

## Supporting Information

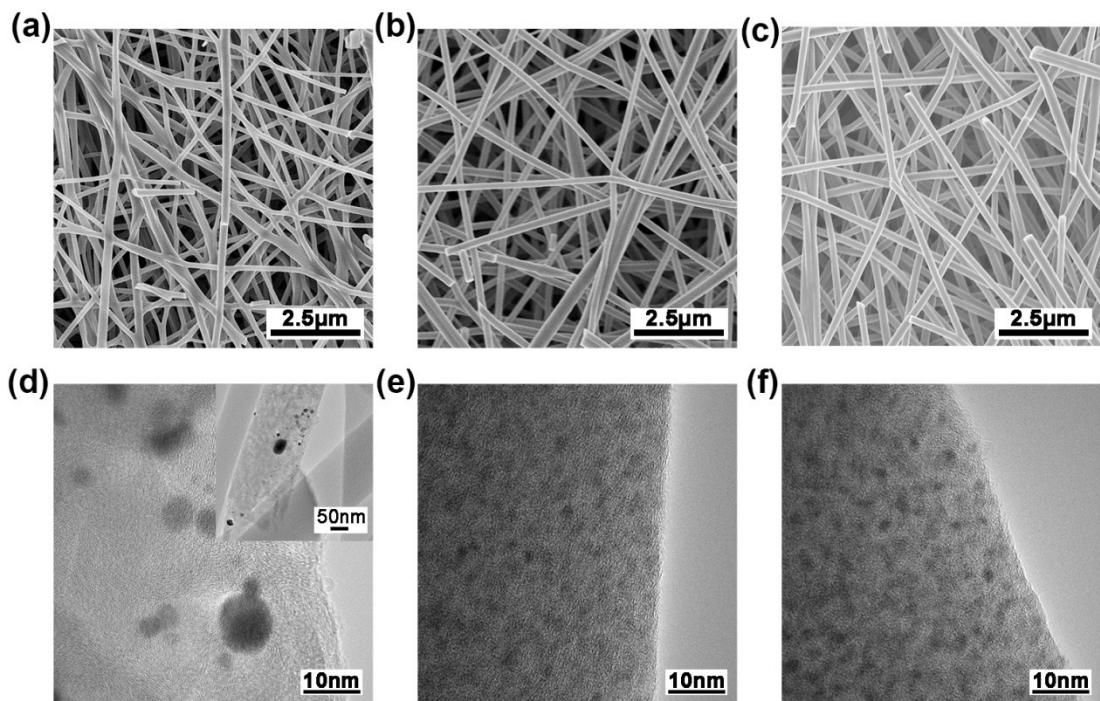
### Atom-precise incorporation of platinum in ultrafine transition metal carbides for efficient synergistic electrochemical hydrogen evolution

Xingxing Pan,<sup>a</sup> Shuanglong Lu,\*<sup>a</sup> Duo Zhang,<sup>b</sup> Ye