

Supporting Information

Superhydrophilic Electrode with Defect-Trapped Pt Nanoparticles Boost the Acidic Hydrogen Evolution Reaction

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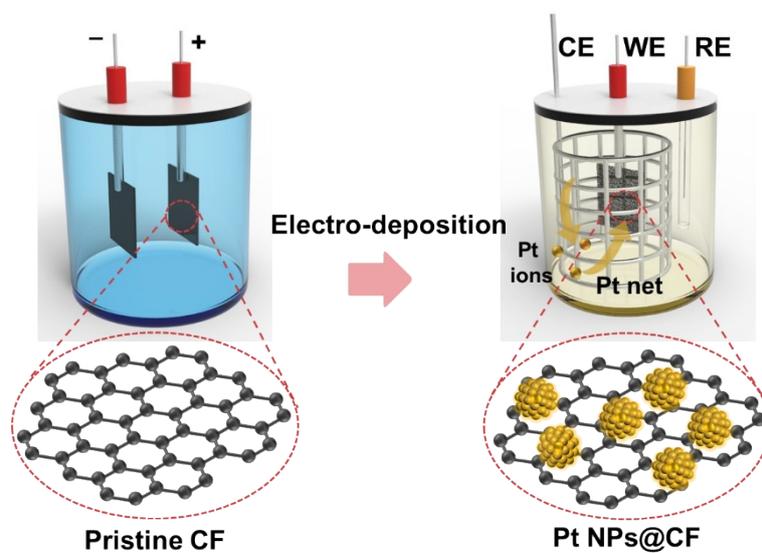


Fig. S1. Schematic illustration of the preparation of Pt NPs@CF electrode.

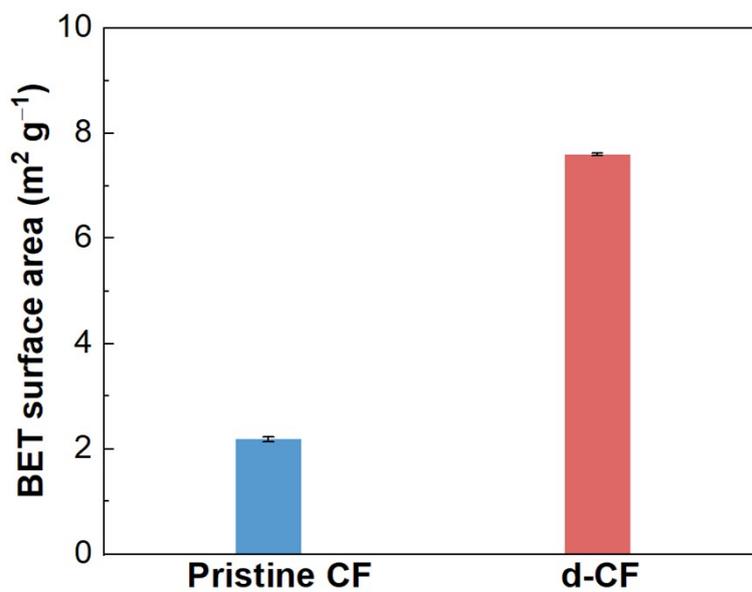


Fig. S2. BET surface area of pristine CF and d-CF

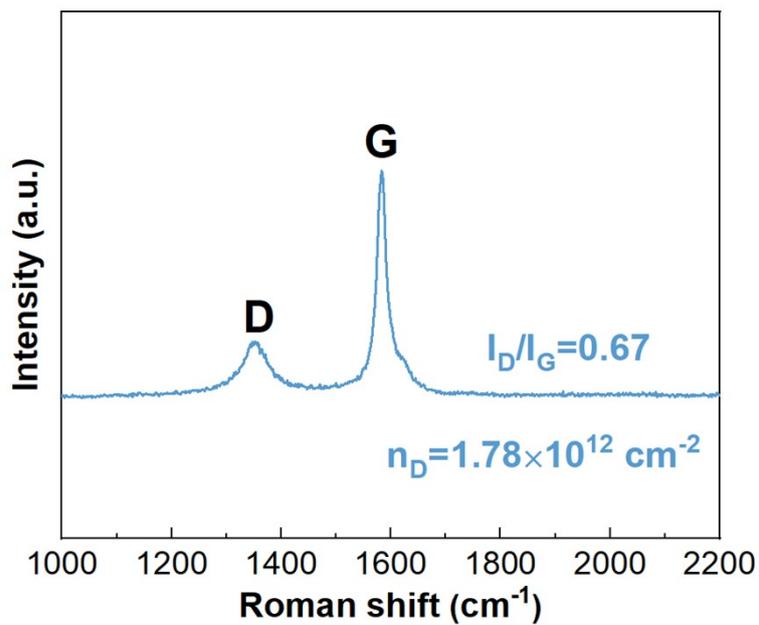


Fig. S3. The corresponding Raman spectra of pristine CF.

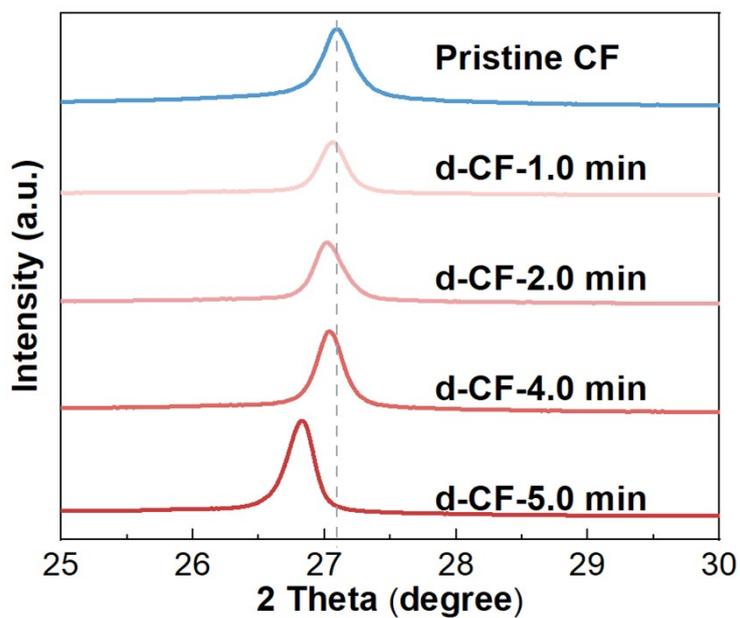


Fig. S4. XRD patterns of pristine CF and d-CF at various anodization time.

