

Supporting Information

Hollow N-doped carbon nano-mushroom encapsulated hybrid Ni₃S₂/Fe₅Ni₄S₈ particle anchored to the inner wall of porous wood carbon for efficient oxygen evolution electrocatalysis

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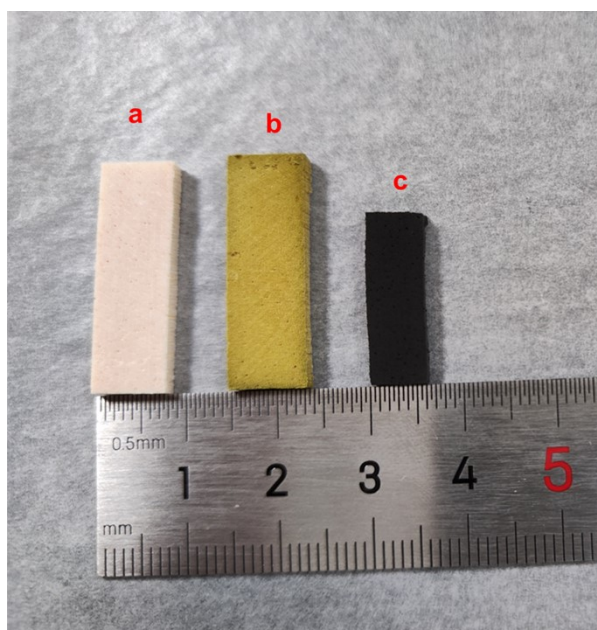


Figure S1. The digital photo of (a) natural balsa wood, (b) impregnated wood, and (c) NiFeS14@NCNM/CW.

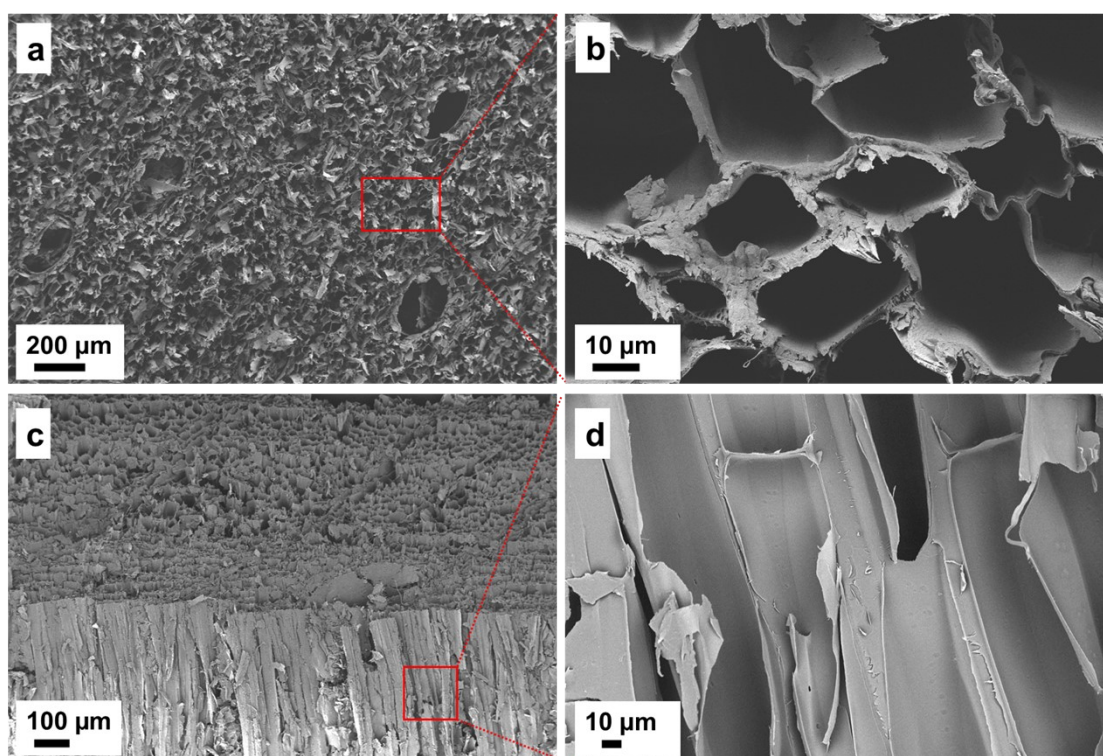


Figure S2. SEM images on the (a, b) cross-section and (c, d) tangential-section view for balsa wood, respectively.

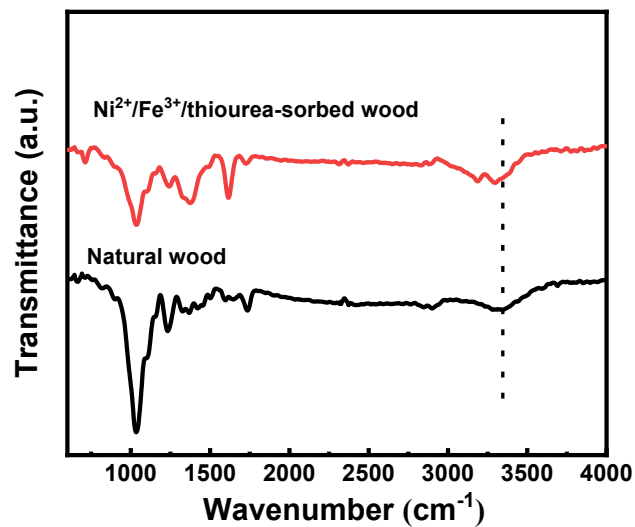


Figure S3. FTIR spectra of natural wood and $\text{Ni}^{2+}/\text{Fe}^{3+}/\text{thiourea}$ -sorbed wood, respectively.

