The supporting information for

A synergetic effect between photogenerated carriers and photothermally enhanced electrochemical urea-assisted hydrogen generation on Ni-NiO/Nickel Foam catalyst

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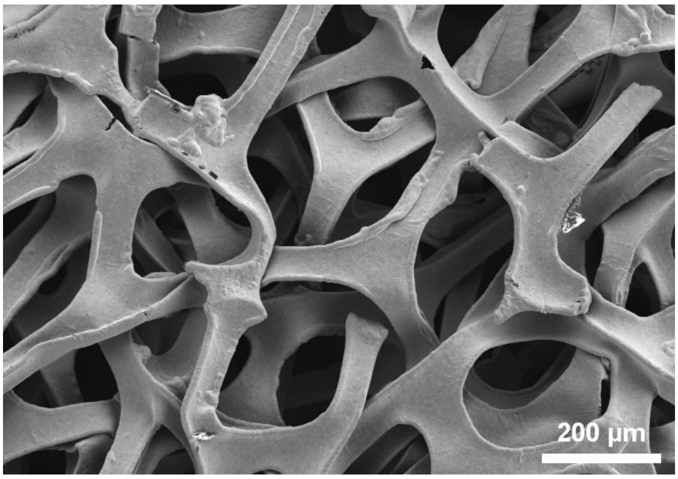


Fig. S1. SEM image of the Ni foam.

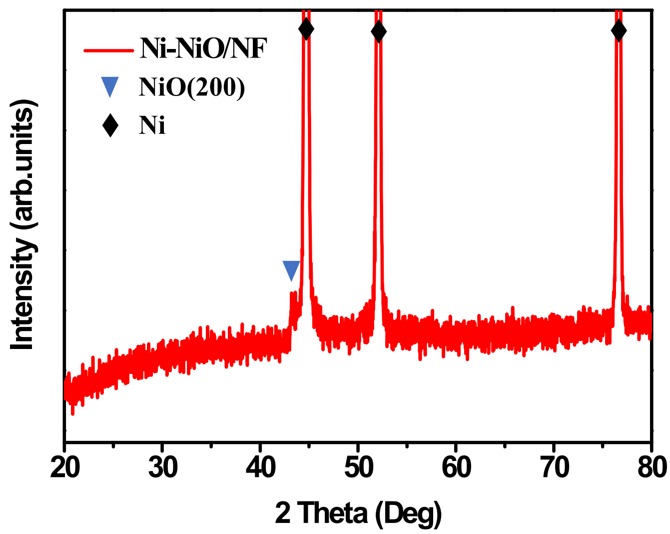


Fig. S2. X-ray diffraction (XRD) pattern of Ni-NiO/NF.

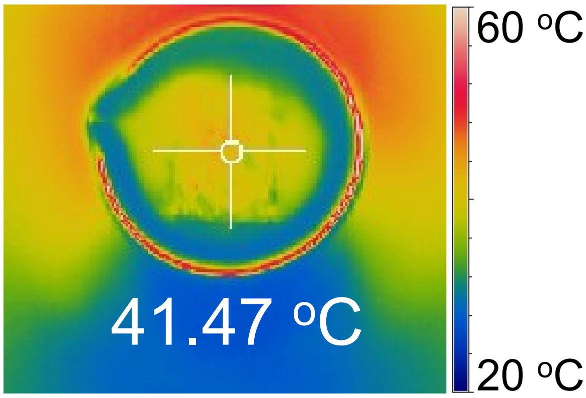


Fig. S3. Infrared photograph of Ni-NiO/NF at full spectrum irradiation of 150 mW cm $^{-2}$ for 60 seconds.