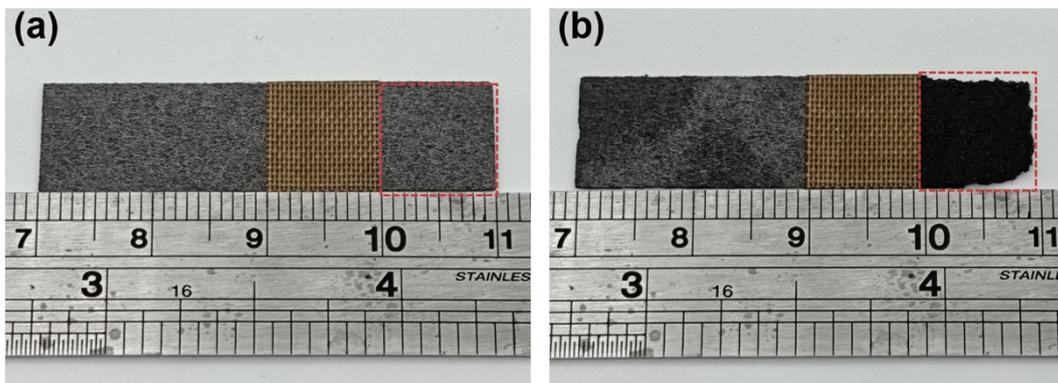


Fig. S5. Optical images of (a) pristine CF and (b) d-CF-5 min.

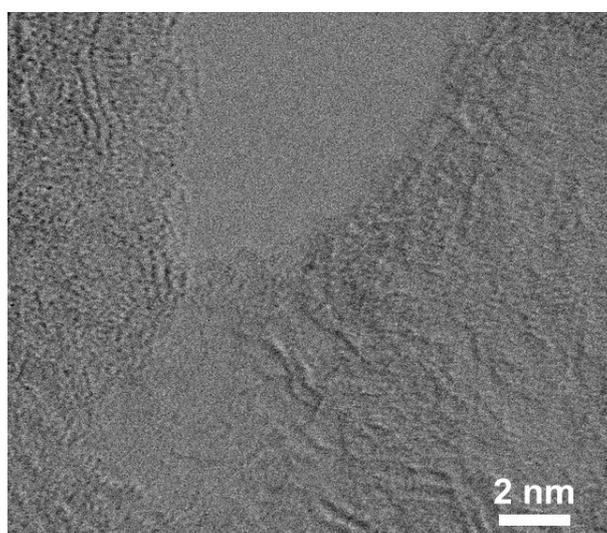


Fig. S6. TEM image of Pt SAs@d-CF.

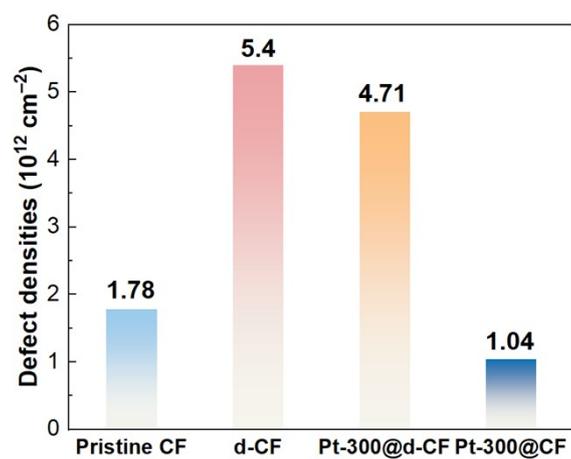


Fig. S7. the comparison of defect densities for pristine CF, d-CF, Pt-300@CF and Pt-300@d-CF.

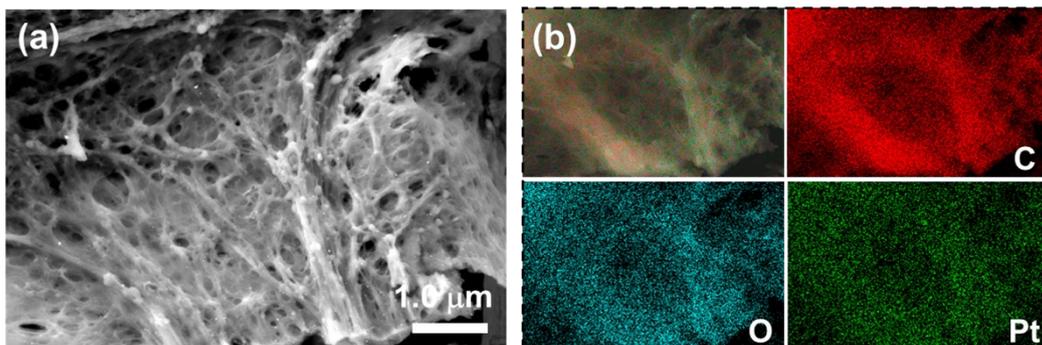


Fig. S8. (a) SEM image and (b) EDS mapping of the Pt-500@d-CF.

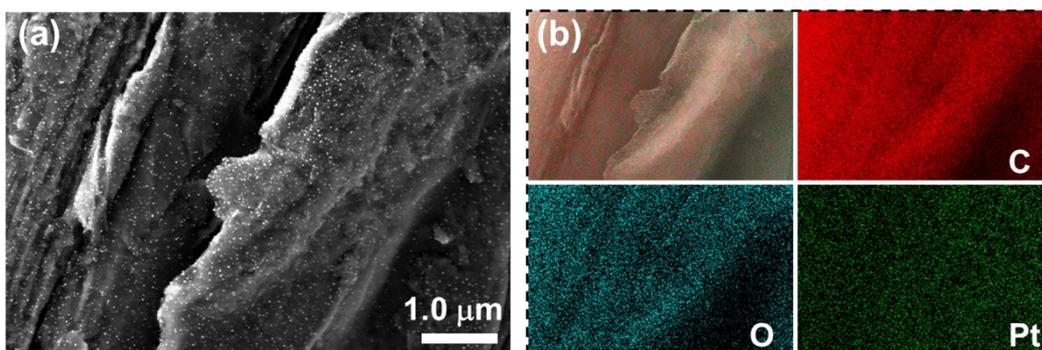


Fig. S9. (a) SEM image and (b) EDS mapping of the Pt-1000@d-CF.