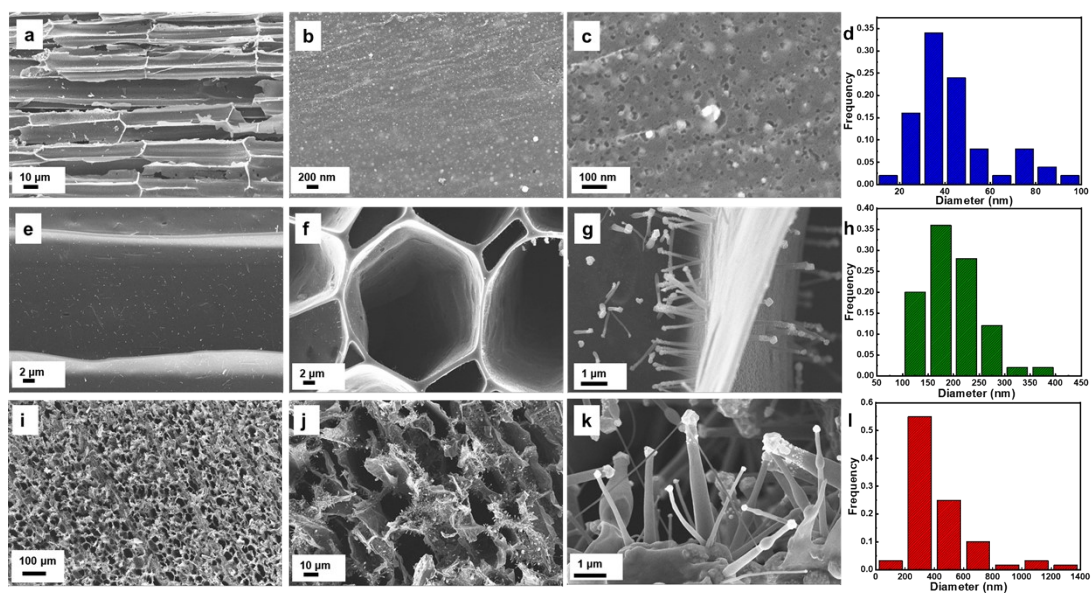


Figure S4. SEM images of the (a-c) NiFe/CW , (e-g) $\text{NiFeS}_8@\text{NCNM}/\text{CW}$, and (i-k) $\text{NiFeS}_{14}@\text{NCNM}/\text{CW}$. The columnar plots show the diameter distribution of the nanoparticles for (d) NiFe/CW , and nano-mushrooms for (h) $\text{NiFeS}_8@\text{NCNM}/\text{CW}$ and (l) $\text{NiFeS}_{14}@\text{NCNM}/\text{CW}$.

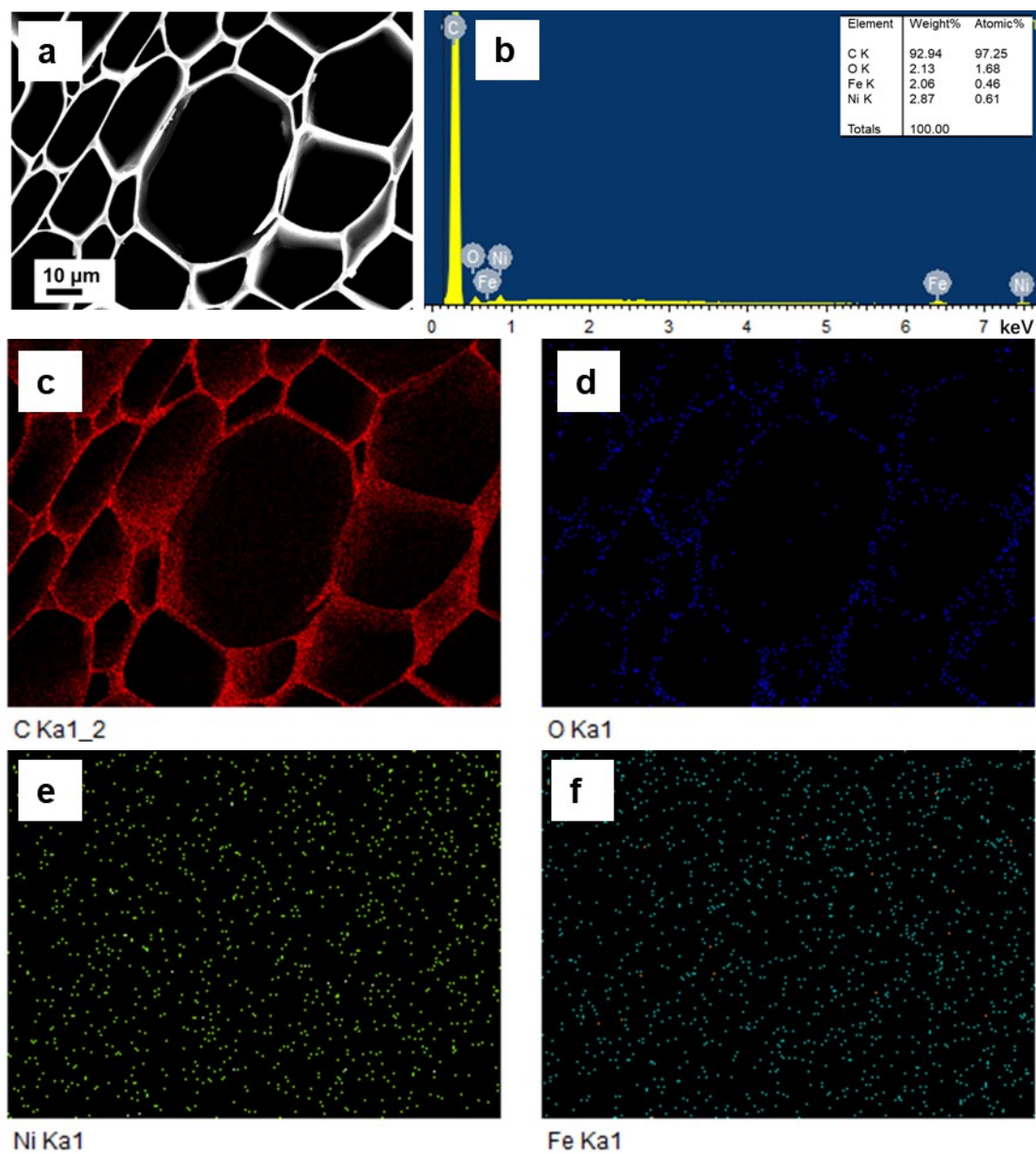


Figure S5. (a) Representative SEM image, (b) the corresponding EDX spectrum, and (c-f) element mapping of NiFe/CW.

