Supporting Information

Tailoring Density of State of $Ni(OH)_2$ with Ni^0 Towards Solar Urea Wastewater Splitting

Li Zou [1], *Wenyan Tao* [2], *Jing Huang* [1], *Shuxiang Wang* [1], *Yijia Zhang* [1], *Keqiang Han* [1], *Yi Hu* [1], *Haoyan Gao* [1], *Pingping Yang* [1], *and Jiale Xie* [1]*

[1] School of New Energy Materials, Southwest Petroleum University, Chengdu, 610500, People's Republic of China.

[2] Tongwei Solar Company, Chengdu, 610299, People's Republic of China.

*Corresponding author. J.L. Xie, E-mail: jialexie@swpu.edu.cn

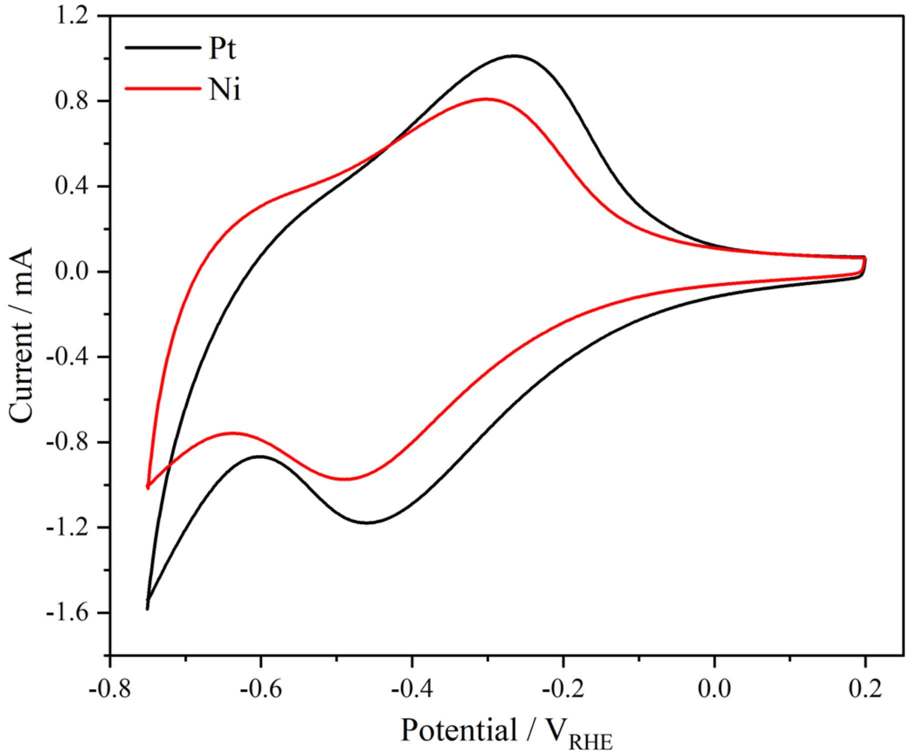

Figure S1. CV curves with Pt and Ni counter electrodes in PBS (pH=6.8) at a scan rate of 100 mV s^{-1}.