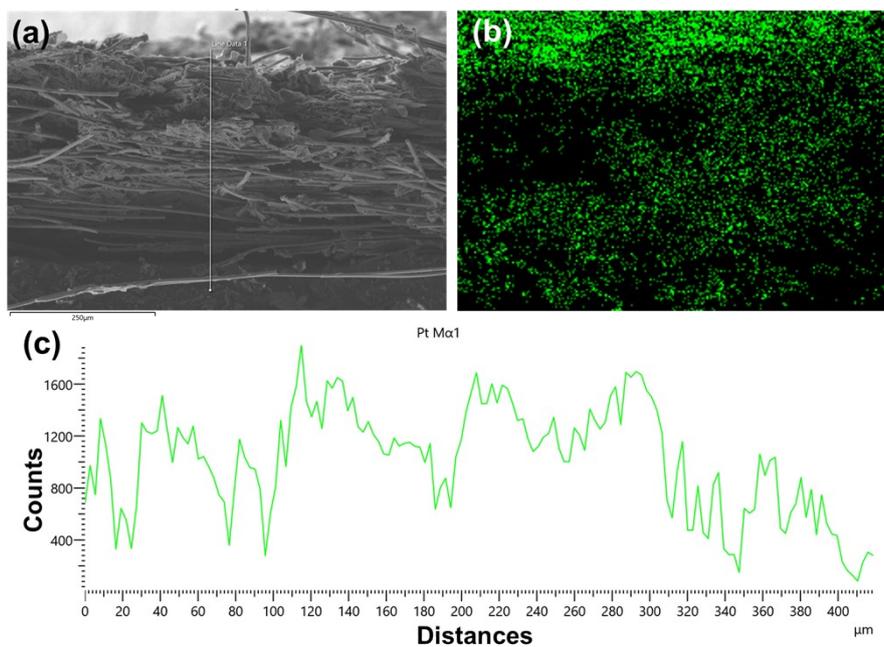


Fig. S10. (a) Cross-sectional SEM image and (b) Pt element mapping of the Pt-5000@d-CF. (c) Line-scan profile of the Pt Mα1 signal intensity along a vertical line across the electrode cross-section.

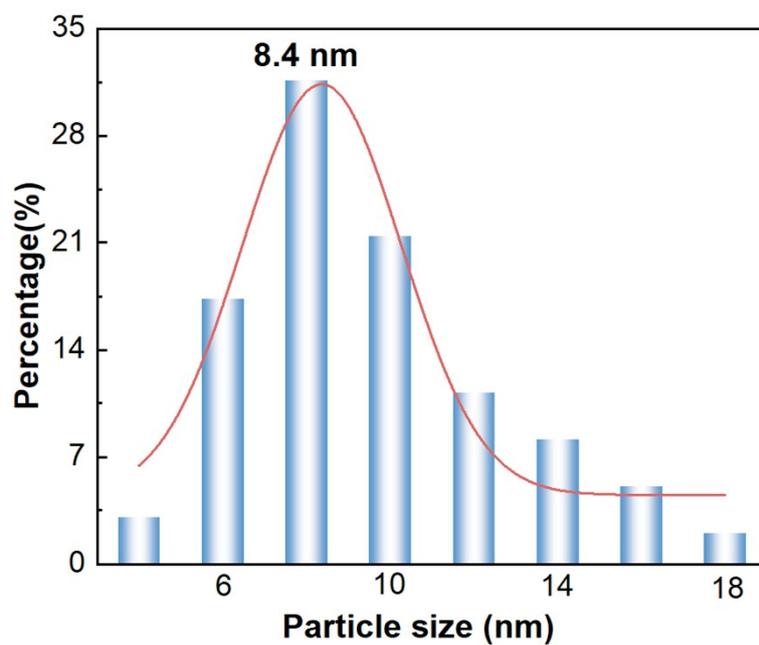


Fig. S11. Pt NPs size distribution of the Pt-5000@d-CF.

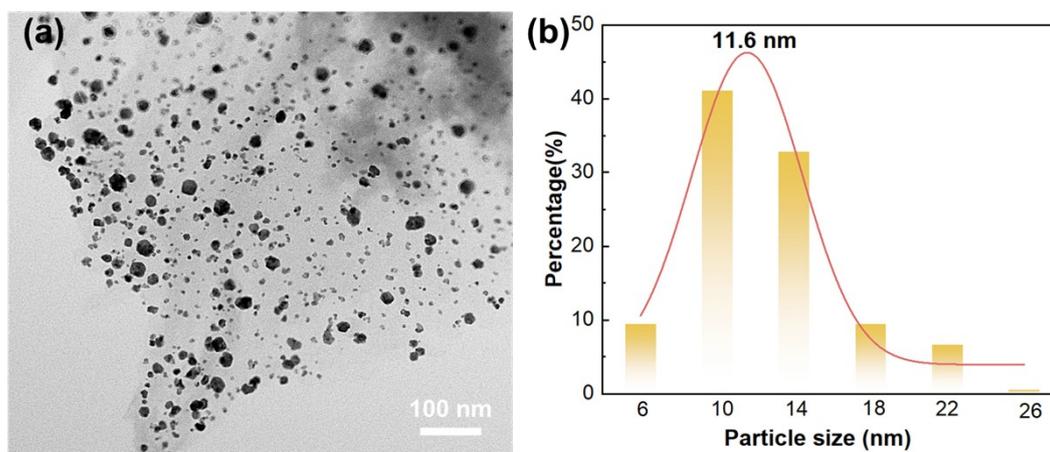


Fig. S12. (a) TEM image and (b) nanoparticle size distribution of the Pt-5000@d-CF.

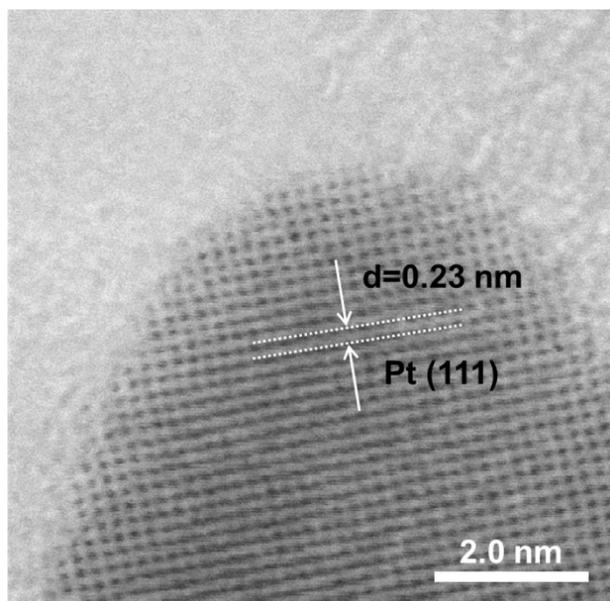


Fig. S13. HRTEM image of the Pt-5000@d-CF.