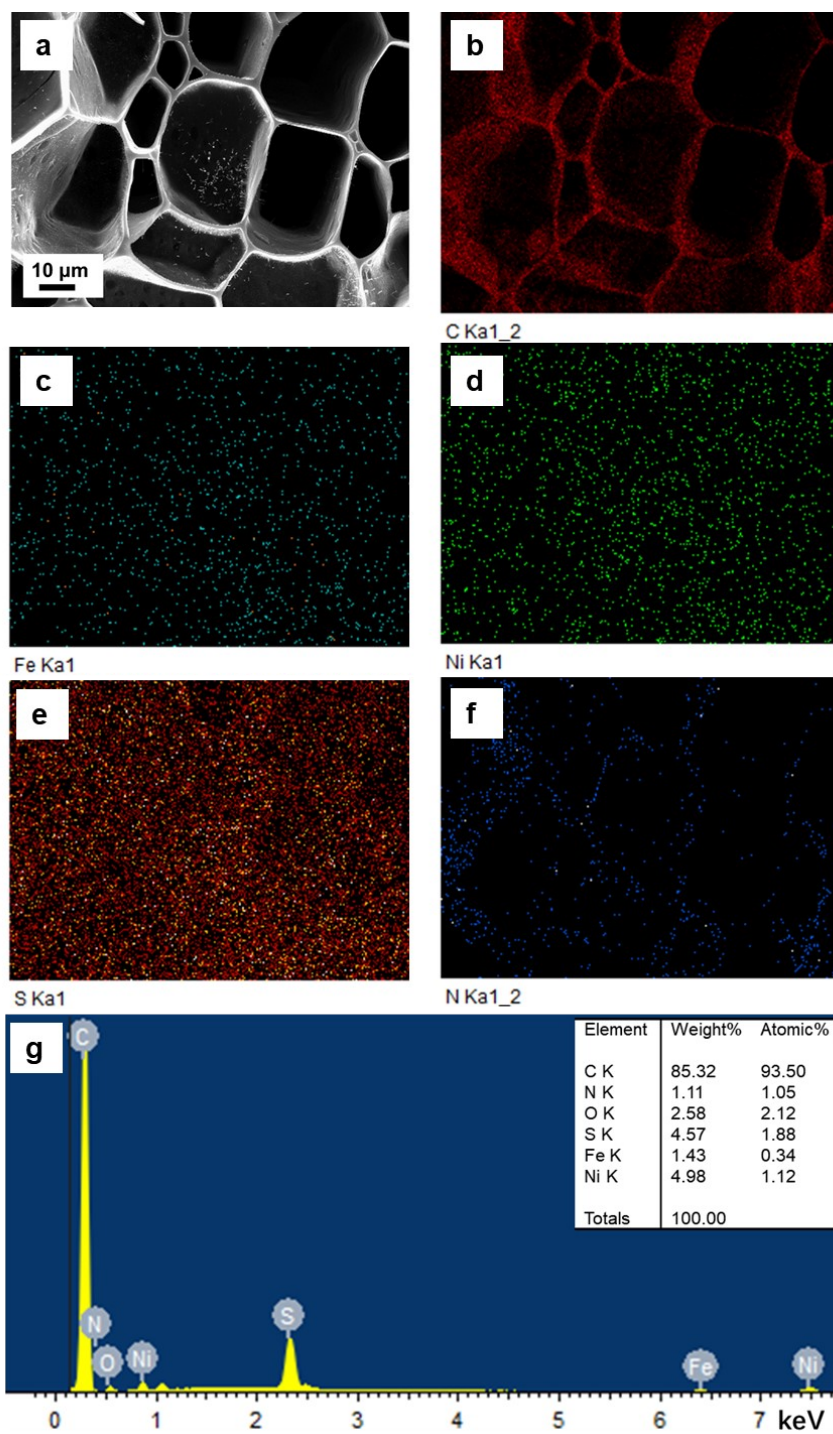


Figure S6. (a) Representative SEM image, (b-f) element mapping, and (g) the corresponding EDX spectrum of NiFeS8@NCNM/CW.

