Supporting Information(SI):

Mo-doped ultrafine VC nanoparticles confined in few-layer graphitic nanocarbon for improved electrocatalytic hydrogen evolution

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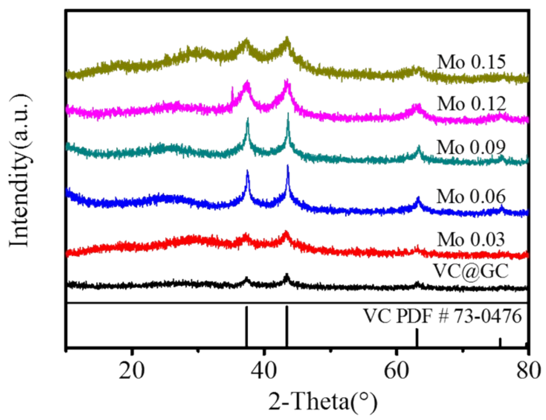


Fig. S1 XRD patterns of samples with different Mo-doping amount.

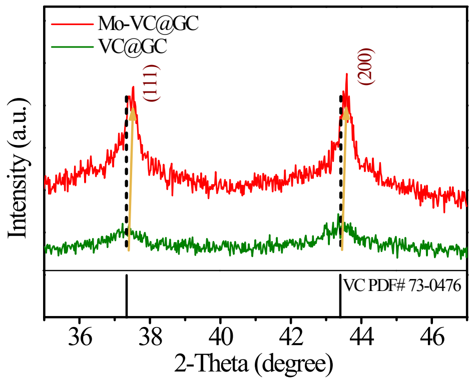


Fig. S2 XRD patterns with zoomed-in image of VC@GC and Mo-VC@GC.

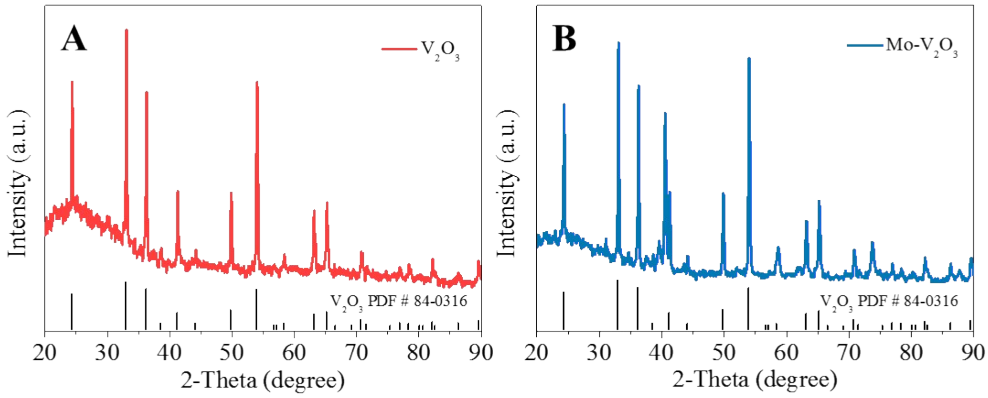


Fig. S3 XRD patterns of (A) V_2O_3 and (B) Mo-V_2O_3.