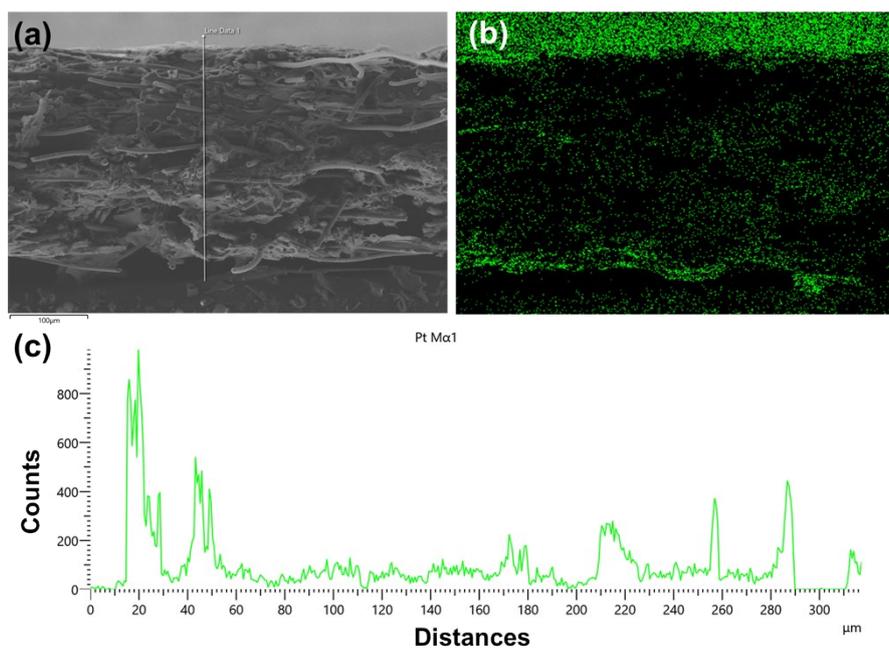


Fig. S14. (a) Cross-sectional SEM image and (b) Pt element mapping of the Pt-5000@CF. (c) Line-scan profile of the Pt Mα1 signal intensity along a vertical line across the electrode cross-section.

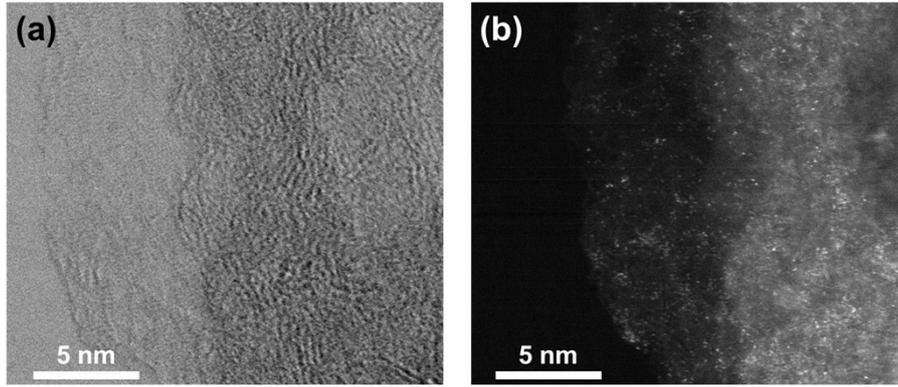


Fig. S15. HRTEM and HAADF-STEM images of Pt SAs in the Pt-5000@d-CF.

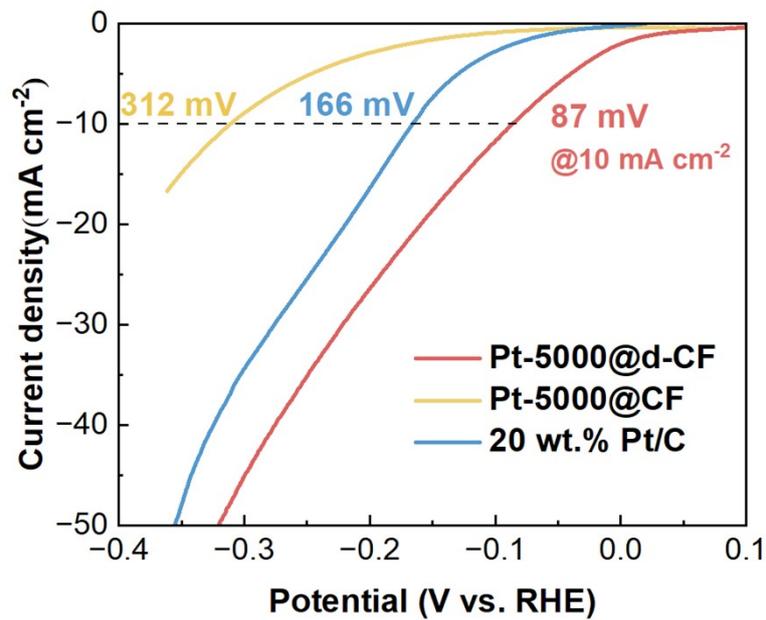


Fig. S16. Alkaline HER performance of Pt-5000@d-CF, Pt-5000@CF, and 20 wt.% Pt/C (0.05 mg cm^{-2}).

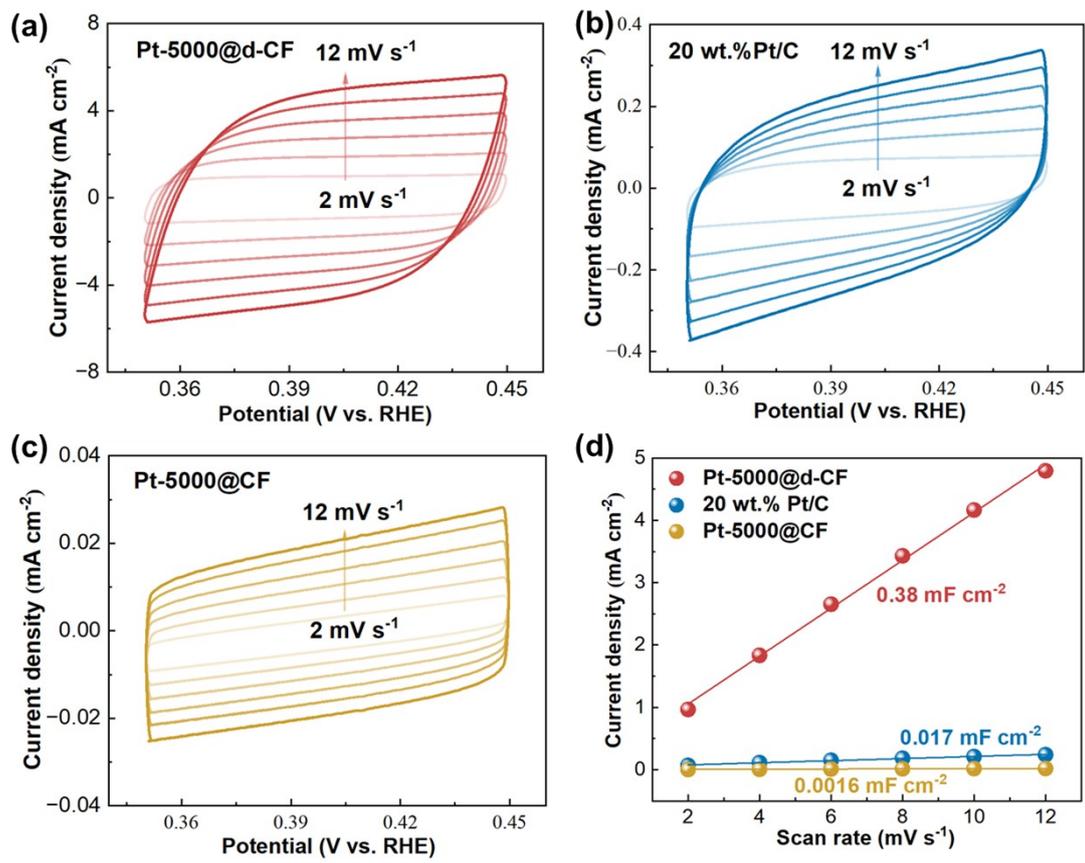


Fig. S17. (a-c) CV curves under different scan rates (2, 4, 6, 8, 10, and 12 mV s⁻¹), and (d) ECSA values for Pt-5000@CF, Pt-5000@d-CF, and Pt/C, respectively.

