 nanotubes.

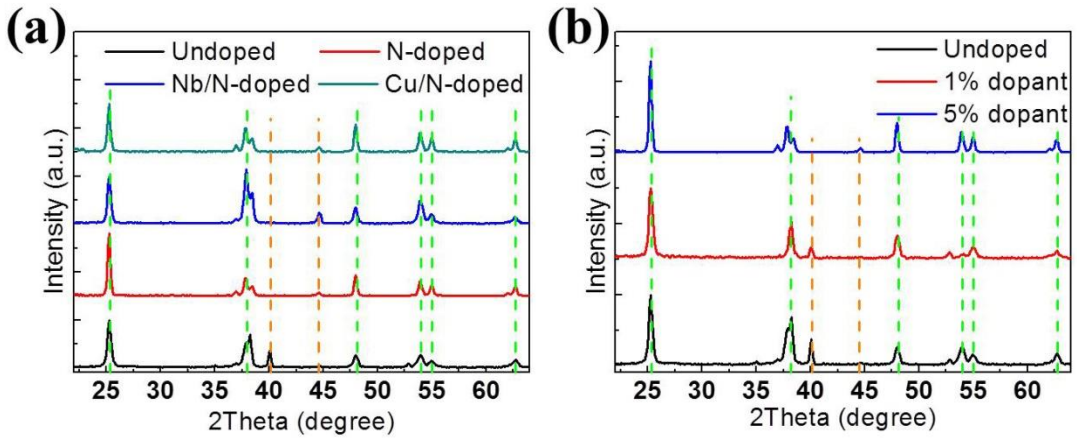

Figure S2. X-ray powder diffraction (XRD) spectroscopy of (a) undoped, anion-doped, and co-doped nanotubes, (b) nanotubes with different dopant level. The dash-green and dash-orange line indicate characteristic peaks for anatase TiO_2 and titanium (from the substrate), respectively.

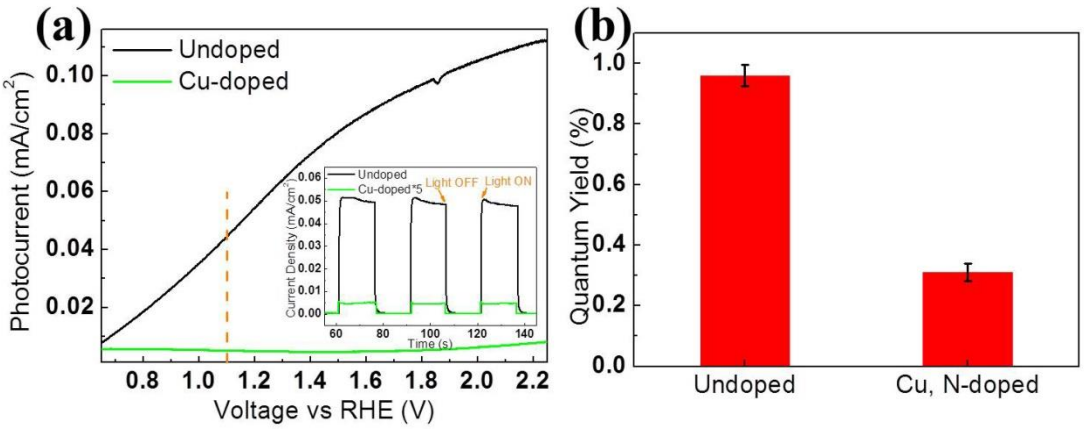

Figure S3. (a) Linear sweep voltammetry of undoped and Cu-doped samples showing the photocurrent density under AM 1.5 (1 SUN) irradiation. The inset is the light ON-OFF current density measurement taken at 500 mV bias vs. Ag/AgCl reference. (b) Quantum yield of Cu, N-codoped TiO_2 nanotubes compared to undoped sample, extracted from methylene blue (MB) test.