Zhang,<sup>c</sup> Fang Duan,<sup>a</sup> Han Zhu,<sup>a</sup> Hongwei Gu,<sup>d</sup> Shua Wang<sup>b</sup> and Mingliang Du\*<sup>a</sup>

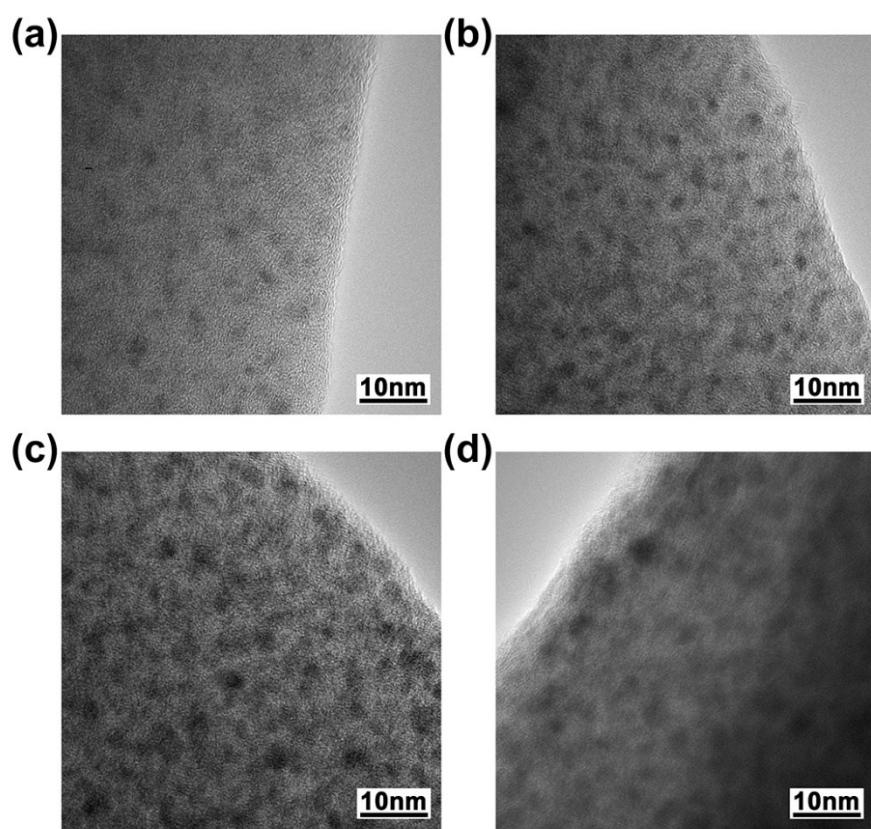
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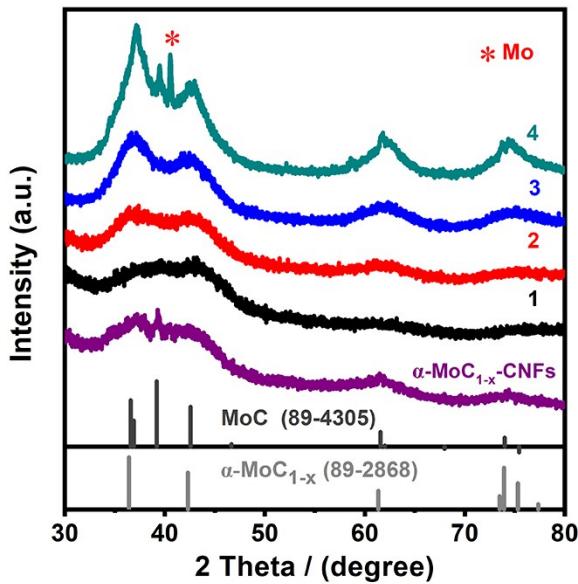