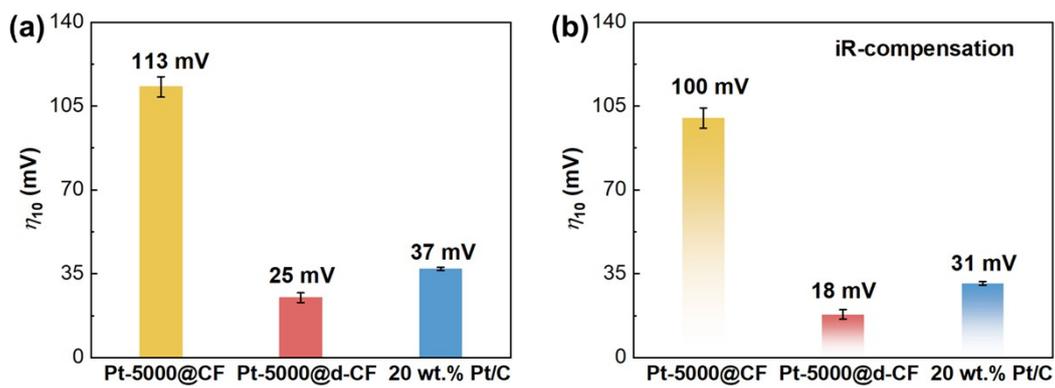


Fig. S18. Comparison of overpotential@10 mA cm⁻² for Pt-5000@CF, 20 wt.% Pt/C, and Pt-5000@d-CF (a) without and (b) with iR compensation.

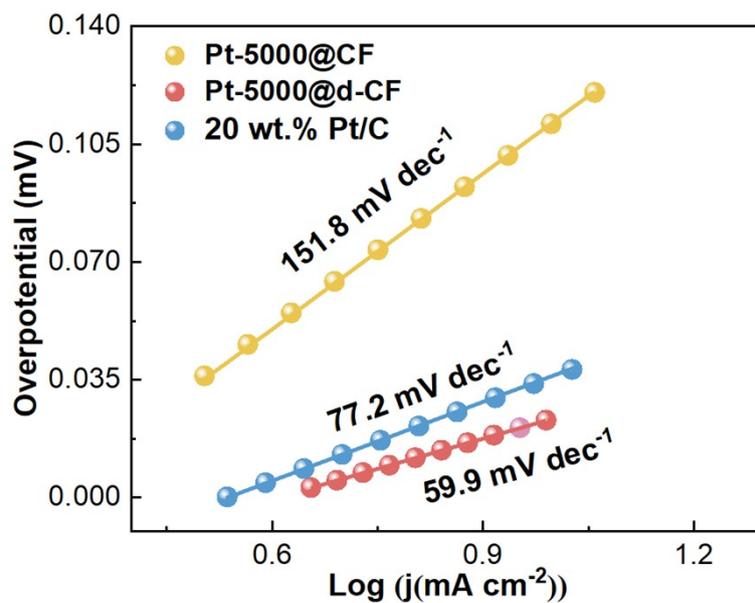


Fig. S19. Tafel slope values of Pt-5000@CF, Pt-5000@d-CF, and Pt/C.

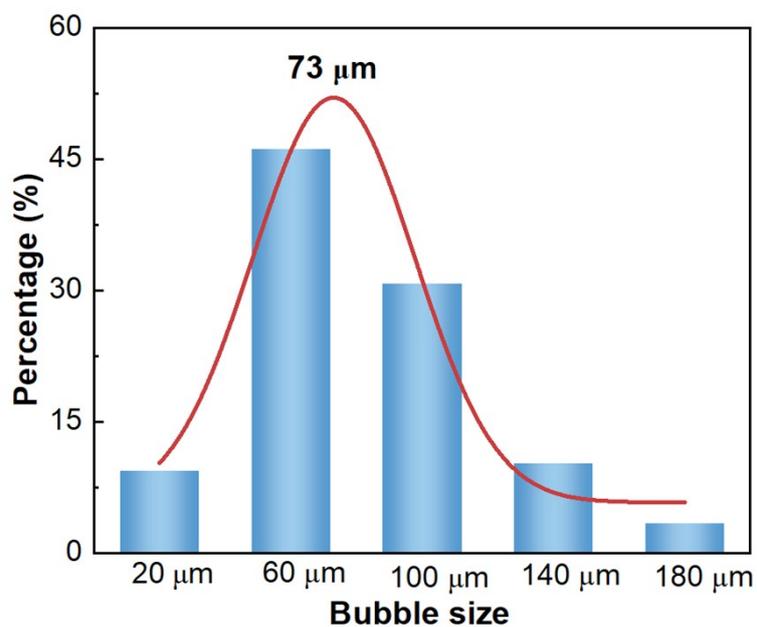


Fig. S20. Size distribution histogram of gas bubbles on Pt-5000@d-CF electrode surface.

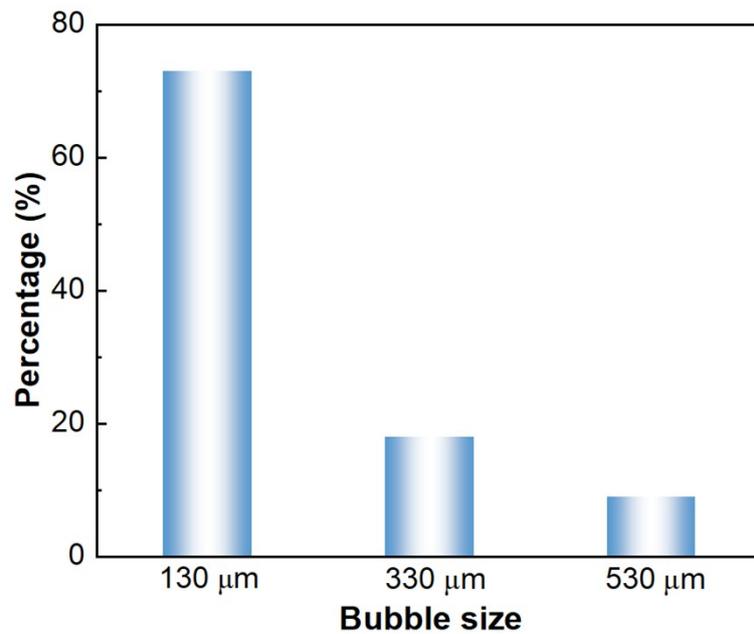


Fig. S21. Size distribution histogram of gas bubbles on Pt/C electrode surface.