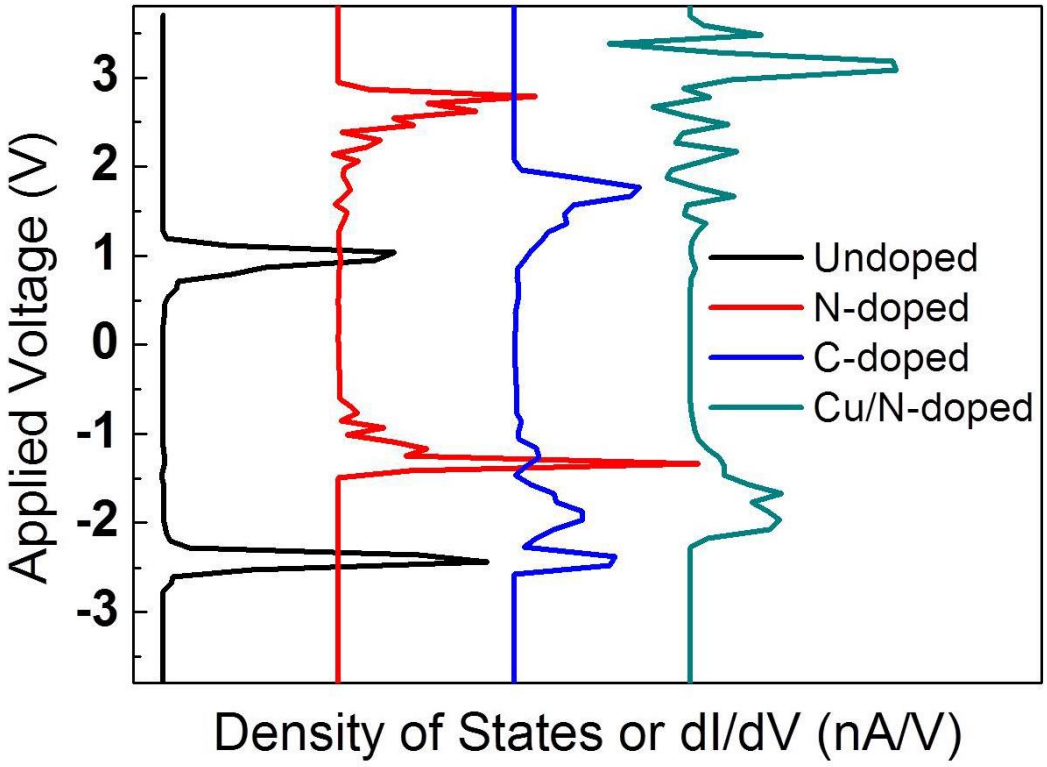

Figure S4. Scanning tunneling spectroscopy (STS) of undoped/doped TiO_2 nanotubes showing the density of states (DOS).

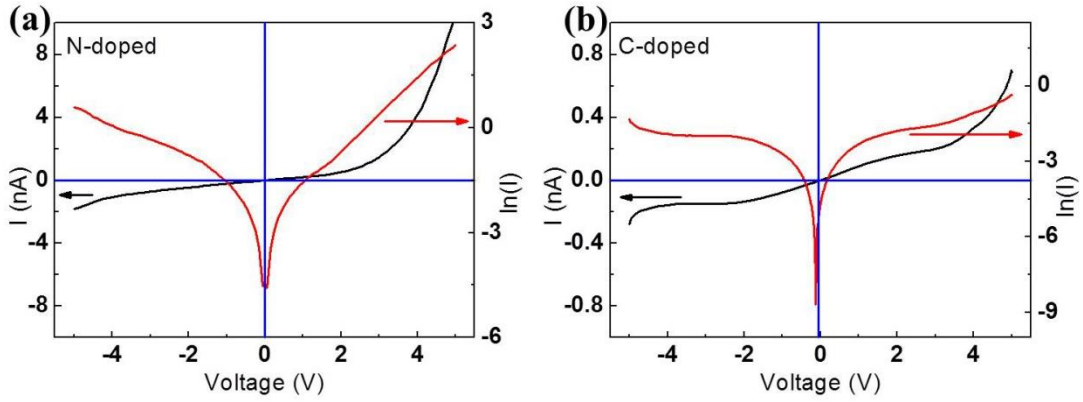

Figure S5. Current-sensing atomic force microscopy (CS-AFM) measurement of (a) N-doped and (b) C-doped TiO_2 nanotubes, showing both the I~V and ln(I)~V characters.

