Electronic Supplementary Material (ESI) for Nanoscale.

Electronic Supplementary Information

Multi-channel V doped CoP hollow nanofibers for high-performance hydrogen evolution reaction electrocatalyst

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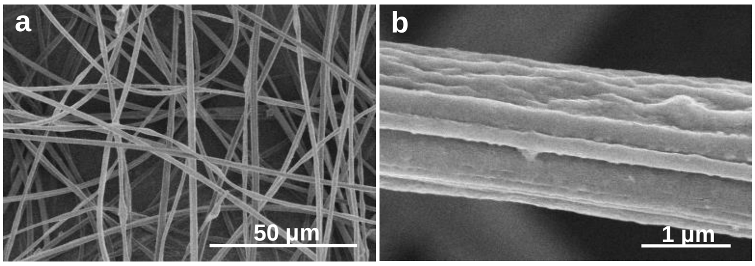

Fig. S1 (a) low magnification and (b) high magnification SEM images for precursor fiber of MC-V-CoP.

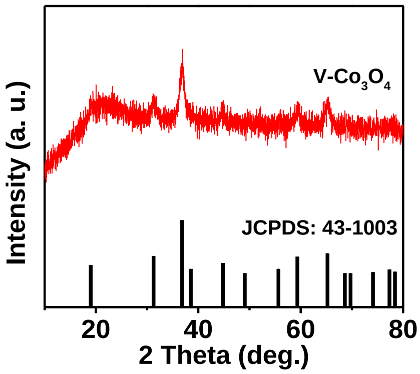

Fig. S2 XRD patterns of V doped Co_3O_4

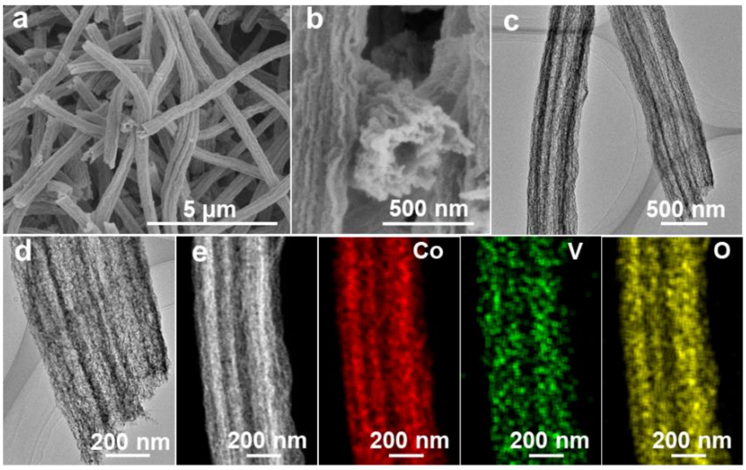

Fig. S3 (a) low magnification and (b) high magnification SEM images of MC-V-Co_3O_4 nanofiber，(c) low magnification and (d) high magnification TEM images of MC-V-Co_3O_4 nanofiber, (e) element mapping of MC-V-Co_3O_4 nanofiber.

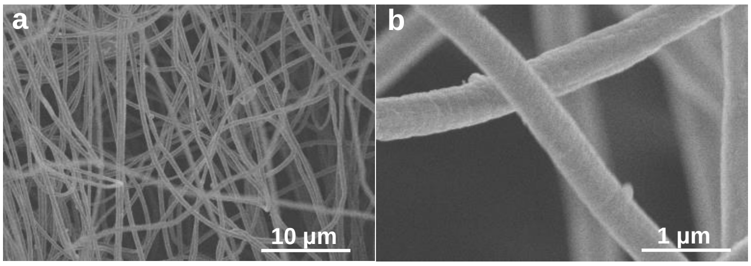

Fig. S4 (a) low magnification and (b) high magnification SEM images of precursor nanofibers for NMC-V-CoP.