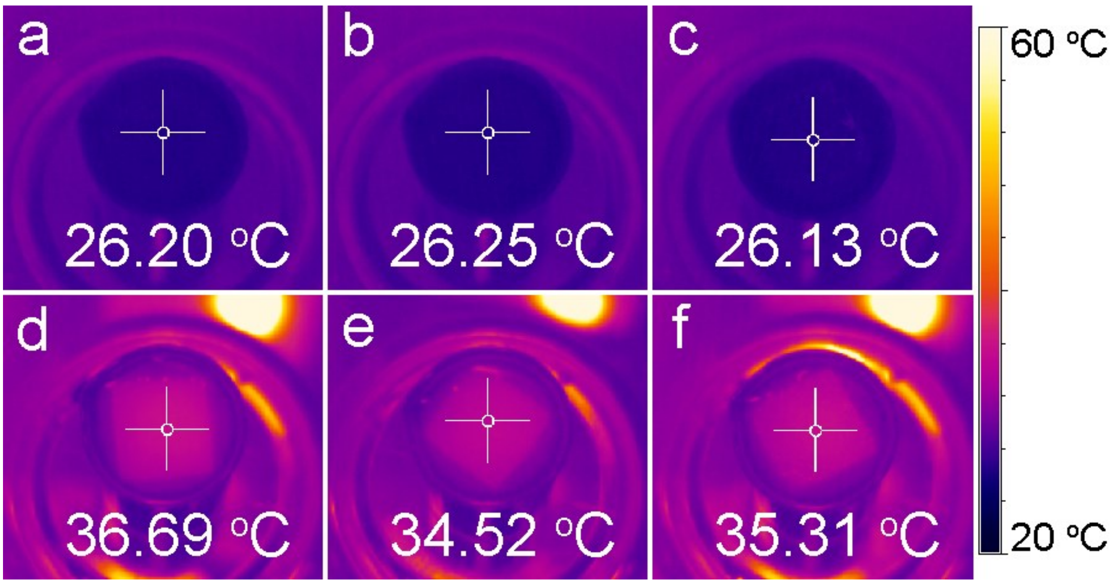


Fig. S4. Infrared photographs without irradiation of (a) Ni-NiO/NF, (b) $Ni(OH)_2$/NF and (c) NF. Bottom row: same infrared photographs under full spectrum irradiation of the highest temperature of (d) Ni-NiO/NF, (e) $Ni(OH)_2$/NF and (f) NF.

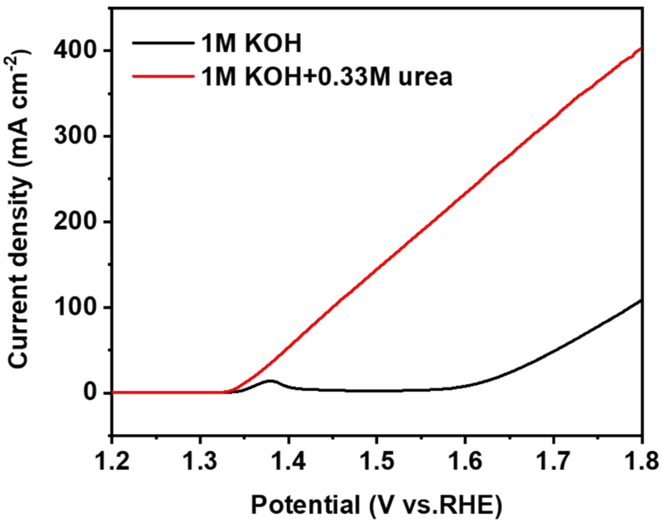


Fig. S5. Linear sweep voltammetry curves for the UOR and OER of Ni-NiO/NF.

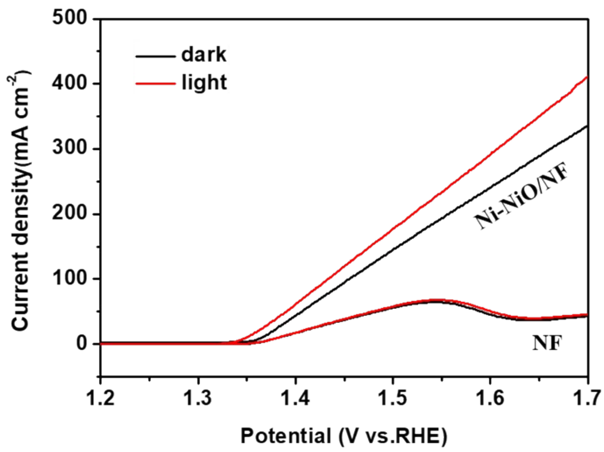
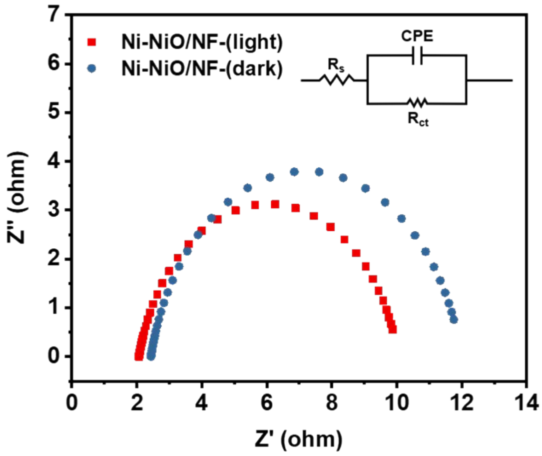


Fig. S6. Polarization curves for the UOR of Ni-NiO/NF and NF with and without irradiation.



	R_s / ohm	R_{ct} / ohm
Light	2.065	7.991
Dark	2.432	9.571

Fig. S7. Electrochemical impedance spectroscopy (EIS): Nyquist plots of Ni-NiO/NF electrode for UOR. The solution resistance and charge transfer resistance for Ni-NiO/NF electrode are also listed.