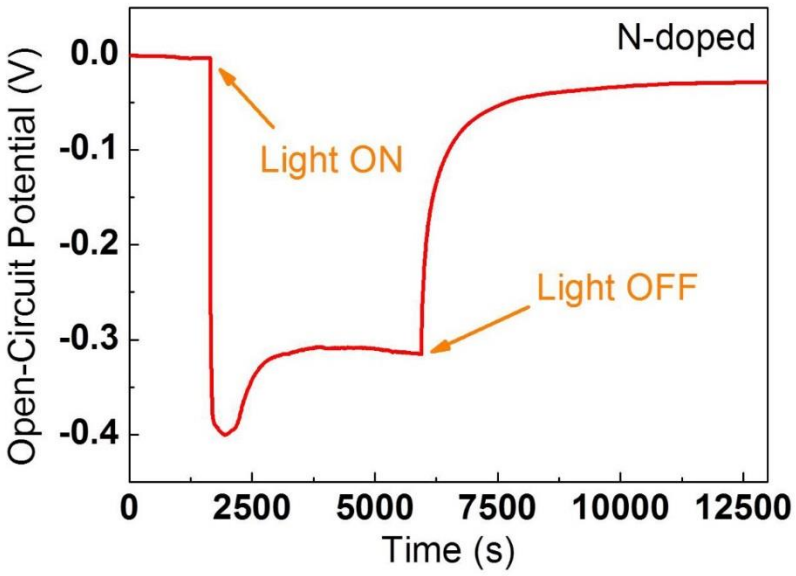

Figure S6. Change of Open-circuit potential with UV light on and off for N-doped TiO_2 nanotubes.

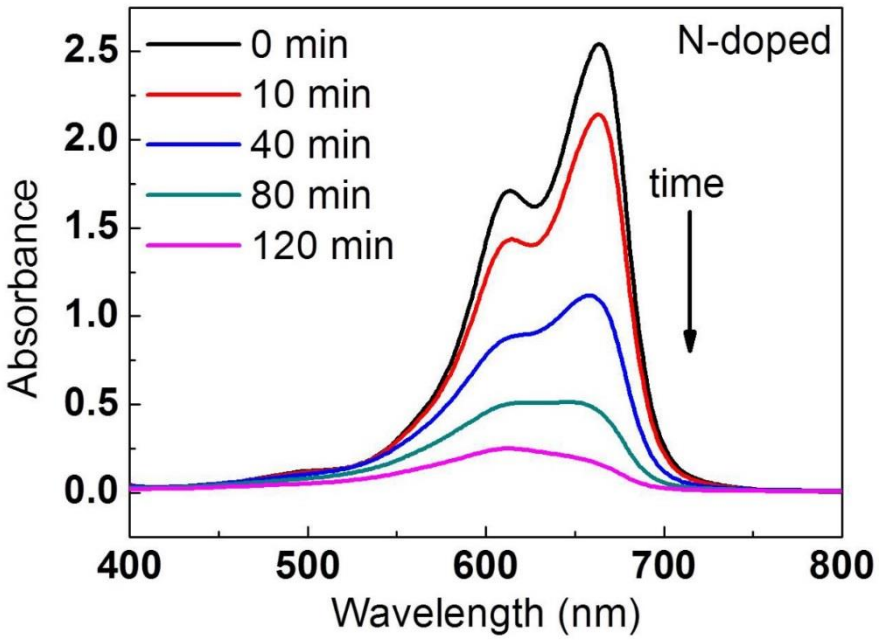

Figure S7. UV-VIS spectrum of methylene blue (MB). The decrease of absorption shows photocatalytic degradation of MB with N-doped TiO_2 nanotubes.