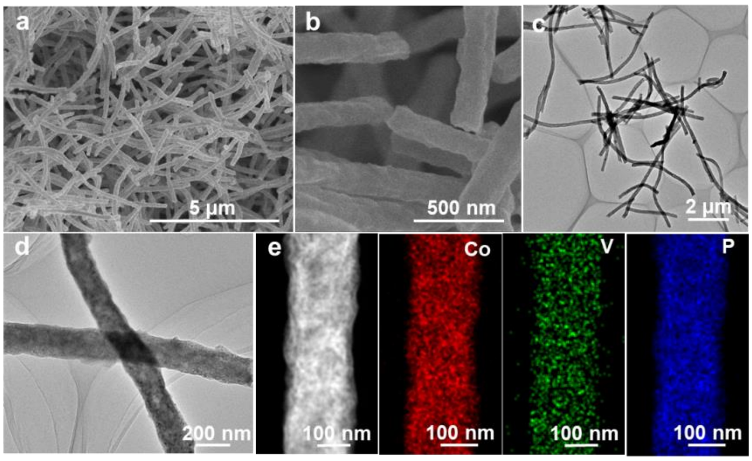

Fig. S5 (a) low magnification and (b) high magnification SEM images of NMC-V-CoP nanofiber，(c) low magnification and (d) high magnification TEM images of MC-V-CoP nanofiber, (e) element mapping of MC-V-CoP nanofiber.

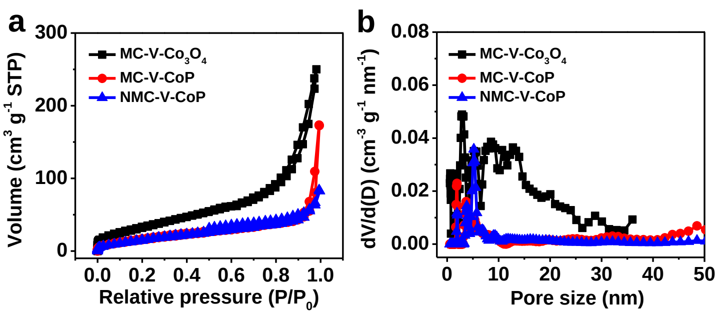

Fig. S6 (a) N_2 adsorption-desorption curves and (b) corresponding pore size distribution of MC-V-Co_3O_4, MC-V-CoP and NMC-V-CoP.

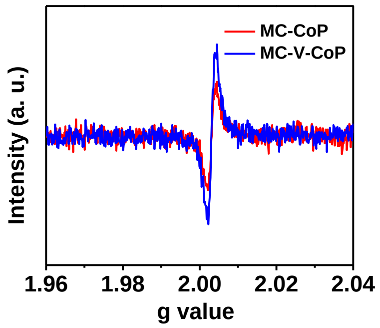

Fig. S7 EPR spectrum of MC-CoP and MC-V-CoP

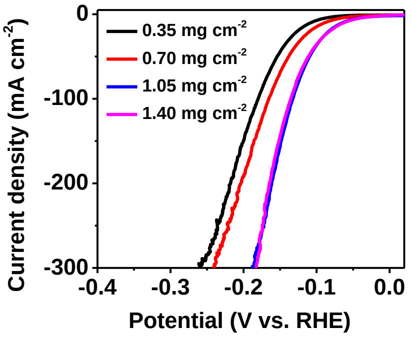

Fig. S8 LSV polarization curves of MC-V-CoP in alkaline medium with different loading weight at the scan rate of 5 mV s^{-1}.