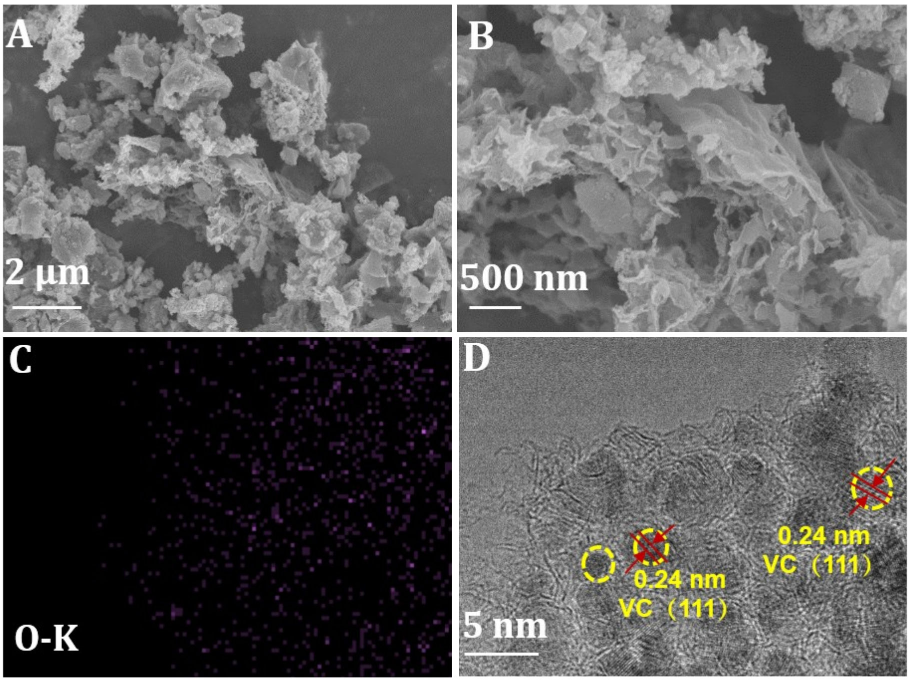


Fig. S4 (A-B) SEM images, (C) the O elemental mapping image, (D) the high-resolution TEM image of Mo-VC@GC.

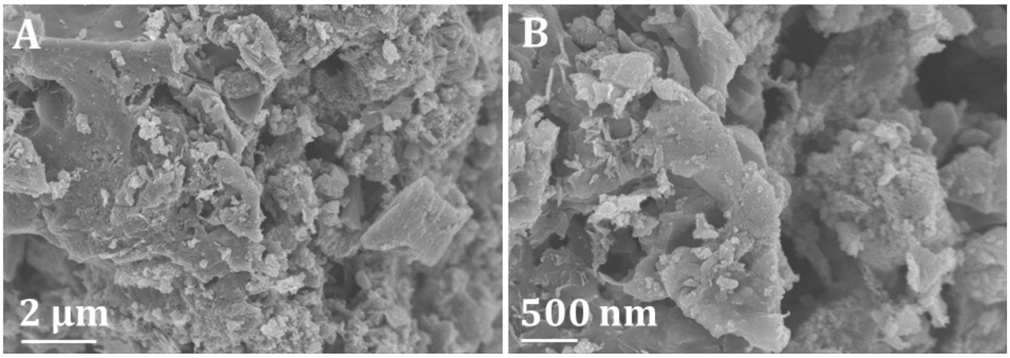


Fig. S5 (A-B) SEM images of VC@GC.

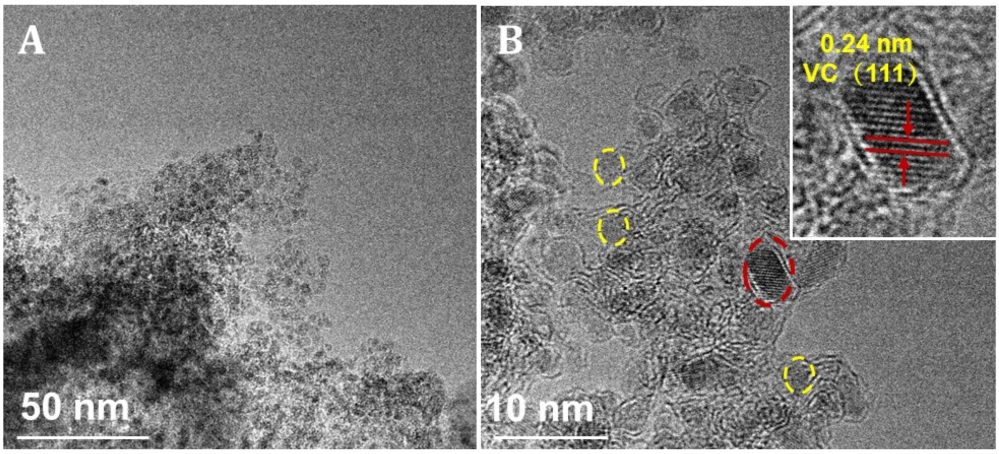
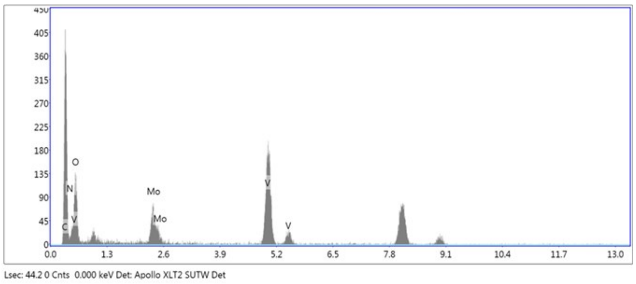


Fig. S6 (A-B) TEM and high-resolution TEM images of VC@GC.