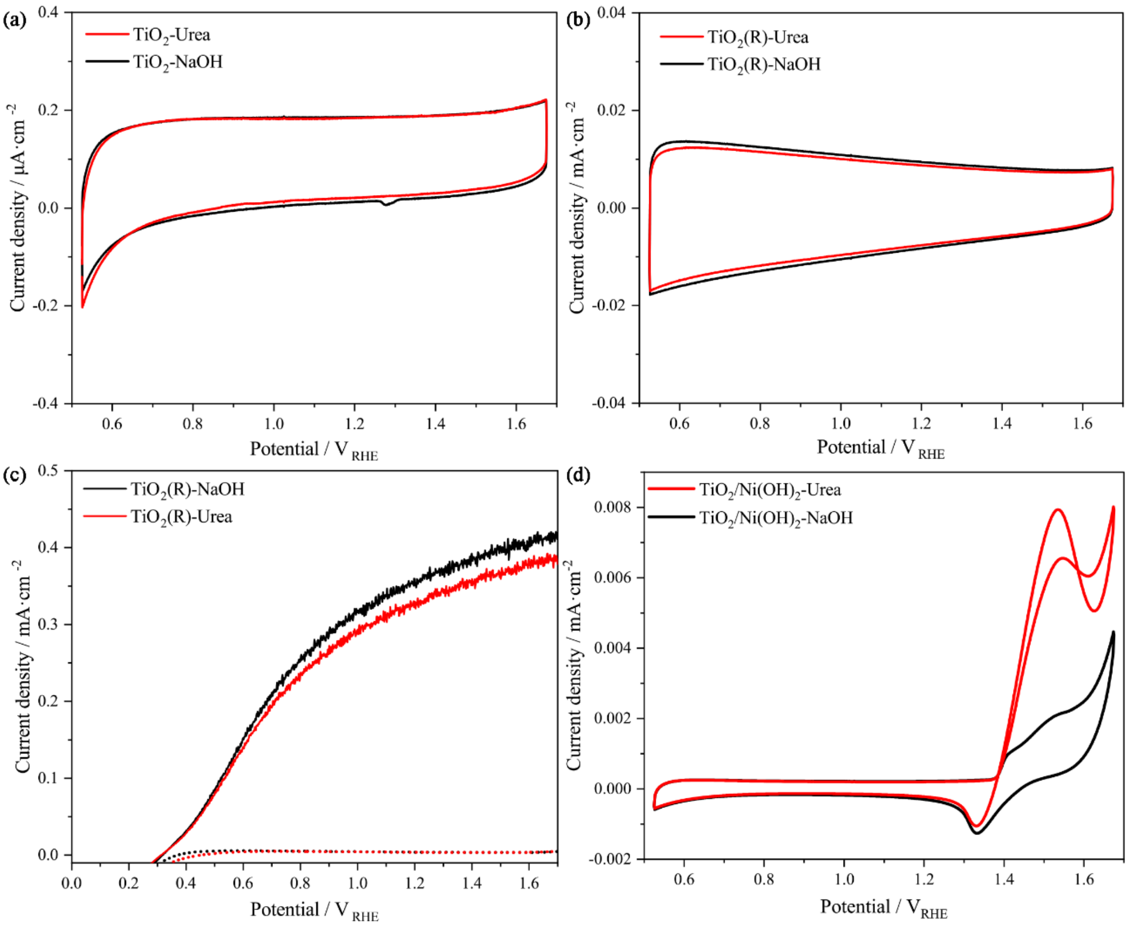

Figure S2. (a) CV curves of TiO_2. (b) CV curves of the electrochemical reduced TiO_2 (TiO_2(R)). (c) Dark (dot line) and light (solid line) of TiO_2(R). (d) Dark CV curves of $TiO_2/Ni(OH)_2$. Test conditions: the electrolyte is 1.0 M NaOH with/without 0.33 M $CO(NH_2)_2$. The scan rate is 20 mV s^{-1}.