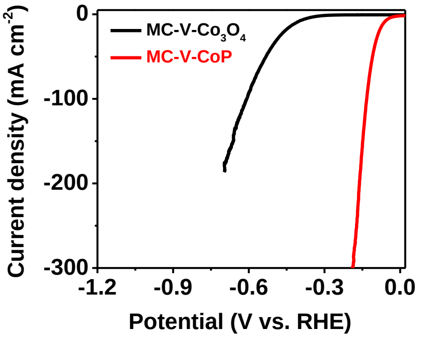

Fig. S9 LSV polarization curves of MC-V-Co_3O_4 and MC-V-CoP in alkaline medium at the scan rate of 5 mV s^{-1}.

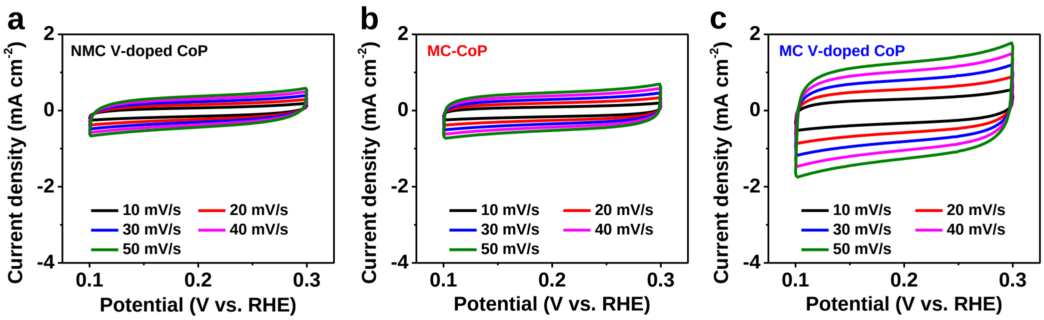

Fig. S10 CV curves of NMC-V-CoP, MC-CoP and MC-V-CoP in alkaline medium with different scan rates.

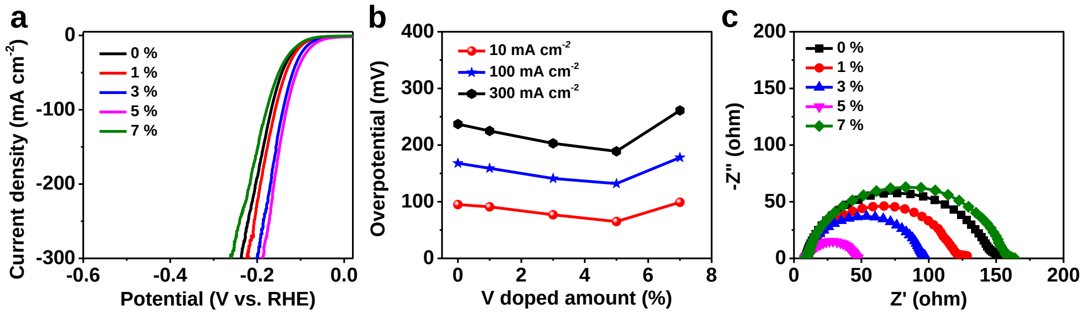

Fig. S11 (a) LSV polarization curves, (b) overpotential at different current densities, and (c) EIS Nyquist plots of MC-CoP with different V doping amount.

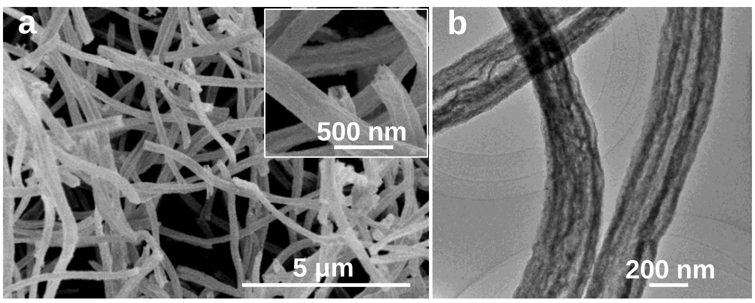

Fig. S12 (a) SEM and TEM image of MC-V-CoP nanofiber fabricated by the weight ratio of PAN to PS as 2:1.