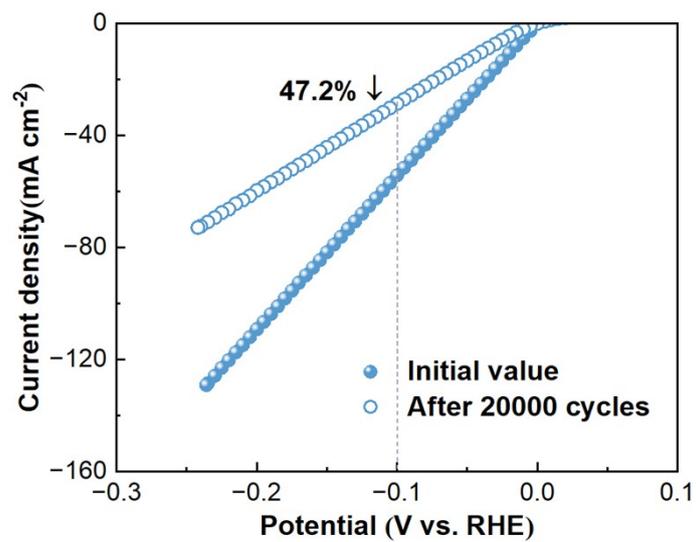


Fig. S22. Potential cycling stability of 20 wt.% Pt/C with catalyst loading of 0.5 mg cm⁻².

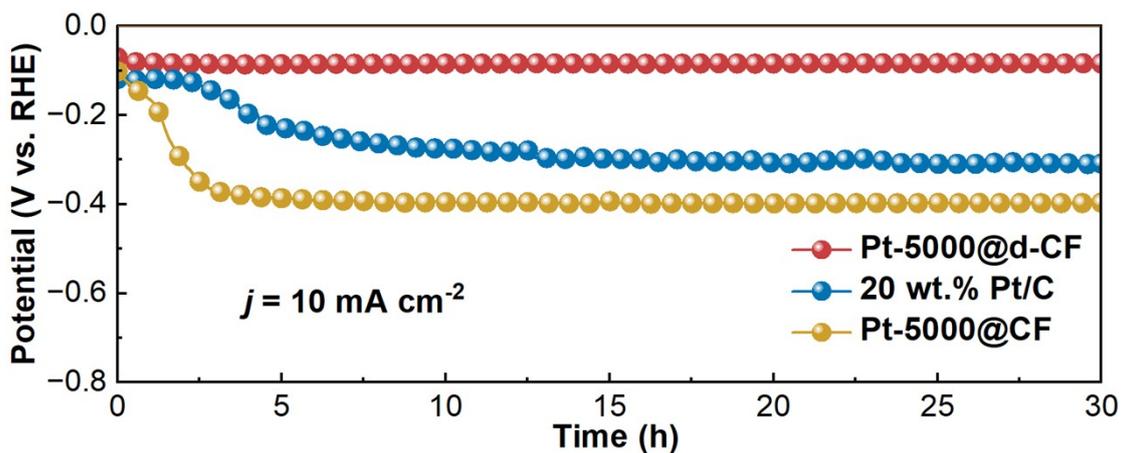


Fig. S23. Stability test of the three electrodes operated at 10 mA cm^{-2} .

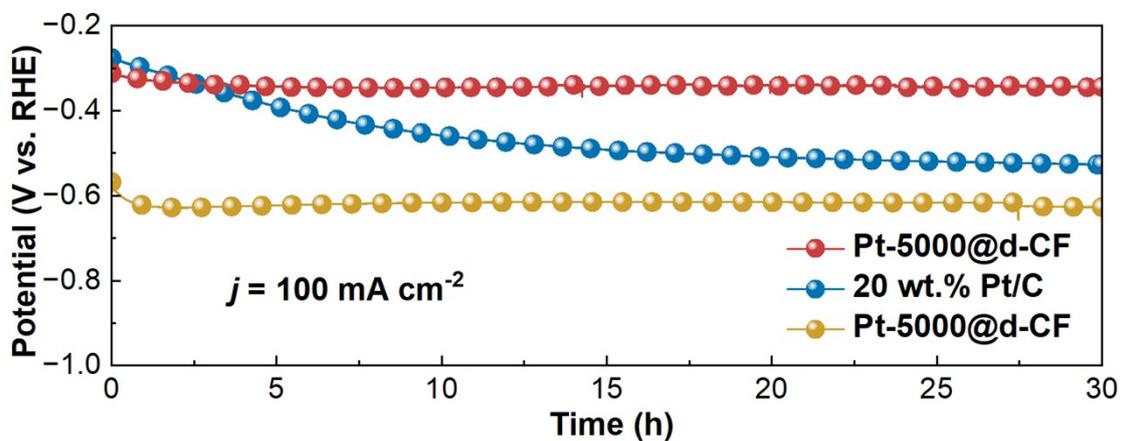


Fig. S24. Stability test of the three electrodes operated at 100 mA cm^{-2} .

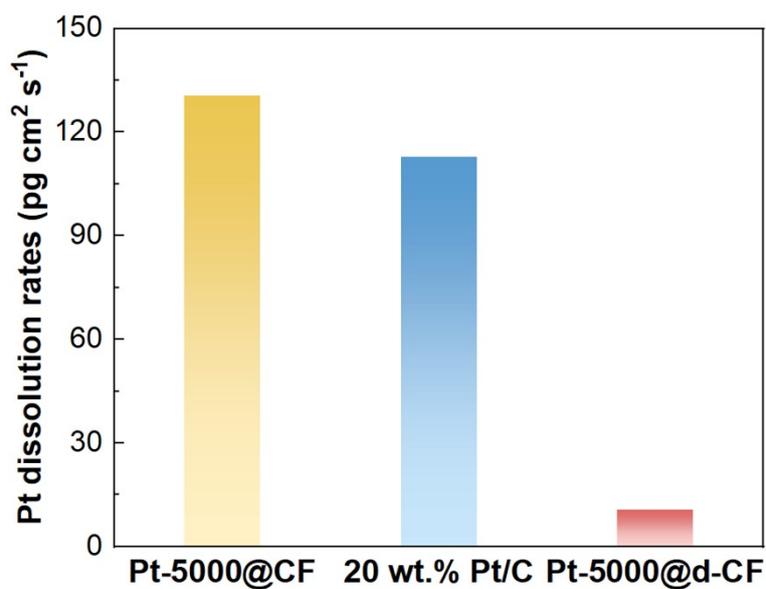


Fig. S25. Pt dissolution rates of the three electrodes measured in $0.5 \text{ M H}_2\text{SO}_4$ during

the stability tests.