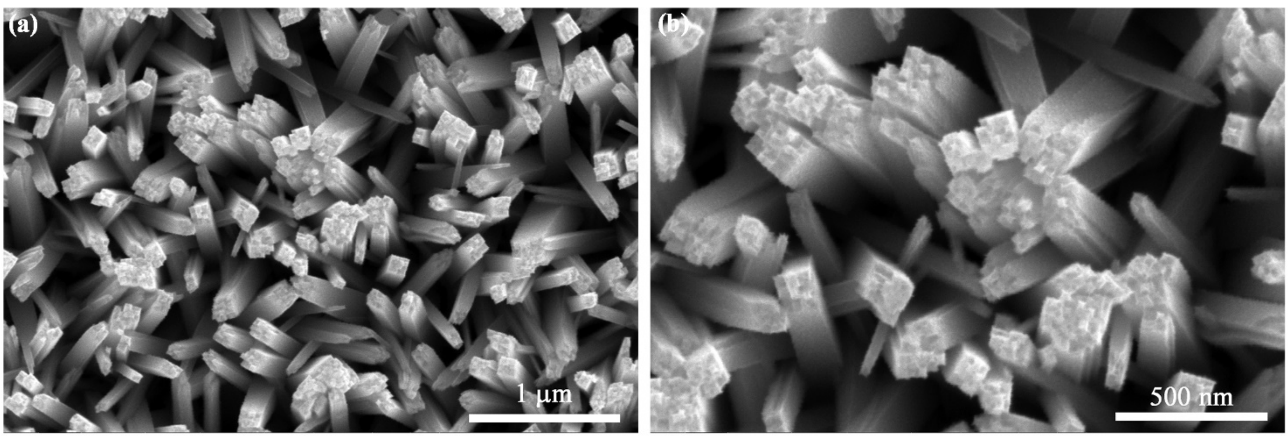

Figure S3. SEM images of $TiO_2/Ni(OH)_2$ photoanodes.

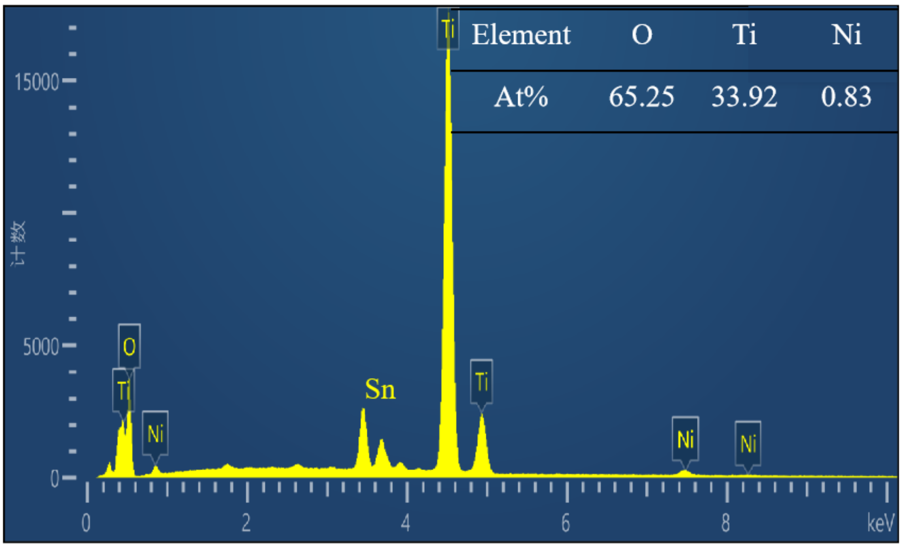

Figure S4. EDS pattern of $TiO_2/Ni^0:Ni(OH)_2$. The inset is the atomic ratios of O, Ti and Ni elements.