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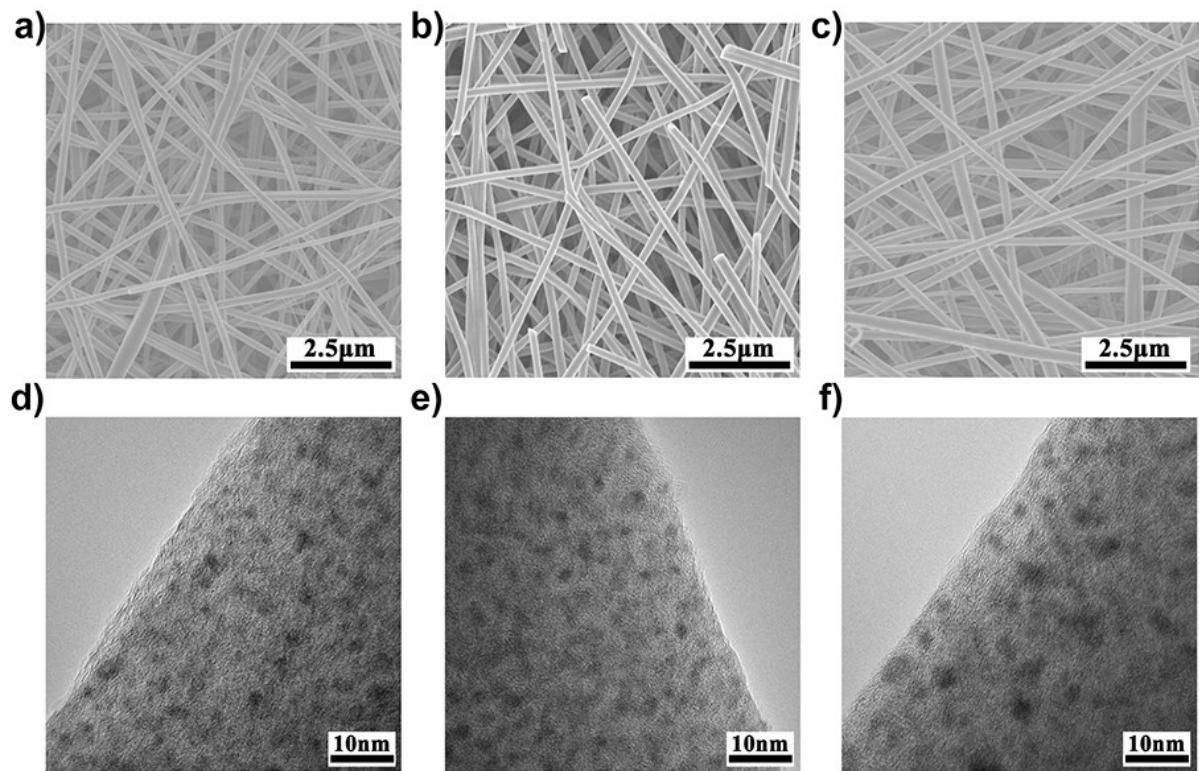
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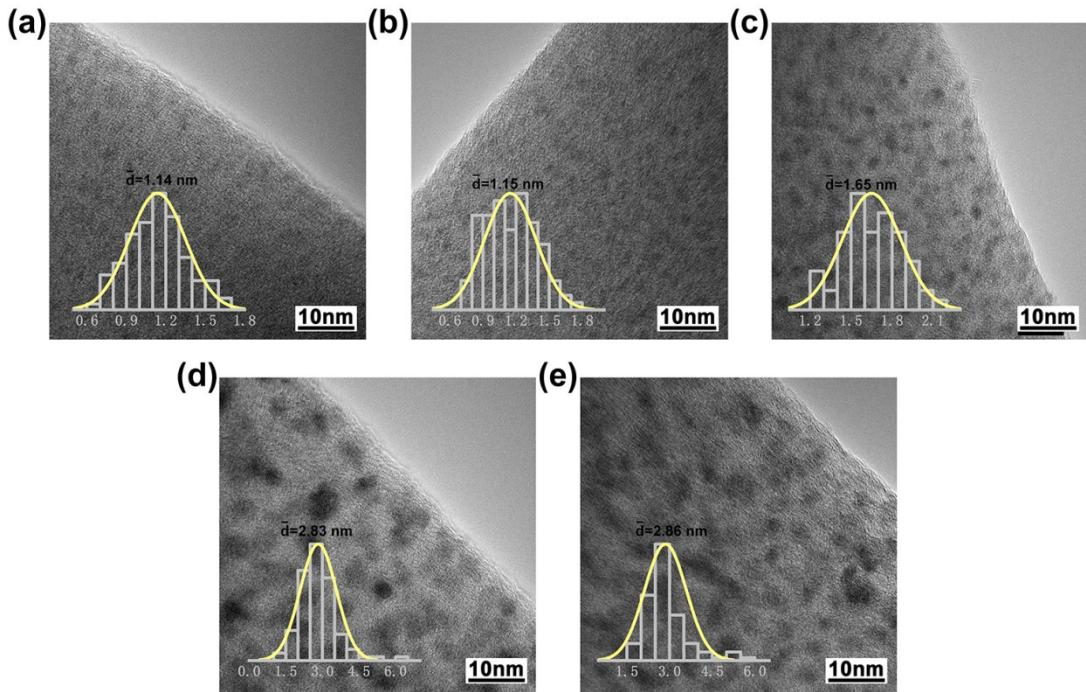
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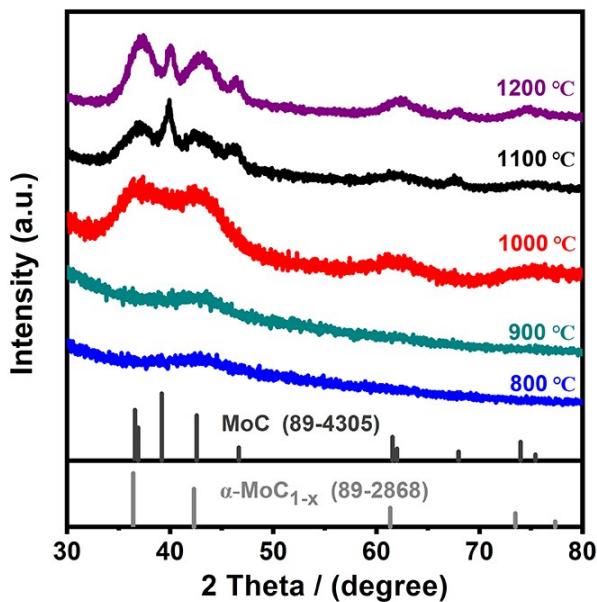
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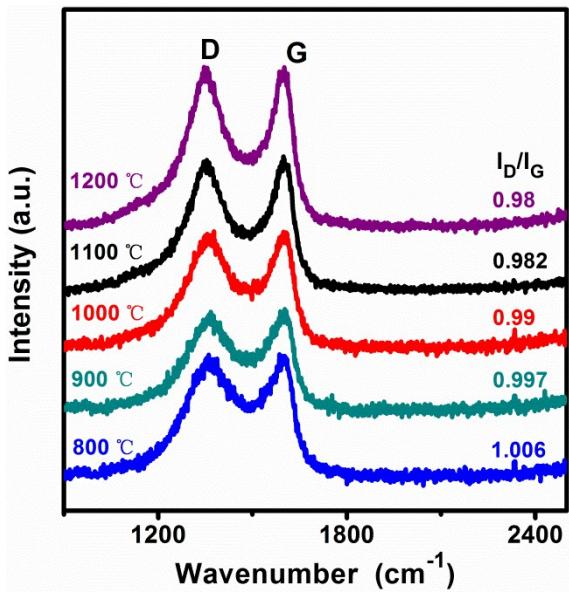