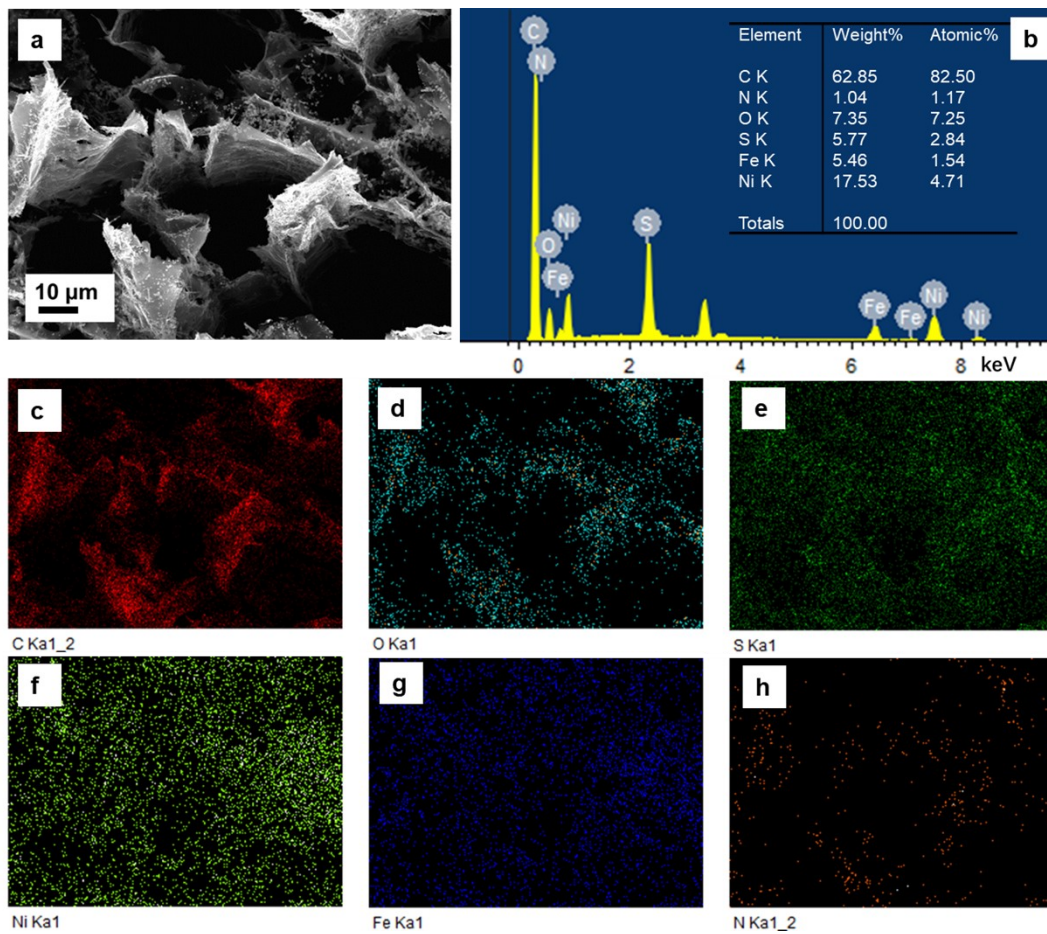


Figure S7. (a) Representative SEM image, (b) the corresponding EDX spectrum, and (c-h) element mapping of NiFeS₁₄@NCNM/CW.

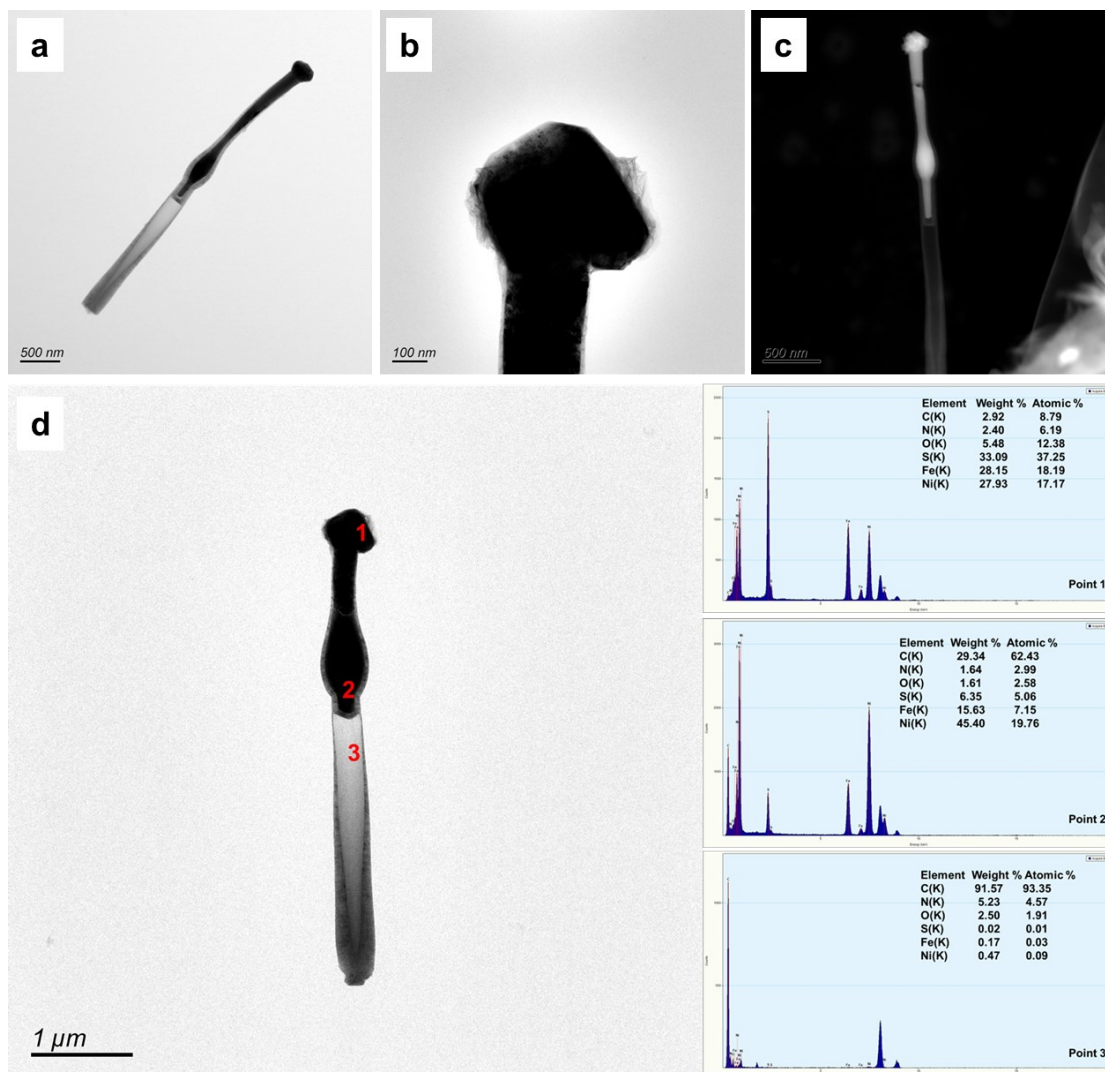


Figure S8. (a, b) TEM, (c) HAADF-STEM images, and (d) EDX spectra corresponding to different points of NiFeS₁₄@NCNM/CW.

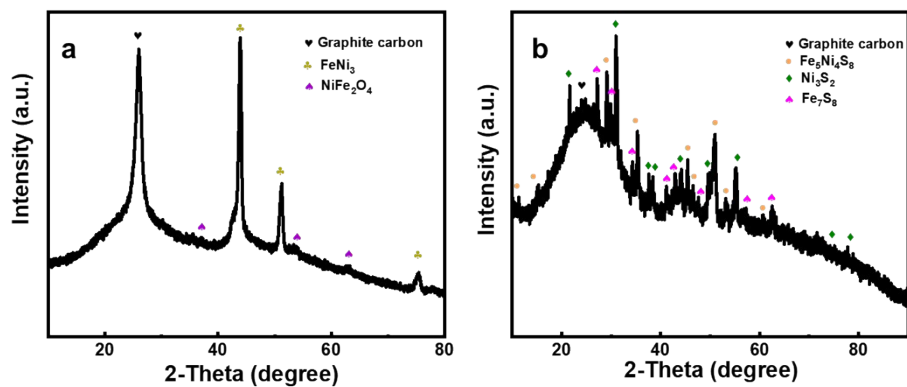


Figure S9. XRD patterns of the (a) NiFe/CW and (b) NiFeS8@NCNM/CW.