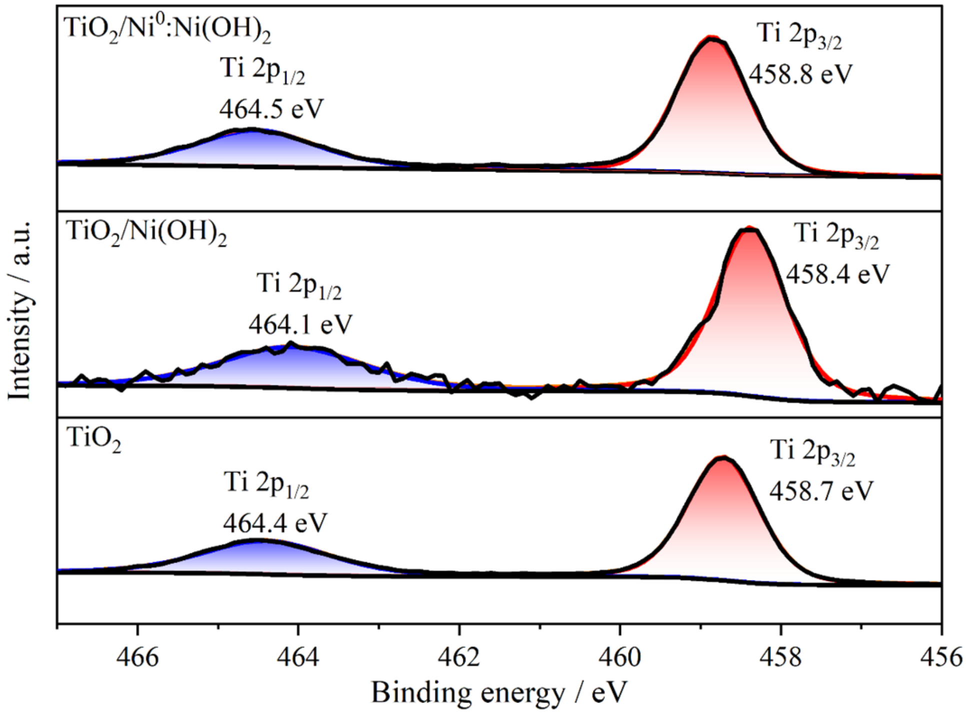

Figure S5. Ti 2p XPS spectra of TiO_2, $TiO_2/Ni(OH)_2$, and $TiO_2/Ni^0:Ni(OH)_2$ photoanodes.

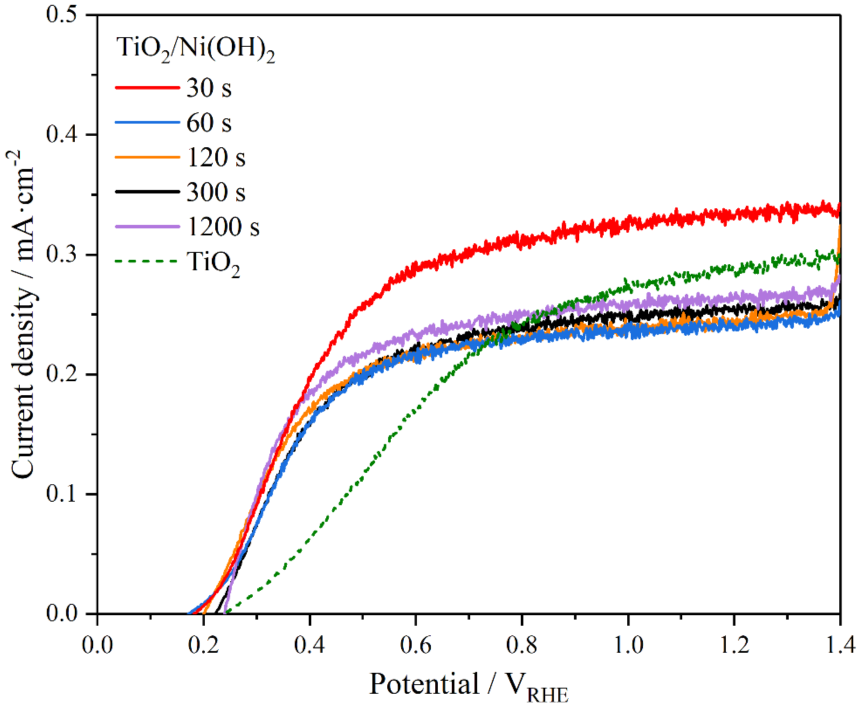

Figure S6. LSV curves of $TiO_2/Ni(OH)_2$ photoanodes with different loading of $Ni(OH)_2$ measured at a scan rate of 20 mV s^{-1} in 1 M NaOH and 0.33 M $CO(NH_2)_2$ under AM 1.5G illumination.