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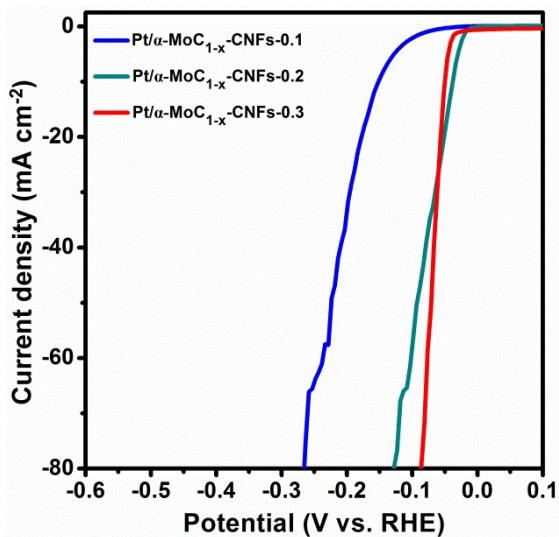
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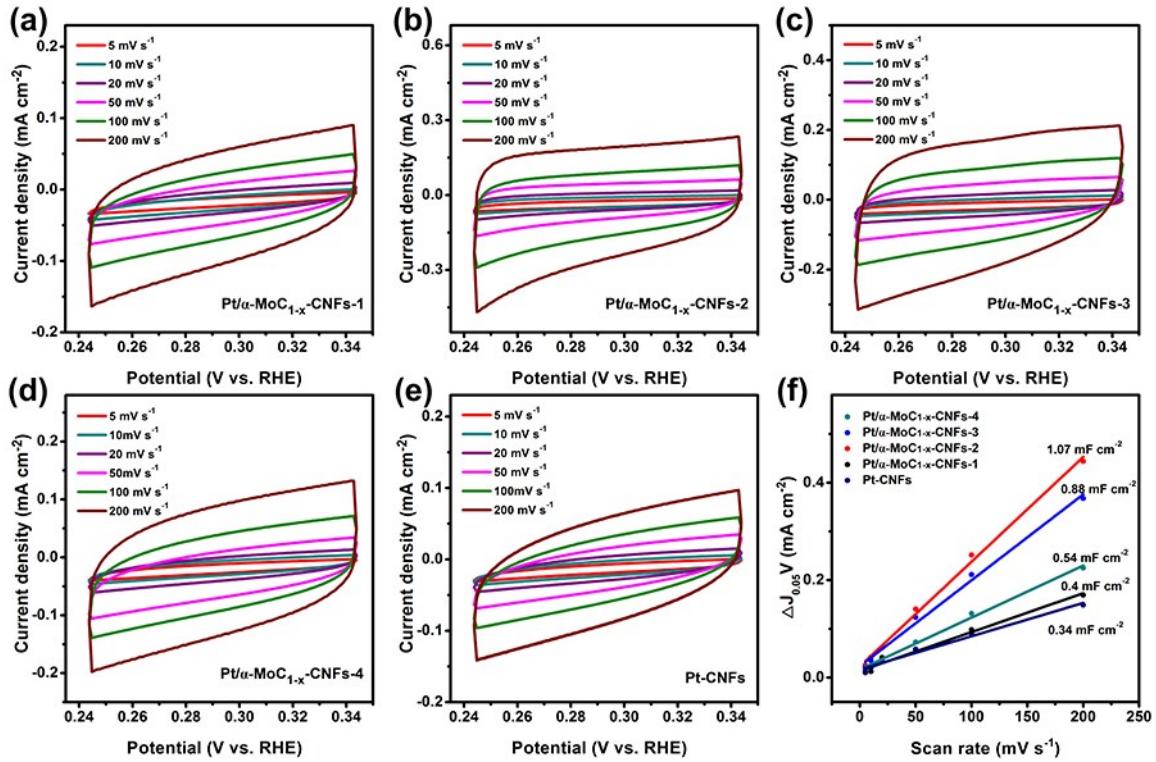
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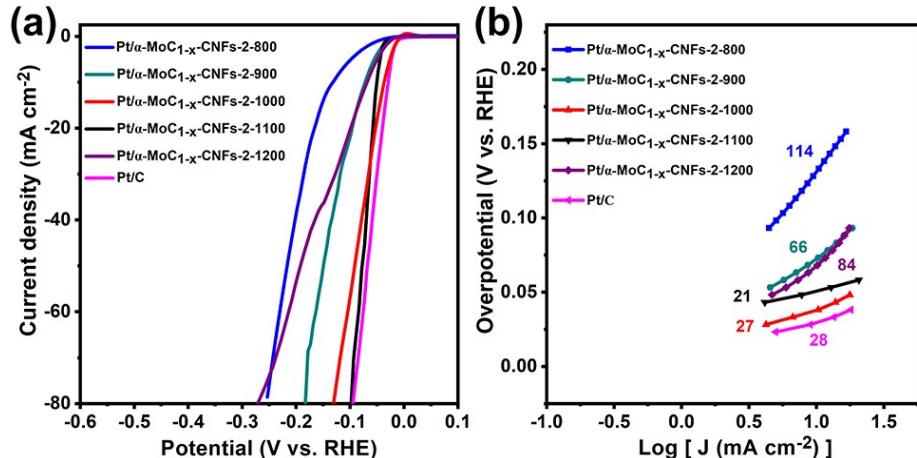