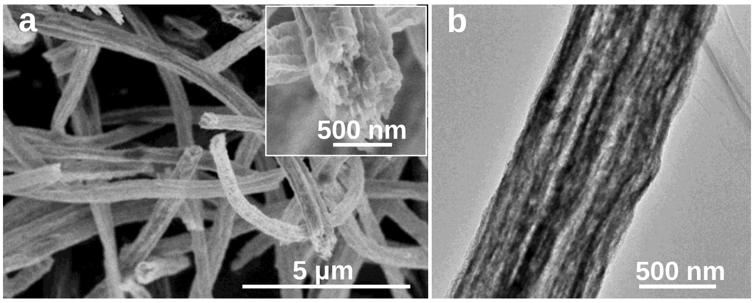

Fig. S13 (a) SEM and TEM image of MC-V-CoP nanofiber fabricated by the weight ratio of PAN to PS as 2:3.

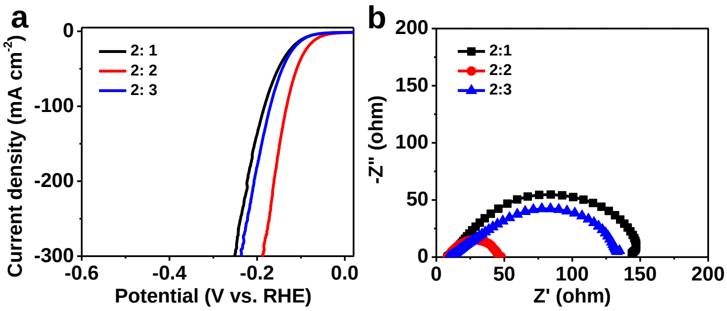

Fig. S14 (a) LSV polarization curves and (b) EIS Nyquist plots of MC-V-CoP nanofiber fabricated by different addition ratio of PA N and PS.

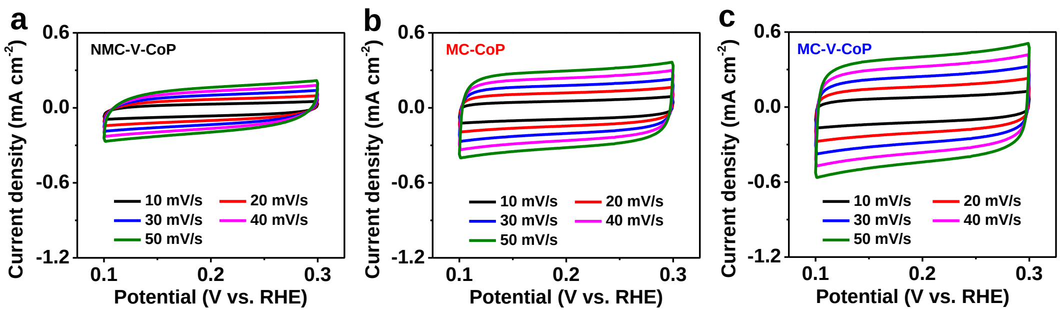

Fig. S15 CV curves of NMC-V-CoP, MC-CoP and MC-V-CoP in neutral medium with different scan rates.

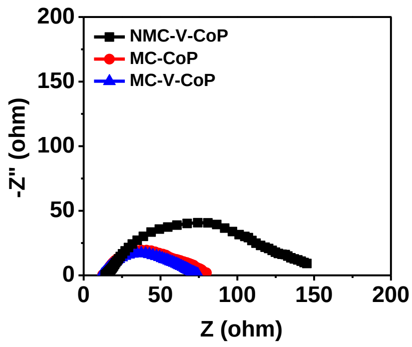

Fig. S16 EIS Nyquist plots of MC-V-CoP nanofiber in neutral medium.