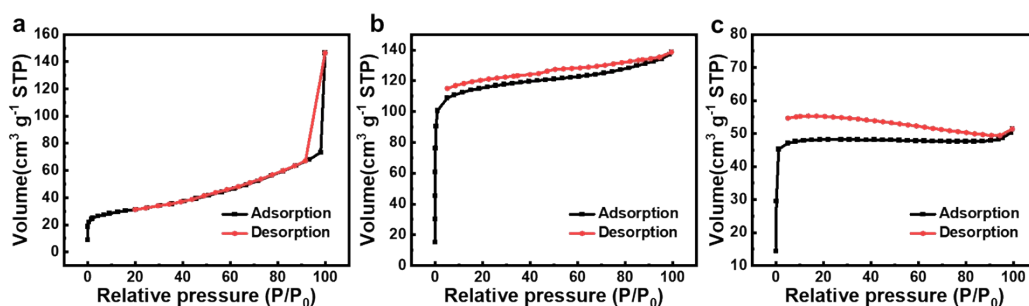


Figure S10. Nitrogen adsorption-desorption isotherms of (a) NiFeS8@NCNM/CW, (b) NiFe/CW, and (c) CW.

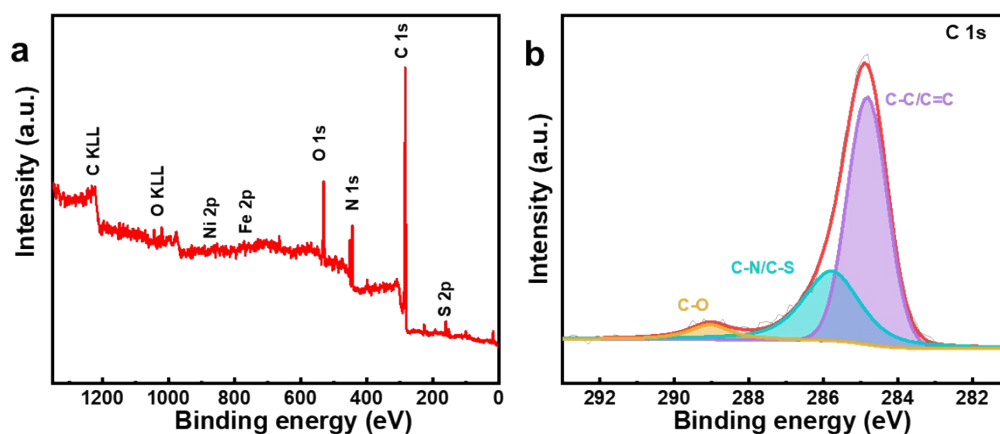


Figure S11. (a) Full XPS spectrum and (b) C 1s high-resolution spectrum of NiFeS14@NCNM/CW.

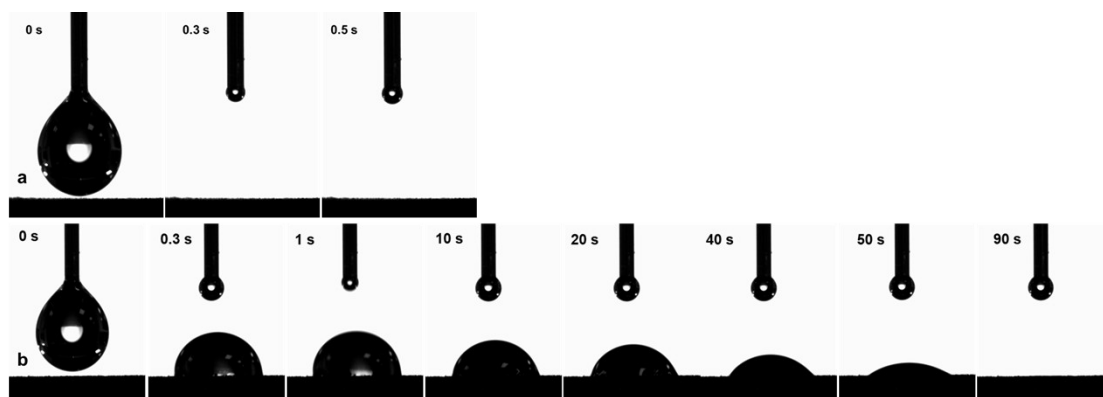


Figure S12. Static-water-droplet contact angles for (a) NiFeS14@NCNM/CW and (b) CW.

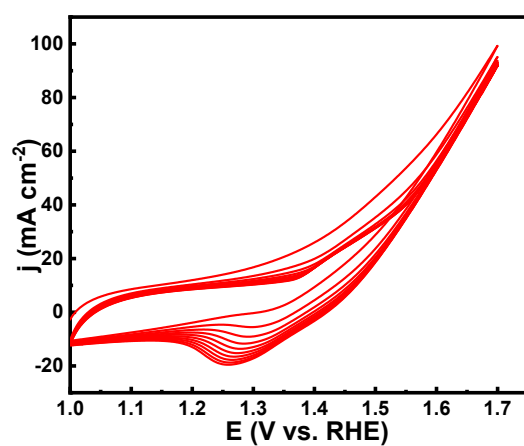


Figure S13. The whole activation CV curves of NiFeS14@NCNM/CW with the scan rate of 50 mV s^{-1} .