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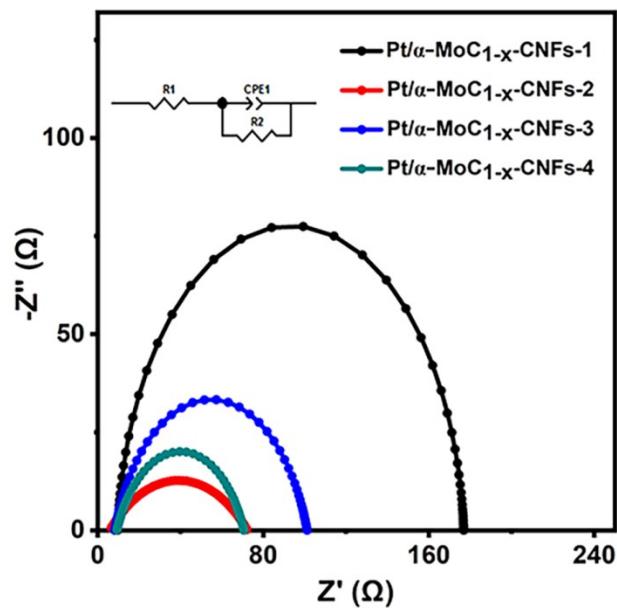
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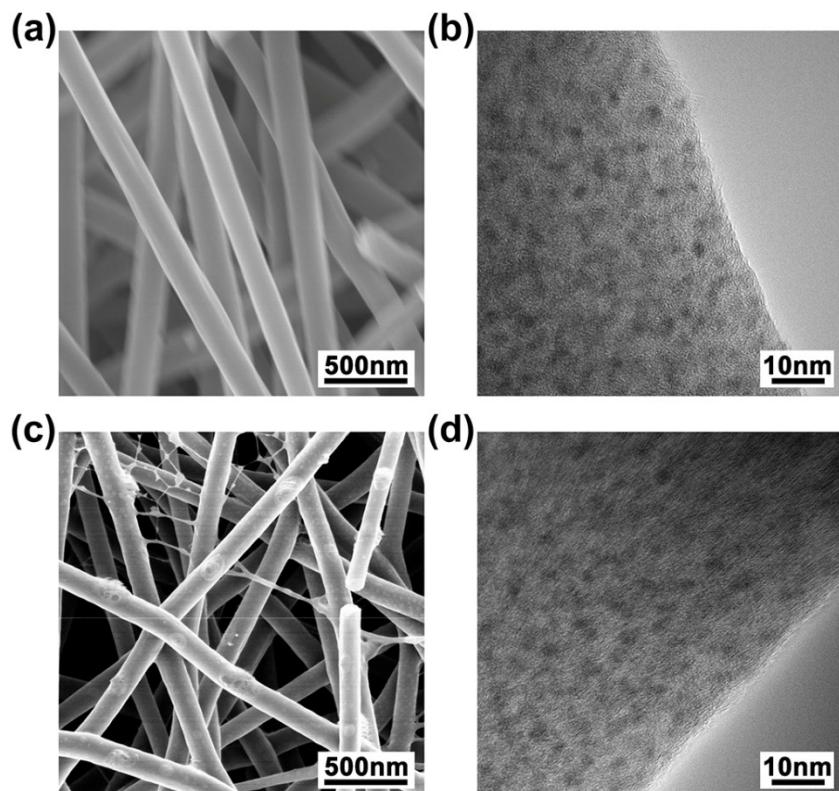
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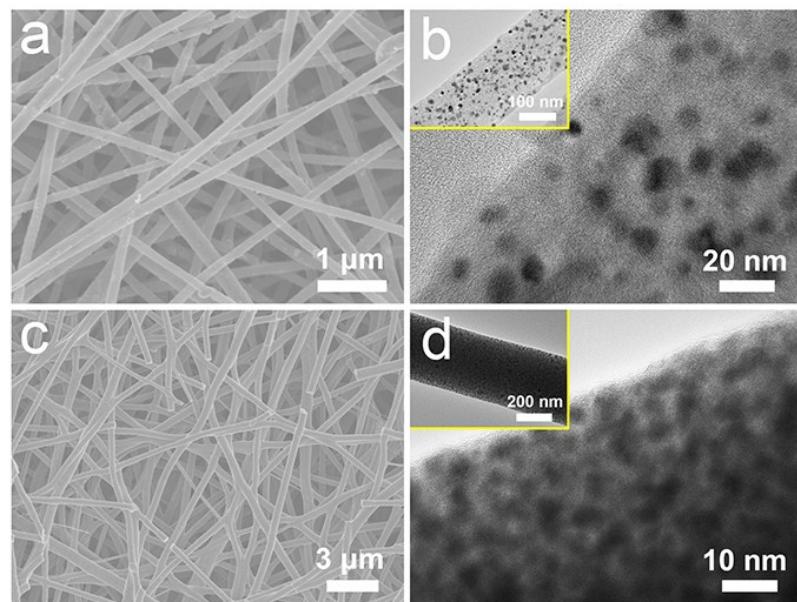