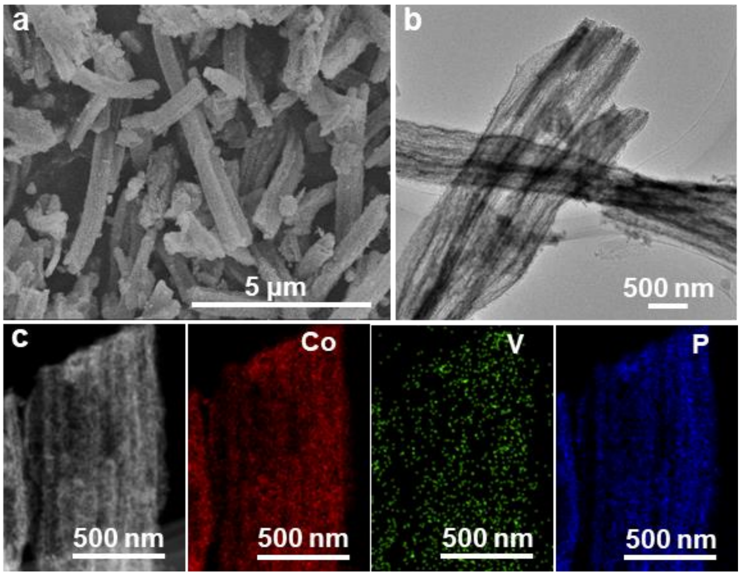

Fig. S17 (a) SEM image, (b) TEM image and (c) element mapping of MC-V-CoP nanofiber after cycling stability test in alkaline medium.

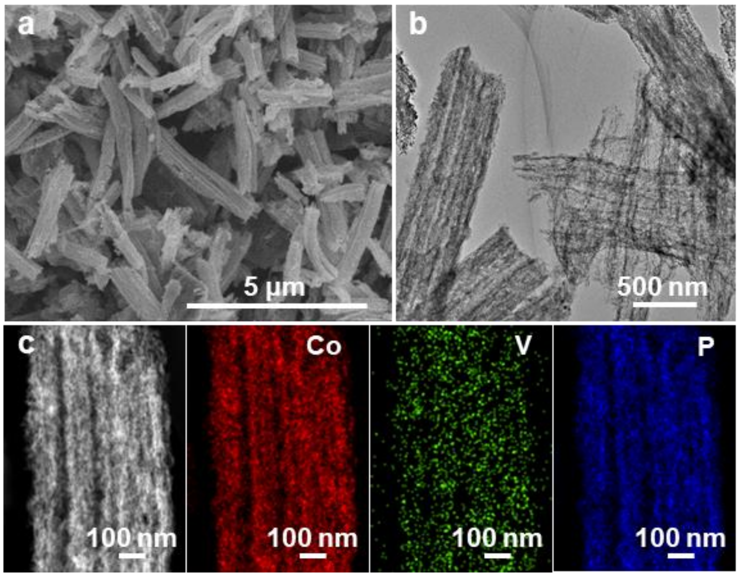

Fig. S18 (a) SEM image, (b) TEM image and (c) element mapping of MC-V-CoP nanofiber after cycling stability test in neutral medium.