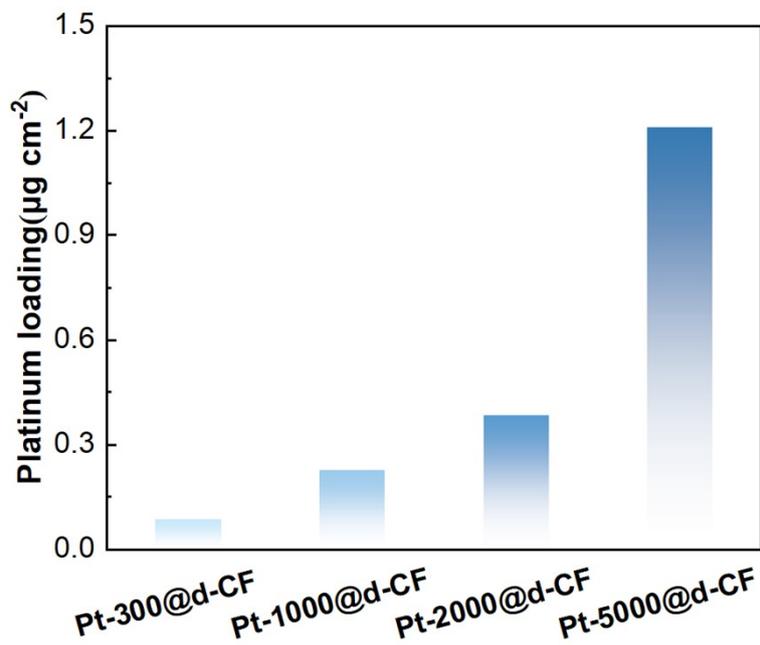


Fig. S26. Pt loading of these four catalysts.

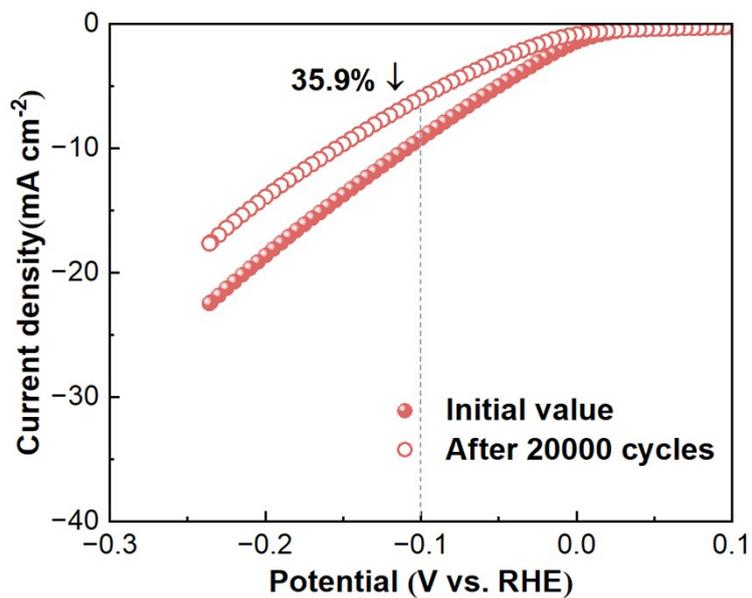


Fig. S27. Potential cycling stability of Pt-1000@d-CF.

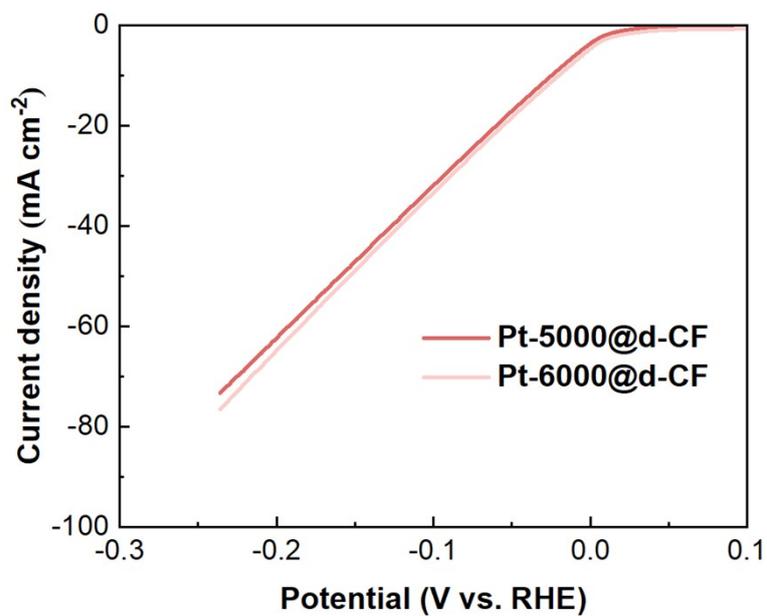


Fig. S28. HER performance of Pt-5000@d-CF and Pt-6000@d-CF.

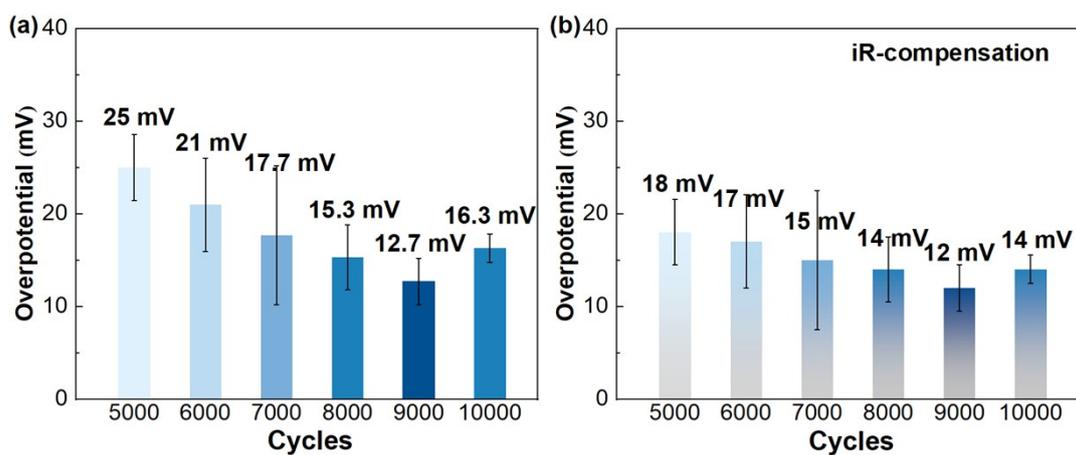


Fig. S29. Comparison of overpotential@10 mA cm⁻² for Pt-5000@d-CF, Pt-6000@d-CF, Pt-7000@d-CF, Pt-8000@d-CF, Pt-9000@d-CF, and Pt-10000@d-CF (a) without and (b) with iR compensation.