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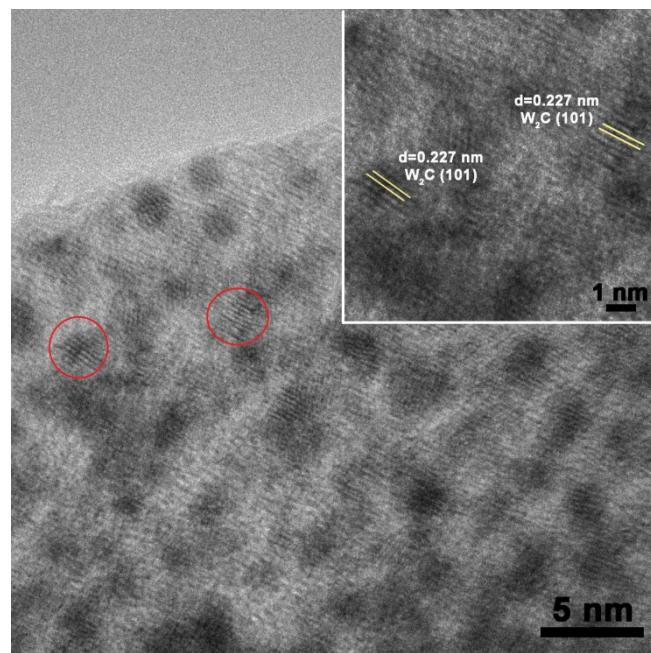
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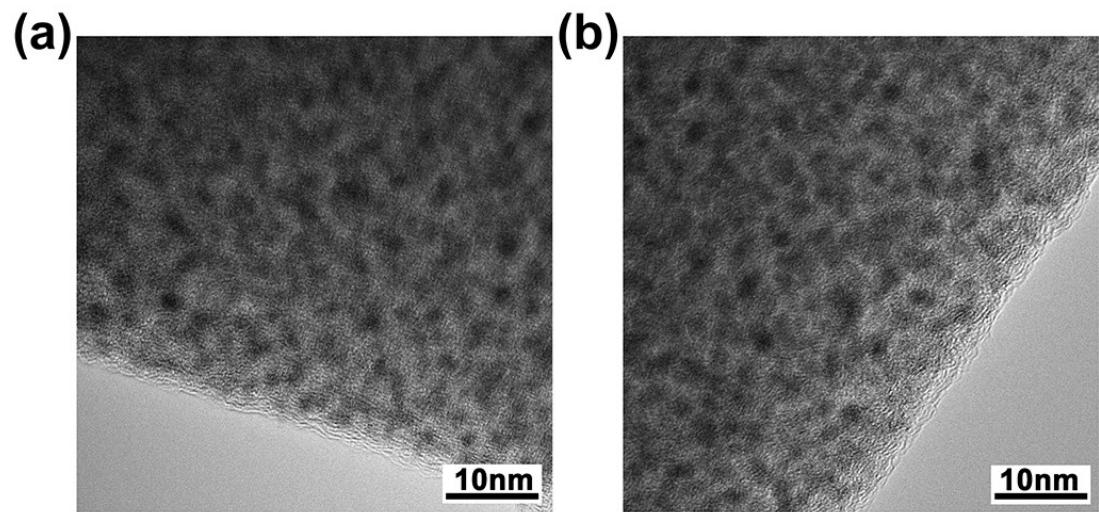
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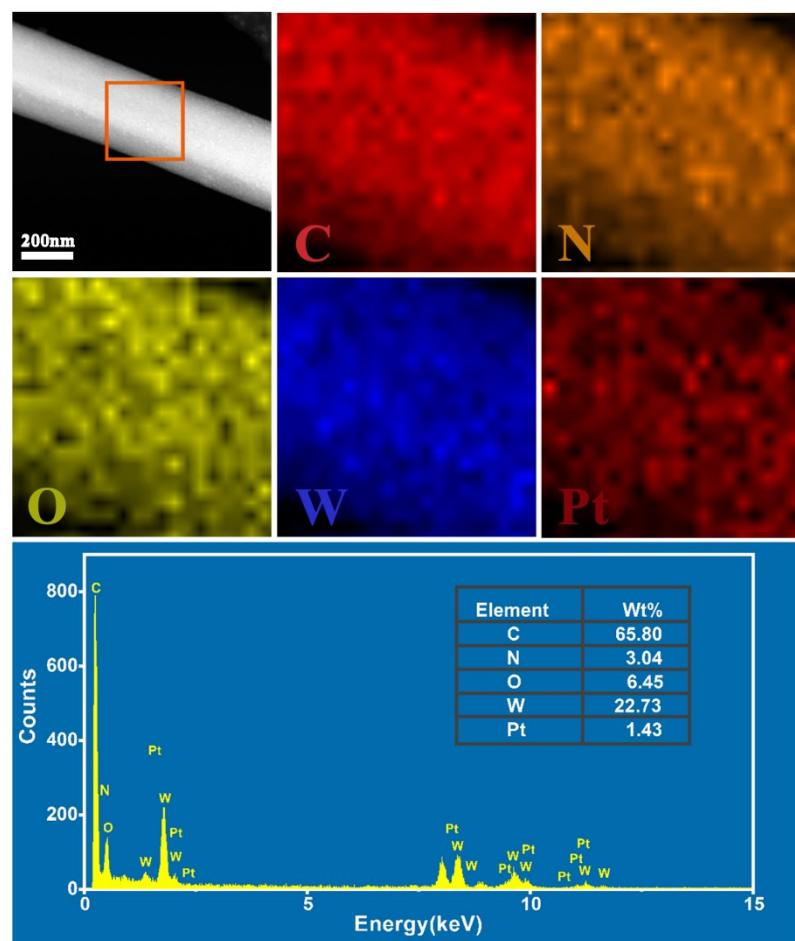