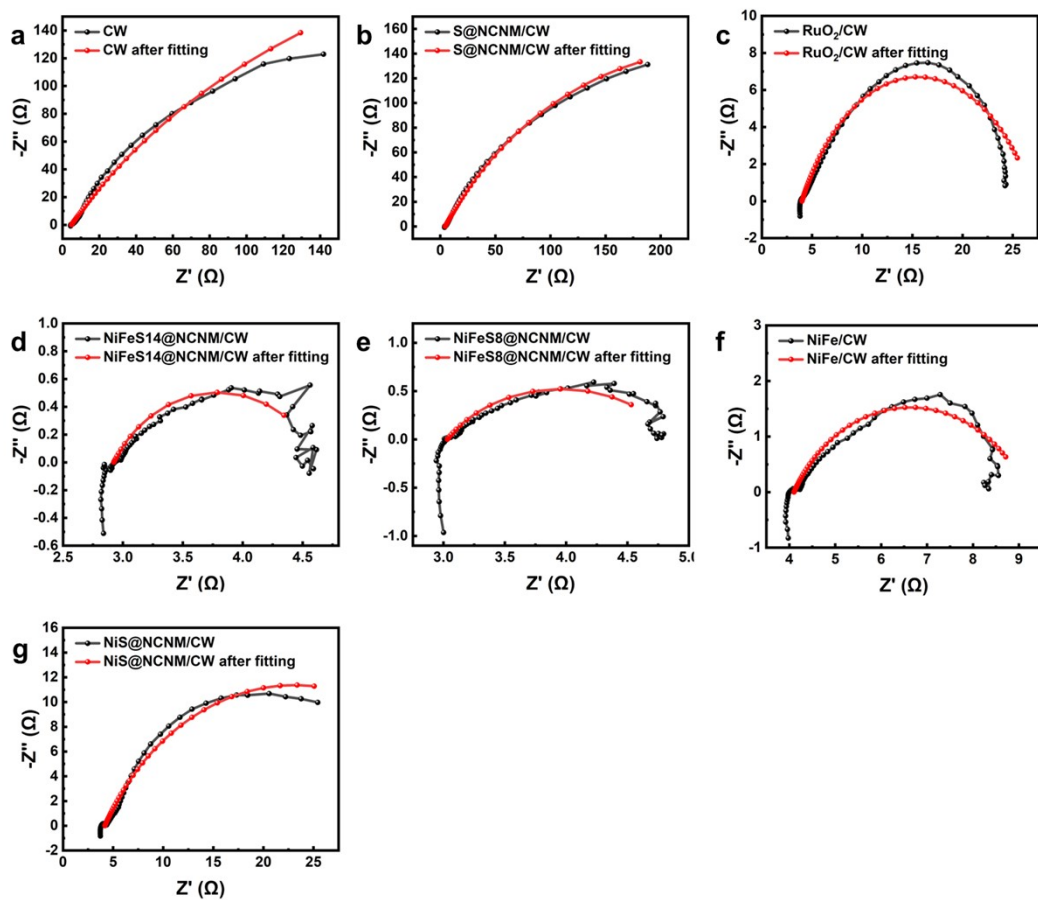


Figure S14. The original and the as-fitted Nyquist plots of different catalysts.

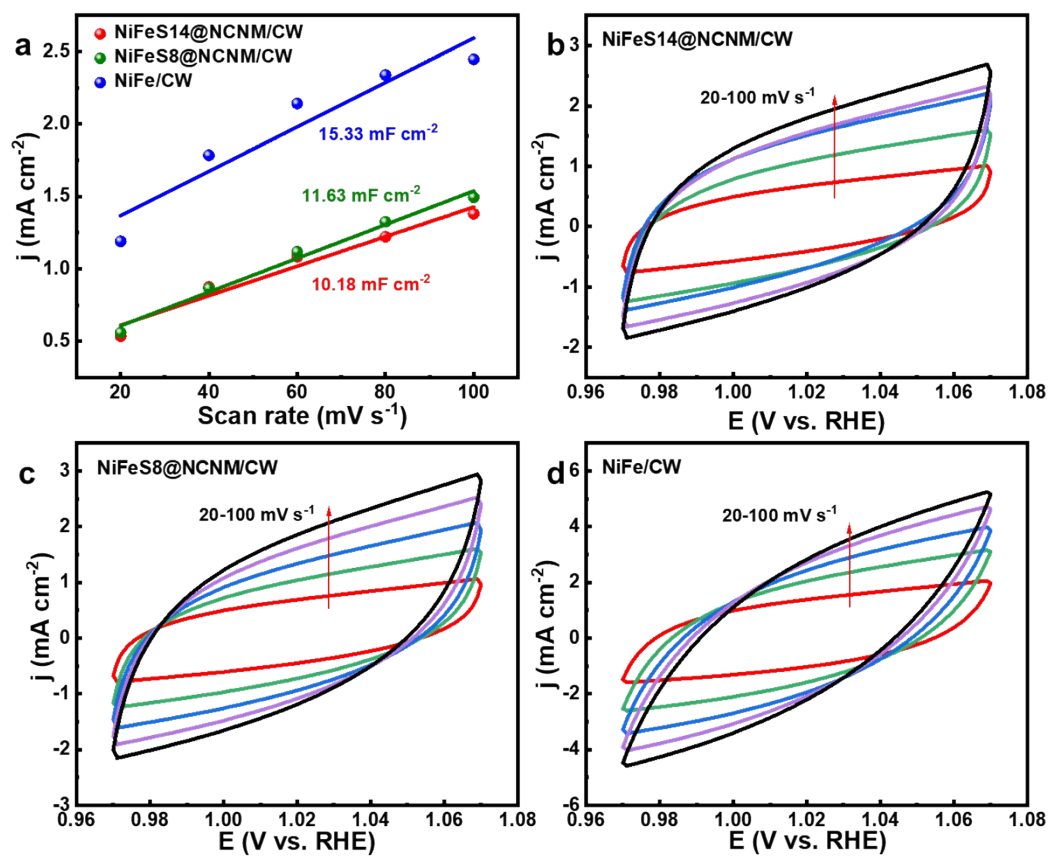


Figure S15. (a) The capacitive currents at 1.02 V vs. RHE as a function of scan rate for different catalysts. CV profiles of (b) NiFeS14@NCNM/CW, (c) NiFeS8@NCNM/CW, and (d) NiFe/CW with different scan rates of 20, 40, 60, 80, 100 mV s⁻¹.