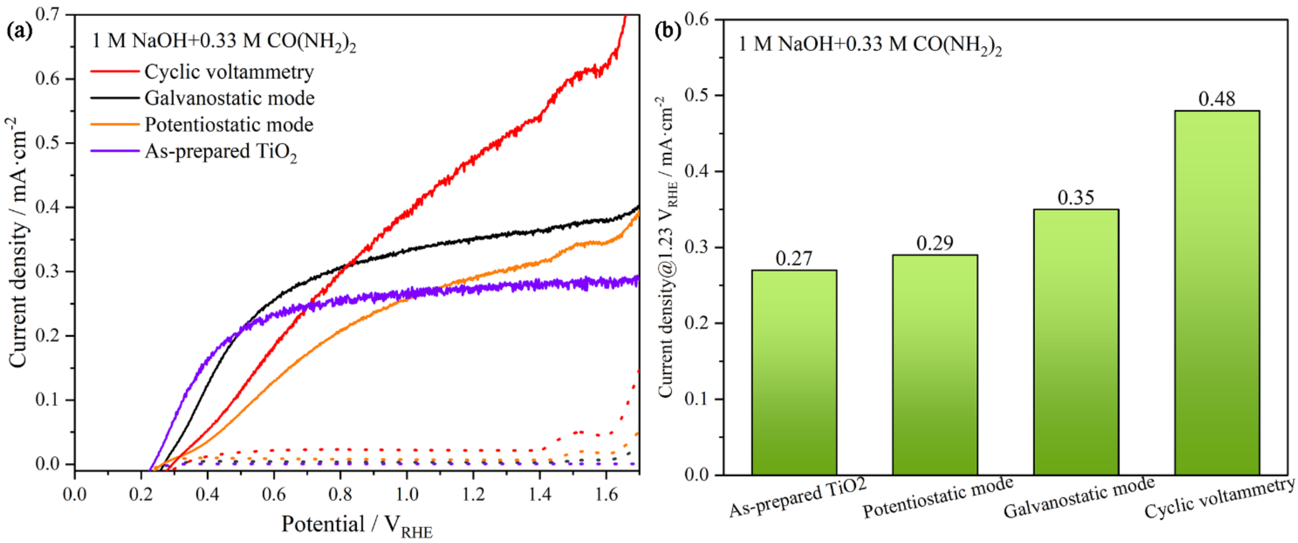

Figure S7. (a) LSV curves of $TiO_2/Ni^0:Ni(OH)_2$ prepared with different electrochemical technologies under AM 1.5G illumination. The dot lines are the corresponding dark LSV curves. Scan rate: 20 mV s^{-1}. (b) Photocurrent density of the above $TiO_2/Ni^0:Ni(OH)_2$ photoanodes at 1.23 V_{RHE}. For the synthesis of $Ni^0:Ni(OH)_2$, the quantity of electric charge during these three techniques is as same as 0.37 C.