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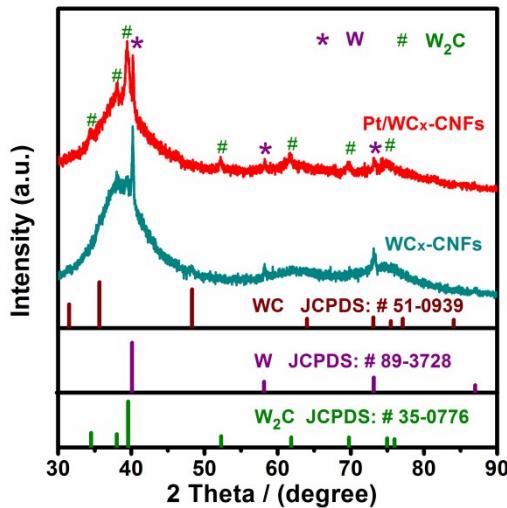
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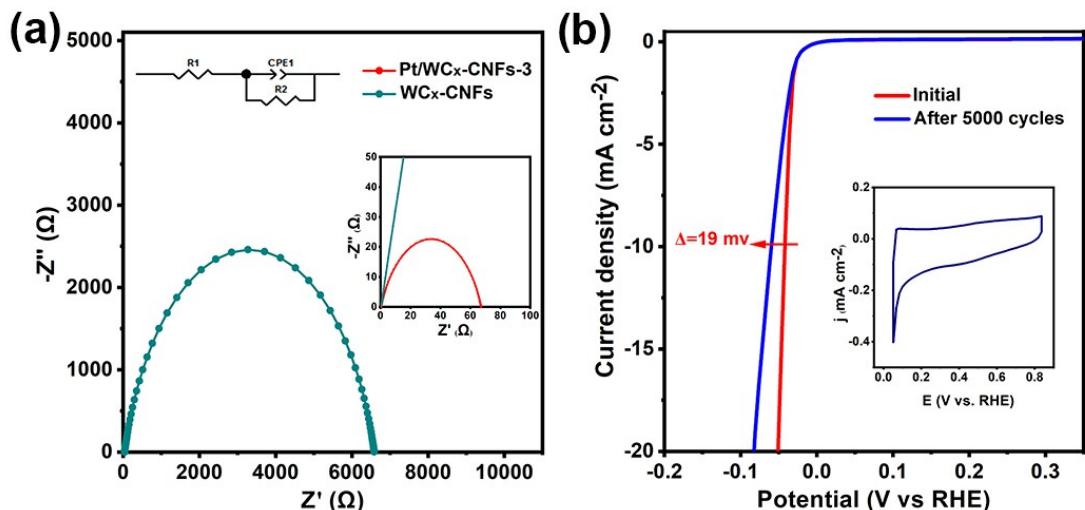
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**Fig S16.** HAADF-STEM-EDS elemental mapping images of Pt/WC<sub>x</sub>-CNFs.