A



B

Element	Weight %	Atomic %	Net Int.	Error %	Kratio
C K	13.90	16.53	37.3	6.90	0.09
N K	53.39	54.46	86.1	8.62	0.18
O K	32.39	28.92	43.7	12.06	0.04
V K	0.27	0.07	113.5	16.45	0.01
MoK	0.05	0.01	11.5	22.17	0.00

Fig. S7 EDX results of Mo-VC@GC.

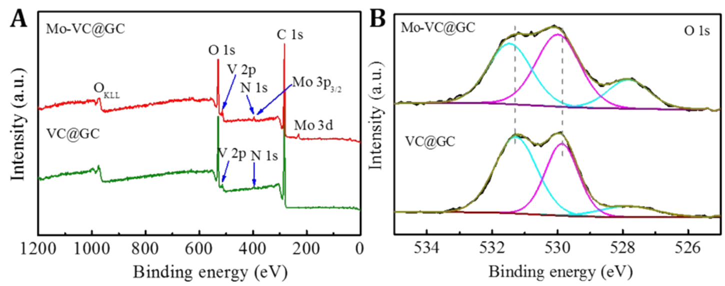


Fig. S8 (A) Survey, (B) O 1s XPS spectra of VC@GC and Mo-VC@GC.

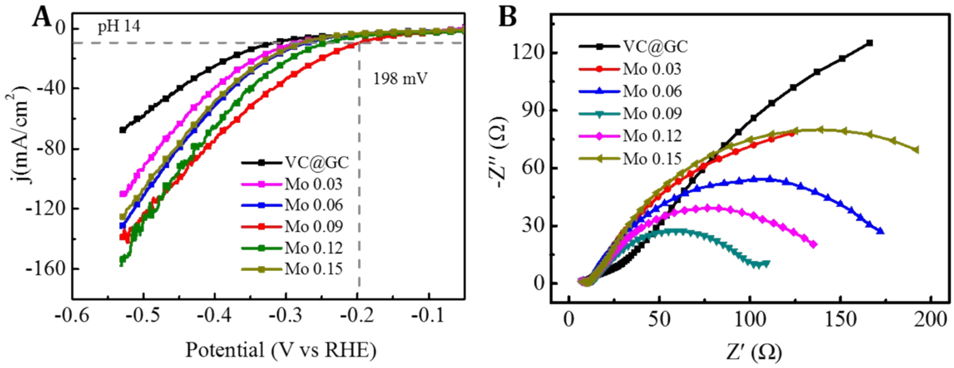


Fig. S9 (A) Polarization curves, (B) Nyquist plots obtained at the overpotential η=233mV of samples with different Mo-doping amount at pH 14.

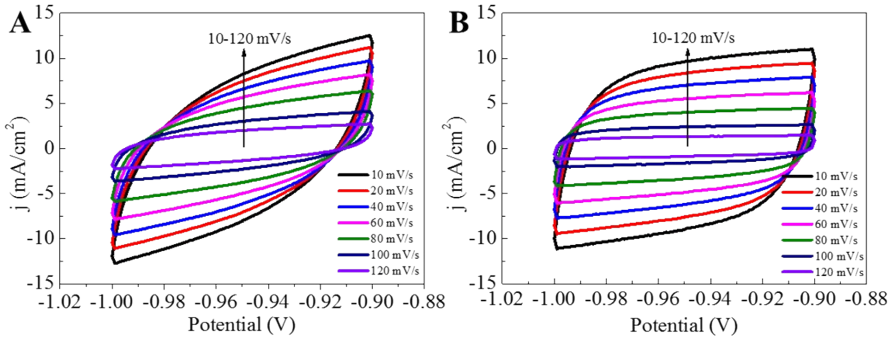


Fig. S10 CV curves of (A) VC@GC and (B) Mo-VC@GC at different scan rates.