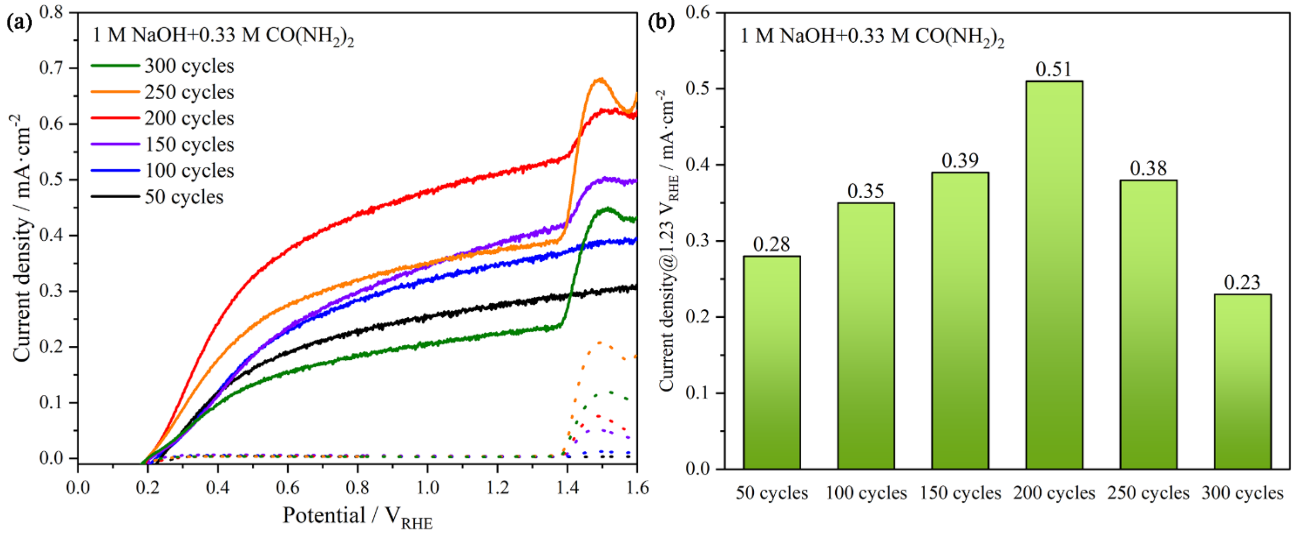

Figure S8. (a) LSV curves of $TiO_2/Ni^0:Ni(OH)_2$ prepared with various CV cycles under AM 1.5G illumination. The dot lines are the corresponding dark LSV curves. Scan rate: 20 mV s^{-1}. (b) Photocurrent density of the above $TiO_2/Ni^0:Ni(OH)_2$ photoanodes at 1.23 V_{RHE}.

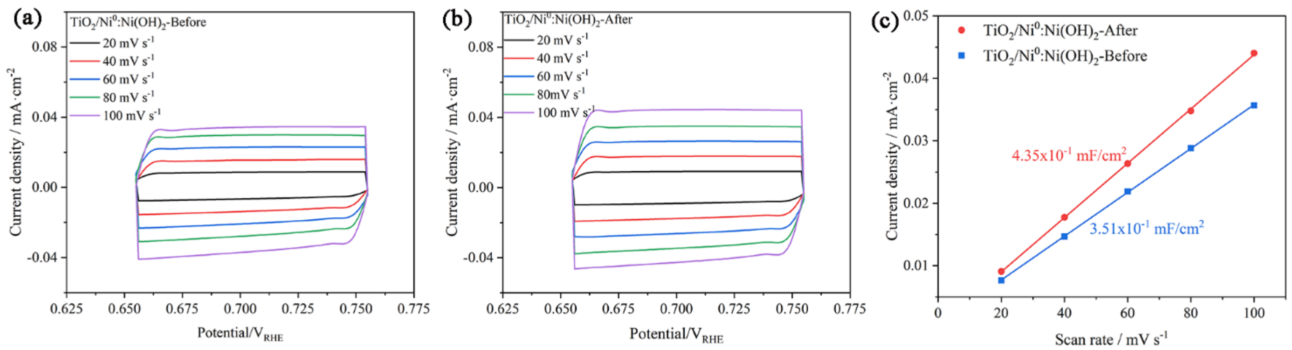

Figure S9. (a) CV curves of $TiO_2/Ni^0:Ni(OH)_2$ before the stability test. (b) CV curves of $TiO_2/Ni^0:Ni(OH)_2$ after the stability test. (e) Capacitances of the above electrodes. Test conditions: the electrolyte of 1.0 M NaOH and 0.33 M $CO(NH_2)_2$.