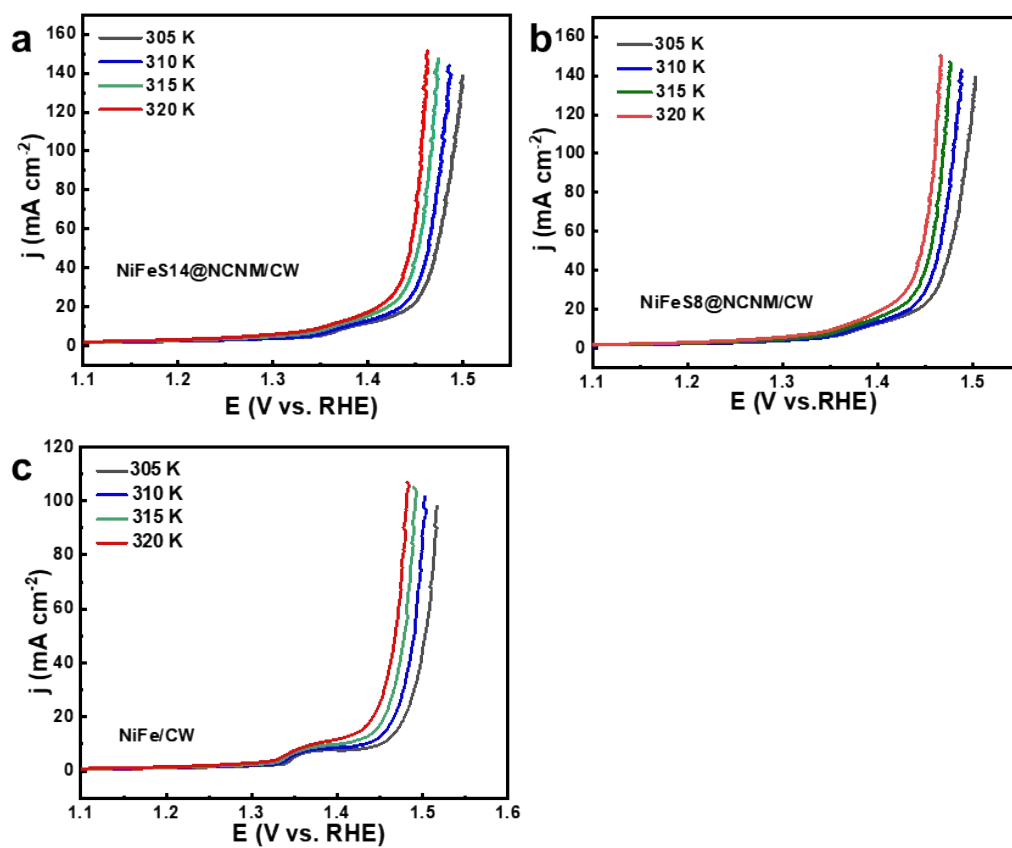


Figure S16. OER polarization curves of the (a) NiFeS14@NCNM/CW, (b) NiFeS8@NCNM/CW, and (c) NiFe/CW in 1 M KOH at different temperatures.

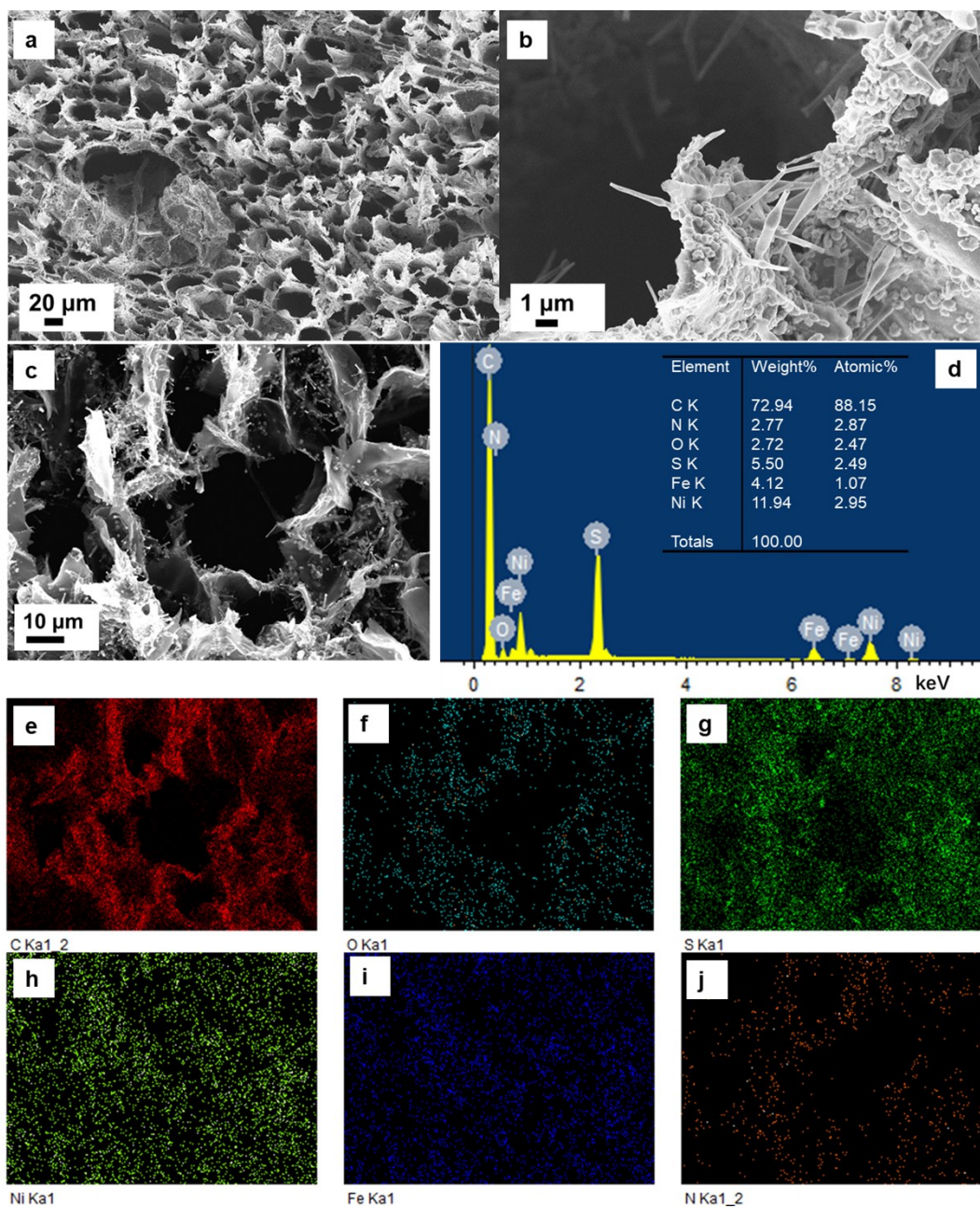


Figure S17. (a-c) Representative SEM images, (d) the corresponding EDX spectrum, and (e-j) EDX mapping of NiFeS14@NCNM/CW after durability test.