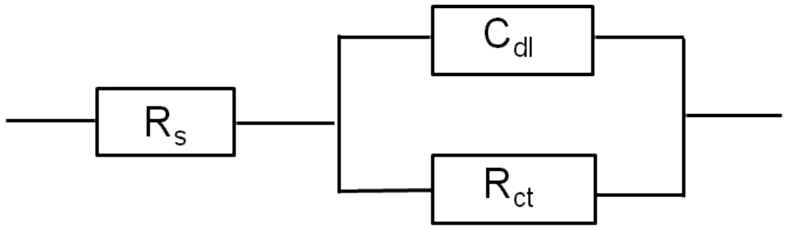


Fig. S11 Electrical equivalent circuit used to simulate the Nyquist plots in Fig. 5C, where R_s is the electrolyte resistance, R_{ct} is the charge-transfer resistance, and C_{dl} represents the double-layer capacitance.

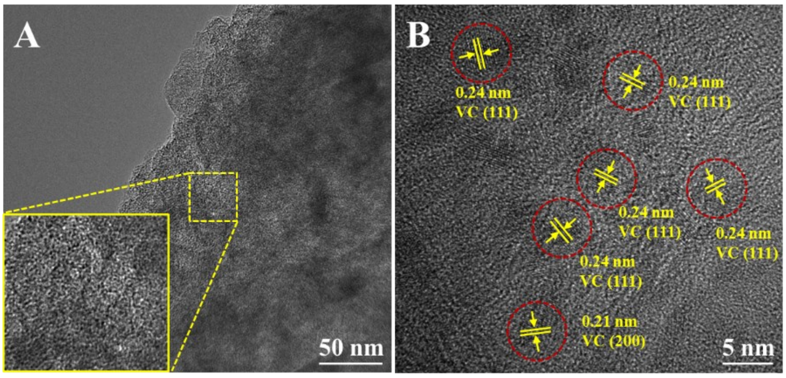


Fig. S12 (A) TEM and (B) HRTEM images of Mo-VC@GC after the stability test of i-t curve for 80h at pH 14.

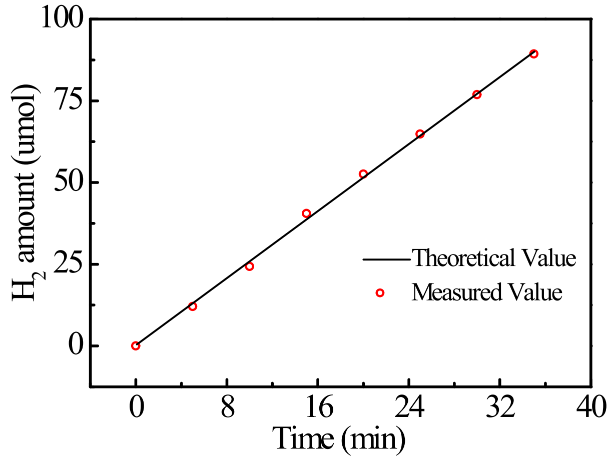


Fig. S13 Hydrogen production efficiency over Mo-VC@GC at a current density of 8.27 mA/cm^2, measured for 35 min.

Table S1. The mass percent of Mo and V in the Mo-VC@GC.

Elements	the mass percentage (%)
Mo	8.66
V	21.65

Table S2. Comparison of HER performance of reported TMCs electrocatalysts.

Catalyst	Electrolyte	η_{10} (mV)	Stability test	Reference
Mo-VC@GC	1 M KOH	198	80 h	This work
VC@NCNT	1 M KOH 0.5 M H_2SO_4	159 161	100 h	*Nanoscale* **2018**, 10, 14272-14279
Ni-VC-@C/Ti	1 M KOH 0.5 M H_2SO_4	146 138	20 h	*J. Mater. Chem. A* **2017**, 5, 23028-23034
VC-NS	0.5 M H_2SO_4	98	10000 cycles	*Nano energy* **2016**, 26, 603-609
Mo_2C/VC	0.5 M H_2SO_4	122	10000 cycles	*Nano Energy* **2019**, 60, 520-526
Mo_2C@GC	0.5 M H_2SO_4	125	10000 s	*ACS Appl. Mater. Interfaces* **2018**, 10, 18761-18770
W_2C@WC	0.5 M H_2SO_4	310	1000 cycles	*Appl. Catal. B* **2018**, 236, 147-153
W_2C@CNT-S	1 M KOH 0.5 M H_2SO_4	148 176	30 h	*Nanoscale* **2019**, 11, 4876-4884
W_2C IO	0.5 M H_2SO_4	146	10 h	*Nanoscale* **2019**, 11, 11505-11512
WC/W2C@C NWs	1 M KOH 0.5 M H_2SO_4	56 69	2000 cycles	*J. Mater. Chem. A* **2018**, 6, 15395-15403