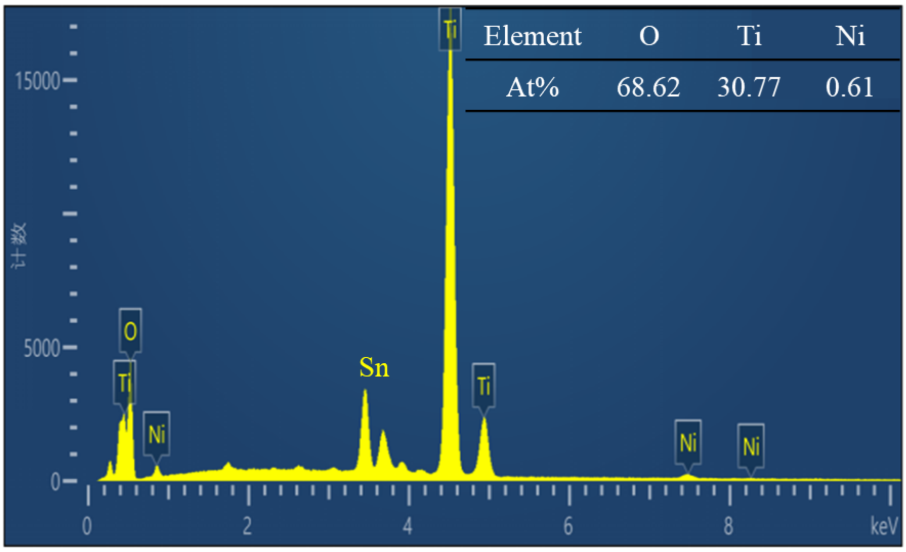

Figure S10. EDS pattern of $TiO_2/Ni^0:Ni(OH)_2$ after stability testing. The inset is the atomic ratios of O, Ti and Ni elements.