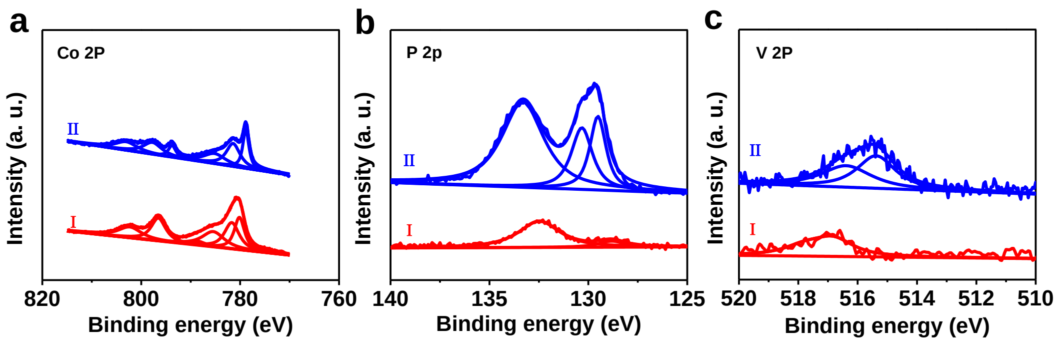

Fig. S19 High-resolution XPS spectrum of MC-V-CoP after long-term test in (I) alkaline and (II) neutral medium, (a) Co 2p, (b) P 2p, (c) V 2p.

Table S1 The comparison of specific surface, pore volume and mean pore size of different electrocatalysts

Sample	Specific surface area (m^2 g^{-1})	Pore volume (cc g^{-1})	Mean pore size (nm)
MC-V-Co_3O_4	101	0.371	14.846
MC-V-CoP	39.9	0.255	2.976
NMC-V-CoP	38.52	0.115	3.322

Table S2 Comparison of HER activity of MC-V-CoP nanofiber with other reported phosphide-based HER electrocatalysts in 1.0 M KOH electrolyte.

Electrocatalyst	Loading (mg cm^{-2})	Current density (mA cm^{-2})	Overpotential (mV)	Reference
MC-V-CoP/GCE	1	10	65	This work
		100	132	
		200	161	
		300	189	
NiCoP nanocone arrays/NF	8	10	104	1
		100	197	
NiCoP/CC	2	10	62	2
		100	158	
$Co_{0.9}S_{0.58}P_{0.42}$/GCE		10	139	3
CoP/NPC/TF		10	80	4
		200	162	
$(Co_{1-x}Ni_x)(S_{1-y}P_y)_2$/G/GCE	3	10	117	5
$Zn_{0.08}Co_{0.92}P$/TM	1.52	10	67	6
NiFe LDH @NiCoP/NF	2	10	120	7
CoP@a-CoO/CC	1.5	10	132	8
Ni–Co–P HNB/NF	2	10	107	9
$CoP/Ni_5P_4/CoP$/NF		10	71	10
		100	140	
Fe-CoP UNSs/NF	1.4	10	67	11
		100	148	
Mo-CoP/CC	2	10	40	12
		100	130	
C-Co_xP/GCE	1	10	121	13
		50	173	
W-CoP NAs/CC	10	10	94	14
NiCoP−CoP nanowires/NF	1.5	10	73	15
		100	183	
N-NiCoP/NCF	2.08	10	78	16
MoP/CC	2.5	10	187	17
$(Fe_xNi_{1-x})_2P$/NF	1.0	10	90	18
CoP/Graphene/CP	2.5	10	83	19
Ni_xP/NF		10	71	20

Note: GCE glass carbon electrode, NF: Ni foam, CC: carbon cloth，TF: Ti foil, TM: Ti mesh, NCF: Ni-Co foam. CP: carbon paper

Table S3 Comparison of HER activity of MC-V-CoP nanofiber with other reported phosphide-based HER electrocatalysts in 1.0 M PBS electrolyte.

Electrocatalyst	**Loading ($mg\ cm^{-2}$)**	**Current density ($mA\ cm^{-2}$)**	**Overpotential (mV)**	**Reference**
MC-V-CoP	1.0	10	106	This work
		100	243	
		300	540	
W-CoP NAs/CC	10	10	102	14
FLNPC@MoPNC /MoP-C/CC	2.42	10	106	21
MoP NA/CC	2.5	10	187	17
CoP NPs@NPC	1.4	10	423	22
Ni_2S_3/NF	1.6	10	170	23
FeP/CC	1.5	10	202	24
CoO/$CoSe_2$	2	10	337	25

Note: GCE glass carbon electrode, NF: Ni foam, CC: carbon cloth, TM: Ti mesh,

Reference

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