**Fig S17.** XRD pattern of the Pt/WCx-CNFs and WCx-CNFs.



**Fig S18.** (a) EIS Nyquist plots of WC<sub>x</sub>-CNFs and Pt/WC<sub>x</sub>-CNFs-3 catalysts, the inset plot is the local enlarged view of the EIS. (b) Stability test of Pt/WC<sub>x</sub>-CNFs-3 through potential cycling, before and after 5000 cycles.

**Table S1.** Summary of all samples in the paper and their HER performance in 0.5 M H<sub>2</sub>SO<sub>4</sub> solution.

Catalyst	Molar Feeding Ratios of Pt(acac) <sub>2</sub> / HPA (mmol) (Final Pt content if it is available)	$\eta_{10}$ (mV)	Tafel slope (mV dec <sup>-1</sup> )
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-1	same amount of Pt(acac) <sub>2</sub> used	0.2 / 0.05	104
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-2		0.2 / 0.1 (1.5 wt% Pt)	38
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-3		0.2 / 0.15	59
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-4		0.2 / 0.2	73
Pt-CNFs		0.2 / ---	348
$\alpha$ -MoC <sub>1-x</sub> -CNFs	--- / 0.1	318	133
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-0.1	0.1 / 0.1	152	81
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-0.3	0.3 / 0.1 (3.3 wt% Pt)	50	20
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-800	0.2 / 0.1	133	114
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-900	0.2 / 0.1	73	66
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-1100	0.2 / 0.1	50	21

Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-1200		0.2 / 0.1	68	84
Pt/WC <sub>x</sub> -CNFs-1	same amount of Pt(acac) <sub>2</sub> used	0.2 / 0.05	47	44
Pt/WC <sub>x</sub> -CNFs-2		0.2 / 0.1	51	50
Pt/WC <sub>x</sub> -CNFs-3		0.2 / 0.15 (2.4 wt% Pt)	42	25
WC <sub>x</sub> -CNFs	--- / 0.15		>500	274
Pt/C	(20 wt% Pt)		30	28

**Table S2.** Comparison of the HER performance for Pt/TMCs-CNFs catalyst with other Pt-based, Mo-based or other transition metal carbide electrocatalysts in 0.5 M H<sub>2</sub>SO<sub>4</sub> solution.

Catalyst	content of Pt (wt%)	$\eta_{10}$ (mV)	Tafel slope (mV dec <sup>-1</sup> )	Journal	Reference
Pt/ $\alpha$ -MoC <sub>1-x</sub> -CNFs-2	1.5	38	27	This work	
Pt/WC <sub>x</sub> -CNFs-3	2.4	42	25	This work	
Pt@Fe-N-C	2.1	60	42	Advanced Energy Material, 2017	[1]
Mo <sub>2</sub> TiC <sub>2</sub> T <sub>x</sub> -Pt <sub>SA</sub>	1.2	30	30	Nature Catalysis, 2018	[2]
ALD Pt/N-GO	2.1	38	29	Nature Communication, 2016	[3]
Pt@PCM	0.53	105	65.3	Science Advances, 2018	[4]
MoC <sub>1-x</sub> /Pt NPs-600	3.0	30	31	Advanced Science, 2019	[5]
$\alpha$ -MoC <sub>1-x</sub> /NC		142	74	Sustainable Chemistry & Engineering, 2019	[6]
Mo- $\alpha$ -MoC <sub>1-x</sub>		115		Advanced Materials Interfaces, 2018	[7]
MoC@graphite		124	43	Journal of Materials Chemistry A, 2016	[8]
Mo <sub>2</sub> C/NCF		144	55	ACS Nano, 2016	[9]
MoC-Mo <sub>2</sub> C		126	43	Chemical Science, 2016	[10]
Ni-Mo <sub>2</sub> C		155	79	Chemical Communications, 2013	[11]
Co-Mo <sub>2</sub> C		140	39	Advanced Functional Materials, 2016	[12]
Mo <sub>2</sub> C-Co		48	39	Advanced Materials, 2018	[13]
Ni-WC		53	43.5	Energy & Environmental Science, 2018	[14]

WN <sub>x</sub> -NRPGC		132	86	Advanced Science, 2018	[15]
Mo <sub>2</sub> C@3DNMC		155	73	Electrochimica Acta	[16]
G@N-MoS <sub>2</sub>		243	82.5	Advanced Materials, 2018	[17]
h-MoN@BNCNT		78	46	Advanced Functional Materials, 2018	[18]

## Supplementary References

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