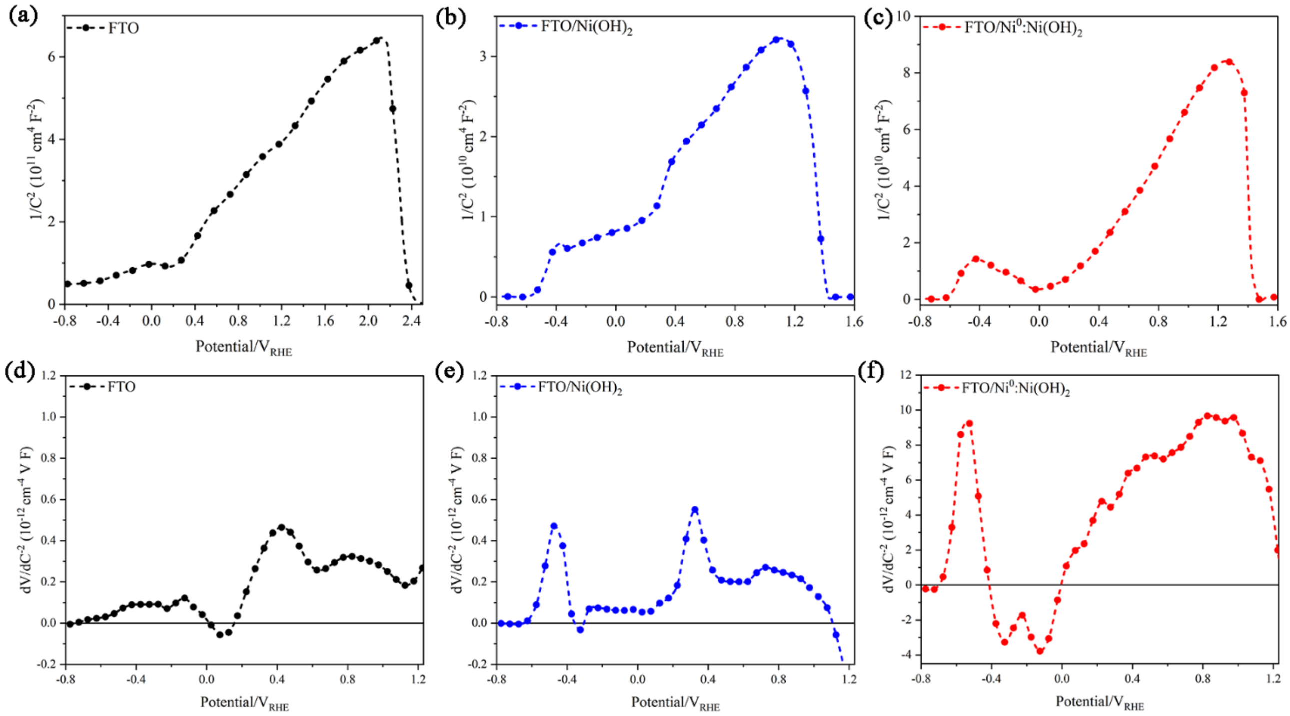

Figure S11. MS plots of (a) FTO, (b) $FTO/Ni(OH)_2$ and (c) $FTO/Ni^0:Ni(OH)_2$. The derivative of the nonlinear MS plots of (d) FTO, (e) $FTO/Ni(OH)_2$ and (f) $FTO/Ni^0:Ni(OH)_2$.

Table S1. Summary the PEC performances of the reported photoanodes for urea oxidation reaction.

Cocatalyst	Photoanode	Electrolyte	PEC performance	Ref.
$Ni(OH)_2$	TiO_2(hydrogenated)	1 M NaOH+0.33 M $CO(NH_2)_2$	J_{ph}=2.51 mA cm^{-2}, E_{on}=-0.2 $V_{Ag/AgCl}$	1
$Ni(OH)_2$	TiO_2/CdS	1 M NaOH+0.33 M $CO(NH_2)_2$	J_{ph}=0.81 mA cm^{-2}, E_{on}=1.23 V_{RHE}	2
$Ni(OH)_2$	Ti:α-Fe_2O_3	1 M NaOH+0.10 M $CO(NH_2)_2$	J_{ph} =1.57 mA cm^{-2}, E_{on} =1.30 V_{RHE}	3
$Ni(OH)_2$/Au/Co	α-Fe_2O_3	Human urine	J_{ph} =7.51 mA cm^{-2}, E_{on} =1.33 V_{RHE}	4
Co-Pi	SnO_2/$BiVO_4$	0.1 M PBS+2% $CO(NH_2)_2$	J_{ph} =3.44 mA cm^{-2}, E_{on} =1.23 V_{RHE}	5
Ni/SiO_x	Si	1 M KOH+0.33 M $CO(NH_2)_2$	J_{ph} =10.00 mA cm^{-2}, E_{on} =1.50 V_{RHE}	6
CoOOH/NiOOH	$BiVO_4$	0.5 M Na_2SO_4+2 % $CO(NH_2)_2$	J_{ph} =4.93 mA cm^{-2}, E_{on} =1.23 V_{RHE}	7

Table S2. V_{fb}, N_D, W_{SCL} of TiO_2 based photoanodes.

Photoanode	V_{fb} / V_{RHE}	N_D / cm^{-3}	W_{SCL}@0.8 V_{RHE} / nm
TiO_2	0.12	$2.63×10^{17}$	169.10
TiO_2/$Ni(OH)_2$	0.2	$6.98×10^{19}$	9.75
TiO_2/Ni^0:$Ni(OH)_2$	-0.16	$1.21×10^{22}$	0.90

Table S3. R_s, R_{bulk}, CPE_{bulk}, R_{ct}, CPE_{trap} of TiO_2 based photoanodes.

Photoanode	R_s / Ω	R_{bulk} / Ω	CPE_{bulk} / F	R_{ct} / Ω	CPE_{trap} / F

TiO_2	25.03	113.40	7.10×10^{-6}	1.18×10^{4}	3.25×10^{-5}
$TiO_2/Ni(OH)_2$	24.68	1447.00	3.79×10^{-7}	1.09×10^{4}	2.51×10^{-6}
$TiO_2/Ni^0:Ni(OH)_2$	25.24	104.80	6.24×10^{-6}	0.87×10^{4}	1.46×10^{-5}

References

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