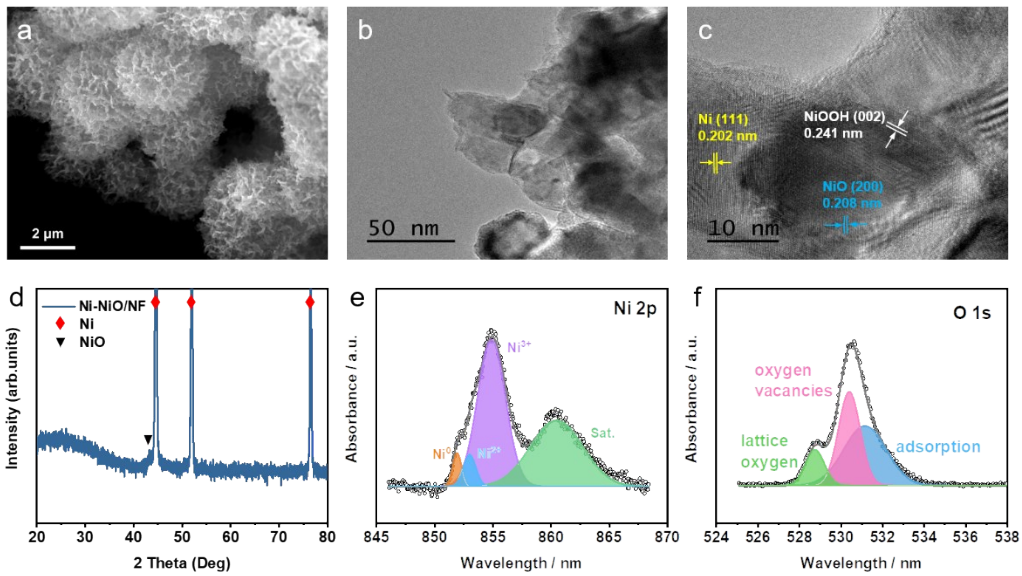


Fig. S8. (a) The SEM image of Ni-NiO after the durability test. (b) TEM image,(c) HRTEM image of Ni-NiO/NF after the durability test. (d) X-ray diffraction (XRD) pattern of Ni-NiO/NF after the durability test. XPS spectra of (e) Ni 2p and (f) O 1s of Ni-NiO/NF after the durability test.

Table S1 The atomic concentration of Ni, O and C species for Ni-NiO/NF and $Ni(OH)_2$/NF from full XPS spectrum.

Catalysts	% At Conc		
	Ni 2p	O 1s	C 1s
Ni-NiO/NF	36	40	24
$Ni(OH)_2$/NF	27	45	28

Table S2 Comparison of the activity of Ni-NiO/NF||Ni-NiO/NF and other reported materials in the urea-assisted electrochemical hydrogen production.

Catalysts	**Electrolyte**	**η (mV) at *j* = 10 mA cm^{-2}**	**Cell voltage (V @ *j* mA cm^{-2})**	**Stability**	**Reference**
Ni-NiO/NF||Ni-NiO/NF	**1 M KOH+0.33M Urea**	**1.48**	**1.7@60**	**5 h**	**This work**
NF@Acid-H_2|| NF@Acid-H_2	1 M KOH+0.5 M Urea	1.49	1.62@50	20 h	1
1% Cu:α-$Ni(OH)_2$/NF|| 1% Cu:α-$Ni(OH)_2$/NF	1 M KOH+0.33 M Urea	1.49	1.74@60	40 h	2
Ni_4N/Cu_3N/CF||Ni_4N/Cu_3N/CF	1 M KOH+0.5 M Urea	1.48	1.7@50	10 h	3
Ni-Co_9S_8/CC|| Ni-Co_9S_8/CC	1 M KOH+0.33 M Urea	1.52	1.76@60	20 h	4
CoMn/$CoMn_2O_4$|| CoMn/$CoMn_2O_4$	1 M KOH+0.5 M Urea	1.51	1.68@100	60000s	5
Pt/C||RuO_2	1 M KOH+0.33 M Urea	1.53	--	--	6

$MnO_2/MnCo_2O_4$|| $MnO_2/MnCo_2O_4$	1 M KOH+0.5 M Urea	1.58	1.85@60	15 h	7
NiMoS||NiMoS	1 M KOH+0.5 M Urea	1.59	2@120	10 h	8
NF-Pt/C||NF-Pt/C	1 M KOH+0.5 M Urea	1.68	--	--	9
Pt/C-IrO_2|| Pt/C-IrO_2	1 M KOH+0.5 M Urea	1.72	--	--	9

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