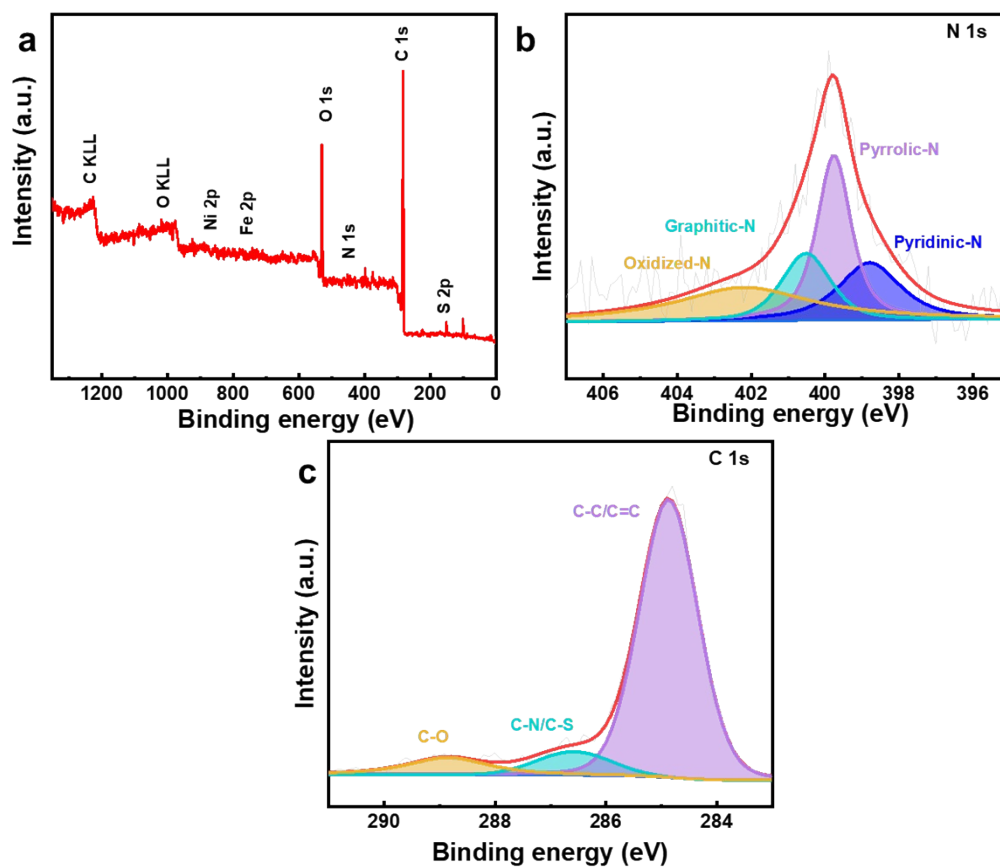


Figure S18. (a) Full XPS spectrum, (b) N 1s, and (b) C 1s high-resolution XPS spectra of NiFeS14@NCNM/CW after the OER durability test.

Table S1. Comparisons of OER activities of NiFeS₁₄@NCNT/CW with those of recently reported biomass-derived carbon-supported electrocatalysts.

Catalyst	Carbon source	η_{10} (mV)	Tafel (mV dec ⁻¹)	Stability(i-t)	Refs.
NiFeS ₁₄ @NCNM/CW	balsa wood	147@10	56.3	retain 93% after 24 h	This work
		250@50			
		mA cm ⁻²			
		mA cm ⁻²			
Co/Ni-CW	basswood	330	68	retain 92% after 10 h	1
Co@N-HPMC	basswood	297	115.7	retain 64% after 3 h	2
Ni-W-B/wood	fir wood	360@50	86.3	retain 90.4% after 50 h	3
Co@NCW	paulownia wood	350	92	stable after 10 h	4
CoFe@NC/WC	spruce wood	315	57.6	stable after 24 h	5
NiFe/DWC	poplar wood	260@100	98	potential retain 97% after 60 h	6
Co@NCW	basswood	410	-	-	7
Ni ₃ Fe-CW	basswood	237	138	retain 94.6% after 50 h	8
FeNiP@NCNT/CW	balsa wood	180@50	60.9	retain 96% after 200 h	9
N/E-HPC-900	eucalyptus wood	440	-	retain 90% after 5.6 h	10
FeNi ₃ @NC	chitosan	277	77	retain ~90% after 10 h	11
CCC-PAN	cotton cloth	351	135	retain 85% after 15 h	12
NPCNS	leaves	340@5	191	retain 83.6% after 20 h	13
Co ₉ S ₈ @Co-N/C	tissue paper	373	78.4	-	14
Fe ₃ O ₄ /NiS@CC	Cotton cloth	310	82	stable after 26 h	15

Table S2. Electrochemical impedance parameters obtained simulating the Nyquist plots in Figure 5f to the equivalent circuit model.

Catalyst	R_s	R_{ct}	CPE-T	CPE-P
NiFeS14@NCNM/CW	2.923	1.739	0.2194	0.66882
NiFeS8@NCNM/CW	3.031	1.856	0.21129	0.6518
NiFe /CW	4.104	5.066	0.11518	0.69006
RuO ₂ /CW	3.994	23.17	0.024906	0.66823
NiS@NCNM/CW	4.179	37.91	0.15231	0.68815
S@NCNM/CW	4.517	505.1	0.019479	0.65664
CW	4.878	671.7	0.030537	0.69094

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