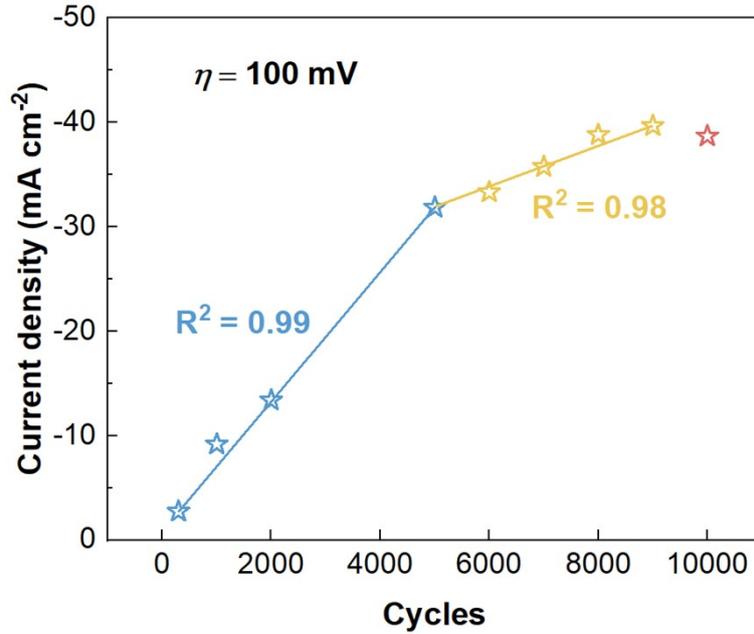


Fig. S30. HER activity at 100 mV for Pt NPs@d-CF with varying metal loading.

Table S1. Content of various oxygen-containing functional groups in pristine CF and d-CF.

Functional group	C=C	C-C	C-O	C=O	O-C=O
Pristine CF	79.4%	13.6%	4.3%	2.7%	0%
d-CF	53.9%	20.6%	7.8%	11.8%	5.9%

Table S2. Binding energy of species from fitting curves of XPS spectra of Pt 4f.

Catalyst samples	Binding energy of Pt 4f (eV)			
	Pt 4f _{5/2}		Pt 4f _{7/2}	
	(II)	(0)	(II)	(0)
Pt-300@CF	76.3	75.4	73.3	72.1
Pt-300@d-CF	76.2	75.1	73.2	71.7
Pt-1000@d-CF	76.4	75.3	73.4	72.2

Table S3. Comparison of the HER performance of Pt-5000@d-CF with various recently

reported Pt-based catalysts in 0.5 M H₂SO₄ electrolyte.

Catalysts	Overpotential @10 mA cm ⁻² (mV)	Mass activity (A mg _{Pt} ⁻¹)	Ref.
Pt-5000@d-CF	25	26.5 @100 mV	
Pt-5000@d-CF	25	14.1 @50 mV	
Pt-1000@d-CF	108	40.2 @100 mV	<i>This work</i>
Pt/C (0.05 mg cm ⁻²)	37	2.4 @100 mV	
Pt/C (0.5 mg cm ⁻²)	18	0.55 @100 mV	
Pt@DG ¹	30	26.05 @100 mV	<i>J. Am. Chem. Soc.</i> , 2022, 144 , 2171-2178
Pt-Ni Ass ²	27.7	2.8 @70 mV	<i>Adv. Mater.</i> , 2018, 30 , 1801741
Pt _M @CN ³	27	22.56 @100 mV	<i>Chem. Eng. J.</i> , 2024, 481 , 148430
PtRu/CC-P ⁴	42	13.96 @100 mV	<i>Nanoscale</i> , 2022, 14 , 15942
Pt _{SA} , P/np-MoS ₂ ⁵	24	5.97 @50 mV	<i>J. Mater. Chem. A</i> , 2024, 12 , 17395-17403
Pt,Ru,Rh,Pd,Re-MoSe ₂ ⁶	36	0.8545 @200 mV	<i>Angew. Chem. Int. Ed.</i> , 2024, 63 , e202405017
Pt-GDY2 ⁷	30	23.64 @100 mV	<i>Angew. Chem. Int. Ed.</i> , 2018, 57 , 9382-9386
Pt-AC/DG-300 ⁸	29	17.93 @50 mV	<i>J. Am. Chem. Soc.</i> , 2020, 142 , 5594-5601
ALD50Pt/N-	38	10.1 @50 mV	<i>Nat. Commun.</i> , 2016, 7 , 13638

doped Gr ⁹			
Pt ₁ /NMHCS ¹⁰	40	2.07 @50 mV	<i>Adv. Mater.</i> , 2021, 33 , 2008599
Pt/f-MWCNTs ¹¹	43.9	18.16 @50 mV	<i>Nano Energy</i> , 2019, 63 , 103849
Pt ₁ /NCNS ¹²	~45	7.1 @50 mV	<i>Small</i> , 2021, 17 , 2007245
Pt SAs/DG ¹³	23	26.2 @50 mV	<i>J. Am. Chem. Soc.</i> 2019, 141 , 4505-4509
Pt ₁ /OLC ¹⁴	38	7.4 @38 mV	<i>Nat. Energy</i> , 2019, 4 , 512-518
Pt SA/m-WO _{3-x} ¹⁵	38	12.8 @50 mV	<i>Angew. Chem. Int. Ed.</i> , 2019, 58 , 16038-16042
PtSA-NT-NF ¹⁶	24	0.07 @50 mV	<i>Angew. Chem. Int. Ed.</i> , 2017, 56 , 13694-13698
WC@C@Pt ¹⁷	30	~0.37 @40 mV	<i>Energy Storage Mater.</i> , 2018, 10 , 268-274
Pt ₁ /MC ¹⁸	25	10 @65 mV	<i>Nat. Commun.</i> , 2017, 8 , 1490
Pt@MoS ₂ /NiS ₂ ¹⁹	34	7.3 @100 mV	<i>Small</i> 2018, 14 , 1800697
Mo ₂ TiC ₂ T _x -Pt _{SA} ²⁰	30	13.3 @100 mV	<i>Nat. Catal.</i> , 2018, 1 , 985-992
Pt-Ni/NiS NWs ²¹	23	5.22 @100 mV	<i>Nat. Commun.</i> , 2017, 8 , 14580
Pt ₁₀ /Ni-ZrO ₂ -NC ²²	57.5	5.31 @100 mV	<i>Green Chem.</i> , 2025, 27 , 6619-6629
Pt/α-MoC ²³	22	14.86 @100 mV	<i>ACS Nano</i> , 2025, 19 , 10038-10047
Pt-NC@Mo ₂ C ²⁴	37	8.99 @50 mV	<i>J. Mater. Chem. A</i> , 2026, Advance Article

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